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Infructescences of *Friisicarpus* nom. nov. (Platanaceae) and Associated Foliage of the Platanoid Type from the Cenomanian of Western Siberia

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Abstract—A new generic name, *Friisicarpus* N. Maslova et Herman, is proposed to replace *Platanocarpus* Friis, Crane, et Pedersen, 1988. Pistillate capitate inflorescences of *Friisicarpus* nom. nov. are reported from the Cenomanian of western Siberia for the first time. They are found in association with leaves of the typical *Platanus*-morphotype. Earlier, remains belonging to this genus were found to be associated with pinnatifid leaves of cf. *Sapindopsis variabilis* Fontaine (Crane *et al.*, 1993).

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Key words: *Friisicarpus*, *Platanocarpus*, platanoid leaves, Cenomanian.

INTRODUCTION

The generic name *Platanocarpus* was initially proposed by Jarmolenko (1935) for Late Cretaceous fruits from the northwestern Karatau that resembled fruits of the modern plane tree. Later, Friis *et al.* (1988) used *Platanocarpus* to describe pistillate heads from the Albian deposits of Maryland (United States) and Santonian–Campanian deposits of North Carolina (United States) and Scania (Sweden). Therefore, *Platanocarpus* Friis *et al.* is a junior homonym of *Platanocarpus* Jarmolenko (Jarmolenko, 1935). Having discussed the problem with Prof. E.-M. Friis, we propose a new generic name that replaces *Platanocarpus* Friis *et al.* in accordance to the International Code of Botanical Nomenclature (Greuter *et al.*, 2000).

SYSTEMATIC PALEOBOTANY

Order Hamamelidales C. Martius, 1835

Family Platanaceae Lestiboudois, 1826

Genus *Friisicarpus* N. Maslova et Herman, nom. nov. = *Platanocarpus* Friis, Crane, et Pedersen, 1988: p. 16 (non Jarmolenko, 1935: p. 19).

Etymology. In honor of the paleobotanist Prof. E.-M. Friis.

Type species. *Friisicarpus marylandensis* (Friis, Crane, et Pedersen) N. Maslova et Herman.

Genus composition. Four species:

Friisicarpus marylandensis (Friis, Crane, et Pedersen) N. Maslova et Herman, comb. nov. (= *Platanocarpus marylandensis* Friis, Crane, et Pedersen, 1988: p. 16, pl. 9, figs. 1–7; text-fig. 2); holotype, Field Museum of Natural History, Chicago, United States, no. PP 34576, United States, Maryland, Patapsco Formation, Late Albian;

