

HEPATICES FROM ROVNO AMBER (UKRAINE),
3. *ANASTROPHYLLUM ROVNOI* SP. NOV.

ПЕЧЕНОЧНИКИ ИЗ РОВЕНСКОГО ЯНТАРЯ (УКРАИНА),
3. *ANASTROPHYLLUM ROVNOI* SP. NOV.

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Abstract

A fossil representative of the leafy liverwort family Anastrophyllaceae is described based on an inclusion in Late Eocene Rovno amber. Based on morphological similarities the fossil is assigned to the extant genus *Anastrophyllum*, as *A. rovnoides* sp. nov., being the first fossil of this genus and the fourth liverwort from Rovno amber.

Резюме

Ископаемый вид печёночников из семейства Anastrophyllaceae выявлен в образце ровенского янтаря, относящегося к позднему эоцену. На основании морфологического сходства образец отнесён к современному роду *Anastrophyllum* и описан как новый для науки вид *A. rovnoides* sp. nov. Данная находка – четвёртый вид печёночников для эоценовой флоры Ровно.

KEYWORDS: fossil, Jungermanniales, liverwort, Marchantiophyta, Ukraine, Rovno, Tertiary, Eocene

INTRODUCTION

Bryophyte inclusions in Baltic amber have been studied since the middle of the XIX century (Berendt, 1845; Göppert, 1853), and since then 23 liverwort species (Grolle & Meister, 2004a) and some 60 moss species (Frahm, 2010) have been described. The majority of bryophyte inclusions can be assigned to extant genera without much doubt. However, the classification of some inclusions is hampered by their incomplete preservation and a lack of many taxonomically relevant characters. Examples include the liverwort *Lophocolea polyodus* Caspary (Lophocoleaceae) that was transferred to the genus *Bazzania* Gray (Lepidoziaceae) (Grolle 1980), and *Lophozia kutscheri* Grolle (Grolle & Meister, 2004a) that was related to *Barbilophozia* Loeske (Grolle & Meister, 2004b). Despite these taxonomical problems, the bryophyte flora of the Eocene Baltic amber forest can be compared with other contemporaneous regional floras.

Among the latter is the Rovno amber flora (Ukraine). Bryophyte inclusions in Rovno amber have been studied

only recently (Ignatov & Perkovsky, 2011; Konstantinova *et al.*, 2012), providing some evidence for the presence of the same species observed in Baltic amber. This finding is not surprising considering the Late Eocene age of the Rovno amber and the distance of only a few hundred kilometers between the Baltic Region and the northern Ukraine (Kosmowska-Ceranowicz, 1999; Perkovsky *et al.*, 2003, 2007, 2010; Aleksandrova & Zaporozhets, 2008a, b). However, several mosses from Rovno appeared to be different from those found in Baltic amber (Ignatov & Perkovsky, 2011, 2013). Most inclusions of liverworts in Rovno amber belong to the genus *Frullania* Dumort. (Konstantinova *et al.*, 2012), which is also commonly represented among the Baltic amber bryophytes. However, the liverwort *Acrolejeunea ucrainica* Mamontov, Heinrichs & Schäf.-Verw. is known only from Rovno amber (Mamontov *et al.*, 2013).

In the present paper we describe another liverwort that has not yet been observed in Baltic or any other Paleogene amber.

