

THE HOOKERIACEAE OF TAIWAN

BAO-YU YANG⁽¹⁾ and WEN-CHING LEE⁽²⁾

The Hookeriaceae is essentially a tropical moss family. 16 species have been reported in Taiwan by previous writers. Cardot⁽⁴⁾ from Faurie's collection reported 4 in 1905; Horikawa⁽⁸⁻¹⁰⁾ reported 4 in 1934 & 1935; Ihsiba⁽¹²⁾ reported one in 1935; Noguchi⁽¹⁶⁻²⁰⁾ reported 5 in 1937 and 1956; Herzog and Noguchi⁽⁷⁾ reported one in 1955, and Iwatsuki⁽¹³⁾ reported one in 1964. The present writers base their studies on the materials collected at different times by Kao, Lee, Yang and others of the Department of Botany, National Taiwan University, and this adds 6 new records for Taiwan namely: *Chaetomitrium acanthocarpum* (Bryol. Jav.) Brotherus, *C. orthorhynchum* (Doz. et Molk.) Bryol. Jav., *Distichophyllum collenchymatosum* Card., *D. nigricaulis* Mitt., *Hookeriopsis sumatrana* (v. d. B. et Lac.), *Eriopus parviretus* Fleisch. *Chaetomitrium* is a new generic record for Taiwan.

Most of the 23 species mentioned were collected on Lanyu (Orchid Island), Chitou in Nantou County and in Taipei County. These being found at the altitudes from 300 to 1100 m. A few of them were collected on Mount A-li in Chiayi County as high as 2400-2600 m.

The present paper treats 10 genera: *Actinodontium*, *Callicostella*, *Chaetomitrium*, *Chaetomitriopsis*, *Cyclodictyon*, *Daltonia*, *Distichophyllum*, *Eriopus*, *Hookeria* and *Hookeriopsis*.

HOOKERIACEAE

Plants small to robust, often soft and flaccid; stems rarely branched, often flattened, loosely to densely foliate, 4-8 ranked; costa single, double or none; leaf cells smooth or papillose, usually somewhat rounded or hexagonal, often lax; alar cells not well differentiated; calyptra conic or cucullate, smooth, scabrous or pilose, generally mitriform, lobed or ciliate at base; capsule oblong, cylindrical, inclined or horizontal, usually symmetrical, outer cells lax, often collenchymatous; operculum rostrate, conic at base; seta elongate smooth or rough; peristome double, teeth 16, generally with median furrow, papillose or transversely striate.

KEY TO THE GENERA OF TAIWAN HOOKERIACEAE

- | | |
|---|------------------------|
| 1. Costa single..... | 2 |
| Costa double or none | 3 |
| 2. Stems scarcely flattened, leaves uniform | <i>Daltonia</i> |
| Stems flattened, leaves dimorphous..... | <i>Distichophyllum</i> |
| 3. Costa none | <i>Hookeria</i> |
| Costa double..... | 4 |

⁽¹⁾ Professor of Botany, National Taiwan University.

⁽²⁾ Research Assistant, Institute of Botany, Academia Sinica.

4. Costa short and faint.....5
 Costa ending beyond midleaf7
5. Leaves bordered, seta prickly.....*Eriopus*
 Leaves not bordered, seta smooth.....6
6. Leaf cells linear, shorter near apex, calyptra strongly
 hispid*Chaetomitrium*
 Leaf cells elongate, papillose at apical angles, calyptra
 sparingly pilose.....*Chaetomitriopsis*
7. Leaves bordered, seta smooth, calyptra naked.....*Cyclodictyon*
 Leaves not bordered, seta smooth or papillose, calyptra
 scabrous or naked8
8. Leaf cells unipapillate, costa strong, ending near apex.....*Callicostella*
 Leaf cells smooth, costa elongate, ending above midleaf 9
9. Peristome teeth papillose, calyptra laciniate*Actinodontium*
 Peristome teeth deeply furrowed, calyptra lobed..... *Hookeriopsis*

1. *Actinodontium* Schwager.

Actinodontium Schwaegr., Suppl. 2 pt. 2 fasc. 1: 75, 1826.

Plants dull yellow-green, in small tufts; leaves ovate lanceolate, borders not distinct; costa double, ending at or beyond midleaf; cells elongate, rhomboidal, smooth, laxer at base; capsule erect, subcylindric; lid long-beaked; calyptra naked, deeply laciniate at base; peristome teeth papillose.

1. *Actinodontium raphidostegum* (C. Muell.) v. d. B. et Lac., Bryol, Jav. 2: 37, Pl. 160, 1862.

Hookeria raphidostega C. Muell. Syn. 2: 677, 1851.

Lepidopilum raphidostegum Broth. in Engl., Nat. Pflanzenfam. 959, 1907.

The present specimen resembles *Actinodontium raphidostegum* in the following respects:

1. Leaves crowded, oblong lanceolate, gradually long-acuminate, slightly plicate, with a few minute teeth near apex.
2. Costa double, slightly divergent, forks unequal in length.
3. Cells linear-rhomboidal, rather smooth, thin-walled, but several layers of rectangular cells toward base.
4. Perichaetium small, seta erect but much longer, almost twice (2 cm.) as long as described in the literature, slightly uneven but occasionally, with one to several warts.
5. Stem much taller than 1 to 1.5 cm. high; branches arising irregularly from a creeping base.

On humus covered rocks. Chiayi County; Mt. Morrison, Kao, Jan. 3, 1964. *Actinodontium raphidostegum* was reported as a new record from Taiwan by Z. Iwatsuki, in Journ. Jap. Bot. 39(6): 178-182, 1964.

2. *Callicostella* (C. Muell.) Mitt.

Callicostella (C. Muell.) Mitt., Journ., Linn. Soc. Lond. Bot. (Suppl.) 1: 136, 1859.

Plants small to medium-sized, dark green to yellowish brown in flat mats; stems prostrate, branched, slightly flattened; leaves oblong-lingulate, rounded or abruptly short-acuminate, toothed above, not bordered; costa double, strong, ending near apex; cells small, angular, irregularly oval, mostly papillose, elongate and smooth below; seta scabrous; capsule inclined or horizontal; peristome teeth furrowed, striate; calyptra conic mitrate, slightly scabrous.

2. *Callicostella papillata* (Mont.) Mitt. Journ. Linn. Soc. Lond. Suppl. 1 (Musc. Ind. Or.) 136, 1859.

Hookeria papillata Mont., Ann. Sci. Nat. 4., 93, 1859.

