

THE GENUS *ANOECTANGIUM* (POTTIACEAE, BRYOPHYTA)
IN RUSSIA

РОД *ANOECTANGIUM* (POTTIACEAE, BRYOPHYTA) В РОССИИ

ELENA A. IGNATOVA¹

ЕЛЕНА А. ИГНАТОВА¹

Abstract

Three species of *Anoectangium* are currently known in Russia: *A. aestivum* (Hedw.) Mitt., *A. handelii* Schiffn. and *A. stracheyanum* Mitt., the latter species is reported for the first time for the country. *Anoectangium thomsonii* Mitt. is excluded from the bryoflora of Russia. *Anoectangium amurense* Broth. and *A. contortum* Broth., both described from the Amurskaya Province of the Russian Far East, are synonymized with *A. stracheyanum*. *Anoectangium aestivum* is a rare species known from northwestern European Russia and the Caucasus; all its records from Asia were based on erroneously identified specimens. *Anoectangium stracheyanum* occurs in the East of Asiatic Russia and is locally abundant in Primorsky and Khabarovsk Territories, spreading westwards almost to Baikal Lake in Irkutsk Province. *Anoectangium handelii* was found only once on Olkhon Island at Baikal Lake. Key for identification, descriptions and illustrations of the species are provided.

Резюме

Род *Anoectangium* представлен в России тремя видами: *A. aestivum* (Hedw.) Mitt., *A. handelii* Schiffn. и *A. stracheyanum* Mitt., последний вид приводится для страны впервые. *Anoectangium thomsonii* Mitt. исключен из флоры мхов России. *Anoectangium amurense* Broth. и *A. contortum* Broth., которые были описаны из Амурской области, отнесены в синонимы *A. stracheyanum*. *Anoectangium aestivum* – редкий вид, известный из немногих местонахождений на северо-западе европейской России и на Кавказе; все указания на нахождение этого вида в азиатской части России были ошибочными. *Anoectangium stracheyanum* встречается на Российском Дальнем Востоке, местами он довольно обычен в Приморском и Хабаровском краях; самое западное местонахождение в Иркутской области. *Anoectangium handelii* был собран только один раз на о. Ольхон на Байкале. Приводится ключ для определения видов, описания и иллюстрации.

KEYWORDS: mosses, *Anoectangium*, Pottiaceae, taxonomy, Russia, phytogeography

In the recent check-list of mosses of East Europe and North Asia (Ignatov, Afonina, Ignatova et al., 2006) three species of *Anoectangium* Schwägr. were listed for the territory of Russia: *A. aestivum* (Hedw.) Mitt. (reported from northwestern European Russia, Caucasus and East Siberia), *A. handelii* Schiffn. (one locality in Baikal Lake area) and *A. thomsonii* Mitt. (Russian Far East).

Subsequent study revealed a number of mistakes in species identification and also ambiguous application of some names. So, the expanded revision of collections from Russia was undertaken, based on herbarium material of MW, MHA, LE, VLA, IRK, KPABG, H, S and some smaller collections. Their study resulted in the following taxonomy of the genus in Russia.

¹ – Department of Geobotany, Biological Faculty, Moscow State University, Moscow 119991 Russia – Россия 119991, Москва, Московский университет, Биологический факультет, каф. геоботаники. E-mail: arctoa@list.ru

ANOECTANGIUM Schwägr., Sp. Musc. Frond. Suppl. 1(1): 33. 1811.

Type species: *A. compactum* Schwägr. (= *A. aestivum*)

Plants in dense or loose tufts, yellow-green in upper part, brownish below. Stems 0.5-4 cm, weakly branching, usually moderately tomentose, rounded-triangular in transverse section, with rather strong central strand, weak sclerodermis, hyalodermis absent. Leaves distantly or densely arranged, straight or contorted and twisted when dry, erect-spreading when wet, uneven in size along the stem, forming alternating zones of smaller and larger leaves, ovate, ovate-lanceolate or oblong-lanceolate, with not differentiated or differentiated base, occasionally constricted above base, acute or acuminate, strongly keeled, narrowly grooved along costa ventrally; margins plane, entire or slightly crenulate at leaf base, sometimes uneven proximally; costa strongly projecting abaxially, ending few cells below apex, percurrent or shortly excurrent, with only dorsal stereid band, dorsal and ventral epidermis, occasionally ventral epidermis absent and guide cells exposed, ventral surface cells elongate, smooth, dorsal surface cells elongate, smooth proximally, slightly to strongly papillose distally; lamina unistratose, distal and median laminal cells subquadrate, densely papillose, papillae low and wide, bifid, more rarely loosely papillose, basal laminal cells short rectangular, shorter to the margins, smooth. Specialized asexual reproduction rare, by multicellular gemmae on rhizoids in leaf axils. Dioicous. Gametangia and sporophytes terminal on short lateral branches. Perichaetial leaves convolute-sheathing, ovate-acuminate. Setae yellow-brownish. Urns yellow-brown, with red rim, elliptic, smooth and glossy, exothecial cells rectangular, thin-walled, annulus of two rows of slightly vesiculose cells, peristome absent. Spores 12-16 μm , finely papillose. Operculum with long oblique beak. KOH laminal reaction yellow.

KEY FOR IDENTIFICATION OF SPECIES OF ANOECTANGIUM IN RUSSIA

1. Leaves ovate, very small, 0.3-0.4(-0.6) mm long; laminal cells loosely papillose; multicellular gemmae sometimes present in leaf axils *A. handelii*

- Leaves ovate-lanceolate to oblong-lanceolate, >0.6 mm long; laminal cells densely papillose; gemmae absent 2
- 2. Leaves incurved when dry, distantly arranged, stem exposed at places; leaves ovate-lanceolate, 0.8-1.6 mm long *A. aestivum*
- Leaves contorted and slightly or occasionally strongly spirally twisted when dry, densely arranged, stem not exposed; leaves ovate-lanceolate to oblong lanceolate, (1.0-)1.5-2.5 mm long *A. stracheyanum*

Anoectangium aestivum (Hedw.) Mitt., J. Linn. Soc., Bot. 12: 175. 1869. – *Gymnostomum aestivum* Hedw., Sp. Musc. Frond. 32. 2 f. 4-7. 1801. – Figs. 1, 5.