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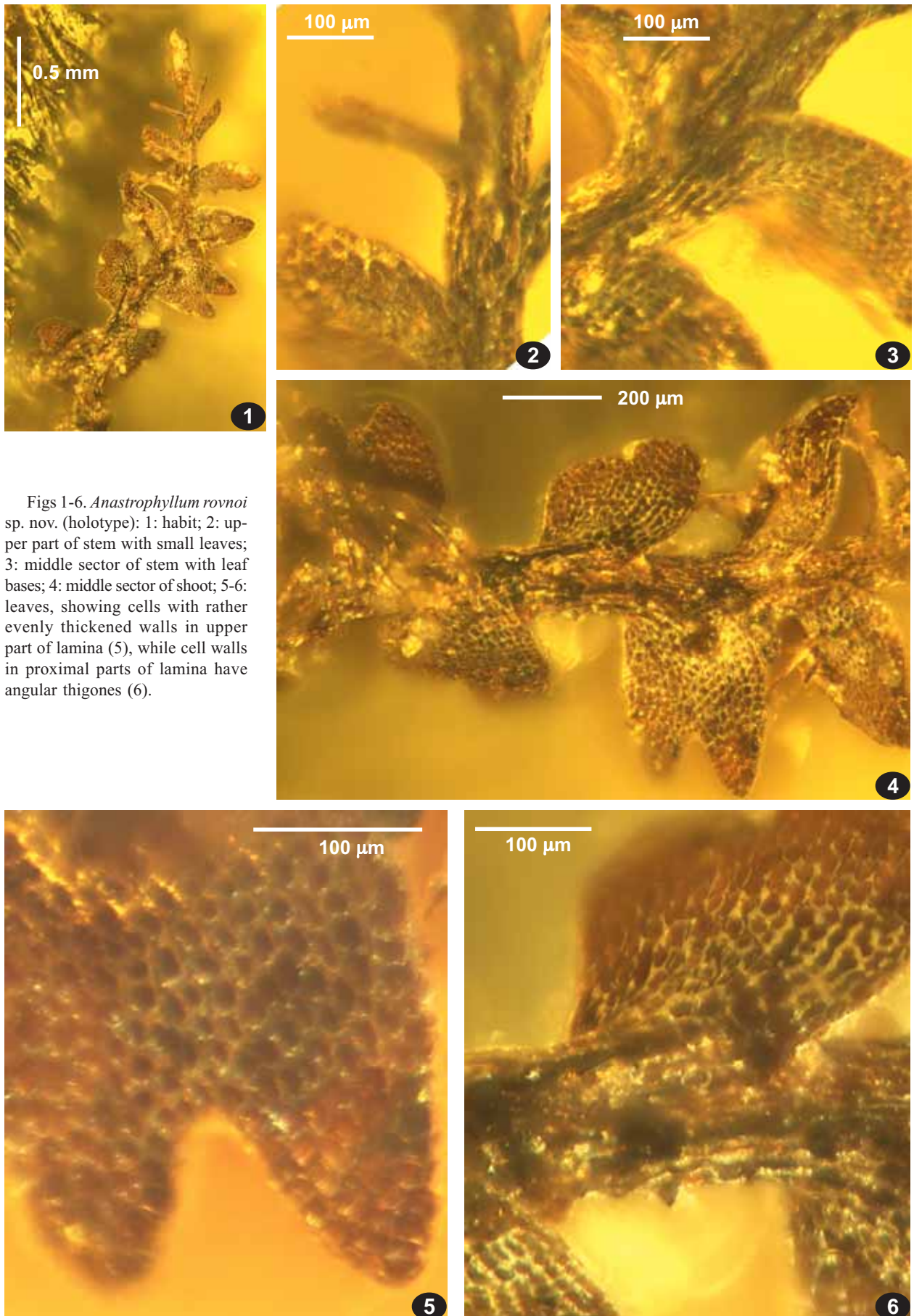
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Figs 1-6. *Anastrophyllum rovnoides* sp. nov. (holotype): 1: habit; 2: upper part of stem with small leaves; 3: middle sector of stem with leaf bases; 4: middle sector of shoot; 5-6: leaves, showing cells with rather evenly thickened walls in upper part of lamina (5), while cell walls in proximal parts of lamina have angular thigones (6).

MATERIALS AND METHODS

The amber piece is part of the Rovno amber collection of the Schmalhausen Institute of Zoology in Kiev (SIZK-K-915-F). After primary preparation the amber piece had a weight of 7.35 gram. The fossil liverwort was photographed using a stereomicroscope Olympus SZX16 with a 1.6x objective lens, equipped with an Infinity 4 digital camera. The images of Figs. 1-6 were obtained from 5-15 optical sections using the software package HeliconFocus 4.50 (Kozub *et al.*, 2008) for a better illustration of the three-dimensional inclusion.

TAXONOMY

The studied inclusion consists of a single sterile shoot with bilobed leaves, indicating that a leafy liverwort is at hand. Its succubous, obliquely inserted leaves, the obtuse to rounded leaf lobes consisting of subisodiametric cells, the nodulose trigones, and the apparent lack of underleaves relate the plant to Anastrophyllaceae (Jungermanniales, Marchantiophyta).

The amber inclusion is morphologically similar to the extant genera *Gymnocolea* (Dumort.) Dumort. and *Anastrophyllum* (Spruce) Steph. with segregated genera, as circumscribed by Váňa *et al.* (2013a, b), but differs from the former in leaf shape and leaf cells, and from nearly all species of the latter in leaf insertion. Extant *Gymnocolea* typically grows in peat bogs and on acidic rocks, whereas *Anastrophyllum* includes lignicolous and corticolous species. Considering the presence of the liverwort inclusion in a piece of fossil tree resin, it is not unlikely that a lignicolous species is at hand. The relatively large size of the amber piece could provide some evidence for its origin from a trunk base. The presence of Chironomidae among the syninclusions indicates a rather moist environment.

Anastrophyllum leaves typically become transverse at the dorsal end of their insertion line and are thus usually strongly concave-canalicate whereas the leaves of the amber inclusion are obliquely inserted and thus nearly flat. Lignicolous species of *Anastrophyllum* often produce gemmae on the shoot tips, but exceptions prove the rule. On the other hand, the preserved scanty plant fragment is not sufficient to make a definite statement on the ability of the species to produce gemmae. Since nearly flat leaves are not completely unknown among extant representatives of *Anastrophyllum*, we assign the fossil to this genus. However, the assignment needs to be scrutinized if more completely preserved fossils become available.

