



Synopsis of Cyatheaceae from Myanmar

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Abstract

A synopsis of Cyatheaceae from Myanmar is presented for the first time. The classification of four genera in Cyatheaceae is applied and 10 species in three genera are tentatively recognized in Myanmar based on herbarium collections and previous reports. Of the 10 recognized species, *Gymnosphaera henryi* and *G. podophylla* are confirmed for the first time with distribution in Myanmar. Some misidentifications of collections in previous reports are clarified. A key to genera and species, diagnostic characters for each species, and notes involving nomenclature and species identification are provided.

Keywords: *Alsophila*, *Gymnosphaera*, nomenclature, *Sphaeropteris*, taxonomy, tree ferns

Introduction

Myanmar, formerly known as Burma, is a country in the northwestern corner of Southeast Asia, with its most areas laying between the Tropic of Cancer and the Equator. It is well known for its rich biodiversity. Myanmar and neighboring Indochina constitute one of nine leading hotspots, called Indo-Burma, across the world in terms of species richness and endemics (Myers *et al.* 2000). However, the ferns, as well as the whole flora in Myanmar, are poorly known due to the very insufficient investigations conducted in this country. Since 1900 only a few accounts (e.g., Christensen 1931, Merrill 1941, Dickason 1946, Bell 1953, Nwe *et al.* 2016, Khine *et al.* 2017) were contributed to the fern flora of Myanmar. There is hitherto no national flora available in Myanmar. To know the outline of ferns in Myanmar, one has to refer the list produced by Dickason in 1946, which is the most up-to-date literature for the fern flora of Myanmar. Dickason (1946) recorded 104 genera and 460 species of ferns at that time from Myanmar.

The Cyatheaceae (scaly tree ferns) represent a remarkable group in ferns due to the rare, arborescent habit. According to Dickason (1946), there were some 10 species of scaly tree ferns, which were all placed in the genus *Cyathea* Smith (1793: 416), at that time in Myanmar. In recent years, Khine *et al.* (2017) reported seven species, including six in *Alsophila* R. Brown (1810: 158) and one in *Sphaeropteris* Bernhardt (1801: 122), from northern and northwestern Myanmar. Fraser-Jenkins *et al.* (2017) adopted only one genus, *Cyathea*, for all scaly tree ferns in a checklist of ferns from India and mentioned that there are also seven but not exactly the same seven scaly tree ferns as reported by Khine *et al.* (2017) with distribution in Myanmar. It is not easy to judge which species recorded by Khine *et al.* (2017) and those by Fraser-Jenkins *et al.* (2017) are additions to the list produced by Dickason in 1946, because two different subdivisions of Cyatheaceae are involved and especially, as mentioned by Fraser-Jenkins *et al.* (2015), the application of *Cyathea brunoniana* (Clarke 1880: 430) Clarke & Baker (1888: 409) in Dickason's time (1946) was very confused. *Cyathea brunoniana* and *C. contaminans sensu* Dickason (1946) are not at all the true *C. brunoniana* and *C. contaminans* (Wallich ex Hooker 1844: 52) Copeland (1909: 60) recorded by Fraser-Jenkins *et al.* (2017), respectively. In addition, *C. decipiens* (J. Scott ex Beddome 1869: 311) Clarke & Baker (1888: 409), *C. oldhamii* (Beddome 1870: 343) Domin (1930: 143), and “*C. umbrosa*” [nom. nud. = *Alsophila umbrosa* Wallich ex Ridley (1926: 6)], which were recognized by Dickason (1946: 119) in Myanmar, were regarded as synonyms by Holttum (1965). Thus, it is necessary to re-identify the old collections and correct the misapplication of names.

The purpose of this account is to sort out the taxonomy of scaly tree ferns based on collections available from Myanmar and to provide basis to know the diversity of species in the modern sense (PPG I 2016). I prefer to adopt

the subdivision of four genera in Cyatheaceae, i.e., *Alsophila*, *Cyathea*, *Gymnosphaera* Blume (1828: 242), and *Sphaeropteris* instead of three genera (*Alsophila*, *Cyathea*, and *Sphaeropteris*) as advocated by PPG I (2016). Each of the four genera is well supported to be monophyletic in molecular phylogenetics and can be distinguished from other three genera in morphology (Korall *et al.* 2007, Korall & Pryer 2014, Dong & Zuo 2018). It is evident that the recognition of four genera in Cyatheaceae is more reasonable than that of only one genus to understand the divergence of scaly tree ferns in morphology, phylogeny, sporogenesis, and geographical distribution (Dong & Zuo 2018).