Plants medium-sized, in moderately dense soft tufts or cushions, yellowish-green in upper part, brownish below. Stems 1-4 cm, erect. Leaves distantly arranged and exposing stem at places, incurved and slightly curled when dry, erect-spreading to patent when wet, ovate-lanceolate or short-lanceolate, without or with the scarcely differentiated base, narrowly acute or acuminate, keeled, carinate, 0.8-1.4(-1.6) mm long, 0.25-0.3 mm wide; margins plane, uneven, slightly papillose-crenulate except for the leaf base; costa strong, 40-75 μm wide at base, ending few cells below apex or percurrent, papillose dorsally in distal 2/3; upper and median laminal cells rounded-quadrate, rounded-hexagonal or transversely widened, 7-10 \times 5-10 μm , with moderately thickened walls, opaque, densely covered by massive low bifid papillae; basal laminal cells hyaline, with moderately thickened walls, subquadrate to short-rectangular, 10-20 \times 8-12 μm , becoming more narrow to the margins; several cells at leaf apex smooth, forming short apiculus. Sporophytes unknown from Russia. Inner perichaetial leaves up to 0.8-1.0 \times 0.3-0.4 mm, gradually acuminate. [Seta 7-10 mm. Urn 0.5-1.0 mm long. Peristome absent. Operculum with long oblique beak. Spores 12-16 μm (from Smith, 2004; Zander & Eckel, 2007)].

Specimens examined: RUSSIA: Murmansk Province: Kutsa Nature Reserve, Jänisköngäs rapids, 10.VII.1934, *Tuomikoski s.n.* (LE); Karachaevo-Cherkessia: Teberda Nature Reserve, Shumka Creek, 2750 m alt., *Onipchenko #205/96*; Khutyj Creek, 1600 m alt., *Onipchenko #36/98* (MW); Karachaevs District, Shubaidai-chat

Gorge, 2600 m alt., *Onipchenko* #137/94 (MW); Arkhyz, Sofiya Mt., 25.VIII.1997, 2635 m alt., *Korotkov s.n.* (MW).

Differentiation. In most cases *A. aestivum* is separated from *A. stracheyanum* by ovate-lanceolate leaves distantly arranged along the stem. *Anoetangium hanedlii* has much smaller leaves, 0.3-0.6 mm long vs. to 0.8-1.6 mm long and grows in very dense tufts and in xeric habitats, while *A. aestivum* is rather a mesophytic species.

Distribution and ecology. *Anoetangium aestivum* is a widespread species, sporadically occurring almost throughout the world: in North, Central and South America, Africa, Eurasia and New Zealand (Zander & Eckel, 2007). However, in Russia it is a rare species known from several localities in the Caucasus and northwestern European Russia. Caucasian collections were made in Teberda and Caucasian Nature Reserves. In the former the species grows mostly in calcareous areas in the alpine belt, at 2600-2750 m elev., on wet cliffs and N-faced rock outcrops and only one collection was from the forest belt, at 1600 m elev., on rocks near waterfall (Ignatova et al., 2008). In Caucasian Reserve it was found in the subalpine belt on calcareous rocks (Akatova, 2002). In northwestern European Russia *A. aestivum* occurs in the Kola Peninsula. Two localities are known: one is in calcareous coastal area of Kandalaksha Bay of the White Sea (Belkina & Likhachev, 1999); another one is at the border with Finland, in the limestone area of Kuusamo. The previous records of this species from Siberia were based on misidentifications of *Molendoa* and *Hymenostylium*.

***Anoetangium stracheyanum* Mitt., J. Linn. Soc., Bot., suppl. 1: 31. 1859. Figs. 2-3, 5.**

A. amurense Broth., Trudy Bot. Muz. Imp. Akad. Nauk 16: 26. 3 f. 1; 4 f. 6. 1916. Neotype (selected here): "362. Amur, Bassin des Giljuj-flusses, am Giljujflusse in der Nahe der Winterhitte Maximov, 10/8/1910, leg. N. Prochorow et O.Kuseneva (H-BR 0141031), syn. nov.

A. contortum Broth., Trudy Bot. Muz. Imp. Akad. Nauk 16: 26. 3 f. 1; 4 f. 6. 1916. Lectotype (selected here): "*Anoetangium contortum* Broth." (H-BR #0141035), syn. nov.

Plants medium-sized, in loose to moderately dense soft tufts or cushions, yellowish-green in

upper part, brownish below. Stems 1-2 cm, erect or often curved downwards in upper part. Leaves densely arranged and hiding stem, incurved and slightly contorted when dry, often slightly secund, sometimes slightly to strongly spirally twisted, patent when wet, constricted above ovate base and then lanceolate, usually slightly widened at mid-leaf, narrowly acute or acuminate, strongly keeled, carinate, (1.0-)1.4-2.0(-2.2) mm long, 0.25-0.4 mm wide at base; margins plane, slightly uneven, sometimes slightly crenulate at shoulders below constriction or entire throughout; costa strong, 50-75 μ m wide at base, excurrent into short apiculus to 5-6 cells long or percurrent, densely or loosely papillose dorsally in distal 2/3; upper and median laminal cells rounded-quadrate, rounded-hexagonal or transversely widened, 6-8 \times 5-12 μ m, thin-walled, opaque, densely covered by massive low bifid papillae; basal laminal cells hyaline, smooth, with moderately thickened walls, rectangular, 12-25 \times 10-12 μ m, becoming more narrow to the margins. Sporophytes rare in Russia. Inner perichaetial leaves 1.0-1.3 \times 0.4-0.5 mm, abruptly acuminate from sheathing base. Seta 6-8 mm. Urn 0.8-1.1 mm long. Spores 12-14 μ m.

