

Genus *Pogonatum* P. Beauv. in Singalila National Park, Darjeeling, eastern Himalaya, India

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ABSTRACT

Sahu V. & Asthana A. K. 2013. Genus *Pogonatum* P. Beauv. in Singalila National Park, Darjeeling, eastern Himalaya, India. *Geophytology* 43(2): 117-124.

During investigation on the bryophytes of Singalila National Park (Darjeeling) and its neighbouring areas, 6 species of *Pogonatum* (*Pogonatum patulum* (Harv.) Mitt., *Pogonatum cirratum* (Sw.) Brid. *Pogonatum neesii* (C. Muell.) Dozy, *Pogonatum microstomum* (Schwaegr.) Brid., *Pogonatum perichaetiale* (Mont.) Jaeg. and *Pogonatum urnigerum* (Hedw.) P. Beauv.) have been identified. These are distinctly characterized by thick, rough textured leaves and hairy calyptras. Costa is either percurrent or excurrent, often toothed on upper surface. Capsule is erect or inclined and cylindrical. Operculum is rostrate with a long or short beak. A detailed morphotaxonomic account of these species, with their current status and key for identification, is provided here.

Key-words: *Pogonatum*, Singalila National Park, Darjeeling, Eastern Himalaya.

INTRODUCTION

Genus *Pogonatum* P. Beauv. is represented in India by 18 taxa (Gangulee 1969, Chopra 1975, Smith 1976, Chopra & Kumar 1981, Hyvönen 1986, 1989, Hyvönen & Lai 1991, Lal 2005, Asthana & Sahu 2012). Gangulee (1969) reported 28 species of *Pogonatum*, out of which 13 are valid, while Chopra (1975) listed 30 species from India, out of which 13 are valid. Chopra and Kumar (1981) described 6 species from western Himalaya and adjacent plains, out of which 4 taxa are valid. A morphotaxonomic account of the taxa with their current status and key for identification of species occurring at Singalila National Park (SNP), Darjeeling is provided. The plants collected from this area have been deposited in the Bryophyte Herbarium, National Botanical Research Institute, Lucknow (LWG).

A key to the species of genus *Pogonatum* from Singalila National Park, Darjeeling

- 1a. Leaf margin entire, end cells of lamellae not divided, quadrate *P. perichaetiale*
- 1b. Leaf margin dentate, end cells of lamellae divided or not divided 2
- 2a. End cells of lamellae in transverse section at maturity divided into two..... *P. microstomum*
- 2b. End cells of the lamellae in transverse section not divided 3
- 3a. End cells of lamellae not strongly differentiated, smooth 4
- 3b. End cells of lamellae strongly differentiated, thick walled papillose *P. urnigerum*
- 4a. End cells of lamellae oval, lamellae 3-5 cells high *P. patulum*
- 4b. End cells of lamellae flat on top or depressed, lamellae 5-7 cells high, leaf margin dentate up to the middle..... *P. neesii*

- 4c. End cells of lamellae rounded, 1-2 cells high, leaf margin dentate up to base *P. cirratum*

DESCRIPTION

Pogonatum perichaetiale (Mont.) Jaeg. in Ber. S. Gall. Naturw. Gos, 1873-74: 257. 1875.

Description: Plants small, growing in loose tufts, 16-25 mm long and 5-6 mm wide with leaves. Leaves incurved and appressed to stem when dry, lower leaves small. Leaves lanceolate with ovate sheathing base, 4-5 mm long and 0.8-1 mm wide, margin entire, apex acute. Costa reddish brown, excurrent in a sharp point, smooth at back. Lamellae numerous, covering almost the entire ventral surface of leaf, 4-cells high, terminal cells of lamellae larger than lower cells, quadrate, thick walled, smooth. Basal cells in sheathing part rectangular, hyaline, 28-48 μ m long and 12-16 μ m wide. Upper leaf cells quadrate to quadrate rounded, thick walled, 12-20 μ m wide, basal cells in the sheathing part 28-60 μ m long and 12-16 μ m wide, one row of cells on the margin short quadrate, 8-12 μ m wide, strongly incrassate. Seta 1.6-2.2 cm long. Capsule erect, ovate, cylindrical, 2-3 mm long and 1-1.5 mm in diameter, Spores rounded, yellowish green, 8 μ m wide.