Materials and methods

Herbarium collections from Myanmar and neighboring regions were studied at BM, E, IBSC, K, L, and US. Through visiting online databases (<plants.jstor.org>, <apps.kew.org>, <bioportal.naturalis.nl>, <collections.nmnh.si.edu>, <data.rbge.org.uk>, etc.) I checked nomenclatural types of all names involved in this account and a part of vouchers on which Dickason's list (1946) of *Cyathea* was based. I had no chance to do field observations in Myanmar but conducted extensive surveys in the neighboring areas such as Bangladesh, S & SW China, and Vietnam, to know the range of morphological variation and the geographical distribution of species. The diagnostic characters of species provided below were based on herbarium collections from Myanmar and those from neighboring regions as well as my field observations beyond Myanmar. Distribution ranges of species were mainly from herbarium specimens or my recent collections, with reference to previous reports, mainly Holttum (1965) and Fraser-Jenkins *et al.* (2017).

Results

The specimens of scaly tree ferns from Myanmar were so far very limited in herbaria. I found only 21 collections (total 42 duplicates), which represent eight species in three genera. Of the eight species, *Gymnosphaera henryi* (Baker 1898: 229) S.R. Ghosh in Ghosh *et al.* (2004: 200) and *G. podophylla* (Hooker 1857: 334) Copeland (1909: 33) are new records to Myanmar. I was able to check about half the vouchers of *Cyathea* cited by Dickason (1946) and found that most determinations given by him are incorrect. For example, Rock's collections numbered 2032, 2041, 2153, and 2341 are all typical *G. henryi* but were misidentified as *Cyathea glabra* (Blume 1828: 242) Copeland (1909: 35) (= *G. glabra*); Rock 9247 is a representative of *Alsophila costularis* Baker (1906: 8), which is characterized by costae and costules abaxially bearing hairs, but was erroneously determined as *Cyathea khasyana* (T. Moore ex Kuhn 1869: 154) Domin (1929: 262) (= *G. khasyana*). Apart from the eight species with vouchers available to me, I included *Alsophila spinulosa* (Wallich ex Hooker 1844: 25) R.M. Tryon (1970: 32) and *Sphaeropteris glauca* (Blume 1828: 243) R.M. Tryon (1970: 21) in this account, though I so far did not see their vouchers from Myanmar. *Alsophila spinulosa* was documented with voucher (*Lace 4752*) in Myanmar by Holttum (1965) and recently reported in Kachin State, northern Myanmar (Khine *et al.* 2017). *Sphaeropteris glauca* was documented with distribution in Myanmar by Fraser-Jenkins *et al.* (2017) who used the name *Cyathea contaminans* (Wallich 1828: 11, no. 320) Copeland (1909: 60). Thus, total 10 species in three genera (three in *Alsophila*, five in *Gymnosphaera*, and two in *Sphaeropteris*) are currently recognized in Myanmar.

Taxonomic Treatment

Key to genera and species of Cyatheaceae in Myanmar

1. Stipe scales conform in structure, soft, and pale or light brown, with regularly arranged teeth at margin (*Sphaeropteris*)2
- Stipe scales marginate in structure, stiff, and dark brown or blackish, without regular teeth at margin.....3
2. Stipe smooth or minutely warty9. *Sphaeropteris brunoniana*
- Stipe, at least on lower part, sharply spiny 10. *Sphaeropteris glauca*
3. Frond-axes usually stramineous or light brown; veins on ultimate segments forked; sori indusiate; 16 spores per sporangium (*Alsophila*).....4
- Frond-axes castaneous or blackish; veins on ultimate segments simple (but sometimes forked in *G. khasyana*); sori exindusiate; 64 spores per sporangium (*Gymnosphaera*)6
4. Costae and costules abaxially hairy.....1. *Alsophila costularis*

-	Costae and costules abaxially hairless.....	5
5.	Stipe and rachis inermous, or at most muricate towards base of stipe; indusia small, hidden by sori.....	2. <i>Alsophila latebrosa</i>
-	Stipe and rachis spiny throughout; indusia visible, enclosing sori before mature	3. <i>Alsophila spinulosa</i>
6.	Fronds 1- or 2-pinnate; if 2-pinnate, fronds with a terminal pinna similar to lateral ones, pinnules crenate or rarely shallowly lobed (less than 1/3 way to costules).....	8. <i>Gymnosphaera podophylla</i>
-	Fronds 2-pinnate-pinnatifid; pinnules, at least those on lower pinnae, lobed over 1/3 way to costules	7
7.	Stipe and lower part of rachis adaxially bearing dense scales uniformly spreading outwards	8
-	Stipe (above base) and rachis without such spreading scales.....	9
8.	Lamina copiously hairy on abaxial surface	4. <i>Gymnosphaera andersonii</i>
-	Lamina abaxially hairless	5. <i>Gymnosphaera henryi</i>
9.	Sori in V shape on ultimate segments	6. <i>Gymnosphaera gigantea</i>
-	Sori in two parallel lines on ultimate segments.....	7. <i>Gymnosphaera khasyana</i>

Alsophila R. Brown (1810: 158).

