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Philonotis (Bartramiaceae, Bryophyta) in Hawai’i and the Pacific: nomenclature, taxonomy and ranges

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In the Hawaiian Islands, the genus *Philonotis* of the family Bartramiaceae has five species: *P. hastata* is pantropical, *P. sullivantii* is endemic to the Hawaiian Islands and *P. hawaiica* is new to Mexico, *P. pseudomollis* and *P. thwaitesii* are new records to Hawai’i. The Hawaiian specimens of *P. falcata* probably represent depauperate forms of male plants of *P. sullivantii*, and *P. falcata* is excluded from the Hawaiian flora. *Philonotis turneriana* is a Himalayan taxon, and is excluded from the Pacific *Philonotis* flora. *Philonotis asperifolia*, *P. pseudomollis*, *P. thwaitesii* and *P. vescoana* occur on several Pacific islands, *P. secunda* occurs in New Caledonia and Samoa and *P. pyriformis* on Rapa Island. *Philonotis tenuis* is known from Norfolk Island; it may have other occurrences in the area, but these need to be confirmed. *Philonotis sharpiana* is synonymized with *P. hawaiica*. *Philonotis angustissima*, *P. parisii*, *P. praemollis* and *P. runcinata* are synonymized with *P. pseudomollis*. *Philonotis etessei* is synonymized with *P. asperifolia*. *Philonotis norrisii* T.J. Kop. *sp. nova* is described. Lectotypes are selected for *P. asperifolia*, *P. runcinata*, *P. sullivantii* and *P. vescoana*. Descriptions and illustrations are provided for *P. asperifolia*, *P. hawaiica*, *P. norrisii* and *P. sullivantii,* and the taxonomy of other taxa is discussed referring to earlier descriptions and illustrations. The taxa are divided into floristic elements. *Philonotis pseudomollis* is the first record to Solomon Islands.

Introduction

Müller (1896) described three species of *Bartramia* from Hawai’i, now placed in *Philonotis*: *P. hawaiica*, *P. macroglobus* and *P. sullivantii*. Brotherus (1904) published two more names, *P. baldwinii* and *P. mauiensis*, which remained *nomina nuda*. Brotherus (1927) excluded the latter two, accepted *P. hawaiica*, *P. macroglobus* and *P. sullivantii* as endemic taxa to Hawai’i, and added *P. laxissima* (= *P. hastata*) and two mainly SE Asiatic taxa, *P. turneriana* and *P. falcata*. Bartram (1933) in his *Manual of Hawaiian mosses* included four species in *Philonotis*: *P. falcata*, *P. hastata*, *P. hawaiica* and *P. turneriana*, with two varieties, var. *turneriana* and var. *sullivantii*. Bartram (1933) further synonymized *P. baldwinii* with *P. falcata* and *P. macroglobus* with *P. turneriana*. Hoe (1974) and Staples *et al*. (2004) did not bring alterations to Bartram’s

(1933) concept. Crosby (1964) presented a key to Hawaiian *Philonotis* species based on characteristics of the laminal areolation.

Whittier (1976) in his *Mosses of the Society Islands* accepted three species: *P. hastata*, *P. runcinata* and *P. vescoana*. Whittier (1976) and Koponen and Norris (1996) and Koponen (2014) synonymized several taxa described from the Pacific area. Miller *et al.* (1978) listed a total of 31 *Philonotis* names, and accepted at the specific level ca. 13 taxa and one variety. Virtanen and Koponen (1998) added *P. secunda* from New Caledonia. After these additions and synonymizations, at least the following taxa were still accepted at the specific level in the Pacific area: *Philonotis falcata* (Hook.) Mitt., *P. hastata* (Duby) Wijk & Marg., *P. hawaiica* (Müll. Hal.) Broth., *P. pseudomollis* Müll. Hal., *P. revoluta* Bosch & Sande Lac., *P. runcinata* Müll. Hal. *ex* Ångstr., *P. secunda* (Dozy & Molk.) Bosch & Sande Lac., *P. tenuis* (Taylor) Reichardt, *P. turneriana* (Schwägr.) Mitt., *P. turneriana* var. *sullivantii* (Müll. Hal.) E.B. Bartram, and *P. vescoana* (Besch.) Paris.

My studies on SE Asiatic and Pacific *Philonotis* began in connection with the research of the genus in Western Melanesia (Koponen & Norris 1996). The specimens collected in Hawai'i and named *P. falcata* seemed to differ from SE Asian plants under the same name (Koponen 1996, 2003, 2012). Also, it became clear that *P. turneriana* occurs mainly in the Himalayan areas (Koponen 2009, 1998, 2010a, 2019a, 2019b, Koponen & Higuchi 2020). In this study, *P. falcata* is excluded from Hawai'i and the status of "*P. turneriana*" evaluated. Recognition of the taxon known as *P. laii* (2010b) in the Pacific and Australian floras (Koponen 2020) and the restudy of type specimens causes several changes in the nomenclature.

Material and methods

This study is based on examination of herbarium specimens, especially types, mainly in BM, FH (especially Pacific material from E.B. Bartram's herbarium), H, H-BR, H-SOL, NY and S. The covered area is called "Oc" in *Index Muscorum* (van der Wijk *et al*. 1969), however, excluding New Guinea and the Solomon Islands, dealt with in Koponen and Norris (1996) and Koponen (2019a). Lord Howe Island and Norfolk Island of Australia, included in *Flora of Australia* by Gilmore (2006) and the other Australian external territories (*see* Streimann & Curnow 1989) are excluded or only shortly discussed under *P. tenuis*. However, the specimens available from the Pacific area, other than Hawai'i, are not numerous and are preserved in numerous herbaria. This made it difficult to get an idea of the variation of the treated taxa, and especially the circumscription of *P. tenuis s. stricto* was problematic (Koponen 2020).

For identification purposes, the terms *mammilla*, *papilla* and *mammilla/papilla* refer to the structure on the cell, which is best seen after alcohol/KOH treatment. In that, the sample is first soaked in absolute ethanol for 15–30 seconds (to get rid of water surface tension) and then briefly in mild KOH solution (to render the cells walls more clearly visible under the compound microscope). The structure may be central on the leaf cell, at either distal or proximal end of the leaf cell, and may be a true papilla (a peg-like projection of the cell wall), or only a bulging cell end or proration. In many leaf cells, both cell ends may have a mammilla/papilla, but in the key and descriptions the character means the one easiest seen under compound microscope. The descriptions of leaf characters and discussions are based on fully grown leaves from below the perichaetium, or from well-developed sterile shoots.

Taxonomy

All Hawaiian and Pacific species of *Philonotis* belong to the section *Philonotula*. In them, the basal leaf margin is either entire or serrate to serrulate, and the apical leaf margin is serrate. In many plants the teeth at the central leaf margin seem to be arranged in pairs (geminate) or the margin is "pluriserrulate". This situation is caused when a papillate laminal cell is adjoining the serrate margin cell and this gives an impression that the margin is geminate or bidentate. The marginal teeth and the papillate leaf cell are not matching together. The papilla of the adjoining laminal cell may be of the same size and shape as the marginal teeth. This kind of serration is here called biseriate (2-seriate). When the papillae of two adjoining laminal cells develop to teeth, the result is a triseriate border. The triseriate (3-seriate) and 4-seriate leaf borders are revolute and look very prominent under the compound microscope.

Key to *Philonotis* in Hawai'i and the Pacific

Philonotis mollis and *P. norrisii* are included in the key — in brackets — although they are not known from the study area.

1. Capsule erect, globose to elliptic, eperistomate; Hawai'i, Mexico .... *P. hawaiica*
1. Capsule horizontal or nodding, globose to gibbous; peristome present; or capsule lacking 2
2. Basal leaf cells bulging or papillate at their proximal cell ends 3
2. Basal leaf cells nearly smooth or with mammilla/papilla at their distal cell ends 5
3. Small species, 1–2 cm; leaves ± straight, acute to acuminate; Hawai'i, Mexico .... *P. hawaiica*
3. Large species, 1–5(10) cm; leaves falcate-secund, acuminate 4
4. Leaf margin at mid-leaf bi- to triseriate; widely ranging in the Pacific area and SE Asia .... *P. vescoana*
4. Leaf margin at mid-leaf serrate or faintly biseriate; Rapa Island, Australia, New Zealand .... *P. pyriformis*
5. Basal leaf cells wide, thin-walled, smooth or with bulging cell ends or slightly papillate; all leaf cells translucent 6
5. Basal leaf cells usually narrower, distinctly mammillate/papillate, ± thick-walled; apical leaf cells opaque 10
6. Leaf apex nearly blunt or shortly acute; costa not reaching apex or percurrent, rarely excurrent; leaf margin at mid-leaf regularly biseriate with blunt teeth; common in the Pacific area .... *P. hastata*
6. Leaves acute to piliferous; costa percurrent or excurrent; leaf margin at mid-leaf biseriate, teeth sharp 7
7. Plants small, ≤ 2 cm; leaves nearly straight, basal leaf cells and often outer basal cells regularly quadrate; leaf apex shortly acute; costa excurrent; leaf margin at mid-leaf bi- to triseriate; Pacific islands .... *P. asperifolia*
7. Plants larger; leaves staight or falcate-secund, acuminate to piliferous 8
8. Plants slender; leaves acuminate; stem apices and innovations develop to slender stolons having reduced, hair-like leaves; large numbers of deciduous propagules present on apices of innovations and along stolons; mid-leaf cells narrow, ≤ 5 µm, and long, ≥ 55 µm .... *P. pseudomollis*
8. Plants larger; leaves long acuminate or piliferous; without slender stolons with hair-like leaves and propagules; mid-leaf cells broader and shorter 9
9. [Basal and mid-leaf leaf cells wide, ± rectangular or rhomboidal .... *P. mollis*]
9. Basal leaf cells often ± quadrate or short-rectangular, mid-leaf cells long-rectangular .... *P. tenuis*
10. Large species, stems 1–3(10) cm; leaf apex long-acuminate with excurrent costa or apex nearly piliferous ... 11
10. Smaller, stems 1–2(3) cm; leaf apex acuminate, costa percurrent or excurrent 12
11. Leaves glossy, from narrow ovate base gradually tapering to acuminate, stiff apex with strong excurrent costa; leaf border plane or slightly revolute at base; Hawai'i .... *P. sullivantii*
11. Leaves brownish or green, not glossy, from ovate base often ± quickly tapering to flexuose, acuminate to piliferous apex; costa weaker; leaf border revolute in ovate part of leaf; New Caledonia, Samoa, SE Asia .... *P. secunda*
12. Plants brownish and stiff; leaf base ovate; both leaf borders revolute nearly their entire length; at leaf base large area of quadrate cells separated from costa by a few rows of elongate cells; SE Asia, rare in the Pacific area .... *P. thwaitesii*
12. [Plants often whitish; innovations flexuose; leaf broadest at insertion; leaf borders plane or revolute at basal leaf; ± quadrate basal leaf cells mixed with rectangular cells, outer basal cells sometimes as a small group of quadrate cells; SE Asia from Japan to New Guinea .... *P. norrisii*]

Philonotis asperifolia Mitt. (Fig. 1)

J. Linn. Soc. Bot. 10: 185. 1868. — LECTOTYPE (designated here): Samoa. Tutuila, (from original handwritten label: "grows on stones and trunks of some trees"); on damp earth and on rocks by water-courses, 20–100 ft., *T. Powell 28* (NY-Mitten); isolectotypes (comm. Mitten, NY, as *P. asperula* Mitt., NY, FH-Fleischer, S-B173174, herb. Regnell). — Synonymized with *P. hastata* by Koponen and Norris (1996).

Philonotis etessei Broth. & Paris, Öfvers. Förh. Finska Vetensk.-Soc. 80A(11): 20. 1909 ("*Etessei*"), *syn. nov.* — LECTOTYPE (designated by Koponen and Norris 1996): New Caledonia. Tipendje, ad rupes, 1902 *M. Etesse 302* (H-BR3083001). — Synonymized with *P. hastata* by Miller *et al.* (1978) and with *P. vescoana* by Koponen and Norris (1996).

