

# A New Species of *Baierella* from the Krasnyi Yar Locality, Early Cretaceous of Western Transbaikalia

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Received December 26, 2006

**Abstract**—Plant remains of *Baierella* R. Potonié (Ginkgoales) were found for the first time in the Lower Cretaceous deposits of the Khilok Formation (Buryatia Republic), where they form a thin coal bed. A new species, *B. averianovii*, is described from the Krasnyi Yar locality. The monodominant burial of the new species in combination with pollen grains of *Ginkgocycadophytus* prevailing in the relevant palynological assemblage allows the authors to reconstruct a monospecific woody wetland plant community.

**DOI:** 10.1134/S0031030107110056

**Key words:** Ginkgoales, *Baierella*, Early Cretaceous, Khilok Formation, Transbaikalia.

## INTRODUCTION

Narrow dichotomously branching leathery leaves are among the most common plant fossils of the Upper Mesozoic of Siberia. They were long conventionally assigned to the genus *Czekanowskia* Heer (Czekanowskiales). Later, Krassilov (1972) assigned fan-shaped and repeatedly dissected leaves with one vein in each terminal segment from the Lower Cretaceous of the Bureya River Basin to *Baierella* R. Potonié of the family Karkeniaceae (Ginkgoales). He believed that this genus occupied a transitional position between *Sphenobaiera* Florin and *Baiera* C.F.W. Braun, differing from them in the highly reduced leaf plate. He also included in this genus *Sphenobaiera uninervis* Samyl., which was described from the Upper Jurassic–Lower Cretaceous of the Aldan River (Samylina, 1963). The plant from the Bureya River Basin shows the following epidermal characteristics: longitudinal (rarely, oblique) orientation of stomata in indistinct interrupted rows, about 15 rows within a lobe, an oval stomatal pit lined by a distinct cutin rib, about half of stomata with papilla-like processes on the proximal walls of the subsidiary cells, distinctly cutinized polar extremities of guard cells, small papillae on some ordinary epidermal cells, and no secretory ducts.

The diagnosis of *Baierella hastata* Krassilov, which was later described from the Lower Cretaceous of Mongolia (Krassilov, 1982), also includes the predominantly longitudinal orientation of stomata and their isolateral distribution.

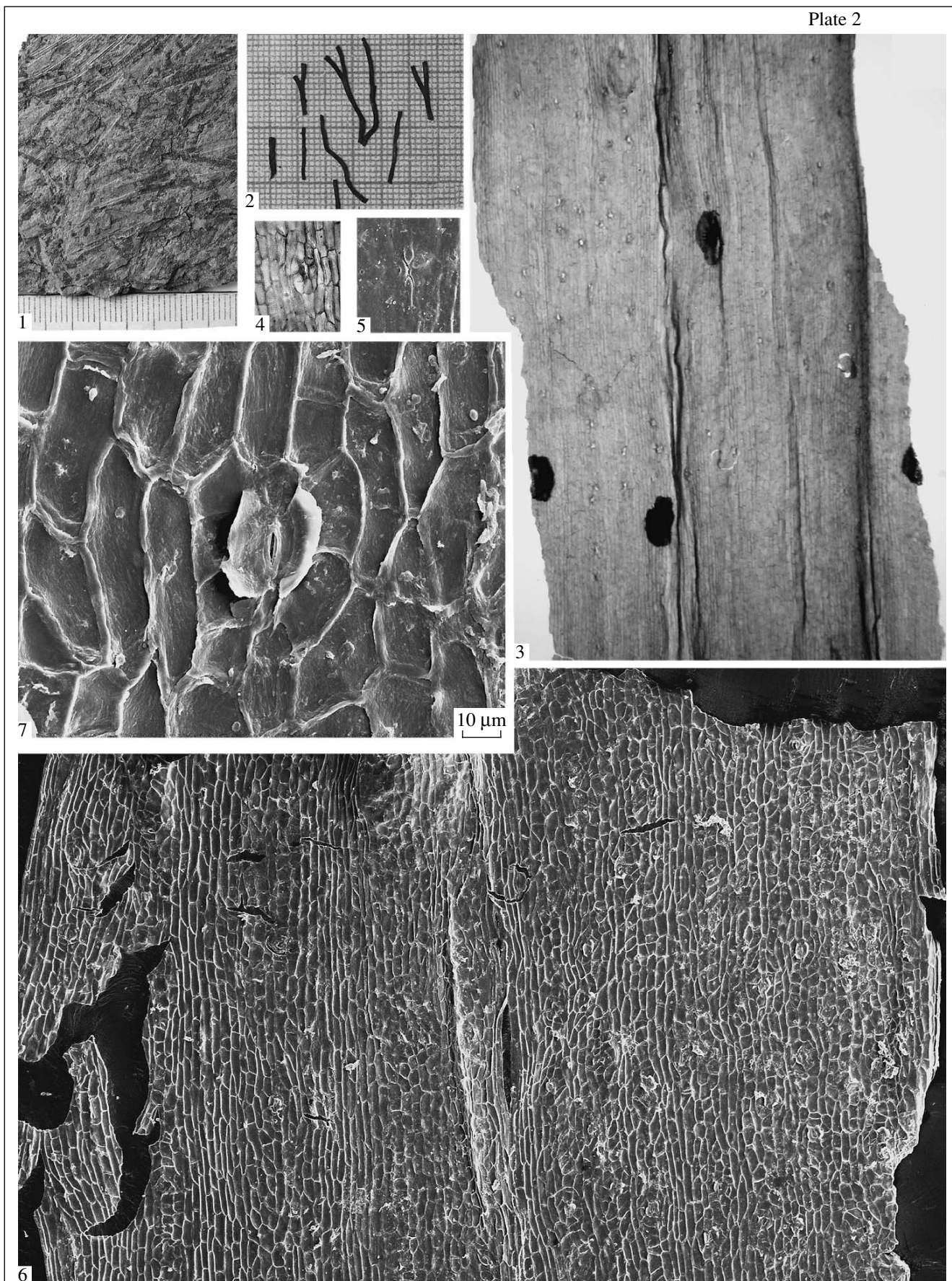
Kiritchkova and Samylina (1979) introduced for dissected ginkgoalean leaves the new genus *Leptotoma* Kiritchk. et Samyl. with three species. This taxon was

