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THE GENUS LYELLIA R.BR. (POLYTRICHACEAE, BRYOPHYTA) IN RUSSIA

РОД LYELLIA R.BR. (POLYTRICHACEAE, BRYOPHYTA) В РОССИИ

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Abstract

In the course of revision of Polytrichaceae for the moss flora of Russia, among collections previously referred to *Lyellia aspera* from southern part of Siberia and Far East, the second species of the genus, *Lyellia crispa* was found. This is the first record for Russia of this species that was known up to now from Himalayas and China. Descriptions, illustrations and habitat data are given and the distribution in Russia is mapped. The differentiation of these two species is discussed.

Резюме

В ходе ревизии семейства Polytrichaceae для флоры мхов России среди образцов, собранных в горах южной части Сибири и Дальнего Востока, относимых раньше к *Lyellia aspera,* выявлен второй вид этого рода, новый для флоры России – *Lyellia crispa*. Ранее этот вид приводился из высокогорных районов западного Китая и Гималаев. Приводятся морфологические описания, иллюстрации, экологическая характеристика и распространение в России обоих видов, обсуждаются их диагностические признаки.

INTRODUCTION

The genus *Lyellia* was first discovered in Russia in Yakutia in Suntar-Khayata Mountain Range by V. B. Kuvaev in 1954. This and the second collection of V.I. Ivanova from Orulgan Range were at first identified (labels in LE) by Z.N. Smirnova as *L. crispa*, the species described from Nepal. Later Smirnova however changed her mind and her first publication on this genus cited it as *L. aspera*, the species described from the Arctic North America (Smirnova, 1958). This paper of Smirnova includes expanded discussion on the morphology and distribution of *Lyellia*, and the possibility of the finding of the second species, *L. crispa*, in mountains in southern regions of Siberia is predicted.

The only one species of *Lyellia,* however was included in handbook of mosses of Arctic of the USSR (Abramova et al., 1961) and Handbook of acrocarpous mosses of the USSR (Savicz-Lyubitskaya & Smirnova, 1970), thus the subsequent publications use only this name for plants from Yakutia (Stepanova, 1986; Afonina & Perfilieva, 1981); Chukotka (Afonina, 2004); Magadanskaya Province (Blagodatskikh, 1984); Taimyr and Putorana Plateau (Afonina & Czernyadjeva, 1995). Besides these northern records, *Lyellia* was found also in more southern localities, but identifications were based on the available handbooks, thus *L. aspera* has been reported from southern regions of Yakutia (Ivanova, 2001) and Khabarovsk Territory (Ignatov et al., 2000).

The revision of the genus *Lyellia* in Siberia reveals however that plants from Arctic regions and from northern Siberian mountains are different from populations of more southern regions. The comparison of the latter with Chinese and Himalayan *L. crispa* and *L. platycarpa* therefore was undertaken.

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Lyellia R. Br., Trans. Linn. Soc. London 12: 561. 1819.

Plants in tall, loose tufts or growing by solitary shoots among other mosses, olive-green to brownish. Stems erect, rigid, unbranched, at base with rhizoids, in lower part with remote scaly leaves or almost leafless,in upper part densely foliate, with complex central strand. Leaves spreading when wet, slightly curved to crisped when dry, with filmy sheathing base and linear or linear-lanceolate limb, above keeled and in dry state almost tubulose, acute to truncate, sometimes with delicate whisker at leaf tip; margin in middle part of limb with simple, in upper limb with double teeth, teeth multicellular, sharp to blunt; costa strong, 1/2 of limb width, disappearing shortly below apex to percurrent, abaxial side in distal 1/3 of leaf toothed, with teeth sometimes joining and forming dorsal lamellae; lamellae on adaxial side of costa numerous, rather high, upper edge entire to slightly crenulate, 1- or at places 2-stratose, upper cells in transverse section not differentiated from cells below (rarely double); limb cells bistratose except 1(-2-3) submarginal rows of unistratose cells; cells of ventral layer somewhat longer than wide, ovate-rectangular, mamillose, with incrassate ventral (outer) cell wall; cells of dorsal layer isodiametric, smooth to mamillose, with strongly or moderately incarssate dorsal (outer) cell wall; cells of sheathing base unistratose, long-rectangular, thin-walled. Dioicous. Androecium disk-shaped. Perichaetial leaves similar to stem leaves. Sporophytes solitary. Seta long, thick. Capsule ovoid, dorsiventral, winged at equatorial fold; hypophysis short and indistinctly differentiated; mouth narrow; exothecial cells not bulging, with evenly incrassate outer cell wall; stomata surrounded by conspicuous ring of enlarged cells or not. Peristome absent. Operculum rostrate. Calyptra naked, covered only operculum.