P. perichaetiale is easily differentiated from other species by its entire leaf margin and apical cells of lamellae with all cells strongly incrassate and quadrate in shape.

Specimens examined: India - Eastern Himalaya: Darjeeling, on way to Sandakphu, Phalut (ca. 12800 ft), 26.4.1965, S. Chandra, LWG 202367B; Sandakphu, Tanglu (ca. 12800 ft), 26.4.1965, S. Chandra, LWG 202447B, 202470B; on way to Sandakphu (ca. 8600 ft), 4.11.2003, A. K. Asthana & Vinay Sahu, LWG 225345B; on way to Sandakphu from Kalapokhari (ca. 9600 ft), 5.11.2003, A. K. Asthana & Vinay Sahu, LWG 225358C.

Range of distribution: Bhutan, China, India (eastern Himalaya: Darjeeling, Sikkim, western Himalaya: Mussoorie, Chakrata, Nainital, Himachal Pradesh: Khadrula, Dalhousie, Lahul,

Beas valley, Kulu & Mandi, South India: Nilgiris), Nepal.

Pogonatum microstomum (Schwaegr.) Brid. in Bryol. Univ. 2: 745. 1827.

Description: Plants robust, green when young, brown when dry, growing in lax tufts. Stems 5-10 cm long and 1.2-1.8 cm wide including leaves. Upper leaves large, closely arranged, not curled, rigid, appressed to stem when dry, erectopate when moist, while lower leaves scale like. Leaves lanceolate, 8-12 mm long and 1.5-2 mm wide, apex acute, margin sharply toothed about $\frac{3}{4}$ of the leaves, costa reddish brown, prominent, toothed at the back above. Lamellae well developed, 3-4 cells high, covering entire surface of the leaf with end cells characteristically divided into 2 flask shaped cells, smooth. Upper leaf cells rounded to quadrate, 8-12 μ m wide, basal cells in the sheathing part 28-60 μ m long and 12-16 μ m wide, rectangular, narrower toward margin. Seta reddish brown, 2.5-2.8 cm long. Capsule erect or slightly inclined, cylindrical, 4-5 mm long and 1.2-1.8 mm in diameter, operculum conical. Calyptra with long hairs, covering whole capsule, 6-8 mm long. Peristome teeth 32 in number. Spores rounded, olive green, 8-12 μ m wide.

P. microstomum can easily be recognized in the field by its typical brownish green colour and fairly large size. The exceptional flask shaped end cells of the lamellae is also an important feature easily revealing the identity of the plant.

Specimens examined: India - Eastern Himalaya: Darjeeling, Forest rest house - Rimbick (ca. 6600 ft), 16.4.1965, S. Chandra, LWG 202002A; Tanglu Bridge (ca. 8250 ft), 24.4.1965, S. Chandra, LWG 202239A; Jalapahar-Ghoom (ca. 7500 ft), 27.9.2002, A. K. Asthana & Vinay Sahu, LWG 224223A; on way to Tanglu from Manebhanjang (ca. 7000 ft), 2.11.2003, A. K. Asthana & Vinay Sahu, LWG 224330D; on way to Tanglu (ca. 7000-8700 ft), 2.11.2003, A. K. Asthana & Vinay Sahu, LWG 224340D, 224353A, 224356B; Singalila National Park (ca. 9300 ft), 3.11.2003, A. K. Asthana & Vinay Sahu,

