

Notes on *Philonotis* (Bartramiaceae, Bryophyta) 18. Ranges of *P. calcarea* and *P. seriata*, and new synonyms of *P. fontana*

Timo Koponen

Finnish-Chinese Botanical Foundation, Mailantie 109, FI-08800 Lohja, Finland, and: Finnish Museum of Natural History, Botany Unit (Bryology), P.O. Box 7, FI-00014 University of Helsinki, Finland (timo.koponen@helsinki.fi)

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Records of *Philonotis calcarea*, *P. fontana*, *P. lutea* and *P. seriata* (Bartramiaceae) in section *Philonotis* in W. Mitten's *Musci Indiae orientalis* are revisited and discussed. The specimens of *P. calcarea* and *P. seriata* available from Southeast Asia are reidentified, and relevant literature reports are reviewed. No correctly identified specimens of *P. calcarea* and *P. seriata* were found from the western and eastern Himalaya, China, Japan or Korea. Hence, the range of *P. calcarea* extends from Greenland through Europe to Afghanistan, Kazakhstan, Kyrgyzstan and Uzbekistan and to the Altai Mountains in Asia. *Philonotis seriata* ranges from Greenland to the Caucasus area and has disjunctions in the Altai Mountains. The names *Bryum zonatum* Schimp., *Philonotis crassinervis* Wils., *P. mongolica* Broth. nom. inval. in synonym. and *P. trachyphylla* Dixon & Badhw. are synonymized with *P. fontana* (Hedw.) Brid. The misidentification of these taxa is due to the modified leaves of male plants, in which the leaf cells may have a central papilla. The records of *P. yezoana* from the Himalayas, Europe (Finland) and Greenland are based on male plants of *P. fontana*.

Introduction

In the course of a revision of the moss genus *Philonotis* (Bartramiaceae) in Southeast Asia, I studied a large number of specimens at the Botanical Museum of the University of Helsinki (H, H-BR, H-SOL) and other herbaria (BM, E, FH, MO, NY), including unidentified ones at E, H, and MO. In spite of the reports of *P. calcarea* from China, no specimens were seen by me from that country (Koponen 1998, 2010a), and *P. seriata* was excluded for Japan and Korea (Koponen

2009a). My collections from Japan in 1969–1972, Taiwan in 1971, Papua New Guinea in 1981 (Koponen & Norris 1996), northeast China in 1981 (Koponen *et al.* 1983), Yunnan in 1981 and 1985 (Koponen & Li 1992), Hainan in 1985 (Lin *et al.* 1992), Sichuan in 1992, or from the excursions to Hunan in 1997–2001 (Koponen 2019) contain neither *P. calcarea* nor *P. seriata*. These two species were also excluded from the checklists of *Philonotis* prepared for Vietnam (Koponen *et al.* 2019), Pakistan (Koponen & Higuchi 2020), the Philippines (Koponen & Schwarz 2022) and

Myanmar (Koponen *et al.* 2022). The easternmost localities of both taxa in Asia are in the Altai Mountains (Koponen *et al.* 2012).

The first records of *P. calcarea* and *P. seriata* from southeast Asia are in Mitten's (1859) *Musci Indiae orientalis*. Koponen (2010a) dealt with the species described by Mitten (1859) and typified some of them, but did not discuss taxa known prior to Mitten's publication.

The purpose of this study is (1) to examine the identity of taxa in *Philonotis* section *Philonotis* (*P. calcarea*, *P. fontana*, *P. lutea*, *P. seriata*) reported by Mitten (1859), and certain additional taxa, (2) to review the literature reports of *P. calcarea* and *P. seriata* and reidentify the herbarium specimens available from Southeast Asia (Asia 2–4 of Wijk *et al.* 1959) to assess their occurrence in that area, and (3) to map the total geographical ranges of *P. calcarea* and *P. seriata*. The herbarium acronyms are according to *Index Herbariorum* (<https://sweetgum.nybg.org/science/ih/>).

Philonotis in William Mitten's *Musci Indiae orientalis*

The descriptions, taxonomy and discussions of the Asiatic taxa of *Philonotis* section *Philonotis* are presented in Koponen *et al.* (2012). Mitten (1859) dealt with four species of *P.* section *Philonotis*: *P. calcarea*, *P. fontana*, *P. lutea* and *P. seriata*. In addition, he mentioned W. Wilson's manuscript name, *Bartramia crassinervis*. Mitten's original herbarium was annexed into NY in 1908, but duplicates, with the original label information, remained at BM (originally Herb. Hookerianum, K).

In the specimen citations, male shoots are marked by ♂ and female shoots by ♀. The abbreviation c.fr. (Lat. *cum fructibus*) means that the specimen has sporophytes. Some localities and dates are based on Thomson's (1852) itinerary.

Philonotis calcarea (Bruch & Shimp.) Schimp.

Coroll. Bryol. Eur. 86. 1856. — *Bartramia calcarea* Bruch & Schimp., Bryol. Eur. 4: 49. 325. 1842. — *Philonotis fontana* ssp. *calcarea* (Bruch & Schimp.) Boulay, Musc. France 214. 1884. — TYPE: Europe (BM, not available).

INFORMATION GIVEN BY MITTEN (1859: 63; boldface by me): "*P. calcarea*. (*Bartramia*, Bruch et Schimp. — *Bartramia crassinervis*, ex parte, Wils. l. c. p. 370.). Hab. In Tibet. occid. reg. temp., T. Thomson! (No. **606**, **618**). In Himalaya boreali-occident., **Royle!** *Species nervo crassiore et cellulis amplioribus a P. fontana facile discernenda*".

IDENTIFICATION OF MITTEN'S SPECIMENS: All of the following specimens represent *P. fontana*. — [**Pakistan.**] Hab. Iskardo, Balti, Tibet, Regio temp. alt. 7000 ped. Coll. T. Thomson **606**, as *P. fontana* (as *P. calcarea* in Mitten 1859) (BM014602690 ♂, Herb. Hookerianum ex K); Iskardo, 7000 no. **606**, as *Bartramia crassinervis* W[ilson] (NY04434477 ♂, Herb. W. Mitten); Iskardo, Nov. 1847 Dr. Thomson, s.n., as *Bartramia* (NY04434476 ♂, Herb. Mitten). — [**India.**] Kunawar, 9 000, 20 Aug. Dr. Thomson **606**, as *B[artramia] fontana* (NY04434472 ♂ ♀ c.fr., Herb. W. Mitten). — [**Pakistan.**] Hab. Rondu, Tibet, Regio temp., alt. 6000 ped. coll. T. Thomson **618**, as *Philonotis calcarea* (BM014602683 ♂, "Herb. Hookerianum 1867"; Indus Valley, Rondu, 6000 no. **618**, as *Bartramia crassinervis* W[ilson] (NY04434475 ♂, Herb. W. Mitten).

