

BRYOPHYTES OF ALTAI MOUNTAINS. III.  
THE GENUS *ULOTA* (ORTHOTRICHACEAE, MUSCI)

МОХООБРАЗНЫЕ АЛТАЯ. III.  
РОД *ULOTA* (ORTHOTRICHACEAE, MUSCI)

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Abstract

Three species of *Ulota* have previously been reported from the Altai Mountains: *U. curvifolia* (Wahlenb.) Lilj., *U. crispa* (Hedw.) Brid. and *U. hutchinsiae* (Sm.) Hamm. A fourth species, *U. rehmannii* Jur., is now added. This species is also recorded for the first time from Asia, previously it was known only from Europe. Brief descriptions, illustrations on the basis of material from Altai, habitat details and distributional notes are given for each species.

Резюме

Ранее на Алтае были известны три вида рода *Ulota*: *U. crispa* (Hedw.) Brid., *U. curvifolia* (Wahlenb.) Lilj. и *U. hutchinsiae* (Sm.) Hamm. Четвертый вид, *U. rehmannii* Jur., впервые приводится для Алтая. Одновременно это первая находка в Азии - ранее этот вид был известен только из Европы. Для всех видов даны краткие описания, иллюстрации, указаны особенности местообитаний и распространение видов.

INTRODUCTION

This paper belongs to a series of treatments on bryophyte flora of Altai Mountains which started in this issue of *Arctoa*. It intends to provide descriptions, illustrations, ecological and bryogeographical data accompanied with taxonomic notes, if necessary, of all groups of bryophytes in this territory. The general characterization of the study area and the history of its bryological exploration are outlined in the introductory paper in this issue of *Arctoa*.

The first record of *Ulota* in the Altai was made by Keller (1914), who mentioned the occurrence of *U. curvifolia*. Later, Krylov (1925) added one more species, *U. americana*, but Bardunov (1974) has convincingly shown that the specimen cited by this author was misnamed and they actually belong to *U. curvifolia*, a species widespread throughout much of the taiga zone in the Altai Mountains. Moreover, Bardunov (1974) reported for Altai also *U. crispa* and *U. hutchinsiae*.

During the course of field study the senior author found that in many localities in Altai *U. crispa* is associated with another species of *Ulota* which differed at first glance by less crispate

leaves and larger plants. Microscopically it has different peristome structure. It was unlike any other Asiatic species of the genus and originally it was assumed to be a new undescribed species. However, the second author discovered the material from Altai is identical to *U. rehmannii*, which has so far been considered as an European endemic species. Thus, four species of *Ulota* are known now in the Altai Mountains.

*Ulota* Mohr

Fairly small, epiphytic and epilithic plants, growing in rounded tufts or extensive mats, green, yellowish- or olive-green above, becoming dark brown or blackish below. Stem 1-2 cm high, erect, forked. Leaves mostly crisped and contorted when dry, usually 1.5-3.0 mm long, lanceolate or linear-lanceolate from more or less differentiated concave, yellowish, elliptic base. Costa moderately strong, percurrent. Upper lamina cells rounded, about 8-13  $\mu$ m in diameter, thick-walled, more or less papillose. Basal leaf cells strongly differentiated, oblong-rhomboidal to linear, with strongly incrassate, yellowish walls in the paracostal area, becoming quadrate to short rectangular, pellucid with thickened transverse walls at the margin. Autoicous (in our species) or occasionally dioicous. Perichaetial leaves not or slightly differentiated. Seta terminal, about 2-3 mm long, straight, thick, sometimes gradually tapering to neck. Mature

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capsules exerted, but sometimes appearing emergent with age, cylindric to urceolate, often with a long tapering neck, 8-ribbed, slightly contorted below the mouth, annulus none; exothecial cells at the mouth sometimes differentiated in color; operculum rostrate; stomata superficial. Peristome double; the exostome teeth 16, united in pairs even after spore dispersion, faintly papillose below, papillose or striolate above, more or less straight when capsula with spores, and becoming reflexed in old and empty capsules; endostome segments 8, linear, often arching above the mouth when exostome reflexed. Calyptra mitrate, lobed, hairy.