Type:—*Alsophila australis* R. Brown (1810: 158).

Tall tree ferns, trunks up to 10 m or more tall; scales castaneous, marginate (with marginal cells differentiated in size and orientation from those on central area); fronds monomorphic or sometimes weakly dimorphic, usually 2-pinnate-pinnatifid; basal skeletonized pinnae (formerly called aplebia) lacking or rarely present; frond-axes (above base of stipe) green on adaxial surface when young and turning stramineous or reddish brown at mature; veins free, forked; sori compital, indusiate or rarely exindusiate; 16 spores per sporangium. Chromosome number: $n = 69$.

A pantropic genus of about 230 species, with more than half species in Malesia, Australasia, and the Pacific. Three species are currently known in Myanmar.

1. ***Alsophila costularis*** Baker (1906: 8).

≡ *Cyathea chinensis* Copeland (1908: 355), non *Cyathea costularis* Bonaparte (1917: 44); *Cyathea yunnanensis* Domin (1930: 172).

Type:—CHINA. Yunnan: Pu-Er (“Szemao”), 1800 m, *A. Henry 13136* (lectotype, 2 sheets, **designated here**, K-000061672! & K-000061674!; isolectotypes: K-000061674!, MO-255955!, NY-00127889!).

Synonyms:—*Hemitelia brunoniana* C.B. Clarke (1880: 430), non *Alsophila brunoniana* Wallich (1832: 241); *Cyathea brunoniana* (C.B. Clarke) C.B. Clarke & Baker (1888: 409). Type: INDIA. Meghalaya: Coalpits, Khasia, *J.D. Hooker & T. Thomson s.n.*, “*Herbarium hookerianum 1867*” (lectotype, selected by Fraser-Jenkins *et al.* [2015: 149], K, not seen).

Diagnostic characters:—Tall tree fern, up to 10 m or more; stipe with a few short aculei at base; lamina 2-pinnate-pinnatifid; pinnae sessile, lower pinnae opposite; costae and costules abaxially hairy; veins forked; sori tightly close to midribs of pinnule-lobes; indusia semi-spherical, attached on costular side of receptacle.

Additional specimens examined:—MYANMAR. **Kachin State:** between Sadung and the border of China (Yunnan), November 1922, *J.F. Rock 7464* (US). **San State:** Hkunpoye, Keng Tung, April 1938, 1200 m, *F.G. Dickason 9247* (L, US).

Distribution:—S & SW China, NE India, Myanmar, Nepal, and N Vietnam.

Note:—There are three sheets of *Henry 13136* deposited at K, each containing fragments of pinnae. The sheets barcoded K-000061672 and K-000061674 are here selected as the lectotype of *Alsophila costularis*, which constitute a single, complete pinna. According to Fraser-Jenkins *et al.* (2015), this species was previously known in India as *Cyathea brunoniana*. However, the name *C. brunoniana* was misapplied by Holttum (1965) to plants having conform scales, for which the correct name is *Sphaeropteris brunoniana* (Wallich 1832: 241, no. 7073) R.M. Tryon (1970: 21), or *Cyathea sollyana* (Griffith 1849: 624) Fraser-Jenkins in Fraser-Jenkins *et al.* (2015: 154) if one prefers only one comprehensive genus in Cyatheaceae.

2. ***Alsophila latebrosa*** Wallich ex Hooker (1844: 37).

≡ *Cyathea latebrosa* (Wall. ex Hook.) Copeland (1909: 52).

Type:—MALAYSIA. Penang. *Wallich 318* (lectotype, designated by Holttum (1965: 473); second-step lectotype, **designated here**, K-001109786!; isolectotypes: K-001109787!, BM-001048035!, BM-001048036!, GH-00020419!, L-0051316!, L-0051322!, ME-295768!, S-P-3341!, S-P-3343!, S-P-6305!, US-00139184!).

