

MOSSES FROM ROVNO AMBER (UKRAINE), 3.
POTTIODICRANUM, A NEW MOSS GENUS FROM THE LATE EOCENE

МХИ ИЗ РОВЕНСКОГО ЯНТАРЯ (УКРАИНА), 3.
POTTIODICRANUM, НОВЫЙ РОД МХОВ ИЗ ПОЗДНЕГО ЭОЦЕНА

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Abstract

Pottiodicranum gen. nov. is described based on an inclusion in Late Eocene Rovno amber. The fossil is characterized by an acrocarpous habit, common for many genera of haplolepidaceous mosses, but differs from all known Paleogene amber fossils of acrocarpous mosses in the presence of several high solid papillae above the lumen of the lamina cells. The papillae are present on the dorsal and ventral side of the lamina and resemble modern Pottiaceae species. However, *Pottiodicranum papillosum* has a striate dorsal costa surface consisting of low ridges similar to those of some species of Dicranaceae s.l., especially *Campylopus* and *Dicranum*. However modern Dicranaceae lack this kind of papillae, while Pottiaceae may have lamellae on the ventral side of the costa, but not on the dorsal side. Thus the Eocene moss fossil possesses a unique combination of characters and apparently belongs to an extinct group of Dicranidae, while the family relationships remain unclear.

Резюме

Из познеэоценового ровненского янтаря описан новый род мхов, *Pottiodicranum* gen. nov. В целом по своему строению он сходен с верхоплодными мхами, особенно представляющими группу гаплолепидных мхов, или подкласс Dicranidae. В то же время, он отличается от всех прочих верхоплодных мхов, известных из янтарей палеогеновых отложений, наличием нескольких высоких цельных папилл над просветом клеток листа. Папиллы развиты как на дорсальной, так и на вентральной сторонах листа и весьма напоминают по своему строению папиллы многих современных родов семейства Pottiaceae. В то же время, *Pottiodicranum papillosum*, единственный вид рода, имеет на дорсальной стороне жилки гребни, а также ясную продольную исчерченность, известную у современных мхов семейства Dicranaceae s.l., особенно у *Campylopus* и *Dicranum*. В то же время у представителей Dicranaceae не бывает таких папилл, а в семействе Pottiaceae неизвестны пластиночки или гребни на дорсальной стороне листа. Хотя все признаки *Pottiodicranum* известны в подклассе Dicranidae, их необычная комбинация делает род уникальным.

KEYWORDS: bryophytes, mosses, fossils, Dicranaceae, Pottiaceae, Dicranales

INTRODUCTION

Study of moss inclusions in Paleogene amber initiated in the 19th century and was at first limited to Baltic amber (Goepfert & Berendt, 1845; Goepfert, 1853; Caspary & Klebs, 1907). A second source of Paleogene moss fossils – Bitterfeld amber – became available in the second half of the 20th century (Liehmann, 2013). Frahm (2004, 2010) extensively studied the mosses in Baltic and Bitterfeld amber and assigned them to 33 genera in some 25 families. Twenty seven of these genera are extant and

four represent form genera. A few inclusions were classified to family level only, and a few taxa were not considered because the original material was not available.

The first mosses from Late Eocene Ukrainian Rovno amber were reported only recently (Ignatov & Perkovsky, 2011, 2013) and so far include representatives of ten genera (extant ones are marked with an asterisk): **Hypnum* Hedw., *Sematophyllites* J.-P. Frahm, **Hypnodontopsis* Z. Iwats. & Nog., *Calymperites* Ignatov & Perkovsky, **Trachycystis* Lindb., *Neckerites* Ignatov & Perkovsky,