[Description mostly from the lectotype in NY] Plants brownish to green, kept together by dense tomentum, shoots ≤ 2 cm, innovations flexuose; leaves 0.2–0.3 mm broad and 1–1.2 mm long, not arranged in rows, erect and imbricate when dry, erect-spreading when wet, broadest at insertion, straight or slightly secund, ± triangular, tapering to short, acuminate apex; margin recurved (or appearing so) from base to near apex, several basal marginal cells thin-walled, margin next to them biseriate and at mid-leaf bi- to triseriate, teeth

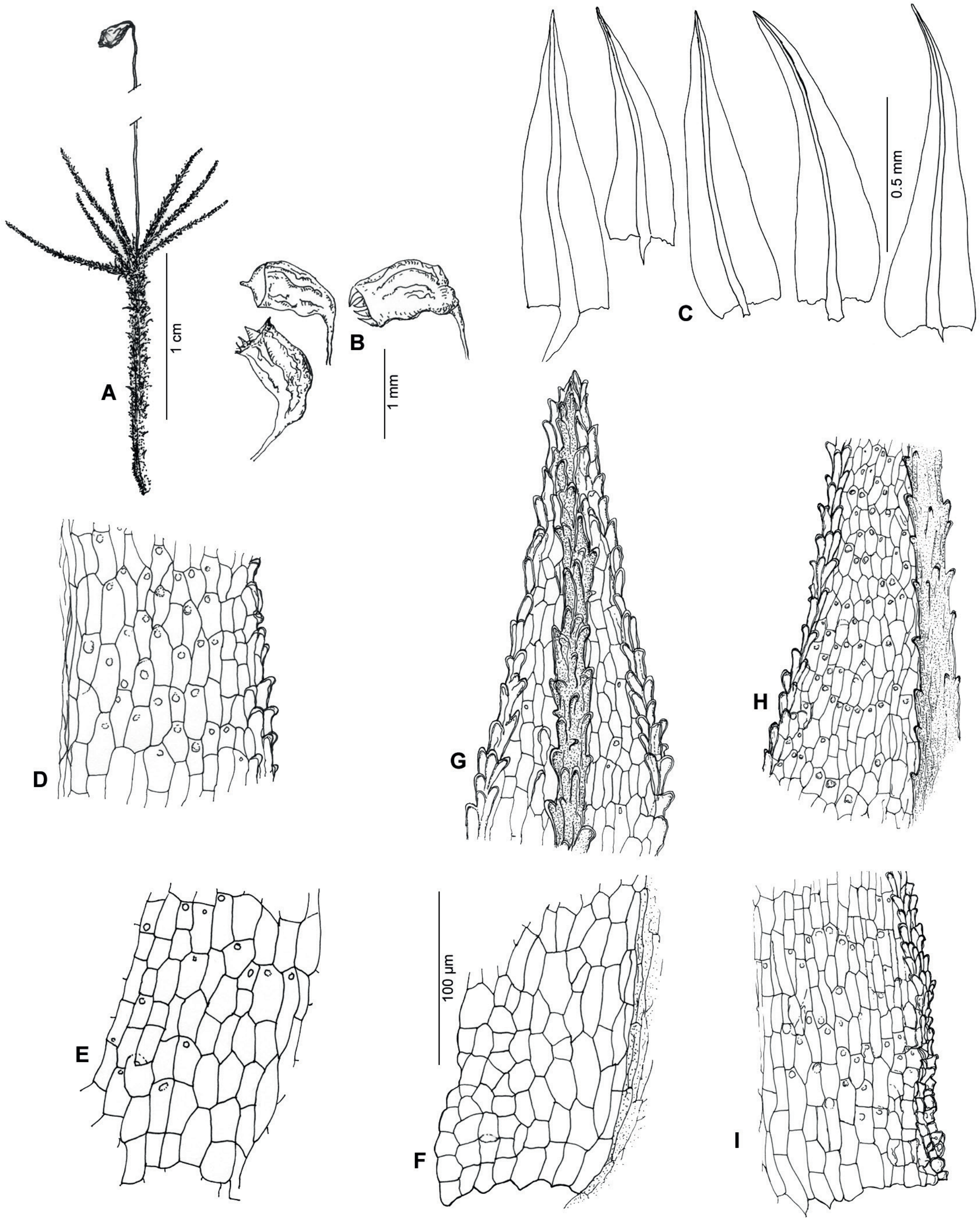

Fig. 1. *Philonotis asperifolia* (from Samoa, *T.C. Yuncker 9420*, NY). — **A**: Growth habit. — **B**: Capsules. — **C**: Leaves. — **D** and **E**: Mid-leaf cells. — **F**: Basal leaf cells at costa. — **G**: Leaf apex. — **H**: Margin and costa near mid-leaf. — **I**: Leaf base at margin.

small, at apex margin serrate; costa ca. 35 µm broad near insertion, nearly smooth at base, roughly serrate apically, shortly excurrent; leaf areolation translucent due to thin cell walls and low papillae; outer basal cells quadrate, 10–12 µm, smooth, cells near costa quadrate to rectangular, 10–12 × 25–50 µm, nearly smooth or slightly mammillate at the distal cell end, mid-leaf cells 10–12 × 20–30 µm, papillate at distal cell end, apical leaf cells 5–7 µm broad. Leafy propagules present. Dioicous. Perichaetial leaves ca. 1 mm long, erect, from ovate base, long-acuminate with costa penetrating to apex, border revolute in narrow apical part; basal leaf cells nearly smooth or slightly mammillate/papillate, 12–15 × 20–57 µm, mid-leaf cells 7–10 × 12–25 µm. Perigonium not seen in the type specimens, but is gemmiform, leaves 1.4–2.5 mm long, base of inner leaves cochleariform, apex abrubtly contracted to an acute-acuminate apex; seta ≥ 3 cm; capsule 1–1.5 mm long, horizontal, rugulose and contracted below mouth when dry; operculum slightly conical, mammillate; peristome double. Spores ca. 25 µm, minutely papillate.

Philonotis asperifolia belongs to the group of SE Asiatic and Pacific species with thin-walled leaf cells with low papillae so that all leaf areolation is translucent. The taxa with a similar translucent areolation are *P. hawaiica*, *P. hastata*, *P. mollis* and *P. pseudomollis*. *Philonotis hawaiica* has the basal leaf cells bulging at proximal cell ends. The three other species can be separated on the basis of leaf shapes, characters of leaf margin and cellular details of the areolation, *see* below and discussions under these taxa.

Philonotis asperifolia was synonymized with *P. hastata* by Koponen and Norris (1996). The restudy of the type of *P. asperifolia* showed that although the plants are of the same size and the basal leaf cells are smooth to slightly mammillate and have similarly translucent areolation as in *P. hastata*, several differences were found. (1) Basal leaf cells are more regularly shortly rectangular and outer basal cells quadrate, while these cells in *P. hastata* are irregularly rectangular, quadrate or rhomboidal. (2) Mid-leaf cells are more distinctly papillate and cells with central papilla occur in *P. asperifolia*. (3) The areolation of the apical portion of the leaf with narrow, papillate cells differs from that of *P. hastata,* which mostly has only bulging cell ends. (4) The leaf has an acute to acuminate apex with a distinctly excurrent costa. In *P. hastata* the apex is shortly acute or nearly obtuse and the costa ends below the apex, is percurrent and only in strong leaves may be excurrent. (5) The serration of the mid-leaf margin is not similarly regularly biseriate with blunt teeth as in *P. hastata*, but is irregularly bi- to triseriate with small teeth.

Two other *Philonotis* species described from the Pacific islands are *P. vescoana* and *P. runcinata* (= *P. pseudomollis*). *Philonotis pseudomollis* is easily distinguished from *P. asperifolia* by its narrow, elongate leaves and the narrow and elongate leaf cells. *Philonotis vescoana* differs from *P. asperifolia* by being a larger plant with longer, longly acuminate leaves. The basal translucent leaf cells in *P. vescoana* are distinctly wider than the opaque, narrower mid-leaf and apical cells, while all leaf areolation in *P. asperifolia* is translucent. Another microscopic difference is in the papillosity of the basal leaf cells. In *P. vescoana* the wide basal leaf cells are mammillate/papillate at the proximal cell end, while these cells in *P. asperifolia* are smooth or slightly bulging at the distal cell end.

The type specimen of *P. etessei* has widely ovate to triangular basal leaves tapering gradually to a long-acuminate leaf apex with an excurrent costa. The leaf areolation is translucent due to elongate thin-walled cells with low mammillae/papillae. This fits best to some Australian specimens named *P. tenuis s. stricto.* However, the type specimen has a character not present in *P. tenuis s. stricto*: mid-leaf cells with a central papilla occur mixed with cells with a papilla at distal cell end (*see* Koponen 2020).

The specimen *C. Skottsberg 1241* (H-BR, *see* below) from Hawai'i, identified as *P. laxissima* (= *P. hastata*) by V.F. Brotherus, has some characters of *P. asperifolia*. It has a totally translucent areolation, and the cells, including basal leaf cells, are distinctly papillose. Moreover, cells with a central papilla are among cells with a papilla at the distal cell end. The serration of leaf margin is bi- to triseriate, not regularly biseriate as in *P. hastata*. The leaf apex is shortly acute with a percurrent costa.

ILLUSTRATIONS. None.

TOTAL RANGE. I have seen specimens from the Pacific islands as indicated below. Similar short-leaved forms (possibly depauperate forms of *P. tenuis*) occur on Lord Howe Island (below) and Norfolk Island (Streimann 2002, taxon named "*Philonotis* sp. B").

Selection of specimens studied. [**Australia**. Lord Howe Island. Erskine Valley, August 1911 *W.W. Watts 453*, *455(a)*, *463*, as *P. jardinii* (H-BR3122003, 005, 006).] — **Fiji**. "Fidschi insulae", Ovalan, 1864 *E. Graeffe*, as *P. asperifolia* (H-BR3122008); *E. Graeffe s.n.* as *P. asperifolia* (NY); Viti Levu, Mba, 1947 *A.C. Smith 5367*, as *P. pilifera* (NY); Viti Levu, N of Nandarivatu, 1947 *A.C. Smith 6042*, as *P. etessei* (NY, US). — [**USA**. Hawai'i. Oahu, 24 August 1922 *C. Skottsberg 1241*, as *P. laxissima* (H-BR3098001). Doubtful; other specimens are necessary to confirm *P. asperifolia* for Hawai'i.] — **New Caledonia**. Ile du Simia, 30 April 1909 *L. Le Rat 1338*, as *P. angustissima* (H-BR3083007). — **Samoa**. Malifa, 23 May 1905 *K. & L. Rechinger 2677* (H-BR3122028); Tutuila, 3 November 1939 *T. C. Yuncker 9420* (NY). — **French Polynesia**. Society Islands. Tahiti. 1896 *J. Nadeaud 284*, as *P. jardinii*, *Mousses de Tahiti* coll. no. 1 (H-BR3122003, NY *ex* herb. Bescherelle); 5 June 1922 *W.A. Setchell & H.E. Paris 5352* (H-BR 3122001). — Note: Miller *et al.* (1978) listed *P. asperifolia* also from Carolines and Marianas.

Philonotis hastata (Duby) Wijk & Marg.

Taxon 8: 74. 1959. — *Hypnum hastatum* Duby *in* Moritzi, Syst. Verz. Zoll. Pfl. 132. 1846. — Lectotype ("Isotype", Iwatsuki 1977, in herb., "type" in illustration text): Indonesia. Java, fl. Tjapus, ad rupes, 1813 *H. Zollinger* (L0060586 = HLB910,104-376).

Bartramia tahitensis Müll. Hall., Bot. Zeitung (Berlin) 17: 220. 1859 ("*Tahitensis*"). — *Philonotula tahitensis* (Müll. Hal.) Besch., Ann. Sci. Nat. Bot. sér. 7, 20: 28. 1894. — *Philonotis tahitensis* (Müll. Hall.) Ångstr., Öfv. K. Vet. Akad. Förh. 30(5): 120. 1873. — Type: French Polynesia. Society Islands. "Insula Tahiti. Van den Bosch donavit" (not seen). — Synonymized by Koponen and Norris (1996).

Bartramia laxissima Müll. Hal., Syn. Musc. Frond. 1: 480, 1849, *nom. illeg.* — *Philonotis laxissima* Mitt., J. Proc. Linn. Soc. Bot. Suppl. 1: 61. 1859, *nom. illeg.* — Homotypic with *P. hastata*.

Philonotis imbricatula Mitt., Proc. J. Linn. Soc. Bot. Suppl. 1: 61. 1859. — *Bartramia imbricatula* (Mitt.) Müll. Hall., Linnaea 36: 12. 1869. — Lectotype (designated by Koponen and Norris 1996): Sri Lanka. *G. Gardner* (NY, herb. Mitten 609). — Synonymized by Koponen and Norris (1996).

Bartramia obtusifolia Mitt. *in* Seemann, Fl. Vit. 381. 1873. — *Philonotis obtusifolia* (Mitt.) Paris, Index Bryol. 926. 1897. — Holotype: Fiji. Ysabel, *P. Veitch* (NY-Mitten). — Synonymized by Koponen and Norris (1996).

Philonotis tildeniae Cardot, Josephine E. Tilden, South Pacific Plants 71B (label), *nom. nud.* — Original collection: French Polynesia. Society Islands. District of Papenoo, Tahiti, October 1909, *J.E. Tilden 71B* (E).