Mitten (1859: 63) cited two *P. calcarea* specimens collected by John Forbes Royle in "Himalaya boreali-occident". Two unidentified *Philonotis* specimens collected by Royle are housed in NY, both of which represent *P. fontana*:

N. W Himalaya. [J.F.] Royle, as *P[hillonotis]* (NY04434465 ♂, Herb. W. Mitten); N. W Himalaya. [J.F.] Royle, as *Philonotis* (NY04434466 ♂, Herb. W. Mitten).

The BM sheet of *P. calcarea*? from "Herb. Musc. W. Wilson 1874", bearing labels titled "Herb. Ind. Or. Hook. fil & Thomson" contains two specimens, both representing *P. fontana*:

[**India.** Uttarakhand.] Hab. Kumaon, Regio temp. alt. 9000 ped. coll. T. Thomson **606b**, no identification (BM014602679 ♂ ♀ c.fr., BM014602680 ♀ c.fr.; also: no data, no. identification, **606b** (BM014602681 ♂ ♀ c.fr.)).

Philonotis fontana (Hedw.) Brid. (Fig. 1)

Bryol. Univ. 2: 18. 1827. — *Mnium fontanum* Hedw., Spec. Musc. 195. 1801. — TYPE CITATION: "Locis paludosis apertis spongiosis" (G, not seen).

INFORMATION GIVEN BY MITTEN (1859: 63; boldface by me): "*P. fontana* Brid. (*Bartramia crassinervis*, ex parte, Wills. in Sched.). Hab. In Himalaya orient. reg. temp., Sikkim, J.D. Hooker! (No. **586**). In Tibet. occid. reg. temp. et alp., T. Thomson! (No. **559**, **564**, **568**, **606**)".

IDENTIFICATION OF MITTEN'S SPECIMENS: All of the following specimens represent *P. fontana*. — [**India.**] Sikkim Himalaya. Lachen, Regio temp., alt 12 000 ped. J.D. H[ooker] **586**, as *P. fontana* (BM14602688 ♀, herb. Hookerianum

ex KEW); Lachen 12 000, **586**, as *B. crassinervis* W[ilson] (NY04434467 ♂ ♀, Herb. W. Mitten); also: no data, *Hooker & Thomson 586* (NY04434483 ♂, Herb. W. Mitten); no data, *Hooker & Thomson 587* (NY04434482 ♂, Herb. W. Mitten). Hab. Tibet. Regio temp. alt. 10–12 000, coll. *T. Thomson*. **559**, as *Philonotis fontana* (BM014602686 ♂, BM014602687 ♂, Herb. Hookerianum ex KEW); 10–12 000, 12 June 1848 no **559**, as *B[artramia] fontana* W[ilson] (NY04434474 ♂, Herb. W. Mitten). Hab. Tibet. Changar, Piti, Regio alp. alt. 13 000 ped. coll. *T. Thomson* **564**, as *Philonotis fontana* (BM014602685 ♀, c.fr., Herb. Hookerianum ex KEW); Tibet, Changar, Piti, 13 000 ped, 29 Aug. 1847 Dr. *Thomson* no. **564**, as *B[artramia] fontana* var. *Bartramia crassinervis* W[ilson] (NY04434473 ♂, Herb. W. Mitten). Hab. [Pakistan.] Kisthwar, Chenab, Himalaya, Regio temp., alt. 8000 ped. coll. *T. Thomson* **568**, as *Philonotis fontana* (BM014602684 ♂, c.fr., BM014602689 ♂, BM014602691 ♀ ♀ c.fr., Herb. Hookerianum ex K); Chenab Himalayah, 8000, 14 June 1848, no. **568**, as *B[artramia] fontana* (NY04434471 ♀, c.fr., Herb. W. Mitten). [India. Kashmir, Ladakh.] Le, Sabu Valley, 13 000, 11 [Oct.] 1847 Dr. *Thomson 567*, as *B. crassinervis* W[ilson] (NY04434481 ♂, Herb. W. Mitten).

Philonotis fontana specimen *T. Thomson 606* (NY04434472 ♂ ♀ c.fr.) was cited under *P. calcarea* in Mitten (1859; see under *P. calcarea*). *Philonotis fontana* ranges in Southeast Asia from the Himalaya through north China to Japan in nemoral to boreal and oronemoral to oroboreal vegetation zones. The range map for China (Zang & He 2007: 180, fig. 6), which shows numerous localities of *P. fontana* in southern China, is misleading because *P. fontana* is rare in warm temperate regions (Koponen 2019).

Philonotis lutea Mitt.

J. Proc. Linn. Soc., Bot., Suppl. 1: 63. 1859. — TYPE CITATION: *Bartramia uncinata*, Wils. l. c. p. 370. — *B. crassinervis*, ex parte, ejusd. l. c. p. 370; [India.] In Himalaya orient. reg. temp., Sikkim, *J.D. Hooker!* (No. 578, 579, 584, 587). — LECTOTYPE (designated by Koponen 2010a): India. Sikkim-Himalaya, ex Herb. J.D. Hooker, Herb. Ind. or. 587 (NY-herb. Mitten!); isoelectotypes: India. Sikkim-Himalaya, ex Herb. J.D. Hooker, Herb. Ind. or. Hook. fil. *T. Thomson 587* (H-BR3117005!, H-SOL1536027!, Communicat. ex Herbario Lugduno-Batavo, H-BR3117007!); syntypes: Herb. Ind. Or. *Hook. fil. & Thomson 579* (H-BR3117008!, H-SOL1536025!), *J.D. Hooker 578, 584* (not seen, in NY according to Leonardi 1992).

Ochi (1962) synonymized *P. lutea* with *P. fontana* and this synonymy was accepted by Koponen (2010a). The types of *P. lutea* are male plants of *P. fontana*.



