Bot. Bull. Acad. Sin. (1998) **39:** 57–68

# Taxonomic revision of *Andreaea* (Mosses, Andreaeaceae) of Taiwan

Tzen-Yuh Chiang

*Department of Biology, Cheng-Kung University, Tainan, Taiwan 700, Republic of China*

(Received June 17, 1997; Accepted August 6, 1997)

**Abstract.** Six taxa of *Andreaea* of Taiwan are revised taxonomically with one new species, *A. taiwanensis* sp. nov., and two new additions, i.e., *A. wangiana* Chen and *A. rupestris* Hedw. *A. commutata* C. Muell. is synonymized to *A. rupestris* var. *fauriei* (Besch.) Tak. Four species have capsules that split from base to tip: *A. taiwanensis*, *A. mutabilis, A. rupestris* var. *rupestris,* and *A. rupestris* var. *fauriei*. *A. taiwanensis*, closely related to *A. mutabilis,* is distinguishable from other *Andreaeae* by its large, loose leaves and rectangular to linear laminal cells. *A. mutabilis* is distinguished from the relatives *A. rupestris* var. *rupestris* and var. *fauriei* by the isodiametric marginal, basal cells. *A. morrisonensis* and *A. wangiana* belong to another group that has capsules with dehiscence in the upper half. A distinctively obtuse leaf apex distinguishes *A. wangiana* from *A. morrisonensis.*

**Keywords:** *Andreaea*; *A. taiwanensis* sp. nov.; Dehiscence of capsule; Taxonomy; Taiwan.

## Introduction

Andreaeaceae, a monotypic family with genus *Andreaea*, are the typical cool-temperate and subpolar mosses, with distribution extending to the alpine tundra of tropics or subtropics (Murray, 1988). In East Asia, As2 region of van der Wijk et al. (1967), five species and one subspecies have been recognized after a series of taxonomic revisions (Chen and Wan, 1958; Noguchi, 1987; Cao and Gao, 1995; also cf. van der Wijk et al., 1969; Crosby et al., 1992). A trend of the reduction of endemic species has become noticeable when most taxa were better understood. For examples, *A. likiangensis* Chen and *A. mamillosula* Chen, previous Chinese endemic species (Chen and Wan, 1958), were lately synonymized into *A. rupestris* Hedw. and *A. rupestris* var. *fauriei* (Besch.) Tak. respectively; *A. yunnanensis* Broth. (=*Didymodon nigrescens* Mitt.; cf. Schultze-Motel, 1970; Chiang and Kuo, 1989) and *A. kashyapii* Dix. [=*Didymodon subandreaeoides* (Kindb.) Zander] were excluded from *Andreaea* (Cao and Gao, 1995). Low ratio of endemism in *Andreaea*, such as only 7.7% in flora of Britain and Ireland (Murray, 1988), is believed to be ascribed to the long-distance dispersal of spores, which homogeneonizes the genetic variation between populations (cf. Chiang, 1997).

Three species of *Andreaea* were previously reported from Taiwan (cf. Chuang, 1973; Lin, 1988). Horikawa (1934) recorded the first taxon, *A. fauriei* Besch. (=*A. rupestris* var. *fauriei*), to this island. *A. morrisonensis* Noguchi, an endemic species, was found on the summit of the highest mountain, Mt. Yushan (Noguchi, 1936). Chuang (1973) published another new species, *A. hohuanensis*, which was later synonymized to *A. mutabilis* Hook. f. & Wils. (Murray, 1988). Two more species, i.e., *A. rupestris* Hedw. and *A. sinuosa* B. M. Murray, were mentioned on a list of the flora of Mt. Yushan (Chiang, 1989), however, without citing any voucher specimens.

Interestingly, only taxa of the section *Andreaea* (subgenus *Andreaea)*, ecostate species, occur in Taiwan and mainland China. Although *A. rothii* Web. & Mohr., a costate species of section *Nerviae* Card. ex. Broth. (subgenus *Andreaea*), appeared on Redfearn and Wu's (1986) *Catalog of the Mosses of China*, it has lately been excluded from the flora of China (Cao and Gao, 1995). In Asia section *Nerviae* with *A. rigida* Wils. (Gangulee, 1969) and *A. subulata* Harv. (Eddy, 1988) is found in India and Malesia, respectively; and another costate taxon, section *Chasmocalyx* Lindb. ex Braithw. (subgenus *Chasmocalyx*) with *A. nivalis* Hook., occurs in Japan only.

Species of *Andreaea* are locally abundant and dominant in the alpine tundra of Taiwan (Chiang, 1989), unlike the "infrequent occurrence of species in mainland China" stated by Cao and Gao (1995). *Andreaea* seemed rare on this island according to the previous records. For example, only one specimen of each species was examined in Chuang's (1973) revision. However this rarity proved illusive when the flora became better understood. The poor samplings were mostly caused by the difficulty of access to the high mountains as well as the indifference of collectors to the tiny mosses. Most *Andreaeae* grow on arid habitats and show a high polymorphism of morphological traits. The aims of this study are to revise the *Andreaea* based on the materials collected from high mountains of this island and to compare them with the taxa of the neighboring areas. Six taxa are studied with one new species, *A. taiwanensis* Chiang and two new additions, i.e., *A. rupestris* and *A. wangiana* Chen, to Taiwan.

[1]Corresponding author. Fax: 011-886-6-2742583; E-mail: tychiang@mail.ncku.edu.tw

## Taxonomic Treatment

Six taxa including five species and one variety of *Andreaea* of Taiwan are revised taxonomically. Materials collected from Taiwan and the type specimens loaned from the herbaria of the New York Botanical Garden (NY), University of British Columbia (UBC), Hattori Botanical Laboratory (NICH), Conservatoire et Jardin botaniques (G), and Institute of Botany, Academia Sinica, Peking (PE) were dissected and examined. Each species is illustrated and described with diagnostic features.

**ANDREAEA** Hedw., Sp. Musc.: 47 (1801).

Plants darkly pigmented, perennial. Stems irregularly branched, central strands absent. Axillary hairs with quadrate, brown basal cells and cylindrical, mucilaginous cells. Leaves costate or ecostate. Pseudopodium slender and short. Sporophytes terminal, seta absent. Capsule dehiscent by 4 longitudinal valves. Annulus, peristome and operculum absent. Spores spherical.