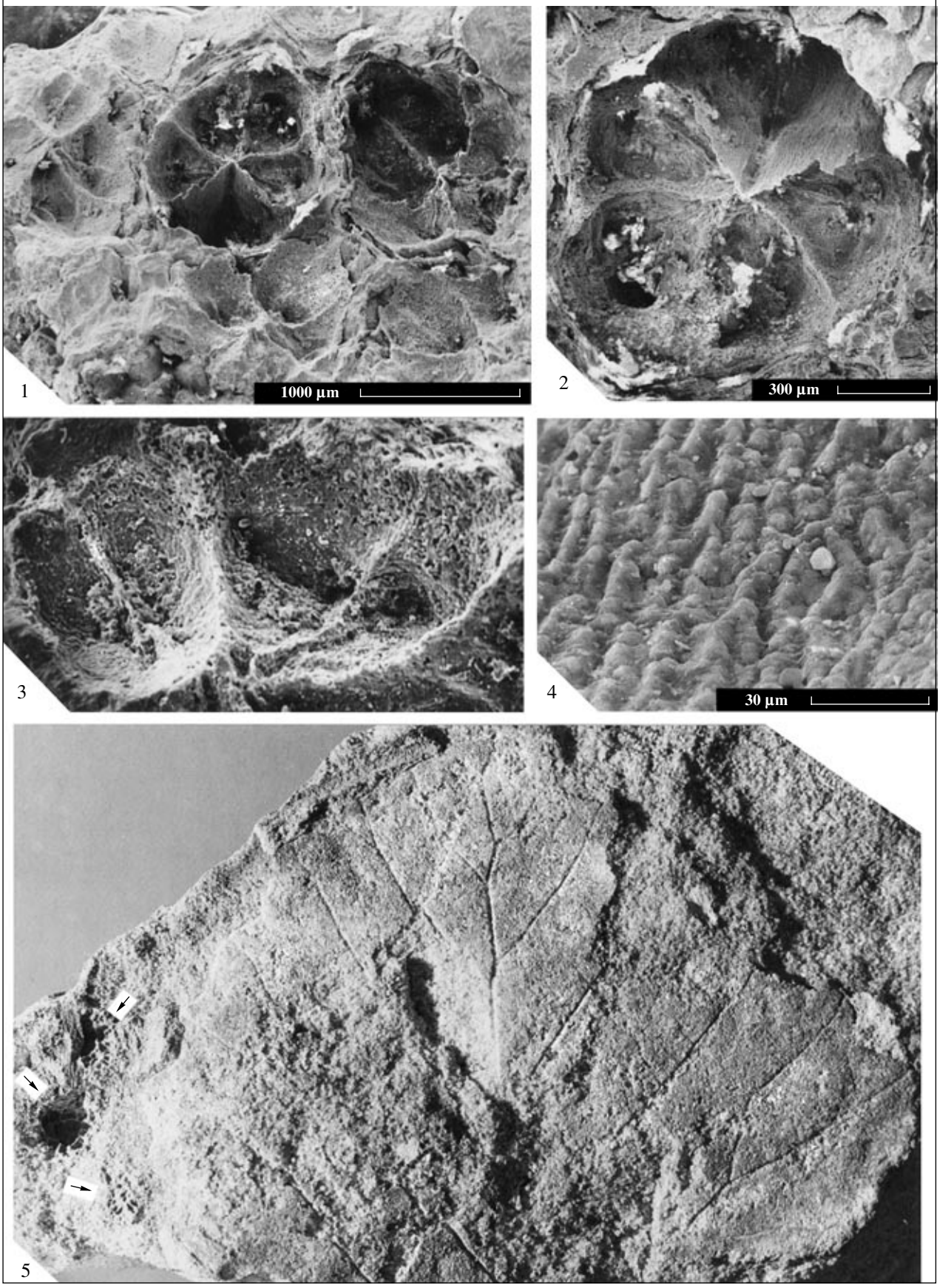
Friisicarpus carolinensis (Friis, Crane, et Pedersen) N. Maslova et Herman, comb. nov. (= *Platanocarpus carolinensis* Friis, Crane, et Pedersen, 1988: p. 17, pl. 10, figs. 1–8); holotype, National Museum of Natural History, Smithsonian Institution, Washington, D.C., United States, no. USNM 401642, United States, North Carolina, Black Creek Formation, Santonian–Campanian;

Friisicarpus brookensis (Crane, Pedersen, Friis, et Drinnan, 1993) N. Maslova et Herman, comb. nov. (= *Platanocarpus brookensis* Crane, Pedersen, Friis, et Drinnan, 1993: p. 329, figs. 1–5, 7–23, 46); holotype, Field Museum of Natural History, Chicago, United States, no. PP 42988, United States, North Virginia, Patapsco Formation, Early–Middle Albian; and

Friisicarpus elkneckensis (Pedersen, Friis, Crane, et Drinnan, 1994) N. Maslova et Herman, comb. nov. (= *Platanocarpus elkneckensis* Pedersen, Friis, Crane, et Drinnan, 1994: p. 292, text-fig. 1, pl. I, figs. 1, 2; pl. II, figs. 1–6; pl. III, figs. 1, 2); holotype, Field Museum of Natural History, Chicago, United States, no. PP 35073, United States, northeastern Maryland, Patapsco Formation, Late Albian.

Friisicarpus nom. nov. is characterized by capitate infructescences that are comprised of 50 to 100 closely packed pentamerous flowers with a prominent undifferentiated perianth. The earliest record of *Friisicarpus*

Plate 12



nom. nov. is dated as Early–Middle Albian (*Friisicarpus brookensis* comb. nov., Crane *et al.*, 1993), and the latest record is dated as Santonian–Campanian (*Friisicarpus carolinensis* comb. nov., Friis *et al.*, 1988).

It is known (Maslova, 2001, 2003) that the Late Albian members of the Platanaceae showed considerable variation in their male reproductive organs, whereas their pistillate organs were more conservative. Thus, the same morphotype *Friisicarpus* nom. nov. was found in Early Cretaceous deposits in association with staminate inflorescences of *Hamatia* Pedersen, Crane, et Drinnan (Pedersen *et al.*, 1994); *Aquia* Crane, Pedersen, Friis, et Drinnan (Crane *et al.*, 1993); and *Platananthus* Manchester (Friis *et al.*, 1988).