Fig. 1. Label and specimen of *Philonotis calcarea* (= *P. fontana*). *T. Thomson 618*, BM014602683 ♂, “Herb. Hookerianum 1867”. © The Trustees of the British Museum.

Philonotis seriata Mitt.

J. Linn. Soc. Bot., Suppl. 1: 63. 1859. — *P. fontana* var. *seriata* (Mitt.) Kind., Bih. Kongl. Svenska Vetensk.-Akad. Handl. 7(9): 255. 1883. — *P. fontana* subsp. *seriata* (Mitt.) Dixon, Stud. Handb. Brit. Mosses 294. 1896. — TYPE CITATION: *Bryum lycopodiiforme*, Schleicher. MSS: In Helvetia, Schleicher ! sterilis. In Britannia boreali in monte Ben-na-Bour, *W. Gardiner!*. — TYPE (designated by Ochi 1962): “India. N. W. Himalaya: Ben na Bour, N. Braemar [Beinn a’ Bhuid mountain in the Scottish Highlands] (*W. Gardiner*, July 1884, as *Bartramia fontana* – type of *Ph. seriata*, in NY”, not available); syntype: In Helvetia, Schleicher ! sterilis (not seen).

The taxonomy and nomenclature of *P. seriata* were for a long time misunderstood in Southeast Asia. The confusion was originally caused by Mitten (1859), as he described *P. seriata* in his book on Indian mosses. Both specimens cited by him, however, are European (Gangulee 1974, Leonardi 1992, Koponen 2009a, 2010a, 2010b). Ochi’s misunderstanding was technical and stemmed from Mitten’s text; Ochi studied the correct specimen. Ochi (1962, 1963) misun-

derstood the taxonomy of *P. seriata*. He accepted the taxon at the varietal level, as *P. fontana* var. *seriata*, and cited numerous Japanese specimens. However, his Japanese *P. fontana* var. *seriata* is a completely different species, *P. yezoana*. Noguchi (1989) adopted Ochi's taxonomic concept.

Other taxa and names, with synonymizations

The names below are synonymized with *Philonotis fontana*.

Bryum zonatum Schimp.

Syn. Musc. Eur. ed. 2: 472, 1876, *syn. nov.* — TYPE CITATION: [Norway.] Habit. Locis humidis ad Bodie Norvegiae septentrionalis, ubi clar. Lorentz Augusto 1868 legit. — SYNTYPE: *Bryum zonatum* Schpr. teste Breidler e spec. orig. verisim. Bodö 30/8 1868 Lorentz. Herb. Kaûrin!, Herb. V.F. Brotherus, teste H. Weimarck 1936 as *Philonotis seriata* (Mitt.) Lindb. (H3106867 = *P. fontana*).

The syntype of *Bryum zonatum* (Fig. 2) has been studied by several bryologists. The most recent identification, made by H. Weimarck in 1936 (Weimarck 1937), is the one cited in the *Index muscorum* (Wijk *et al.* 1959). The plants in the specimen are very slender and the leaves similar to those situated below the perigonium in other male plants of *P. fontana* (see Fig. 3). The leaf shape is ovate with only a short opaque apex. The basal leaf cells are smaller than those typically found in the male leaves of other specimens. The leaf cells have low mammillae or papillae at the proximal cell end, but leaf cells with central papillae were not observed. The leaf margin is nearly entire and double-crenulate teeth are hardly present.

Philonotis mongolica Broth.

in Kabiersch, Hedwigia 77: 111. 1937, *nom. inval. in synon.*, new assign. — SPECIMEN CITATION: Zentralasien: Mongolia occ. Kuen-lun, ad fl. Karadarja – June 1885 – N.V. Przewalski n. 121! und 121 b z.T.! – Original collection: Mongolia occid. Kuen-lün, ad fontes in fauce fl. Keriä-darja, 30 June 1885 N.M. Przewalsky 121 (H-BR3117010!, 3117016!, 3117015!; BM!, ex herb. horti Petropolitani; BM!, com.

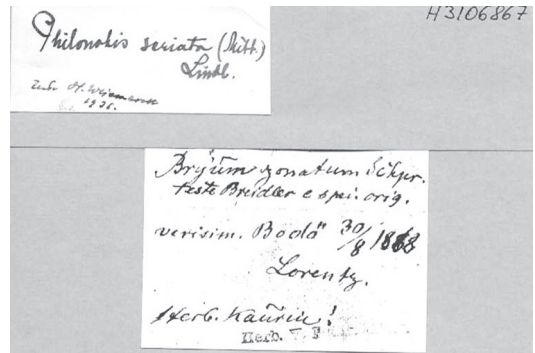


Fig. 2. Label of the syntype of *Bryum zonatum* (H3106867). Published with permission.

Brotherus, ex herb. Bescherelle); Mongolia occidentalis, Kuen-lün, Keriä-Darja, ad fontes, 1885 VI 1b/J. N.N. Przewalski, s.n. (FH781722).

Kabiersch (1937), Gangulee (1974), and Zang and He (2007) synonymized *P. mongolica* with *P. seriata*. The type material consists of male plants of *P. fontana*.

Philonotis trachyphylla Dixon & Badhw.

Rec. Bot. Surv. India 12: 175. 1938, *syn. nov.* — TYPE CITATION: [India.] Kashmir, Moist soil, Zanskar (below Shingola), 15,500 ft.; 27 Aug. 1928 (No. 931 type). Lahul-Bhaga valley (Ramzak to Rampozampa), 12,500 ft. (No. 965). — LECTOTYPE (designated here): R.L. Badhwar 931 (BM1087246!); syntype: Lahul-Bhaga valley (Ramzak to Rampozampa), swampy place at 12 500 ft. R.L. Badhwar 965 (BM555241!).

Koponen and Higuchi (2020) studied a number of *Philonotis* specimens from Pakistan. These included *P. falcata*, *P. fontana*, *P. pseudomollis* (as *P. laii*, see Koponen 2020a, b) and *P. trachyphylla*. *Philonotis calcarea* was not present in that collection. Koponen and Higuchi (2020) mistakenly cited V.F. Brotherus's herbarium specimens of *P. calcarea* as *P. falcata*; these had in fact been reidentified as *P. fontana* (see below).