Selected specimens examined: RUSSIA: Primorsky Territory: Olga District, waterfall on Milogradovka Creek, 310-370 m alt., *Ignatov* #07-311, 07-295 (MHA); Ussurijsk District, Ussurijsky Nature Reserve, Anikin Creek, 235 m alt., *Ignatov* #08-41; Kamenka (Komarovka) Creek, 150 m alt., *Ignatov* & *Ignatova* #06-2909, 06-2888 (MHA); Partizansky District, Lazovsky Pass, 800 m alt., *Ignatov et al.* #06-2988 (MHA); Lazo District, Elomovsky Creek, 200-550 m alt., *Ignatov et al.* #06-2179 (MHA); Vladivostok Area, Bolshaya Sedanka Creek, 50-100 m alt., *Ignatov et al.* #06-2484 (MHA); Khabarovsk Territory: Verkhnebureinsky District, Bureya River near "Tri Brata", 470 m alt., *Ignatov* #97-844 (MHA); Bureinsky Nature Reserve: Pravaya Bureya River, 580 m alt., *Ignatov* #97-841 (MHA); Kuraigagna Creek, 950 m alt., *Ignatov* #97-836 (MHA); 1050 m alt., *Ignatov* #97-835 (MHA); Medwezh'e Lake, 1600 m alt., *Ignatov* #97-1271 (MHA); Amurskaya Province: Gilyuj River basin, Gilyuj River near Maksimov's settling, 10.VIII.1910, *Prokhorov* & *Kuzeneva s.n.*(LE, #362); Irkutsk Province: Bodajbo District, Vitimsky Nature Reserve, Amalyk River, 29.VI.1984, *Bardunov s.n.* (IRK); Verkhnij Uryakh Creek, 30.VIII.1986, *Bardunov s.n.* (IRK); Sakhalinskaya Province: Kuril Islands, Shikotan Island, 300-320 m alt., *Bakalin* #K-45-3-07, K-45-13-07, K-42-28-07

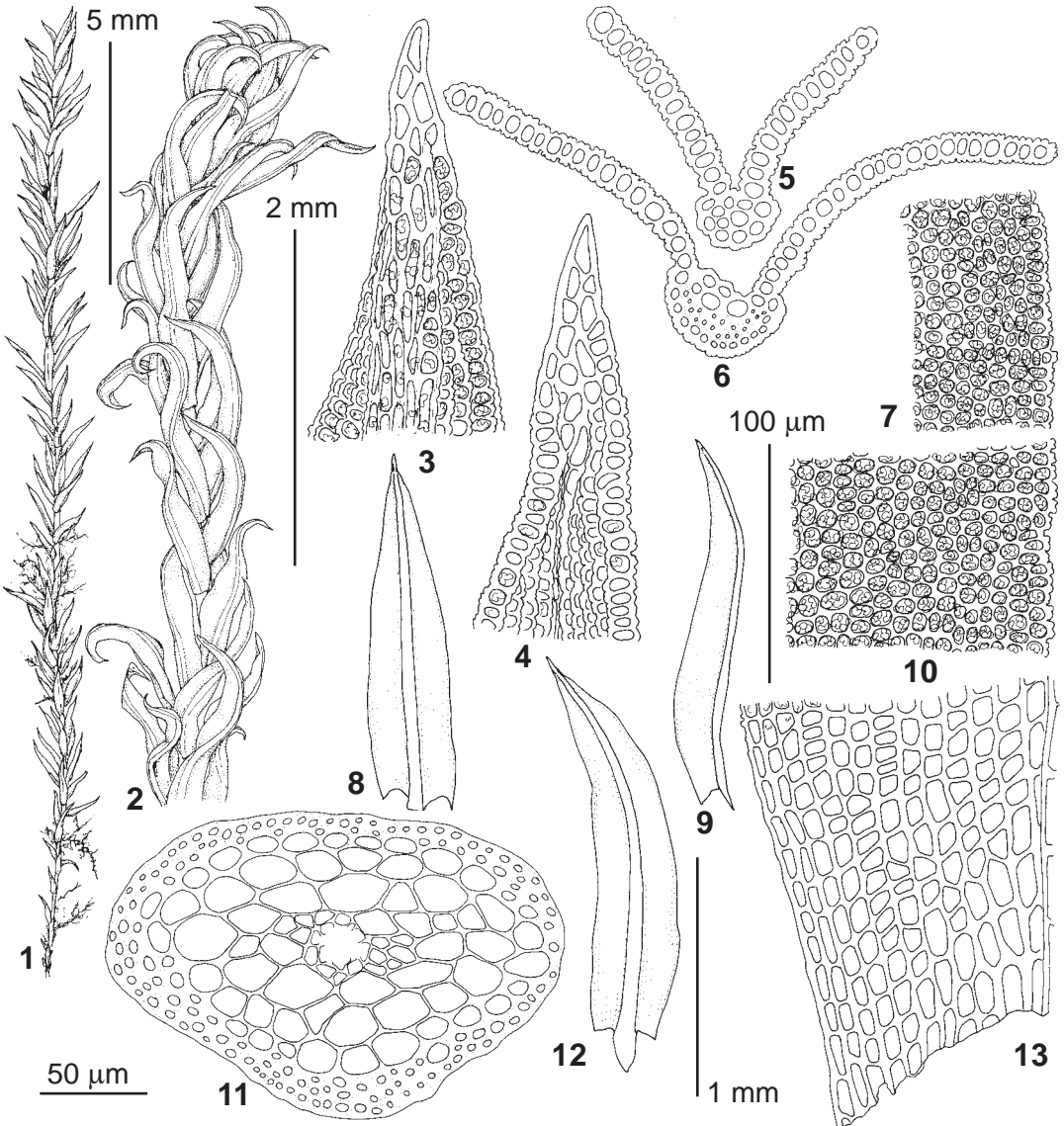


Fig. 1. *Anoetangium aestivum* (Hedw.) Mitt. (from Russia, Karachaevo-Cherkessia, Teberda Reserve, *Onipchenko* #137/94, MW): 1 – habit, wet; 2 – habit, dry; 3-4 – leaf apices; 5-6 – leaf transverse sections; 7 – upper laminal cells; 8-9, 12 – leaves; 10 – median laminal cells; 11 – stem transverse section; 13 – basal laminal cells. Scale bars: 5 mm for 1; 2 mm for 2; 1 mm for 8-9, 12; 100 µm for 3-4, 7, 10, 13; 50 µm for 5-6, 11.

(MHA). INDIA: Madras State, *Foreau* #457 (S); NEPAL: 5.VI.1972, *Iwatsuki* #212 (H); JAPAN, Honshu, 17.X.1962, *Iwatsuki* s.n. (S).

Selected specimens examined of *Anoetangium thomsonii*: INDIA: NW Himalaya 29.IV.1898 *Duthie* (S); Simla, 1934, *Chopra* s.n. (H; Musci Sel. Crit. Exs. Mus. Nat. Hist. Vondobonensis, Verdoorn 109); JAPAN, Honshu, 3.XI.1974, *Takaki* s.n. (H; Musci Jap. Exs. 1352).

