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ON RICCIA MARGINATA AND RELATED SPECIES (RICCIACEAE, MARCHANTIOPHYTA)

О RICCIA MARGINATA И РОДСТВЕННЫХ ВИДАХ (RICCIACEAE, MARCHANTIOPHYTA)

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Riccia marginata Lindb. was described by S. O. Lindberg (1877) from the outskirts of the town of Sortavala near the north shore of Lake Ladoga, Republic of Karelia, Russia. The species has been forgotten in most recent liverwort accounts of Europe, including Russia. Lectotypification of *R. marginata* is provided. *R. marginata* shares most characters with *R. beyrichiana* Hampe ex Lehm. It differs from «typical» plants of *R. beyrichiana* in having smaller spores, with ± distinctly finely areolate to roughly papillose proximal surfaces and a narrower and shorter thallus, as well as in scarcity or absence of marginal hairs. It may represent continental populations of the suboceanic-submediterranean *R. beyrichiana*, known in Russia from the Leningrad Region and Karelia only. The variability of spore surfaces in *R. beyrichiana* is discussed and illustrated by SEM images. A comparison with the spores of *R. bifurca* Hoffm. is provided. The question how distinct *R. marginata* is from *R. beyrichiana* needs to be clarified by molecular studies in the future, when adequate material is available. *R. marginata* is for the time being, provisionally, included in *R. beyrichiana.*

Keywords*:* nomenclature, lectotypification, taxonomy, *Riccia marginata, Riccia beyrichiana*, *Riccia lescuriana* var. *glaucescens*, *Riccia bifurca*, spores.

Riccia marginata Lindb. была описана S. O. Lindberg (1877) из окрестностей г. Сортавала, находящегося на северном берегу Ладожского озера в Республике Карелия. Вид был пропущен во всех современных сводках по печеночникам Европы и России. На основании изучения синтипа и оригинального описания проведена лектотипификация *R. marginata. R. marginata* по большинству признаков сходна с *R. beyrichiana* Hampe ex Lehm., от «типичных» растений которой отличается более мелкими спорами с более или менее явной мелкоячеистой или продолговатобугорчатой в зрелом состоянии структурой проксимальной поверхности, более узким слоевищем и едва развитыми или отсутствующими ресничками. *R. marginata* может представлять континентальные популяции

R. beyrichiana, известной в России только из Ленинградкой области и Карелии. Рассмотрена и проиллюстрирована (SEM) изменчивость структуры спор *R. marginata* и *R. beyrichiana*. Проведено сравнение со спорами *R. bifurca* Hoffm. Степень таксономической обособленности *R. marginata* от *R. beyrichiana* может быть выяснена посредством молекулярных исследований при наличии достаточного материала. В настоящее время *R. marginata* рассматривается как провизорный синоним *R. beyrichiana*.

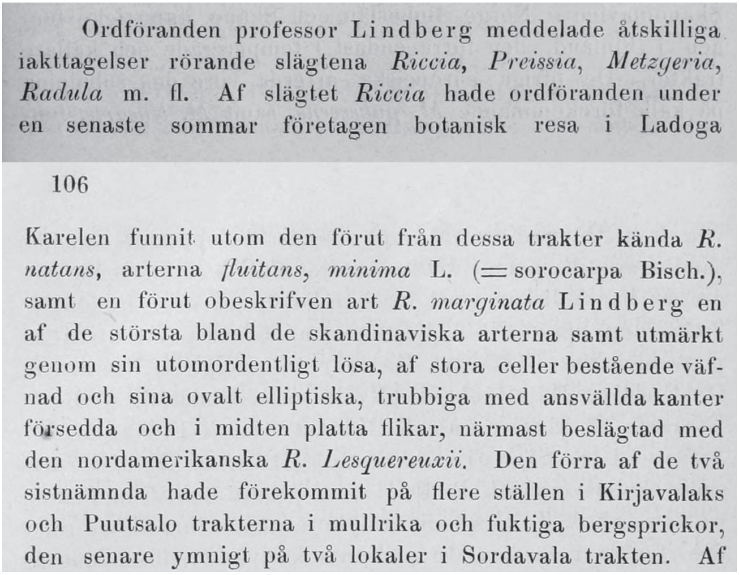
Ключевые слова*:* номенклатура, лектотипификация, таксономия, *Riccia marginata, Riccia beyrichiana*, *Riccia lescuriana* var. *glaucescens*, *Riccia bifurca*, споры.