### *Key to Taxa of Andreaea of Taiwan*

1. Capsule longitudinal split from the base to the tip ..... 2
1. Capsule longitudinal split confined to the upper half .. ..... 5
   2. Basal marginal cells isodiametric, leaves gradually tapering to an acute apex from an ovate base ..... 3
      3. Plants small, ca. 1.0 cm long, densely leaved; median laminal cells quadrate or rhomboid ..... ..... *A. mutabilis*
      3. Plants medium to large, up to 5.0 cm long, loosely leaved; median laminal cells narrowly rectangular or lanceolate ..... *A. taiwanensis*
   2. Basal marginal cells rectangular, leaves narrowed to a short, blunt apex from an ovate base ..... 4
      4. Leaves ovate-lanceolate, with longer acumen, plane, apex acute to obtuse; autoicous ..... ..... *A. rupestris* var. *rupestris*
      4. Leaves ovate-lanceolate to ovate, panduriform, concave, apex obtuse; mostly dioicous ..... ..... *A. rupestris* var. *fauriei*
         5. Leaves ovate-lanceolate, acute at apex ..... ..... *A. morrisonensis*
         5. Leaves lanceolate, obtuse at apex ..... ..... *A. wangiana*

**1. Andreaea taiwanensis** T.Y. Chiang, sp. nov.—TYPE: Taiwan. Nantou Co., Mt. Yushantongfeng, ca. 3,200 m alt., in *Abies* forest, on rock, 30 Nov 1987, *Chiang 24299* (holotype: HAST!) Figure 1

*Andreaea* sect. *Andreaea*. mediocris vel grandis, laxe foliatus. Caulis erectus vel adscendens, ramosus vel simplex, 0.8–5.0 cm longus. Folia lanceolate, sensim apicem longe acuminata, 0.32–0.56 mm longus, 0.15–0.25 mm lata, ecostata. Cellulae foliorum superiores roundatatae vel quadratae, mediae 7.5–22.5 µm longae, rectangulares, centrales sinuatae, inferiores linearis, paulatim sinuatae. Bracteae perichaetii oblongo-lingulatae, acuminatae. Pseudopodia erecta, ca. 2 mm longa. Theca 0.31–0.37 mm longa, valvis 4 basim versus dehiscentibus.

Plants reddish, medium- to large-sized, loosely leaved. Stems erect to ascedent, single or forked, 0.8–5.0 cm long. Leaves lanceolate, from an ovate base tapering to an acute apex, 0.32–0.56 mm long, 0.15–0.25 mm wide, margins plane or incurrved, ecostate. Axillary hairs with one basal cell and one mucilaginous cell. Apical leaf cells small, round to quadrate; median laminal cells rectangular, 7.5–22.5 µm long, papillose and pitted; basal marginal cells isodiametric, median basal cells linear, pitted. Perichaetial leaves oblong-lingulate, acuminate. Pseudopodium erect, ca. 2 mm long. Capsules 0.31–0.37 mm long, splitting with four valves from base to tip.

*Distribution*. Taiwan.

*Andreaea taiwanensis* is one of the largest plants of Section *Andreaea*. It is closely related to *A. mutabilis* in sharing dehiscence of capsules from base to tip and ovate-lanceolate leaves with isodimetric basal marginal cells. It also resembles *A. morrisonensis* in having pointed leaf apex. The major feature differentiating it from *A. mutabilis* and other *Andreaeae* is the narrowly rectangular to linear median, laminal cells.

**2. Andreaea morrisonensis** Nog., Trans. Nat. Hist. Soc. Formosa 26: 139. 1936.—TYPE: Taiwan. Tainan. Tataka-Niitatkasita, *Noguchi 6515* (holotype: NICH) Figure 2

Plants dark-brown to brown, small, 0.8–1.0 cm long, in dense turfs. Stems erect, single or forked, densely leaved. Leaves lanceolate, tapering to an acute and pointed apex from an ovate leaf base, ca. 1 mm long, 0.25 mm wide; margins plane; ecostate. Apical leaf cells small, round to quadrate, ca. 4 µm long; median laminal cells longer, ca. 16.2 µm long, 8.1 µm wide, distinctly papillose on dorsal surface and pitted; marginal and median basal cells linear, pitted. Perichaetial leaves oblong-lingulate, ca. 1.5–2.0 mm long. Pseudopodium erect, ca. 0.6 mm long. Capsules splitting to 4 valves at upper half, dark-brown, lower half yellowish.

*Additional specimens examined*. **TAIWAN.** Nantou Co., Mt. Yushan, *Chiang 19339, 19340* (mixed with *A. wangiana*), Mt. Yushantungfeng, ca. 3,200 m alt., *Chiang 24873* (HAST); Kaohsiung Co., Takuanshan, ca. 3,200 m alt., *Chiang 14029* (HAST).

*Distribution*. Endemic to Taiwan.

*Illustration*. Noguchi (1936): f.1: 1–6.

Since the report of this endemic species (Noguchi, 1936) quite a few materials have been collected. Compared to other Taiwan species, *A. morrisonensis* appears relatively rare. Cao and Gao (1995) illustrated an "*A. morrisonensis*" not referring to the type specimen. It seems more likely to be *A. mutabilis* that is characterized by hav-