Callicostella papillata (Mont.) Mitt. Card., Beih. Bot. Cent. 19: 125, 1905; Ihsiba, Musc. Nip. 170, 1929; Journ. Soc. Trop. Agr. 7(2): 198, 1935.

Callicostella papillata (Mont.) Jaeg. var. *longifolio* Fl. Musc. Fl. Buit. 3: 1026, f. 174, 1906-08; Nog. Journ. Jap. Bot. 13: 788, 1937; Herg. et Nog. Journ. Hat. Bot. Lab. 14: 65, 1955.

Leaves oblong-lingulate, abruptly short-acuminate, irregularly toothed above; cells papillose; calyptra scabrous above; costa double, strong, ending abruptly near apex; seta smooth, somewhat curved at tip; capsule oval to elongate; peristome striate.

On rotten logs, Taipei County: Chiu-chih (屈尺)

Callicostella papillata (Mont.) Mitt., was first recorded from Taiwan by Cardot 1905.

3. *Chaetomitrium* Doz. and Molk.

Chaetomitrium Doz. and Molk., Musc. Frond. ined. Archip. Ind. 117, 1846.

Plants small or medium-sized growing in dense tufts on trees; stems elongate, creeping, usually pinnate, frequently with axillary clusters of broad filaments on ultimate branches; upper branches spreading and forked; leaves ovate, concave, short-acuminate or rounded; cells linear, shorter near apex, more or less papillose; seta elongate, papillose; capsule inclined; peristome teeth striate, not furrowed; calyptra hispid or spinose-ciliate, usually fringed at base.

KEY TO THE SPECIES OF *CHAETOMITRIUM*

- Costa extending to nearly the middle of leaf; cells linear at base, minutely spiculate at both end, tips attenuated with propagula *C. acanthocarpum*
 Costa short, faint; cells linear, shortly spinose-papillose at apical end..... *C. orthorrhynchum*

3. *Chaetomitrium acanthocarpum* Bryol. Jav., Brotherus, V.F. in Engler & Prantl, Nat. Pflanzenfamilien, ed. 2, 11: 257-260, 1925.

Plants (Pl. I Figs. 1-3) relatively robust, golden, brownish green, glossy; stems irre-

gularly pinnate, prostrate, secondary stem upright, densely foliate; branch leaves widely spreading, ovate, plicate, margin serrate, finely toothed on the back but coarsely at the apex; costa double, ending the near middle of leaf; cells linear, shorter near apex but twice as long at base, generally minutely spiculate at both ends. Capsule not seen. New record from Taiwan.

On rock, mixed with lichens, Chiayi County; Mt. A-li, Alt. 2400 m., Oct. 27, 1962, Lee 348.

New generic record for Taiwan.

4. *Chaetomitrium orthorrhynchum* (Doz. et Molck.) Bryol. Jav. Bartram in Philip. Journ. Sci. 68: 270, 1939.

Plants (Pl. I Figs 4-10) golden green in dense mats; stems densely pinnate and bipinnate; branches slender; branch leaves ovate-lanceolate, acuminate, about 1 mm. long, ultimate branch leaves smaller, concave, constricted below apex; margins serrate 2/3 of the way down; teeth spreading at apex; costa double, short; cells linear, sharply spinose-papillose at apical angles, especially prominent on back of upper leaf; perichaetial leaves lanceolate 2-2.5 mm. long, with a long tapering ciliate-dentate apex; seta 10-12 mm. long, smooth below, setose above; calyptra hispid above, mitriform at base; capsule inclined; lid long-beaked; peristome teeth not furrowed.

New record for Taiwan.

On branches of trees. Taitung County; Chang-yuan (樟原), IX compartment, Hsin-kan, Dec. 5, 1939, Suzuki-Tokio ST 19987.

4. *Chaetomitriopsis* Fleisch.

Chaetomitriopsis Fleisch., Laubmfl. Java 4: 1371. 1921.

Plants slender, wiry, yellowish-green in compact tufts; stem creeping, pinnate and bipinnate; branch leaves squarrose-spreading with decurved points, ovate, acuminate; costa double, short; cells elongate, papillose at apical angles; seta smooth; capsule pendulous; peristome double; calyptra cucullate, sparingly pilose.

5. *Chaetomitriopsis glaucocarpa* (Schwaegr.) Fleisch, Brothierus in Engler and Prantl, Nat. Pflanz. Fam. ed. 2, 11: 260, 1925; Bartram in Philip. Journ. Sci. 68: 273, Pl. 20, f. 348, 1939; Ihsiba, Musc. Nipp. 170, 1929.

Hypnum glaucocarpon Reinw. in Schwaegr. Suppl. 3 pt. 1 fasc. 2, 228, 1828; Card. in Beih. Bot. Cent. 19: 146, 1905.

Plants up to 10 cm. long; stem leaves broadly ovate, long-acuminate; branch leaves crowded, orbicular-ovate, squarrose-spreading with deflexed points, short acuminate; stem leaves broadly ovate, long-acuminate; margins sharply serrulate in upper half; costa double, short, forks unequal; cells linear-rhomboidal, papillose at apical angles; seta 2-3.5 cm. long, smooth, curved at tip; capsule ovoid-cylindric, pendulous, covered with waxy, granular bloom when young; peristome teeth striolate, with zigzag median line; calyptra cucullate, sparsely pilose.

This specimen differs from *C. glaucocarpa* in its branch leaves having a narrower

blade and being longer, broadly acuminate instead of orbiculate-ovate and short acuminate as described in Bartram. Monoicous.

On logs. Taipei County; Chiu-chih (屈尺), reported by Cardot in 1905.

This species was first reported from Taiwan by Cardot 1905 as *Hypnum glaucocarpon*, but by Ihsiba as *C. glaucocarpa* in 1929.

5. *Cyclodictyon* Mitt.

Cyclodictyon Mitt., Journ. Linn. Soc. Lond. Bot. 7: 163. 1864.

Plants medium-sized, soft, delicate, in flat mats; stems prostrate, branched; leaves narrowly bordered, areolate complanate, oblong-ovate, short acuminate; costa double, ending beyond mid-leaf; cells large, rounded-hexagonal, smooth; seta elongate, smooth; capsule horizontal; peristome teeth striate, deeply furrowed; calyptra naked.

6. *Cyclodictyon blumeanum* (C. Muell.) Broth., E. & P. Pflanzenfam. ed. 1 Musci 934, 1907.