During the work on the liverwort collections in the Herbarium of Sextus Otto Lindberg, Botanical Museum, University of Helsinki (H-SOL), it was discovered that *Riccia marginata* Lindb., described from the territory of the Republic of Karelia, was not mentioned in Russian liverwort accounts (Savicz, Ladyzhenskaya, 1936; Schljakov, 1982; Konstantinova, Potemkin, Schljakov, 1992; Konstantinova, Bakalin et al., 2009[2010]; Potemkin, Sofronova, 2009).

This species was not at all listed in most treatments of Scandinavian liverworts (Jørgensen, 1934; Buch, 1936; Koponen et al., 1977; Damsholt, 2002) either, and is not represented in the Index Hepaticarum Names Database. However, it was mentioned by J. P. Norrlin (1878: 22) and listed as a synonym of *R. beyrichiana* Hampe ex Lehm. in K. Müller's (1905–1916, 1951–1958) treatment of European and S. Arnell's (1956) treatment of Fennoscandian liverworts. In Müller's flora (l. c.) it was listed as *R. marginata* Lindb. msc.! A reference to the original description of *R. marginata* is provided only in Arnell (1956), Index Hepaticarum volume 12 (Geissler, Bischler, 1990) and «Tropicos Database».

Original description of Riccia marginata (Lindberg, 1877 — fig. 1).

«The chairman Professor S. O. Lindberg presented numerous observations concerning the genera *Riccia, Preissia, Metzgeria, Radula,* etc. Of the genus *Riccia* the chairman had found during his botanical trip to Ladoga Karelia last summer besides *R. natans* — earlier known from these areas — also the species *R. fluitans, R. minima* L. (= *sorocarpa* Bisch.) and a formerly undescribed species *R. marginata* Lindberg, which is one of the largest among the Scandinavian species as well as notable through its unusually loose tissue composed of large cells and through the ovally elliptic, blunt, centrally flat lobes with swollen margins. It is closest related to the North American *R. Lesquereuxii.* The former one of the last-mentioned two species [must mean *R. sorocarpa. — T. A.*] had occurred at several places in the Kirjavalaks and Puutsalo regions in humus-



Ordföranden professor Lindberg meddelade åtskilliga iakttagelser rörande slägtena *Riccia*, *Preissia*, *Metzgeria*, *Radula* m. fl. Af slägtet *Riccia* hade ordföranden under en senaste sommar företagen botanisk resa i Ladoga

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Karelen funnit utom den förut från dessa trakter kända *R. natans*, arterna *fluitans*, *minima* L. (= sorocarpa Bisch.), samt en förut obeskrifven art *R. marginata* Lindberg en af de största bland de skandinaviska arterna samt utmärkt genom sin utomordentligt lösa, af stora celler bestående väfnad och sina ovalt elliptiska, trubbiga med ansvällda kanter försedda och i midten platta flikar, närmast beslägtad med den nordamerikanska *R. Lesquereuxii*. Den förra af de två sistnämnda hade förekommit på flere ställen i Kirjavalaks och Puutsalo trakterna i mullrika och fuktiga bergsprickor, den senare ymnigt på två lokaler i Sordavala trakten. Af

Fig. 1. Original description of *Riccia marginata*: Meddelanden af Societas pro Fauna et Flora Fennica "1876" 3 Feb – 3 Mar 1877. 1: 105–106. [In Swedish]

rich and moist rock crevices, the latter one [must mean *R. marginata. — T. A.*] at two places in the Sordavala tract.»[1]

This description does not provide enough basis for correct species interpretation according to the present taxonomy. However, it includes morphological characters which Lindberg clearly regarded as diagnostic, such as large size, unusually loose tissue with large cells, and elliptic, blunt, centrally flat lobes with swollen margins. Therefore *R. marginata* is regarded as undoubtedly validly published.

Typification of *Riccia marginata*

Syntypes of *Riccia marginata* were found in H-SOL in folders of *R. bifurca* Hoffm. (7 specimens) and among Piippo: Hepaticae exsiccatae S. O. Lindbergii (no. 525) as *R. beyrichiana*. The former 7 specimens were studied in 1926 by C. E. O. Jensen and annotated as *R. lescuriana* Austin, which today is considered to be a synonym of *R. beyrichiana*. The syntype materials are homogeneous and represented by plants with the habit of *R. beyrichiana* and spores with a sculpturing, similar to that species, but the spores are generally of smaller size.

