

Notes on *Philonotis* (Musci, Bartramiaceae),
5. *P. caespitosa* and *P. falcata* in South Africa,
and Status of *P. afrocapillaris*

Koponen, T.

Finnish–Chinese Botanical Foundation
Mailantie 109, FIN-08800 Kirkniemi, Finland
timo.koponen@helsinki.fi

Abstract. *Philonotis caespitosa* Wils. ex Milde is recorded for the first time for Africa. *P. caespitosa* of the section *Philonotis* was previously known as a holarctic circumpolar species. *P. afro-capillaris* Dix. ex Sim is synonymized with *P. comosa* (Broth.) Griffin & W. R. Buck. These taxa are illustrated and their taxonomy and nomenclature discussed. A revised key to South African *Philonotis* is provided, and the distribution of *P. falcata* (W. J. Hook.) Mitt. is mapped.

Introduction

To complete study of the distribution of *Philonotis falcata* (Hook.) Mitt. (Koponen 1996a), the African specimens so named in the Botanical Museum of the University of Helsinki (H) underwent revision. The collections contained correctly identified specimens, but also included specimens of two other species of *Philonotis*. One of these is *P. caespitosa* Milde, but the other species remained unidentified.

This study continues the revision of *Philonotis* which began by study of southeast Asiatic and Pacific species of *Philonotis* Brid. (Koponen & Norris 1996, Koponen 1998, Koponen & Virtanen 1998, Virtanen & Koponen 1998, Koponen 1999).

Revised key to *Philonotis* in South Africa

This key is based on Magill's (1987) keys of South African *Bartramidula* and *Philonotis*, to which some sectional characters are added (see Koponen 1996a, 1996b).

1. Leaves bordered by 4–8 rows of narrow, elongated, incrassate cells; leaf cells smooth *P. vagans*

1. Leaves unbordered, or indistinctly bordered by rectangular cells; leaf cells papillate, mamillate or prorate 2.
2. Leaf cell papilla central on cell; plants with glaucous bloom 3. *P. scabrifolia*
2. Leaf cell papilla distal or proximal on cell; plants yellowish green to brownish 3.
3. Leaf cell mammilla or papilla at proximal cell end; proximal leaf border crenulate or double-crenulate (perpendicular crenulae formed by two adjoining border cells), teeth only on distal leaf directed towards apex 3. *P. caespitosa*
3. Leaf cell mammilla or papilla at distal cell end, or on both cell ends; leaf border serrulate-serrate by projecting cell corners directed towards apex 4.
4. Leaf cells mammillose or papillose at distal cell end 5.
4. In basal areolation, mammilla at proximal cell end and in distal areolation at distal cell end 8.
5. Leaves falcate and keeled, distinctly in 5 rows *P. falcata*
5. Leaves straight, not in rows 6.
6. Both leaf borders recurved to revolute; leaf cells distinctly papillose 3. *P. africana*
6. Leaf borders plane or slightly recurved; leaf cells smooth or slightly mammillose or prorate 7.
7. Leaf cells + lax, rectangular to oblong-hexagonal; costa generally ending below apex *P. hastata*
7. Leaf cells regularly narrow-rectangular, generally incrassate; costa short-excurrent *P. dregeana*
8. Leaves narrowly lanceolate; apex acuminate to subulate; perichaetial leaves strongly differentiated, long-linear; capsule wall warty; spore surface warty *P. comosa*
8. Leaves narrowly lanceolate to ovate-acuminate, acuminate; perichaetial leaves ovate to short-oblong, acuminate *P. globosa*

Philonotis section *Philonotis*

Characteristics of the section *Philonotis* are leaf cells with mammilla or papilla at the proximal cell end or central on the cell; the proximal leaf border crenulate or double-crenulate (perpendicular crenulae formed by two

adjoining border cells), and the leaf margin teeth only on the distal leaf directed towards the apex; leaves secund or straight, rarely in five rows.