Koponen and Higuchi (2020) listed as *P. trachyphylla* specimens from Pakistan (Higuchi 19487, 19561, 19837). I reidentified these specimens as *P. fontana*. The specimens cited from China (4 specimens), India (3) and Nepal (1) were not available for re-examination.

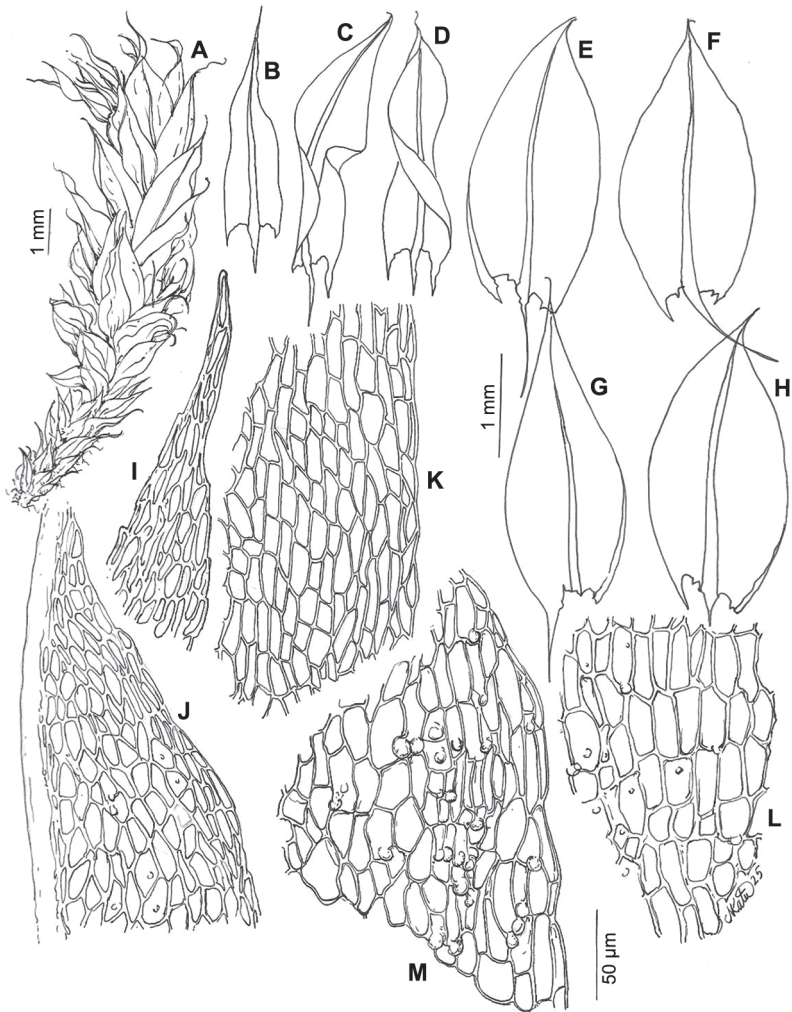


Fig. 3. *Philonotis fontana*, male plant (from Herbarium of the late East India Company, no. 220, H-BR; **E–M** from modified shoot). — **A**: Shoot. — **B–D**: Leaves from just below where a perigonium develops. — **E–H**: Leaves. — **I** and **J**: Leaf apex. — **K**: Leaf border at mid-leaf. — **L**: Laminar cells near leaf base. — **M**: Alar cells.

Koponen and Uotila (2023) reported *P. trachyphylla* as new to Afghanistan, but the specimen *P. Uotila* 16575 (H3214800) actually represents male plants of *P. fontana*.

Literature review and specimen identification by country and region

Western Himalaya: Kashmir and Pakistan

Gangulee (1974) did not include *P. calcarea* in his *Mosses of Eastern India and adjacent regions*, stating: “Although Mitten defined the

species in “*Musci Indiae Orientalis*”, no Indian specimens were known at that time.” However, in the introduction to *Philonotis* he mentioned it from “As 3a”, which is the westernmost part of the Himalayas. This refers to old records in the literature (Mitten 1859, Brotherus 1898, *see* above and below). Kabiersch (1937) cited the range of *P. calcarea* as it was given by Brotherus (1924), and included the Himalaya.

Brotherus (1898) listed two specimens as *P. calcarea*, the first of which represents *P. fontana*:

[India. Jammu and Kashmir.] Kashmir, supra Gulmarg, 10–11 000', 2 June 1892 *J.F. Duthie* 11361 (H-BR3131014!, BM14602682! ♂ ♀ c.fr.); [Pakistan. Gilgit-Baltistan] Astor, Mushkin in Valle Astor 9–10 000 *J.F. Duthie* 12850 (not seen, not in BM, not in H-BR).

Gabriel Dismier, after revising *Philonotis* in France and North America (1907, 1908, 1910, 1911), wrote a paper on the Southeast Asian species (Dismier 1912a). In another paper (Dismier 1912b), he mentioned having received specimens on loan from V.F. Brotherus's "beautiful collection of Asiatic *Philonotis*". He had not previously seen *P. seriata* from Asia, but now identified two Brotherus specimens as belonging to that taxon:

Herbarium of the late East India Company, no. 220. *Bartramia falcata* – N.W. Himalaya, Herb. Falconer. Distributed at the Royal Garden, Kew. 1875 (herb. Brotherus; Fig. 4); Flora of Kashmir. Dist. Baltistan. n° 14.294, *Bartramia falcata*, Deosai Plains by the Scheosar Lake at 12–13 000 feet by J. F. Duthie (herb. Brotherus et herb. Mus. de Paris).