considered to be characterized by a repeatedly dichotomizing leaf plate with narrow fleshy segments, which are tetragonal in transverse section, the occurrence of stomata of the upper leaf surface near marginal zones, and the irregular orientation of guard cells of stomata (Kiritchkova and Samylina, 1979). These authors stressed that “the distinguishing feature of the leaf epidermal morphology of *Leptotoma*, unknown in leaves of other Ginkgoales, is a median zone of the upper surface of the leaf that is devoid of stomata” (Kiritchkova and Samylina, 1979, p. 1532). They remarked that although finely dissected ginkgoalean leaves were sometimes determined as *Baierella*, they refrained from using this genus since its epidermal morphology was unknown.

We believe that the leaves that are, on the one hand, so similar in general morphology, and, on the other hand, dissimilar in epidermal structure, should be referred to as different genera: *Leptotoma*, with a tetragonal transverse section of terminal segments, median zone of the upper epidermis lacking stomata, and irregular orientation of stomata, and *Baierella*, with stomata on both leaf surfaces (more numerous stomata on the lower surface) and longitudinal orientation of stomata.

## MATERIAL AND METHODS

The fossil material was collected during the summer of 2002, in the Khilok River Basin (Buryatia Republic) by the field trip team of the Zoological Institute of the Russian Academy of Sciences (St. Petersburg) under the direction of A.O. Averianov and comes from the Krasnyi Yar locality (50°40′32.9″ N, 107°54′55.4″ E),



Khilok Formation (Skoblo et al., 2001). A thin (no more than 20 cm) coal layer was found among sandy beds containing abundant vertebrate remains (Skutschas, 2003). The layer is filled with thin forking leaves.

The leaf cuticle was conventionally processed with Schulze solution and alkali, and then slides for light microscopy and stubs for electron microscopy were prepared.

The sample for palynological analysis from the coal layer was macerated according to the standard technique of Luber and Waltz for highly metamorphosed rocks and coals (*Paleopalynology*, 1966).

Photographs were made by L.F. Simanenko using a Zeiss Axioplan 2 imaging light microscope and by P.P. Safronov using a Zeiss EVO-50XVP scanning electron microscope in the electron microscopy facility of the Laboratory of noble metal analysis of Far East Geological Institute, Far East Division of the Russian Academy of Sciences.