Whittier (1976) listed *P. tahitensis* as a dubious taxon, "probably"connected with *P. hastata*, listed it hesitatingly under *P. runcinata* and repeated Müller's (1859) protologue. Koponen and Norris (1996) synomized *P. tahitensis* on the basis of the protologue. The characters mentioned by Müller (1859), such as pale color, small papillae, double teeth of leaf margin and the costa ending before the apex, are characters of *P. hastata*. These same characters separate *P. hastata* from the other Pacific species of *Philonotis*. The pale color is caused by the translucent areolation; opaque, narrow, thick-walled cells are absent in the apical portion of the leaf.

The basal leaf cells in most *P. hastata* specimens studied from SE Asia and the Pacific are smooth or slightly bulging, rectangular to rhomboidal. The blunt marginal teeth are in two clear rows (regularly biseriate). As to differences with *P. asperifolia*, *see* under that taxon.

Illustrations. Fleischer 1904: 613 (fig. 116, as *P. evaninervis*); Bartram 1933: 138 (fig. 101, as *P. laxissima*); Whittier 1976: 189 (fig. 52D–G); Iwatsuki 1977 (figs. a–o, drawn from the type of *P. hastata*); Noguchi 1989: 573 (fig. 254A, as *P. evanidinervis*; fig. 254B as *P. hastata*); Koponen and Norris 1996: 8 (fig. 3); Eddy 1996: 231 (fig. 487), 232 (fig. 488A–D); Zang and He 2007: 182 (pl. 232, figs. 1–6); Koponen *et al.* 2019: 79 (fig. 3A–I).

Total range. Pantropical.

Selection of specimens studied. **Fiji**. Type of *Bartramia obtusifolia* (*see* above). — **New Caledonia**. Pic Pembai, July 1909 *L. Le Rat* 160k (H-BR3083005). — **Samoa**. Upolu, 18 May 1903 *M. Fleischer B1149*, as *P. hastata* (NY). — **French Polynesia**. Society Islands. Tahiti. 1896, *J. Nadeaud 984*, *Mousses de Tahiti* coll. no. 1 (H-BR3122009, as *P. jardinii*). — **Vanuatu** ("New Hebrides"). Aneityuru, May–June 1913 com. *Gunu*, herb. Watts 426 (H-BR3098016); Santo, 1909 *F.G. Bovie* (H-BR3083006). — Notes: Miller *et al.* (1978) listed *P. hastata* also from Marquesas, Carolines, Marianas, Easter Island and Lord Howe. Bartram (1933) cited specimens from Hawai'i but I have not seen them.

Philonotis hawaiica (Müll. Hal.) Broth. (Fig. 2)

Nat. Pflanzenfam. 1(3): 645. 1904. — *Bartramia hawaiica* Müll. Hal., Flora 82: 447. 1896 ("*Hawaiica*"). — *Bartramidula hawaiica* (Müll. Hal.) Paris, Ind. Bryol. Suppl. 36. 1900. — Type: USA. Hawai'i. "Insulae Hawaiicae, sine loco speciali sed in montibus altissimis": Dr. *W. Hillebrand* ("*Bartr. hawaiica* CM. Hawaii" (H-BR, possible syntype, only one stem of the moss).

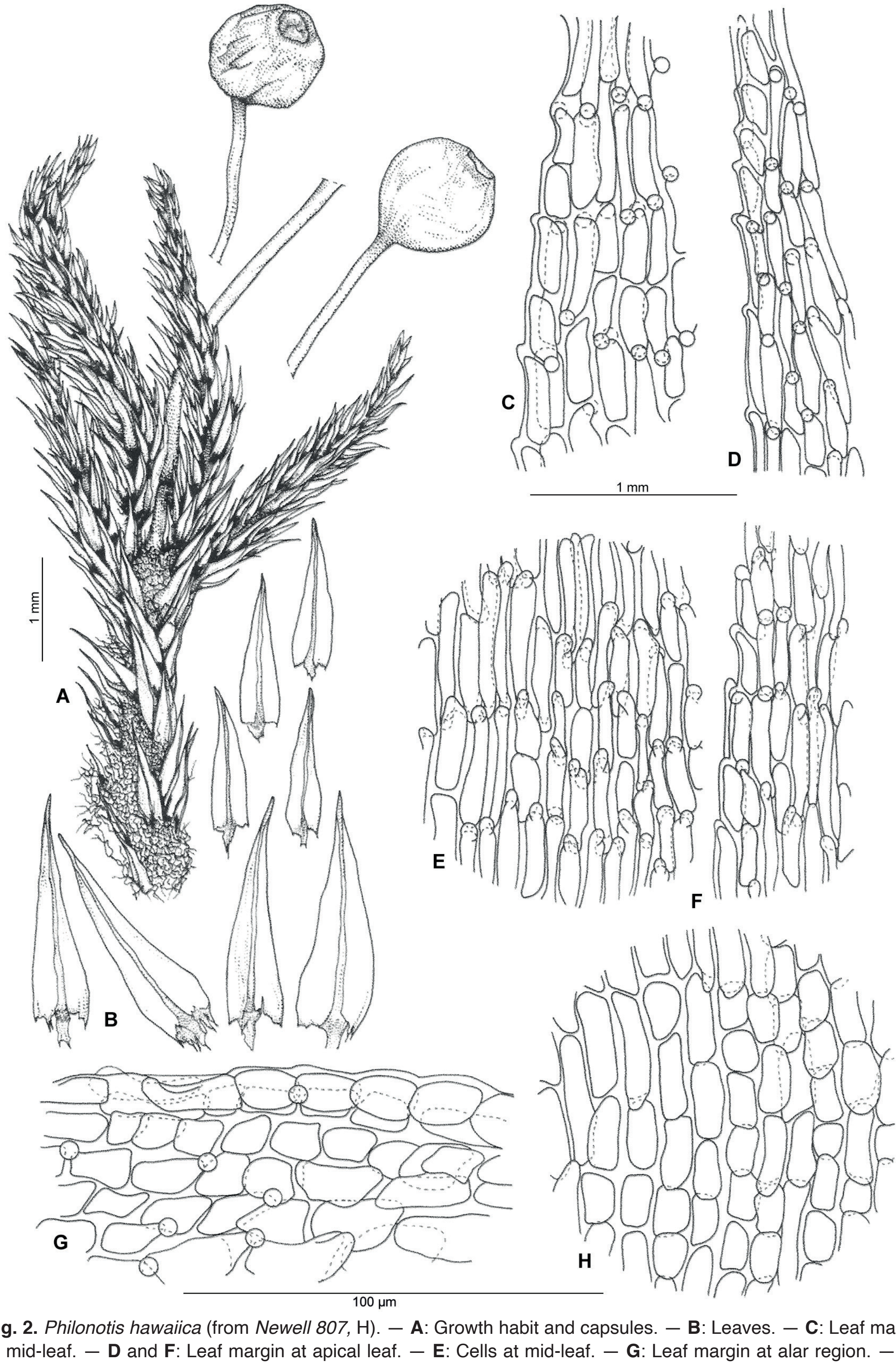

Fig. 2. *Philonotis hawaiica* (from *Newell 807,* H). — **A**: Growth habit and capsules. — **B**: Leaves. — **C**: Leaf magin at mid-leaf. — **D** and **F**: Leaf margin at apical leaf. — **E**: Cells at mid-leaf. — **G**: Leaf margin at alar region. — **H**: Basal leaf cells.

Philonotis mauiensis Broth., Boll. Soc. Bot. Ital. 1904: 21. 1904, *nom. nud.*, *new assign*. — ORIGINAL COLLECTION: USA. Hawai'i. "Paia, in insula Maui, valley sides, 600 ft. alt., Mart. 1903" *D.D. Baldwin 5424*, Hb. E. Levier (H-BR).

Philonotis sharpiana D.G. Griffin & W.R. Buck, Bryologist 92: 376. 1989, *syn. nov.* — HOLOTYPE: Mexico. Oaxaca. Mid-way between Tuxtepec and Oaxaca on route 180, on wet soil at roadside, alt. 6300 ft., 27 December 1970 *H. J. Webster et al. 233-d* (FLAS; isotype NY).

Plants brownish, small, stems 0.5–2 cm, densely tufted or stems separate among other mosses; leaves ca. 1 mm long and 0.3 mm broad, not arranged in rows, imbricate when dry, erect-spreading when wet, broadest at or near insertion, gradually tapering to an acute to acuminate apex; leaves on innovations smaller but otherwise similar to stem leaves; leaf border plane, basal marginal cells thin-walled, quadrate to short-rectangular; margin at mid-leaf roughly bi- to triseriate, at apex serrate; costa mostly excurrent, 25–50 µm broad near insertion, at leaf base slightly papillate, at apex roughly serrate; leaf areolation totally translucent, or basal quadrate cells clearer, 12–25(50) × 12–15 µm, broadly mammillate at proximal or both cell ends, towards apex leaf cells gradually narrower, with distinct papilla at distal cell ends, 22–50 × 5 µm at mid-leaf and leaf apex; propagules often present, 0.5–0.7 mm long, with stalk as long as the part with leaflets. Dioicous. Perichaetial leaves from triangular concave base, abruptly subulate by excurrent costa; basal cells 30–75 × 7–12 µm, mammillate at proximal cell ends, mid-leaf and apical cells narrower, papillate. Perigonia terminal, bud-like, inner perigonial leaves from broad obovate, concave base abrubtly tapering to subulate apex, costa weak, leaf cells in concave part mammillate at proximal cell end, 50–100 × 7–12 µm, mid-leaf and apical cells narrower, papillate at both cell ends. Seta ca. 1 cm; capsule erect, ca. 1 mm long, globose or subglobose when wet, ellipsoid when dry, capsule wall smooth or wrinkled when dry; exothecial cells ± isodiametric, 25–30(37) µm, thick-walled, collar cells 7–10 rows; collar exserted; stomata cryptopore; operculum low obtuse with small mammilla; peristomes lacking; spores ca. 25 µm.

Philonotis hawaiica is recognized by its small size, the translucent areolation of leaves, the leaf cells with firm, equally thickened walls and the tiny, erect capsule. The basalmost leaf cells are wide and translucent, and they have a bulging mammilla at the proximal cell end, but mid-leaf and apical leaf cells are papillate at the distal cell ends. This character distinguishes *P. hawaiica* from the other Pacific species of the section *Philonotula* (except *P. vescoana*) which have the mammilla/papilla at the distal cell end of all leaf cells. *Philonotis hawaiica* shows variation in the breadth of leaf cells and in the length of the costa. The leaf apex is either acute with a percurrent costa or acuminate by an excurrent, stiff costa. Narrow leaves tend to have narrower cells. Although the cells are rather gradually narrower from the leaf base towards apex, in some plants the basal area with a majority of quadrate cells looks more transparent than the apical part with narrower cells.

Philonotis hawaiica is about of the same size and the leaf shapes are similar as those in *P. bartramioides*. *Philonotis hawaiica* differs in having firmer walls of the leaf cells, apical leaf cells wider, a more strongly papillate to serrate costa, the leaf margin not as strongly recurved and the peristomes lacking. *Philonotis calomicra* is another small-sized SE Asian taxon with erect capsules and bulging basal leaf cells. It has more flexuose, falcate leaves, leaf cells with thinner walls than *P. hawaiica* and a rudimentary peristome. *Philonotis hastata* is near the size of all of them, but it has larger, smooth or slightly mammillate/papillate leaf cells and a short-acute to obtuse leaf apex, and the costa not reaching the apex, percurrent or rarely shortly excurrent.

Philonotis hawaiica was compared with North American species with erect capsules, *P. cernua*, *P. erecta* and *P. sharpiana*, which are eperistomate, and *P. buckii* (Griffin 1994, 2014). *Philonotis buckii* has a peristome. *Philonotis sharpiana* is dioicous while *P. erecta* and *P. cernua* are synoicous (Griffin & Buck 1989). The diagnostic characters of *P. hawaiica* fit to *P. sharpiana*. There is a difference in the growth habit. *Philonotis hawaiica* grows usually in dense tufts but the plants of the *P. sharpiana* type are separate stems among other mosses. Later specimens with a similar growth habit were confirmed from Hawai'i.

ILLUSTRATIONS. Bartram 1933: 137 (fig. 199); Griffin and Buck 1989: 377 (figs. 34–41, as *P.*

sharpiana); Griffin 1994: 554 (fig. 418, as *P. sharpiana*).

TOTAL RANGE. Hawai'i; new to Mexico.