Philonotis caespitosa Wils. ex Milde (Fig. 1)

Bryol. Silesiaca 241. 1869. — *P. caespitosa* Lorenz, Bryol. Notizb. 90. 1865, *nom. nud.* — *P. fontana* var. *caespitosa* (Milde) Limpr., Krypt. Fl. Schlesien 1: 116. 1875. — *P. fontana* subsp. *caespitosa* (Milde) Dix., Stud. Handb. Brit. Moss. 294. 1896. — Types (not seen): **Schlesien.** Hasenau vor Obernigk, 30.VIII. 1862 *J. Milde*, in June with fruits; bei Strehlen, *Hilse.* **Mark.** Grünewald, *Solms, Bolle.* **Preussen.** Tilsit, *Heidenreich.* **Baden.** Oberbaden, VI. *Sickenb.*

The African specimens of *Philonotis caespitosa* are rather similar to the plants of the northern hemisphere populations. Most of the specimens represent sterile shoots, which are slender and with erect-spreading distant leaves. The slightly secund leaves are $0.3\text{--}0.5 \times 0.8\text{--}1.3$ mm and often maintain their bright green color in dried specimens. The leaves have a plane border and taper gradually from a narrow ovate base to an acuminate apex with excurrent costa. The lamina is rather translucent, since the mamillae or papillae of the cells are not very pronounced, and since the laminal cells are rather wide, $10\text{--}15 \times 20\text{--}45$ μm at the basal leaf, and $5\text{--}10 \times 20\text{--}40$ μm at the distal leaf. Leaf margin is entire at base, the double crenulate serrations are around mid-leaf, and the margin in the upper third of the leaf is serrate or serrulate. Female plants and sporophytes were not among the material studied, but two specimens (*van Rooy 2991, 3700*) have male stems. The leaves on these are concave, imbricate, and erect, and a little broader and shorter than the leaves from sterile shoots. The perigonal leaves are acute, which resembles the plants from northern populations.

Philonotis caespitosa can be separated from the other South African species of *Philonotis* by the sectional characters, the papillae or mammillae being proximal on laminal cells. The second leaf character, the double crenulate basal leaf, is not as pronounced as in the larger species of the section, such as *P. fontana* (Hedw.) Brid. or *P. seriata* Mitt., but double crenulate teeth were present on every leaf studied. In the earlier bryological literature (Limpricht 1895, Loeske 1905, Rancken 1914, Brotherus 1923, Jensen 1939) the character double crenulate or "double mammillate" leaf margin served as a diagnostic character of the species related to *Philonotis fontana*, but later this character was forgotten. In the species of the other sections, the basal leaf is entire or crenulate to serrulate. The other species of the section *Philonotis* recorded for northern and central Africa are *P. fontana* and *P. tomentella* Mol. (O'Shea 1995).

Descriptions and illustrations: Rancken 1914: 21 (fig. 2); Brotherus 1923: 358 (fig. 63: C–D); Lawton 1971: pl. 115 (figs. 10, 11); Andersen et al. 1976: 225 (fig. 74.5); Smith 1978: 460 (fig. 222: 14–17); Crum & Anderson 1981: 655 (fig. 311: A–C, as *Philonotis fontana* var. *caespitosa*); Nyholm 1998: 262 (fig. 221).

In "Index Muscorum" (Wijk et al. 1967), the authority of *Philonotis caespitosa* is credited to *Jur. Verh. Zool. Bot. Ges. Wien* 11: 234. 1862. In that volume, *P. caespitosa* is not mentioned at all, and much later in Juratzka's posthumous flora (1882) it was dealt with at the varietal level.

According to many authors such as Jaeger (1876–1879) and Paris (1894–1898), the name is based on W. Wilson's label name in "Musc. brit. No. 287," which I have not seen, or on "*Bartr. caespitosa* Wils. Ms" (Juratzka 1882, Crum & Anderson 1981). Therefore, before the times of the present Code, the name was credited to Wilson, but Milde was mentioned in the nomenclature by such authors as Jaeger & Sauerbeck (1876–1879), Limpricht (1895), Jensen (1939), Brotherus (1923), and Podpěra (1954). The mistake in "Index Muscorum" was later copied by many recent floras and checklists, the one exception being Smith's (1978) flora. It may be added that W. Wilson's specimen "Musc. brit. No. 287" does not belong to the syntypes of *P. caespitosa*, since Milde (1869) did not cite it in the protologue.