Differentiation and variation. Leaves of *A. stracheyanum* are usually longer than those of *A.*

aestivum, they are more crowded, hiding the stem. A clearly differentiated leaf base with constriction at transition to upper part of leaf makes leaves “wasp-waisted”, which is conspicuous in most cases (Fig. 2) and quite helpful for recognizing the species. There are few specimens from Kuril Islands (Shikotan Island) with short leaves, ca. 1 mm long, which are scarcely constricted above base, but they are narrow lanceolate and densely arranged. I tentatively attribute them to *A. stra-*

cheyanum, taking into consideration that the plants are underdeveloped due to growth in quite harsh habitat. In some specimens leaf margins are clearly serrulate at shoulders (Fig. 3), but this character is not constantly expressed.

Distribution and ecology. *Anoetangium stracheyanum* is rather frequent and locally abundant in a southern part of Primorsky Territory. It was found in almost all well explored areas, at 50-800 m elev. There are also numerous collections from Khabarovsk Territory, Bureya River, from 470-1600 m elev. In Amurskaya Province the species was collected from '150-200 m' to '400-450 m' elev. The westernmost localities (cf. Fig. 5) of *A. stracheyanum* in Russia are in Irkutsk Province, Vitimsky Nature Reserve, where it was collected in the forest belt. The species usually grows on shady cliffs and rock outcrops along small brooks, creeks and rivers, sometimes also on rock outcrops in forest on mountain slopes. Contrary to *A. aestivum*, which usually occurs in a rather small quantity (at least where I saw it in Russia), *A. stracheyanum* is often fairly abundant and easily recognized from a distance due to bright yellow-green colour of cushions. Outside Russia *Anoetangium stracheyanum* is known in Asia from China (Li Xing-jiang & al., 2001), Japan (Saito, 1975), India, Burma and Vietnam (Gangulee, 1969) and in the eastern North America (Zander & Eckel, 2007).

Taxonomy. In most of previous publications this species was reported in Russia as *A. thomsonii*. The latter species was described by W. Mitten from Himalayas, as well as *A. stracheyanum*, and later it was also discovered in Japan and China (Saito, 1975; Li Xing-jiang & al., 2001). *Anoetangium thomsonii* was characterized by Mitten as a robust plant with leaves widened above the middle and costa being almost smooth, whereas for *A. stracheyanum* a small size of plants and costa scabrose dorsally were emphasized. There is a considerable inconsistency between the authors of different subsequent floras in circumscription of *A. thomsonii* and *A. stracheyanum*. Leaf length for *A. thomsonii* is given as either over 1.7 mm (Gangulee, 1969), 1.3-1.7 mm (Li Xing-jiang & al., 2001) or 1.0-1.5 mm (Saito, 1975), for *A. stracheyanum* it is reported either up to 1.4 mm (Gangulee, 1969), 0.8-2.0 mm (Li Xing-jiang et al., 2001), 1.0-1.5 (Zander & Eck-

el, 2007) or 1.5-2.0 mm (Saito, 1975). Costa is characterized as almost smooth and percurrent in *A. thomsonii* vs. scabrose and excurrent in *A. stracheyanum* by most authors. Leaves are described as crisped and contorted in *A. thomsonii* vs. incurved in *A. stracheyanum* (Gangulee, 1969); crisped and contorted in *A. stracheyanum* and incurved and contorted in *A. thomsonii* (Li Xing-jiang et al., 2001), while Saito (1975) considers that they do not differ in this character. Most authors emphasize that in *A. stracheyanum* leaves are constricted above leaf base, while in *A. thomsonii* they have no such a constriction and the lamina is oblong-lanceolate from rather narrow base, with maximal width at or above mid-leaf. Saito (l.c.) also notes that the leaves of *A. stracheyanum* have crenulate margins at shoulder part, while leaves of *A. thomsonii* have entire margins.

Specimens from Russia are rather variable in size of plants and leaves, and their leaves vary from slightly curved to strongly spirally twisted in dry state, but they all have leaves with clear constriction above leaf base. In most collections they are slightly widened above this constriction (so becoming "weakly wasp-waisted" in terms of Zander & Eckel, 2007), but being in mid-leaf usually not wider than at the base (Fig. 2). In some collections, however, especially from the northern limit of the species in Khabarovsk Territory and Amurskaya Province, most leaves are not or scarcely widened above this constriction (Fig. 3), and distal lamina is \pm parallel-sided. At the same time, few weakly wasp-waisted leaves can usually be found in these collections among the best developed plants as well. Leaf length in Russian Far Eastern plants is variable, but in most collections it ranges from 1.5 to 2.0 mm, thus agree with Saito' (1975) circumscription of *A. stracheyanum*. Leaf margins are serrulate at shoulders in some specimens, but in many Russian collections they are totally entire. Summing up, the combination of characters and especially the leaf shape excludes placement of Russian plants in *A. thomsonii*, suggesting their position in *A. stracheyanum*.

Anoetangium amurense Broth. was described from Amurskaya Province and was previously synonymized with *A. thomsonii* by Chen (1941). We