SELECTION OF SPECIMENS STUDIED. **USA**. Hawai'i. Hilo, 1911 *M. Newell s.n.* (H-BR); at 1500 ft., 1911 *Brother Mathias Newell 807*, *ex* herb. Lillie (H); "Flowerbed", 1975 *C. Clark 3271A* (H). Kaua'i. 25 November 1960 *Degeners & Cadenheads 27* (FH940461). Maui. 7 August 1939 *O. Degener* (FH940502), *O. Degener 23* (NY). Oahu. "In loco umbroso prope "little Greenwich", *F. Diedrichsen s.n.* (H-BR); "in lapide ad catarractam", 1846 *F. Diedrichsen s.n.* (H-BR); 11 January 1930 *E.B. Bartram 51* (NY); 1961 *W. C. Steere 61-9* (NY); 1903 *M. Fleischer B4009*, *4011–4013* (NY). — **Mexico**. The type of *P. sharpiana* (*see* above).

Philonotis pseudomollis (Müll. Hal.) A. Jaeger (Fig. 3)

Ber. Thätigk. St. Gallischen Naturwiss. Ges. 1873–74: 1875 (Ad. 1: 544). 1875. — *Batramia pseudomollis* Müll. Hal., Linnaea 37: 150. 1872. — TYPE: Australia. Queensland. Brisbane river "Australiae occidentalis, unde inter alios muscos misit Amalie Dietrich" (not seen). — *See* Koponen (2020).

Bartramia pallida Hampe, Linnaea 40: 307. 1876 (August). — *Philonotis pallida* (Hampe) A. Jaeger, Ber. Thätigk. St. Gallischen Naturwiss. Ges. 1877–78: 437. 1879. — LECTOTYPE (designated by Koponen 2020): Australia. "Ostaustralien, leg. *Eaves*" (H-BR3121012). — Synonymized by Koponen (2020).

Philonotis runcinata Müll. Hal. *ex* Ångstr., Öfvers. Kongl. Svenska Vetensk.-Akad. Förh. 33(4): 52. 1876 (between 11 October and 8 November), *syn. nov*. — *Philonotula runcinata* (Ångstr.) Besch., Ann. Sci. Nat. Bot. sér. 7, 20: 28. 1894. — LECTOTYPE (designated here): Society Islands. "Tahiti", 1852 *N.J. Andersson*, herb. J. Ångström (S-B6562, as *P. tahitensis*); isolectotypes (S-B6560, S-B6561 *ex* herb. Forstr. Dr. Georg Roth, S-B6563 *ex* herb. Hj. Möller, H-SOL-1537015, *ex* herb. Hj. Möller, NY). — NOTE. The protologue of *Philonotis runcinata* is confusing: "120. *Philonotis tahitensis* est *Philonotis runcinata* C. Müll., mscr. — [+ description] — A. *Ph. tahitensi* longa diversa". By this, Ångström (1876) actually corrected his earlier identification as *P. tahitensis* in Ångström (1873, on p. 120 = *P. hastata*) and described a new species. This probably means that J. Ångström had a letter, or at least a specimen from C. Müller, in which *P. runcinata* was mentioned or named.

Philonotis parisii Thér., Diagn. Esp. Var. Nouv. Mouss. 8: 5. 1910 ("*Parisi*"). — ISOTYPES: New Caledonia. Col d'Annieu, August 1908 *M. Buso 1196* (H-BR3083014); *M. Buso s.n.*, *ex* herb Thériot, Paris, G. Roth and Hj. Möller (S-B173718). — Synonymized by Koponen and Norris (1996) with *P. runcinata*.

Philonotis mollis (Dozy & Molk.) Mitt. var. *flagellaris* M. Fleisch., Musci Fl. Buitenzorg 2: 619. 1904. — LECTOTYPE (designated by Koponen 2010b): Indonesia. [West-Java]. Am Salak, Buitenzorg, Succamandri, [an Böschungen, 600 m], 1 May 1898 *M. Fleischer*, No. 289 Centur. Ex pl., (FH); isolectotype (H-BR); = M. Fleischer, Musc. archip. Ind. 289 (1902); syntype *ex* herb. G. Roth (S-B173667). — Synonymized with *P. laii* by Koponen (2010b).

Philonotis praemollis Broth. & Paris, Öfvers. Förh. Finska Vetensk.-Soc. 51A(17): 20. 1909. — LECTOTYPE (designated by Koponen & Norris 1996): New Caledonia. Mont Dzumac, ad terram, July 1908 *L. Le Rat 1161* (H-BR3083009!). — Synonymized with *P. runcinata* by Koponen and Norris (1996).

Philonotis australis Mitt. var. *surculigera* Dixon, Bull, Torrey Bot. Club 42: 104. 1915, *syn. nov.* — New Zealand. Otago, *Petrie* (not seen). — *See* under *P. tenuis* below.

Philonotis mollis (Dozy & Molk.) Mitt. var. *simplicicaulis* Zanten, Nova Guinea Bot. 16: 293, pl. 25 fig. 1. 1964. — HOLOTYPE: Indonesia. West Papua. Jayawijaya, Star Mts., Mt. Antares, Camp 39a, on trunk of tree in rain forest, alt. 1500 m, 11 July 1959, *B.O. van Zanten 496b* (L!; syntype no. *874b* in L!). — Synonymized with *P. mollis* by Koponen and Norris (1996) and with *P. laii* by Koponen (2019a).

Philonotis angustissima Müll. Hal. *ex* Tixier, Crypt. Bryol. Lichenol. 7: 228, fig. 2. 1986. — *Bartramia angustissima* Müll. Hal., Rev. Bryol. 14: 57. 1887, *nom. nud*. — *Philonotis angustissima* (Müll. Hal.) Paris, Index Bryol. 917. 1897, *nom. inval*. — ISOTYPES: New Caledonia. Mont Atso, *T. Saves 18* (H-BR3083018); *ex* herb. N.C. Kindberg (S). — Synonymized with *P. runcinata* by Koponen and Norris (1996).

Philonotis laii T.J. Kop., Acta Bryolich. Asiatica 3: 91, fig. 1. 2010. — HOLOTYPE: China. Hunan Prov., Wulingyuan World Heritage Area, Zhangjiajie, Huangshizhai. On cliffs in low evergreen forest along path, on moist partially shaded cliff, at 910–985 m, 8 October 1997 *T. Koponen, S. Huttunen & P.-C. Rao 51641* (H!). — Synonyms and paratypes, *see* Koponen (2010b as *P. laii*). — Synonymized by Koponen (2020).

When the New Guinean and the Pacific species of *Philonotis* were treated by Koponen and Norris (1996), *P. laii* (2010b) was not yet known. Later studies (Koponen 2019a, 2019b, Koponen *et al*. 2019) showed that I had confused *P. laii* with several small-sized taxa, *P. hastata*, *P. mollis* and *P. runcinata* (new name *P. norrisii*, *see* below). Older names were known to it only at the varietal level as *P. mollis* var. *flagellaris* from Java and *P. mollis* var. *simplicicaulis* from New Guinea.

The safe character of *P. pseudomollis*, the elongate stolons with miniature leaves and propagules, is not present in all specimens, and they obviously develop late in the growing season. When such stolons are not present, the reliable characters of *P. pseudomollis* are the stems with narrow leaves secund to one direction, and long (≥ 55 µm), regularly rectangular and narrow (ca. 5 µm) cells at mid-leaf. The identity of the

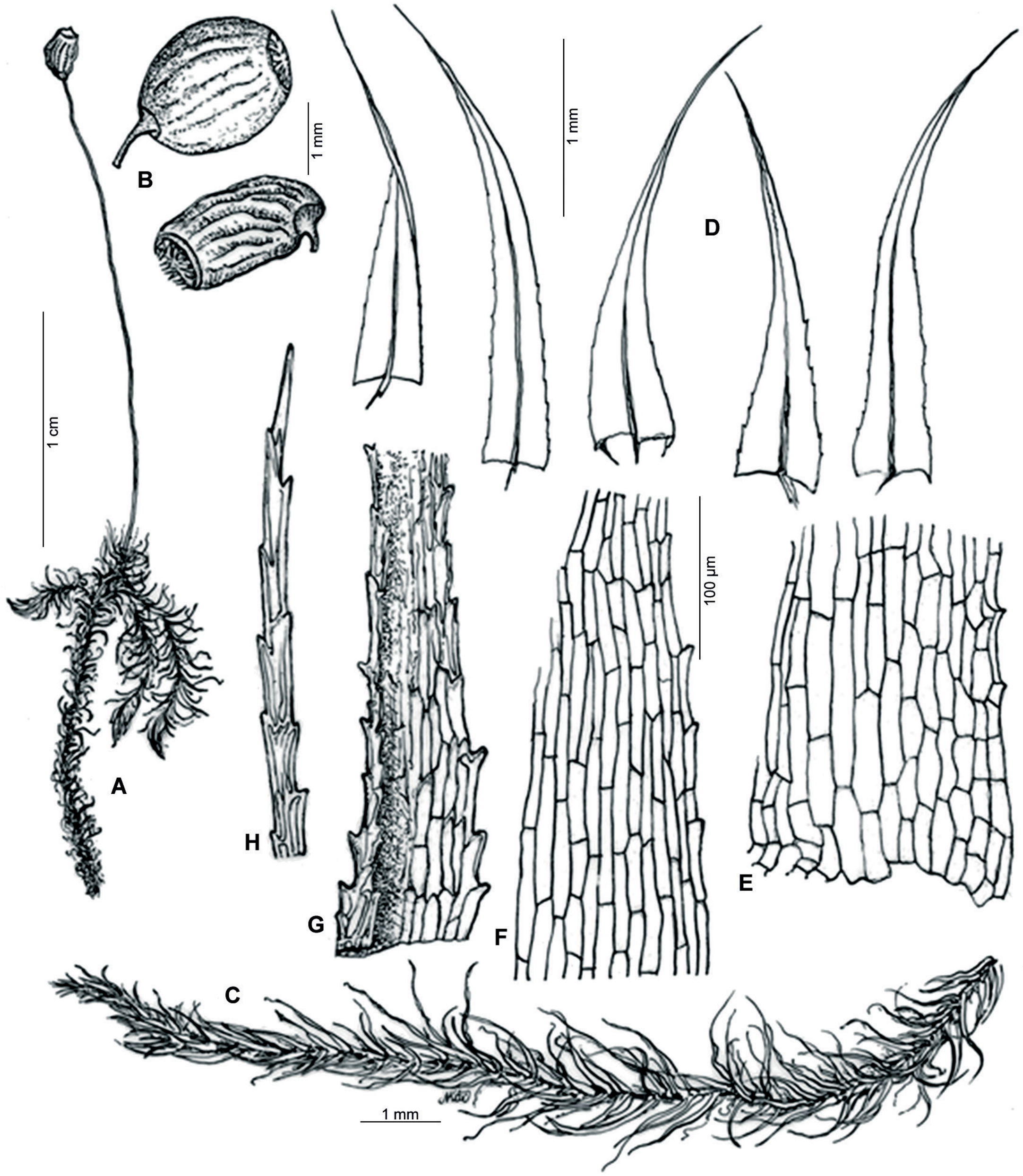

Fig. 3. *Philonotis pseudomollis* (from Yunnan, *P.L. Redfearn, Jr. 34087*, MO3980072). — **A**: Growth habit. — **B**: Capsules. — **C**: Creeping stolon with reduced apical leaves. — **D**: Leaves. — **E**: Leaf base between costa and margin. — **F**: Leaf areolation and margin at mid-leaf. — **G**: Leaf margins at leaf apex. — **H**: Leaf apex.

type of *P. angustissima* and *Newell 808* from Hawai'i (below) is confirmed by the elongate stolons with miniature leaves and propagules.

The taxonomy and diagnostic characters separating *P. pseudomollis* (as *P. laii*) from *P. hastata* and *P. mollis* were discussed earlier (Koponen 2010b, 2019a, 2019b). *Philonotis pseudomollis* has similarly a ± translucent leaf areolation as in *P. mollis*, which, however, mostly has a longly acuminate, nearly piliferous leaf apex, and much wider cells at the leaf base. *Philonotis hastata* has wider, ± smooth basal leaf cells than *P. pseu-*

domollis, and the costa is weaker in the shortly acute or nearly obtuse apex. The characters of *P. norrisii*, discussed previously by Koponen *et al*. (2019, as *P. runcinata*), are treated more accurately below under *P. norrisii*.

Illustrations. Tixier 1986: 229, (fig. 2, as *P. angustissima*); Whittier 1976: 189 (fig. 52H–K, as *P. runcinata*); Streimann 2002: 8 (fig. 2: 16–19); Tan and Ho 2008: (fig. 9 and figs. on pp. 78 and 79, as *P. hastata*); Koponen 2010b: 138 (fig. 1, as *P. laii*); Koponen *et al.* 2019: 81 (fig. 4, as *P. laii*).