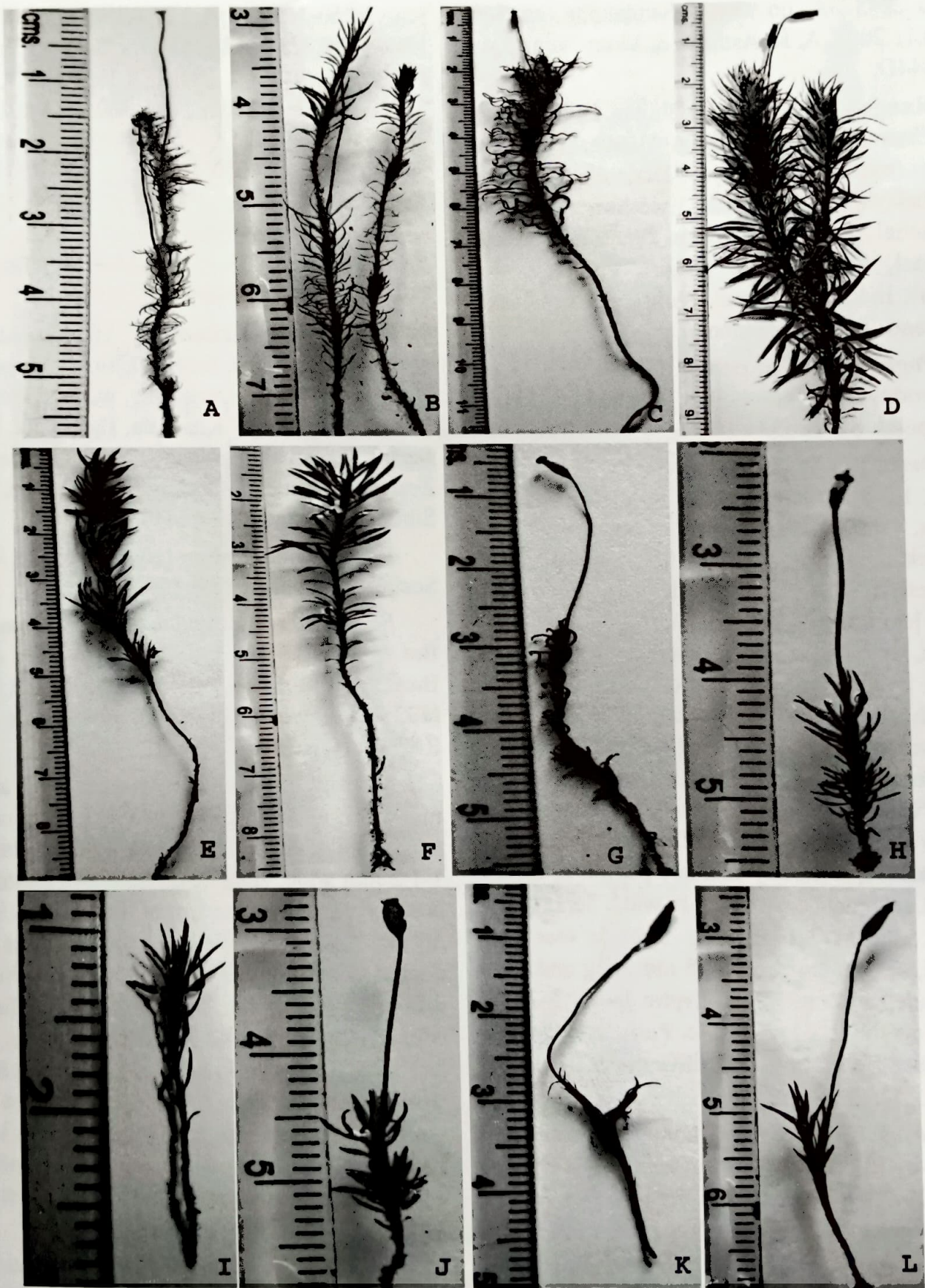


Plate 1

A-B. *Pogonatum patulum*. A. Plant in dry condition. B. Plant in wet condition. C-D. *P. cirratum*. C. Plant in dry condition. D. Plant in wet condition. E-F. *P. microstomum*. E. Plant in dry condition. F. Plant in wet condition. G-H. *P. neesii*. G. Plant in dry condition. H. Plant in wet condition. I-J. *P. perichaetiale*. I. Plant in dry condition. J. Plant in wet condition. K-L. *P. urnigerum*. K. Plant in dry condition. L. Plant in wet condition.

LWG 224373A; on way to Sandakphu (ca. 8600 ft), 4.11.2003, A. K. Asthana & Vinay Sahu, LWG 225344D.