Dismier accepted specimen no. 220 as being *P. seriata*, partly because the lamina cells had a central papilla. Kabiersch (1937) and Koponen (2009a) likewise accepted the specimen as *P. seriata*. In fact, the specimen is a male plant of *P. fontana* (H-BR, folder 3118, Figs. 1 and 2). Dismier identified the specimen 14294 as *P. seriata* var. *adpressa*. However, the duplicate of Duthie 14294 in the Paris herbarium contains some features of *P. fontana* var. *adpressa* and *P. falcata*, and Dismier did not confirm the identification of the specimen. The specimen Duthie 14294 (H-BR3119013) again consists of *P. fontana* male plants. Also the following specimens represent *P. fontana*:

[Pakistan.] Kashmir. Kaylee-ban, Gurais Valley, 10 500 p., 1 July 1901 Inayat Khan 2933, as *P. calcarea*, Bryotheca E. Levier. Musci Indiae orientalis, curante cl. W. Gollan

lecti, det. V. F. B. (H-BR3125007 = H3313157); Kashmir, Vallis Surú, Surú–Purkutte, 3200–3400 m, 11 June 1913 L. Borelli, as *P. calcarea* (H-BR3125004); Kashmir, Vallis Brahma in jugo Nun–Kun, ca. 3800 m, July 1913 L. Borelli, as *P. calcarea* (H-BR3125001). — **India**. Western Himalayas, 1931 W. Koelz 509, as *P. calcarea*, det R.S. Williams (NY04434490); Kashmir, Lidar Valley, 11 500 f., 23 May 1901 Inayat Khan 2932, as *P. calcarea*, forma, det. V.F. Brotherus, Bryotheca E. Levier (H-BR3131017 ♂, "Nach meiner Überzeugung die '*fontanum-adpressa*' = *Ph. adpressa* Ferg. apud Hunt, nec Limpricht = *Ph. fontana* v. *adpressa* (Ferg.) Loeske & Mönkemeyer" (manu L. Loeske), NY04434492 ♂).

Eastern Himalaya: India and Nepal

All the following specimens are *P. fontana*. **India**. Jammu and Kashmir, Julion, above Pahlgam, 10–11 000', 30 July 1945 R.R. Stewart 21867a, as *P. calcarea*, det. E.B. Bartram (FH781720, NY04434488); [Himachal Pradesh, Punjab] Kulu Himalaya, June 1930 W. Koelz 21, as *P. calcarea*, det. R.S. Williams (NY04434489); Kulu Himalaya, 30 June 1930 W. Koelz 272, as *P. calcarea*, det. R.S. Williams (NY04434491). — **Nepal**. East Nepal. Gangulee (1974) cited a *P. seriata* specimen: NICH 236139 (1700 m), (not seen). Gangulee's illustration (1974: fig. 543) was drawn from a male shoot of *P. fontana*.

China

Zang and He (2007) recorded and mapped *P. calcarea* for China. One of the specimens cited is W.-X. Xu 17 (HKAS), from Yunnan Province, Binchuan Co. It is illustrated in Zhang and He (2007: plate 230: 11 as having distal papillae on the cells at the leaf apex and therefore represents *P. falcata*, not *P. calcarea*. Additionally, Tan and Yu (1997) cited the following specimens as *P. calcarea*, but they actually represent *P. falcata*:

Qinghai Province. Yushu Tibetan Autonomous Pref., Yushu Co., wet margin of shaded pond, with *Tamarix* groves, at 3700–3800 m, 29 June 1995 B.C. Tan 95-191 (FH781718, MO4435502, H3249016); B.C. Tan 95-178 (FH781717), 95-192 (FH781719).

Zang and He (2007: plate 235: 1–6) cited *P. seriata* specimens from four Chinese provinces and mapped three sites. The specimens from the nemoral or meridional vegetation zones must be misidentified (Koponen 2010b). The illustrations (plate 235: 1–6) are also unconvincing.

Herbarium of the late East India Company.

No. 220 *seriata* Mitt.
Bartramia falcata H.B.K. "
 + Bryum Schleicheri teste Dismier
 N. W. HIMALAYA. Herb. Falconer.

Distributed at the Royal Gardens, Kew. 1875.

Fig. 4. Label of the Herbarium of the late East India Company, no. 220. *Bartramia falcata*, N.W. Himalaya, Herb. Falconer. Distributed at the Royal Gardens, Kew. 1875 (H-BR). After receiving the specimen back from D.G. Dismier, V.F. Brotherus added the annotation to the label "*seriata* Mitt. teste Dismier". Published with permission.

The following specimen, cited as *P. seriata* in Koponen *et al.* (2012) due to a technical mistake, actually represents *P. tomentella* (Koponen *et al.* (2012: 48):

Yunnan. *Lijiang*, Yulong Snow Mts., under *Rhododendron* shrubbery, 3800 m, 1980 *X.-J. Li* 80-217 (H 3239870, HKAS 43151).

The following specimen was cited as *P. seriata* by Tan and Yu (1997), but it actually represents *P. falcata*:

Qinghai. *Yushu Tibetan Autonomous Pref.*, Yushu Co., on wet grassy bank, 1995 *B.C. Tan* 95-187, as *P. seriata* (FH781721).

Japan, Korea

Koponen (2009a) excluded *P. seriata* (*P. fontana* var. *seriata*) from Japan and Korea; the specimens so named (Ochi 1962, Noguchi 1989) are mainly *P. yezoana*. *Philonotis seriata* is also excluded from the most recent checklists of Japan (Suzuki 2016) and Korea (Kim *et al.* 2020).

Greenland and Europe

The specimens cited below and reported as *P. yezoana* are in fact male plants of *P. fontana*:

Bull. Soc. Bot. Genève, sér. 2, 1: 123. 1909. — TYPE CITATION: Japon. Mori ([*Faurie*] n. 3505, sér. I) ; Kominato (n. 42, sér. I); Aomori (n. 406, sér. I; Kinashi, n. 3, 8, 46, 52); Rishiri (n. 665); Hakodate (n. 1901, 2738); Osorezan (n. 2123); Ikaregaseki (n. 2669); Corée: Ouen-San (n. 591). — LECTOTYPE (designated by Koponen 2009a): Japan. Sur de lac e Mori (Yezo), 5 May 1889 *Faurie* 3505 (BM!); isolectotypes (PC!, KYO, not seen); syntypes, see Koponen 2009a: *Faurie* 3, 8, 46, 52, 591, 665, 2123 (KYO, not seen); 406, 2669, 2738 (PC!, KYO, not seen); 1901 (H-BR!, PC!, S-B174057!, KYO, not seen). — The information on the specimens in KYO is according to Ochi (1962).

Koponen (2009b) reported a *P. yezoana* specimen, in which the leaf characters correspond to those of modified stem leaves of male *P. fontana*, and the obtuse perigonal leaves also conform to those of *P. fontana*. Numerous leaf cells have a central papilla. The specimen has been identi-

fied as *P. fontana* var. *caespitosa* by C. Jensen, as *P. tomentella* by L. Loeske and *P. fontana* var. *pumila* by W.M. Zales:

Greenland. Maneot, [Maneet/Manit at Fiskefjord, 63°10'N, 50°50'W], leg. *A.N. Kornerup*, 7 June 1878 (H-BR 3137018).