Total range. *Philonotis pseudomollis* (old records as *P. laii*) has a wide range in continental SE Asia (map in Koponen 2010b), cf. Koponen (2019a, 2019b), Koponen *et al*. (2019), Koponen and Higuchi (2020). The Australian specimens were dealt with and it was recorded for New Zealand by Koponen (2020, *see* also *P. australis* var. *surculigera* below, under *P. tenuis*). Streimann (2002, as "*Philonotis* sp. B") reported it from Norfolk Island. The wide range may be a result of spreading by man. The habitats are often places disturbed by human activities such as road sides. A similar case is *Pogonatum neesii*, which ranges from continental SE Asia to Australia and the Pacific, and has a similar habitat as that of *P. pseudomollis* (Hyvönen & Koponen 2019: 119).

Selection of specimens studied. **Fiji**. Viti Levu. 29 June 1974 *D.H. Norris 44688* (H); Vanua Levu. 10 July 1974 *D.H. Norris 45415* (H). — **USA**. Hawaiian Islands. 1911 *Brother Matthias Newell 808*, *ex* herb Lillie (H-BR); Hawai'i. 22 February 1955 *W.H. Welch 16723* as *P. turneriana* (NY). — **Marquesas Islands**. 16 October 1934 *J.P. Chapin 724*, as *P. vescoana* (NY). — **New Caledonia**. Types of *P. angustissima* and *P. praemollis* (above); 1904–1909 *L. Le Rat* (H-BR3083008, 010, 013, 015–017, all as *P. angustissima*); August 1908 *M. Buso*, as *P. praemollis* (S-B173756). — **French Polynesia**. Society Islands. Type of *P. runcinata* (above); Tahiti. 3 June 1922 *W.A. Setchell & H.E. Paris 5339*, as *P. jardinii* (H-BR3122010), 26–28 September 1964 *H.O. Whittier 2549*, as *P. ?vescoana* (NY). Mooréa. July 1975 *J.L. De Sloover 20955* (NY). Rapa Island. 9 July 1934 *F.R. Fosberg 11457* (H). — **Solomon Islands** (first record). Kolombangara. 14 August 1977 *D.H. Norris 49224* & *G.L. Roberts* (H).

Philonotis pyriformis (R. Br. bis) Wijk & Marg.

Taxon 11: 222. 1962. — *Bartramia pyriformis* R. Br. bis, Trans. & Proc. New Zealand Inst. 32: 146. 1900. — Type: New Zealand. Near Lake Te Anau, rocks dripping with water, December 1890 *R. Brown* (not seen).

The specimen from Rapa Island was compared with some New Zealand specimens in H (Otago, *M. Fleischer B 127*; Campbell Island, *D.H. Vitt 3031*) and it agrees with them. Edwin B. Bartram identified the specimen as *P. vescoana*. Both *P. pyriformis* and *P. vescoana* have rather wide basal leaf cells and often the basalmost cells are bulging or papillate at the proximal cell ends. The apical leaf cells are long and narrow. In the specimens studied, the papillae in *P. pyriformis* are taller than the papillae in *P. vescoana*, and its plants are taller and the habit rather coarse.

Illustration. Sainsbury 1955: 313 (pl. 46, fig. 1).

Total range (Gilmore 2006). Australia, New Zealand.

Specimen studied. **French Polynesia**. Rapa Island, 1921? Whitney expedition, as *P. vescoana* (NY).

Philonotis secunda (Dozy & Molk.) Bosch & Sande Lac.

Bryol. Javan. 1: 156, tab. 126. 1861. — *Bartramia secunda* Dozy & Molk., Pl. Jungh. 3: 332. 1854. — Lectotype (designated by Touw 2006): Indonesia. "Java, [Junghuhn], 910,104-700, herb. Sande Lacoste L, *ex* herb. Dozy & Molkenboer; illustrated in *Bryologia Javanica*)" (L0624213). – The earlier typification by Virtanen and Koponen (1998) did not specify a particular set.

Breutelia neocaledonica Broth. & Paris, Öfvers. Förh, Finska Vetensk.-Soc. 53A(11) : 22. 1911. — Lectotype (designated by Koponen & Virtanen 1998): New Caledonia. "Nov. Caledonia Septentr. Ad radicies m. Panié" February 1910 *L. Le Rat* (H-BR0480011). — Synonymized by Virtanen and Koponen (1998).

The difficulties in separating SE Asian *Philonotis* with long-acuminate or even with piliferous leaves have been discussed previously (Koponen & Norris 1996, Koponen 2009, 2010a, 2010b, 2019a, 2019b). *Philonotis secunda* has broadly ovate leaves often quickly tapering to a nearly piliferous apex and often a rather distinct alar group formed by translucent, strongly papillate basal marginal and outer basal cells. These characters, and the strong, triseriate leaf margin are present in the type of *Breutelia neocaledon-*

ica. *Philonotis falcata* has either shortly acute or long-acuminate leaves, which, however, are in five rows. This separates *P. secunda* with long-acuminate leaves from *P. falcata*. The leaf base of *P. secunda* is broader than that in *P. mollis*, which has leaves widest at the insertion and wide, translucent cells at the basal and mid-leaf. *Philonotis sullivantii* differs from *P. secunda* by narrower leaves with a stiff, excurrent costa. The capsule of *P. secunda* is elongate and distinctly striate, while the capsule of *P. sullivantii* is short (globose when wet) and when dry, the striae are not similarly distinct and the capsule in part is only irregularly rugose.

Illustrations. Dozy and Molkenboer 1855–70: tab. 126; Eddy 1996: 238 (fig. 492); Virtanen and Koponen 1998: 330 (fig. 1a–g).

Total range. Not yet known in detail. The type is from Java and the species has been reported from Vanuatu (Virtanen & Koponen 1998), Japan (Koponen 2009), New Guinea (Koponen 2019a), and Hunan Province of China (Koponen 2019b), and confirmed for many countries and islands of SE Asia (author's unpubl. data).

Specimens studied. **New Caledonia**. The type of *Breutelia neocaledonica* (*see* above). — **Samoa**. Viti Levu, 1941 *O. Degener 14471*, as *P. revoluta* (FH940501, NY).

Philonotis sullivantii (Müll. Hal.) Paris (Fig. 4)

Index Bryol. Suppl. 268. 1900. — *Bartramia sullivantii* Müll. Hal., Flora 82: 448. 1896. — *Philonotis turneriana* var. *sullivantii* (Müll. Hal.) E.B. Bartram, Bernice P. Bishop Mus. Bull. 101: 142. 1933. — Lectotype (designated here): USA. From the protologue: "Insulae Hawaiicae, sine loco speciali: Dr. *W. Hillebrand* copiose legit 1872"; from the label in C. Müller's handwriting: "*Philonotis sullivantii* mihi nsp Insulae Hawaicae: Dr. *Hillebrandt* lgt. Hb. C. Müller" (H-BR3121005). — Syntype: USA. Hawai'i. 1886 *F.L. Clarke* (not seen).

Bartramia macroglobus Müll. Hal., Flora 82: 448. 1896. — *Philonotis macroglobus* (Müll. Hal.) Paris, Index Bryol. Suppl. 267. 1900. — Possible syntypes: USA. Hawai'i. From the protologue: "West Maui, in faucibus montium, 3000 ped. alt., *D.D. Baldwin*"; from the label in V.F. Brotherus's handwriting: "*Philonotis macroglobus* (C.M.) W.-Maui, in ravines on rocks, 3000', 1875, leg. *D.D. Baldwin 35*" (H-BR3122017); 1875 *D.D. Baldwin 35* (FH940530). — Syntype: USA. Hawai'i. Molokai, "Pali of Wailan", *Dr. W. Hillebrand s.n.* (not seen). — Synonymized with *P. sullivantii* (as *P. turneriana*) by Bartram (1933).

Philonotis baldwinii Broth., Boll. Soc. Bot. Ital. 1904: 21. 1904, *nom. nud*. — Original collections: USA. Hawai'i. From the protologue: "Ins. Maui occid., socia *Plagiochila Gaudichaudii*, 1876, ster. ([*Baldwin*] *n. 205 p.p.*" (not seen); "Ins. Maui or. ad rupes humentes vallis prope Glenside, 90 m, Jan. 1901 [*Baldwin*], ster" (not seen); "Ins. Maui loco non notato, 1875 [*Baldwin*], ster." (not seen in H-BR); "= *Philonotis Baldwinii* Broth. *nov. spec.* (in litt. 1903, "cotype"), in insula Maui, 1875, *D.D. Baldwin*, Bryotheca E. Levier, determ. V.F. Brotherus n. 1188" (FH220028; *ex* herb. G. Roth, S-B173173). — Synonymized with *P. falcata* by Bartram (1933).

Philonotis pulchella J.K. Small, Mosses of the Hawaiian Islands distributed by J.K. Small (label), *nom. nud*. — Original collection: USA. Hawai'i. On dripping rocks, near falls of the Hanapepe River, Kauai, 1895 *A.A. Heller* (NY).

Brotherus (1924) knew two species of the section "*Euphilonotis*" from Hawai'i: *P. turneriana*, "with leaves in ± clear rows when dry", and *P. sullivantii*, "leaves not in rows when dry". Brotherus (1924) kept *P. falcata* separate from them and gave SE Asia as its range. He did not mention at all his *P. baldwinii* (*nom. inval.*) and later rejected it (Brotherus 1927). However, on the labels of his herbarium specimens he synonymized *P. baldwinii* with *P. falcata*. It can be added that several early authors, including Brotherus, used the name *P. turneriana* instead of *P. falcata* for Asian specimens. Three envelopes of *P. turneriana* in Brotherus' herbarium contain mostly *P. falcata*. This misunderstanding continued still in Kabiersch's (1937) monograph (*see* Koponen 1998, 2009, 2010a, 2019a, Koponen & Higuchi 2020).

Two of the four species of *Philonotis* which Bartram (1933) accepted for Hawai'i, *P. hawaiica* and *P. laxissima* (= *P. hastata*) are small-sized and rather easily distinguished (*see* under *P. asperifolia*). Two larger species he named *P. falcata* and *P. turneriana*. He separated these taxa by several characters, such as the shape of leaves, characters of the leaf margin and costa and the length of basal leaf cells. For Bartram's "*P. turneriana*" two possible names are available, *P. macroglobus* and *P. sullivantii*. These were described in the same publication by Müller (1896, as *Bartramia*). Bartram (1933) synonymized *B. macroglobus* with *P. turneriana* and, at the same time, made the combination *P. turneriana* var. *sullivantii*. If this, and Brotherus's (1924) selection of names (he did

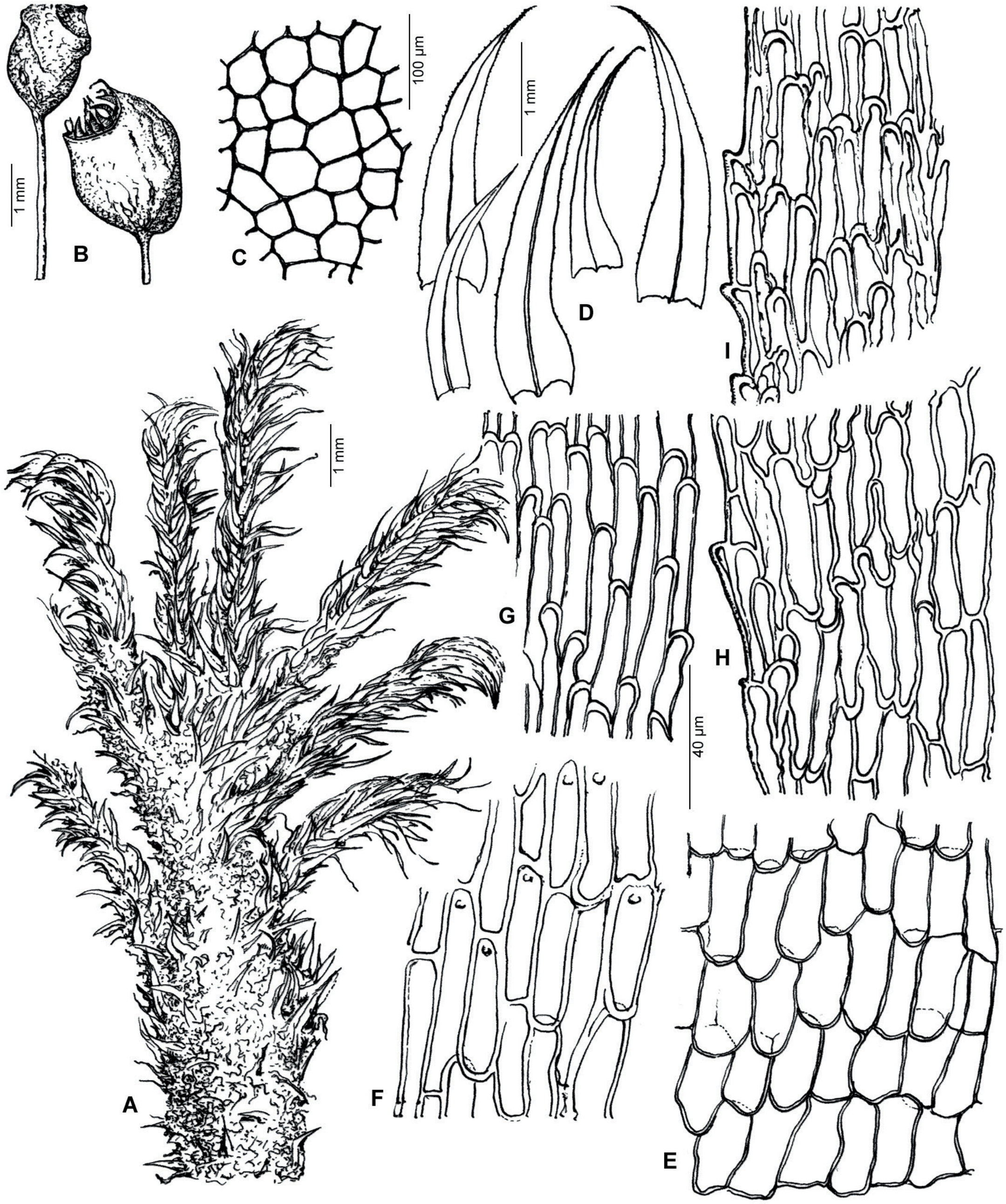

Fig. 4. *Philonotis sullivantii* (from the lectotype *W. Hillebrand*, H-BR3121005). — **A**: Growth habit. — **B**: Capsules. — **C**: Exothecial cells of capsule. — **D**: Leaves. — **E**: Basal leaf cells. — **F** and **G**: Leaf cell areolation at mid-leaf. — **H**: Leaf margin at mid-leaf. — **I**: Leaf margin at apex.

not mention *P. macroglobus*), is followed, the Hawaiian taxon shall get the name *P. sullivantii*.