The genus includes 3 species in Asia, North America and Greenland.

The genus name is after American bryologist, Charles Lyell, 1767-1849, expert in Polytrichales.

1. Leaves with whisker at apex ..... *L. aspera*
— Leaves without whisker at apex 2
2. Leaves 5-10 mm long, straight, curved to slightly crispate, erect-spreading when wet; dorsal limb cells smooth, with incrassate dorsal (outer) walls; lamellae 45-90 μm high, or (4-)6-8(-15) cells high, in side view cells with rounded angles, thick-walled, 8-10(-14) x 6-8 μm, not in horizontal rows ..... *L. aspera*
— Leaves 10-14 mm long, rather strongly crisped, strongly reflexing when wet; dorsal limb cells mamillose, with not incrassate dorsal (outer) walls; lamellae 35-50 μm high, or (2-)4-6(-7) cells high, in side view cells with rather sharp angles, isodiametric, 6-9(-13) μm, often arranged in horizontal rows .... *L. crispa*

Lyellia aspera (I. Hagen & C.E.O. Jensen) Frye in Grout Moss Fl. N. Amer. 1: 111. 1937 (= *Philocrya aspera* I.Hagen & C.E.O. Jensen, Meddel. Gronland. 15: 388. 1898). Fig. 1, 3

Stems (3-)6-8(-12) cm. Leaves when dry straight (in smaller plants), curved or sometimes more or less crisped; in wet state straight to slightly curved. Leaves (5-)7-8(-10) mm long, 0.6-0.7 mm wide in mid-leaf; at apex somewhat truncate and with delicate whisker; whisker hyaline to light brownish, almost entire, easily deciduous in old leaves; ventral lamellae (10-)14-30(-38), 45-90 μm high [(4-)6-8(-15) cells high]; in side view upper edge somewhat wavy [as a result of different number of cells in lamellae], lamellae cells short-rectangular, 8-10(-14) μm high, with more or less rounded angles, thick-walled, not arranged in regular horizontal rows; dorsal cells of limb 6-9(-12) μm, smooth, with strongly incrassate outer walls. Cells of sheathing base 6-8:1. Sporophytes rare. Seta 2.5-4 cm. Capsules erect when young, inclined to horizontal at mature, 6-7 mm long, 3-4 mm wide; stomata not surrounded by conspicuously enlarged cells or sometimes by moderately enlarged cells. Spores 12-15(-18) μm. Calyptra unknown in Russia. Sporophytes were found in Yakutiya (Suntar-Khayata Range, Silyapsky Range), Taimyr, Chukotka and Magadan Province. They were discussed and illustrated by Afonina & Andreeva (1993).

