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ASTEROCELASTRUS CRETACEA, A MID-CRETACEOUS ANGIOSPERM FROM BOHEMIA

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Abstract

Krassilov, V.A. and Pacltová, B., 1989. *Asterocelastrus cretacea*, a mid-Cretaceous angiosperm from Bohemia. Rev. Palaeobot. Palynol., 60: 1–6.

Asterocelastrus cretacea Velenovskỳ and Viniklár (1926) from the Cenomanian of Bohemia is redescribed as a capsulate pentamerous fruit with an inferior syncarpous ovary fused to a calyx cup and containing the basally attached anatropous seeds or ovules, two per locule. Its most plausible affinity is rosalean, while its antiquity may suggest a nonconventional way to syncarpy.

Introduction

Several recently discovered reproductive structures are obviously not sufficient to disclose even a crude picture of the diversity of mid-Cretaceous angiosperms. Further evidence may come from old museum collections which need revision with modern methods or at least detailed redescription. One such collection, from the well-known Cenomanian deposits of Bohemia (see Pacltová, 1971, 1977 for the age assignment) and studied by Velenovskỳ and Viniklár in 1926–1929, is now in the Charles University, Prague. It is rich in reproductive structures, most prominent among which are numerous fruits of *Asterocelastrus cretacea*. They are described in Czech and German (Velenovskỳ and Viniklár, 1926, pp.21, 50 resp.) as the "fruit capsules 1–1.5 cm in diameter, 5-loculate, with two seeds in each locule borne on a central placenta. The lobes are extended in the stiff, horny, star-like spreading appendages. On the back side there is a small scar, apparently a point where the fruit was abscissed from its pedicel". Traces of the cup tips ("eine Spur nach den Kelchzipfeln") between the horny appendages are said to indicate a carpellate rather than receptaculate nature of the fruit (i.e., superior rather than inferior ovary) and the Celastracean affinities. A South African genus, *Pterocelastrus*, is considered as an extant analogue though its pistils are 3-loculate. One schematic drawing of a specimen and two reconstruction drawings are given, none of which shows the alleged cup tips.

The fruits are preserved on a grey mudstone as impressions or casts with crumbled coaly compressions on them. Our intention was to macerate the coaly crumbles for cuticles or attached pollen grains, but none were obtained. Therefore, we contented ourselves with the external morphology.

Asterocelastrus cretacea Velenovskỳ et Viniklár (Plates I, II)

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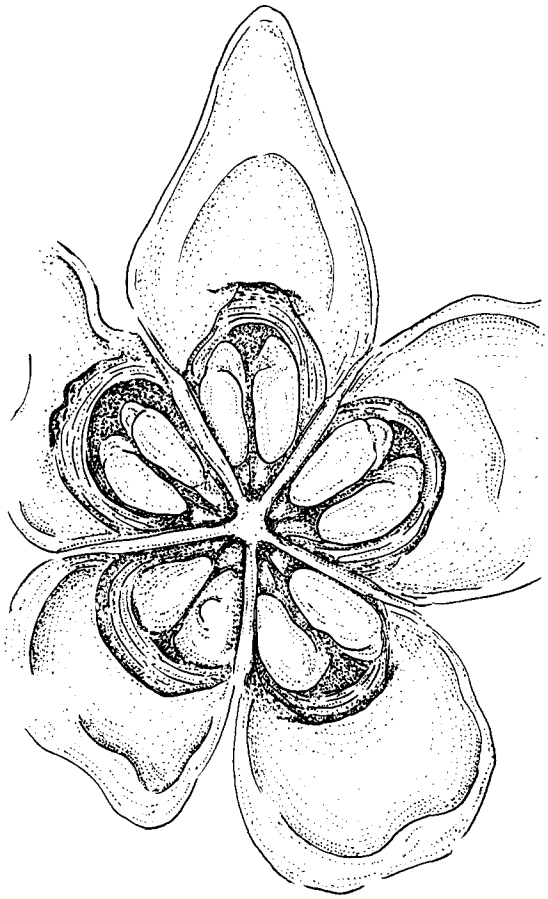

Fig.1. *Asterocelastrus cretacea* from the Cenomanian of Bohemia, N B39. Fruit showing five locules with two anatropous seeds each, fused to the 5-lobed calyx cup.