#### SYSTEMATIC PALEOBOTANY

##### DIVISION PINOPHYTA (GYMNOSPERMAE)

##### Order Ginkgoales

##### Genus *Baierella* R. Potonié, 1933

##### *Baierella averianovii* Bugdaeva, sp. nov.

Plate 2, figs. 1–7

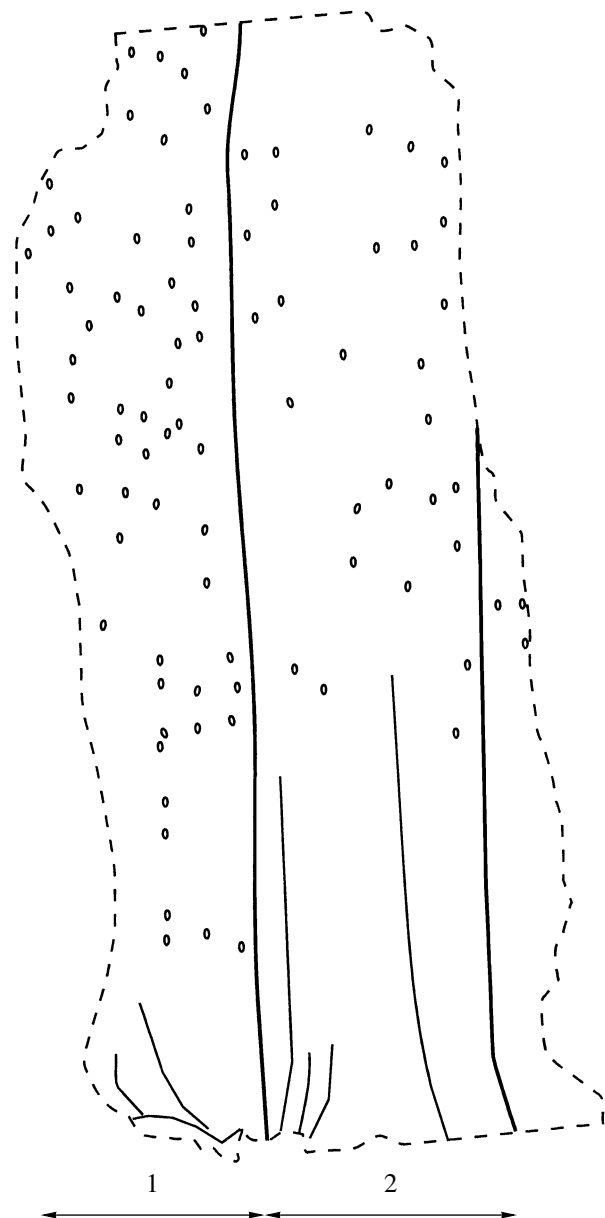
**Etymology.** In honor of the paleontologist A.O. Averianov.

**Holotype.** IBSS, no. ZBKYa-1; dissected twice dichotomizing leaf; Russia, Buryatia Republic, Khilok River Basin, Krasnyi Yar locality; Khilok Formation, Lower Cretaceous (Pl. 2, figs. 2–7, Fig. 1).

**Diagnosis.** Narrow dichotomizing dissected leaves with acuminate lobes with one vein. Stomata on both sides of leaf plate, in prevailing longitudinal orientation, with five to seven subsidiary cells. Anticlinal walls ridged. Periclinal walls of inner epidermal surface slightly wrinkled or striate.

**Description** (Fig. 1). The collection contains leaf fragments lacking a base. They are narrow, dichotomously dissected at an acute angle. The longest fragment is up to 2 cm long and 0.8–1.0 mm wide (Pl. 2, fig. 2). The width of leaves at the point of dichotomy is about 1.5 mm.

The leaves are amphistomatic, anisolateral (stomata of the lower epidermis are more numerous than those of the upper epidermis). The cuticles of both sides are



**Fig. 1.** Occurrence of stomata on the lower (1) and upper (2) leaf epidermises. The leaf width is 1 mm.

equally thick (Pl. 2, fig. 3). The lower epidermis is not subdivided into stomatal and non-stomatal zones (Fig. 1). Stomata are relatively regularly distributed over the surface of the lower epidermis; they are arranged in more or less distinct interrupted rows, six to nine rows per the width of the leaf. The number of sto-

#### Explanation of Plate 2

**Figs. 1–7.** *Baierella averianovii* Bugdaeva, sp. nov., holotype IBSS, no. ZBKYa-1: (1) monodominant bedding of leaves,  $\times 1$ ; (2) some leaf fragments,  $\times 1$ ; (3) leaf cuticle, note dark rounded bodies of fungal infections,  $\times 40$ ; (4) a stoma in transmitted light,  $\times 15$ ; (5) a stoma, outside view, SEM,  $\times 40$ ; (6) lower and upper surfaces of the leaf cuticle, SEM,  $\times 100$ ; (7) a stoma, SEM,  $\times 700$ . Russia, Buryatia Republic, Khilok River Basin, Krasnyi Yar locality, Khilok Formation, Early Cretaceous.

mata varies from 16 to 22 per 1 mm<sup>2</sup>. They are predominantly longitudinally (rarely obliquely) orientated. There are about six subsidiary cells, which are not thickened and form an irregular oval with a broken outline (Pl. 2, figs. 4, 7). Walls of subsidiary cells that are faced towards the guard cells bear papillae overhanging the stomatal aperture (Pl. 2, fig. 5). Underdeveloped stomata are occasionally present.