Cyclodictyon blumeanum (C. Muell.) Ihsiba, Musc. Nipp. 170. 1929; Bartr. in Philip.

Journ. Sci. 68: 264. 1939; E. & P. Nat. Pflanzenfam. ed. 1, Musci 934, 1907;

Ibid. ed. 2, 11: 236, f. 602, 1925.

Hookeria Blumeana C. Muell., Musc. frond 2: 676, 1851; Card., Beih., Bot. Cent.

19: 125, 1905; Ihsiba, Journ. Soc. Trop. Agr. 7: 198, 1935.

Plants whitish green, medium-sized to moderately robust in flat mats; stems prostrate, irregularly branched; leaves complanate, asymmetric, oblong-ovate or ovate-lanceolate, short, acuminate at apex, bordered with 1 or more rows of linear cells, coarsely toothed toward apex; costa double, strongly divergent, extending beyond midleaf; median leaf cells large, rounded to oblong-hexagonal; seta reddish; capsule horizontal, peristome teeth striate, medium furrow marked; calyptra naked, lacinate at base.

On rotten logs, Taipei County; Chiu-chih (屈尺).

This species was first reported from Taiwan as *Hookeria blumeana* by Cardot in 1905 and as *Cyclodictyon blumeanum* by Ihsiba in 1929.

6. *Daltonia* Hook. et Tayl.

Daltonia Hooker and Taylor, Musc. Brit. 80, 1818.

Plants small or medium-sized, more or less glossy; stems laxly erect, not or scarcely flattened; leaves ovate or lanceolate, acuminate, distinctly bordered, carinate with a broad median fold above; costa single, ending below apex; seta lateral, scabrous above; peristome teeth papillose; calyptra deeply fringed at base.

KEY TO THE SPECIES OF *DALTONIA*

- Upper leaf cells narrowly rhomboidal-elongate, lax toward
base; border 3-4 rows wide below*D. angustifolia*
- Upper leaf cells lenticular, incrassate; border 5-8 rows wide
below, 2 rows above*D. aristifolia*

7. *Daltonia angustifolia* Doz. et Molk., Musc. Frond. Archip. Ind. N. Spec. p. 5. 1844; Nog. Journ. Sci. Hiro. Univ. 3: 48. 1937; Bartram, Philip. Journ. Sci. 68: 256. 1939.

Plants small, yellowish-green in lax tufts, about 1 cm. long; leaves crowded, erect, slightly flexuose when dry, rigid when moist, 2-2.6 mm. long, less than 0.4 mm. wide, linear lanceolate, gradually acuminate; margins recurved; costa ending below apex; upper cells narrowly rhomboidal, elongate and lax toward base, border cells elongate, poorly defined, 3-4 rows wide below; seta slightly scabrous near tips; capsule nodding; peristome papillose; calyptra deeply fringed.

On trees. Taiwan.

8. *Daltonia aristifolia* Ren. et Card., Rev. Bryol. 105. 1896; Nog. Journ. Sci. Hiro. Univ. 3: 50. 1937; Bartr. Contr. U. S. Nat. Herb. 26: 99. 1928.

Daltonia stenophylla Mitt. Journ. Linn. Soc. London, Bot. 12: 402. 1869 in Crum & Steere: Mosses of Porto Rico, N. Y. Acad. Sci., Vol. VII, Part 4: 534. 1957.

Plants about 12 mm. high with leaves 1-2 mm. broad, radiculose below; leaves imbricate, straight or lightly twisted when dry, linear-lanceolate, narrowly acuminate; keeled with narrow median fold, up to 3 mm. long; margins narrowly revolute, entire; border rather indistinct below, 5-8 rows wide at base, 4-6 rows at midleaf and 2 rows above; costa ending about 4/5 up; upper cells lenticular, somewhat incrassate; calyptra nearly smooth above; seta short, reddish, roughened above; capsule erect operculum erect, rostrate.

On twigs, fern stipes, trunks and shrubs.

Both *Daltonia angustifolia* and *D. aristifolia* were recorded for Taiwan in Journ. Sci. Hiro. Univ. 3: 48-50, 1937 by A. Noguchi.

7. *Distichophyllum* Doz. et Molk.

Distichophyllum Doz. et Molk. Musc. Frond. ined. Archip. Ind. 99. 1846.

Plants medium-sized or robust; stems flattened, sparingly branched; leaves dimorphous, crowded, complanate, ovate or spatulate, entire, pointed or rounded at apex, with a narrow border of elongated cells; leaf cells hexagonal, smooth, laxer at base; costa single, ending near or above midleaf; seta smooth or papillose; capsule erect or pendulous; peristome teeth striate, deeply furrowed along median line; calyptra fringed, naked or pilose.

KEY TO THE SPECIES OF *DISTICHOPHYLLUM*

1. Leaves long cuspidate.....*D. cuspidatum*
 Leaves minutely apiculus2
2. Leaves bordered all around3
 Leaves not bordered in upper half.....*D. osterwaldii*
3. Cells collenchymatous; borders broad and distinct*D. collenchymatous*

- Cells non-collenchymatous; upper borders narrow,
 lower ones broad4
4. Plants small; calyptra smooth*D. maibarae*
 Plants large; calyptra scabrous; juxtacostal cells differentiated5
5. Seta papillose; costa extending to near apex or 2/3 of
 the leaf.....6
- Seta smooth; costa extending to middle of the leaf.....*D. jungermannioides*
6. Juxtacostal cells irregularly hexagonal, well differentiated.....*D. mittenii*
 Juxtacostal cells hexagonal, gradually smaller toward
 margin.....*D. nigricaulis*
9. *Distichophyllum collenchymatosum* Card. Bull. Soc. Bot. Geneve., 2 ser. 3: 278,
 1911; Nog. in Journ. Soi. Hiroshima Univ. B. 2. 3: 149, 1938; Nog. in Journ. Hat.
 Bot. Lab. 17: 23-26, 1956.

Plants 1.5-3 cm. tall, 3-4 mm. broad (Pl.II Figs. 1-4) leaves slightly undulate, less so in lower dorsal leaves, costa somewhat diversing into a fork-like structure ending below the apex, cells hexagonal, with conspicuous collenchymatous walls; small perichicheal leaves and club-like gemmae are found among the leaves.

New record for Taiwan.

On wet rocks near water falls. I-lan County; Chia-chi, Dec. 2, 1962, *Kao & Feung*, 1623; Lanyu (Orchid Island), 500 m., Aug. 5, 1954, *Kao*, 380.