Plants green to brownish, glossy, loosely or tightly tufted, small to tall, 1–5(10) cm; old shoots with dense rhizoid cover; innovations short but stout; leaves 1.3–1.9(2.5) mm long and 0.5–0.6 mm wide, imbricate and erect when dry, erect-spreading when wet, falcate-secund, concave, from ovate base gradually tapering to acuminate apex, not arranged in rows; leaves on innovations narrower than leaves from below perichaetium; leaf margin plane or slightly revolute at base; 1–5 basal leaf margin cells thin-walled, roundish or irregularly shaped, translucent, margin next to them biseriate, at leaf apex serrate; costa strong, long-excurrent, 40–50 µm wide near base, dorsally with papillae or protruding cell corners on both sides of costa; leaf areolation mostly opaque, basal leaf cells 15–40 × 7–12 µm, quadrate to short-rectangular, mid-leaf cells elongate with sharp ends or vermiculate, 15–55 × 5 µm, distinctly narrower than basal cells, apical leaf cells elongate, prosenchymatous or vermiculate 17–52 × 5 µm; all leaf cells with distinct papilla at distal cell ends; thin-walled, translucent outer basal cells together with thin-walled basal marginal cells in leaves of adult female stems appearing as an alar group; alar group small or absent on leaves from innovations. Short-leaved propagules seen in one specimen. Dioicous. Perichaetial leaves 1.7–2.0 mm long, base broad-triangular, with long, excurrent costa; areolation translucent; cells only slightly mammillate; perigonia terminal, discoid; perigonial leaves 2.3–3 mm long, with broad, concave base and lax, translucent areolation, contracted quickly to long, acuminate apex with dense areolation. Growth of male plant continued often by only one innovation. Setae 2–5 cm; capsules 2–4 mm long, horizontal, globose, ellipsoid or gibbous, old capsules constricted below mouth, irregularly furcate in distal part both dorsally and ventrally, proximal part wrinkled; both ridge cells and furrow cells 50–75 µm, ± isodiametric; ridge cells conspicuously collenchymatous, striae cells thin-walled; mouth cells 7–9 layers. Calyptra mitrate. Operculum nearly flat, mammillate. Exostome ca. 450 µm, endostome ca. 400 µm, cilia reduced. Spores ca. 25 µm, minutely papillate.

The habit characters of *P. sullivantii* are its brownish, lightly lustrous color and rather stiff, falcate-secund leaves. These are erect to erect-sprerading when dry and erect-spreading when wet. The innovations are rather short. The male plants are more slender than the female plants and their leaves often are more falcate and more spreading. When the leaves are short and densely situated, the habit of male plants is very different from the habit of female plants. The basal leaf cells are narrow, with a distinct papilla at the distal cell ends and often thick-walled so that cell corners are rounded nearly like trigones. The row of thin-walled, roundish or irregularly shaped cells of the basal leaf margin and the thin-walled outer basal cells may appear as an alar group. This is best seen in the stem leaves; in the leaves of the innovations the alar group is not as distinct or is absent. The teeth of the leaf margin are biseriate at mid-leaf and the apical leaf is serrate. The leaf border may be revolute at base, or sometimes plane. The capsule is irregularly furcate, the striae are not similarly regular as in *P. secunda*.

A major problem in the Hawaiian *Philonotis* flora are the plants named as *P. falcata* (Bartram 1933). For solving the problem of *P. sullivantii versus P. falcata* in the Hawaiian Islands, Bartram's specimens from the Farlow Herbarium (FH) were studied. The comparison of the Hawaiian specimens with SE Asiatic *P. falcata* specimens showed that the Hawaiian plants most resemble the short-leaved forms of *P. falcata*, described as "var. *carinata* Mitt." (*see* Kabiersch 1937, Koponen 2010a, 2019b). The habit of Hawai'ian plants resembles that of Asian plants; the leaves are distintly falcate, but shorter, ± triangular and with a strong excurrent costa. The basic difference between the SE Asian and Hawaiian plants is that the former has the leaves in five spiral ranks along the stem. This is one of the characters used in the keys to distinguish *P. falcata* from the other taxa. This character is absent from the Hawaiian plants, in which the leaves are spirally arranged along the stem. A microscopic study revealed other distinctions. The Hawaiian plants have the basal leaf cells shorter and narrower with thicker walls and taller papillae. The basal leaf margin of Asian plants (= *P. falcata*) has one to 10 roundish thin-walled cells. These cells in Hawaiian plants are similar, but among the roundish cells there are irregularly shaped cells with bulging corners, and basal marginal cells often form a distinct group with basal cells. In the Asian plants (= *P. falcata*) the alar group is less differentiated, consisting at most of several translucent cells in large leaves. In fact, the alar differentiation and opaque basal cell areolation in Hawaiian "*P. falcata*" is rather similar to the same characters in

P. sullivantii (*see* above). Moreover, it was discovered that the male plants of *P. sullivantii* are more slender than female plants, and their stem leaves are narrower and more spreading than the leaves from the female stems. My decision is that the Hawaiian plants named *P. falcata* are *P. sullivantii*, possibly depauperate male plants.

ILLUSTRATIONS. Bartram 1933: 141 (fig. 103, as *P. turneriana*), 140 (fig. 102, as *P. falcata*).

TOTAL RANGE. Endemic to Hawai'i.

SELECTION OF SPECIMENS STUDIED. **USA**. Hawaiian Islands. Exsiccata: Hoe, W.J. 1975: Bryophyta Hawaica exs. Ser 1: Musci 29 (H). [Dozens of specimens in FH, H, H-BR and NY as *P. sullivantii*, *P. turneriana* and *P. macroglobus*]. "Insulae Hawai'ienses", 1876 *D.D. Baldwin 4* (H-BR3122915, as *P. macroglobus*). Hawai'i. Hilo, 1911 *M. Newell 628* (H-BR3122912, as *P. baldwinii = P. falcata*), *M. Newell 630*, *884* (H-BR3122016, 3122021 as *P. baldwinii = P. falcata*), *629* (H, as *P. turneriana*), *M. Newell 627*, *631* (H-BR, as *P. turneriana*), *855* (H); 1913 *M. Newell 854*, *883* (H-BR, as *P. turneriana*); Kohala Mts., 1 January 1932 *H. St. John 11515* (FH940504); Mauna Loa, 19 September 1922 *C. Skottsberg 1371* (FH940537), *1381* (H-BR3122022). Kaua'i. Kaua'i Co., 30 January 2015 *J.R. Shevock 46359* (CAS, H). Maui. Eastern part, 11 February 1930 *E.B. Bartram 565a* (FH940519, as *P. macroglobus*); Haleakala Nat. Park, 13 June 1975 *W.J. Hoe 3492.0* (H, NY). Moloka'i. Northern slope of Hanaliioliio, 24 April 1928 *O. Degener & H. Wiebke 2784* (FH940524). Oahu. Near Kaaumakua, 22 February 1928 *H.F. Bergman* (FH940510); Koolan Mts., 19 January 1930 *E.B. Bartram 158a* (FH940516, as *P. macroglobus*), *E.B. Bartram 157* (H, as *B. turneriana*); Kaala, 29 November 1969 *W.J. Hoe 1920.0* (FH940539).

Philonotis thwaitesii Mitt.

Proc. J. Linn. Soc. Bot. Suppl. 1: 60. 1859 ("*Thwaitesii*"). — LECTOTYPE (designated by Koponen & Norris 1996): Sri Lanka. Central Prov., *G. Thwaites C.M. 91* (NY herb. Mitten); isolectotypes: herb. Mitten (NY, H-SOL).

Philonotis revoluta Bosch & Sande Lac., Bryol. Jav. 1: 158, pl. 128. 1861. — LECTOTYPE (designated by Koponen & Norris 1996): Indonesia. Java, *F.W. Junghuhn* (L, herb. v. d. Sande Lacoste).

Philonotis socia Mitt., J. Linn. Soc., Bot. 8: 151. 1864. — TYPE: Japan. Nagasaki, *Oldham* (H-SOL). — Synonymized by Ochi (1970).

Philonotis yunckeriana E.B. Bartram *in* Yuncker, Bernice P. Bishop Mus. Bull. 220: 15. 1959, *syn. nov.* — HOLOTYPE: Tonga. Niuafo'ou, on soil in open area just above 1946 lava flow, on way to summit of main crater, 16 May 1953 *Yuncker 16017* (FH-Bartram), 2 isotypes: NY (*ex* herb. W. Welch). — Further synonyms, *see* Koponen and Norris (1996).

Philonotis thwaitesii has stiff, nearly straight leaves with acute to acuminate apices and both leaf borders revolute from base to near the apex. A special character is the wide areas of quadrate cells at the basal leaf separated from the costa by only a few rows of ± rectangular, elongate cells. This separates it from *P. norrisii* (*see* under that species), which is smaller, has both quadrate and rectangular cells mixed at basal leaf, and has one or both leaf borders revolute at base. The specimen *K. & L. Rechinger 3277* (*see* below) has shortly acute leaves but the quadrate basal leaf cells and revolute leaf border fit *P. thwaitesii*. *Philonotis thwaitesii* can hardly be confused with the species with long-acuminate or piliferous leaves, these being *P. secunda*, *P. sullivantii* and *P. vescoana.*

Koponen and Norris (1996) synonymized *P. yunckeriana* with *P. runcinata*, but I remember doing so hesitatingly. Its narrow leaves are widest at insertion and taper gradually to an acute apex with an excurrent costa. Both leaf borders are revolute and the strong leaf border is 2–4-seriate. All leaf cells have a distinct papilla at the distal cell ends. Basal leaf cells near the costa are are ± short-rectangular and distinctly broader than mid-leaf cells. The costa is percurrent and very strong, so that the unistratose part of lamina is narrow. *Philonotis yunckeriana* resembles nearest *P. thwaitesii*; it has a group of quadrate outer basal cells, but the area of quadrate cells does not range across the basal leaf as in typical *P. thwaitesii*. The type of *P. yunckeriana* represents a plant of which I have not seen other specimens, and is here synonymized with *P. thwaitesii* with some hesitation.

ILLUSTRATIONS. Dozy and Molkenboer 1855–70: tab. 128 (as *P. revoluta*); Brotherus 1924: 463 (fig. 405A–D); Kabiersch 1937: 98 (Abb. 31, fig. 13, as *P. socia*); Bartram 1939: pl. 12, fig. 201, *as P. revoluta*); Ochi 1963: tab. 7 (figs. A–S, as *P. socia*); Ochi 1970: 25 (fig. 49); Iwatsuki and Mizutani 1972: pl. 18 (fig. 252, as *P. socia*); Gangulee 1974: 1122 (fig. 546); Noguchi 1989: 561 (fig. 245 B); Koponen and Norris 1996: 15 (fig. 6); Koponen *et al.* 2019: 84 (fig. 5).