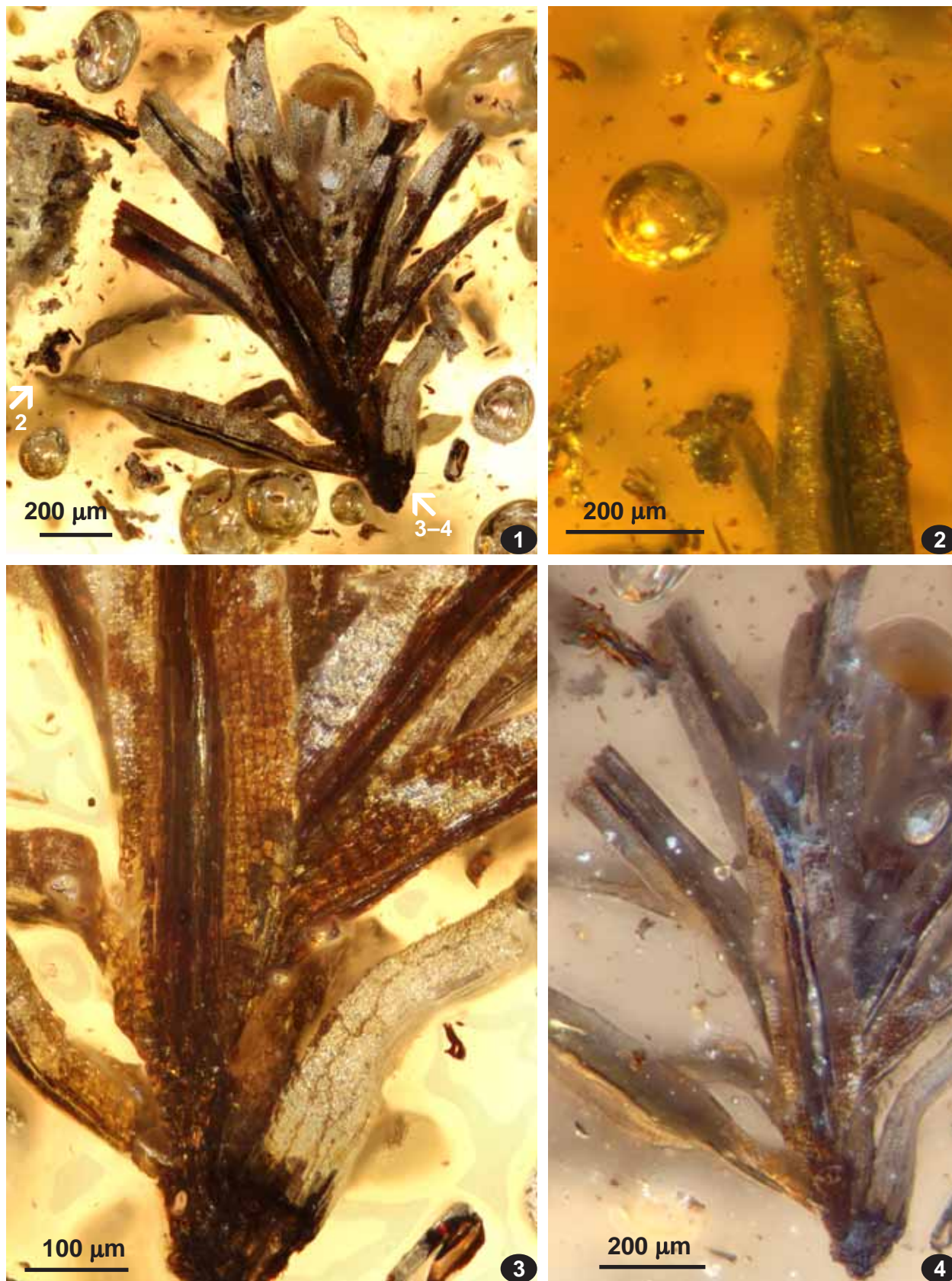
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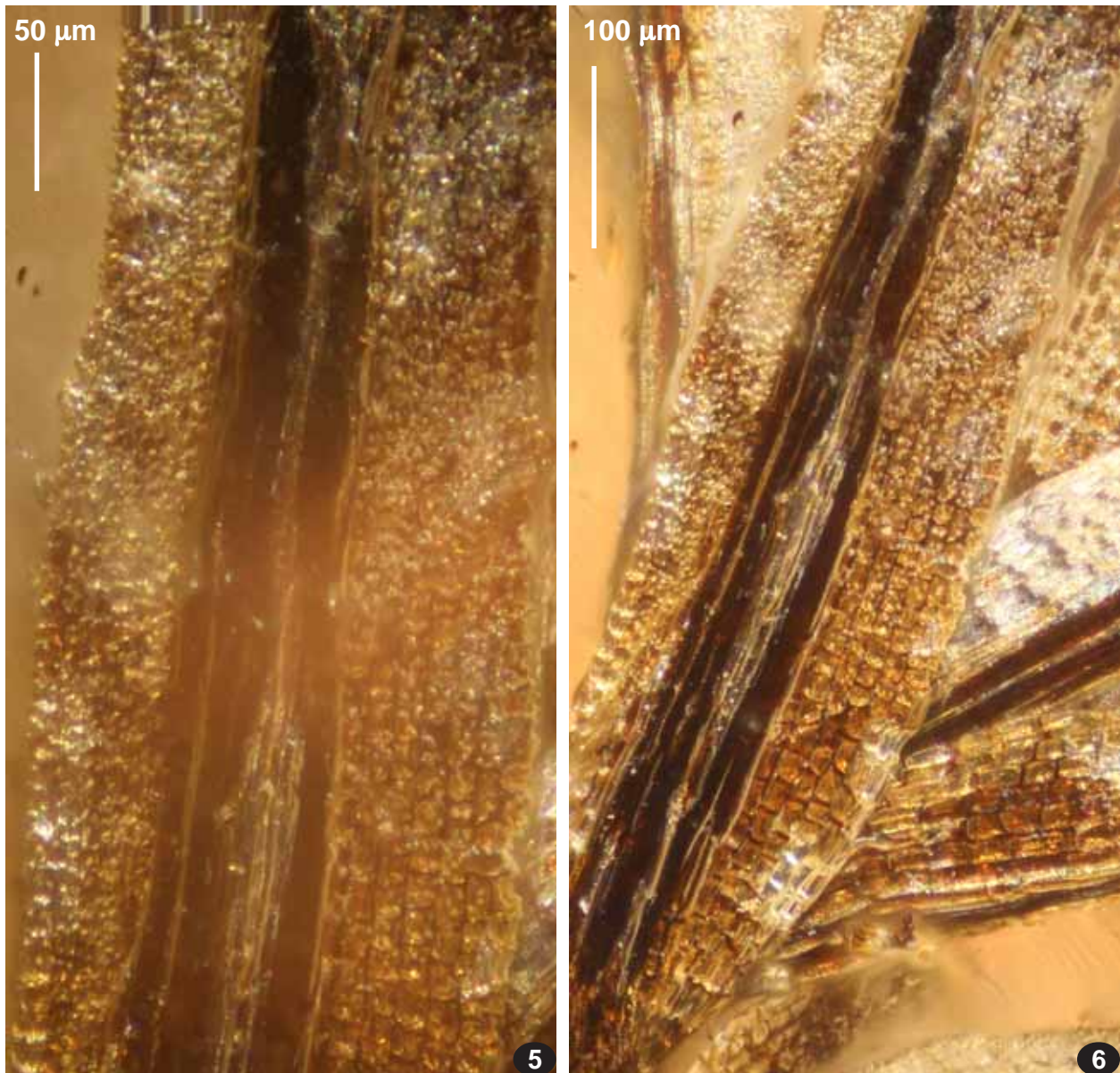
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Figs. 1–4. *Pottiodicranum papillosum* sp. nov. (from SIZK-K-10070): 1: Holotype, total view; details of further images arrowed and numbered; 2: upper part of leaf with retained apical part; 3–4: leaves of lower portion of shoot, views at different angles, contrasting areolation (3) and ridged dorsal costa (4).