10. *Distichophyllum cuspidatum* Doz. et Molk. Musc. frond. ined. Archip. Ind. 101,
 1846; Bryol. Jav. 19, 1861; Fleisch, Musc. Fl. Buit. 3: 987, 1808; Nog., in Journ.
 Sci. 68, 1939.

Plants small, stems about 1 cm. high, densely foliate, leaves oblong-lanceolate, abruptly contracted to a long, sharp, cuspidate point, bordered all around with 2-3 rows of linear cells, confluent at apex; costa slender, ending well below base of acumen; cells hexagonal, collenchymatous, larger, rhomboidal rectangular toward middle; according to Noguchi no sporogonia have been found on Formosa specimens.

On decaying branches and fern petioles. Chiayi County; along road side near Tung-pu, *A. J. Sharp*, March 14, 1965.

11. *Distichophyllum jungermannioides* (C. Muell.) Bosch et Lac. Bryol. Jav. 2: 22, 1861;
 Fleisch Musc. Fl. Buit. 3: 977, 1908; Horik. in Journ. Jap. Bot. 11: 504, 1935;
 Herz. et Nog. in Journ. Hat. Bot. Lab. 14: 65, 1955.

Plants dioicous. The special characters of this species are: the concave broadly spatulate leaves, the short cuspidate apex; the short costa reaching below midleaf.

Botel Tobago (Orchid Island).

12. *Distichophyllum maibarae* Besch. in Journ. Bot. 13: 41, 1899; Horik. in Bot. Mag. Tokyo 48: 715, 1934; Nog. Musci Japonici V. The Genus *Distichophyllum*, Journ. Hat. Bot. Lab. 17: 21-23, 1956.

Plants (Pl.II Figs. 5-10) small, in dense mats; stems about 10 mm. long; leaves contracted and undulated when dry; dorsal and ventral leaves oblong, symmetrical and short

apiculate; lateral ones spatulate and longer than the dorsal, asymmetrical, margins entire; costa slender and flexuous, ending far beneath apex; upper leaf cells quadrate hexagonal and slightly collenchymatous, lower leaf cells oblong and delicate; capsule and seta smooth; perichaetial leaves ovate and acute; calyptra not seen.

On stone, Chiayi County; Mt. A-li, Sept. 16, 1960, *Tseng and Chuang* 208.

13. *Distichophyllum mittenii* Bosch. et Lac. Bryol. Jav. 2: 25. 1861; Fleisch. Musc. Fl. Buit. 3: 987, 1908; Noguchi in Journ. Jap. Bot. **13**: 788, 1937; Noguchi in Journ. Hat. Bot. Lab. **17**: 27, f. 4, 1-6, 1956.

Plants robust, 7 mm. broad with leaves; leaves constricted when dry, both lateral and dorsal leaves symmetrical, spatulate-ligulate from a much narrowed base, with rounded, broad apices, minutely apiculate, bordered with 2 rows of linear cells below, one layer above; costa slender, flexuose, yellowish, reaching 2/3 the length of the leaf; leaf cells large in a wide area surrounding the costa, hexagonal with non-collenchymatous walls, cells near apex and margin much smaller; seta slender, densely papillate; calyptra scabrous above, mitriform at base.

Under a cliff, Nantou County; Chi-tou, 1800 m., July 8, 1952, *Kao*, 036, 100. Taitung County; Chuang-yuan. *T. Suzuki*, ST 19941.

14. *Distichophyllum nigricaulis* Mitt., Bryol. Jav. 2: 19, 1861; Bartram in Philip. Journ. Sci. **68**: 258, 1939.

Plants small, 1-1.5 cm. long, the scanty specimen in the packet examined showed the general structure of the leaf. The undulate margin is very close to *D. nigricaulis* Mitt. in Bartram f. 323, the lanceolate ovate upper leaf strongly undulate from a subspathulate base, apiculate, up to 2 mm. long, 1 mm. broad instead of 3 mm × 1.5 mm. as described; leaf cells at margin and apex $12\mu \times 12\mu$, upper median cells $29\mu \times 29\mu$, basal near costa $71\mu \times 32\mu$ to $78\mu \times 34\mu$, border all around, 2 rows of cells wide above, 3-4 rows wide below; costa slender, ending some distance under apex. The plant is very close to *D. collenchymatosum* Card. in having cells with corner thickenings; but the costa being slender and not forking at its end; and it differs from *D. nigricaulis* Mitt. in being undulate only near the apex. No sporophyte has been seen. New record for Taiwan.

On soil, Taipei County; Kan-kou, April 13, 1960, *Yang*, 1232.

15. *Distichophyllum osterwaldii* Fleish. Musc. Fl. Buit. 3: 994, 1908; Horik. in Asahina's Nippon Inkwasoyokubutu Dukan 955, Pl. 460, 1939; Bartr. in Philipp. Journ. Sci. **68**: 260, 1939.

Plants (Pl. II Figs. 11-16) small, 1-2.5 cm. long, 1-2 mm. broad, but according to Fleisch, being robust, 8 mm. broad with leaves, and according to Bartram, stems up to 7 cm. long, simple or forked. Based on the dimorphous leaves, lateral leaves being spatulate, and dorsal and ventral leaves being oblong; the border consisting of 3-4 rows of linear cells in the lower half, gradually decreasing toward the apex, we find this plant is very close to *D. osterwaldii*. Sporophyte not seen.

On rock, Lanyu (Orchid Island), 500 m., Aug. 5, 1954, *Kao* 38, 38b.

8. *Eriopus* (Brid.) C. Muell.

Eriopus (Brid.) C. Muell. in Bot. Stg. 828. 1847.

Plants medium-sized, brownish-green in lax tufts; stems wiry, prostrate or ascending, flat, laxly foliate, with propagula in upper leaf axils; leaves ovate, short-acuminate, bordered, serrate above, costa double and short; cells hexagonal or rhomboidal, smooth; seta prickly; calyptra naked or pilose, fringed.

KEY TO THE SPECIES OF *ERIOPLUS*

1. Leaf borders distinct, costa double, faint.....2
 Leaf borders not distinct, costa single, short or none*E. spinosus*
2. Leaf cells oval-hexagonal; upper leaf sharply serrate; with
 propagula in axils or at tips*E. parviretus*
 Leaf cells elongate-hexagonal; upper leaf minutely
 denticulate, without propagula.....*E. mollis*
16. *Eriopus mollis* Card. in Bull. Soc. Bot. Geneve, 2 Ser., 3: 278, 1911; Broth. in Engler-Prantl. Nat. Pflanzfam. ed 2, 11: 233, 1925; Nog. in Trans. Nat. Soc. Formosa, 24: 291. 1934; Sak. Musc. Jap. 111, 1954.