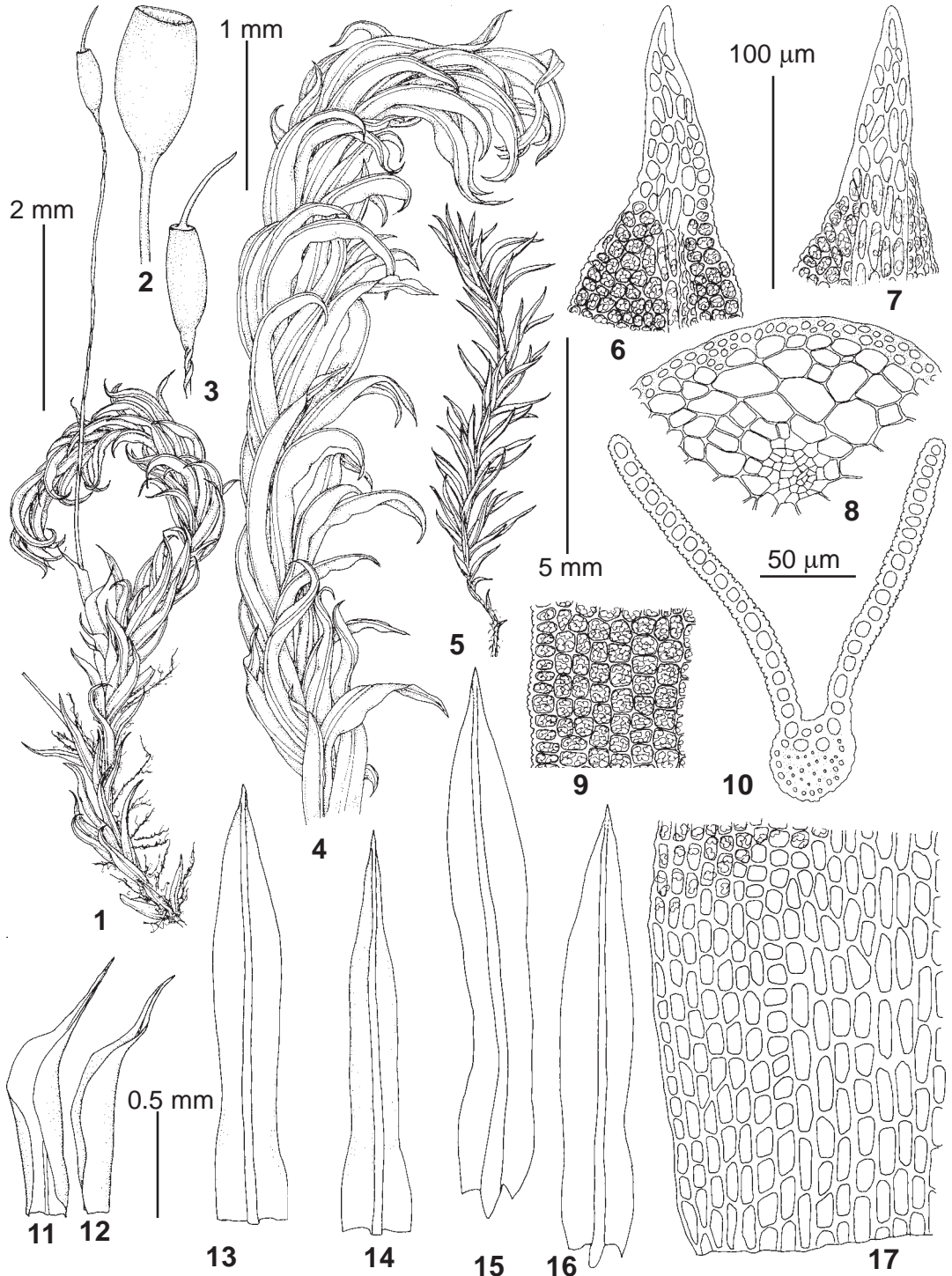


Fig. 2. *Anoetangium stracheyanum* Mitt. (from Russia, Primorsky Territory, Ignatov & Ignatova #06-2988, MHA): 1, 4 – habit, dry; 2-3 – capsules; 5 – habit, wet; 6-7 – leaf apices; 8 – stem transverse section; 9 – median laminal cells; 10 – leaf transverse section; 11-12 – inner perichaetial leaves; 13-16 – leaves; 17 – basal laminal cells. Scale bars: 5 mm for 5; 2 mm for 1; 1 mm for 2-4; 0.5 mm for 11-16; 100 μm for 6-7, 9, 17; 50 μm for 8, 10.