#### KEY TO THE *ULOTA* SPECIES OF ALTAI

1. Leaves crispate when dry ..... 2
1. Leaves not crispate when dry, straight or only slightly contorted ..... 3
2. Epiphytic or epixylic, rare epilithic moss with strongly crispate leaves, 2-3 mm long; upper leaf cells moderately papillose with low papillae, basal leaf cells moderately oblong to rhomboidal; peristome teeth papillose throughout ..... *U. crispa*
2. Exclusively epilithic moss with moderately crispate leaves, 1.5-2.0 mm long; upper leaf cells strongly papillose with high and often forked papillae; basal leaf cells at leaf base narrowly linear with strongly incrassate lateral walls; peristome teeth papillose below, striolate above ..... *U. curvifolia*
3. Corticolous, very occasionally epilithic moss; leaves slightly contorted; the rims of both operculum and urn bright red; peristome teeth papillose below, striolate above ..... *U. rehmannii*
3. Saxicolous moss; the rims of the urn and operculum yellowish-green to slightly orange; leaves rigid, fairly straight; peristome teeth papillose throughout ..... *U. hitchinsiae*

#### *Ulota rehmannii* Juratzka, Verh. Zool.-Bot.

Ges. Wien 14: 191 1864. Fig. 1.

Stem ca. 2.0 cm high, dark green or yellow green above, brownish below. Leaves 2.0-2.5 mm long, straight or somewhat contorted when dry, with widened base; upper leaf cells rounded, about 12  $\mu$ m, papillose, basal paracostal cells oblong, 15-25 x 5-7  $\mu$ m with strongly incrassate walls. Seta about 2-3 mm long. Stomata few, 2-12 per capsule, typically two exothecial cells in width. The urn rim bright red, composed of 4-5 rows of strongly incrassate cells. Operculum with a straight beak and bright red rim.

Peristome teeth faintly papillose below, striolate above. Spores ca. 30  $\mu$ m in diameter, densely covered by papillae of ca. 1.5  $\mu$ m. Calyptra smooth or sparsely haired.

This species is readily recognized from *U. crispa*, with which often grows together, by its straight or weakly crisped leaves and striolate outer surface of the exostome teeth in the upper part. When mature capsules are available *U. rehmannii* is immediately recognizable by its bright red rim of the operculum, whereas in *U. crispa* the operculum rim is not differentiated in color. In addition, *U. rehmannii* has somewhat shorter leaves, stomata typically of two exothecial cells in width, smooth or somewhat hairy calyptra, exothecial cells below the mouth differentiated in 4-5 row and somewhat larger, ca. 30  $\mu$ m, and more coarsely papillose spores.

*Distribution:* *Ulota rehmannii* was described from the Tatra Mountains in the Western Carpatians of Poland - type: "...Herr A. Rehmann an Bauemen in subalpinen Waeldern des Tatragebirges bei Zakopane sammelte und mir zu Ende des Jahres 1862 gefaelligst mittheilte" [Holotype: "*Orthotrichum Rehmannii* Schlieph. n. sp. Ad arbore in sylvaticis Tatra aestate 1862, lg. A. Rehmann" - W-Juratzka!; isotypes BP!, KRAM-B!] (Juratzka 1864). However this species has not been rediscovered at the *locus classicus* since. Probably it is now extinct in Poland, the case typical of many epiphytic mosses in Central Europe. In Europe the species is exceedingly rare and known only a few localities in the Alps of Austria, Switzerland and Germany (specimen seen). It was also reported from Czechoslovakia (Duell 1985), Ukrainian Carpatians (Szafran 1936) and from the Caucasus: Imeretia - Oprtscheti ad fl. Rion (Brotherus 1893). World distribution of *U. rehmannii* is shown on Fig. 2.

*Ulota rehmannii* appears to be rather common in lower forest zone in the North-Eastern Altai, where it grows on trunks of *Betula*, *Alnus*, *Sorbus*, *Salix* (where also *U. crispa* occurs), but it seems to prefer thin twigs of *Abies*, growing together with *O. speciosum*, *O. sordidum*, *O. vladikavkanum*, *Amblystegium serpens*, etc. Very rare it thrives also on nearby rocks. Most collections of this species came from regions with a particularly wet and mild climate in forest dominated with *Pinus sibirica* and *Abies sibirica*, at an elevation of 400-1000 m. *U. rehmannii* has recently also been found in collections from the Western Sayan Mountains by Bardunov (pers. comm. and his duplicate specimen in MHA). Therefore it is likely the species is more widespread in mountains of South Siberia, than it is known today.