Diagnostic characters:—Tall tree fern, up to 10 m or more; stipe inermous or sometimes with a few short aculei at base; lamina 2-pinnate-pinnatifid; pinnae sessile to obviously petiolate, lower pinnae opposite or alternate; costae and costules abaxially covered with copious bullate-based scales; veins forked one or two times; sori close to midribs of pinnule-lobes; indusia semi-disc like (hemitelioid), attached on costular side of receptacle, hidden by sori.

Additional specimens examined:—MYANMAR. **Mon State**, Thaton District, 7 March 1909, *J.H. Luce 4683* (E).

Distribution:—Cambodia, S China, Myanmar, Indonesia, Malaysia, Thailand, and Vietnam.

Note:—In the protologue *Wallich 318* from Penang and a collection of Mark from Assam are cited gatherings. There are 12 duplicates of *Wallich 318* at seven herbaria. Holttum (1965: 473) effectively lectotypified the name by saying that the “type” is at K (Wallich Herbarium). However, there are two sheets of *Wallich 318* at K and there is no evidence showing that they are two parts of a single specimen. Here I conduct a second-step lectotypification by designated one of the two sheets at K as the lectotype.

3. *Alsophila spinulosa* (Wall. ex Hook.) R.M. Tryon (1970: 32).

Basionym:—*Cyathea spinulosa* Wall. ex Hooker (1844: 25).

Type:—NEPAL. Without precise locality, *N. Wallich 178* (lectotype, **designated here**, K-001044562!; isolectotypes: K-001109467!, K-001109468!, K-001109469!).

Synonyms:—*Alsophila decipiens* J. Scott ex Beddome (1869: 311); *Cyathea decipiens* (J. Scott ex Bedd.) C.B. Clarke & Baker (1888: 409). Type: INDIA. West Bengal: Darjeeling, in 1868, *Anonymous 8500* (holotype, K-000061710!).

Diagnostic characters:—Tall tree fern, up to 10 m or more; stipe and rachis spiny throughout; lamina 2-pinnae-pinnatifid; pinnae obviously petiolate, alternate on rachis; costae and costules abaxially covered with copious ovate scales; veins forked; sori tightly close to midribs of pinnule-lobes; indusia spherical but easily breaking when mature.

Distribution:—Bangladesh, Bhutan, S & SW China, India, Japan, Myanmar, Nepal, Thailand, and Vietnam.

Note:—I failed to find a voucher of *Alsophila spinulosa* from Myanmar. This species was recorded in Myanmar by Holttum (1965) occurring in Dawna Hills (Kayah State) and by Khine *et al.* (2017) in Hponkanrazi and Hponyinrazi (Kachin State).

Gymnosphaera Blume (1828: 242); *Cyathea* subg. *Cyathea* sect. *Gymnosphaera* (Blume) Holttum (1963: 115).

Type:—*Gymnosphaera glabra* Blume (1828: 242).

Arborescent or shrub-like ferns, trunks mostly 1–3 m tall; scales castaneous, marginate; fronds monomorphic to distinctly dimorphic, 1- to 3-pinnate, frequently with one to several pairs of basal skeletonized pinnae (but lacking in species of mainland Asia); frond-axes (stipe, rachis, and costa) usually castaneous or blackish; veins free (rarely with the lowest veinlets confluent), mostly simple; sori dorsal on veinlets, exindusiate (hemitelioid indusia present in *G. capensis* (Linnaeus 1781: 445) S.Y. Dong in Dong & Zuo (2018: 15) only); 64 spores per sporangium. Chromosome number: $n = 69$.

About 40 species: 28 in Asia to the western Pacific, 10 in Africa, and 2 in America. Five species currently known in Myanmar.

4. *Gymnosphaera andersonii* (J. Scott ex Bedd.) Ching & S.K. Wu (1983: 54).

Basionym:—*Alsophila andersonii* J. Scott ex Beddome (1869: 166).

≡ *Cyathea andersonii* (J. Scott ex Bedd.) Copeland (1909: 56).

Type:—INDIA. Sikkim: Valley of River Rungbee, 300–750 m, July 1868, *J. Anderson s.n.* (lectotype [4 sheets], designated by Holttum [1965: 475], K-0000 000061717!, K-000061718!, K-000061719!, K-000061720!).

Diagnostic characters:—Low or semi-arboreal tree fern, rarely up to 3 m; stipe inermous; lamina 2-pinnae-pinnatifid; pinnae shortly petiolate, alternate or the basal pair sub-opposite on rachis; costae and costules abaxially covered with copious hairs; veins simple; sori in V-shape, or in nearly two parallel rows on each pinnule-lobe, medial between midrib and margin; indusia lacking.