South African specimens studied:

Cape. Witteberg Mountains, Jouberts Pass, 8 km E of Lady Grey, alpine heath grassland, on soil over basalt, 1,950 m, *van Rooy* 2698; 9 km on Jouberts Pass turnoff from Barkley East–Lady Grey road, wooded rock outcrops on the farm Clobert, alpine heath grassland, on mud over rock, 1,850 m, 1986 *van Rooy* 2788 (H). **Lesotho.** Sani River banks 7 km from Sani Top along road to Mokhotlong, alpine heath grassland, in bog, 2,775 m, 1987 *van Rooy* 3460 (H). Sani Flats, 2 km from Border Post Mokhotlong, disturbed alpine heath grassland, on soil of river bank, among grass, 2,850 m, *van Rooy* 3700 (H); 3 km from Oxbow Lodge to Butha Buthe, alpine heath grassland, in basalt crevice, 2,550 m, 1987 *van Rooy* 2867 (H), in bog, 2,550 m, *van Rooy* 2842 (H); Mahlasela Hill (West), 10 km from New Oxbow Lodge to Mokhotlong, basalt outcrops, alpine heath grassland, on wet soil in open, 3,100 m, 1987 *van Rooy* 2991 (H); Sani Top, along Upper Sani Valley, N of Border Post, alpine heath grassland, in rock overhang, 2,860 m, 1987 *van Rooy* 3528 (H). **Natal.** Natal Drakensberg, Sani Top, along basalt cliffs below escarpment, east of Border Post, alpine heath grassland, on wet rock, 2,800 m, 1987 *van Rooy* 3653 (H), along escarpment SE of Border Post, alpine heath grassland, on rock ledge in gully, 2,900 m, 1987 *van Rooy* 3602 (H), on rock, under water drip, *van Rooy* 3583 (H).

Philonotis section *Philonotula* (B. S. G.) A. Jaeger

Plants small to medium-sized, inhabiting moist to mesic habitats in temperate to tropical areas. Proximal leaf border entire, crenulate or serrulate; all leaf cells often narrow and mammillose or papillose to the leaf base; single papilla or more pronounced mammilla/papilla at the distal end of the leaf cell. The capsule horizontal or inclined, ellipsoid or gibboid; peristome complete.

Philonotis falcata (W. J. Hook.) Mitt.

J. Linn. Soc. Bot. Suppl. 1: 62. 1859. — *Bartramia falcata* W. J. Hooker, Trans. Linn. Soc. London 9: 317. 27 f. 4. 1808. — *P. fontana* var. *falcata* (W. J. Hook.) Brid., Bryol. Univ. 2: 21. 1827. — Type: Nepal, coll. Dr. Buchanan (Herb. Hooker, Dr. Smith 1808. No. H/2359, ex herb. Kew, BM, holotype!; ex herb. Dawson Turner, ex herb. Hook., BM, isotype!).

Bartramia afrofontana Müll. Hal., Hedwigia 38: 93. 1899. — *Philonotis afrofontana* (Müll. Hal.) Paris, Ind. Bryol. Suppl. 264, 1900. — Synonymized by Magill (1987).

Philonotis falcata was known as *P. afrofontana* from South Africa (Brotherus 1924, Sim 1926), Malawi (Bartram 1953) and Zambia (Phiri & Ochyra 1985), until Magill (1987) discovered the synonymy. Since then it has been recorded for Zimbabwe (Best 1990) and Rwanda and Zaire (Ochyra 1993). Hodgetts et al. (1999) found it to be locally quite common in Lesotho.

Philonotis falcata can be separated from other South African *Philonotis* by the keeled leaves in five rows. This is best seen in the innovation leaves. The microscopic characters are the entire leaf base margin and the basal leaf cells which are regularly rectangular and twice as broad as the distal leaf cells. The basal leaf lamina thus looks more translucent or paler than the basal leaf of species such as *P. africana*, which has much denser areolation.

The African specimens of *Philonotis falcata* studied so far do not differ from the Asiatic plants. The variation in the African population, however, is not as wide as in the Asiatic ones. The leaf shape of African plants is always similar, from an ovate base tapering to a short acute apex with costa ending at the apex (var. *carinata* (Mitt.) Ochi, 1962), while plants with long acuminate leaf apices with excurrent costa are common in Asiatic plants (var. *falcata*).