Genus **Anastrophyllum** (Spruce) Steph. (family Anastrophyllaceae)

Description (for characters seen in the amber inclusion). Plants minute to vigorous, erect or ascending but shoot tips usually curved; sparsely branched. Leaves alternate, bifid, distichous, succubously inserted, with oblique ventral and transverse dorsal insertion; flat to concave-canalicate. Cells firm, thin-walled, with large,

nodulose trigones; cuticle smooth or indistinctly to strongly papillose. Underleaves absent or vestigial.

Type species: *Anastrophyllum donianum* (Hook.) Steph..

Anastrophyllum (incl. *Anastrophyllopsis* (R.M. Schust.) Váňa & L. Söderstr. and *Schizophyllopsis* Váňa & L. Söderstr.) is widely distributed mostly in mountaineous regions of the world. It includes ca. 30 extant species (Schuster, 2002). So far, no fossils have been described.

Anastrophyllum rovnoi Mamontov, Heinrichs & Váňa, sp. nov. Figs 1-6

HOLOTYPE: Klesov. Rovno amber. Late Eocene. SIZK-K-915-F. Syninclusions in K-915-F: Fagaceae stellate hairs; one specimen of Hymenoptera, one of Aphidinea, and two of Chironomidae; and in K-916 [originally the same piece as K-915] one specimen of Chironomidae (Figs 1-6).

Material: A single unbranched, 2.2 mm long and up to 0.8 mm wide sterile shoot with well exposed stem and seven pairs of bilobed leaves. Rhizoids are present in lower parts of the ventral stem surface. The dorsal side of the plant is covered by a thick amber layer and thus not available for study. Cells outlines are well visible on stem and leaves.

Description: Sterile, 2.2 mm long and up to 0.8 mm wide shoot. Stem 110–125 µm wide, cortical cells rectangular, 9–13×18–22(–29) µm, walls moderately thickened. Rhizoids on lower portion of ventral stem surface, as long as leaves, colorless, scarce, spreading at right angle to stem; leaves remotely arranged, bilaterally inserted and oriented, thus distichous, alternating, succubous, in ventral half with obliquely arcuate insertion line, not decurrent ventrally. Lower two pairs of leaves larger than upper ones, 250–330×425–60 µm, obliquely inserted, plane or somewhat concave, perpendicularly spreading, elliptical, entire-margined, bilobed to 0.4 of leaf length, sinus obtuse to rounded, lobes sub-equal, triangular, 9–11 cells wide at base, apex obtuse to somewhat rounded. Subsequent two pairs of leaves transversely inserted, concave-conduplicate, lamina spreading from stem at right angle, but bases spreading at an angle of 40–45°. Upper three pairs of leaves decreasing in length towards shoot apex, 270 µm to 110 µm, thus substantially smaller than lowermost leaves, transversely inserted, somewhat concave to almost flat, erect spreading, with angle of leaf-stem divergence decreasing from 70° to 20° towards shoot apex, uppermost leaves therefore appressed to stem. Leaf cells arranged in irregular rows parallel to leaf margins, conspicuously elongated in basal and lower median portions of lamina, with distinctly incrassate walls and nodulose trigones. Cells of lobe apex and margins elongate to rounded-quadrate, 12–15×15–22 µm, central leaf cells larger, rounded-elongate, 12–18×22–26 µm. Cuticle smooth. Underleaves absent. Gemmae absent.

Differentiation: Although the placement of Eocene plant fragments to extant species is problematic *per se*,

quite a number of mosses and hepatics from Baltic and Rovno amber were assigned to extant species (Frahm, 2010; Grolle & Meister, 2004a; Ignatov & Perkovsky, 2011). This classification could be applied to material superficially similar to extant species, and at the same time with no contradicting characters. However, the assignment of fossils to extant taxa should not only be based on morphological similarities but also on divergence time estimates based on molecular evidence (Heinrichs *et al.*, 2007; Lóriga *et al.*, 2013).

Anastrophyllum rovnói resembles *A. ellipticum* Inoue and *A. lignicola* D.B. Schill & D.G. Long as well as *Gymnocolea inflata* (Huds.) Dumort., but differs in some morphological characters. The former two species are known from the Altai, the Himalaya region and East Asia (Inoue, 1978; Higuchi, 2011; Schill & Long, 2002, 2003; Long, 2011; Mamontov & Vilnet, 2013). They share with *A. rovnói* a small-size and broadly elliptical leaves divided to 0.4 of their length. However, both extant species differ from *A. rovnói* in their sub-transverse to transverse leaf insertion, which is oblique to sub-transverse in *A. rovnói*. Furthermore, the leaf lobes of *A. ellipticum* and *A. lignicola* are mostly acute (occasionally obtuse), whereas *A. rovnói* has only obtuse leaf lobes. *Gymnocolea inflata* resembles *A. rovnói* in its leaf insertion but has larger leaf cells and wider leaf bases (ratio of width at leaf middle to that at leaf base 1.9–2.1 in *G. inflata* vs. 1.3–1.5 in *A. rovnói*).

ACKNOWLEDGEMENTS

The research was partially supported by the Russian Foundation for Basic Research (grant numbers 12-04-01476, 13-04-01427, 14-34-50157).

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