Additional specimens examined:—MYANMAR. **Kachin State:** Hkawng Lamhpu, 27°01'43"N, 98°21'44"E, 900 m, 15 March 2009, *N.H. Xia et al.* 892 (IBSC).

Distribution:—SW China, N & NE India, and Myanmar.

5. *Gymnosphaera henryi* (Baker) S.R. Ghosh in Ghosh *et al.* (2004: 200).

Basionym:—*Alsophila henryi* Baker (1898: 229).

≡ *Cyathea henryi* (Baker) Copeland (1909: 38).

Type:—CHINA. Yunnan: Mengtze, *A. Henry 11451* (lectotype, **designated here**, K-000061684!; isolectotypes: BM-001048268!, E-00385949!, GH-00020413!, K-000061683!, K-000061685!, MO-255953!, NY-00127893!, NY-00127894!, US-00055262!, US-00065495!).

Diagnostic characters:—Low or semi-arboreal tree fern, rarely up to 3.5 m; stipe inermous; lamina 2-pinnate-pinnatifid; pinnae sessile, all or at least lower pinnae opposite on rachis; costae and costules abaxially covered with minute lanceolate or scurfy scales; veins simple; sori in V-shape on pinnule-lobes; indusia lacking.

Additional specimens examined:—MYANMAR. **San State:** Keng Tung, 525–930 m, January to February 1922, *J.F. Rock 2032, 2041, 2153, & 2341* (US).

Distribution:—Currently known in S & SW China, Laos, Myanmar, and Vietnam.

Note:—*Gymnosphaera henryi* was previously mistaken for and subsumed under *G. gigantea*. For example, the species recorded as *G. gigantea* in China (Xia 1989, Zhang 2004, Zhang 2006, Dong 2009, Zhang & Nishida 2013) was misreport of *G. henryi*. Rock's collections of *G. henryi* (i.e., *Rock 2032, 2041, 2153, & 2341*) were all identified by Dickason (1946: 119) as *Cyathea glabra* (= *G. glabra*). Actually, *G. glabra* is very similar to *G. gigantea* in morphology (Holtum 1963); both are very different from *G. henryi* by lacking 2-rowed scales throughout stipe and lower part of rachis.

6. *Gymnosphaera gigantea* (Wall. ex Hook.) S.Y. Dong (2019: 87).

Basionym:—*Alsophila gigantea* Wall. ex Hooker (1844: 53).

≡ *Cyathea gigantea* (Wall. ex Hook.) Holtum (1935: 318).

Type:—BANGLADESH (Sylhet) or NEPAL, *N. Wallich 321* (lectotype, **designated here**, K-001044558!; isolectotypes: K-001044559!, K-001044560!, K-001044561!, K-000639703!, K-000639704!).

Synonym:—*Alsophila umbrosa* Wall. ex Ridley (1926: 6). Type: MALAYSIA. Penang, *N. Wallich 336* (lectotype, **designated here**, K-000636525!; isolectotypes, K-000636526!, K-001109846!, K-001109847!).

Diagnostic characters:—Low or semi-arboreal tree fern, trunks rarely up to 1 m; stipe inermous; lamina 2-pinnate, with pinnules shallowly or lobed half way to costules; pinnae mostly shortly petiolate, rarely sessile, alternate or rarely lower 1–2 pairs opposite; costae and costules abaxially bearing scurfy scales; veins simple; sori in V-shape; indusia lacking.

Additional specimens examined:—MYANMAR. **Mon State:** Kyain, Moulmein (Mawlamyine), February 1938, 30–150 m, *F.G. Dickason 6854 & 6860* (US). **Kachin State:** Putao, 27°43'35"N, 98°52'19"E, 870–1050 m, 14–17 March 2009, *X.F. Gao et al.* 2142 & 2484 (IBSC), *N.H. Xia et al.* 1711 (IBSC); Myitkyina, 12 January 1958, 150 m, *H.S. McKee 6036* (US). **Tanintharyi:** without precise locality, in 1827, *N. Wallich 180* (K); Kambauk, 125 m, 17 October 1998, *J.F. Maxwell 98-1161* (L).

Distribution:—Bangladesh, Bhutan, Cambodia, Indonesia, Laos, Malaysia, Myanmar, Nepal, Sri Lanka, Thailand, and Vietnam.

7. *Gymnosphaera khasyana* (T. Moore ex Kuhn) Ching in Ching & Lin (1984: 196).

Basionym:—*Alsophila khasyana* T. Moore ex Kuhn (1869: 154).