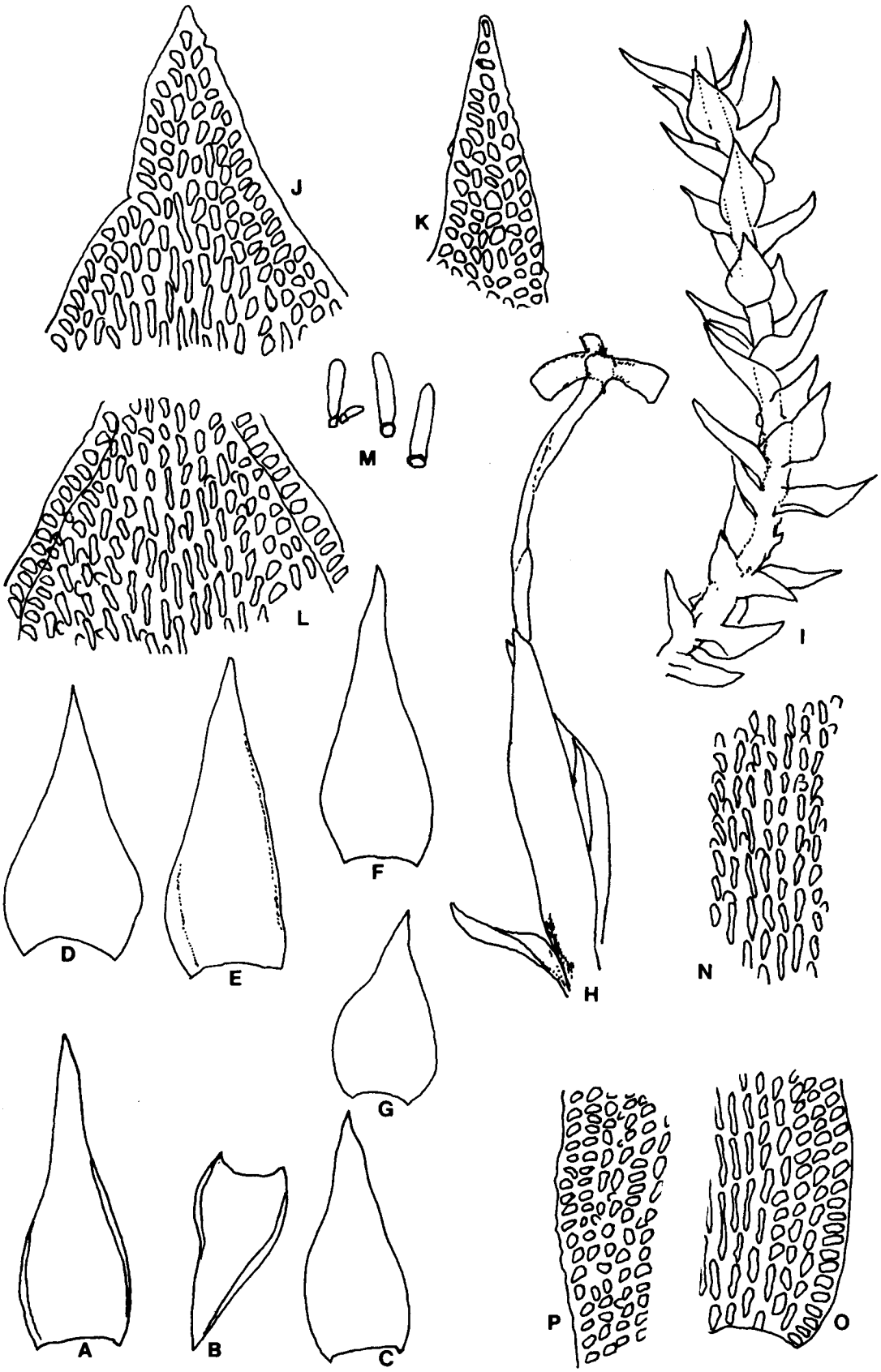


**Figure 1.** *Andreaea taiwanensis* Chiang. A–G, Leaves (×95); H, Perichaetial leaves and capsules (×39); I, Part of branch (×39); J–K, Leaf apex (×375); L, Median and marginal laminal cells (×375); M, Axillary hairs (×375); N, Median laminal cells (×375); O, Leaf basal cells (×375); P, Leaf marginal cells (×375). (Drawn from *Chiang 24299*, holotype).

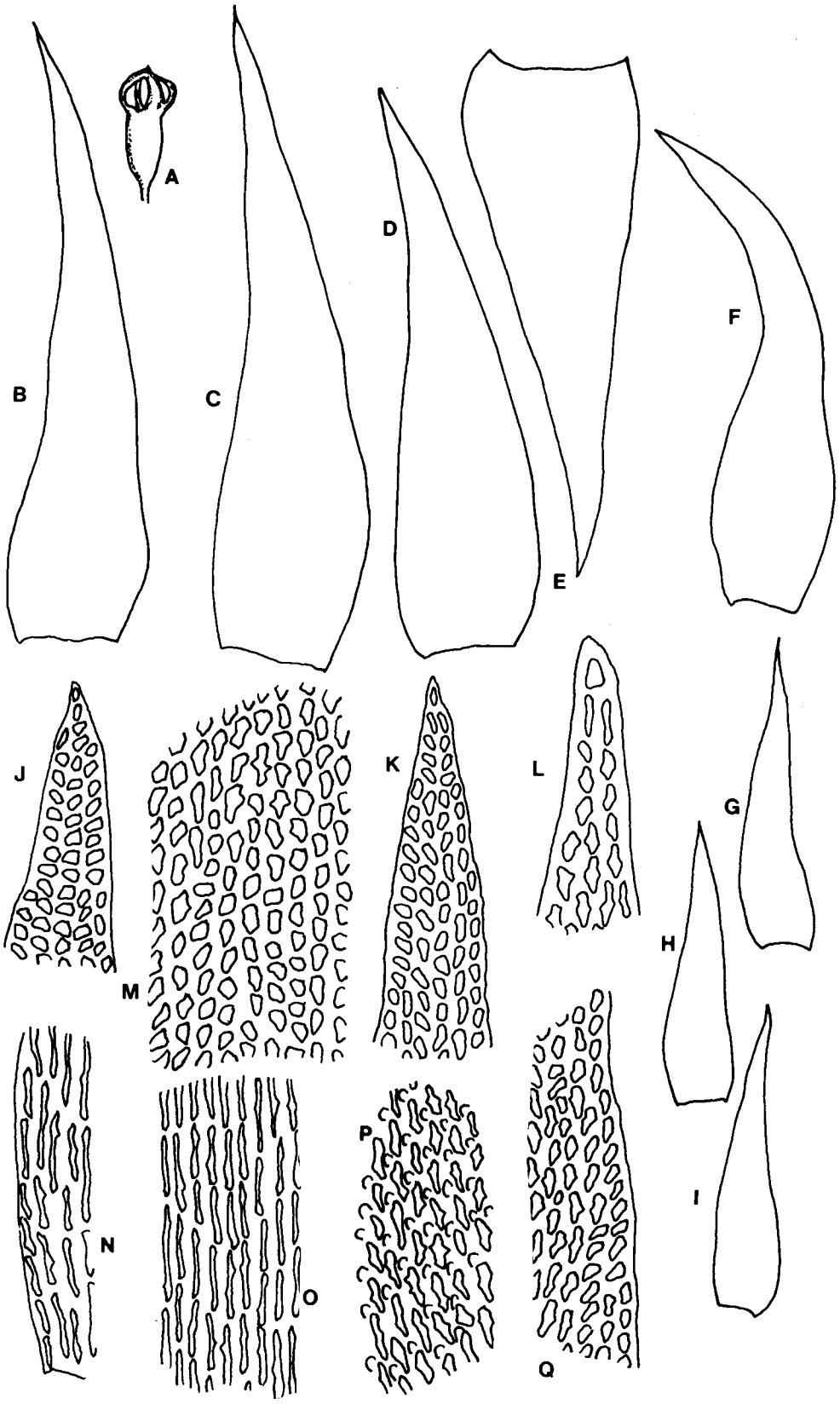


**Figure 2.** *Andreaea morrisonensis* Nog. A, Capsule (×16); B–F, Leaves (×95); G–I, Leaves (×39); J–K, Apex of mature leaves (×375); L, Apex of young leaf (×375); M, Median laminal cells (×375); N, Basal marginal cells (×375); O, Basal cells (×375); P, Median laminal cells (×375); Q, Marginal cells (×375). (A–B, drawn from *Chiang 19340*; D–F, K, L, P, Q, drawn from *Noguchi 6515*, holotype; G–J, M–O, drawn from *Chiang 24873*).

ing ovate leaf-base with shorter apex and isodiametric basal marginal cells. That "margins incurved on both sides throughout" emphasized as one of the key features by Cao and Gao (1995) appears only in several populations of *A. mutabilis* and definitely not in *A. morrisonensis*.