Ecology. In dwarf-shrub–mossy tundras, nival communities, herbaceous types of *Betula nana* s.l., *Salix spp., Alnus fruticosa* communities, *Larix* forests (especially open forests) with *Sphagna*, usually on north-facing slopes, in rock crevices and ledges. Many collections indicate somewhat calcareous substrate, but in others soil/rocks are clearly acidic. It grows rarely in extensive pure tufts, but more commonly occurs by individual

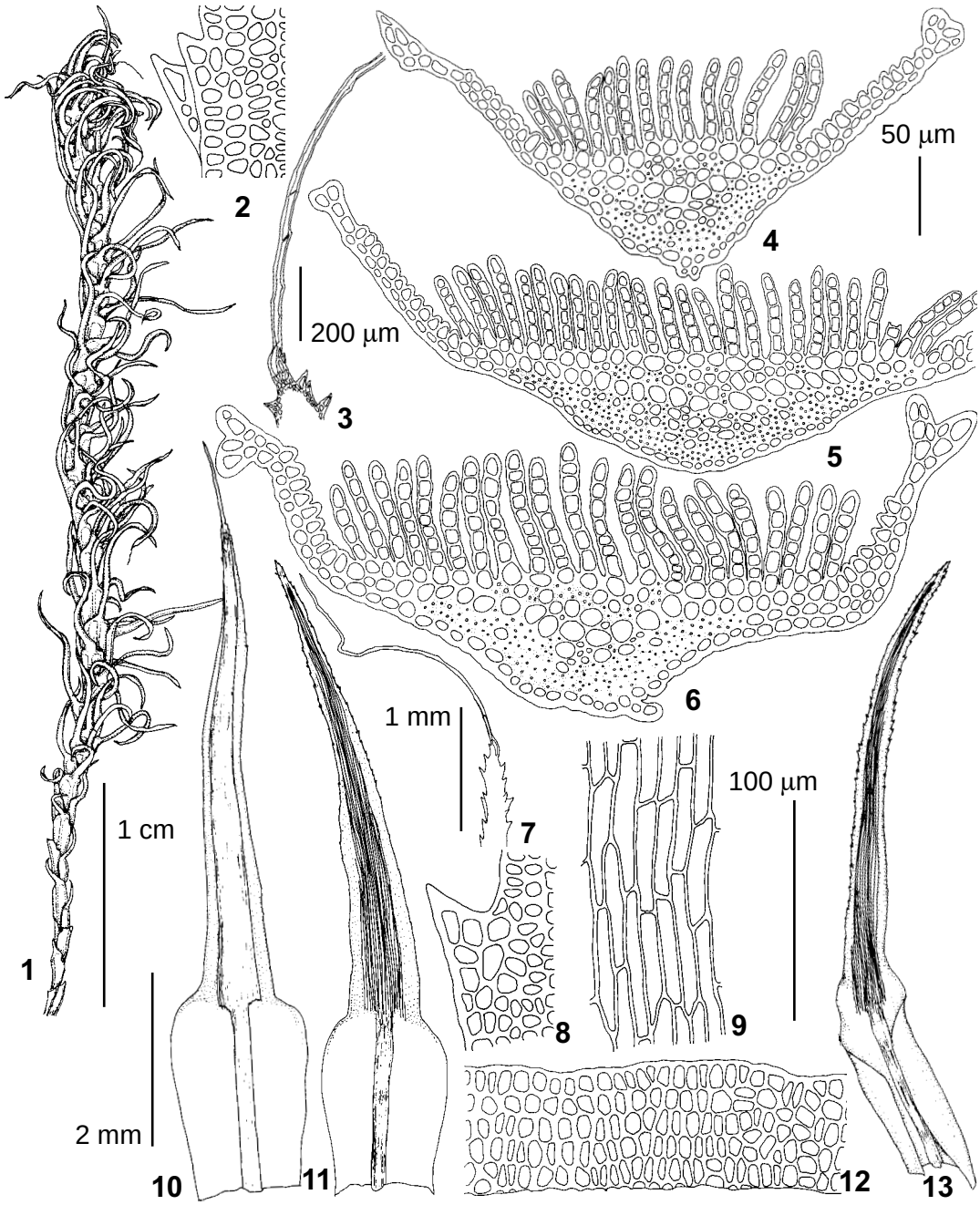

Fig. 1. *Lyellia aspera* (I. Hagen & C.E.O. Jensen) Frye (1-5, 7-13 from West Chukotka, 4.VII.1977 *Koroleva s.n.,* LE*; 6* – from Anabar Plateau, *Fedosov #07-299,* MHA): 1 – habit, dry; 2 – teeth at upper leaf margin; 3,7 – leaf tip with whisker; 4-6 – leaf transverse sections; 8 – tooth at mid-leaf margin; 9 – basal laminal cells; 10-11, 13 – leaves; 12 – part of ventral lamella, side view. Scale bars: 1 cm for 1; 2 mm for 10-11, 13; 1 mm for 7; 200 μm – for 3, 100 μm – for 2, 8-9, 12; 50 μm – for 4-6.

plants among *Aulacomnium turgidum, Campylium stellatum*, *Dicranum flexicaule, Ditrichum capillaceum, Pleurozium schreberi, Pogonatum urnigerum, Pohlia crudoides, Polytrichastrum alpinum, Rhizomnium andrewsianum, Sanionia uncinata, Sphagnum spp., Stereodon subimponens,*