≡ *Cyathea khasyana* (T. Moore ex Kuhn) Domin (1929: 262).

Type:—INDIA. Assam: Khasi Hills, *J. D. Hooker & T. Thomson s.n.* (lectotype, BM, designated by Holtum [1965: 479], not seen; isolectotype, GH-00020416!).

Synonyms:—*Alsophila oldhamii* Beddome (1870: 343); *Cyathea oldhamii* (Bedd.) Domin (1930: 143). Type: INDIA. Assam: Khasi Hills, *Oldham s.n.* (holotype, K-001044514!).

Diagnostic characters:—Medium-sized, trunks up to 5 m; stipe inermous; lamina 2-pinnate-pinnatifid; pinnae petiolate, alternate; costae and costules abaxially covered with copious scurfy and bullate-based scales; veins simple or sometimes forked; sori in two rows, close to midribs of pinnules-lobes; indusia lacking.

Additional specimens examined:—MYANMAR. **Kachin State:** Changtifang and Kambaiti, between Sadung and the border of China (Yunnan), November 1922, *J.F. Rock 7431* (US).

Distribution:—Bhutan, China (Yunnan), India, Myanmar, and Nepal.

Note:—*Gymnosphaera khasyana* was sampled in molecular analyses and was confirmed to be a member of *Gymnosphaera* (Dong & Zuo 2018). Gastony (1974), however, reported 16 spores per sporangium in *G. khasyana*. Gastony's report was based on the collection *Dickason 9247* (US) (erroneously printed as *9347*), which is actually a collection of *Alsophila costularis* characterized by hairs present on abaxial surface of costa and costule. The misidentification of *Dickason 9247* as *G. khasyana* and the erroneous report of 16 spores in *G. khasyana* should be corrected.

8. *Gymnosphaera podophylla* (Hook.) Copeland (1947: 98), Fig. 1.

Basionym:—*Alsophila podophylla* Hooker (1857: 334).

≡ *Cyathea podophylla* (Hook.) Copeland (1909: 33).

Type:—CHINA. Zhejiang (formerly Chekiang): Chu Shan, *T. Alexander s.n.* (lectotype, selected by Holttum [1965: 475], K-000061678!).

Diagnostic characters:—Low or semi-arboreal tree fern, trunks rarely up to 2.5 m; stipe inermous; lamina 1- or 2-pinnate, with terminal pinnae conform to lateral ones, and pinnules crenate or rarely lobed 1/3 way to costules; pinnae petiolate, alternate or rarely opposite at base; costae and costules abaxially bearing lanceolate scales; veins simple; sori in two rows, close to midribs, or sometimes forming V-shape; indusia lacking.

Additional specimens examined:—MYANMAR. **Kachin State:** Ratbaw, Putao, 27°26'04"N, 97°54'30"E, 500–750 m, 23 March 2009, *X.F. Gao et al. 2733* (IBSC); Jubali village in Misong District, 12 May 2009, *B.Q. Xu et al. 5207 & 5218* (IBSC).

Distribution:—Cambodia, S China, Japan, Laos, Thailand, and Vietnam; new record to Myanmar.

Note:—*Gymnosphaera podophylla* is a common species in tropical and subtropical areas of East Asia (Dong 2009) but has not been recorded from Myanmar. Of all known species of *Gymnosphaera* in mainland Asia (Dong & Zuo 2018), this species is the only one having both 1-pinnate and 2-pinnate fronds and having characteristic entire (or sometimes shallowly lobed) pinnules. The Kachin vouchers (*Gao et al. 2733* and *Xu et al. 5207 & 5218*) are consistent in having 1-pinnate fronds, with pinnae subentire or shallowly lobed to less than 1/3 way to costae (Fig. 1), agreeing well with the form of *G. podophylla* with 1-pinnate fronds found in China and Vietnam. However, the three collections from Kachin State all have wholly free veins and in this aspect are different from the East Asian collections of *G. podophylla*; in the latter, if the fronds are 1-pinnate, the veins are partially anastomosing, i.e., the basal pair of veins confluent and forming a row of narrow-triangular areoles on either side of costae. As indicated by phylogenetic analyses (Dong *et al.* 2019), *G. podophylla* as currently circumscribed is a species complex. The Kachin collections characterized by wholly free veins are surely belonging to the *G. podophylla* complex and probably represent a different taxon in East Asia and Indochina.

Sphaeropteris Bernhardt (1801: 122); *Cyathea* subg. *Sphaeropteris* (Bernh.) Holttum (1963: 124).

Type:—*Sphaeropteris medullaris* (Forster 1786: 74) Bernhardt (1801: 122).