Range of distribution: Bhutan, Burma, China (Szechuan, Taiwan, Xizang, Yunnan), Formosa, India (eastern Himalaya: Darjeeling, Sikkim, Meghalaya, Naga Hills, western Himalaya: Himachal Pradesh, Mussoorie, Dhanolti, Chakrata, Nainital, South India: Nilgiri, Palni, Western Ghats); Indonesia, Nepal, Philippines, Sri Lanka, Thailand, Tonkin, Vietnam.

Pogonatum urnigerum (Hedw.) P. Beauv. in Prodr. Cinq. Six. Fam. Aethéog. Mousses Lycopodd. 84. 1805.

Description: Plants erect, stiff, medium sized, 1.5-3 cm long and 5-6 mm wide including leaves, stem base shortly procumbent with rhizoids. Leaves not curled, stiff, linear lanceolate (appressed to stem when dry) erectopate to erect, leaf margin dentate almost along the whole length, apex acuminate, sheath of the lamina, ovate, hyaline, margin entire. Costa prominent, reddish brown, ending in an acuminate point and usually with few teeth at the back. Lamellae numerous, 5-6 cells high at middle, covering most of the ventral surface of lamina, cells quadrate to shortly rectangular, end cells highly differentiated, thick walled, distinctly coarsely papillose, brown, large. Leaf apical cells 8-12 μm wide. Seta reddish brown, erect, 2-2.2 cm long. Capsule erect, urn shaped, operculum conic, 4-5 mm long and 1-1.8 mm wide, wide mouth. Calyptra hairy, 5-7 mm long, covering whole capsule. Peristome teeth 32 in number. Spores rounded, olive green, 12-16 μm wide.

P. urnigerum is easily distinguished from other species by its terminal cells of lamellae which are distinctly thickened and papillose and leaves not curled when dry.

Specimens examined: India - Eastern Himalaya: Darjeeling, (ca. 6600 ft), 18.4.1965, S. Chandra, LWG 202078; Tanglu Bridge (ca. 8250 ft), 24.4.1965, S. Chandra, LWG 202245A, 202258B, 202266A, 202290A; Tanglu-Sandakphu

(ca. 8250-11500 ft), 25.4.1965, S. Chandra, LWG 202323B, 202338C; Tanglu-Sandakphu, Phalut (ca. 11500 ft), 26.4.1965, S. Chandra, LWG 202371B, 202377A, 202382A, 202425B, 202463B, 202471A, 202474A; on way to Sandakphu (ca. 9000-10100 ft), 4.11.2003, A. K. Asthana & Vinay Sahu, LWG 225352B, 225367C, on way to Phalut from Sandakphu (ca. 11,700-12000 ft), 6.11.2003, A. K. Asthana & Vinay Sahu, LWG 225382A, 225395D, 225396H.

Range of distribution: Africa, Antarctica, Australia, Caucasus, Eastern China, Europe, India (eastern Himalaya: Darjeeling, western Himalaya: Himachal Pradesh - Khadralla, Dalhousie, Lahul), Japan, Kamchakta, Nepal, New Guinea, New Zealand, North & South America, Pakistan, Persia, Siberia, Tasmania, West Indies.

Pogonatum patulum (Harv.) Mitt. in J. Linn. Soc., Bot. Suppl. 1: 152. 1859.

Pogonatum hexagonum Mitt. J. Linn. Soc., Bot. Suppl. 1: 151 (1859). *Pogonatum decolyi* Broth. in Brühl, Rec. Bot. Sur. India 13(1): 126 (1931). *Pogonatum strictifolium* Broth. in Brühl, Rec. Bot. Sur. India 13(1): 126 (1931).

Description: Plants 30-40 mm long and 5-7 mm wide including leaves. Leaves green, incurved and curled when dry, lanceolate, 4-6 mm long and 1-1.2 mm wide, apex acuminate, margin toothed, costa percurrent or excurrent. In the cross section of the leaves, lamellae covering almost entire ventral surface of the leaves, 3 to 5 cells high, no differentiation of the end cells of lamellae, end cells of lamellae rounded. Costa prominent. Upper leaf cells 8-12 μm wide, rounded to quadrate in shape. Basal leaf cells in the sheathing part 36-60 μm long and 8-16 μm wide. Seta reddish brown, 16-20 mm long, capsule 2.5-3 mm long and 0.8-1 mm wide. Spores rounded, olive green and 8 μm wide.