Ulvinen (2016) reported a specimen identified by him and confirmed by me as *P. yezoana*, and also a second specimen (*T. Kypärä* 2104, OULU, H4259521) was collected from the same site in 2016 (Ulvinen & Kypärä 2016):

Finland. Kittilän Lappi (KiL/Lkk). Kolari, Pallas-Ylläs National Park, Ylläs mountain (Varkaankurunoja Brook?). U.C. *Pohlia wahlenbergii*, 9 August 1965 *Arvi J. Huuskonen s.n.* (OULU, H4259111).

The *Huuskonen s.n.* specimen has the typical leaf shape of male plant of *P. fontana* (Fig. 5). The leaf cells are shortly rectangular and many cells have a central papilla. The double-crenulate serration of the leaf margin supports the identification as *P. fontana*, as *P. yezoana* has ± serrate to serrulate teeth at the leaf margins. The second specimen, *Kypärä* 2104, consists of young shoots. The leaves are more long-acuminate and the leaf cells longer than in the *Huuskonen* specimen. Many cells have a central papilla, and the marginal teeth are double-crenulate.

World ranges of *Philonotis calcarea* and *P. seriata*

The maps are based primarily on specimens housed in the herbarium of the Botanical Museum of the University of Helsinki (H, H-BR and H-SOL), as well as on specimens from other herbaria and from collectors mentioned in the Acknowledgements. A few additional records are from the literature (Koponen *et al.* 2012, Kürschner & Frey 2011, Ros-Espin *et al.* 2013).

Range of *Philonotis calcarea* (Fig. 6)

NORTH AMERICA. Zales (1973: 104) excluded *P. calcarea* from the continental North American flora, and Griffin (2002) recorded it only

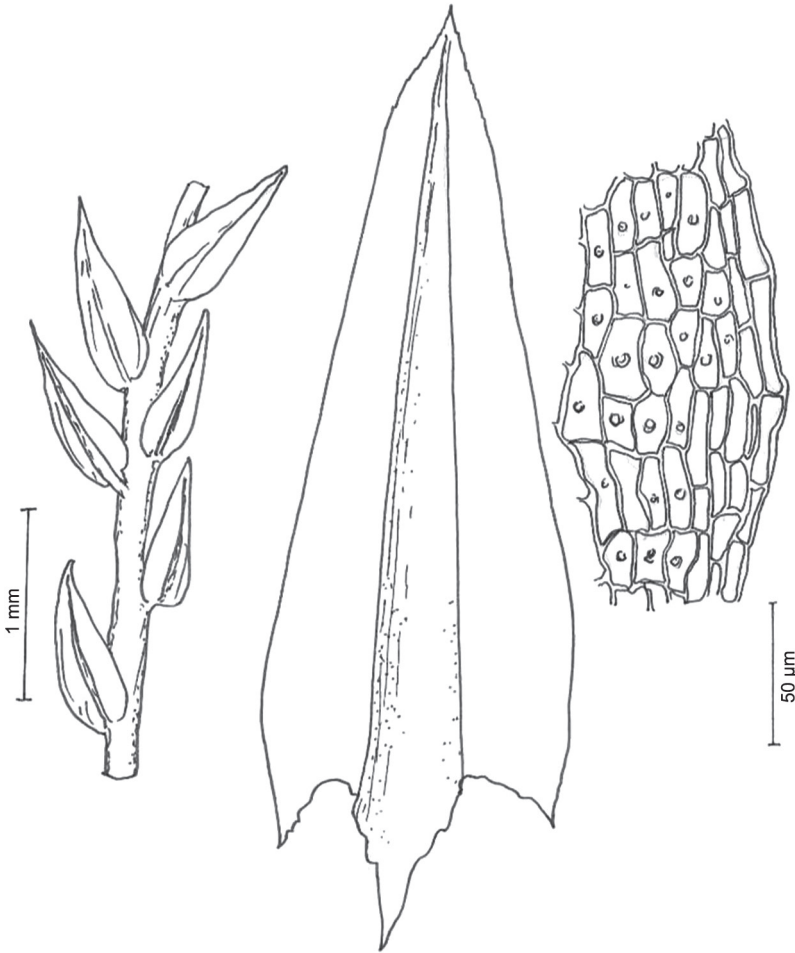


Fig. 5. *Philonotis fontana* (Arvi J. Huuskonen s.n., H4259111). A shoot, leaf and cells at mid-leaf.

from Greenland. I have seen one specimen from Greenland, which is cited below. Malcolm *et al.* (2009) recorded it from California, but it was later excluded from the Californian flora (J.R. Shevock, pers. comm. by letter; *see also* Shevock & Aguero 2022).

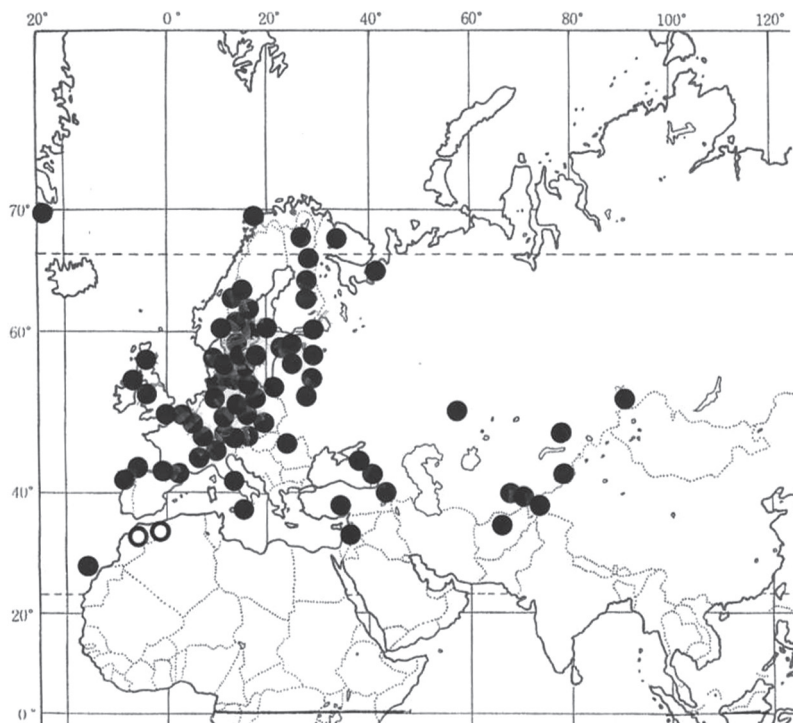
Greenland. Angmagssalik Distr., Qingertivaq, 66°06'N, 37°13' W, 19 July 1969 K. Holmen 69-811 (H3105710).