Low or tall tree ferns, trunks up to 10 m or more; scales usually pale or pale-brown, conform (with marginal cells conform to central ones in size and orientation), and toothed at edges; fronds monomorphic, 1- to 2-pinnate, without skeletonized pinnae at base; frond-axes (above base of stipe) green on adaxial surface in living state and turning stramineous or light brown in herbarium; veins free, forked; sori compital, exindusiate or rarely indusiate; 64 spores per sporangium. Chromosome number: $n = 69$.

About 103 species (PPG I 2016), throughout Asia, Malesia, Australasia, and Polynesia, with six species in tropical America (Holttum 1963). Two species currently known in Myanmar.

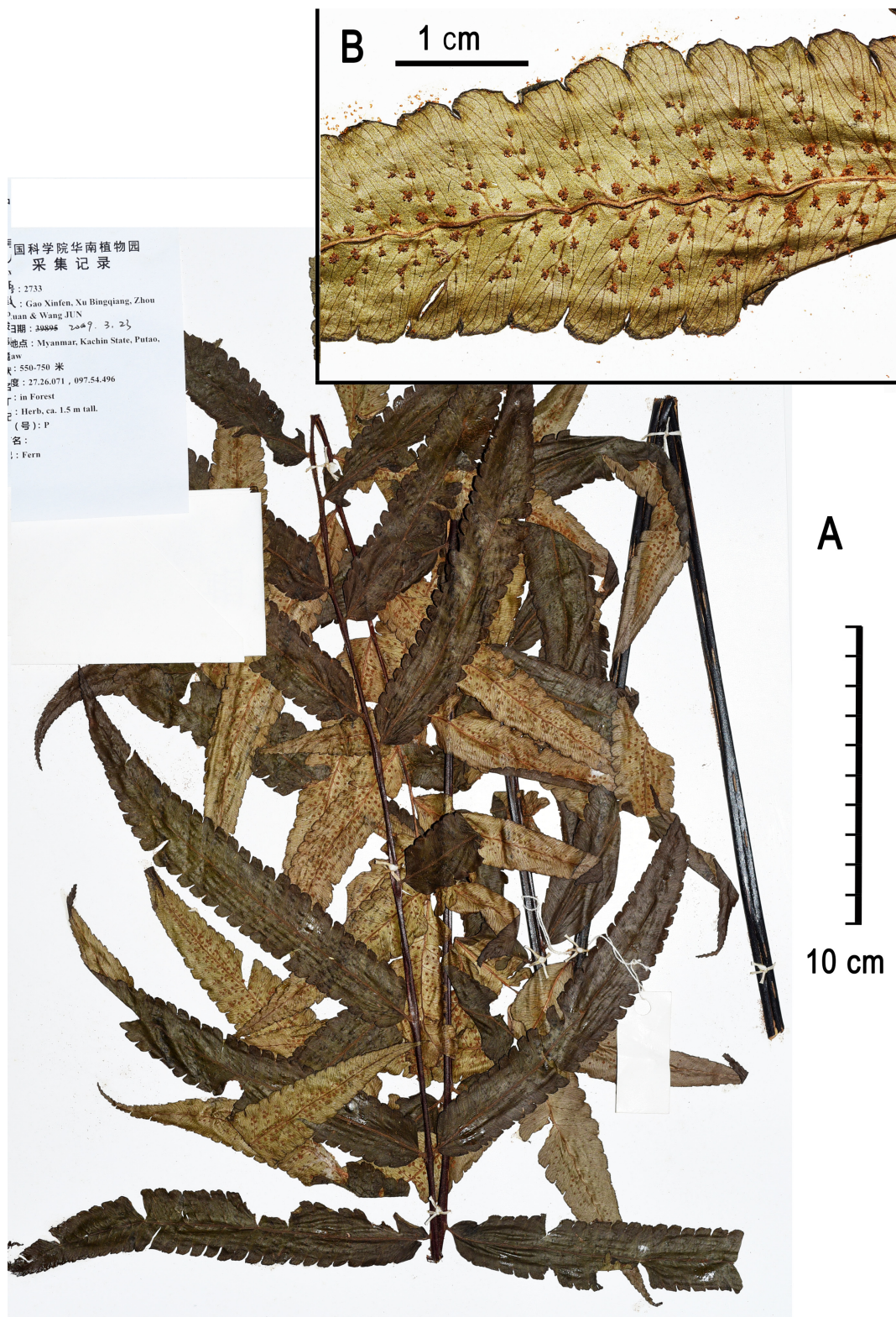


FIGURE 1. A collection of *Gymnosphaera podophylla* (Hook.) Copel. from Myanmar (*Gao et al.* 2733 at IBSC). A, a 1-pinnate frond; B, a portion of a pinna, showing free veins and dorsal sori.