Figs. 5–6. *Pottiodicranum papillosum* sp. nov. (from SIZK-K-10070): dorsal side of leaves showing median (5) and median to lower parts, note the increase of cell size towards the leaf base (6). Note also the ridged dorsal side of costa.

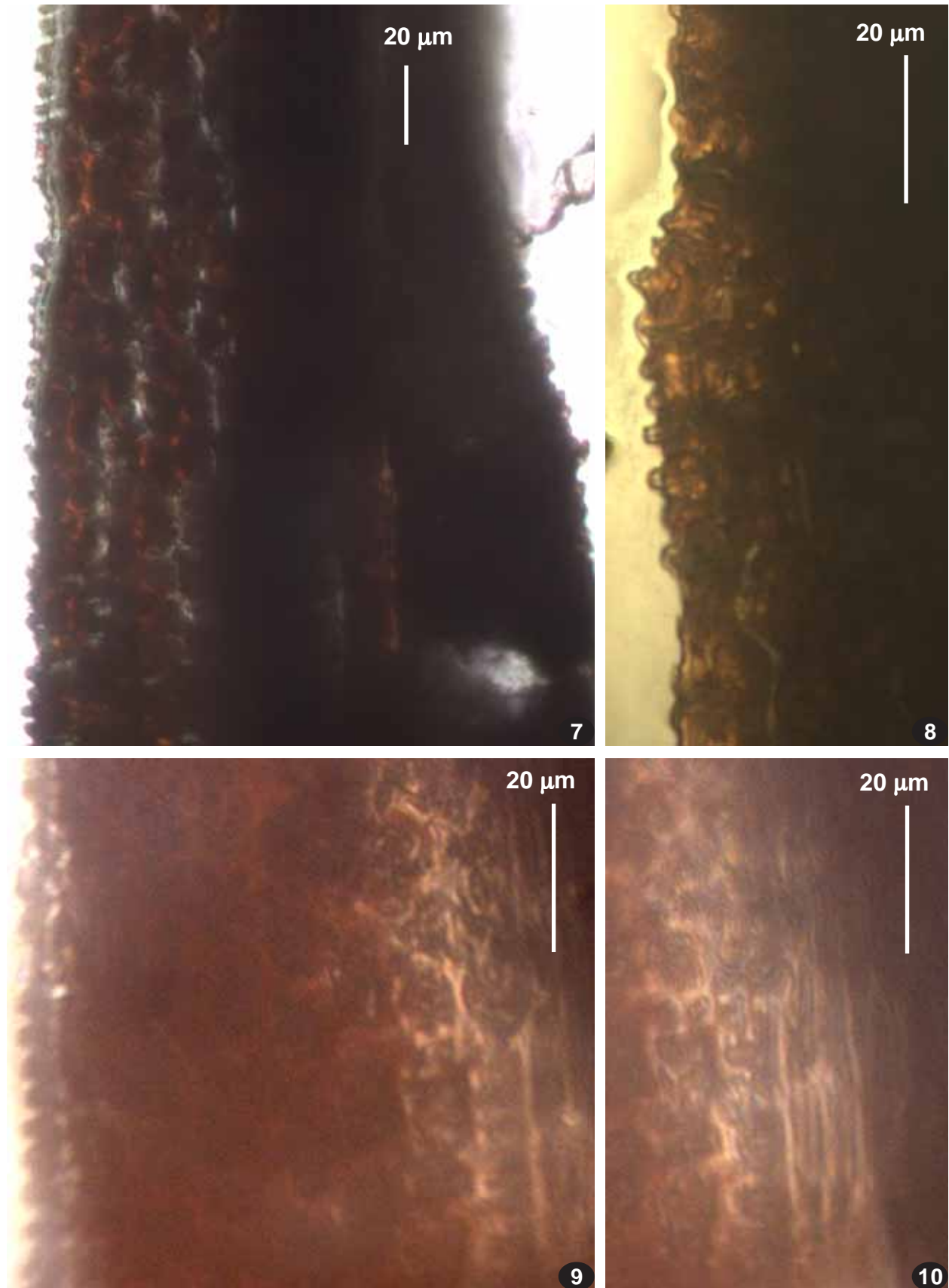
**Palamocladium* Müll. Hal., **Ctenidium* (Schimp.) Mitt., **Tristichella* Dixon, and **Isopterygium* Mitt.

Most of these genera have also been recognized in Baltic and Bitterfield amber, and despite some differences in the species composition of these ambers, the moss floras resemble each other (1) in the prevalence of pleurocarps: seven out of ten moss genera in Rovno amber, and 22 out of 33 in Baltic and Bitterfield amber; and (2) the presence of well-recognizable species, e.g. representatives of the genera *Trachycystis* and *Hypnodontopsis*. So far only a single acrocarpous moss from Rovno amber is unknown from Baltic and Bitterfield amber: *Calymperites ucrainicus* Ignatov & Perkovsky (Ignatov & Perkovsky, 2013). A second fossil genus which is so far unique to Rovno amber is described below.