Ordinary epidermal cells are arranged in rows. Most of these cells are longitudinally elongated, but transversely elongated and tetragonal cells with obliquely orientated transverse walls are also common. Polygonal and triangular cells, as well as cells with irregular outlines are present. Ordinary epidermal cells may bear a small rounded papilla. The anticlinal walls of cells are thickened and convex; often, the transverse walls are more thickened. An indistinct striation or wrinkles are traceable on periclinal walls. The cells measure 12–22 × 20–50 μm.

The upper epidermis differs from the lower one by less numerous stomata (9–12 per 1 mm<sup>2</sup>), which are arranged in short interrupted rows and more or less regularly situated. A row of elongate tetragonal epidermal cells (about 24) is visible in the central part of the upper epidermis. They measure 5–8 × 25–100 μm. It is possible that in imprint, this row of cells resembles a midrib, which is mentioned in Bureya and Mongolian species. In the middle area of this row, the cells are less elongated and stomata are present (Pl. 2, fig. 6).

**Comparison.** The specimens of *Baierella* from the Krasnyi Yar locality and *Baierella uninervis* (Samyl.) Krassilov differ in their epidermal morphology: the latter species has more densely situated stomata on the lower epidermis (32 per 1 mm<sup>2</sup> by comparison to *B. averianovii* with 16–22 per 1 mm<sup>2</sup>), stomatal apparatuses are often situated so close to each other that they share encircling or marginal subsidiary cells, the stomatal pit is lined with a distinct cutin rib, polar extensions of guard cells are relatively strongly cutinized, anticlinal walls are thin and straight, and subsidiary cells are much larger (Krassilov, 1972). The new species differs from *B. hastata* Krassilov because the Mongolian plant has a stomatal pit margined with a cutin thickening or papillae, rounded central thickenings on guard cells, and long and cutinized poles (Krassilov, 1982).

**Remarks.** Narrow dichotomously dissected leaves of the Ginkgoales were described as *Leptotoma*, with the type species *L. lenaensis* Kiritchk. et Samyl. The genus originally included three species from the Middle Jurassic of Mangyshlak and the Late Jurassic and Early Cretaceous of Yakutia (Kiritchkova and Samylina, 1979). These three species, along with *L. slastenowii* Kiritchk. and *L. latifolia* Kiritchk., which were described later from the Lena River Basin (*Phytostratigraphy...*, 1985), are characterized, according to their authors, by stomata of the upper leaf surface restricted to marginal zones and irregular orientation of

guard cells (we should point out that in the latter two species the orientation of stomata is predominantly longitudinal). These generic features do not characterize the Transbaikalian plant, which has longitudinal orientation of guard cells of stomata and stomata of the upper epidermis that apparently are not restricted to marginal zones.

**Material.** Several pieces of rock, crowded with leaf fragments, Krasnyi Yar locality (Khilok Formation, Buryatia).

## DISCUSSION

We have revealed that the coal-forming plants of the Khilok Formation were members of the Ginkgoales. Leaves of *Baierella* form a thin coal bed in the Krasnyi Yar locality. Since the burial is monodominant, we suppose that this plant formed monospecific wetland plant communities. Most leaves of *Baierella* are affected by fungi (Pl. 2, fig. 3), that implies that they were exposed to air for about one year before burial. Modern mycology shows that a relatively long preparation period is needed for the leaf epidermis to be colonized by mycobiota (*Micromyces...*, 1984).

The palynological assemblage demonstrates a low taxonomic diversity. It is dominated by gymnosperms, mostly pollen grains of *Ginkgocycadophytus*, which were apparently produced by *Baierella*. Bisaccate pollen grains close to the Pinaceae (*Alisporites aequalis* (Bolch.) Chlon. and *A. similis* (Balme) Dett.) and Podocarpaceae (*Podocarpidites multesimus* (Bolch.) Poc.) are in insignificant numbers. Spores of fernlike plants (*Cyathidites minor* Coup. and *Leiotriletes* spp.) and lycopods (*Densoisporites vellatus* Weyl. et Krieg., *Leptolepidites verrucatus* Coup., and *Retitriletes subrotundus* (K.-M.) E. Sem.) are very rare.

Palynological data also testify to the prevalence of woody vegetation. It is most probable that members of the Ginkgoales grew on the shore of a lake, whereas conifers grew at a certain distance from the place of burial, representing slope vegetation. The paucity of plants of lower tiers, as reflected by the palynological spectrum, probably indicates a genuinely reduced understory.

## ACKNOWLEDGMENTS

We are grateful to A.O. Averianov for the provided opportunity to participate in the Transbaikalian field trip of 2002, to P.P. Skutschas for the assistance during the field trip, and to L.F. Simanenkov and P.P. Safronov for making photographs.

The study was supported by the Far East Division of the Russian Academy of Sciences, grant no. 06-III-A-06-141 and Presidium of the Russian Academy of Sciences, grant nos. 06-I-P18-081 and 06-I-P11-022.

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