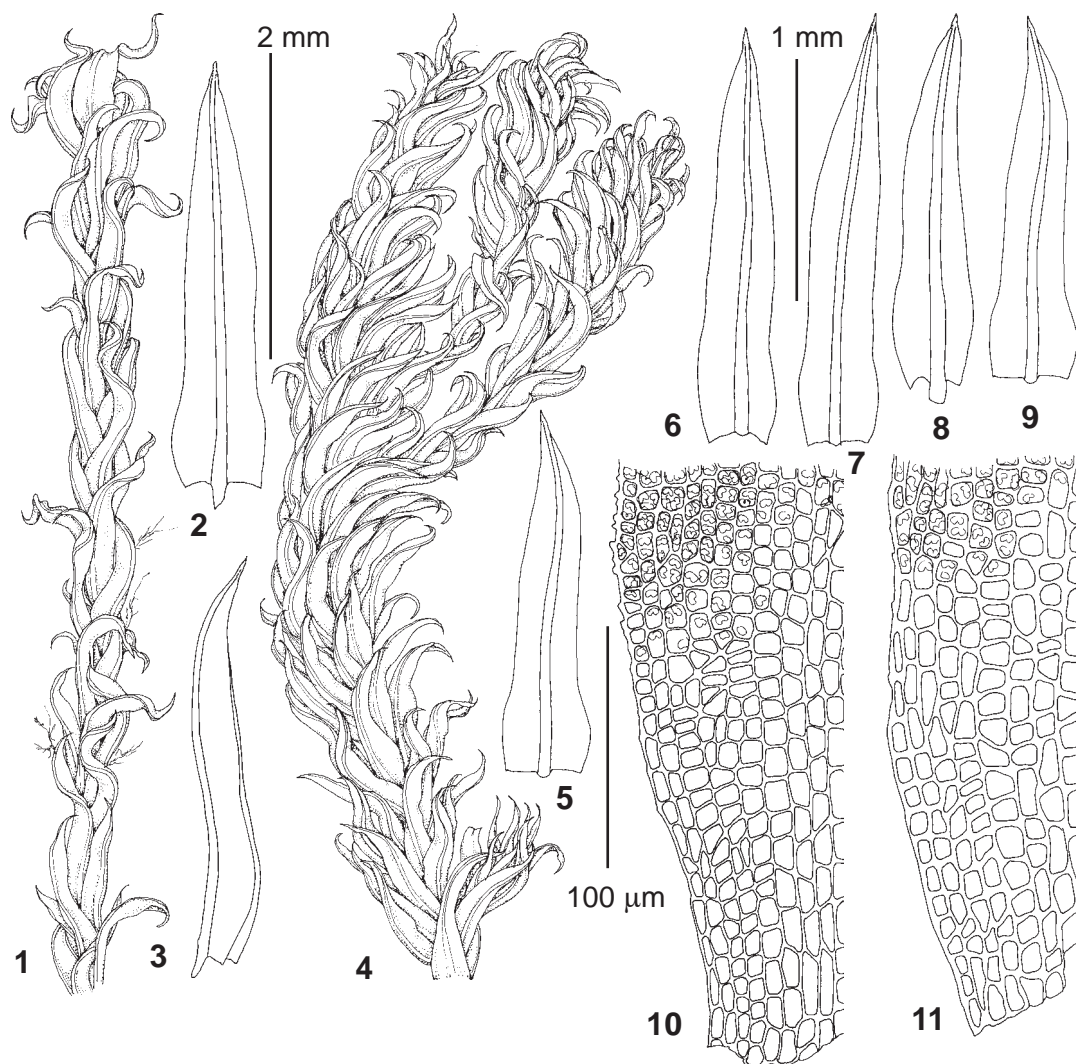


Fig. 3. *Anoetangium stracheyanum* Mitt. (1-3, 11 – from isotype of *A. amurense* Broth., Russia, Amurskaya Province, Gilyuj River basin, 10.VIII.1910, Prokhorov & Kuzeneva #362, LE; 4-5 – from lectotype of *A. contortum* Broth., H-Br #0141035; 6-7 – from Khabarovsk Territory, Bureinsky Reserve, Ignatov #97-844, MHA; 8-9, 10 – from Khabarovsk Territory, Bureinsky Reserve, Ignatov #97-839, MHA): 1, 4 – habit, dry; 2-3, 5-9 – leaves; 10-11 – basal laminal cells. Scale bars: 2 mm for 1, 4; 1 mm for 2-3, 5-9; 100 µm for 10-11.

failed to find any type material in LE, H and H-BR. The specimen cited in protologue (our translation from Russian: “bank of Zeya River opposite Bolotov’s cabin (zaimka), on cliffs, 18.VIII.1908, coll. Prokhorov & Kuzeneva, № 48c”) is absent in these herbaria. The species is represented in LE (label in Russian) and H-BR (labels in German) by another specimen of the same collectors: “362. *Anoetangium amurense* Broth. Amurskaya Province, Gilyuj River basin, Gilyuj River near Maksimov’s winter cabin (zi-

movie), in cliff crevices, 10.VIII.1910, N. Prokhorov & O. Kuzeneva” (being large, the collection is kept in H-BR in two envelops with identical labels, ##0141030 and 0141031). The geographic position of these two localities is known only approximately, the distance between them is 100-150 km according to the description of the expedition routes (Brotherus et al., 1916). The species name in the labels is written by Brotherus and the specimen agrees with the original description in all essential characters. Thus, we select the spec-

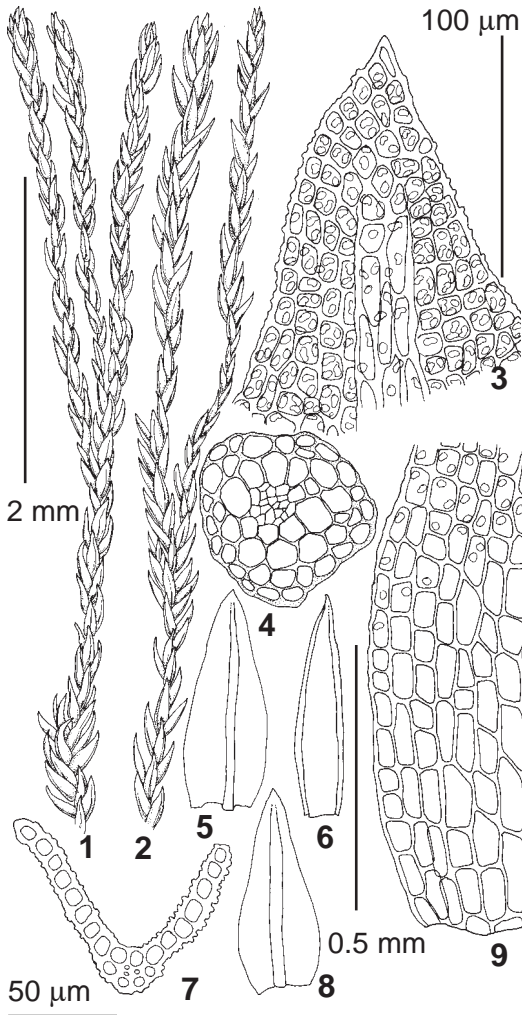


Fig. 4. *Anoetangium handelii* Schiffn. (from Russia, Irkutsk Province, Olkhonsky District, MRS (Sakhyurte) Settlement, 31.VIII.1997, *Bardunov s.n.*, IRK): 1 – habit, dry; 2 – habit, wet; 3 – upper laminal cells; 4 – stem transverse section; 5-6, 8 – leaves; 7 – leaf transverse section; 9 – basal laminal cells. Scale bars: 2 mm for 1-2; 0.5 mm for 5-6, 8; 100 µm for 3, 9; 50 µm for 4, 7.

imen in H-BR #0141031 as a neotype of *A. amurense* (another specimen, H-BR #0141030 and the specimen in LE should be considered as isotypes). The plants of the neotype collection represent the phenotype common at the northern limit of the species distribution, with leaves not or only weakly widened above constriction (Fig. 3).

Anoetangium contortum Broth. was described from the same locality with *A. amurense*

(“right bank of Zeya River opposite Bolotov’s settling (zaimka), on cliffs, 18.VIII.1908, coll. Prokhorov & Kuzeneva, № 60”). It was treated as a separate species by Savicz-Lyubitskaya & Smirnova (1970) and Ignatov & Afonina (1992), but listed as a synonym of *A. thomsonii* by Ignatov, Afonina, Ignatova et al. (2006). There are no specimens of *A. contortum* in LE, and there is a single specimen in H-BR (#0141035), with label that has nothing but the species name handwritten by Brotherus. Plants of this specimen agree with the original description and we see no better choice for the typification than to select this specimen as a lectotype of *A. contortum*, even despite it has no geographic information in the label. The Brotherus’ hand-writing can be assumed as the evidence that this is the same specimen as cited in protologue, as no other specimens were reported for this species neither by Brotherus (1916), nor in other subsequent publications.