Plants tender, 2-3 cm. high, darkish-green, in loose tufts or scattered; stems prostrate or suberect, with brown rhizoids in lower portion; stem leaves obtuse, short apiculate, margins plane with distinct borders of 2-3 rows of cells, the upper half minutely denticulate, the lower entire; costa faint, short and forked; leaf cells, elongate-hexagonal large and lax toward lower leaf; seta with long spines on the surface, longer and larger towards base.

On rock, Taitung County; Lanyu, (Orchid Island) Alt. 500 m., Aug. 5, 1954, *Kao* 37a, 38a; Taipei County; on the road from Hsin-tien to Kwei-shan, Dec. 19, 1940, *Nakamura-Taizo*, 568.

17. *Eriopus parviretus* Fleisch, Die Musci der Flora von Buitenzorg. 1008-1010, 1906-1908; Bartram, E. B. in the Philip. Journ. of Sci. 68: 262-263, 1939.

Plants (Pl. I Figs. 11-16) pale-green, glossy in lax tufts; stems wiry, erect, up to 3 cm. long, flat, slightly attenuate at the tip with filiform propagula in upper leaf axils; leaves ovate, short-acuminate, sharply serrate in upper half, bordered all around, generally with 2-3 rows of linear cells; costa faint; leaf cells oval-hexagonal, about twice as long, slightly larger toward the base; bracts broad, oval, acute; perichaetial leaf 3-4 mm. long, bordered with one layer of cells thick, cuspidate; calyptra small, ciliate at base; seta ciliate; a special feature of this specimen being the leaf margins in 2 layers of cells instead of 2-3 layers as in the original description and 2-4 in Bartram's Philip. Mosses, usually one layer of cells thick in upper part of leaf; seta prickly; calyptra pilose above. All other characters agree with that of *E. parviretus* Fl. New record for Taiwan.

On soil, Taipei County; Wen-shan, Alt. 950 m., Sept. 16, 1939, *Suzuki-Tokio*, 19988.
 18. *Eriopus spinosus* Nog. Journ. Sci., Hiroshima Univ. 3: 51, 1937; Nog. Prelim. List of Mos. Jap. and Adj. Areas, 1959.

Sterile: plants rigid, about 1.5 cm. high, laxly foliate; stems flat, about 4 mm. wide with leaves; leaves oblong, symmetric or asymmetrical, short, acuminate, acutely spinose-dentate; costa single, short and faint; leaf cells rhomboidal or elongated-hexagonal, walls slightly thickened, medium cells $88-100 \times 18-22\mu$, apical cells $40-50 \times 14-7\mu$ and basal $110-130 \times 22-30\mu$; margins indistinct diverging into 2-3 series of somewhat long, narrow cells.

Fertile: Plants (Pl. III Figs. 1-5.) darkish green, about 2 cm. high; stems simple, laxly foliate; leaves 1.5-1.8 mm. wide, 2.2 mm. long, acuminate, serrate as in *E. spinosus* Nog., but more than half way downward; cells rhomboidal with large lumen, almost uniform in size, $112 \times 22\mu$, slightly smaller towards base; stem cross section shows, cortical cells of one layer consisting of 20 or more cells surrounding a medulla of larger, thin-walled cells, about 6 cells in width and 4 in depth so the stem appeared slightly flattened in outline, differing from the circular stem of *E. spinosus* Nog.; as to the degree of serration in the upper stem leaves and the layers of cortical cells and the number of medulla cells enclosed in the stem, these characters are all variable in size and degree. Costa faint or none; perichaetial leaves linear-lanceolate, slightly concave, about 1.4 mm. long, 0.5 mm. broad, margins not bordered, plane, smooth; seta 4.5 mm. long, curved at upper end, loosely hispid except the top and basal ends, the longest hairs on upper seta about 135μ long by 30μ broad, shorter and narrower toward base; capsule horizontal, oblong-ovoid, cells of the outer capsule wall about 13.5μ in diam. with conspicuous dark-brown corner thickenings; peristome double, teeth 16, striate and furrowed; calyptra and operculum not seen; spores subglobose about 9μ in diam.

On the bark of trees. Ilan County; Mt. Taihei, about 2200 m., *A. Noguchi*, 6601a type, in Herb. Hiros. Univ. Aug. 1932.

On rotten wood. Chiayi County; Mt. A-li, 2600 m., March 14, 1965, *A. J. Sharp*.

The specimen from Mt. Ali is very close to *E. spinosus* Nog. in its general appearance, though it is much more robust and larger in size, its serrate stem leaves as well as the rhomboidal, elongated leaf cells. Our specimen seems to be a mature plant of *E. spinosus* Nog. whose sporophytic phase has never been described before.

We are deeply grateful to Dr. A. J. Sharp of the University of Tennessee for his kindness in furnishing us with this specimen which he collected from Mt. A-li, in one of his recent collecting trips in Taiwan.

9. *Hookeria* Smith.

Hookeria Smith. Trans. Linn. Soc. 9: 276, 1809.

Plants large, soft in lax, pale green mats; stems complanate-foliate, sparsely branched; leaves large, ovate, oblong, entire, plane-margined, costa absent; cells large and lax, narrower at margins, smooth; calyptra mitrate, smooth, slightly lobed; seta smooth, elongate; capsules inclined; annulus falling with operculum; peristome teeth papillose, not furrowed, somewhat bordered.

KEY TO THE SPECIES OF *HOOKERIA*

Leaves ovate, broad, acute at apex.....*H. acutifolia*

Leaves narrower, not so acute.....*H. nipponensis*

20. *Hookeria acutifolia* Hook. ex Schwaegr., Suppl. Sp. Musc. 2, 2(1): 36, 1826; Welch, W. H., The Hookeriaceae of the U. S. A. and Canada, The Bryologist 65(1): 7-10, 1962.

Plants in soft, glossy mats, light green to yellowish green when moist, whitish when dry, frequently complanate; stems prostrate 3-6 cm. long, occasionally up to 10 cm., 5-6 mm. broad; leaves 5-6 mm. long, 2.5-3 mm. broad, imbricate, thin, soft, glossy, ovate-lanceolate, narrowed at base, often radiculose at apical or subapical areas; costa absent, cells oblong-hexagonal, thin-walled, small at apex. longer and narrower in marginal row. Sporophyte not seen.