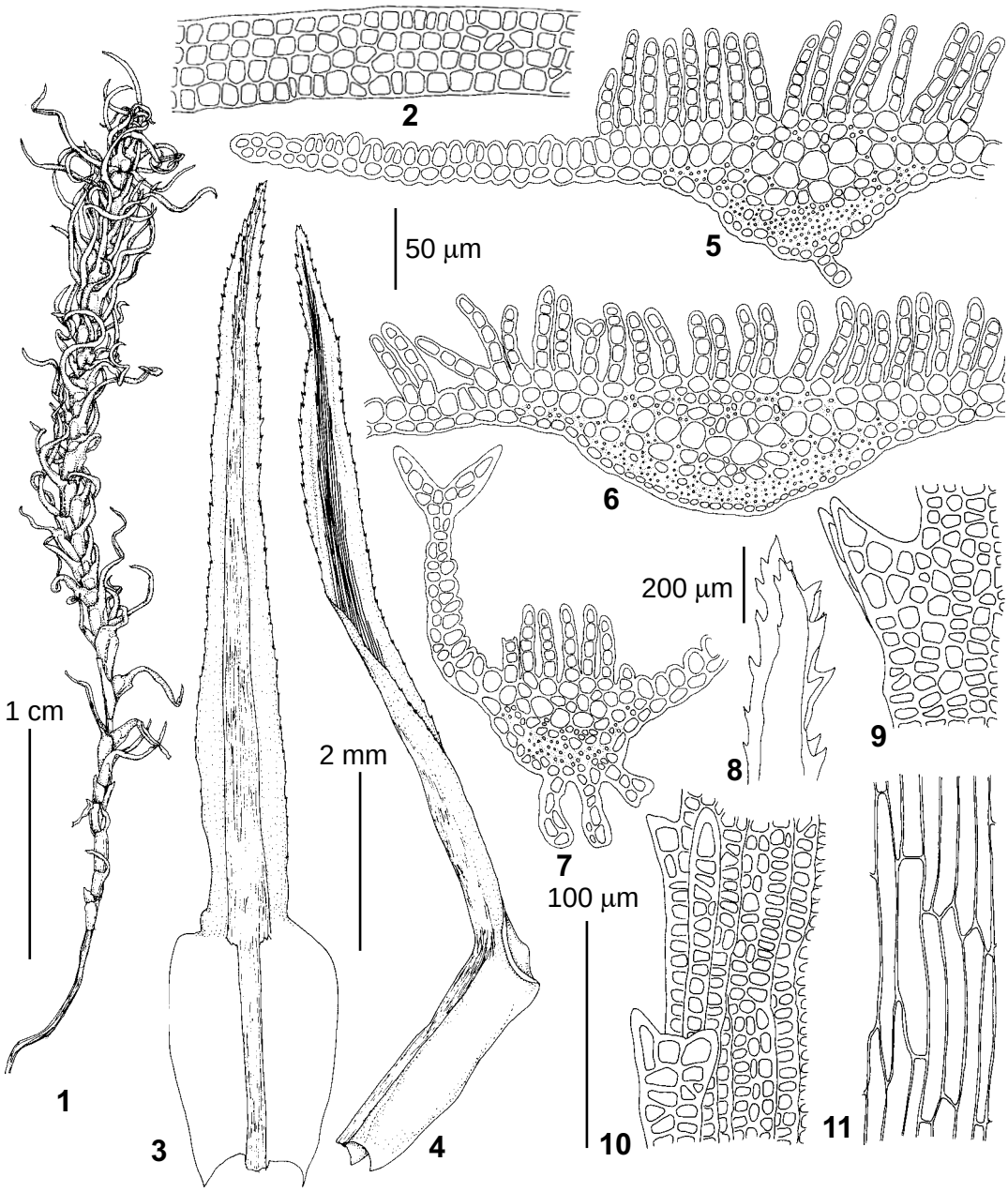

Fig. 2. *Lyellia crispa* R. Br. (from Khabarovsk Territory, *Ignatov #97-511,* MHA): 1 – habit, dry; 2 – part of ventral lamella, side view; 3-4 – leaves; 5-7 – leaf transverse sections; 8 – leaf tip; 9 – teeth at upper leaf margin; 10 – teeth at mid-leaf margin; 11 – basal laminal cells. Scale bars: 1 cm for 1; 2 mm for 3-4; 200 μm – for 8; 100 μm – for 2, 9-11; 50 μm – for 5-7.

Tomentypnum nitens. It reaches 1633 m alt. in Yakutia (Verkhoyansky Range), 1262 m in Kamchatka; the highest elevation in North America is 1450 m (Smith Merrill, 2007).