We recorded the genus *Friisicarpus* nom. nov. for the first time from the Late Cretaceous of western Siberia. These plant remains come from the stratotype of the Simonovo Formation, Verkhnyaya Glinka outcrop, near the village of Simonovo (Chulym River). The specimens were collected by I.V. Smokotina (GP Krasnoyarskgeols"emka, Krasnoyarsk) in 1998 and were passed to the authors for further study. The collection is housed in the Geological Institute of the Russian Academy of Sciences (GIN), no. 4874. The Simonovo Formation is composed of conglomerates (base of the section) and intercalating kaolinized sandstones, cross-bedded sandstones, siltstones, and claystones. The total thickness of the Verkhnyaya Glinka ravine section reaches 20 m. The plant fossils under description occur in sandstones at the base of the section. In addition to platanoid remains, *Sequoia* cf. *fastigiata* (Sternb.) Heer, *Cupressinocladus* (?) sp., and fragments and imprints of carbonized wood were also recorded from this section. The Simonovo flora is dated as Cenomanian or Cenomanian–Turonian (Lebedev, 1962; Lebedev and Markova, 1962; Vakhrameev *et al.*, 1970; Budantsev, 1979; Gol'bert *et al.*, 1987; Golovneva, 2002).

The fossil material from the stratotype of the Simonovo Formation that we assign to *Friisicarpus* sp. is an imprint (and its counterpart) of an axial fragment bearing four capitate inflorescences, as well as several detached heads. The reproductive structures were preserved as cavities in the rock, duplicating the external sculpture of the object. Although such preservation did not support specific determination, the generic assignment is beyond doubt.

A rock fragment with an imprint of a head of *Friisicarpus* sp. was placed on an SEM stub and was studied with a CamScan microscope. Four sessile pistillate heads are closely packed on a relatively prominent ribbed axis (Pl. 12, fig. 5). The diameter of the heads is about 5 mm. There are 44 to 48 flowers in one head. The margins of particular flowers are distinct, which implies the existence of a developed perianth (Pl. 12, fig. 1). The flowers are pentamerous (Pl. 12, fig. 2). The carpels are devoid of stylodes, are apically widened, with a bilobed and triangular-conical widening (Pl. 12, fig. 3). The apical surface of the carpel is more or less uniform, ribbed, without visible stomata or trichomes (Pl. 12, fig. 4).

Most records of *Friisicarpus* nom. nov. (*F. marylandensis* comb. nov., *F. carolinensis* comb. nov., and *F. elkneckensis* comb. nov.) were not associated with foliage. The sole exception is *F. brookensis* comb. nov., which was reported in association with staminate inflorescences of *Aquia brookensis* Crane, Pedersen, Friis, et Drinnan and leaves of cf. *Sapindopsis variabilis* Fontaine (Crane *et al.*, 1993). The genus *Sapindopsis* has pinnately compound or pinnatifid leaves and was long related to the subclass Rosidae. However, epidermal studies of leaves of *Sapindopsis* (Upchurch, 1984) and pistillate and staminate heads that were associated with these leaves (Crane *et al.*, 1993) confirm the supposition (Hickey and Doyle, 1977; Crane, 1989) that this genus belongs to the Platanaceae. No pinnately compound or pinnatifid leaves occur in modern plane trees. However, fossil members of the Platanaceae with such morphotypes are known from the Cretaceous (*Sapindopsis* Fontaine, see Fontaine, 1889; Hickey and Doyle, 1977; Upchurch, 1984; Crane *et al.*, 1993; and *Erlingdorfia* Johnson, see Johnson, 1996) and from the Early Paleogene (*Platanites* Forbes, see Crane *et al.*, 1988).