On rock, on decayed wood in forest and on soil. Taipei County; Nan-se-chi, Wen-shan, 950 m., Sept. 9, 1939, *Suzuki-Tokio* ST19989; Taichung County; Hsiao-hsieh-shan, Dec. 1, 1961, *Kao* 2426, 1068; Chiayi County; Mt. A-li, Alt. 2600 m., Oct. 27, 1962, *Lee* 169a.

21. *Hookeria nipponensis* (Besch.) Broth. Engler-Prantl, Pflanzam. ed. 2, 11: 236, 1925; Horikawa in Asahina's Nippon Inkwasoyokubutu Dukan, 955, f. 5-16, 1939; Herz. et Nog. in Journ. Hat. Bot. Lab. 14: 65, 1955.

H. nipponensis (Besch.) Broth. resembles *Hookeria acutifolia* Hook. According to Noguchi⁽¹⁴⁾ "the sporophyte and leaf cells of these two species are very similar, they can not be distinguished from one another, the shape of the leaves may be considered a determining character. *Hookeria acutifolia* is distinguished from *H. nipponensis* by the robuster habit and the more acute point of the leaf. This distinction, however, is not constant and the species are sometimes mingled with each other. *H. nipponensis* is only a northern form of *H. acutifolia* and it should more appropriately be included in a variation circle of the latter." However, the cylindrical pendent capsule in Nakamura 15, distinguished from others by the curved seta forming a loop-like knot just below the capsule is noteworthy. The several species we have examined are much smaller than *H. acutifolia*, stems 2-3 cm. long, 3-4 mm, broad, soft pale green, sometimes in small mats.

On shady rocks, Taitung County; Lanyu, (Orchid Island) Alt. 300 m., Aug. 3, 1954, *Kao* 1233, 1234, 1235; Nantou County; Chi-tou, Alt. 1100 m. *Yang* 1236; Taipei County; Mt. Seven-star, Feb. 4, 1940, *Nakamura Taizo*, 15.

10. *Hookeriopsis* (Besch) Jaeg.

Hookeriopsis (Besch.) Jaeg. Ber. St. Gall. Natur. Ges. 1875-76: 358, 1877.

Plants small to medium-sized in dense mats; stems creeping, usually complanate-foliate; leaves ovate-lanceolate to oblong, asymmetric, usually di- or polymorphous, dorsal and ventral obliquely appressed, lateral larger and spreading; margins plane, usually unbordered, sharply toothed above; cells oblong-hexagonal to linear, smooth; costae double ending above midleaf, unequal in length; seta elongate, usually smooth; capsule inclined to horizontal; annulus not differentiated; operculum long-rostrate; peristome teeth striate, furrowed, endostome yellowish, papillose or nearly smooth; calyptra naked, lobed at base.

22. *Hookeriopsis pappeana* (Hamp.) Jaeg. Adumbr. 2: 262 (1874-75); Brotherus in Engler-Prantl, Nat. Pflanzfam. ed. 2, 11: 243, 1925; Ihsiba, Class. Moss. Nipp.: 81, 1932.

Hookeria pappeana Hpe. Icon. Musc. tab. 2; C. Mull. Syn. Musc. frond. 2: 194, 1851; Card. in Beih. Bot. Centralbl. 19: 125, 1905.

Chiu-chih, Taipei County (No. 198; c. pedicell. juven.), recorded by Cardot in Beih. Bot. Cent. 19: 125, 1905.

23. *Hookeriopsis sumatrana* (v. d. B. et Lac.) Brotherus in Engl. Nat. Pflzf. Lief. 227/28 p. 942 (1907); Fleischer, Musci Fl. Buit. 3: 1029, 1908; Nog. Pre. List Mos. Jap. Adj. Ar. P. 43, 1959.

Monoicous. Plants (Pl. III Figs. 6-17.) glossy green, tinted with reddish brown in loose mats; stems creeping with smooth reddish rhizoids, irregularly pinnate about 3-6 cm. long, densely foliate; stem cross sections almost round, central portion made up of thin-walled cells, surrounded by 2-3 rows of thick-walled, colored cells; branches irregularly pinnate, prostrate or ascending up to 1 cm. long, complanately foliate; leaves di- or polymorphous, the ventral and dorsal laxly appressed, lateral spreading, somewhat larger, concave and rugose when dry, about 2 mm. long, 0.5-1 mm. broad; margins revolute on lower part of leaf, serrate towards tip, teeth often double; costae double, reaching mid-leaf or 2/3 of the leaf; cells lax, scarcely thick-walled, spindle-rhomboidal, 10-15 μ broad and 3 times as long, rectangularly broader at base; perichaetial branch stout, many-leaved; involucre bracts small, oval, abruptly acuminate; seta reddish brown, 12/15 mm. long, smooth at base, gradually roughened toward neck; capsule inclined or horizontal, epidermal cells thick-walled, mostly rectangular 1: 2, annulus not differentiated, operculum long-beaked, peristome teeth striate, furrowed, endostome yellowish, papillose; calyptra straw-yellow (grayish-white in dry specimens) cucullate, long-beaked at top, lobed at base; spores greenish, transparent, smooth or minutely papillose, about 10-14 μ in diam. New record for Taiwan.

On rotten wood in wet mountain forests, Taichung County; An-ma Shan, alt. 2000 m., March 22, 1965, J. M. Chao 5201.

This specimen is very similar to *Hookeriopsis sumatrana* Broth., differing only by hav-

ing a lobed calyptra, and not being lacinate at base. *H. sumatrana* was reported from both West and East Java, on the barks of forest trees at altitudes of 1450–2100 m. and also from Sumatra, but it was reported as very rare there. Noguchi also reported its occurrence in Japan⁽²¹⁾ in 1959. But this is the first time it has been collected from Taiwan.

Thanks are due to Mr. J. M. Chao for sending me such beautiful, rare specimens for this study.

ACKNOWLEDGMENTS

Grateful acknowledgments are made to Dr. A. J. Sharp of the University of Tennessee, for his kindness in furnishing materials of *Distichophyllum cuspidatum* and *Eriopus spinosus*, on which our description of the species is based; to Dr. Z. Iwatsuki of the Hattori Botanical Lab., Japan, for his kind assistance in providing photostat copies of references on several Taiwan species of the Hookeriaceae; and Dr. A. Noguchi of Kumamoto University of Japan for his kindness in lending his type specimen of *Eriopus spinosus* Nog. for comparison.