9. *Sphaeropteris brunoniana* (Wall.) R.M. Tryon (1970: 21).

Basionym:—*Alsophila brunoniana* Wallich (1832: 241).

Type:—BANGLADESH. Mt. Sillet, *W. Gomez s.n.* (*Wallich Cat. No.* 7073) (holotype, two sheets, K-001126691!, K-001126692!).

Synonyms:—*Alsophila sollyana* Griffith (1849: 624); *Cyathea sollyana* (Griff.) Fraser-Jenk. in Fraser-Jenkins *et al.* (2015: 154). Type: INDIA. Assam: “Sadiye”, in 1836, *W. Griffith s.n.* (holotype, not seen).

Diagnostic characters:—Tall tree fern, up to 10 m or more; scales pale, with blackish setae at edges; stipe inermous or rarely with a few short aculei at base; lamina 2-pinnate-pinnatifid; pinnae petiolate, alternate or sometimes lower 3–4 pairs subopposite; costae and costules abaxially subglabrous or bearing a few scurfy scales toward bases and a few hairs toward apexes; veins forked; sori in two rows, tightly close to midribs; indusia lacking.

Additional specimens examined:—MYANMAR. **San State:** Keng Tung, 525–690 m, January 1922, *J.F. Rock 2097* (US).

Distribution:—Bangladesh, Bhutan, S & SW China, India, Myanmar, Nepal, and Vietnam.

Note:—*Sphaeropteris brunoniana* was frequently misapplied as *Cyathea brunoniana* (e.g., Holttum 1965: 487) or *C. contaminans* (e.g., Dickason 1946: 119). In addition, it is notable that, the authorship of *Alsophila brunoniana* should be attributed to Wallich (1832) instead of Wallich ex Hooker (1844) (Fraser-Jenkins *et al.* 2015); the latter appears after *A. brunoniana* in nearly all taxonomic literature and online databases of nomenclature. Since the confusion on the misapplication of *Cyathea brunoniana* has been elucidated by Fraser-Jenkins *et al.* (2015), it does not appear necessary to conduct more nomenclatural changes to the present and related species, such as rejecting *Alsophila brunoniana* Wallich (1832) or rejecting *Hemitelia brunoniana* C.B. Clarke (1880) as suggested by Fraser-Jenkins *et al.* (2015). If four genera in Cyatheaceae are adopted, the present species should be named *Sphaeropteris brunoniana* (Wall.) R.M. Tryon and the accepted name of *Hemitelia brunoniana* C.B. Clarke is *Alsophila costularis* Baker; if only one genus for all scaly tree ferns is adopted, the present species should be called *Cyathea sollyana* (Griff.) Fraser-Jenk., and the accepted name of *Hemitelia brunoniana* is *Cyathea brunoniana* (C.B. Clarke) C.B. Clarke & Baker.

10. *Sphaeropteris glauca* (Blume) R.M. Tryon (1970: 21).

Basionym:—*Chnoophora glauca* Blume (1828: 243).

≡ *Alsophila glauca* (Blume) J. Smith (1841: 419).

Type:—INDONESIA. Java, *F.W. Junghuhn s.n.* (lectotype, **designated here**, L-0063133!; isolectotype, L-0063134!).

Synonyms:—*Alsophila contaminans* Wall. ex Hooker (1844: 52); *Cyathea contaminans* (Wall. ex Hook.) Copeland (1909: 60). Type: MALAYSIA. Penang, *N. Wallich Num. List 320* (lectotype, **designated here**, BM-001048070!; isolectotype, US-00139201!).

Diagnostic characters:—Tall tree fern, up to 10 m or more; scales pale, with blackish setae at edges; stipe, as well large part of rachis, obviously aculeate throughout; lamina 2-pinnate-pinnatifid; pinnae petiolate, alternate; costae and costules abaxially subglabrous or bearing a few scurfy scales and some hairs; veins forked; sori in two rows, close to midribs; indusia lacking.

Distribution:—India, Indonesia, Laos, Malaysia, Myanmar, New Guinea, Philippines, Singapore, and Thailand.

Note:—I did not find any vouchers of *Sphaeropteris glauca* from Myanmar. This species is included here based on the report of Fraser-Jenkins *et al.* (2017). It is possible to be found in tropical forest areas of southern Myanmar.

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