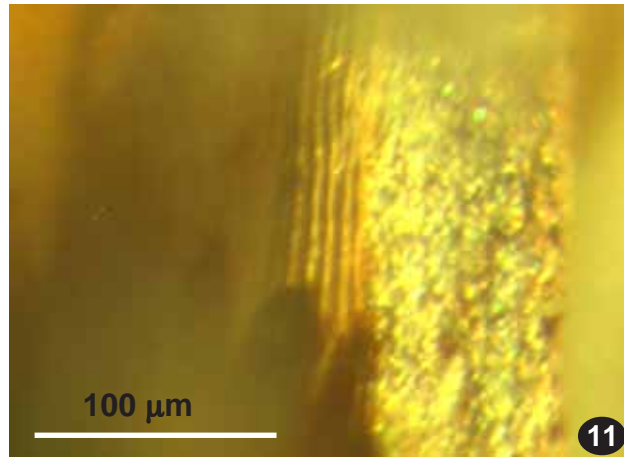
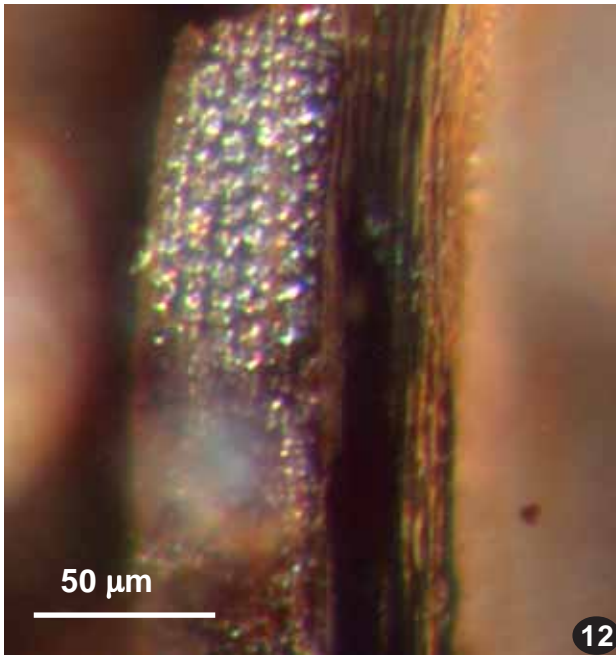
MATERIAL AND METHODS

The late Eocene amber specimen SIZK-K-10070 originates from the Pugach quarry (Klesov) in the Rovno Province of the Ukraine. Detailed information on the locality and its age is available from Ignatov & Perkovsky (2011). Having about the same age as Baltic amber (Perkovsky *et al.*, 2003, 2007, 2010), Rovno amber comprises a somewhat more southern fauna (Dlussky & Rasnitsyn, 2009; Naden *et al.*, 2016; Perkovsky 2011, 2016). So far, only a few fossils of bryophytes have been recognized.

Specimen SIZK-K-10070 was studied under a compound light microscope Olympus CX41 and a stereomicroscope Olympus SZX16 equipped with an Infinity 4 digital camera, and also with a Carl Zeiss AxioScope A1 compound microscope equipped with a Canon 60D dig-



Figs. 7–10. *Pottiodicranum papillosum* sp. nov. (from SIZK-K-10070): dorsal sides of leaves in upper part, magnified to show areolation and papillosity patterns, better seen at margins. The presence of several papillae per cell is especially apparent from the comparison of cell size and papillae density. '10' shows irregularly isodiametric laminal cells and rectangular costal cells. Consider that '10' shows an area just a little to the right of '9' where costal cells are seen with poor focus at the right margin of the picture.



Figs. 11–12. *Pottiodicranum papillosum* sp. nov. (from SIZK-K-10070): upper portions of leaves in dorsal view showing leaf areolation and papillosoity. The presence of several papillae per cell is apparent from the comparison of cell size and density of papillae. '12' shows irregularly isodiametric lamina cells and rectangular costa cells

ital camera. Incident and transmitted light were often used simultaneously. Most micrographs were obtained from a series of optical sections and composed using the software package HeliconFocus 4.50 (Kozub *et al.*, 2008) for a better illustration of the three-dimensional inclusion.

TAXONOMY

Genus **Pottiodicranum** gen. nov. [order Dicranales, family insertae sedis]

Description: Stem erect; densely foliated, terete. Leaves erect, oblong-lanceolate, gradually acuminate; costa strong, percurrent, on dorsal surface striate to ridged; margins entire; lamina cells irregularly round-quadrate, moderately thick-walled, with several simple, high cylindric papillae per cell; basal cells slightly enlarged, short rectangular.

Etymology: The name of the genus points to a combination of characters of two extant families, Dicranaceae (s.l.) and Pottiaceae.