Grateful acknowledgment is also made to the National Council for Science Development for the research grant which has enabled the writers to carry out this work.

LITERATURE CITED

- (1) BARTRAM, E. B.: Philip. Journ. Sci. **68**: 258, 261-270, 1939.
- (2) BROTHERUS, V. F.: Engler and Prantl's Die Natürlichen Pflanzenfamilien ed. 2, **11**, 220-265, 1925.
- (3) CARDOT, J.: Beih. Bot. Centralbl. 124-125, 1906.
- (4) CARDOT, J.: Bull. Soc. Bot. Geneve 2, Ser. **3**: 278, 1911.
- (5) CRUM, H. A.: Mosses from Honduras II, The Bryologist, **55**, No. 4, 1952.
- (6) CRUM and STEERE: The Mosses of Porto Rico and the Virgin Islands. 532-552, 1957.
- (7) HERZOG and NOGUCHI: Journ. Hat. Bot. Lab. **14**: 65, 1955.
- (8) HORIKAWA, Y.: Bot. Mag. Tokyo, **48**: 715-16, 1934; Journ. Jap. Bot., **11**: 504, 1935.
- (9) HORIKAWA, Y.: Bot. Mag. Tokyo, **50**: 384, 1936.
- (10) HORIKAWA, Y.: Nippon Inkwasoyokubutu Dukan, 953-955, pl. 459-460, 1939.
- (11) IHSIBA, N.: Musc. Nipp., 167-171, 1929.
- (12) IHSIBA, N.: Journ. Soc. of Trop. Ag. 197-204, 1935.
- (12) IWATSUKI, Z.: Journ. Jap. Bot. **39**: No. 6, p. 179-182, 1964.
- (14) NOGUCHI, A.: Brief Note on Hookeria nipponensis, Misc. Bryol. Lichenol. **2**: 130-132, 1962.
- (15) NOGUCHI, A.: Journ. Hat. Bot. Lab. **14**: 65, 1955.
- (16) NOGUCHI, A.: Journ. Hat. Bot. Lab. **17**: 21-27, 1956.
- (17) NOGUCHI, A.: Journ. Jap. Bot. **13**: 788, 1937.
- (18) NOGUCHI, A.: Trans. Nat. Hist. Soc. Formosa. **24**: 291, 1934.
- (19) NOGUCHI, A.: Journ. Sci. Hiro. Univ. **3**: 48-53, 1937.
- (20) NOGUCHI, A.: Trans. Nat. Hist. Soc. Formosa. 139-147, 1935.
- (21) NOGUCHI, A.: List of Mosses of Japan and adjacent areas 1959.
- (22) NOGUCHI, A.: Studies on the Jap. Mosses of Isobryales and Hookeriales II.
- (23) WANG, C. K.: An Enumer. of all sp. of Musci Recorded from Taiwan, with some species recently known from this area. Biol. Bull. 5, Dept. of Biol. Tunghai Univ. 1961.
- (24) Welch, W. H.: The Bryologist **65**: 7-10, 1962.
- (25) YANG & LEE: Botanical Bulletin of Academia Sinica **5(2)**: 181, 1964.

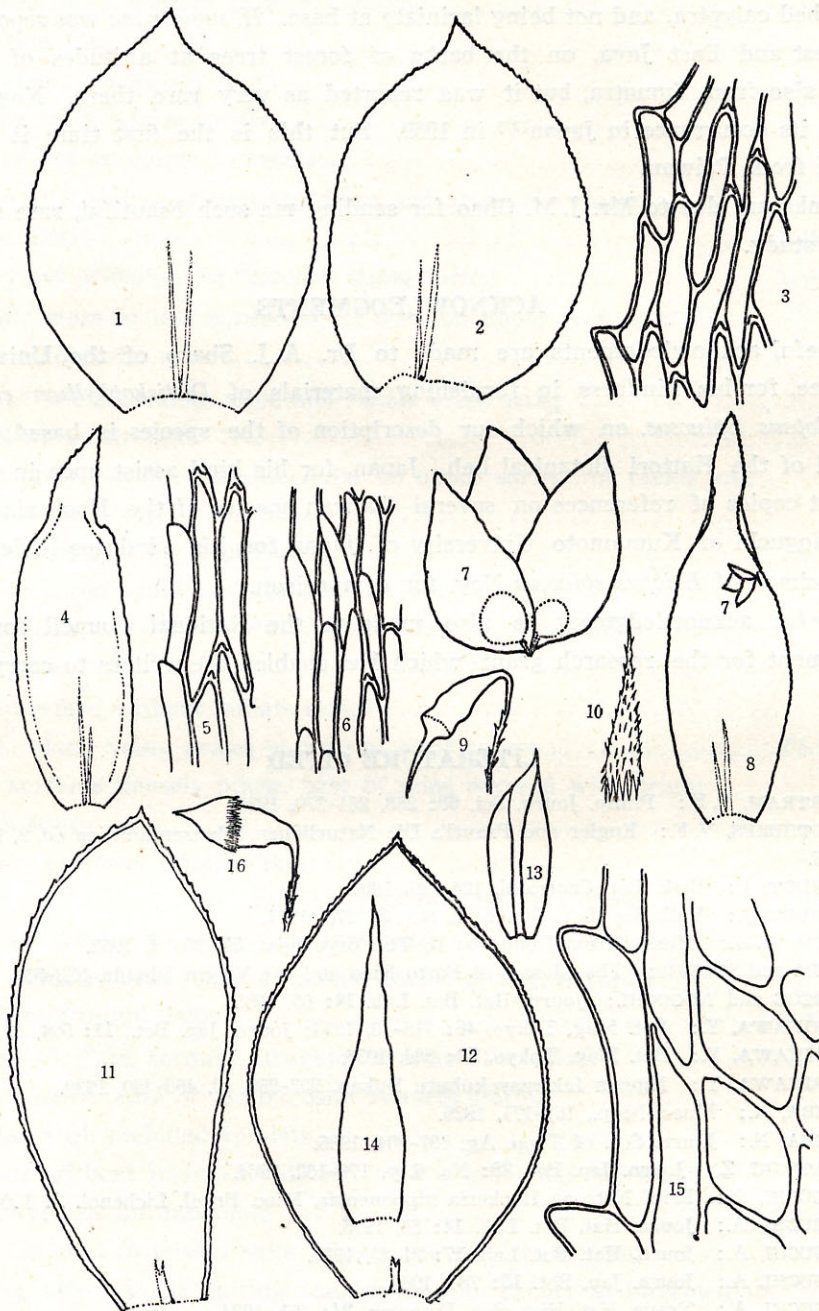


Plate I. *Chaetomitrium* Doz. & Molk. and *Eriopus parviretus* Fl.