*A. morrisonensis* is characterized by its acuminate, pointed leaves, plane leaf margins, and the dehiscence of capsules at the upper half. It is related to *A. wangiana* in sharing the sporophytic features. The key characteristics that differentiate *A. morrisonensis* from *A. wangiana* are the acute and pointed leaf apex and plane leaf margins.

**3. *Andreaea mutabilis*** Hook. f. & Wils., London J. Bot. 3: 536. 1844. Figure 3

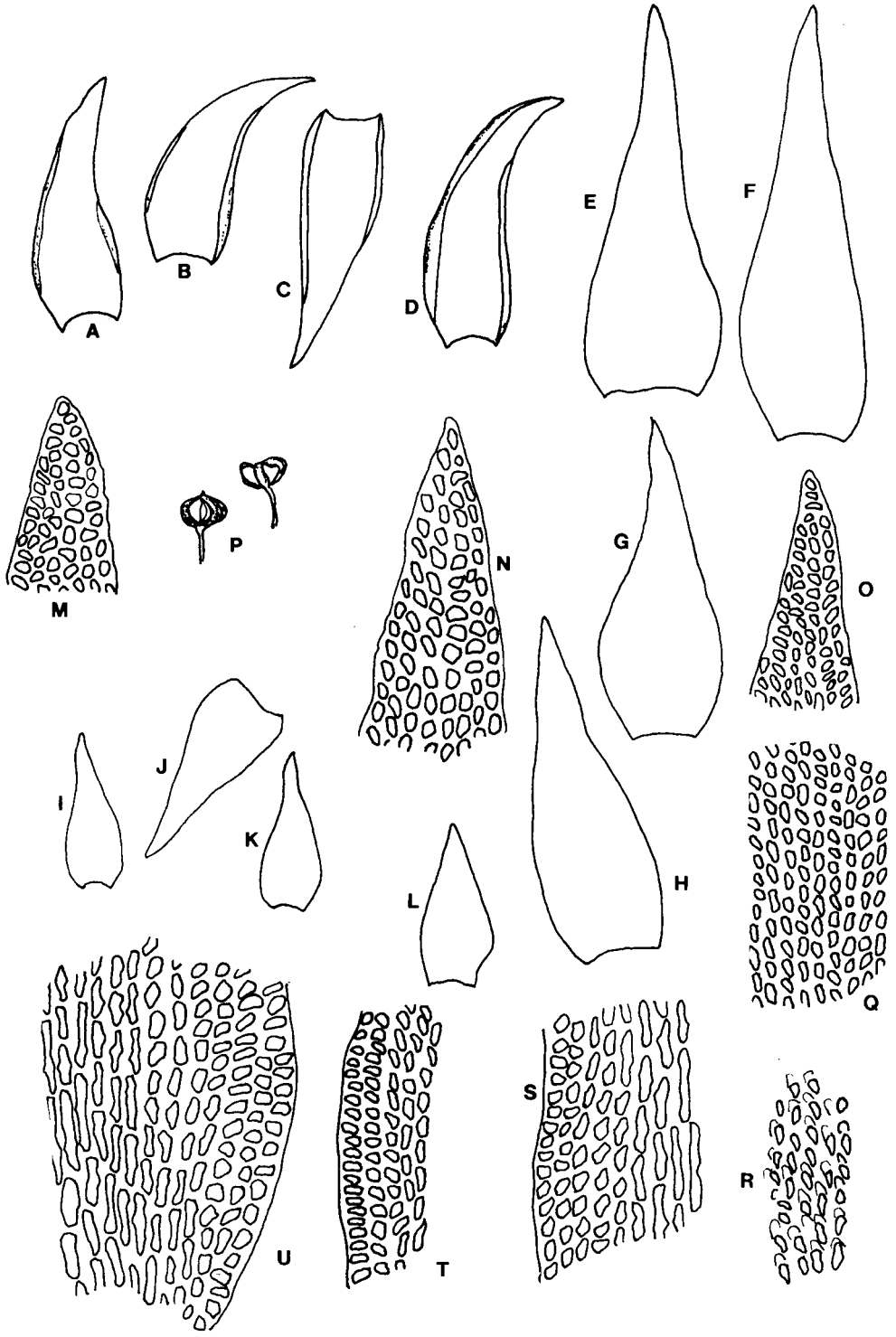


**Figure 3.** *Andreaea mutabilis* Hook. f. & Wils. A–H, Leaves (×95); I–L, Leaves (×39); M–O, Leaf apex (×375); P, Capsules (×10); Q–R, Median laminal cells; S–U, Basal median and marginal cells (×375). (A–D, M, P, drawn from *Chiang 19756*; E–H, O, Q, S, T, drawn from *Chuang 5914*, holotype; I–L, N, U, drawn from *Chiang 19754*; R, drawn from *Chiang 14033*)

*Andreaea hohuanensis* Chuang, J. Hattori Bot. Lab. 37: 427. 1973.—TYPE: Taiwan. Taichung Co., Tayuling to Mt. Hohuan, 3,200 m alt., *Chuang 5914* (holotype: UBC!)

Plants small, reddish to black. Leaves lanceolate, ovate at base, tapering to a somewhat blunt apex, ca. 1 mm long, 0.3 mm wide; margins incurved, entire; ecostate. Upper laminal cells round, thick-walled; median cells rectangular, ca. 6.7–14.8 µm long, 4.0–6.7 µm wide; basal marginal cells isodiametric, basal median cells linear, pitted. Perichaetial leaves oblong-lingulate, sheathing and convolute. Pseudopodium erect, ca. 1 mm long. Capsules small, ca. 0.43–0.64 mm long, 4 valves, dehiscence from base to tip.

*Specimens examined*. **TAIWAN.** Nantou Co., Mt. Yushan, ca. 3,200 m alt., *Chiang 19349, 19351, 19404, 19448, 19494, 19751, 19754, 19756, 19762, 24323, 24846, 29552*, *29764* (HAST); *Chuang 1510* (UBC); Hsinchu Co., Mt. Itzeshan, ca. 3,000 m alt., *Chiang 4891, 5073, 5074* (HAST); Taichung Co., Mt. Hohuanshan, ca. 3,200 m alt., *Chiang 3509* (HAST); Kaohsiung Co., Mt. Takuanshan, ca. 2,800–3,000 m alt., *Chiang 13947, 13950, 14031, 14033* (HAST), Mt. Hsiang-yang-shan, ca. 3,500 m alt., *Chiang 17572, 17615* (HAST).

*Distribution*. North America, South America, Europe, Australia, Tasmania. New Zealand, New Guinea, Celebes, Borneo, Taiwan

*Illustrations*. Chuang (1973): f.3; Cao & Gao (1995) f. 1. (as *A. morrisonensis*) & 2.