SPECIMENS EXAMINED: ***RUSSIA:*** **Taymyrsky Autonomous Distrct**: Khatanga, Kotuj River, 24.VII. 1983 *Andreeva* (LE), S+; Putorana Plateau, Kapchuk Lake, 27.VII.1978 *Vilde* (LE); same, *Czernyadjeva #10, 15, 63,106* (LE); Anabar Plateau, Odikhincha Mt., 550 m alt., *Fedosov #07-299* (MW); Anabar Plateau, Merkyu River, *Fedosov #07-266* (MW); Anabar Plateau, Kotuj River, *Fedosov #07-65* (MW); Taimyrsky Reserve, Medvezhya River, *Fedosov #05-233* (MW).

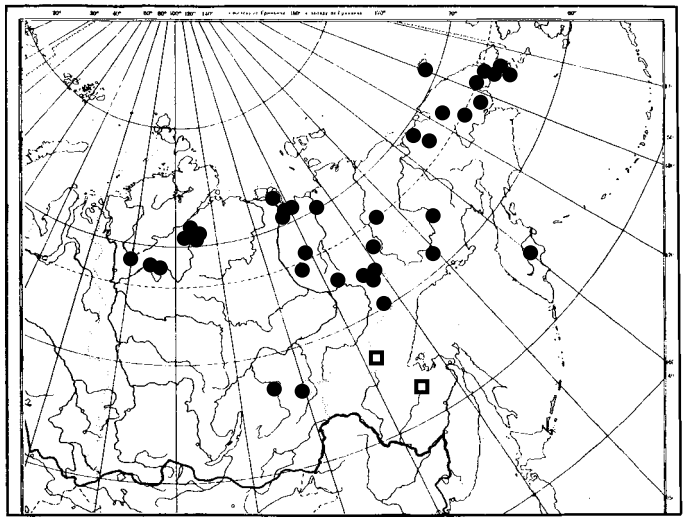

Fig. 3. Distribution of *Lyellia aspera* (I. Hagen & C.E.O. Jensen) Frye (●) and *Lyellia crispa* R. Brown (□) based on specimens cited in the text.