Figs. 1-3. *Chaetomitrium acanthocarpum* Bryol Jav. Broth. 1. Dorsal leaf $\times 32$. 2. Lateral leaf $\times 32$. 3. Cells from upper leaf $\times 320$. 4-10. *C. orthorrhynchum* (Doz & Molk.). 4, 8 leaves $\times 152$. 5. Cells from upper leaf $\times 320$. 6. Ditto, from the back of leaf $\times 320$. 7. A male branch $\times 320$. 9. Capsule $\times 12$. 10. Calyptra $\times 16$. 11-16. *Eriopus parviretus* Fl. 11. Lateral leaf $\times 32$. 12. Dorsal leaf $\times 32$. 13, 14. Perichaetial leaves. $\times 32$. 15. Marginal cells of upper leaf $\times 320$. 16. Capsule $\times 320$.

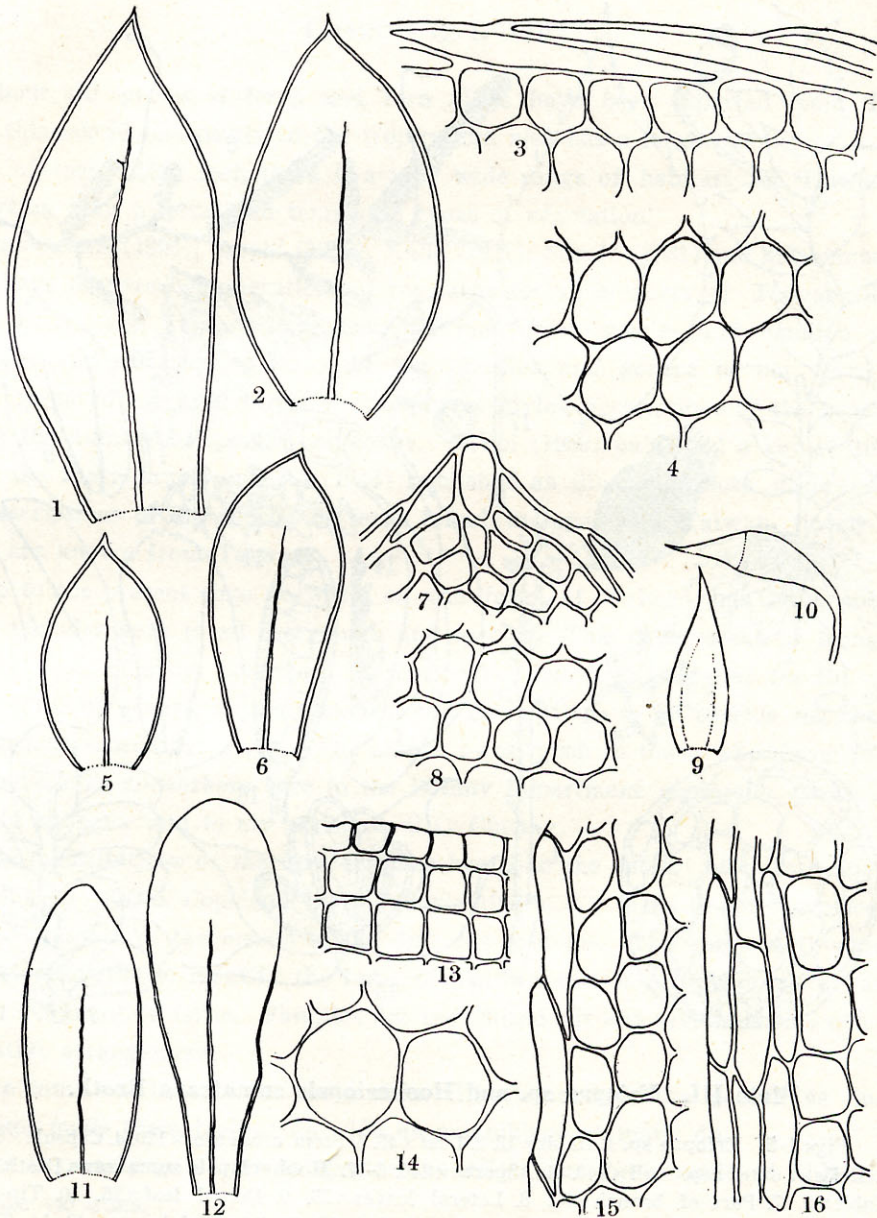


Plate II. *Disticophyllum* Doz. and Molk.

Figs. 1-4. *D. collenchymatosum* Card. 1. Lateral leaf $\times 32$. 2. Dorsal leaf $\times 32$. 3. Margin of mid-leaf $\times 320$. 4. Cells from ditto near costa $\times 320$. 5-10. *D. maibarae* Besch. 5. Dorsal leaf $\times 32$. 6. Lateral leaf $\times 32$. 7. Leaf apex $\times 320$. 8. Cells from middle of upper leaf $\times 320$. 9. Perichaetial leaf $\times 32$. 10. Capsule $\times 16$. 11-16. *D. osterwaldii* Fl. 11. Dorsal leaf $\times 32$. 12. Lateral leaf $\times 32$. 13-16. Cells from ditto $\times 320$. 13. From leaf apex. 14. From midleaf near costa 15. From upper leaf margin. 16. From lower leaf margin.



Plate III. *Eriopus* sp. and *Hookeriopsis sumatrana* Broth.

Figs 1-5. *Eriopus* sp. 1. Habit $\times 12$. 2. Leaf $\times 45$. 3. Stem cross sec. $\times 120$. 4. Capsule $\times 35$. 5. Cells of outer cap. wall $\times 440$. 5a. Spores $\times 440$. 6-17. *Hookeriopsis sumatrana* Broth. 6. Habit $\times 3$. 7. Part of branch $\times 20$. 8. Lateral leaves $\times 25$. 9. Dorsal leaf $\times 25$. 10. Tip of ditto $\times 440$. 11. Tip of 8 $\times 440$. 12. Enlarged cell of 11. 13. Perichaetial leaves $\times 42$. 14. Tip of ditto $\times 100$. 15. A cluster of antheridia $\times 150$. 16. One antheridium enlarged. 17. Capsule with calyptra $\times 14$. 18. Spores $\times 440$.