Most of characters mentioned in protologue of *A. contortum* are completely within the variation of *A. stracheyanum*, although it does not contradict e.g. *A. thomsonii* as well. However, the type specimen has characteristic constriction above leaf base that disagree with the latter species. Strongly spirally twisted leaves were considered to be the main diagnostic character of *A. contortum* by Brotherus (l. c.). However, the rich recent collections from the northern limit of *A. stracheyanum* in Asiatic Russia demonstrate the great variation of this character. Plants with incurved leaves and plants with strongly spirally twisted leaves are sometimes present within the same collection. Thus, *A. contortum* is also synonymized here with *A. stracheyanum*.

Anoetangium handelii Schiffn, Ann. K.K. Naturhist. Hofmus. 27: 490, figs. 51-59. 1913. – Fig. 4–5.

Plants small, in very dense tufts, light brownish-green in upper part, brownish below. Stems 4–7 mm, occasionally forked. Leaves densely arranged, straight and appressed when dry, erectopatent when wet, ovate, acute, keeled, carinate, 0.3–0.4(–0.6) mm long, 0.2–0.3 mm wide at base; margins plane, slightly uneven, minutely papillose-crenulate; costa ca. 25 µm wide at base, ending 4–5 cells below apex, papillose dorsally in dis-

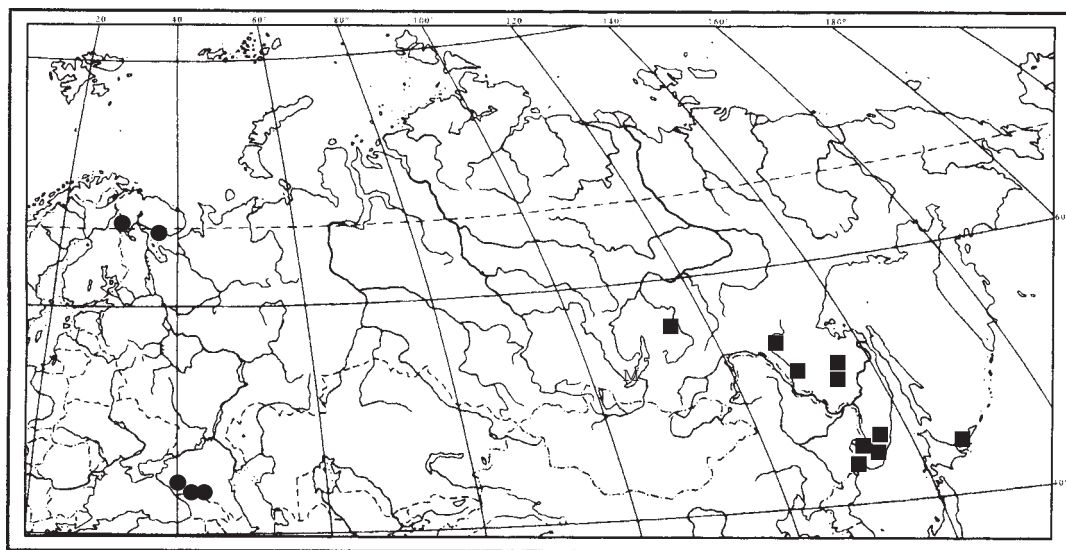


Fig. 5 Distribution of *Anoetangium aestivum* (circle), *A. stracheyanum* (square), *A. handelii* (star) in Russia.

tal 2/3; upper and median laminal cells rounded-quadrate, rounded-hexagonal or short rectangular, 10-12×10-20 μm , thin-walled, translucent, with sparse massive low bifid or simple papillae; basal laminal cells hyaline, smooth, with moderately thickened walls, rectangular, 10-14×15-30 μm , becoming shorter to the margins. Sporophytes unknown. [Asexual reproduction by multicellular gemmae on rhizoides in leaf axils].

Specimens examined: RUSSIA: Irkutsk Province, Olkhonsky District, Sakhyurte Settlement, 31.VIII.1997, *Bardunov s.n.* (IRK). UKRAINE: Crimea, Karadag Mt., Karagach Range, 9.VI.1984, *Partyka s.n.* (LE). TAJIKISTAN: Gissarsky Range, Kondora Gorge, 9.IX.1945, *Kuprevich s.n.* (LE); Darvazsky Range, Pyandzh River basin, Surkh-Dara Gorge, *Mamatkulov #5207* (LE); Gazimajlik Mts., Gandzhino Settlement, *Mamatkulov #2963* (LE). UZBEKISTAN: Tashkent Province, Ugam River basin, Humsan Settlement, 2.VI.1965, *Nazarenko #25* [det. Abramov & Abramova] (LE).

Differentiation. Specimen from Lake Baikal area differs from collections from Tajikistan and Crimea (LE) in larger upper laminal cells, 10-12 μm vs. 7-9 μm , it also lacks gemmae in leaf axils, so its identification is somewhat uncertain. However, the combination of elongate surface cells of costa, smooth adaxially and papillose abaxially, costa ending below leaf apex, large stem central strand and very dense tufts excludes its placement to any other genera: *Hymenostylium*

lacks the stem central strand, *Molendoo* and *Gymnostomum* have adaxial surface of costa broader and papillose. Habitually specimen from Baikal is very similar to specimens from Tajikistan, in which axillary rhizoidal gemmae are also very few and difficult to find. The Baikal plants are somewhat fragile, and this feature is mentioned also by Zander and Weber (2005) for specimens from Colorado.

Distribution and ecology. *Anoetangium handelii* is a rare xeric species. It was described from Turkey and subsequently reported from Tajikistan, Turkmenistan, Uzbekistan, Afganistan, Iraq, Iran, Israel in Asia, Crimea in Ukraine, which remains the only known locality in Europe, and in North America in Colorado, Nevada and California (Frey & Kürschner, 1991; Ignatov, Afonina, Ignatova et al., 2006; Zander & Eckel, 2007). Zander & Weber (2005) describe the microhabitat of the species in Colorado as very deep horizontal fissures of rocks where the only small amount of moisture can reach, but they are exposed to sunlight during winters when the sun is low. According to Mamatkulov (1990) *A. handelii* is rather widespread in Tajikistan, in mountains at 700-2800 m, on limestone and sandstones, in rock crevices and not very deep caves, in xeric and sunny habitats, but sometimes near springs. In Crimea it was collected in crevices of volcanic rocks on Karadag Mt., where perma-

nent creeks or brooks are absent (Partyka, 2005). Similarly, Olkhon Island of Baikal Lake has a xeric climate despite its position in the lake. It has the highest number of sunny days and the lowest annual precipitation, ca. 180 mm per year, in the region. The species was collected here in fissures of limestone outcrops.