*Specimens examined:* Artybash 450 m (22/14); Bele 500

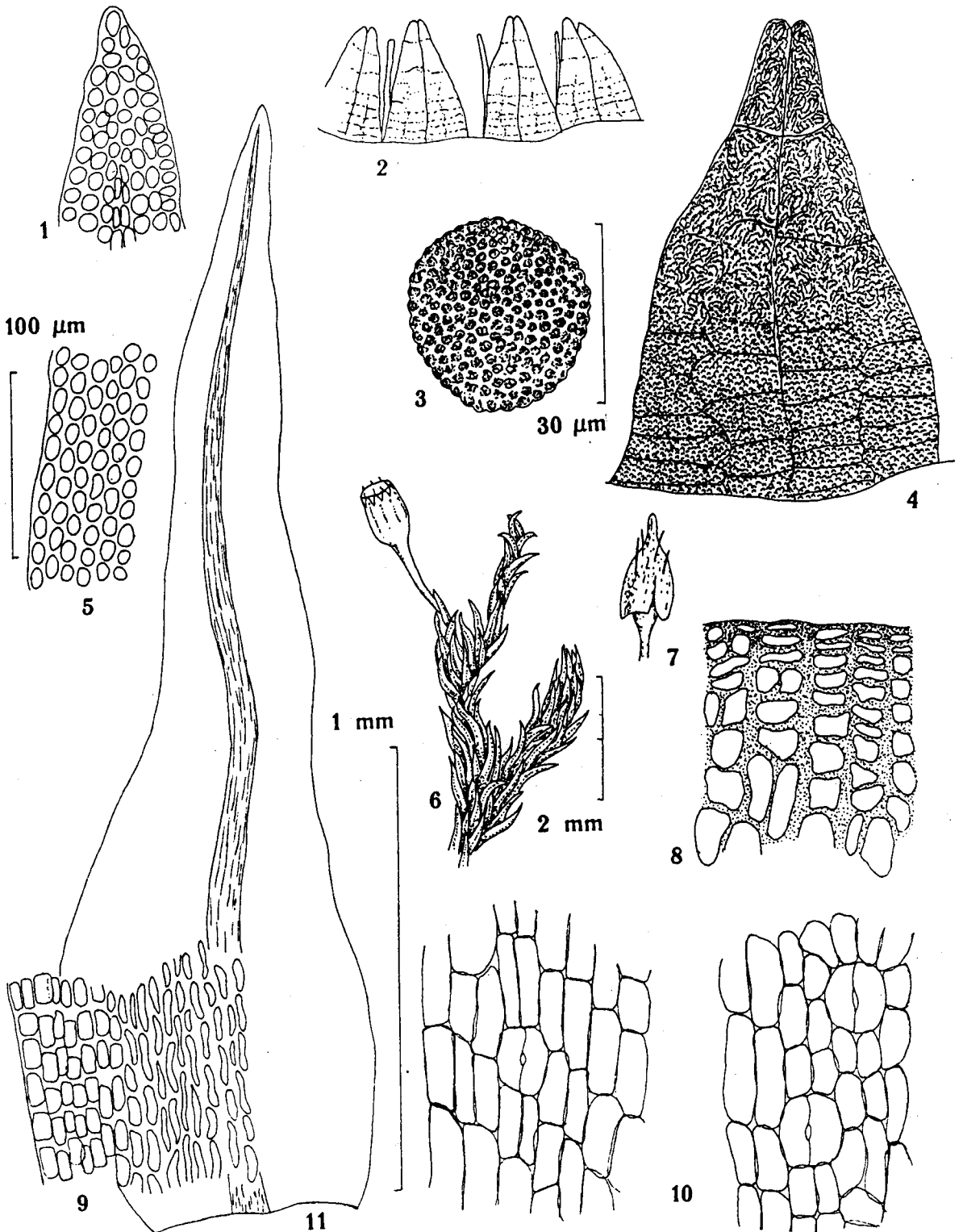


Fig. 1. *Ulota rehmannii* Jur. (from *Yaihyu* 460 m, Ignatov 0/1800): 1 - cells of leaf tip, 2, 4 - parts of peristome, 3 - spore, 5 - upper lamina cells, 6 - habitus, 7 - calyptra, 8 - exothecial cells below the mouth, 9 - basal cells, 10 - stomata, 11 - leaf. Scale bars: 2 mm - for 6, 7; 1 mm - for 2, 11; 100  $\mu$ m - for 1, 4, 5, 8-10; 30  $\mu$ m - for 3.

m (0/38a); *Bolshoye Istyube Creek* 470 m (18/73); *Chemal Creek*, 3 km upstream 450 m (34/209; 34/51); *Chiri Creek*, 1000 m (15/102); *Kumzir* 450 m (20/17); *Ust-Sema* 380 m (24/46); *Yaihyu* 450 m (1/67), 460 m (0/1800); *Yurga* 450 m (21/24a); *Kairu Creek*, 8 km upstream