[1] Translated from Swedish by T. Ahti.

Riccia marginata Lindb., Meddelanden af Societas pro Fauna et Flora Fennica "1876" 3 Feb – 3 Mar 1877. 1: 106. (Plates I: *3–9*; III: *1–6, 8, 9*).

[Morgonbladet 1874 (237): 1. 13 Oct 1874 (nom. nud.); Helsingfors Dagblad 1874(289): 2. 23 Oct. 1874 (nom. nud.); Bot. Not. 1874: 156. 3 Nov. 1874 (nom. nud.)].

Thalli in partial rosettes or in intricate mats or single, glistening, pale or greyish-green, frequently with violet or reddish-purple margins near branch apices, usually becoming yellowish-white to brownish with age. Thalli 1–3 furcate or simple, 2–5 mm long, ultimate branches (0.75)1–1.5(2) mm broad, 1–2 mm long, linear-cuneate to linear-obovate, with a broad flat channel ($^1/_4$)$^1/_3$–$^1/_2$ of branch-width or wider and thick, raised and slightly convex margins, 250–350(500) µm wide, the apex broadly rounded or somewhat narrowed or retuse; the margins mostly entire, sometimes with a few short, generally thin-walled, blunt and ± smooth hairs, with apical wall not thickened, to 125 µm long and 30–40 µm wide (Plate III: *2, 8, 9*). Thallus long persistent, in section near apices of ultimate lobes × 1.5–2 as wide as high, in older sectors × 2.5–3.5(4) as wide as high, sides ± oblique and ± swollen to lobe apices. Cells of dorsal thallus surface 45–55 × 45–60 µm. Ventral scales violet to hyaline. Cells of ventral scales 38–80 µm long and (25)35–55 µm wide (hyaline scales usually have larger cells, whereas pigmented scales have shorter cells), with thin to somewhat thickened walls.

?Monoicous, often fertile. The archegonium neck deep violet. Spores deep brown at maturity, yellowish and brownish when immature, rounded triangular in outline, 75–90(115) µm in diam., with wing-like lighter pigmented and finely papillose, not areolate edge, which gets broader (to 7 µm) toward the angles. Angles often with pores. Distal spore surface with 5–6(7) alveoles across, each 10–13(15) µm, some alveoles may be incomplete. Proximal spore surface distinctly finely areolate-papillose (areoles 5–7 µm in diam.) when immature to indistinctly areolate and roughly papillose when mature (Plate I: *3, 5, 7, 8*). Trilete scar ± distinct.

Ecology. On partly shaded or open, moderately dry, bare brown humus soil over and in crevices of granite rocks near Lake Ladoga in area of high air humidity. Associated with *Riccia sorocarpa* Bisch. and *Asterella gracilis* (F. Weber) Underw. [*Mannia gracilis* (F. Weber) Schill et D. G. Long]. The type locality also has amphibolite in the bedrock.

Lectotype (designated here**)**: Russia. Republic of Karelia. Karelia ladogensis: "occidentem versus Liikolavuori[1], ad terram nudam apricam

[1] Liikkolanmäki or Liikkolanvuori at present.

et in fissuris humosis solo apertis, numquam in umbratis montis, 3 verst e Sordavala", 9 Julii 1874. S. O. Lindberg in Piippo: Hepaticae exsiccatae S. O. Lindbergii no. 525, as *Riccia beyrichiana* Lehm. (H 4230603).

Syntypes. Russia. Republic of Karelia. "Fennia, Ladoga, Sordavala, in monte Liikolavuori", 9 Julii 1874 S. O. Lindberg (H-SOL 2745018); "Karelia ladogensis, Sordavala, in m. Liikolavuori", 1 Julii 1874 S. O. Lindberg (H-SOL 2745020); "Fennia, Ladoga, Sordavala, in fiss. humosis mont. Liikolavuori", 18 Junii 1874 S. O. Lindberg (H-SOL 2745001); "Fennia, Ladoga, Sordavala, una c. *R. minima* et *Fimbriaria* ad terram nudam apricam et in fissuris humosis solo apertis, numquam in umbrosis, mont. amphibol. Liikolavuori, occidentem versus non rara", … 18 Junii 1874 S. O. Lindberg (H-SOL 2745015); "Sordavala, Liikolavuori", 18 Junii 1874 S. O. Lindberg (H 4230602).