*A. mutabilis*, one of the widespread species, was previously named as *A. hohuanensis* (Chuang, 1973) to the Taiwan populations (cf. Murray, 1988). It is related to *A. rupestris* and *A. rupestris* var. *fauriei* in sharing dehiscence of capsules and laminal cells. *A. mutabilis* differs from the latter taxa by the isodiametric basal marginal cells and less pitted basal cell walls.

**4. Andreaea rupestris** Hedw. var. **rupestis**, Spec. Musc. 47. 1801.—TYPE: "In rupibus Sueciae, Angliae, Bructeri (negant Ehrhart et Schrader) et Saxoniae superioris abunde ad saxa Bielberg Annaemontani" [lectotype: selected by Vitt (1980), G-Hedwig!] Figure 4

*Andreaea likiangensis* Chen in Chen and Wan, Acta Phytotax. Sinica 7: 103. 1958.—TYPE: China: Yunnan, Likiang, *Hsu 335a* (holotype: PE!)

Plants small, dark brown, ca. 1.0–2.0 cm long. Leaves ovate-lanceolate, 0.69–0.79 mm long, 0.25–0.38 mm wide, with acute to obtuse apex; margins entire, mostly plane. Apical laminal cells round to quadrate; median laminal cells rhomboid, 8.1–10.8 µm long, papillose on dorsal surface; basal marginal and median cells linear, pitted. Perichaetial leaves oblong-lingulate, 1.5–2.0 mm long. Pseudopodium erect, ca. 1.5 mm long. Capsules exerted, 4 valves, split from tip to two thirds length. Autoicous.

*Specimens examined*. **CHINA.** Shaanxi, Mt. Tai-pei-shan, ca. 4,000 m, *Lee 717* (paratype of *A. mamillosula*, PE!); **TAIWAN.** Nantou Co., Mt. Yushan, ca. 3,600 m alt., *Chiang 19265, 19336, 19490, 24331, 28810* (HAST); Taichung Co., Mt. Hsueshan, ca. 3,000 m alt., *Chiang 5126* (HAST); Kaohsiung Co., Mt. Takuanshan, *Chiang 14030*, Mt. Hsiang-yang-shan, *Chiang 16985* (HAST).

*Distribution*. Worldwide, new to Taiwan.

*Illustrations*. Cao & Gao (1995): f. 3. & f. 5: G-M.; Murray (1988): f. 21; Crum & Anderson (1981): f. 24.

*Andreaea rupestris* is polymorphic as stated by Murray (1988). Quite a few names were previously given to the same species, such as *A. petrophila* Ehrh. ex Fuernr. and varieties of *A. rupestris* including varieties *acuminata, flaccida, sylvicola,* and *gracilis* (Murray, 1988). It is noticeable that the dehiscence of the capsules seems variable. Cao and Gao (1995) described and illustrated (Fig. 2) the splitting from apex to base nearly. Alternatively the dehiscence may be two-thirds [Murray (1988): f. 21] or three-fourths [Lawton, (1971): Pl. 1] the length of the capsules. The capsule dehiscence of the materials from Taiwan appears close to Murray's illustration. Diagnostably nodose, thick-walled basal cells distinguish *A. rupestris* var. *rupestris* from *A. mutabilis* and autoicous sexuality distinguishes it from var. *fauriei.*

*A. mamillosula*, a Chinese species (Chen and Wan, 1958), was lately synonymized to *A. rupestris* var. *fauriei* (Cao and Gao, 1995). Nevertheless, among the paratypes two collections, i.e., *Lee 717 & 856*, appeared more likely to be *A. rupestris* var. *rupestris* based on the autoicous sexuality and leaf shape.

*A. rupestris* var. *rupestris* is a new addition to the moss flora of Taiwan. On this island it is widespread and abundant at alpine tundra.

**5. Andreaea rupestris** Hedw. var. **fauriei** (Besch.) Tak., J. Hattori Bot. Lab. 11: 90. 1954. Figure 5

*Andreaea fauriei* Besch., Ann. Sci. Nat. Bot. Ser. 7, 17: 392. 1893.—TYPE: Japan. "Yezo: monte de Hakkoda", 6 Jun 1886, *Faurie 138* (isotype: BM!)

*Andreaea rupestris* ssp. *fauriei* (Besch.) W. Schultze-Motel, Willdenowia 5: 24. f. 4, 5. 1968.

*Andreaea commutata* Muell. in Bot. Zeit. 22: 373. 1864.—TYPES: Patria. Sikkim-Himalaya: Tunkra-Pass, Kankola, reg. alpina, 15,000 ped. alta: 22 Aug 1849, *Hooker 3* (Lectotype, lectotypification designated here based on the best authentic collection deposited in Mitt. Herb. NY!), Panchen, 12,000 ped. alta: 14 Jul 1849, *Hooker 2* (Paratype, Mitt. Herb. NY!), syn. nov.

*Andreaea mamillosula* Chen in Chen and Wan, Acta Phytotax. Sinica 7: 96, 102. f.3. 1958.—TYPE: China, Fukine, Wu-yi-shan, ca. 1,750–1,800 m alt., *Chen et al. 960* (holotype: PE!)

Plants reddish-brown to blackish, small, ca. 1.0 cm long. Leaves ovate-lanceolate, panduriform, concave, with obtuse apex; margins incurved above. Median laminal cells rhomboid; basal marginal and median cells linear, pitted.