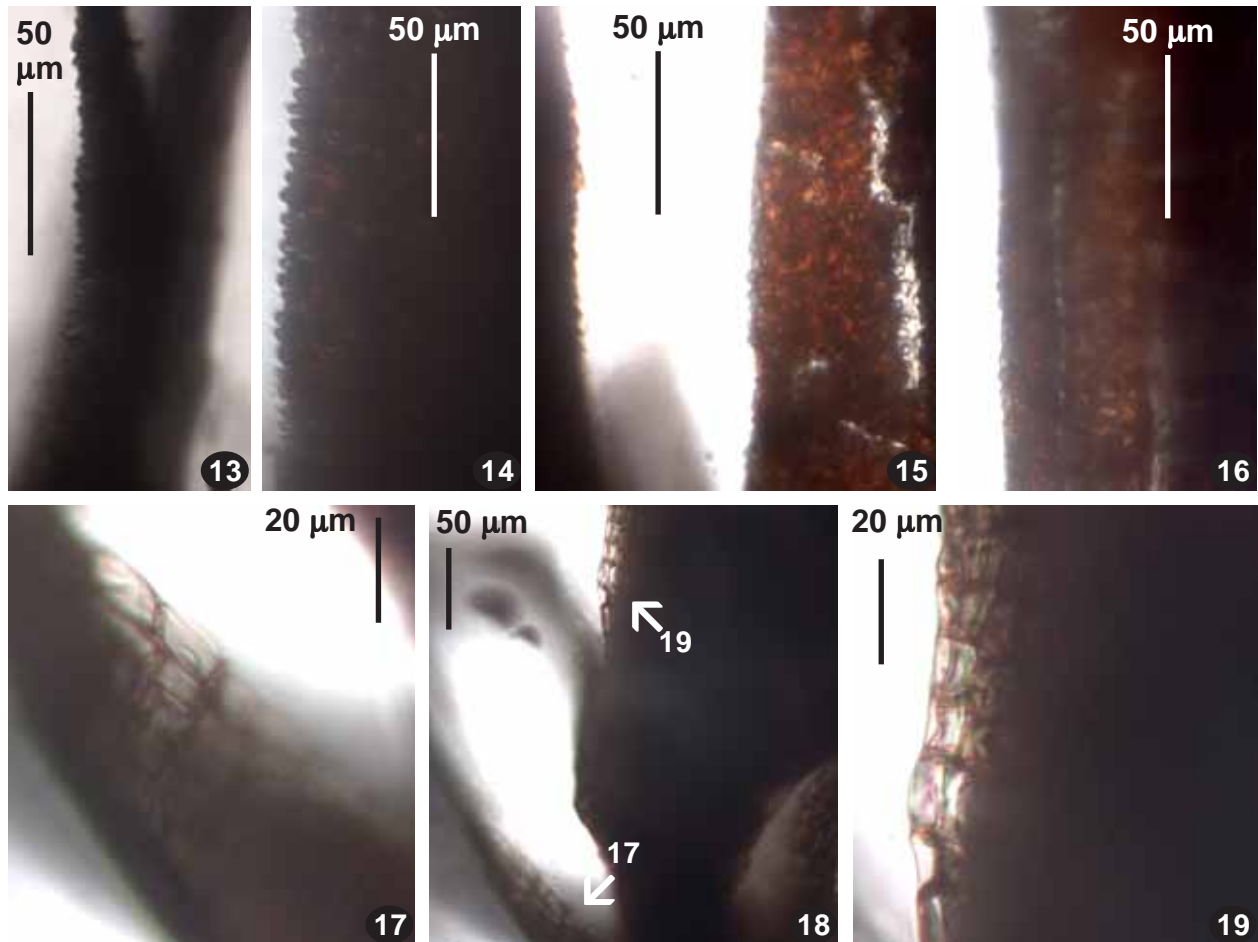
Type species: *Pottiodicranum papillosum* sp. nov.

Comparison: *Pottiodicranum* has the most prominent papillae among the Paleogene moss fossils. Among extant bryophytes, this type of papillae commonly occurs in the species-rich family Pottiaceae. The vast majority of its 1500 extant species has papillose lamina cells (Zander, 1993). However, assignment of *Pottiodicranum* to Pottiaceae is questionable considering the characteristics of the costa. The ridges on the dorsal surface of the costa (well visible in proximal to median parts of leaves, costa in distal parts regularly striolate) resemble *Dicranum* Hedw. (Dicranaceae) and *Campylopus* Brid. (Leucobryaceae) (Goffinet *et al.*, 2009), which was formerly also assigned to Dicranaceae.