EUROPE AND AFRICA. *Philonotis calcarea* is known from most European countries (Duell 1985) and from the Mediterranean region, including Morocco and Algeria in North Africa (Ros-Espin *et al.* 2013). However, according to Jóhansson (1995), it is not present in Iceland, and was not mapped for that country by Hallingbäck (2008). *Philonotis calcarea* seems to

be common in areas with limestone substrate. I studied many specimens from the central European mountainous regions, including the Alps, Carpathians and Pyrenees. Hallingbäck's (2008) map shows it to be common in the area extending from Denmark to the southern part of Norway. In Great Britain, it is common in calcareous areas; according to Hill and Hodgetts (2014), "It is a common and characteristic component of highly calcareous lowland fens in Ireland and N Wales". In Finland, with its mostly granitic bedrock, *P. calcarea* is rare, and it is also sporadic in the European part of Russia (Koponen *et al.* 2012).

I have not seen specimens from continental Africa. *Philonotis calcarea* has been cited from Azores (Nyholm 1998; specimens not seen) and the Canary Islands, from Gomera and Tenerife

Fig. 6. Total range of *Philonotis calcarea* based mainly on the specimens at H, H-BR and H-SOL, with some additions from the herbaria listed in the Acknowledgements and from Koponen *et al.* (2012). Vouchers from North Africa were not seen.



(Dierkse *et al.* 1993). A specimen from Gran Canaria that I have examined is cited below:

Spain. Gran Canaria. “Ariinas”, 24 April 1897 *O. Gelet* s.n. (H-BR3125047 = H3313117).

ASIA (FROM TURKEY TO AFGHANISTAN). Kürschner and Frey (2011) recorded *P. calcarea* (var. *calcarea*) from Afghanistan, Iraq, Iran, Israel, Lebanon, Syria and Turkey. Accordingly, the range extends to the Himalayas. Koponen *et al.* (2012) recorded and mapped the distribution of *P. calcarea* in Russia. The easternmost localities are in the Altai Mountains. In the area between the Altai and Afghanistan, *P. calcarea* is known from Kazakhstan, Kyrgyzstan and Uzbekistan:

Kazakhstan. Thian Shan: in trajektu Santasch, 22 July 1896 *V.F. Brotherus* (H-BR3125028 = H3313136); Semipalatinsk, Distr. Saisan, in ripa fl. Terzokty, in saligno steppi, 10 July 1908 *A.N. Sjedelnikoff* s.n. (H-BR-3125013 = H3313151). — **Kyrgyzstan.** Alpes Alexandri, Tokmak, in aqua stagnante, reg. campestr., 26 May 1896 *V.F. Brotherus*, *Musci turkestanici* 345 (H-BR3125023 = H3313135); Alatau transiliensis, Djassylkol ad fl. Kabin majorem, 18 June 1896 *V.F. Brotherus* (H-BR 3125 002 = H3313162); Kumbelpass,

9000 p. s. m., Sept. 1876 *A. Regel* 3347 (H-BR 3125022 = H3313142); Tschirtschikthal, Saylik, 4–6000 p. s. m., 1876 *A. Regel* 3293 (H-BR3125014 = H3313150); Pamir, im montibus Alai ad Sufi Kungan, submas. in rivulo, 2100 m, 18 June 1898 *O. Paulsen* 428 ex p. (H-BR3125003 = H3313161). — **“Turkestan”.** Karamuk, 3 Sept. 1878 *Newessky* 3102a (H-BR3125043 = H33131121); Ters-agar, 10 Sept. 1878 *Newessky* 3109a (H-BR 3125 016, = H3313148); Bochtscha, 4 Aug. 1878 *Newessky* 3105 (H-BR3125045 = H3313119). — **Russia.** Altai Republik. Kuraisteppe, im Waldsumpfe, 30 June 1908 *V.N. Veretschagin* s.n. (H3105739); Kuraisteppe, pr. Kureja, June 1907 *V. Veretschagin* s.n. (H-BR3125023 = H3313141); Kurai, ad fl. Kysyl-tosch, 16 June 1907 *I. Veretschagin* s.n. (H-BR3125025 = H3313139); Turochak Distr., Teletzkoe Lake, Yailyu, spring mire at the lake shore, along spring water at 440 m, 23 July 1991 *M. Ignatov*, Mosses of USSR 151, as *P. fontana* var. *falcata* (H3232585, also cited by Koponen *et al.* 2012); Altaj, prope fl. Czui, apud p. Kuroi, regio Ojrotsk, 19 July 1926 *V. Baratov* 867 (H-BR3125044 = H3313120). — **Uzbekistan.** Okur bei Aksu (Angren) südöstl. v. Taschkent, 11 June 1880 *A. Regel* 3140 (H-BR3125010 = H3313154); Issykkul, sinterbeschlagene Granitfelsen der warmen Quellen des Dorfes Terskei-Aksu östlich von der Stadt Karakul, 6–6500 p., 26 Sept. 1877 *A. Regel* 3217 (H-BR3125015 = H3313149); Sarafschan, 1893 *Komarov* s.n. (H-BR3125038 = H3313126, H-BR3125924 = H3313140); Fergana, in fauce fl. Kugart, 1 June 1911 *O. von Knorring* & *Z. von Minekiewicz* 890 (H-BR3125027 = H3313137); Fergana, in trajektu Kugart, 2 June 1911 *O. von Knorring* & *Z. von Minekiewicz* 263 (H-BR3125039 = H3313125). — **“Transkasp-**