According to Smith (1976), *Pogonatum aloides* did not occur anywhere in Asia. Specimens named as *P. aloides* (Hedw.) P. Beauv. from the Himalaya usually belong either to *P. neesii* (C. Müll.) Dozy s.l., or to *P. hexagonum*. The specimen cited as *P.*

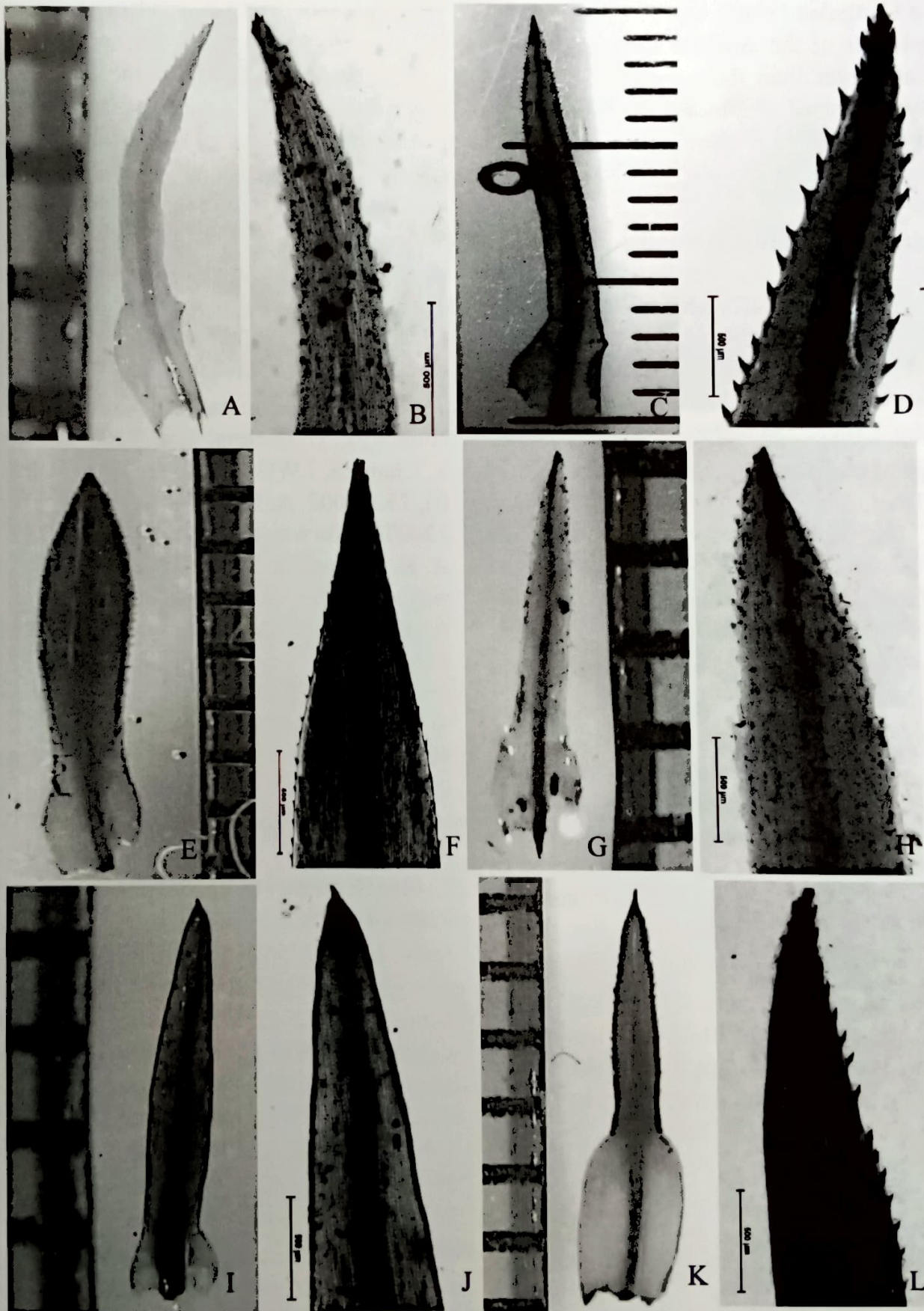


Plate 2

A-B. *Pogonatum patulum*. A. Leaf. B. Apical margin of leaf. C-D. *P. cirratum*. C. Leaf. D. Apical margin of leaf. E-F. *P. microstomum*. E. Leaf. F. Apical margin of leaf. G-H. *P. neesii*. G. Leaf. H. Apical margin of leaf. I-J. *P. perichaetiale*. I. Leaf. J. Apical margin of leaf. K-L. *P. urnigerum*. K. Leaf. L. Apical margin of leaf.

aloides in Gangulee (1969) was *P. hexagonum* in which end cells of the lamellae are oval in cross section and larger than those beneath. Hyvönen (1989) synonymised *P. hexagonum*, *P. decolyi* and *P. strictifolium* to *P. patulum*. *P. patulum* is differentiated with its closely associated species by its low lamellae.

Specimens examined: India - Eastern Himalaya: Darjeeling, Ranjeet Forest Bridge (ca. 6600 ft), 20.4.1965, S. Chandra, LWG 202224C; Gurdum Forest (ca. 11500 ft), 7.11.2003, A. K. Asthana & Vinay Sahu, LWG 225401A; Gurdum Forest (ca. 7900 ft), 8.11.2003, A. K. Asthana & Vinay Sahu, LWG 225451D.

Range of distribution: Caucasus, East Nepal, Eastern Tibet, Europe, India (eastern Himalaya: N.E.F.A, Darjeeling, Khasi and Jaintia Hills, Sikkim, western Himalaya, South India: Nilgiri, Western Ghats), Japan, North America, North and central Africa, Siberia, Thailand.

Pogonatum neesii (C. Muell.) Dozy. in Ned. Kruidk. Arch. 4(1): 75. 1856.