Irkutsk Prov.: Visimsky Nature Reserve, Kanakovka Creek, 3.VII.1984 *Bardunov* (IRK, LE). **Yakutia**: ***Bulun Distr.***: Samoilovsky Island, VIII.1998 *Zhurbenko & Czernyadjeva* (LE); Kharaulakh Range, Suonannakh Creek, 13.VIII.1982 *Prefilieva & Stepanova* (SASY); Kosisty Cape, 14.VIII.1982 *Prefilieva & Stepanova* (SASY); Uktaa Creek, 5.VII.2006 *Ivanova* (SASY); Chekanovsky Range: Ayakit Creek, 2.VIII. 1956 *Norin & Kildyushevsky* (LE); Tigitae Creek, 12.VII.2006, 13.VII.2006 *Ivanova* (SASY); ***Ust-Yana Distr.***: Kular range, 24.VII.1978 *Stepanova* (SASY); ***Aeveno-Bytantaisky Distr.***: Orulgan Range: Bytantai River, Kel'-Senae Creek, 18.IX.1965 *Dobretsova & Afonina* (SASY, LE); Saeriilichaeaen Creek, 15.IX. 1965 *Perfilieva & Afonina* (SASY, LE); Undyulyung River, Byrand'ya Creek, 11.VII.1990 *Nikolin & Stepanova* (SASY); ***Tompo Distr.***: *Verkhoyansk Range*: Tompo River, Khunkhada Creek, 1.VIII.1954 *Kuvaev* (LE); Menkule River, Chukomnan Creek, 5.VIII.1956, 25.VIII.1956 *Perfilieva* (SASY, LE); *Suntar-Khayata Range:* Kyurbyulyakh, 17.VII.2003, S+ *Ivanova* (SASY); Nekyulyak Creek, 15.VII.2003 *Ivanova* (SASY); ***Kobyaisky Distr.***: *Verkhoyansk Range*: Kele River, 4.VIII.1987 *Nikolin & Stepanova* (SASY); ***Mom Distr***.: Silyapsky Range, Indigirka River, In'yali Creek, 24.VI.1986 *Afonina* (LE), S+; Ystan-Yuryakh Creek, 24.VI.1986, 29.VI.1986 *Afonina* (LE); Kyllakh Creek, 8.VII.1957 *Nosova & Abramovy* (LE); ***Ust-Maya Distr.***: Yudoma-Maya Upland, Solnechny Settlement, 3.IX.2000 *Иванова* (SASY, MHA). **Chutotsky Autonomous District**: Chukotsky Upland, Iskaten Range, Zalif Kresta, 17.VIII.1977, 19.VIII. 1977 *Afonina* (LE); Zalif Kresta, Aegvekinot Settlement, 21.VI.1970 *Afonina* (LE); Zalif Kresta, 8 km from Aegvekinot to Iul'tin, 21.VI.1970 *Afonina* (LE); 32 km from Aegvekinot to Iul'tin, 2.VIII.1967 *Afonina* (LE); 174-177 km from Aegvekinot to Iul'tin, 15.VIII.1967 *Afonina* (LE); Anadyr River, Baran'e Lake, 2.VIII.1980 *Afonina* (LE); Anadyr River, Bezymyannoe Lake, 9.VII.1977 *Afonina* (LE); Bilibino, Kikuviem River, 4.VII.1977, S+, *Koroleva & Afonina* (LE, MHA, SASY); Bilibino, 30.VIII.1974 *Afonina* (LE); Paekulnej Range, Yuzhnyj Paekulnejveem River, 17.VIII.1979 *Afonina* (LE); Tanyurer River, Bezymyannoe Lake, 11.VII.1979, 14.VII.1979 *Afonina* (LE); Vrangel Island, Tundrovaya River, 1996 *Kholod & Afonina* (LE); Pelyavaam River, 19.VII.1989 *Afonina* (LE); Caunskaya Guba, Pinejveem River, 18.VII. 1982 *Slichenkova & Afonina* (LE); Krauze Cape, Lavrentiya Bay, 29.VIII.1975, 30.VIII.1975 *Afonina* (LE); Gelmimliveem River, 11.VII.1972 *Sekretareva & Afonina* (LE); Aerguveem River, Vatamkajvaam Creek, 4.VII.1980 *Afonina* (LE); **Magadan Prov.**: Tenkinsky Distr.: Stokovyj, "Contact" Science Station, 18.VIII. 1973 (S+), 28.VI.1974 *Blagodatskikh* (LE); Sibit-Tyaellaekh "Aborigen" *Science Station*, 17.VIII.1976, S+, *Blagodatskikh* (LE). **Kamchatskaya Prov.**: Klycheskaya Volcano Group, #55, *Czernyadjeva* (LE).