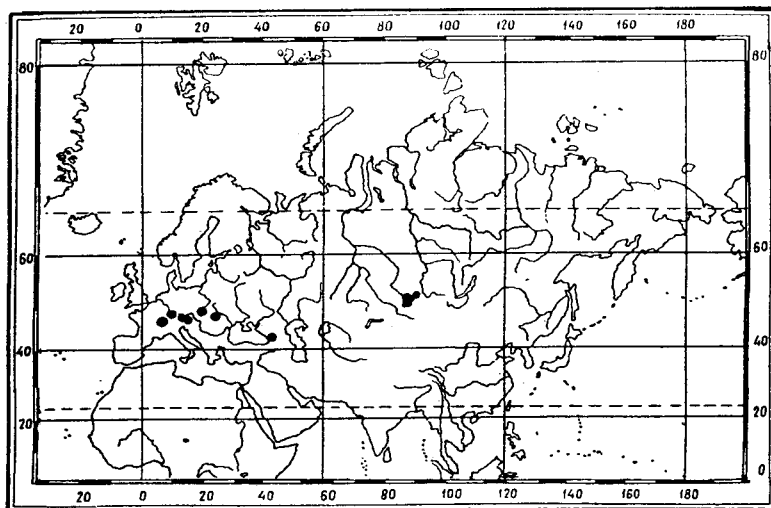


Fig. 2. World distribution of *Uloa rehmannii* Jur.

***Uloa crispa* (Hedw.) Brid., Muscol. Recent. Suppl. 4: 112 1819[1818].** Fig. 3.

*Orthotrichum crispum* Hedw., Spec. Musc. Frond. 162. 1801.

Stem ca. 2.0 cm high, green or yellow-green above, brownish to blackish below. Leaves 2-3 mm long, strongly crispate when dry, narrow lanceolate, with widened base; upper leaf cells rounded, about 10  $\mu$ m, papillose, paracostal basal cells oblong, 15-25 x 5-7  $\mu$ m, with strongly incrassate walls. Seta about 2-3 mm long. Stomata 1 cell in width. The rim of the urn yellowish-green, formed of 2-3 rows of strongly incrassate cells. Peristome teeth faintly papillose throughout. Spores ca. 25  $\mu$ m in diameter covered by papillae of ca. 2.5  $\mu$ m. Calyptra densely haired.

For differences between *Uloa crispa* and *U. rehmannii* see note under the latter species. From *U. curvifolia* it differs in its corticolous habitat, longer and more crispate leaves, entirely papillose peristome teeth and weakly papillose lamina cells.

**Distribution:** *Uloa crispa* shows a clear affiliation to areas with an oceanic climate, both in Eurasia and North America. Moreover, the species is known to occur in Northern Africa and on Macaronesian islands. In Siberia, *U. crispa* has been recorded only from Altai and the Kulumys Range in the Western Sayan Mountains (Bardunov 1974). The latter is very similar to Altai in respect of its wet and mild climate. Also it has been reported from Yuzhnyi Altai Range in Kazakhstan (Sakauova 1992), and it is the only place of the occurrence of *U. crispa* in Middle Asia. In the Altai *U. crispa* is usually an epiphyte on trunks of *Betula*, *Salix*, *Padus* and *Alnus*. It grows occasionally on twigs of *Caragana* and *Ribes* and also rather frequently on bark of fresh fallen logs and on wood of stumps. Occasionally it thrives on rocks in

forests, where it occurs on trees. All the collections came from the shore of Teletzkoye Lake or surrounding areas, an area with wet and mild climate. Most often it occurs in forests dominated with *Pinus sibirica* and *Abies sibirica*.

**Specimens examined:** Bele 500 m (0/38); Bolshoi Mianok Creek, at mouth 450 m (Zolotukhin 8.VIII.1988); Bolshoi Shaltan Creek 530 m (0/1746; 0/1747); Bolshoye Istyube Creek 470 m (0/1750; 18/38; 18/73a; 18/90); Chulcha River, in middle course 1000 m (9/14); Kamga Creek, 10 km upstream 500 m (0/92); 540 m (0/1754); Kamga Creek, 6 km upstream 490 m (0/1751); Karatash 450 m (Zolotukhin 14.VII.1987); Kobukhtushka 450 m (Zolotukhina 13.VII.1988); Korbu 450 m (Zolotukhin 20.X.1988); Kyga River, 1 km upstream 450 m (0/1752); Srednij Shaltan Creek 600 m (0/1748); 640 m (0/127; 0/1745); Yailyu 450 m (Zolotukhina 14.VII.1988; 0/1753); 460 m (0/1749); 480 m (0/1744); Yurga 450 m (21/24).

***Uloa curvifolia* (Wahlenb.) Lilj., Utkast Sv. Fl. 3: 546. 1816.** Fig. 4.

*Orthotrichum curvifolium* Wahlenb., Fl. Lapp. 365. 1812.

Plants forming extensive tufts, yellowish-green in the uppermost part and dark-brown to black below. Stem 1.5 cm high. Leaves strongly curved to moderately crispate when dry, 1.5-2.0 mm long, lanceolate with well-demarcated base, sharply to bluntly acute. Upper lamina cells 12-15  $\mu$ m wide, strongly papillose with high, forked papillae. Basal leaf cells narrowly linear except for 1-3 marginal rows forming a distinct border. Seta 2-3 mm long, straight to flexuose or geniculate. Capsulae with long neck, strongly ribbed, with the exothecial cells over ribs strongly incrassate on lateral walls. Operculum nearly plane with a long narrow beak. Exostome teeth 16, in 8 pairs, papillose below, striolate and slightly eroded and perforate above; endostome segments 8, relatively wide, smooth. Spores ca. 20  $\mu$ m, papillose.