Holotype: N B39, Velenovskỳ and Viniklár, p.21 (50), plate I, 11 (Plate I, 3, 4, 6).

Emended diagnosis: Fruits capsulate, shortly pedicellate, with a prominent torus of the receptacle, radially symmetrical, pentamerous. Perianth members star-like spreading, about 10 mm long, proximally fused in a cup about 7 mm in diameter. Ovary inferior, syncarpous, carpels proximally fused to the calyx cup and to each other for about 2/3 their length. Ovules (seeds) two per carpel, basally attached, anatropous.

Description

One specimen B 39a (Plate I, 5) shows a semiclosed capsule 10 mm wide with a short pedicel and apically converging lobes. All the rest are open capsules — the five-lobed radially symmetrical star-like structures showing gynoecial parts adnate to the perianth lobes which are proximally fused for about 1/3 of their length. Free distal portions of the lobes are pointed, smooth, often twisted or inrolled. Contrary to the above description by Velenovskỳ and Viniklár, they do not appear stiff or horny. Though in none of the available specimens are all the five lobes fully exposed, they seem equal, 8–8.5 mm long, with free tips about 5 mm long.

The fused proximal parts of the lobes form an almost circular cup about 7 mm in diameter, containing locules with seeds. A polygonal area, 1 mm wide in the center of a cup, might represent a torus of the receptacle (Plate I, 1, 3; Plate II, 1, 2). The locules are radially disposed and appear as median depressions of the cup sectors. They are elliptical, about 3 × 2.5 mm, proximally adnate for 2 mm, then diverging and rounded. The adnate portions are separated by ridges superimposed on the cup sutures which extend beyond them as sharp lines 1–1.5 mm long (Plate II, 5). The ridges are prominent, smooth or with a slight indication of a median groove, but without any traces of coaly matter or rock matrix separating adjacent locules. Neither is there any coal or matrix between the latter and the cup with which they appear to form one whole structure.

Free distal portions of the carpels can be traced a few mm outside the cup but none of them are preserved to full length. As distinct from the locules, they are separated from the lobes by a thin layer of coal and the intervening matrix (Plate I, 6). The stylar impressions seem rugose while the locules are smooth, bounded by a concentrically striated distal border (Plate I, 4).

There are two seeds per carpel, preserved as compressions or more often as casts, almost filling the locule. Both seeds seem equally developed, ovate, about 1.5 mm long, broadly rounded at the chalazal end and bluntly pointed at the micropyle facing receptacle.