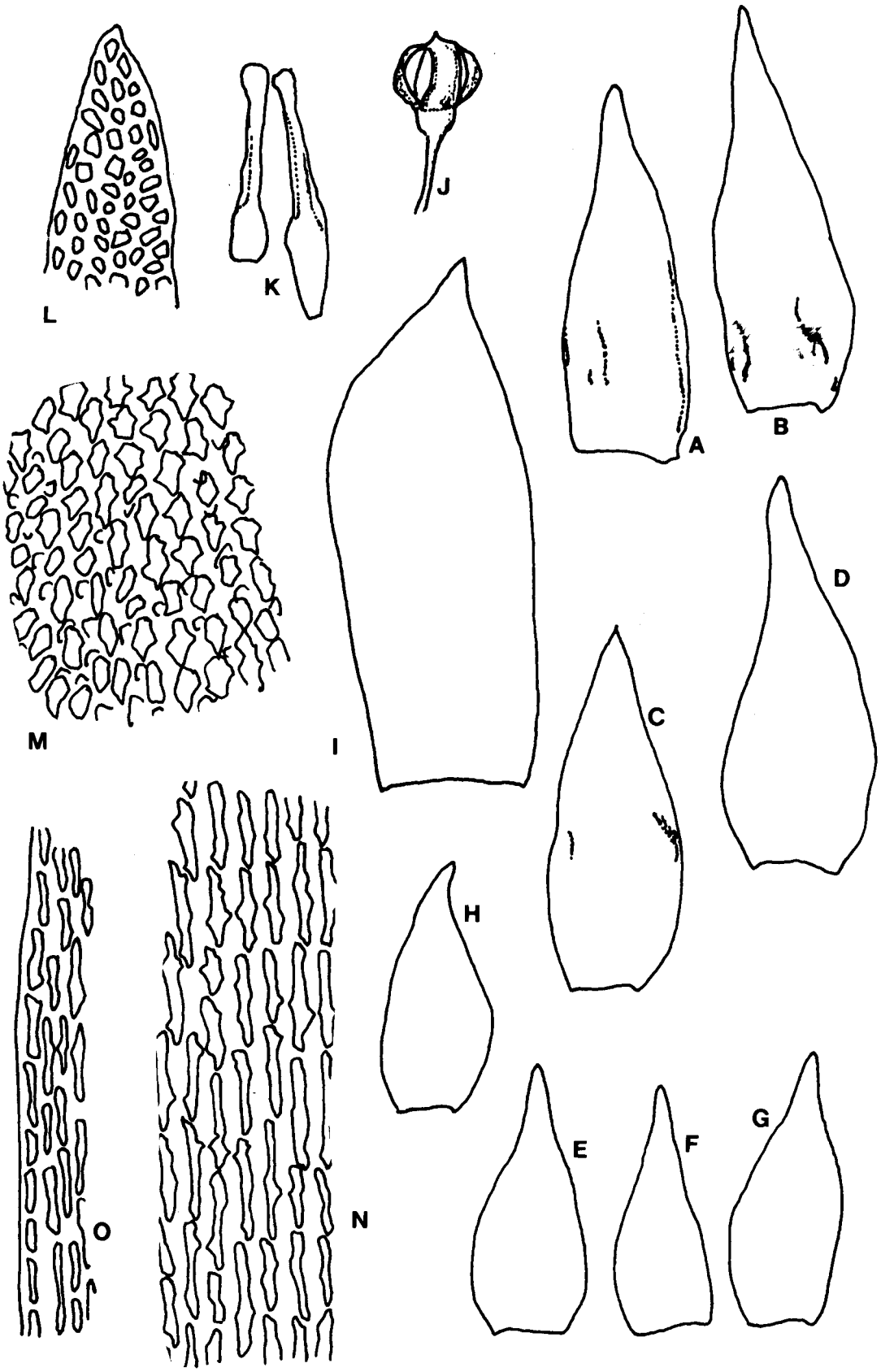


**Figure 4.** *Andreaea rupestris* Hedw. var. *rupestris*. A–D, Leaves (×95); E–H, Leaves (×39); I, Perichaetial leaf (×39); J, Capsule (×16); K, Archegonia (×39); L, Leaf apex (×375); M, Median laminal cells (×375); N, Basal median cells (×375); O, Marginal basal cells (×375). (A–D, L, drawn from *Chiang 16985*; E–K, M–O, drawn from *Chiang 19490*).

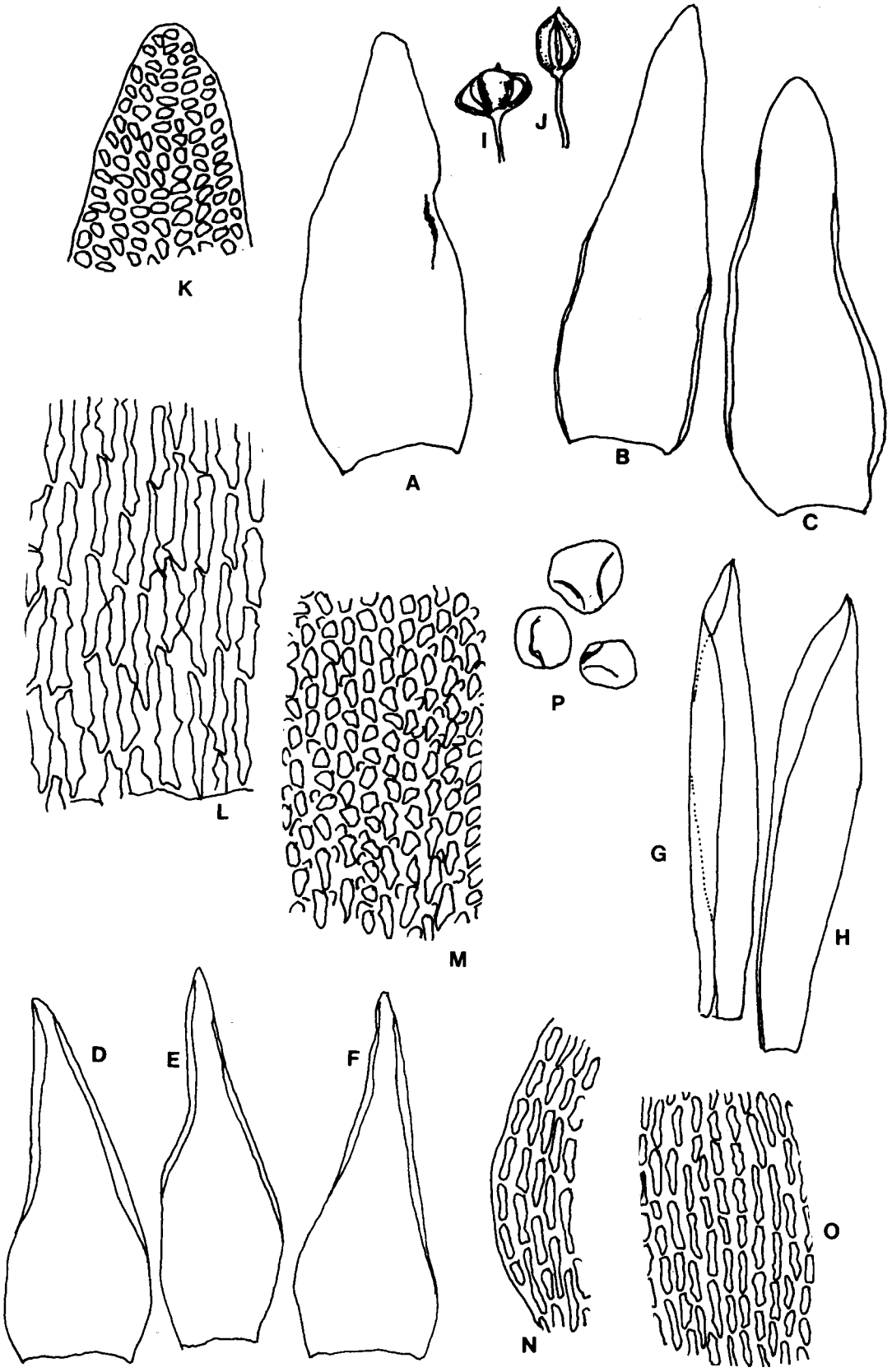


**Figure 5.** *Andreaea rupestris* Hedw. var. *fauriei* (Besch.) Tak. A–F, Leaves (×95); G–H, Perichaetial leaves (×39); I–J, Capsules (×16); K, Leaf apex (×375); L, Median basal cells (×375); M, Median laminal cells (×375); N, Marginal basal cells (×375); O, Basal cells (×375); P, Spores (×375). (A–C, K, M, drawn from *Chiang 28642*; G, H, L, P, drawn from *Chiang 29080*; D–F, N, O, drawn from *Hooker 2*, holotype of *A. commutata* C. Muell.)