Polytrichum neesii C. Müll. Syn. Musc. Frond. 2: 563. 1851. *Pogonatum junghuhnianum* (Dozy & Molk.) Dozy & Molk., Bryol. Java 1: 40, f 31. 1856. *Polytrichum junghuhnianum* Dozy & Molk., Pl. Jungh. 3: 324. 1854 - Synonymized by Dixon & Potier de la Varde (1927). *Pogonatum akitense* Besch., Ann. Sci. Nat. Bot. Ser. 7, 17: 1893 - Synonymized by Hyvönen (1989).

Description: Plants erect, medium sized, growing in loose tufts. Stem 20-30 mm long and 5-7 mm wide including leaves. Upper leaves crumpled and curled when dry, erectopate to spreading when moist. Leaves linear lanceolate, 5-6 mm long and 1-1.2 mm wide, apex acute, margin sharply toothed up to middle, costa percurrent, prominent, slightly toothed at the back above. Leaf base hyaline slightly sheathing. Lamellae well developed, almost covering ventral surface of the leaf, 5-7 cells high, end cells of lamellae slightly larger, flat topped or depressed in the middle, thin walled, smooth. Upper leaf cells rounded to quadrate, 8-12 μ m wide, basal leaf cells in the

sheathing part 36-52 μ m long and 8-12 μ m wide, rectangular. Seta reddish brown, 1.7-2 cm long. Capsule erect to slightly inclined, cylindrical, 4-5 mm long and 0.8-1.8 mm in diameter, operculum conic rostrate. Calyptra hairy, felty, 6-8 mm long, covering whole capsule. Peristome teeth 32 in number. Spores rounded, yellowish green, 8 μ m wide.

P. neesii is most common species in India. It is differentiated by other species by its 5-7 cells high lamellae and end cells of lamellae slightly larger and depressed in the middle.