Extant Pottiaceae lack a ridged or distinctly striolate dorsal costa surface, whereas cells with several high pa-

pillae per leaf cell do not occur among extant representatives of Dicranaceae s.l. A few genera of Dicranaceae s.l. such as *Amphidium* Nees (Amphidiaceae or Rhabdoweisiaceae, if a narrow family concept is applied) have papillose cells yet their papillae differ from those of *Pottiodicranum* in size and shape. Papillose cells are also known in some members of the large tropical moss family Calymperaceae, which is also nested in Dicranales s.l. (*i.e.*, including Pottiaceae). However, the dorsal surface of the costa of extant Calymperaceae is smooth or dentate to spinose but not lamellate or striate/ridged and, in addition, most species of this family have coarsely serrate leaf margins and very large, hyaline and thin-walled basal leaf cells (cancellinae). The papillae of some species of Orthotrichaceae are very similar to those of *Pottiodicranum*, however, their costae are never ridged. Ridged to almost winged costae occur in several species of *Grimmia* (Grimmiaceae), but most species of this family have smooth cells. Round papillae are known, *e.g.*, in *G. caespiticia* (Brid.) Jur. and *G. elatior* Bruch ex Bals.-Griv. & De Not., but their cells are never pluripapillose and the papillae are restricted to the lamina cells of the distal leaf portion. Pluripapillose cells are known from species of the Grimmiaceae genus *Niphotrichum* (Bedn.-Ochyra) Bedn.-Ochyra & Ochyra (or the *Racomitrium canescens*-group), but these species have ovate leaves with a relatively much narrower costa than in *Pottiodicranum*; and, in addition, their costae are never ridged. Furthermore, their mid-leaf lamina cells are elongate and provided with regularly sinuose longitudinal walls. Therefore, the combination of character states of *Pottiodicranum* does not correspond to any family of extant mosses.

Considering the morphological overlap of *Pottiodicranum* and extant Dicranaceae s.l. and Pottiaceae, we presume that *Pottiodicranum* most likely belongs to the



Figs. 13–19. *Pottiodicranum papillosum* sp. nov. (from SIZK-K-10070): Papillose leaf cells in upper (13–14) and in median to lower portions of leaves (Figs. 15–16), showing a gradual decrease of papillae size towards leaf base. Smooth cells along the lower leaf margins are shown in 17–19.

subclass Dicranidae (incl. Dicranaceae, Leucobryaceae, Pottiaceae, Rhabdoweisiaceae, Amphidiaceae, Rhabdoweisiaceae, Grimmiaceae, Hypodontiaceae), although a relationship to Orthotrichaceae of the subclass Bryidae cannot be completely excluded.

Pottiodicranum papillosum sp. nov. (Figs. 1–19).

Holotype: Rovno amber. Late Eocene. SIZK-K-10070 [separated from collection sample # 4-1659, Pugach quarry (Klesov) in the Rovno Province of the Ukraine, weight of the raw piece 7.3 gram, size 39×22×18 mm. Syninclusions: stellate hairs].

Description: Stem ca. 5 mm long, unbranched. Leaves 1–1.3 mm long, 0.17–0.20 mm wide, gradually acuminate, acute, channeled; margins plane, entire (but papillae present), costa single, percurrent, 50–65 µm wide, on dorsal surface ridged in the central portion of leaves, deeply and distinctly striolate towards leaf apex and base; ridges prominent, mainly 3 in number; lamina cells in upper and median part of leaf irregularly quadrate-rounded, ca. 10×10 µm, with 3–5 round papillae per cell; papillae 2–3 µm high in upper leaf portion; cells in leaf center in regular longitudinal rows, 6–7 rows from each

side of costa, quadrate, ca. 10×10 µm, papillose, papillae 1–2 µm high; basal cells quadrate to short rectangular, smooth, larger upper and median laminal cells, to 13–20×11–13 µm.

Material: The fossil consists of one small gametophyte fragment (Fig. 1), obviously representing the upper part of a shoot. Most leaves are relatively large, with upper parts broken; only a single completely preserved leaf with an acute leaf tip is present (arrowed in Fig. 1 and Fig. 2). A group of rather small leaves is embedded in larger leaves and may surround either gametangia or a young subterminal innovation. Papillae are well visible along the leaf margins; they decline towards leaf base.

Most leaves are visible from the dorsal side yet a few portions of the ventral leaf surface are also visible.

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