PLATE I

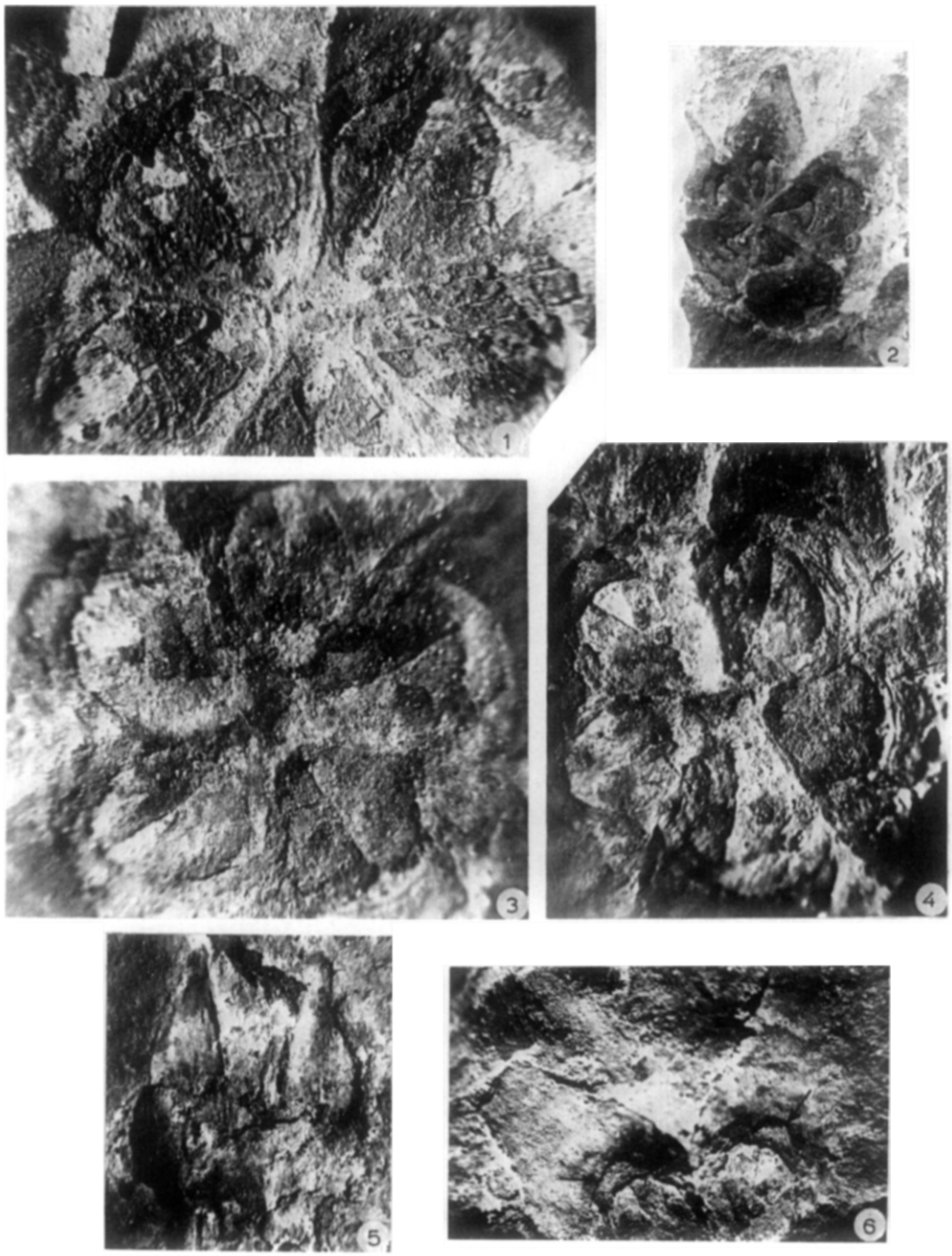

PLATE I

Asterocelastrus cretacea from the Cenomanian of Bohemia
1, 3. Fruits showing five biovulate locules. 1, N B42. 2, N B39, ×10.
2. Fruit, general aspect, N B45, ×3.
4. Fruit showing concentrically striated distal border of the locules (arrows), N B39, ×7.
5. Semiclosed capsule, N B39a, ×4.
6. Two fruit segments showing free stylar portions of the carpels (arrows) overlapped by the perianth lobes, ×5.