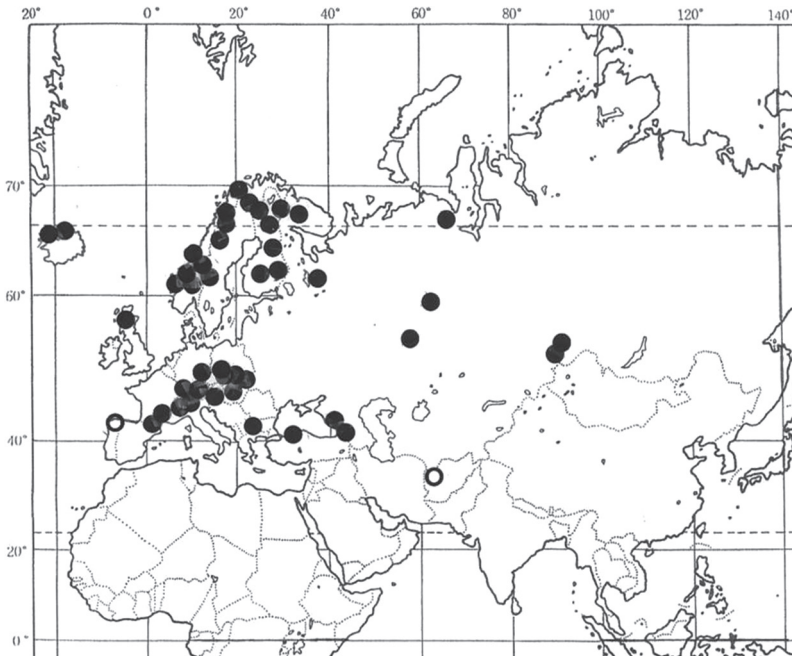


Fig. 7. Total range of *Philonotis seriata* based mainly on specimens at H, H-BR and H-SOL, with some additions from the herbaria listed in the Acknowledgements and from Koponen *et al.* (2012). Vouchers from the Pyrenees and Afghanistan were not seen.

ien“ (country uncertain). Distr. Karatinsk, Schluht Eldera, zwischen Sjuit und Chagar-dag, 15 May 1916 E.G. Tschernjakovskaja 1143 (H-BR3125949 = H3313115). — **Afghanistan.** Hauz-i-Mahiha, 15 July 1948 M. Kōie (NY04683188).

Range of *Philonotis seriata* (Fig. 7)

Among the approximately 100 European specimens of *P. seriata* housed in H, a total of 16 were reidentified as *P. fontana*. The most remarkable of these is the syntype of *Bryum zonatum* (see above). The habitats of *P. seriata* include springs or spring-fed brooks in areas with siliceous bedrock. This explains its range from Greenland (Koponen 2012, not shown in Fig. 7) through Iceland and Scotland to continental Europe. In the Central European mountains and the Pyrenees, localities are in the oroboreal zone or higher and the taxon is absent from lowland areas. In boreal Fennoscandia, for example in southern Finland, suitable habitats are scarce, but along the Scandes it is not rare. The habitat requirements also explain its occurrence in the Ural Mountains and the Caucasus region. The easternmost localities are in the Altai Mountains. Records from Iran and Afghanistan (Frey & Kürschner 1991) need to be confirmed.

Discussion

Examining *Philonotis* material from Pakistan, I found some specimens with a central papilla on the mid-leaf cells (Koponen & Higuchi 2020). These had been previously named *P. yezoana* (Koponen *et al.* 2019) and were reidentified as *P. trachyphylla*, which was previously confused with *P. tomentella* (see Koponen & Higuchi 2020). The papillae are present on both short $\pm$ quadrate mid-leaf cells and centrally on elongate cells. The plants with papillae on the mid-leaf cells turned out to be male plants of *P. fontana*. However, central papillae were not seen on all male plants. In a previous study on Pacific *Philonotis*, the papillate middle leaf cells were found to be a useful character for separating *P. asperifolia* from *P. hastata* (Koponen 2020b).

The central papillae of the male plant of *Philonotis fontana* were mentioned first by Dismer (1912b), when he identified the specimen Herbarium of the late East India Company no. 220 as *P. seriata*. The rediscovery of this character in *P. fontana* was a great surprise. The mid-leaf cells of *P. yezoana* with central papillae were thought to be a unique character in Asian *Philonotis*. Only the southern hemisphere taxon

P. scabrifolia of the section *Catenularia* and *P. corticata* (Crum & Griffin 1981, Griffin 1994), described from Mexico, have a similar central arrangement of papillae on the leaf cells as *P. yezoana*.

The sectional placement of *P. yezoana* is unclear. Koponen *et al.* (2012) placed it in the section *Philonotis* based on DNA sequences. The central papillae have no use in sectional placement: species of section *Philonotis* have leaf cells with a mammilla/papilla at the proximal cell end, while species of section *Philonotula* have the papilla/mammilla at the distal cell end of all leaf cells, or only the basal leaf cells have a mammilla/papilla at the proximal end, and the mid-leaf and apical cells have a distal papilla. The marginal teeth are more useful: in species of section *Philonotis*, the leaf margins at midleaf are double-crenulate, while in section *Philonotula* they are serrate to serrulate, or bi- to 4-seriate. The leaf margins of *P. yezoana* are serrulate, as in the section *Philonotula*.

Summary and conclusion

It seems evident that the identification of some plants of *P. fontana* by Mitten (1859) as *P. calcarea* and *P. lutea*, the invalid name *P. mongolica* (Kabiersch 1937), the citation by Dismier (1912b) and Kabiersch (1937) of some Himalayan specimens as *P. seriata*, as well as the description of *Bryum zonatum* (Schimper 1876) and *P. trachyphylla* (Dixon & Badhwar 1938) are all due to modified leaves of *P. fontana* male plants. The identifications of *P. yezoana* from the Himalayan area, Europe (Finland) and Greenland are also based on male specimens of *P. fontana*.

On the basis of the studied specimens and reliable published records, *P. calcarea* is locally common in Europe. Its range extends from Greenland to the central Asian countries of Kazakhstan, Kyrgyzstan and Uzbekistan, and to Altai Mountains in Russia. In the material I studied, no specimens from the western Himalaya (Pakistan and Indian Kashmir), eastern Himalaya or China were identified as *P. calcarea*.

Philonotis seriata occurs in Greenland and in mountainous or northern areas in Europe. In

Asia, the easternmost localities are in the Altai Mountains in Russia. No specimens from the western Himalaya (Pakistan and Indian Kashmir), eastern Himalaya or China were identified by me as *P. seriata*.

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