Descriptions and illustrations: Brotherus 1924: 466 (fig. 408); Bartram 1939: Pl. 12 (fig. 204); Ochi 1962: PL 4 (as *P. falcata* var. *falcata*), PL 5 (as *P. falcata* var. *carinata*); Gangulee 1974: 1111 (Fig. 539); Noguchi 1989:

569 (fig. 252); Magill 1987: 428 (fig. 123: 6-9); Koponen 1996a: 115, (fig. 1); Kürschner & Ochyra 1999: 272, (fig. 2).

South African specimens studied:

South Africa. Rydal Mt., *H. A. Wager 86* (H-BR); Orange River Colony, 1908 *G. Bailrie 143* H-BR). **Cape.** Cap de Bonne Esperance, *Mac Owen* (H-BR, ex herb. J. Cardot); 9 km on Jouberts Pass turnoff from Barkly East-Lady Grey road, wooded rock outcrops on the farm Clobert, alpine heath grassland, 1,850 m, 1986 *van Rooy 2780* (H), 8 km east of Lady Grey, alpine grassland, on soil over basalt, 1,950 m, 1986 *van Rooy 2698* (H). **Lesotho.** Sehlabathebe National Park, hills around sandstone outcrops just E of Lodge, moist grassland, on rock, 7,900 ft., 1977 *Magill 4341* (H); Sengu River crossing, between Mokhotlong and Tlokoeng, along river banks and small box canyon, on soil over rock, 2,050 m, 1987 *van Rooy 3203* (H); Lekokoaneng, sandstone cliffs along road between Maseru and Teyateyaneng, grassland with cultivation, on sandstone, 1,600 m, 1987 *van Rooy 2831* (H); Khubelu River crossing between Tlokoeng and Mapholaneng, cliffs along river banks, grassland with cultivation, on soil among grass, 2,000 m, 1987 *van Rooy 3244* (H); Oxbow Lodge, moist stream bank in heathland, 8,500 ft, 1982 *Deall & Killick 73a* (H). **Natal.** Newcastle, Farm Pietsrust 18 km N of Newcastle, on rocks, 1978 *Fourie 12700* (H); Cathedral Peak Forest Station, Upper Indumeni Forest, *Podocarpus* montane forest, on rock, 1978 *Magill 5692* (H); Natal Drakensberg, Bushmens nek, Ngwangwane River W of Border Post, sandstone outcrops in grassland, water seepage over cliff, 1,650 m, 1984 *van Rooy 1474* (H); Natal Midlands, Mtwalume Falls, 3 km from Highlats on road to Umzinto, on cliffs at top of falls, on wet cliff, 900 m, 1982 *van Rooy 1036* (H). **Orange Free State.** The farm Olievenrand near the Elandsberg between Zastron and Wesselsdale, wooded mountain slopes, on sandstone cliff at waterfall, 1,500 m, 1986 *van Rooy 2452* (H). **Transvaal.** Van Reenen, *H. A. Wager 264* (H-BR); Lydenburg, 1892 *F. Wilms 2420* H-BR); Pretoria, Silverton Ridge, 1928 *Kresfelder 1116* (H).

Philonotis section *Bartramidula* (Bruch & Schimper) Mitt.

Plants small; inhabiting ephemeral habitats in temperate to tropical areas; basal leaf cells wide and mammillose; upper leaf cells narrower, papillose. In the basal areolation more pronounced mammilla or papilla at the proximal end of leaf cell, in the distal areolation pronounced mammilla or papilla mostly at the distal cell end; capsule erect, globose or ellipsoid; peristome reduced or lacking.

Magill (1987) accepted the genus *Bartramidula* B. S. G., which has been separated from *Philonotis* on the basis of the capsules being mostly

erect and globose to elliptic and the reduced peristome, while *Philonotis* has an inclined, gibbose capsule, and the peristome is complete. Griffin & Buck (1989) came to the conclusion that the gametophytes of *Bartramidula* are in all major respects indistinguishable from those of *Philonotis*, and that the patterning of papillosity seen in leaves of *Bartramidula* does not represent a major departure from that found in *Philonotis*. Griffin & Buck (1989) also discussed the capsule characters of *Bartramidula* and described the great variety existing, and they synonymized the genera.