Specimens examined: India - Eastern Himalaya: Darjeeling, (ca. 9200 ft), 26.4.1965, S. Chandra, LWG 202509A; Tiger Hill (ca. 8400 ft), 25.9.2002, A. K. Asthana & Vinay Sahu, LWG 224074A; on way to Teesta (ca. 5600 ft), 26.9.2002, A. K. Asthana & Vinay Sahu, LWG 224162B; on way to Senchal lake Teesta (ca. 7500 ft), 27.9.2002, A. K. Asthana & Vinay Sahu, LWG 224201A, 224204C; on way to Tanglu from Manebhanjang (ca. 7000 ft), 2.11.2003, A. K. Asthana & Vinay Sahu, LWG 224336A; on way to Tanglu (ca. 8200-8600 ft), 2.11.2003, A. K. Asthana & Vinay Sahu, LWG 224344B, 224355B; on way to Singalila National Park (ca. 9200 ft), 3.11.2003, A. K. Asthana & Vinay Sahu, LWG 224364A, 224365C, 224366B; on way to Sandakphu from Gairibas (ca. 8200-8400 ft), 4.11.2003, A. K. Asthana & Vinay Sahu, LWG 225326D, 225333B; Gurdum Forest (ca. 9900 ft), 7.11.2003, A. K. Asthana & Vinay Sahu, LWG 225429C; along upper Sirikhola water stream (ca. 7800 ft), 8.11.2003, A. K. Asthana & Vinay Sahu, LWG 225465B; on way to Rimbick (ca. 6800 ft), 9.11.2003, A. K. Asthana & Vinay Sahu, LWG 225498B; Tiger hill (ca. 8000 ft), 10.11.2003, A. K. Asthana & Vinay Sahu, LWG 225522B.

Range of distribution: Australia, Bhutan, China, East Nepal, Europe, Fiji, India (eastern Himalaya: Assam, Darjeeling, Khasi and Jaintia Hills, Sikkim, western Himalaya: Mussoorie, Nainital, Simla-Dalhousie, South India: Coorg, Nilgiri, western Ghats, Palni), Indonesia, Japan,