Specimens not cited in the protologue: "Fennia, Ladoga, ins. Puutsalo, in terram humosam et humidiusculam praeruptis rup. granit", 30 Junii 1874 S. O. Lindberg (H-SOL 2745 016); Ladoga, ins. Puutsalo, 30 Junii 1874 S. O. Lindberg (H 4230601).

Topotype. Russia. Republic of Karelia. North shore of Lake Ladoga, outskirts of town of Sortavala, western slope of Liikkolanmäki (Liikkolanvuori) Mt., near highway (61°43′31.1″ N, 30°42′06.0″ E), open granitic rocky slope surrounded by forest, on exposed bare moderately dry brown soil over granite rock, ass. with *Riccia sorocarpa* and *Asterella gracilis*, 19 July 2011 A. D. Potemkin, V. M. Kotkova, A. I. Maksimov № L11-21, L11-22b (LE). A few thalli with immature green and brown spores.

Taxonomic position of *Riccia marginata*

Riccia marginata shares most characters of *R. beyrichiana* as treated by recent European authors (Jovet-Ast, 1986; Paton, 1999; Damsholt, 2002). It differs, however, from the latter in a mostly narrower [(0.75)1.0–1.5(2.0) mm vs. 0.8–2.5(3.0) mm)] and shorter thallus (2–5 mm vs. 5–15 mm) and smaller spores [75–90(115) μm vs. (70)90–120(130) μm] with fewer distal alveoles [5–6(7) vs. (5)6–9] as well as in a weaker development of marginal hairs or in totally lacking hairs.

Spore structure in the *Riccia beyrichiana-marginata* complex

Spores of both the treated species are rounded-triangular in outline. Their general structure in *R. marginata* is essentially similar to what is found in *R. beyrichiana*. It should be noted that light microscope observations of the spores may result in misinterpretation of the structure and above all in delimitation of the wing. The marginal area of spore

surface (the area between distal and proximal spore surfaces) in these species is usually devoid of areolation, ± papillose and looks lighter than the rest of spore surface (Plate I). Because of that it may be defined as a wing. In fact the wing in these species is mostly not developed and the marginal spore area represents a structure resembling a mountain range between the distal and proximal spore surfaces (Plate I: *10, 11*; Macvicar, 1926: 18, Fig. 3). The marginal spore area often bears pores, located at the angles and they are mostly turned to the distal surface of the spore (Plate I: *2–4, 10, 11*). The papillose structure of marginal surface in *Riccia marginata* and most phenotypes of *R. beyrichiana* differs from *R. bifurca*. The latter species has spore size similar to *R. marginata* but has a more extensive areolation of the distal surfaces expanded to the almost smooth wing (Plate II: *1, 3, 7*). Occasionally *R. beyrichiana* may develop spores similar to *R. bifurca* both in areolation and wing. Such spores have been found in material issued in V. Schiffner: Hepaticae europaeae exsiccatae no. 1141, as *R. lescuriana* Austin var. *glaucescens* (Carrington) Müll. Frib. (Plate II: *4–6, 8*), and are also illustrated by Jovet-Ast (1986: Pl. 64: *61, 62*) and on website "Identification des Ricciaceae d'Europe". Spores of *R. lescuriana* var. *glaucescens* differ from spores of *R. bifurca* in being larger [100–115 μm vs. (65)70–90(100) μm], in having variable areolation of the proximal surface and in distinctness of the trilete scar (cf.: Plate II: *4–6, 8* vs. *1, 3, 7*). Spores of *R. beyrichiana* from the Mediterranean (Jovet-Ast, 1986: Pl. 39: *9, 10*; 64: *61, 62*; website "Identification des Ricciaceae d'Europe") are even more similar to *R. bifurca* in areolation of the proximal surfaces. They mostly differ from spores of the latter species in larger size. The Mediterranean specimens of *R. beyrichiana* have a variable trilete scar, according to Jovet-Ast (1986: 337) strongly or feebly developed — "à marque triradiée forte or faible" (cf. Jovet-Ast, 1986: Pl. 39: *9, 10*).