Capsules splitting from near base to tip. Dioicous or monoicous occasionally.

*Specimens examined*. **TAIWAN.** Hsinchu Co., Mt. Tapachienshan, ca. 3,500 m alt., *Chiang 4890* (HAST), *5056* (HAST, NMNS), *Lai 7739* (TAI); Taichung Co., Mt. Shimenshan, *Chiang 3512*, Mt. Chilaishan, ca. 3,500 m alt., *Chiang 16909* (HAST), Mt. Hohuanshan, *Chiang 3368* (NMNS); Kaohsiung Co., Mt. Takuanshan, ca. 2,800–3,200 m alt., *Chiang 14018, 14032, 14036, 14045* (HAST), *14023* (NMNS), Mt. Hsiang-yang-shan, *Chiang 16336, 16389* (HAST); Nantou Co., Mt. Yushan, *Chiang 19317, 19318, 19315, 19348, 19354, 19393, 19438, 19487, 19751, 19755, 19757, 19760, 28642, 28807, 29075, 29079, 29080* (HAST), *19336, 24331, 24299*, *Lin 207391, 207276* (NMNS). **JAPAN.** Honshu, Nagano, Mt. Kirigamine, ca. 1,800 m alt., *N. Takaki*, June 1950 (HAST, NMNS); **CHINA.** Anhui, Mt. Huangshan, *Chen 6357, 6358* (NMNS).

*Distribution*. China, Korea, Japan, Taiwan, and India.

*A. fauriei* was either treated as a variety (Takaki, 1954; Noguchi, 1987; Murray, 1988) or a subspecies (Schultze-Motel, 1970; Cao and Gao, 1995) of *A. rupestris*. The distribution of this taxon seems discrete from that of *A. rupestris* in mainland China with overlapping at Mt. Taibei of Shaanxi Province. Var. *fauriei* is mainly distributed in southeast China and var. *rupestris* grows in the north and southwest mainland. However, the trend of differentiated distribution of the two taxa in Taiwan seems not as significant as described above. They even tend to grow at similar vegetation type of the same localities. Here I rather recognize this taxon at variety level, that is, *A. rupestris* var. *fauriei*.

Sexuality is one of the most interesting phenomena in *A. rupestris* var. *fauriei*. When this taxon was first described, Bescherelle (1893) distinguished *A. fauriei* from *A. petrophila* Ehrh. (=*A. rupestris*) based on the dioicous sexuality and panduriform leaves. Several decades later Takaki (1953) discovered some deviated populations with monoicous sexuality in Japan (Noguchi, 1987). Cao and Gao (1995) described *A. rupestris* ssp. *fauriei* as mostly dioicous, nevertheless, without indicating the materials with monoicous sexuality. According to my own observation on the collections from Taiwan, dioicous sexuality is predominant in most populations of *A. rupestris* var. *fauriei* except for one sample (*Chiang 19755*) collected from Mt. Yushan.

*A. commutata* C. Muell., an Indian species, has "guitar-shaped" leaves, by which it was distinguished from *A. rupestris* (Gangulee, 1969). Evidently panduriform leaves with middle part constricted have been observed from *A. rupestris* var. *fauriei* frequently [see Fig.1 of Takaki (1953) and Fig. 1 of Noguchi (1987)]. After examining the type specimens of *A. commutata* I synonymize it into *A. rupestris* var. *fauriei* based on its dioicous sexuality and incurved leaf margins.

**6. Andreaea wangiana** Chen in Chen and Wan, Acta Phytotax. Sinica 7: 101. 1958.— TYPE: CHINA. Szechuen, Chia-wa-lung, Si-ma-la, ca. 2,800 m alt., *Wang 32837* (holotype: PE!) Figure 6

*A. sinuosa* auct. non Murray (1986): Chiang (1989): p. 34.

Plants small, dark-brown to blackish, ca. 0.8–1.2 cm long, in dense turfs. Leaves lanceolate, tapering to an obtuse apex, ca. 0.70–0.95 mm long, 0.15–0.20 mm wide; margins incurved. Upper laminal cells round to quadrate; median laminal cells quadrate or rhomboid, ca. 9.5–13.3 μm long, 4.0–6.6 μm wide, papillose, occasionally smooth; basal median and marginal cells linear, pitted. Perichaetial leaves oblong-lingulate, ca. 1.7–2.1 mm long. Capsules splitting at upper half, lower half yellowish.

*Specimens examined*. **CHINA.** Schensi, Mt. Taipeishan, ca. 3,600 m alt., *Lee 716* (paratype of *A. wangiana*, PE!); Yunnan, Likiang, *Hsu 335* (paratype of *A. wangiana*, PE!). **TAIWAN.** Nantou Co., Mt. Yushan, ca. 3,600 m alt., *Chiang 19339, 19340* (mixed with *A. morrisonensis*), *19346* (HAST).

*Distribution*. China, new to Taiwan.

*Illustrations*. Chen & Wan (1958): f. 1; Cao & Gao (1995) f. 6.

This species was previously recorded in southwest China. When it was first described, Chen and Wan (1958) claimed it was closely related to *A. densifolia* because of the shared dehiscence of capsules in the upper half. Gao (1985), in a floristic study on *Andreaea* of Tibet, even misidentified *A. wangiana* as *A. densifolia*. Chen and Wan (1958) argued that smooth laminal cells would distinguish *A. wangiana* from *A. densifolia*. Nevertheless, when I examine the type specimens of *A. wangiana*, laminal cells of young leaves appear distinctly papillose and relatively less papillose on mature ones. Papillose cell walls of leaves are very distinct in the collections from Taiwan. In addition, acuminate leaves, another key feature that differentiates these two species, seem to exist in *A. densifolia* as well. The average leaves of *A. densifolia* may not have been precisely illustrated by Gangulee (1969). Leaves with ovate base and short, blunt apex (Fig. 23: L, Gangulee, 1969) are strikingly different from the acuminate ones shown on branches (Fig. 23: $P_2$, $P_A$ and $P_{AD}$ in Gangulee, 1969), which resemble leaves of *A. morrisonensis*. The status of *A. densifolia* remains doubtful. The type specimen, *J. D. Hooker 6b*, of *A. densifolia*, deposited in the Herbarium of New York Botanical Garden (NY), loaned to Dr. B. M. Murray and not available to this study, would need to be examined.