***U.S.A.*: Alaska.** *Steere #A1018, A891, A937, A1133, 20903, 20925, 650726-33* (LE).

Lyellia crispa R.Br., Trans. Linn. Soc. London 12(2): 562. 1819. Figs. 2-3

Stems 6-8(-13) cm. Leaves when dry contorted in middle part of stem, above strongly crisped; in wet state more or less strongly curved. Leaves 12-14 mm long, 0.75-0.85 mm wide in mid-leaf; at apex truncate to shortly acute, without whisker; ventral lamellae (15-)22-28(-32), 40-50 μm high [(2-) 4-6(-7) cells high], upper edge not wavy; lamella cells short-rectangular to quadrate, 5-8 μm high,

with clear angles, moderately thick-walled, arranged in many places in regular horizontal rows; dorsal cells of limb 7-8(-10) μm, mamillose, with moderately incrassate outer walls. Cells of sheathing base 7-10(-12):1. Sporophytes unknown in Russia.

Ecology: on shaded rocks along streams at 1050-1100 m alt. in South Yakutia and on rocks near lake at 1600 m alt. in Khabarovsk Territory.

SPECIMENS EXAMINES: ***RUSSIA:*** **Yakutia**: ***Neryungri Distr.***: Tokinsky Stanovik Range, Maloye Toko Lake, Vodopadny Creek, 27.VII.1990 *Volotovsky & Ivanova* (SASY); Tokinsky Stanovik Range, Bolshoye Toko Lake, Sredny Brat Creek, 27.VII.1995 *Volotovsky & Ivanova* (SASY, LE). **Khabarovsk Territory**: Dusse-Alin Range, Medvezh'e Lake, 1550 m, *Ignatov #97-511, 97-512* (MHA); same, *Iwatsuki #60303* (MHA, NICH).

NEPAL: *J.D. Hooker #773 (S+), #774, #1180 (S+), #1181* (S+) (LE); *P.D. Sharma VIII.1957* (LE), S+.

Specimens from South Yakutia and Khabarovsk Territory differ from *L. aspera* in (1) the absence of developed capillaceous whisker at leaf tip; (2) not incrassate and mamillose dorsal cells of limb; (3) more thin-walled and angular cells of lamellae on side view; (4) strongly reflexed leaves in wet state (the junction of limb and sheathing base is folded in front view of leaves mounted in slide).

There are two species of *Lyellia* in China, *L. crispa* and *L. platycarpa* Cardot & Thér. (Wang Mei-zhi et al., 2005). They differ from each other mainly in sporophytic characters: capsule horizontal vs. erect; stomata surrounded by conspicous ring of cells vs. without peculiar areolation around stomata, correspondingly. At the same time, these two species are virtually identical gametophytically, thus sterile South Siberian material is difficult to attribute to one of them.

Comparison with rather limited material of these two species demonstrated that mamillose dorsal cells of limb and strongly reflexed leaves in wet state are not the case *L. platycarpa*, therfore we refer South Siberian material to *L. crispa.* At the same, we admit that more thorough analysis (especially if it would be possible to get fresh material of a number of populations of all species of the genus) may reconsider the identity of South Siberian populations.