The structure of proximal spore surfaces of *Riccia marginata* and *R. beyrichiana* apparently depends on spore maturity and, according to Damsholt (2002: 792), probably on humidity of the habitat. Damsholt (l. c.) mentioned that "plants from Nordic countries, as well as plants from Greenland and North America, have spores with smooth inner face (i. e. proximal surface), but some Nordic plants have spores with shallowly and indistinctly alveolate inner face. These plants originate from the very humid northern part of the Swedish west-coast, perhaps indicating a character linked to humid climatic conditions." It is possible, that the distinct areolation of proximal surfaces of spores, found in Mediterranean populations and illustrated by Jovet-Ast (1986), could be caused by a more humid local climate.

The immature, yellowish brown spores develop distinct fine areolation on proximal surface (Plate I: *5*), whereas the mature dark brown spores loose such an areolation apparently due to thickening of the spore wall beneath the areolation and the lamellae of the alveoles (Plate I: *1, 3, 7, 8*). Paton (1999: 578) noted: "As spores mature the lamellae forming the wall of the alveolae may become thicker and the tubercules may be more robust and the spores often darken with age". Such correlations between spore maturity and structure of its surface definitely must be taken into account, when spore structure is considered, as well as humidity conditions during spore maturation should be considered.

A comparison of *Riccia marginata* and *R. beyrichiana* in thallus characters provides little differences. *R. marginata* differs from *R. beyrichiana* in the mostly narrower and shorter thalli and the scarce formation of marginal hairs. The latter species, however, is variable in those characters (Jovet-Ast, 1986; Schuster, 1992; Paton, 1999) and the above-mentioned distinctions cannot be diagnostic. It can be hypothesized that *R. marginata* may represent an isolated population of *R. beyrichiana*, formed after the Pleistocene, with origin in spores, distributed in -, and transferred from western Europe.

In 2011, one of the authors, Potemkin, made an attempt to collect *R. marginata* at the type locality near Sortavala to obtain fresh material for molecular comparison of *R. marginata* and *R. beyrichiana*. However, only few and rather weakly developed thalli (Plate III: *3*) were found (see topotype cited above).

The facts above persuaded us to recognize *Riccia marginata* as a phase of *R. beyrichiana* distinguished by smaller spores and thalli. To which degree it is taxonomically distinct from *R. beyrichiana* needs to be clarified by molecular studies in the future, when sufficient material is available. Taking into account that *R. beyrichiana* was described from North America and the American populations are reported to differ from the European ones (Schuster, 1992), material from both continents and from northern and southern localities with different climate and humidity must be considered for such a study.

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als from Botanical Museum University of Helsinki to St. Petersburg. Kell Damsholt is gratefully acknowledged for reading the manuscript, and providing valuable advice and corrections.

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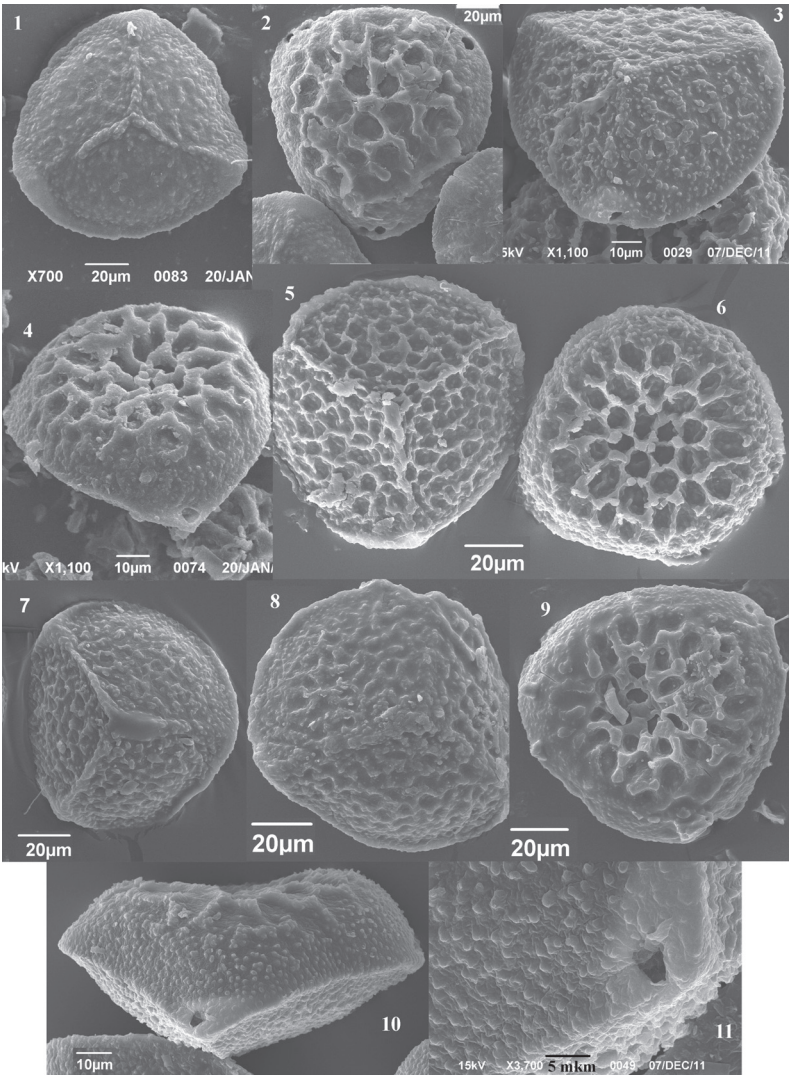