On the basis of my studies carried out on *Philonotis*, it seems very likely that *Bartramidula* is polyphyletic, meaning that the erect, globose to elliptic capsule with reduced peristome has evolved several times. However, since I have not yet studied all the species of *Philonotis* and *Bartramidula*, I treat *Bartramidula* at the sectional level as a working hypothesis.

Philonotis comosa (Broth.) Griffin & W. R. Buck (Fig. 1)

Bryologist 92: 376. 1989. — *Bartramidula comosa* Broth., Nat. Pflanzenfam. 1(3): 644. 1904. — *Bartramia comosa* Hampe & Müll. Hal., Bot. Zeit. 17: 221. 1859, *hom. illeg.*, non Mitten, Fl. Tasman. 2: 195. 1859. — Type: South Africa. Cape, Houteniqua, Montagne Pass, Breutel (BM, not seen; a probable syntype in H!).

Philonotis afro-capillaris Dix. ex Sim, Bryol. Afr. 309. 1926, syn. nov. — Isotype: Cape. Wilderness, George, IV.1924 Miss A. Taylor sub Sim 10153 (PRE).

Descriptions and illustrations: Brotherus 1924: 459 (fig. 402: H–Q, as *Bartramidula comosa*); Sim 1926: 304 (as *Bartramidula comosa*), 310 (as *Philonotis afrocapillaris*); Magill 1987 (fig. 121: 1–14, as *Bartramidula comosa*).

Sim (1926) described *Philonotis afrocapillaris* based on a single specimen. H. N. Dixon had confirmed the new species: "I know nothing like it, except some forms of our European *P. capillaris*." Magill (1987) studied the type and described it as "an unusual specimen with narrowly lanceolate leaves." He synonymized it with *P. dregeana* (Müll. Hal.) A. Jaeger, thinking that "the elongated stems and distant leaves indicate environmentally induced modification of this specimen". The discovery of one differing specimen among the specimens named as *P. falcata*, and Sim's (1926) illustration of *P. afrocapillaris* leads me to think that it might provide the name for the specimen that I was unable to identify. The type of *P. afrocapillaris*, however, showed to be *P. comosa*.

Two South African species of the *Philonotis* section *Bartramidula*, *Philonotis comosa* and *P. globosa* (Müll. Hal.) Griffin & W. R. Buck, can be

distinguished on the basis of the characters in the key. Magill (1987) found that the sterile specimens of *P. globosa* are practically indistinguishable from *P. dregeana*. However, the difference in the mammilosity of basal leaf areolation separates these species.

Discussion

Pócs (1976, 1992) has paid special attention to the correlation between tropical African and Asian bryofloras, excluding pantropical taxa occurring also in South America. Pócs (1992) recorded a total of 178 bryophytes, 70 liverworts, and 108 mosses that have an Afro-Asian bicontinental distribution area. He grouped this set of species into distribution pattern types on the basis of the distribution of the species in tropical Africa, Asia, and Australasia. He recognized 31 distribution patterns. The bryophytes which are widely distributed in Africa and Asia, a total of 32 species, make up the most common pattern group. Pócs (1992) included *Philonotis falcata* in the distribution pattern group of species widely distributed in Asia, but in Africa limited to South Africa. Only four other species showed this distribution pattern. The recent finds of *P. falcata* enlarge its African range (Fig. 2). Accordingly, its total range more closely resembles the ranges of 17 other species, such as *Plagiochasma appendiculatum* Lehm. & Lindenb., *Enthostodon wichurae* M. Fleisch., *Fissidens atroviridis* Besch., and *Garckea comosa* (Dozy & Molk.) Wijk & Marg., which Pócs (1992) included within the distribution pattern group of species widely distributed in Asia, but in Africa restricted to East Africa. However, since a modern world monograph of *Philonotis* awaits its compiler, I only can predict that some other Afro-Asian bicontinental taxa may be hiding within the numerous species of *Philonotis* described from tropical Africa. For instance, a preliminary comparison of Asian *P. thwaitesii* Mitt. and *P. africana* (Müll. Hal.) Paris showed them to be closely related, if not identical.