ACKNOWLEDGEMENTS

I am greatly indebted to curators of LE and IRK for specimen loans and to curators of H and S for arrangement of my work in Herbariums. The work was partly supported by the Programm "Biodiversity" of Russian Academy of Sciences and Scientific School Program НШ-4243-2008.4.

LITERATURE CITED

- [АКАТОВА, Т.В.] AKATOVA T.V. 2002. Листостебельные мхи Кавказского заповедника (Западный Кавказ, Россия). – [Moss flora of the Caucasian Nature Reserve (Western Caucasus, Russia)] *Arctoa* **11**: 179-204.
- [BARDUNOV, L.V.] БАРДУНОВ Л.В. 1990а. Мохообразные. – [Mosses] *В кн.: Уникальные объекты живой природы бассейна Байкала (ред. Попов Л. В.), Новосибирск, Наука [In: Popov, L. V. (ed.), Unikalnye ob'ekty zhivoj prirody basseina Baikala. Novosibirsk, Nauka]*: 49-50.
- [BELKINA, O.A. & A.Yu. LIKHACHEV] БЕЛКИНА О.А., А.Ю. ЛИХАЧЕВ 1999. Некоторые особенности флоры листостебельных мхов Кандалакшского заповедника (Белое море). – [Some peculiarities of the moss flora of Kandalaksha State Reserve (White Sea, North-West Russia)] *Бот. Журн. [Bot. Zhurn.]* **84**(11): 36-49.
- [BROTHERUS, V., O. KUZENEVA & N. PROKHOROV] БРОТЕРУС В., О. КУЗЕНЕВА, Н. ПРОХОРОВ 1916. Список мхов из Амурской и Якутской областей. – [List of mosses of Amurskaya and Yakutskaya Provinces]. *Труды Бот. Музея Имп. Акад. Наук [Trudy Bot. Muz. Imp. Akad. Nauk]* **16**: 1-71.
- CHEN, P. C. 1941. Studien über die ostasiatischen arten der Pottiaceae. I. – *Hedwigia* **80**: 1-76.
- FREY, W. & H. KÜRSCHNER 1991. Conspectus bryophytorum Orientalium et Arabicorum. An annotated catalogue of the bryophytes of Southwest Asia. – *Bryophyt. Biblioth.* **39**: 1-181.
- GANGULEE, H.C. 1969. Mosses of Eastern India and adjacent regions. Published by the author, Calcutta. Vol. 1: 1-830.
- IGNATOV, M.S. & O.M. AFONINA (eds.) 1992. Check-list of mosses of the former USSR. – *Arctoa* **1**: 1-85.
- IGNATOV M.S., O.M. AFONINA, E.A. IGNATOVA, A. ABO-LINA, T.V. AKATOVA, E. Z. BAISHEVA, L.V. BARDUNOV, E.A. BARYAKINA, O.A. BELKINA, A.G. BEZGODOV, M.A. BOYCHUK, V.YA. CHERDANTSEVA, I.V. CZERNYADJEVA, G.YA. DOROSHINA, A.P. DYACHENKO, V.E. FEDOSOV, I.L. GOLDBERG, E.I. IVANOVA, I. JUKONIENE, L. KANNUKENE, S.G. KAZANOVSKY, Z.KH. KHARZINOV, L.E. KURBATOVA, A.I. MAKSIMOV, U.K. MAMATKULOV, V. A. MANAKYAN, O.M. MASLOVSKY, M.G. NAPREENKO, T. N. OTNYUKOVA, L.YA. PARTYKA, O.YU. PISARENKO, N.N. POPOVA, G.F. RYKOVSKY, D.YA. TUBANOVA, G.V. ZHELEZNOVA, VI. ZOLOTOV 2006 [2007]. Check-list of mosses of East Europe and North Asia. – *Arctoa* **15**: 1-130.
- [IGNATOVA, E.A., M.S. IGNATOV, N.A. KONSTANTINOVA, VI. ZOLOTOV & V.G. ONIPCHENKO] ИГНАТОВА Е.А., М.С. ИГНАТОВ, Н.А. КОНСТАНТИНОВА, В.И. ЗОЛОТОВ, В.Г. ОНИПЧЕНКО 2008. Флора мохообразных Тебердинского заповедника. – [Bryophytes of Teberdinskiy State Nature Reserve] *Флора и фауна заповедников [Flora i fauna zapovednikov]* **112**: 1-86.
- LI XING-JIANG, SI HE & Z. IWATSUKI 2001. Pottiaceae. – *In: Li Xing-jiang & M.R. Crosby (eds.). Moss Flora of China*. Vol. **2**: 114-249.
- [MAMATKULOV, U.K.] МАМАТКУЛОВ У.К. 1990. Флора мохообразных Таджикской ССР. Т. 1. – [The flora of the bryophytes of the Tajik SSR, Vol. 1] *Dushanbe, Donish [Душанбе, Донии]*, 320 pp.
- [PARTYKA, L.Ya.] ПАРТЫКА Л.Я. 2005. Бриофлора Крыма. – [Bryoflora of Crimea] *Киев, Институт ботаники НАН [Kiev, N.G. Kholodny' Inst. Bot. NAN]*, 170 pp.
- SAITO, K. 1975. A monograph of Japanese Pottiaceae (Musci). – *J. Hattori Bot. Lab.* **39**: 373-537.
- [SAVICZ-LYUBITSKAYA, L.I. & Z.N. SMIRNOVA] САВИЧ-ЛЮБИЦКАЯ Л.И., З.Н. СМІРНОВА 1970. Определитель листостебельных мхов СССР. Верхлоплодные мхи. – [Handbook of mosses of the USSR. The acrocarpous mosses] *Л., Наука [Leningrad, Nauka]*, 822.
- SMITH, A.J.E. 2004. The moss flora of Britain and Ireland. Cambridge University press. 1012 pp.
- ZANDER, H.R. & P.M. ECKEL 2007. Anoetangium. – *In: Zander, H.E. (ed.). Flora of North America. Vol. 27. Bryophytes: Mosses, part 1*: 520-523.
- ZANDER, H.R. & W.A. WEBER 2005. Anoetangium handellii (Bryopsida, Pottiaceae) in the New World. – *Bryologist* **108** (1): 47-49.