The species is readily recognized from all

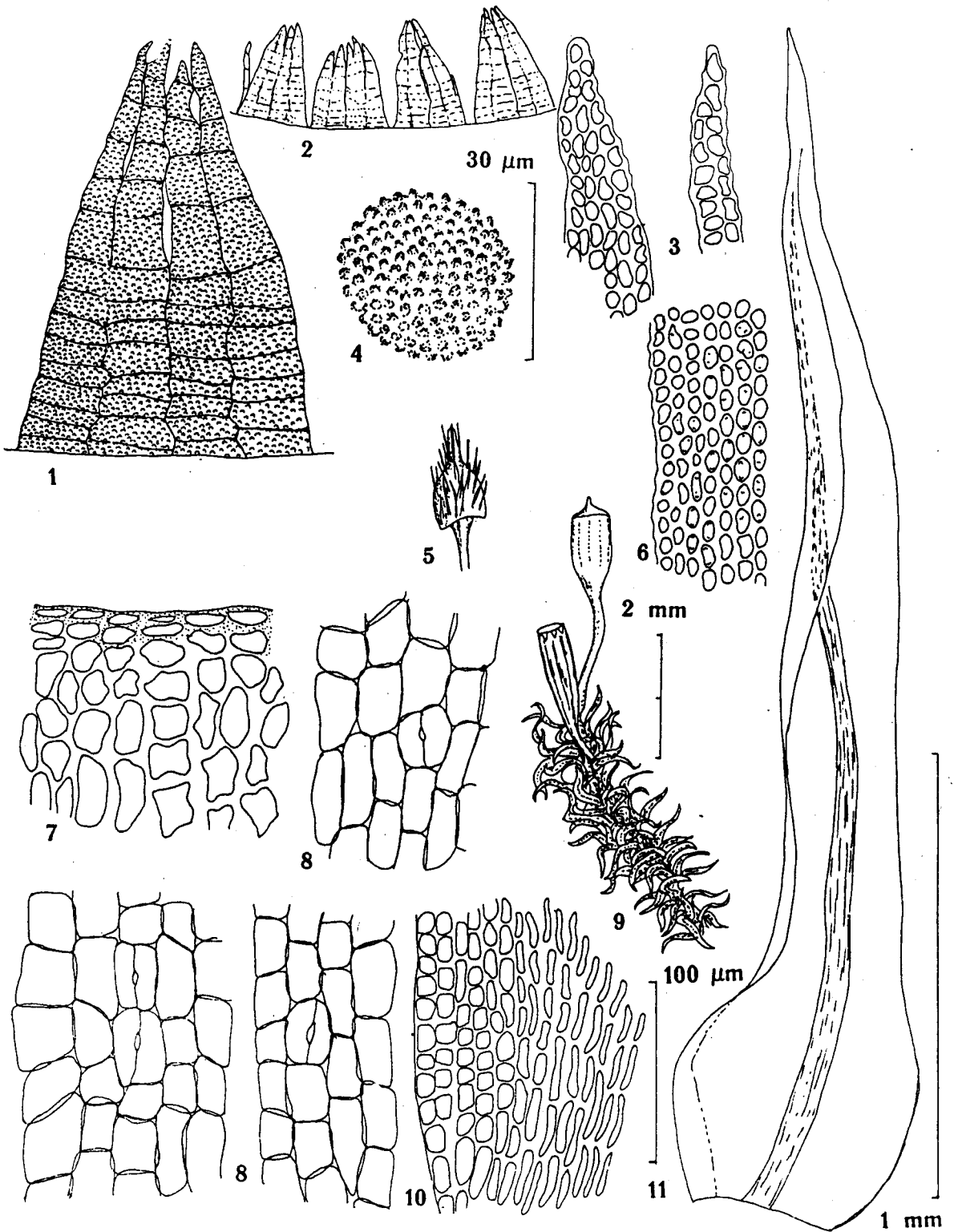


Fig. 3. *Ulota crisper* (Hedw.) Brid. (from *Yailyu* 460 m Ignatov 0/1749): 1-2 - parts of peristome, 3 - cells of leaf tips, 4 - spore, 5 - calyptra, 6 - cells of upper lamina, 7 - exothecial cells below the mouth, 8 - stomata, 9 - habitus, 10 - cells of leaf base, 11 - leaf. Scale bars: 2 mm - for 5, 9; 1 mm - for 2, 11; 100 μm - for 1, 3, 6-8, 10; 30 μm - for 4.