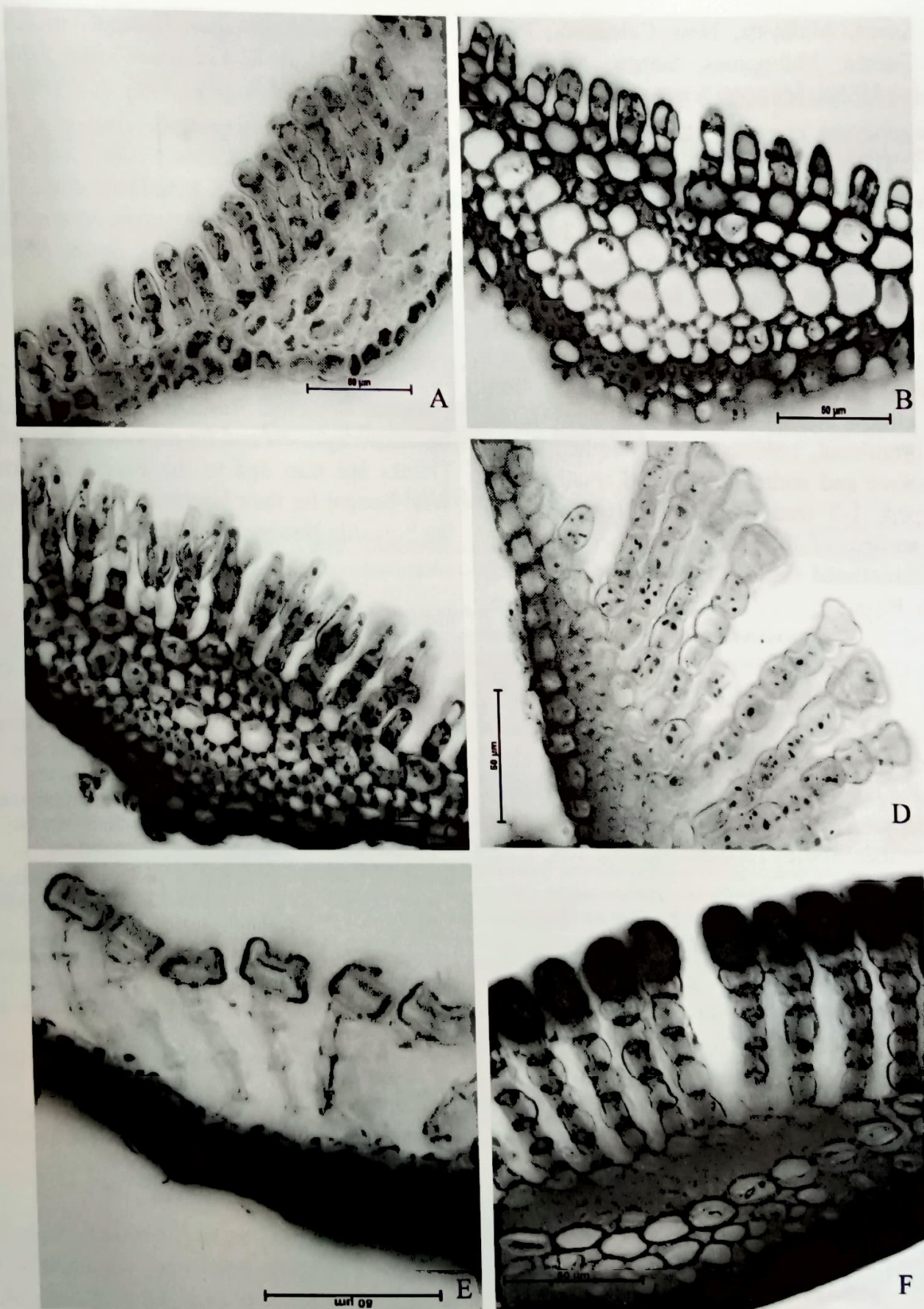


Plate 3

A-F. Cross sections of leaves showing lamellae. A. *Pogonatum patulum*. B. *P. cirratum*. C. *P. microstomum*. D. *P. neesii*. E. *P. perichaetiale*. F. *P. urnigerum*.

Java, Korea, Malaysia, New Caledonia, Papua New Guinea, Philippines, Samoa, Sri Lanka, Thailand, USSR, Vanuatu, Vietnam.

Pogonatum cirratum (Sw.) Brid. in Bryol. Univ. 2: 110. 1827.

Description: Plants robust, solitary or loosely caespitose. Stem 11-14 cm long and 1.5-2 cm broad with leaves. Lower part bracteate, gradually becoming larger upwards. Leaves curled and somewhat crumpled when dry, erect spreading when moist. Leaves linear lanceolate, 15-20 mm long and 1.5-2 mm wide, margin dentate from tip to almost end of the leaf base, apex acute, costa prominent, reddish brown, toothed at the back above and ending in spine. Lamellae well developed, 1-2 (rarely 3) cells high, covering entire surface of the leaf having lamellae with not differentiated rounded end cells, thin walled, smooth. Basal cells in the sheathing part 60-80 μm long and 12-16 μm wide, rectangular. Upper leaf cells 8-12 μm wide, rounded to quadrate, thick walled. Seta erect, reddish brown, smooth, 2.5-3 cm long. Capsule cylindrical, erect to slightly inclined, 4-6 mm long and 1.5-2 mm in diameter, operculum conic rostrate. Calyptra hairy, covering whole capsule, felty, 6-8 mm long. Peristome teeth 32 in number. Spores rounded, olive green, 8-12 μm wide.

Specimens examined: India - Eastern Himalaya: Darjeeling, Forest rest house - Rimbick (ca. 6600 ft), 16.4.1965, S. Chandra, LWG 202015A; Tanglu (ca. 8250 ft), 24.4.1965, S. Chandra, LWG 202259A; Tanglu-Sandakphu (ca. 11500 ft), 25.4.1965, S. Chandra, LWG 202333B; Singalila National Park (ca 8600 ft), 3.11.2003, A. K. Asthana & Vinay Sahu, LWG 224395; on

way to Sandakphu from Kalapokhari (ca. 9600 ft), 5.11.2003, A. K. Asthana & Vinay Sahu, LWG 225359C, 225360A.

Range of distribution: Ambonia, Bhutan, Borneo, Celebes, China, East Nepal, India (eastern Himalaya: N.E.F.A, Darjeeling, Sikkim), Indonesia, Japan, Java, Malaysia, Moluccas, New Guinea, Oceania, Philippines, South Africa, Sri Lanka, Sumatra, Thailand.

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