This species was misidentified in my previous study (Chiang, 1989; cf. Redfearn et al., 1995) as *A. sinuosa* Murray, a species having dehiscence in the upper half of its capsules and distributed in Scotland, British Columbia, and the Aleutian Islands (Murray, 1988). *A. wangiana* is similar to *A. sinuosa* in sharing the dehiscence of capsules, narrowly lanceolate leaves with somewhat obtuse apex, and papillose laminal cells. The major feature that characterizes *A. sinuosa* and distinguishes it from other ecostate *Andreaeae* is the distinctly sinuose cell walls of basal laminal cells. However, I can hardly agree with

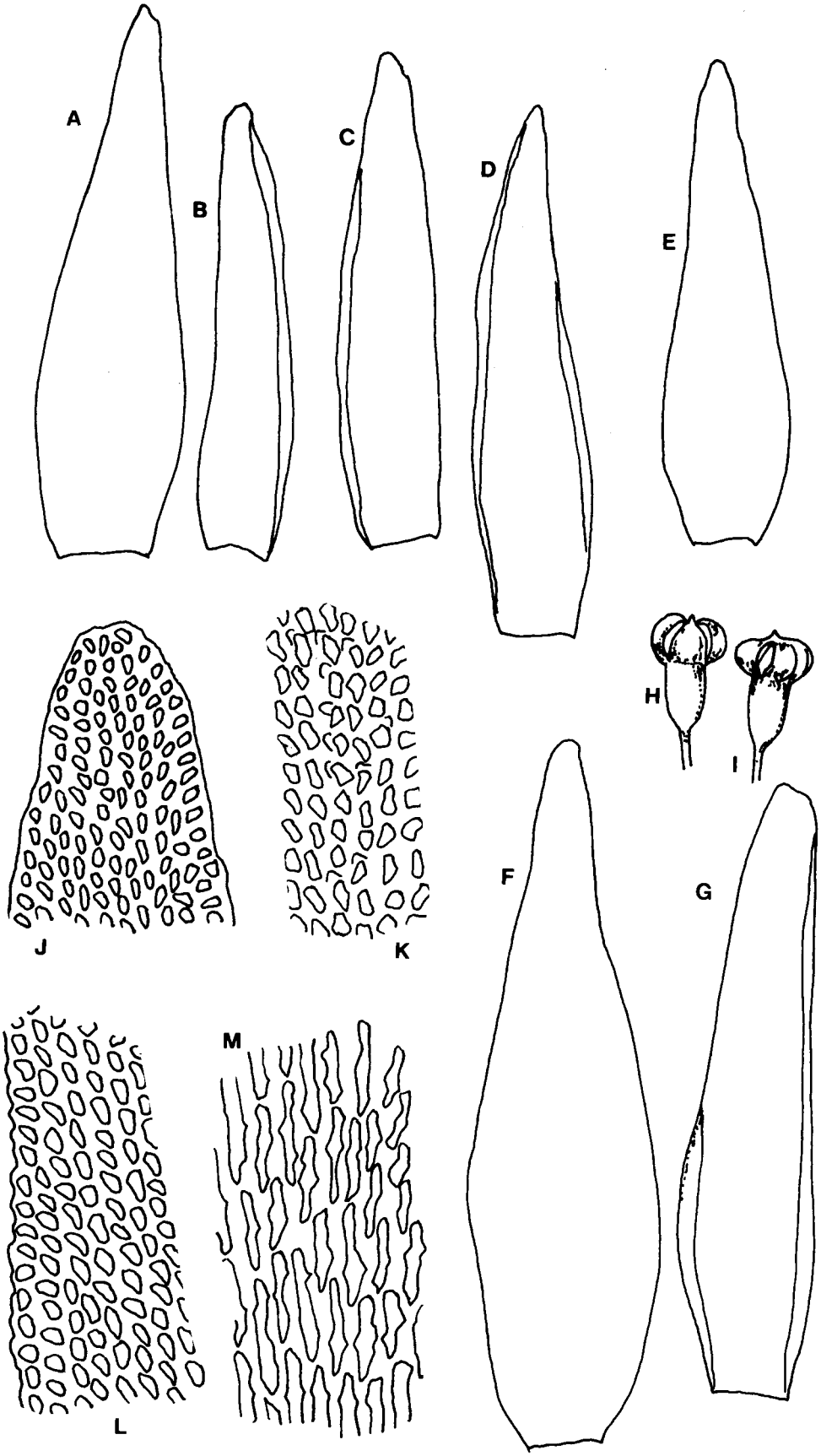


**Figure 6.** *Andreaea wangiana* Chen. A–G, Leaves (×95); H–I, Capsules (×16); J, Leaf apex (×375); K, Median laminal cells (×375); L, Marginal cells (×375); M, Basal cells (×375). (A–E, H–J, L, M, drawn from *Chiang 19346*; F.G.K. drawn from *Wang 32837*, holotype).

Murray's (1988) argument that the closest relatives of *A. sinuosa* are among costate taxa in sect. *Nerviae* having sinuose cell walls, axillary hairs with persistent mucilaginous cells, and infrequent spore abortion. On one hand, persistent mucilaginous cells and infrequent spore abortion occur not only in sect. *Nerviae* but also in the ecostate species, such as *A. mutabilis.* On the other, the difference between sinuose and strongly pitted cell wall, such as in *A. alpina* Hedw., seems less than clear-cut. Logically, if Murray's assumption is correct, then the infrageneric and sectional classification of *Andreaea* adopted in Murray (1988) should be discredited. Certainly the phylogeny of *Andreaea* still remains unknown. To reconstruct the phylogeny, either the relative conservativeness of gametophytic features, e.g., sinuose cell walls, versus sporophytic characters, e.g., dehiscence of capsules, needs to be resolved by means of ontogenetic study, or other evidence independent of morphological characters is required.

**Acknowledgments.** I am very grateful to Prof. C. I. Peng for getting all the loans via the Institute of Botany, Academia Sinica, Taipei; to Prof. Zen. Iwatsuki for the loan of *A. nivalis* of Japan and the type of *A. morrisonensis* from the Hattori Botanical Laboratory; to Prof. P. C. Wu for the loan of type specimens of the Chinese *Andreaea* from the Institute of Botany, Academia Sinica, Beijing; and to Prof. W. R. Buck for the loan of *A. commutata* from the New York Botanical Garden. I also want to thank the curators of University of British Columbia, Conservatoire et Jardin botaniques and National Museum of National Science, Taichung. I am indebted to the reviewers, for the instructive comments on this study.

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