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LITERATURE CITED

[ABRAMOVA, A.L., L.I. SAVICZ-LJUBITSKAYA & Z.N. SMIRNOVA] АБРАМОВА А.Л., Л.И. САВИЧ-ЛЮБИЦКАЯ, З.Н. СМИРНОВА 1961. Определитель листостебельных мхов Арктики СССР. – [Handbook of mosses of Arctic of the USSR] *Л., Изд-во АН СССР [Leningrad, Izd. Akad. Nauk SSSR], 716 pp.*

[AFONINA, O.M.] АФОНИНА О.М. 2004. Конспект флоры мхов Чукотки.– [Moss flora of Chukotka] *Спб., БИН РАН [Sankt-Petersburg, Bot.Inst.RAS], 260.*

[AFONINA, O.V. & E.N. ANDREEVA] АФОНИНА О.М., АНДРЕЕВА Е.Н. 1993. О нахождении спорогона мха Lyellia aspera (Hag. et C.Jens.) Frye. – [De sporogoniis Lyellia aspera (Hag. et C.Jens.) Frye. Inventis notula]. *Новости сист. низш. раст. [Novosti sist. Nizsh.rast.]* **29**: *132-138.*

AFONINA, O.M. & I.V. CZERNYADJEVA 1995. Mosses of the Russian Arctic: check-list and bibliography. – *Arctoa* **5**: *99-142.*

[AFONINA, O.M. & V.I. PERFILJEVA] АФОНИНА О.М., В.И. ПЕРФИЛЬЕВА 1981. Листостебельные мхи северовостока Якутии (Верхоянский район). – [Mosses of northeast of Yakutia (Verkhoyansk District)]. *Новости сист. низш. раст. [Novosti sist. Nizsh.rast.]* **18**: *188-198.*

[BLAGODATSKIKH, L.S.] БЛАГОДАТСКИХ Л.С. 1984. Листостебельные мхи Колымского нагорья – [Mosses of Kolyma Upland]. *Магадан, Ин-т Биол. пробл. Севера [Magadan, Inst. Biol. problem Severa], 45 pp.*

IGNATOV, M.S., B.C. TAN, Z. IWATSUKI & E.A. IGNATOVA 2000. Moss flora of the Upper Bureya River (Russian Far East). – *J. Hattori Bot. Lab*. **88**: *147-178*.

[IVANOVA, E.I.] ИВАНОВА Е.И. 2001. Листостебельные мхи Южной Якутии. – [Mosses of Southern Yakutia]. *Новосибирск [Novosibisk], 136 pp.*

[SAVICZ-LYUBITSKAYA, L.I., Z.N. SMIRNOVA] САВИЧ-ЛЮБИЦКАЯ Л.И., З.Н. СМИРНОВА 1970. Определитель листостебельных мхов СССР. Верхоплодные мхи. – [Handbook of mosses of the USSR. The acrocarpous mosses] *Л., Наука [Leningrad, Nauka], 822 pp.*

[SMIRNOVA, Z.N.]СМИРНОВА З.Н. 1958. Lyellia R. Br. – новый род для бриофлоры СССР – [Lyellia R. Br. – a new genus for URSS bryoflora] *Бот. журн. [Bot.Zhurn.]* **43** *(6): 850-855.*

SMITH MERRILL, G.L. 2007. Lyellia. – *In:Zander, R.H. (ed.) Flora of North America North of Mexico. Oxford University Press: New York.* **27**: *159-160.*

[STEPANOVA, N.A.]СТЕПАНОВА Н.А. 1986. Конспект флоры мхов тундр Якутии – [Moss flora of tundras in Yakutia]. *Якутск [Yakutsk], 120 pp*.

WANG MEI-ZHI, WU PENG-CHENG, SI HE & Z.K. MAGOMBO 2005. Polytrichaceae. – *In: Wu Peng-cheng & M.R.Crosby (eds.) Moss flora of China. English version. Vol. 8. Sematophyllaceae–Polytrichaceae: 292-366.*