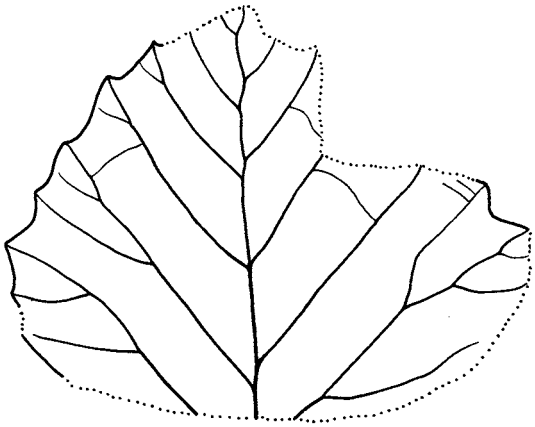
Infructescences of *Friisicarpus* sp. from the Simonovo Formation were found in association with leaves of the typically *Platanus*-morphotype (Pl. 12, fig. 5). Although the infructescences and leaves were not found in organic connection, their definite platanoid characteristics and the close proximity of these remains within the same piece of rock suggest that they belong to the same mother plant.

The leaves that are associated with the heads of *Friisicarpus* sp. from the Simonovo Formation are simple, with lateral lobes, slightly asymmetrical (Pl. 12, fig. 5; figure). The leaf plates are broadly rhomboidal. The lateral lobes are small and triangular. The left and right lobes are situated at different heights and are slightly different in size. The leaf margin is dentate-incised. The teeth are triangular, some of them are low and rounded, and others are concave-concave with a longer basal side. The areas between the teeth are rounded. The venation is palmate-pinnate and craspedodromous. The main vein is undulated and, in the upper portion of the leaf plate, broken. The basal veins are well-developed, resemble the secondary veins in thickness and degree of branching, vary in length, and are straight or slightly

Explanation of Plate 12

Figs. 1–4. *Friisicarpus* sp., GIN, no. 4874/1b-2, SEM: (1) fragment of a head; (2) a flower; (3) apical regions of two carpels, ×120; and (4) the apical surface of a carpel.

Fig. 5. Leaf associating with infructescences of *Friisicarpus* sp., GIN, no. 4874/1a-1, heads of *Friisicarpus* sp. are indicated by arrows, GIN, no. 4874/1a-2, ×2.



Leaf associating with infructescences of *Friisicarpus* sp. The drawing is based on the imprint and its counterpart, GIN, nos. 4874/1a-1 and 4874/1b-1, ×1.

curved. There are four or five basiscopic branches, which are arching. The acroscopic branches are well-developed, are identical to secondary branches in thickness, and end in teeth. The secondary veins are arranged in four or five pairs. They fork from the main vein; the lower ones branch, the upper ones do not branch. Tertiary venation is branched-scalariform.

Leaves of this morphotype are common in Cretaceous floras of the Northern Hemisphere. Their earliest records are dated as Early Cretaceous. Since the end of the 19th century, such leaf remains have been routinely assigned to the extant genus *Platanus*. The morphological similarity between such leaves and leaves of modern members of this genus is obvious. As a consequence, it was long believed that *Platanus* appeared early in the geological record. However, no reproductive remains of *Platanus* have been reported from Cretaceous deposits. The earliest heads of this genus are known from the Paleocene (Maslova, 1997; Kvaček *et al.*, 2001). Moreover, paleobotanical studies show that in the geological past leaves of the typical *Platanus*-morphotype may have been associated with reproductive organs different from those of *Platanus* (Krassilov, 1976; Maslova and Krassilov, 2002; Maslova and Kodrul, 2003; Maslova and Herman, 2004). These recent finds show the necessity of a thorough revision of many Cretaceous leaf species of *Platanus*, including possible generic realignments (Maslova, 2001, 2002; Maslova and Kodrul, 2003; Maslova and Herman, 2004). Based on observable features of leaf morphology, Krassilov (1979) proposed a morphological classification of leaves for the naming of such dispersed leaf remains of Cretaceous angiosperms. Maslova *et al.* (2005) proposed the generic name *Ettingshausenia* Stiehler, 1857 with the type species *E. cuneifolia* (Bronn) Stiehler, 1857 to designate Cretaceous and Early Paleogene leaves of the modern *Platanus* morphology.

The record of infructescences of *Friisicarpus* sp. from the Cenomanian of western Siberia has increased the known geographical range of this genus. *Friisicarpus* nom. nov. is associated both with several types of staminate inflorescences and with leaves of various morphotypes (pinnately compound and pinnatifid of *Sapindopsis* and lobed leaves of typical *Platanus*-morphology). These data show considerable stability of the female reproductive system in early members of the Platanaceae.

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