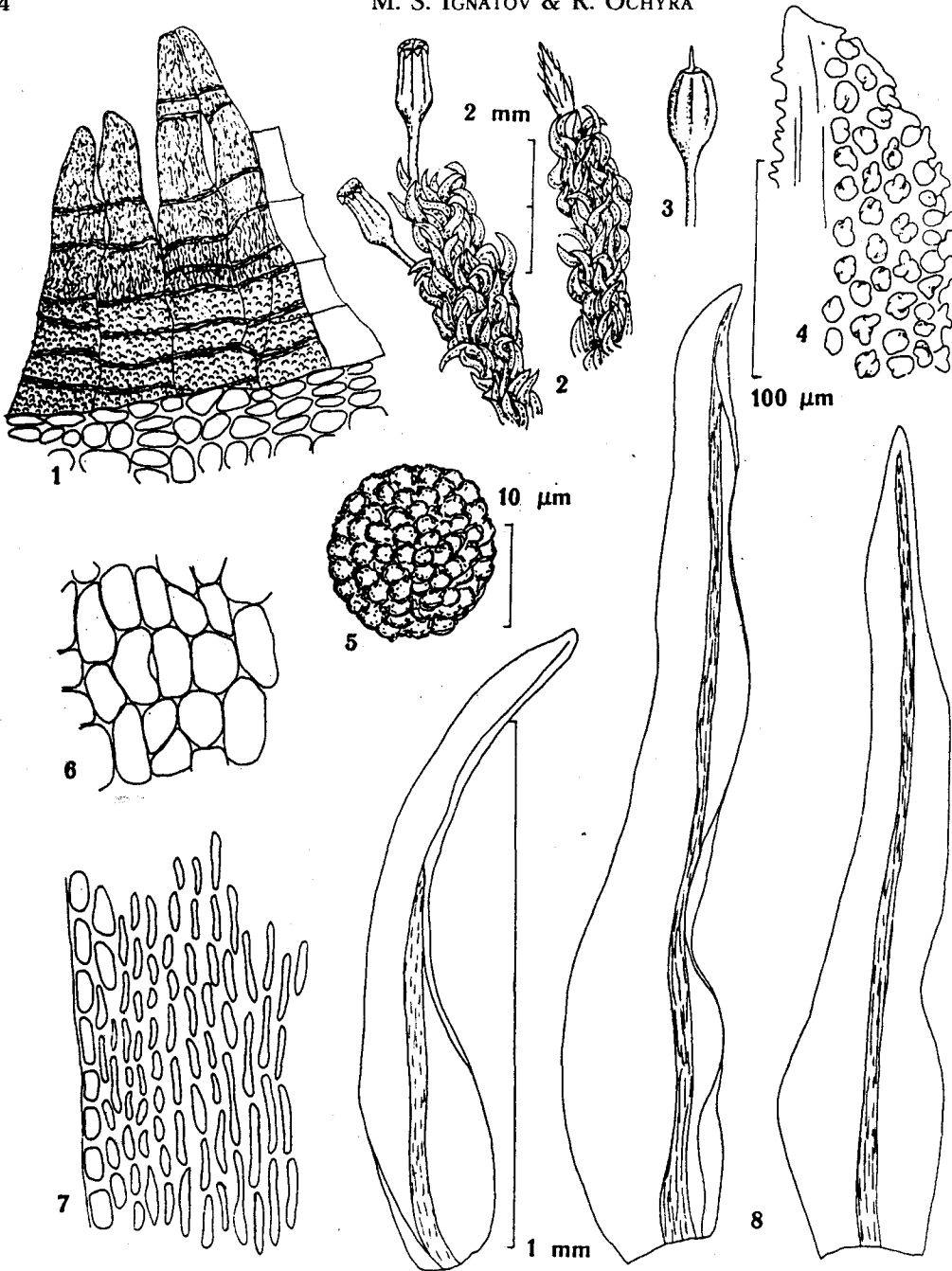


Fig. 4. *Ulota curvifolia* (Wahlenb.) Lilj. (from Kairu Creek, 16 km upstream 1400 m, Ignatov 14/3): 1 - part of peristome, 2 - habitus, 3 - capsula, 4 - cells of leaf tip, 5 - spore, 6 - stoma, 7 - basal cells, 8 - leaves. Scale bars: 2 mm - for 2, 3; 1 mm - for 8; 100 µm - for 1, 4, 6, 7; 10 µm - for 5.

other species in the Altai Mountains by its habitat preferences, small leaves with strongly papillose lamina cells, as well as smooth and broad endostome segments.