TOTAL RANGE. *Philonotis thwaitesii* is one of the most common *Philonotis* species in SE Asia (*see* Ochi 1962, 1963, as *P. socia*, range in Japan; Koponen 2019b, range in Hunan Province of China). The range in SE Asia extends from the

Himalayas to Japan in the east and New Guinea in the south. New to Hawai'i.

Specimens studied. **USA**. Hawai'i. Oahu, 19 April 1895 *A.A. Heller 2171* (NY). — **Samoa**. Lanutoo, August 1905 *K. & L. Rechinger 3277* (H-BR3122007). — **Tonga**. Type of *P. yunckeriana* (*see* above). — Note: Miller *et al.* (1978) listed *P. thwaitesii* (as *P. revoluta*) from Fiji, Carolines and Marianas.

Philonotis vescoana (Besch.) Paris

Ind. Bryol. 931. 1897. — *Philonotula vescoana* Besch., Ann. Sci. Nat. Bot. sér. 7, 20: 29. 1894 ("*Vescoana*"). — Lectotype (designated here): French Polynesia. Society Islands. Tahiti, *J.N.E. Vesco* (herb. É. Bescherelle, BM); isolectotype (FH). — Synonymized erroneously with *P. asperifolia* by Koponen (2019a).

Philonotis setosa Broth. & Paris, Öfvers. Förh. Finska Vetensk.-Soc. 80A(11): 22. 1911. — Lectotype (designated by Koponen & Norris 1996): New Caledonia. Dent de St. Vincent, 1425 m, July 1909 *L. Le Rat 1434* (H-BR3083011). — Synonymized with *P. vescoana* by Koponen and Norris (1996).

Philonotis novoguineensis Reimers, Hedwigia 69: 126. 1929. — Type: Indonesia. "Nova Guinea neerlandica: in reg. flum. Mamberamo, in monte Doorman. 3260 m", 24 October 1920 *H.J. Lam 1711* (not seen). — Synonymized by Koponen and Norris (1996).

Philonotis hamata E.B. Bartram, Lloydia 5: 266, pl. 2, fig. 23. 1942. — Holotype: Indonesia. Irian Jaya. Jayawijaya, 9 km NE of Lake Habbema, 2800 m camp. Abundant on clay of landslip in forest, alt. 2800 m, October 1938 *L.J. Brass 10604* (FH-Bartram). — Synonymized by Koponen and Norris (1996).

Philonotis pilifera Dixon *ex* E.B. Bartram, Bishop Mus. Occ. Pap. 19: 224. 1948. — Holotype: Fiji. Viti Levu, Nadarivatu, ca. 2700 ft., March 1941 *W. Greenwood 756* (FH). — Synonymized with *P. vescoana* by Koponen (2014).

The type of *P. setosa* has longly acuminate nearly piliferous leaves and a similar areolation of thin-walled elongate leaf cells and a few cells with central papilla as in the type of *P. etessei*, synonymized with *P. asperifolia* (*see* above). However, it has some basal leaf cells with proximal papillae, which refers it to *P. vescoana*.

Philonotis vescoana differs from three other common Pacific species, *P. asperifolia*, *P. hastata* and *P. pseudomollis*, by the basal leaf cells being ± bulging or papillate at proximal cell ends, and a stronger bi- to triseriate leaf border. *Philonotis hastata* has wide leaf cells and *P. pseudomollis* very narrow and long mid-leaf cells. The basal leaf cells of *P. vescoana* are ± translucent and mammillate/papillate at proximal cell ends and they are wider than the opaque mid-leaf and apical leaf cells. Koponen and Norris (1996) connected the epithet *vescoana* (listed erroneously as a synonym of *P. asperifolia* by Koponen 2019a) to the most common *Philonotis* occurring in New Guinea. The restudy of the type of *P. asperifolia* revealed that the New Guinea plants are larger and stronger, including larger capsules, 2–3.5 mm long, which are 1–1.5 mm long in the type of *P. asperifolia*. Whittier (1976) mentioned this difference in the capsule sizes of *P. asperifolia* and *P. vescoana*.

Philonotis vescoana was described from the Society Islands and has since then been reported from several Pacific islands and under various names. Instead, it has been unknown to the workers on the continental SE Asia and neighboring island groups. Koponen and Norris (1996), and later Koponen (2019a, as *P. asperifolia*) found *P. vescoana* to be the most common species of *Philonotis* on the high elevation mountains in New Guinea. It was described as *P. novoguineensis* by Reimers (1929) and as *P. hamata* by Bartram (1942) from New Guinea.

Illustrations. Bartram 1936: 11 (fig. 4, as *P. viridifolia*); Bartram 1942: 265 (fig. 23, as *P. hamata*); Whittier 1976: 194 (fig. 53, as *P. vescoana*); Koponen and Norris 1996: 17 (fig. 7, as *P. vescoana*); Eddy 1996: 232 (fig. 488 E–F, as *P. nitida*, drawn from a collection of *P. hamata* (= *P. vescoana*); Koponen 2014: 135 (fig. 1, as *P. vescoana*); Koponen *et al.* 2019: 78 (fig. 2A and G–I).

Total range. In addition to the Pacific area, *P. vescoana* ranges from New Guinea through the Philippines to Japan (author's unpubl. data). Koponen *et al.* (2019, as *P. asperifolia*) recorded it from Vietnam.

Specimens studied. **Fiji**. Viti Levu, 1947 *A.C. Smith 5204*, as *P. pilifera* (NY); Naitasiri, 21 August–18 September 1947 *A.C. Smith 6096* (NY); Ba Prov., 28 July 1974 *D.H. Norris 44491*, *44495*, *44500*, *44501* (all in H); E of Nadarivatu, 29 July 1974 *D.H. Norris 44695* (H); near Nadrivatu, 28 July 1974 *D.H. Norris 44377* (H). — **French Polynesia**. Marquesas Islands. Nukuhiva, 15 October 1947 *J. Eriksson 33bis* (H). Society Islands. 1896 *J. Nadeaud 281*, as *P. vescoana*, *Mousses de Tahiti* coll. no. 1 (H-BR3122011); Tahiti, *Nadeaud 280* (NY, *ex* herb. Bescherelle, as *P. vescoana*). — **New Caledonia**. Type of *P. setosa* (*see* above), and July 1904 *L. Le Rat*, as *P. angustissima* (H-BR3122004). — **Samoa**.

Samoa. *Powell 34* (NY); Upolu, *K. & L. Rechinger s.n.* (H-BR3122023), *L. & C. Rechinger*, det. V. F. Brotherus = *Krypt. exs. mus Palat. Vindob*. 1796 (exsiccate; H, NY).

Species excluded from Hawaiian and Pacific flora

Philonotis falcata (Hook.) Mitt.

J. Linn. Soc. Bot. Suppl. 1: 62. 1859. — *Bartramia falcata* Hook., Trans. Linn. Soc. London 9: 317, 27 f. 4. 1808. — *Philonotis fontana* var. *falcata* (Hook.) Brid., Bryol. Univ. 2: 21. 1827. — Lectotype (designated by Koponen 2012): Nepal. Coll. Dr. *Buchanan*, herb. Hooker, Dr. *Smith 1808*, No. H/2359, *ex* herb. Kew (BM); isolectotypes: *ex* herb. Dawson Turner, *ex* herb. Hooker (BM).

The taxonomy of *P. falcata* was discussed by Koponen (1996, 2003, 2009, 2010a, 2012, 2019b), and the characters distinguishing *P. falcata* from *P. sullivantii* under the latter taxon above.

Illustrations. Ochi 1962: pl. 4 (figs. A–D, drawn from the type of *P. falcata*); pl. 5 (figs. A–F, drawn from the type of *P. carinata*); Noguchi 1989: 569 (fig. 252A and B); Koponen 1996: 115 (fig. 1); 2012: 154 (fig. 1); Eddy 1996: 234 (fig. 489); 235 (fig. 490, as *P. turneriana*); Kürschner and Ochyra 1999: 272 (fig. 2); Koponen *et al*. 2012: 29 (fig. 3); Koponen *et al*. 2019: 79 (fig. 3J–N).

Total range. *Philonotis falcata* ranges from Africa (Koponen 2003) through southwest Asia (Koponen 1996, 2012), Himalayas and China (Koponen 2019b) to Japan and Russian Far East (Koponen *et al*. 2012). The southernmost localities in Asia are in Java Island. Excluded from Hawai'i.

Philonotis runcinata Müll. Hal. *ex* Ångstr.

Öfvers. Kongl. Svenska Vetensk.-Akad. Förh. 33(4): 52. 1876 (between 11 October and 8 November). — *Philonotula runcinata* (Ångstr.) Besch., Ann. Sci. Nat. Bot. sér. 7, 20: 28. 1894. — Synonymized with *P. pseudomollis*, *see* above.

Philonotis turneriana (Schwägr.) Mitt.

J. Linn. Soc. Bot. Suppl. 1: 62. 1859. — *Bartramia turneriana* Schwägr., Spec. Musc. Suppl. 3(1): 238. 1828 ("*Turneriana*"). — Lectotype (designated by Koponen 2009): Nepal. "Hooker misit" (G!, herb. Schwägrichen).

The diagnostic characters of *P. turneriana* are its lustrous, lanceolate, plane or slightly concave, ± straight leaves with a piliferous apex, and rather dense areolation throughout the leaf. The leaf border may be slightly revolute at the basal margin. The lustrous habit and the shape of leaves are similar to *P. sullivantii*, but the leaf apex in the latter is acuminate with a strong, excurrent costa while *P. turneriana* has ± piliferous leaves. Moreover, *P. turneriana* has no translucent alar group and the leaf is broadest at the insertion, while in *P. sullivantii* it is broadest above the insertion; the basal leaf is ± narrowly ovate. The taxonomy of *P. turneriana* was discussed by Koponen (2009, 2010a, 2019a) and Koponen and Higuchi 2020).

Illustration. Ochi 1962: pl. 2A–D, drawn from the type specimen of *P. turneriana*.

Total range. *Philonotis turneriana* is distributed in the Himalayan area, I have studied specimens from Yunnan and Sichuan provinces of China, and provisionally from the Philippines and Taiwan (author's unpubl. data). Excluded from Hawai'i.

Doubtful taxa

Philonotis jardinii, *P. st.-johnii* and *P. viridifolia* are listed below as doubtful species. Koponen and Norris (1996) studied their types, but, at that time, the identity of *P. laii* with *P. pseudomollis* was not yet known and *P. asperifolia* was misunderstood. Therefore, the identity of these species needs confirmation.

Bartramia rigida Sulliv.

in Exped. Wilkes. p. 11" (Sullivant 1859; not seen, cited from Miller *et al*. 1978).

In the protologue of *Bartramia* (*Philonotis*) *sullivantii*, Müller (1896) cited this name as a synonym, but it is lacking in *Index Muscorum* (van der Wijk *et al*. 1967, 1969). Miller *et al*. (1978) treated it as a synonym of *P. sullivantii*.

Philonotis angustissima var. **gracilis** Thér.

Bull. Acad. Int. Geogr. Bot. 19: 22. 1909. — TYPE: New Caledonia. Yahoué at 100 m, leg. *Franc* (not seen).

Philonotis jardinii (Besch.) Paris

Index Bryol. 923. 1897. — *Philonotula jardinii* Besch., Ann. Sci. Nat. Bot, sér. 7, 20: 29. 1894 ("*Jardini*"). — HOLOTYPE: French Polynesia. Society Islands. Tahiti, 1852, *ex* herb. É. Jardin (herb. Bescherelle, BM). — Synonymized hesitatingly with *P. hastata* by Bartram (1931, as *P. laxissima*) and by Whittier (1976).

The synonymization by Koponen and Norris with *P. hastata* (1996) needs to be confirmed.

Philonotis st.-johnii E.B. Bartram

Occ. Pap. Bernice P. Bishop Mus. 15: 334. 1940 ("*St-Johni*"). — HOLOTYPE: French Polynesia. Mangareva Islands, Aukena Island, Koiovao (Koivao), moist basal cliff, alt. 15 m, 1934 *St. John 14667* (FH-Bartram).

The synonymization by Koponen and Norris with *P. hastata* (1996) needs to be confirmed. Miller *et al*. (1978) listed *P. st.-johnii* from Gambier (Mangareva, Aukena), Austral Islands (Marotiri), and Pitcairn.

Philonotis tenuis (Taylor) Reichardt, *s. stricto*

Reise Novara 1(1): 178. 1870. — *Bartramia tenuis* Taylor, Phytologist 1: 1095. 1844. — TYPE: Australia. Norfolk Island, *A. Cunningham* (not seen).