PLATE II

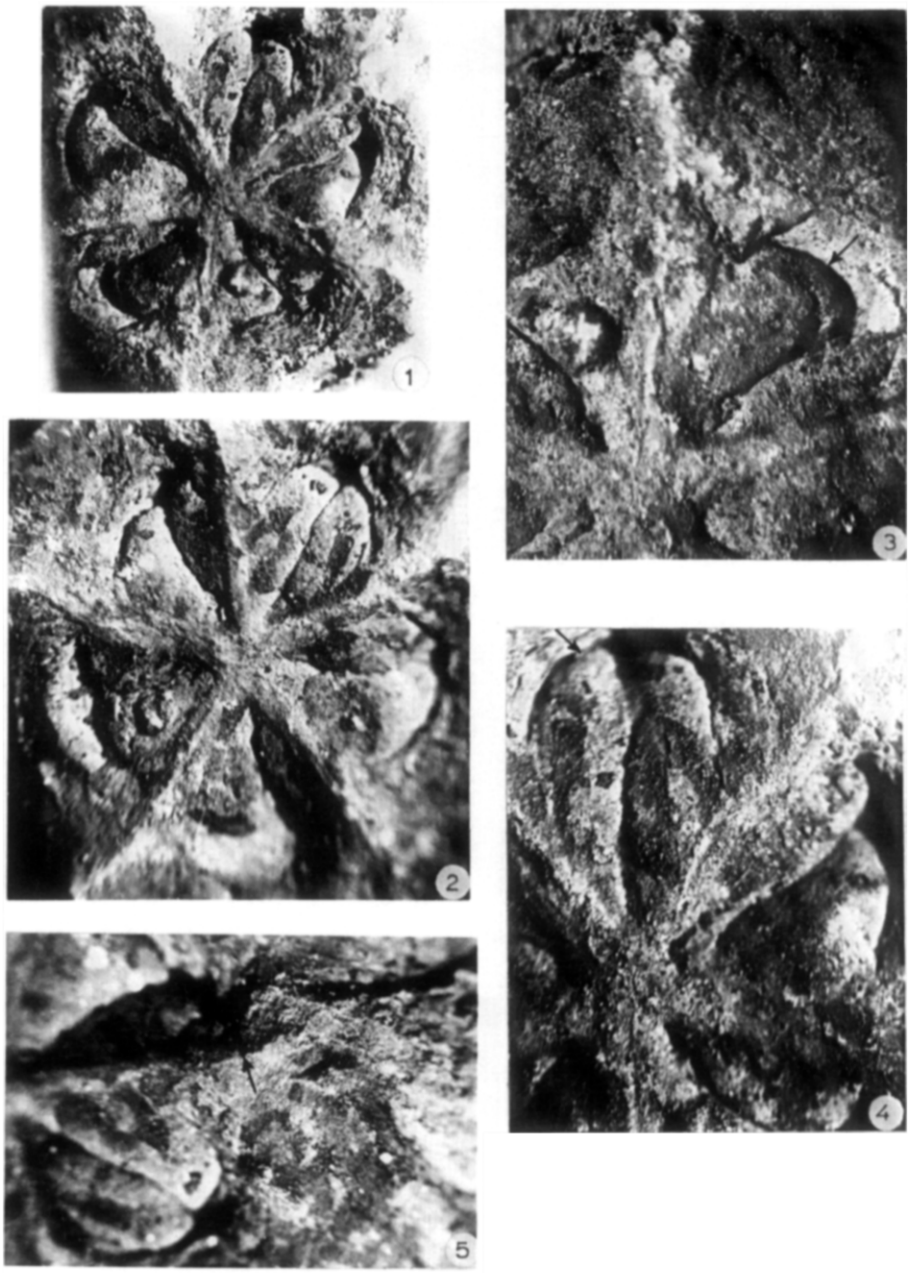

PLATE II

Asterocelastrus cretacea from the Cenomanian of Bohemia.
1, 2. Locules containing casts of the ovules or seeds, separated by ridges, N B45, ×7 and 9.
3, 4. Anatropous ovules showing funicles (arrow), N B45, ×15.
5. A ridge between the locules (arrows) extending to a sinus between the perianth lobes, N B45, ×10.

They are basally attached by their thick funicles (Plate II, 3, 4).

Discussion

We believe that Velenovskỳ and Viniklár (1926) have accurately described *Asterocelastrus* as a pentamerous capsule consisting of two-seeded carpels, but their interpretation of the free lobes as the carpel appendages seems unlikely since the carpels occur within a cup formed by the proximal parts of the lobes. Thus, we are inclined to see the five-lobed structure as a floral cup formed by the proximally fused perianth members, while the ovary was inferior rather than superior. If so, then the rosalean affinity appears more plausible than the originally suggested celastralean one because in the latter order the ovaries are superior or at best semi-inferior fused to the nectary dicks (Cronquist, 1981).