Plate I. Spores of *Riccia marginata* (*3–9*) and *R. beyrichiana* (*1, 2, 10, 11*). *1, 3, 5, 7, 8* — proximal surface (*5* — of immature yellowish-brown spore); *2, 6, 9* — distal surface (*2* — with pores at angles; *6* — of immature yellowish-brown spore); *4* — distal and lateral aspect with pore; *10* — lateral aspect with pore; *11* — structure of edge between distal and proximal surfaces (fragment of *10*, magnified). *1, 2* — from Sweden, Bohuslän H-SOL 2745012; *3* — from H-SOL 274501 (syntype of *R. marginata*); *4–6, 8, 9* —from H-SOL 4230603 (lectotype of *R. marginata*); *7* — from H-SOL 2745018 (syntype *of R. marginata*); *10, 11* — from Belarus, 24.06.1989 D. I. Tretjakov (LE).

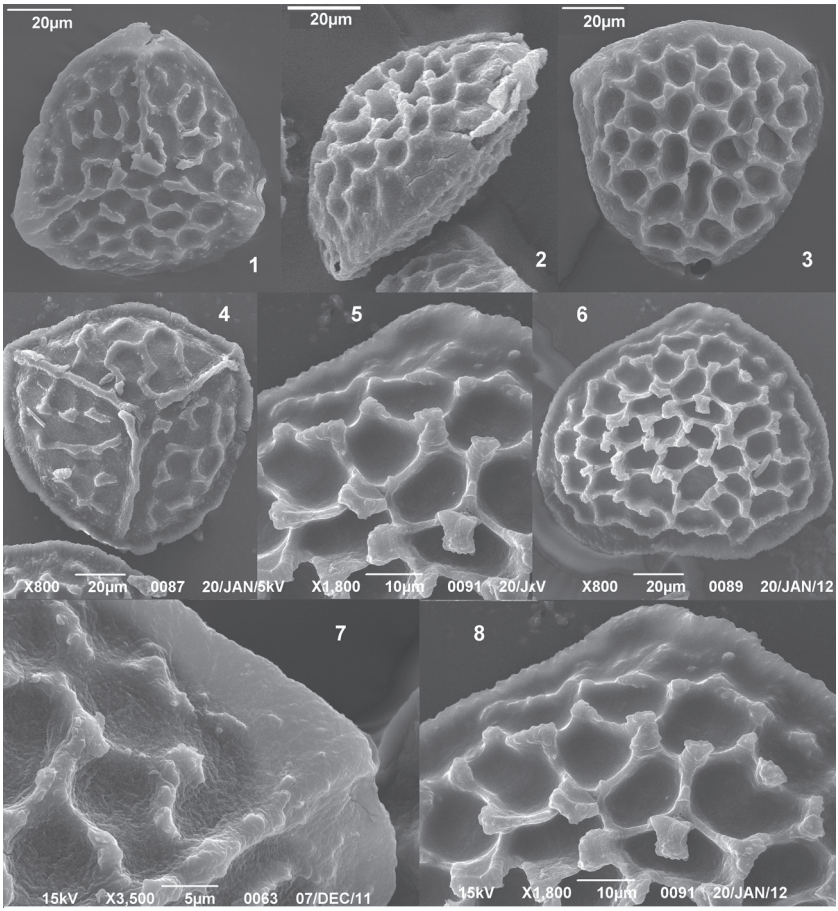

Plate II. Spores of *Riccia bifurca* (*1–3, 7*) and *R. beyrichiana* (*R. lescuriana* var. *glaucescens*) (*4–6, 8*).