Philonotis caespitosa has been variously accepted. The best specialists on European *Philonotis*, G. Dismier (1856–1942) and L. Loeske (1865–1935), did not hesitate in giving it species status (Loeske 1905, 1906, Dismier 1908). It is worthwhile to note that Loeske's (1905) problem was not to separate *P. caespitosa* from *P. fontana* and its relatives, but from *P. marchica* (Hedw.) Brid., which belongs to a different section of *Philonotis*, section *Philonotula*. In Europe, the recent floras accept *P. caespitosa* at the specific level (Andersen et al. 1976, Smith 1978, Frey et al. 1995, Nyholm 1998). In North America, Lawton (1971) accepted it at the specific level, while Crum & Anderson (1981) treated it as a variety of *Philonotis fontana*, as did Ignatov & Afonina (1992) in their check-list of the former Soviet

Union. On the basis of the literature, it has a wide range in Europe, North America (Dismier 1910, Lawton 1971) and Siberia (Nyholm 1998).

Several theories can be offered to explain the presence of *Philonotis caespitosa* in South Africa. First, some bipolar disjunctions of holarctic circumpolar bryophytes are known from South Africa, such as *Saelania glaucescens* (Hedw.) Broth. (Schofield 1974), *Abietinella abietina* (Hedw.) M. Fleisch., and *Bryoerythrophyllum recurvirostrum* (Hedw.) Chen (Magill 1981). Second, it may have intermediate stations in central African mountains not yet detected, or the specimens lie unidentified or are under other names in herbaria. Third, its introduction to South Africa by human activities is not out of the question. Many European bryophytes are known to be human introductions into New Zealand (Schofield 1974) and Australia (Streimann 1998), and the same is possible in South Africa with a longer colonization history than they have.

The key provided gives five other species. Of them, *P. africana*, *P. dregeana* (Müll. Hal.) A. Jaeger, and *P. hastata* (Duby) Wijk & Marg. belong to the section *Philonotula*. *P. africana* has denser leaf cell areolation than the other South African species of the section, which with the distinct papillosity of leaf cells makes the leaves obscure. These characters and its reflexed leaf margin separates it from other species of *Philonotis* in South Africa. According to Magill (1987), *P. dregeana* differs from *P. hastata* by having regularly narrow-rectangular laminal cells (rectangular to weakly oblong-hexagonal in *P. hastata*), narrower leaves, and costa short excurrent (ending below the apex or occasionally percurrent in *P. hastata*). The latter character depends on the age or maturity of the plant. Leaves from young stems and from innovations are often obtuse, and the costa is weak. The leaves on mature stems below the gametangia in Asiatic plants commonly have percurrent costa, and leaves with excurrent costa are not rare.

Philonotis scabrifolia (Hook. F. & Wils.) Braithw. belongs to the section *Catenularia* (Müll. Hal.) Paris, and *Philonotis vagans* (Hook. f. & Wils.) Mitt. belongs to the section *Pseudo-Mniobryum* Broth. They can be distinguished by the characters in the key.