**Distribution:** *Ulota curvifolia* is principally a northern species, occurring in Western Europe only in Scandinavia and at very few disjunct localities in Alps of Austria and Switzerland. It is known to occur in the northern regions of European Russia, in

the Ural Mountains (from the Polar to Southern Urals of Bashkiria, in the mountains of South Siberia (where it has been recorded in all areas hitherto studied bryologically) and neighboring areas of northern Mongolia. In the Russian Far East it ranges from mountains of Amur River Basin in Khabarovsk Territory and Amurskaya Province north to the Chukotka Peninsula. A similar distribution pattern it has in North America - it is widespread in the mountain area of Canada extending southward to

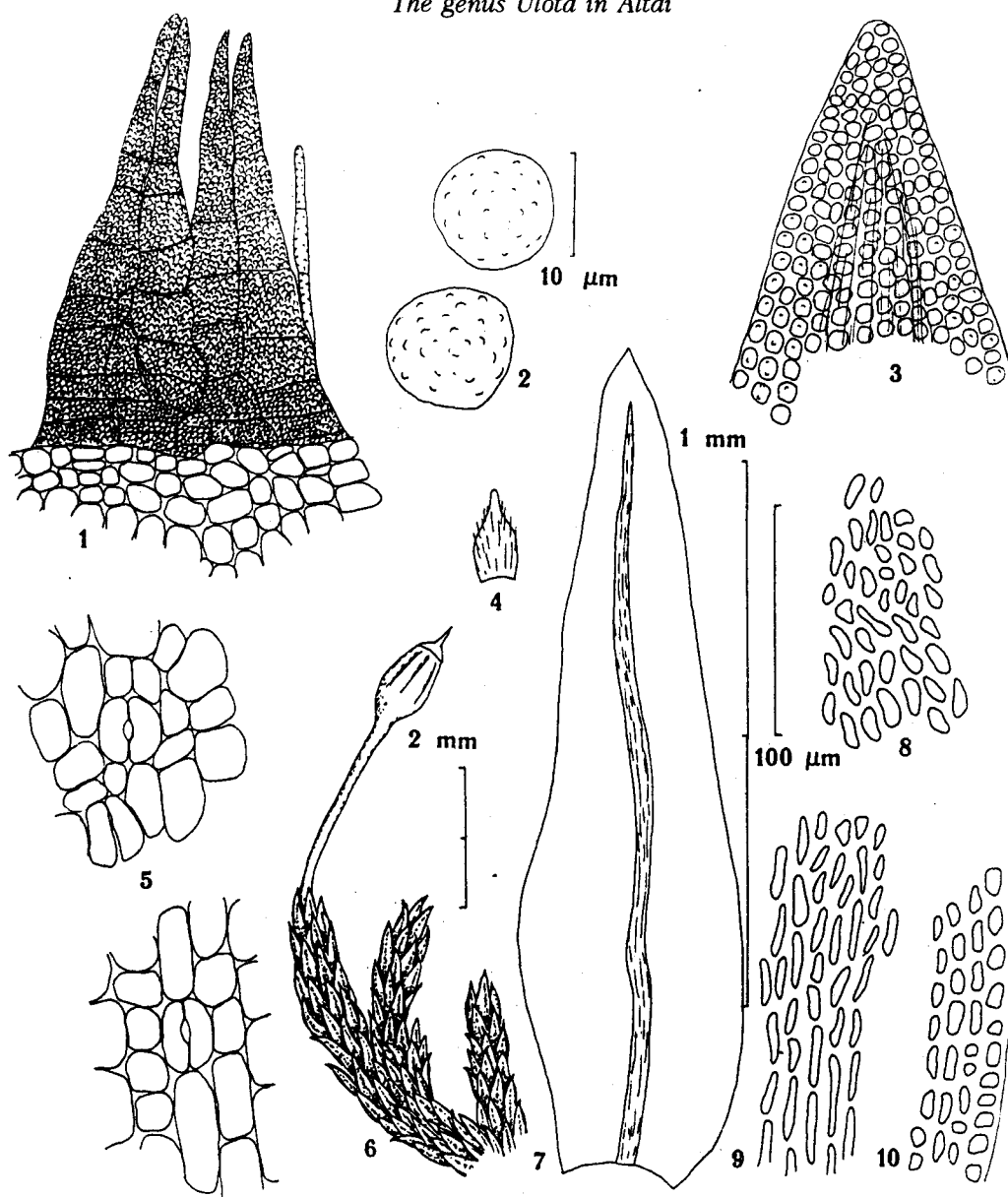


Fig. 5. *Ulota hutchinsiae* (Smith) Hammar (from *Udalovka*, 240 m, Bardunov 8.VII.1966, MHA): 1 - part of perisome, 2 - spores, 3 - cells of leaf tip, 4 - calyptra, 5 - stomata, 6 - habitus, 7 - leaf, 8 - upper lamina cells, 9 - paracostal basal cells, 10 - marginal basal cells. Scale bars: 2 mm - for 4, 6; 1 mm - for 7; 100  $\mu\text{m}$  - for 1, 3, 5, 8-10; 10  $\mu\text{m}$  - for 2.