Miller *et al*. (1978) listed *P. tenuis* from Norfolk, Kermadec and Lord Howe islands, which belong to Australia and are excluded from this study. To confirm the nomenclature and range of *P. laii* (= *P. pseudomollis*), a study of Australian specimens was carried out (Koponen 2020). Also Streimann's (2002) study from Norfolk Island and Seppelt's (2004) from Macquarie Island were reviewed. The study revealed (1) two older names for *P. laii*, and (2) that *P. tenuis* includes several entities that merit specific status.

The diagnostic characters of *P. tenuis s. stricto* are its rather slender habit with leaves erect-spreading to wide-spreading from the stem, and a strongly acuminate or nearly piliferous leaf apex, outer basal cells varying from short-rectangular to subquadrate, and mid-leaf cells longly elongate. The cell walls are thick or thin and the papillae at the distal cell ends are rather low. Leaf cells with central papillae were not observed. The basal leaf marginal cells are ± quadrate or roundish and thin-walled, the margin next to them is biseriate by small, blunt teeth. The leaf areolation is ± translucent. These characters agree to the descriptions by Sainsbury (1955), Scott and Stone (1976), Catcheside (1980) and Streimann (2002).

Some Pacific specimens of *P. asperifolia* and *P. vescoana* (*see* the discussion under these taxa) showed relationships with *P. tenuis*. The habit characters and leaf shape and cellular details of *P. vescoana* resemble *P. tenuis s. stricto*. Especially slender, not yet fertile shoots of *P. vescoana* may have rather wide cell areolation from the leaf base to the apex. The major difference is that *P. vescoana* has at least several basal leaf cells mammillate/papillate at the proximal cell ends, while the corresponding cells are bulging or papillate at the distal cell ends in *P. tenuis s. stricto.* Also, the 2–3-seriate leaf border of *P. vescoana* is stronger than the biseriate border of *P. tenuis*. *Philonotis asperifolia* resembles *P. tenuis* in its cellular details such as regularly quadrate outer basal cells and elongate cells at mid-leaf, and the translucent areolation. However, the leaf apex is shortly acute in *P. asperifolia*, while it is longly acuminate or nearly piliferous in *P. tenuis*. *Philonotis asperifolia* has often cells with central papilla mixed with cells papillate at the distal cell ends; cells with central papillae were not observed in *P. tenuis s. stricto.* The mid-leaf border is stronger, 2–3-seriate in *P. asperifolia*.

Despite some similarities, *P. asperifolia* cannot likely be just a short-leaved modification of *P. tenuis s. stricto*. The independent specific status is reinforced by the fact that it has been collected with sporophytes. However, its relation to *P. tenuis* can be confirmed only by a revision of *P. tenuis s. lato* (*see* Koponen 2020). Special attention should be paid on the mammillosity/

papillosity characters of the leaf cells and on the sporophyte. *Philonotis heterophylla*, occurring in S India and Sri Lanka, shares some characters with *P. tenuis* (author's unpubl. data).

Streimann (2002) treated the *Philonotis* species of Norfolk Island. In addition to *P. tenuis* he described two taxa, named "*Philonotis* sp. A" and "*Philonotis* sp. B". The description of "sp. A" may correspond to *P. asperifolia*. For certain, his "sp. B" is *P. pseudomollis* (Streimann 2002: fig. 1: 16–19). In this connection it may be mentioned that Sainsbury's (1955) description of *P. australis* var. *surculigera* from New Zealand fits the characters of *P. pseudomollis*, which was reported from that country by Koponen (2020).

Seppelt's (2004) illustrations of the growth habit (fig. 1), leaf shapes (figs. 2–4) and leaf apex (fig. 5) do not fit reasonably well with *P. tenuis*, and neither does the illustration of midlaminal cells (fig. 6). In them the papillae are at the proximal cell ends, while in *P. tenuis* they are at the distal cell ends. The illustration represents one of the taxa included in the circumscription of *P. tenuis* by Gilmore (2006), *see* Koponen (2020).

ILLUSTRATIONS. Sainsbury 1955: 313 (pl. 46, fig. 2); Scott and Stone 1976: 339 (pl. 63); Catcheside 1980: 289 (fig. 173); Streimann 2002: 8 (fig. 2: 1–11); Bednarek-Ochyra 2014: 300 (figs. 1–7).

TOTAL RANGE (Gilmore 2006). Australia, including Lord Howe and Norfolk islands, New Zealand, Africa.

Philonotis uncinata (Schwägr.) Brid.

Bryol. Univ. 2: 221. 1827. — *Bartramia uncinata* Schwägr., Spec. Musc. Suppl. 1(2) 60: 57. 1816.

Index Muscorum gives this from Am 1–3, 5, Austr 2 (= New Zealand) and Oceania. Neither Sainsbury (1955) nor Fife (1955) mentioned it from New Zealand. I do not know what the record from Oceania is based on.

Philonotis viridifolia E.B. Bartram

Occ. Pap. Bernice P. Bishop Mus. 11(20): 11, fig. 4. 1936. — HOLOTYPE: Fiji. Vanua Levu: Mbua, upper Ndama River valley, elevation 100–300 m, on rocks in streams, *A. C. Smith 1695* (FH-Bartram).

The synonymization with *P. vescoana* by Koponen and Norris (1996) needs to be confirmed.

Discussion: floristic elements

The bryofloristic elements in the Pacific region have been discussed and grouped in several different ways based on their ranges in the continental Southeast Asia, Malesia, New Guinea and the Pacific. Schuster (1983) based his notions on the evolution and plate tectonics, and paid little attention to Pacific Island groups, including Hawai'i. Hyvönen (1989) compared the moss floras of Western Melanesia (New Guinea and Solomon Islands) with the floras of neighboring districts and worldwide and recognized 11 different groups. The oceanic species were classified into two groups, Asian–Ocenian and Asian–Oceanian–Australian. Enroth (1991) found the same 11 groups within the hepatic floras. Piippo (1992) identified four main areas of hepatic affinity: (1) Australia and New Zealand, (2) New Guinea and adjacent areas, (3) Malaysia, and (4) Sino-Japanese area and Bhutan. Piippo and Koponen (1997), based on moss floras, distinguished three main areas of affinity: (1) Australia and New Zealand, (2) New Guinea and neighboring Melanesia, and (3) northern area, represented in their study by Bhutan and Korea. The disjunct floras of Hawai'i and the Society Islands did not have a close relation to the other areas. Pócs *et al.* (2019) included the taxa of the liverwort genera *Cheilolejeunea* and *Drepanolejeunea* occurring in the Pacific into four elements: Malesian–Pacific (Asian-Oceanian), Indomalesian–Pacific, Pacific (reaching only New Guinea), and pantropical.

However, to my mind, in the naming of floristic elements the main part, or "core area", of the range should be emphasized. If a taxon ranges widely in continental and insular SE Asia, I think it is unnecessary to emphasize some few occurrences in the Pacific area.

According to Staples *et al.* (2004) altogether 75 species of mosses are endemic to Hawai'i, among them *Philonotis hawaiica* and *P. turneri*-

ana var. *turneriana* and var. *sullivantii*. *Philonotis hawaiica* is here reported also from North America, and the latter variety is treated as *P. sullivantii*. Whittier (1976: 38) only shortly stated that [in the Society Islands] "the general level of endemism is low and the floristic affinities with Hawaii, New Zealand, the Marquesas, and other high Pacific islands are quite clear. For mosses, endemism is below 20%." This agrees with the range of *P. asperifolia* in the Pacific.

Endemic to Hawai'i: *P. sullivantii*.
Endemic to Pacific islands: *P. asperifolia*.
Hawai'i–North America: *P. hawaiica*.
Australia–New Zealand–South Pacific: *P. pyriformis*.
Pantropical: *P. hastata*.
SE Asiatic warm temperate to subtropical, with some occurrences in the Pacific (Indomalesian–Pacific): *P. pseudomollis*, *P. secunda*, *P. thwaitesii*, *P. vescoana*.
South temperate element: *P. tenuis* (in Norfolk Island). The species of this element range in the temperate areas of New Zealand and Australia with extensions to Africa and South America.

Philonotis norrisii

Since *P. runcinata* falls in the synonymy of *P. pseudomollis*, the plant treated in my papers (Koponen & Norris 1996, Koponen 2019a) as *P. runcinata* needs another name. Koponen and Norris (1996) synonymized several species with *P. runcinata*. The types of most of them were restudied by me. *Philonotis angustissima*, *P. parisii* and *P. praemollis* are synonymous with *P. pseudomollis*. I do not know of any older name for "*P. runcinata*". Accordingly, I propose a new name for it.

Philonotis norrisii T.J. Kop., *sp. & nom. nov.*

Holotype: Papua New Guinea. Morobe Prov.: NW of Musom village (18 km N of Lae). First stream crossing 1 km NW of Musom. On road side banks with gravel and road outcrops, alt. 600 m, 6°34´S, 146°59.5´E, on cliff, 9 May 1981 *Timo Koponen 27760* (H).

Eponymy. I selected the epithet *norrisii* to honor the memory of Daniel H. Norris (1933–2017), an expert of mosses and my notable companion on excursions in Papua New Guinea in 1981, the source of a series of joint papers on Western Melanesian bryoflora.

The description of "*P. runcinata*" by Koponen and Norris (1996) contains characters of both *P. norrisii* and *P. pseudomollis*. The description below is based mainly on the holotype of *P. norrisii*.

Plants ca. 1 cm tall, pale green, in loose tufts; stems kept together by dense tomentum, branched with subfloral innovations, branches flexuose; leaves on stem below perichaetium 0.2–0.4 mm broad and 0.8–1.2 mm long, erect-spreading when dry, patent to spreading and straight to slightly secund when moist, broadest at insertion or just above it, tapering acuminate from narrowly ovate base, not piliferous; borders or one border revolute from base; basal leaf margin with a few thin-walled, roundish cells, margin next to them irregularly serrulate and then bi- to triseriate, teeth small; costa brownish, 20–30 µm at base, papillosely toothed on dorsal side, excurrent; basal leaf cells thin-walled, 5–10 × 12–22 µm, outer basal cells often quadrate, cells rectangular near costa, mid-leaf cells irregularly rectangular, 5 × 15–32 µm, thin-walled with projecting papilla at distal cell ends, apical leaf cells 5 µm wide. Dioicous; perichaetia terminal, inner perichaetial leaves with filiform apices. basal leaf cells thin-walled, papillate at distal cell ends; perigonia not found in the type specimen; setae 2–3 cm; capsules horizontal to inclined, globose to ellipsoid, sulcate and constricted below mouth when dry, ca. 1–1.5 × 1.5–2 mm; operculum low-conic; peristome teeth brown, 0.4 mm long, papillose; endostome nearly as long as exostome, basal membrane half of endostome, cilia lacking. Spores ca. 25 µm, papillose in light microscope.

Philonotis norrisii is one of the taxa unnoticed by the authors dealing with SE Asiatic moss floras (Fleischer 1904, Kabiersch 1937, Bartram 1939, Noguchi 1989). However, it is not rare in the coastal areas of the continent and the islands from Japan to New Guinea. It is a small plant, the erect stem is only ca. 1 cm tall, and the plant gives an impression that the flexuose innovations rise directly from the substrate. The color of the herbarium specimens is pale or whitish. *Philonotis norrisii* (as *P. runcinata*) was confused with *P. pseudomollis* (as *P. laii*) in my earlier papers. The differences are: (1) *P. norrisii* is smaller, fertile stems are ca. 1 cm tall, while *P. pseudomollis* stems are 1–2 cm. (2) Sterile shoots (innovations) of *P. norrisii* are flexuose, while those of *P. pseudomollis* are erect or creeping with leaves secund to one direction (later shoots develop further to slender stolons with miniature leaves and propagules). (3) In *P. norrisii* a few proximal basal marginal cells are smooth and the bi- to triseriate margin extends near the base and one or both borders are revolute. In *P. pseudomollis* the entire or crenulate basal part below the biseriate part is longer and the border is plane (compare Koponen & Norris 1996 fig. 5i as *P. runcinata* with fig. 1k as *P. laii* in Koponen 2010b). (4) The biseriate teeth in *P. norrisii* are shorter and smaller than those of *P. pseudomollis*. (5) Basal leaf cells are subquadrate to short rectangular with distinct papilla at distal cell end in both species. However, the cells are more regularly rectangular, narrower and longer in *P. pseudomollis*. The difference is clear at mid-leaf, the cells are 15–32 µm long in *P. norrisii* and to 55 µm long and only 5 µm broad in *P. pseudomollis*.

ILLUSTRATION. Koponen and Norris 1996: 13 (fig. 5, as *P. runcinata*).

TOTAL RANGE. Reported (as *P. runcinata*) from New Guinea (Koponen & Norris 1996, Koponen 2019a) and Japan (Koponen 2009). Specimens have been identified from Taiwan, the Philippines, Java and Borneo (author's unpubl. data).

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Index to names (the names of the taxa accepted for Hawai'i and the Pacific area are set in boldface).