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Illustrations

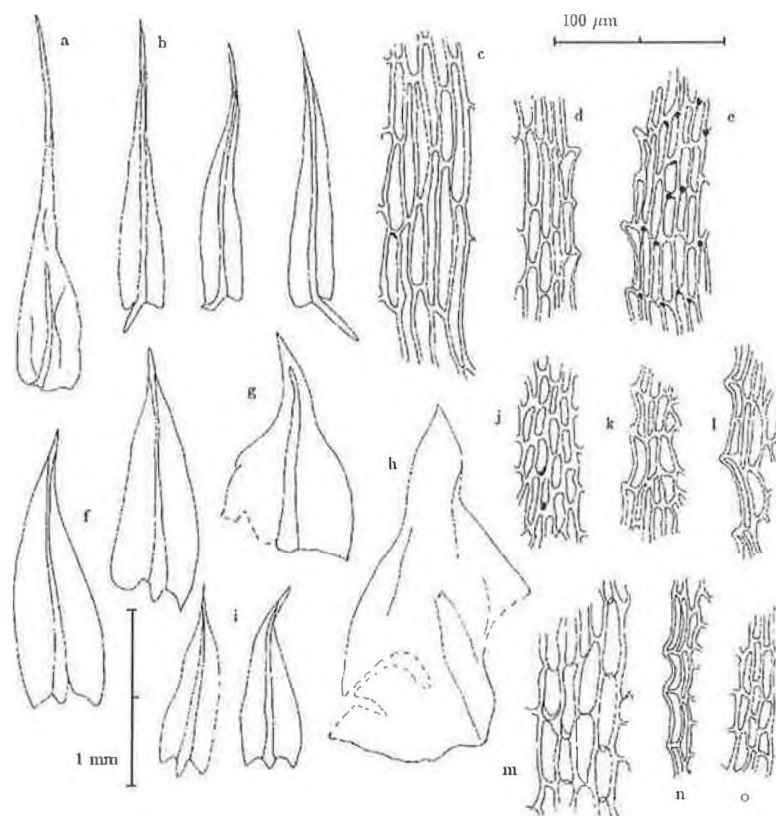


Fig. 1. *Philonotis comosa* (Broth.) Griffin & W. R. Buck. (a–e, from the type of *P. afrocapillaris* Sim, PRE). a: Perichaetial leaf. b: stem leaves. c: basal leaf cells. d: leaf border near leaf base. e: leaf border and leaf cells near apex. — *Philonotis caespitosa* Wils. ex Milde (f–h, j, l, m from van Rooy 3700, in H; i, k, n, o from van Rooy 3653, in H). — f, i: stem leaves. g: inner perigonal leaf. h: outer perigonal leaf. j: leaf cells near apex. k: leaf border near apex. l, n: leaf border at midleaf. m: leaf cells near base. o: border near base. — “1 mm” scale for the leaf shapes, and “100 μm ” scale for the cellular details.

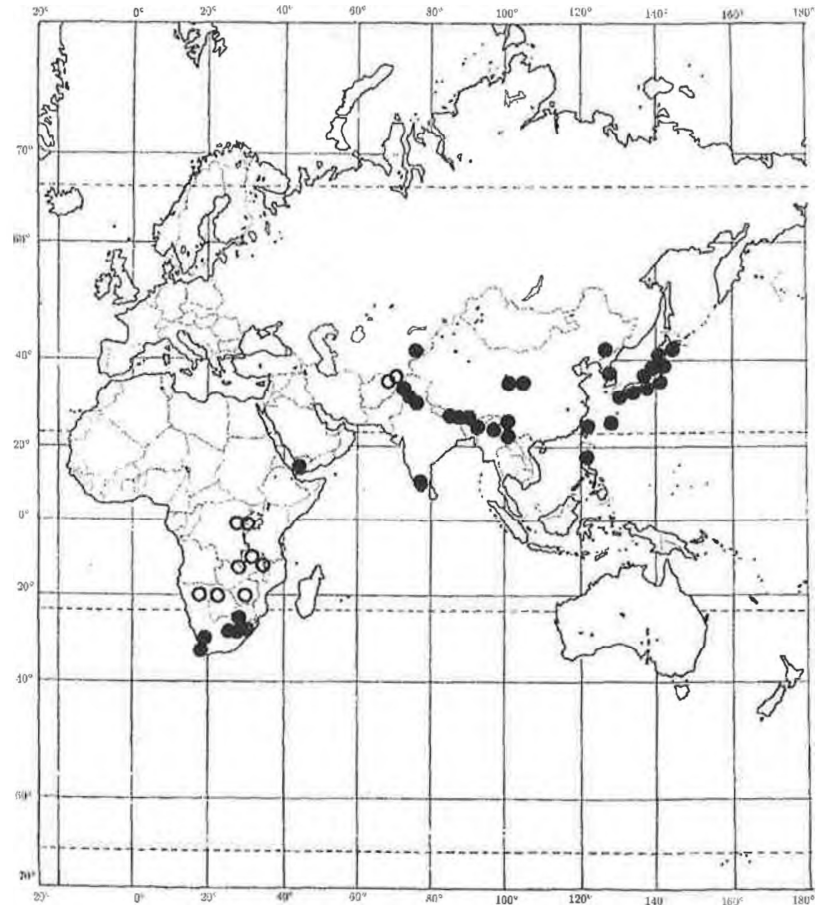


Fig. 2. Distribution of *Philonotis falcata* (W. J. Hook.) Mitt. Solid circles = specimens observed (H). Open circles = literature reports.