Capsules are common in the Saxifragaceae, the extant members of which differ from *Asterocelastrus* in the less extensive calyx to ovary fusion and also in having more seeds per carpel. More closely matching states of these both characters can be met with within the Rosaceae (in which, however, the capsulate fruits are rare). Members of the latter family with epigynous floral parts are confined to the Maloideae. Notable in them are various degrees of syncarpy and the ovary to floral cup fusion (Sterling, 1965), as well as the basally attached ovules. The comparison can be extended to *Stanvaesia*, a maloidean genus with five carpels (Sterling, 1965).

Among the Cretaceous reproductive structures assigned to the Rosidae, *Scandianthus* Friis and Scarby (1982; Friis, 1985) from the Senonian of Sweden has inferior cenocarpous ovary and capsulate fruits, but the perianth members are free and the gynoecium consists of two carpels with many ovules on apical placentas. It is comparable with some extant crassulaceous genera from which it differs in having fewer and more completely fused carpels while the extant members of the Saxifragaceae typically have floral cups.

In *Sarysua* from the Senonian of Kazakhstan (Krassilov et al., 1983), the ovary is pentamerous and syncarpous but free from perianth. The calyx is dialysepalous with caudate sepals, reflexed at the fruiting stage. The locules are long, distally slit-like.

The actinomorphic pentamerous flowers from the Cenomanian of North America (Basinger and Dilcher, 1984) have syncarpous and loculicidal, but supposedly superior gynoecium and the perianth members are free.

Obviously similar is *Paleorosa similkameensis* Basinger from the Eocene of British Columbia (Basinger, 1976). It is described as a flower in which the sepals, petals, and stamens are fused to form a floral cup which "resembles a five-lobed calyx tube". Five carpels are inserted at the base of the floral cup. They are fused to the floral cup up to the level of ovules and appear also fused to one another, but a close examination is said to reveal a continuous epidermis surrounding each carpel. The ovules are two per carpel, equally developed, basally attached, erect, and anatropous. *Paleoroza* is classified as an extinct primitive member of the Rosaceae, supposedly close to the incipient Maloideae. *Asterocelastrus* and *Paleoroza* are at different developmental stages and they are differently preserved. Nevertheless, there are many points of resemblance between their gynoecial structures and floral cups and, specifically, fig.2 in Basinger (1976) showing the floral cup, five carpels and two ovules per carpel, looks much like our Plate II, 1.

The gynoecia appear syncarpous in both cases, but in *Paleoroza* there is an epidermis layer between adjacent carpels which are, thus, adnate but not fused. In the case of *Asterocelastrus*, the common walls of adjacent carpels are solid without any distinct partitions and, though decisive evidence of sections is lacking, it seems unlikely that they contained separate epidermis layers.

Conclusion

Asterocelastrus from the Cenomanian of Bohemia is interpreted as a capsulate fruiting

stage of an actinomorphous, pentamerous, epigynous flower with proximally connate perianth lobes and carpels fused to each other up to the level of ovules, two-seeded, locules, and basally attached anatropous ovules. It is comparable with certain extant members of the rosaceous tribe Maloideae (Sterling, 1965) and, among fossils, with *Paleorosa similkameensis* from the Eocene of British Columbia (Basinger, 1976). Presently the most ancient member of the Rosales, *Asterocelastrus*, does not conform to the conventional idea of a primitive archetypal rosalean floral structure. The extensive part fusion and the biovulate carpels are more often than not considered advanced character states in the order.

The great antiquity of *Asterocelastrus* may suggest a simpler and more direct way to syncarphy than our traditional idea of it, that is, by marginal fusion of the open protocarpellate structures not unlike the coniferalean or gnetalean seed-scale complexes, and more specifically, not unlike *Eoantha* described by one of us from the Lower Cretaceous of Transbaikalia (Krassilov, 1984). However much more work is needed to corroborate these suggestions.

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