1, 4, 7 — proximal surface; *2* — lateral aspect; *3, 5, 6, 8* — distal surface. *1–3, 7* — from Orel Region, Kotkova OP 09-130a, LE; *4–6, 8* — from North Wales, Portmadoc, V. Schiffner: Hepat. Europ. Exs, no. 1141, as *R. lescuriana* var. *glaucescens* (LE).

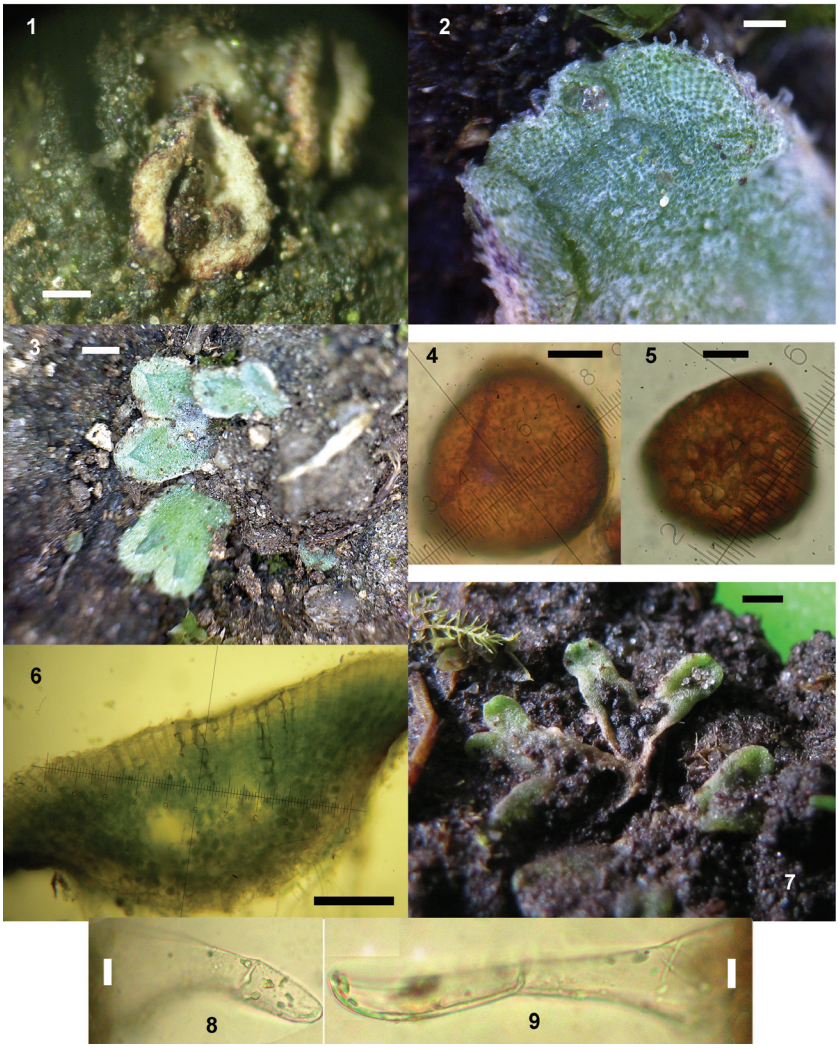

Plate III. *Riccia marginata* (*1–6, 8, 9*) and *Riccia bifurca* (*7*).
1, 2 — apical part of thalli (*2* — with vestigial marginal cilia); *3, 7* — thalli; *4, 5* — spores, light microscope view, proximal and distal surfaces respectively; *6* — thallus cross section; *8, 9* — marginal cilia. *1* — from H-SOL 274501 (Syntype *of R. marginata*); *2–6, 8, 9* — from topotype of *R. marginata* Potemkin, Kotkova, Maksimov № L11-21 (LE); *7* — from Orel Region, Kotkova OP 09-130a (LE). Scale bars: *1* — ~300 μm; *2* — ~ 100 μm; *3* — ~ 350 μm; *4, 5* — ~ 25 μm; *6* — ~ 150 μm; *7* — ~ 500 μm; *8, 9* — ~ 10 μm.