the border of the United States, but it is absent in the latter country. The species has also been recorded from Greenland. In the Altai Mountains *U. curvifolia* is a rather common species, occurring exclusively in the taiga zone, from 1400 to 2300 m, with a maximum of its occurrence at an elevation of 1700-2000 m, where it is found on overhangs of practically all big rock outcrops, often associated with *Cynodontium strumiferum*. In the Sayan Mountains it descends to a much lower elevation of 500 m (Bardunov, 1974).

*Specimens examined*: *Ayulyuyuzynuk Creek* 2050 m (0/992); *Kairu Creek*, 16 km upstream 1400 m (14/3); *Karakem River*, 6 km upstream 1600 m (0/993); *Kayakkatuyarykskij Creek* 1800 m (8/198); 1950 m (3/56); *Kukol* 1800 m (0/994); *Saluru Creek*, upper course 2250 m (36/172); *Tamanel*

*Peak* 1950 m (34/93); *Yakhansoru Lake* 1850 m (Zolotukhin 28.VI.1990).

***Ulota hutchinsiae* (Smith) Hammar**, Monogr. Orthotrich. Ulot. Suec. 27. 1852. Fig. 5. *Orthotrichum hutchinsiae* Smith, Engl. Bot. 36: pl. 2523. 1813.

Plants 1.5 cm high, green or yellow-green above, olive-green to brown below. Leaves 1.5-2.0 mm long, rigid, with the base not much widened, straight when dry. Upper lamina cells rounded, about 10  $\mu\text{m}$ , becoming very irregular, with thickened walls in mid-leaf. Basal paracostal cells linear with strongly incrassate walls, 10-20 x 3-5  $\mu\text{m}$ , forming sometimes a well-defined group, but on some leaves indistinct

and then the leaf base composed of shorter rhombic cells. Basal cells at margin with very thick transverse walls and moderately thickened longitudinal walls, similar in color to the upper lamina cells. Capsules exerted on setae about 3-4 mm long, with an indistinct neck. Peristome teeth 16, united in 8 pairs, faintly papillose throughout, ca. 0.25-0.28 mm long. Endostome segments papillose, most uniseriate, sometimes biseriate, papillose, ca. 0.15 mm long. Operculum conic-convex, rostrate. Calyptra hairy. Spores 14-17  $\mu\text{m}$  in diameter, with very low papillae to nearly smooth.

*Ulotia hutchinsiae* differs from other species of the genus by the combination of its saxicolous habitats, rigid leaves, highly exerted capsules with poorly developed neck [this characters making it superficially more similar to *Orthotrichum anomalum*, rather than to *Ulotia* species, as noted by Crum and Anderson (1981)], and relatively small spores, 12-17  $\mu\text{m}$  in diameter. In addition *U. hutchinsiae* has a weak border and the less conspicuous group of yellow, narrowly linear basal paracostal cells in comparison to other species of the genus. *U. hutchinsiae* can hardly be mistaken for the other species in the Altai Mountains. *U. curvifolia* differs from it in its invariably crispate leaves, stronger papillose cells and larger spores. *U. rehmannii* has a bright red rim of the operculum, peristome teeth striolate above, more soft leaves and larger spores. *U. crispa* has, among others, crispate and gradually acuminate leaves and larger spores.

The plants of *U. hutchinsiae* from the Altai

Mountains differ somewhat from those from Central Europe (Germany, Sweden) and North America (U.S.A., Canada) in (1) the ornamentation of the peristome teeth which are papillose throughout, not striolate above in the uppermost 2-3 plates; (2) somewhat larger and not so incrassate upper lamina cells; and (3) nearly smooth spores. However, available material is insufficient to consider these differences as having a taxonomic value.

*Distribution:* The species was described from British Isles and is known from many countries in Western Europe (Duell 1985). Within the former Soviet Union it has been recorded from the Baltica, the Ukrainian Carpatians and the Caucasus. In North America, the species is known in many states and provinces of the temperate zone, ranging from Georgia northward to Labrador and south-eastern Alaska. Though in Index Muscorum (Wijk & al. 1969) cited in AS2, this record is not confirmed in recent checklists from this area. So far, this species is known in Siberia, and probably whole Asia, from a single collection, made by Bardunov in the middle course of Biya River, on cliff face.

*Specimen examined:* Udalovka [cliff "Ikonostas"], 240 m (Bardunov 8.VII.1966, IRK, MHA!).

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