

Polypodium and Goniophlebium of Japan,
Corea, Ryukyu and Taiwan

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The present paper is a taxonomic review of *Polypodium* (11 spp.) and *Goniophlebium* (1 sp.) known from Japan, Corea, Ryukyu and Taiwan. The delimitation of these genera is in accordance with *Genera Filicum* of COPELAND. All materials, except where otherwise stated, are preserved in the Herbarium of the Kyoto University.

Key to genera and species

1. All pinnae confluent at base or the lower ones free and broadly adnate to the rachis I. *Polypodium* 2
1. Pinnae, at least the lower ones, free, articulate to the rachis.
II. *Goniophlebium* (12) *G. argutum*
2. Veins all free (cf. also (9) *P. microrhizoma*) 3
2. Veins anastomosing regularly to form at least one row of costal areolae, each with one simple excurrent soriferous included veinlet 5
3. Blades clothed with woolly intestiniform long gray hairs beneath.
(3) *P. fauriei*
3. Blades glabrous beneath 4
4. Scales on rhizome usually concolorous; blades oblong-lanceolate or ovate-lanceolate; sori medial (1) *P. vulgare*
4. Scales on rhizome with dark-coloured median band; blades linear-lanceolate or sometimes oblong-lanceolate; sori nearer to the margin than to the costa (2) *P. virginianum*
5. Pinnae entire or nearly so; rhizome glabrous or sparsely scaly, thick and carnose, often glaucous 6
5. Pinnae depresso-serrate or crenate or provided with minute incisions one between each pair of lateral main vein 10

- 6. Blades beneath puberulous 7
- 6. Blades beneath glabrous or nearly so 9
- 7. Rhizome naked or very sparsely clothed with ovate-acuminate scales hardly over 2 mm. long; stipes glabrous (4) *P. niponicum*
- 7. Rhizome more or less densely clothed with linear-subulate scales 4–5 mm. long 8
- 8. Blades very densely puberulous on both surfaces, the basal pinnae horizontal, the stipe puberulous (5) *P. transpianense*
- 8. Blades sparsely puberulous on both surfaces, the basal pinnae somewhat deflexed, the stipe glabrous (6) *P. amamianum*
- 9. Rhizome glabrous except the growing tip which is covered with deciduous small scales (7) *P. formosanum*
- 9. Rhizome sparsely clothed with linear-subulate hair-pointed scales to 5 mm. long (8) *P. raishaense*
- 10. Lower pinnae broadly adnate at base, but not contiguous each other; veins sometimes free in the same pinna (9) *P. microrrhizoma*
- 10. All pinnae confluent; veins anastomosing everywhere 11
- 11. Costa of pinna not decurrent at base; pinnae depresso-serrate or provided with minute incision one between each pair of lateral main vein. (10) *P. amoenum*
- 11. Costa of pinna decurrent at base 12
- 12. Pinnae irregularly and largely crenate-serrate (11) *P. someyae*
- 12. Pinnae apparently entire, but provided with minute incision one between each pair of lateral main vein (11) *P. someyae* var. *awaense*

I. *Polypodium* L.

(1) *Polypodium vulgare* L. Sp. Pl. 2: 1085. 1753; FERNALD, *Rhodola* 24: 136. 1922; OGATA, Ic. Fil. Jap. 2: pl. 93. 1929; FOMIN in Fl. Sib. Or. Extr. 5: 181. 1930; CHING, Contr. Inst. Bot. Nat. Acad. Peiping 2: 39. 1933.

Kuriles, Hokkaido, northern district of Honsyu, and also found in a few restricted localities of western Honsyu and on Isl. Uturyoto in the Japan Sea, at low elevations, usually on rocks. Specimens from the noteworthy localities are:

Japan. Pref. Tottori: Matsuzaki, Tohaku-gun, HISAUCHI (Herb. Tokyo Univ.); Asauzu-mura, Tohaku-gun, OGATA. Pref. Simane: Urage in Oki, MARUYAMA 606.

Corea. Isl. Uturyoto (Dagelet I.), NAKAI 4091–4093 (Herb. Tokyo Univ.).

Widely distributed throughout the northern temperate zone and also recorded from several remarkably disjunct localities.

(2) *Polypodium virginianum* L. Sp. Pl. 2: 1085. 1753; FERNALD, *Rhodola* 24: 141. 1922; FOMIN in Fl. Sib. Or. Extr. 5: 183. cum fig. 1930; CHING, Contr. Inst. Bot. Nat. Acad. Peiping 2: 39. 1933.

Saghalien, Hokkaido, and northern Corea, probably not uncommon, also in

several restricted localities of cold regions of Honsyu (TAGAWA, Acta Phytotax. Geobot. **15**: 12. 1953), at low elevations, usually on mossy rocks or tree trunks in mountain forests.

The range is from north-eastern N. America to north temperate regions of Eastern Asia.

(3) **Polypodium fauriei** CHRIST, Bull. Herb. Boiss. **4**: 672. 1896; CHING, Contr. Inst. Bot. Nat. Acad. Peiping **2**: 40. 1933.— *Polypodium vulgare* L. var. *japonicum* FR. et SAV. Enum. Pl. Jap. **2**: 244. 1877.— *Polypodium japonicum* (FR. et SAV.) MAXON, Fern Bull. **10**: 42. 1902, not HOUTT. 1783; OGATA, Ic. Fil. Jap. **2**: pl. 85. 1929.

Widely spread from Hokkaido and the southern Kuriles south to Kyusyu and Quelpart, at low and middle elevations, usually on mossy tree trunks in the heart of a mountain.

Not found elsewhere. This distinct and well known species has been fully discussed by CHRISTENSEN (Dansk Bot. Ark. **5**. n. 22. 9. 1928) and by CHING (l. c.) as a linking species between those with open venation and with Goniophleboid one, but it does not appear in the detailed description.

Rhizome creeping, about 3 mm. thick in dried specimen, densely scaly; scales brown or reddish-brown, broadly ovate-acuminate, subentire, 2–3 mm. long, bearing a tuft of long reddish-brown hairs on the back. Stipes more or less approximate, much shorter than blades, glabrous, stramineous or brownish, 1.5–7 cm. long; blades lanceolate or oblong-lanceolate, sometimes narrowly lanceolate, rarely ovate-lanceolate, acuminate or caudate-acuminate, usually attenuate toward the base, pinnatifid nearly to the rachis into numerous almost horizontal pinnae, 5–25 cm. or sometimes to 30 cm. long, 3–7 cm. wide, quite glabrous above, sparsely clothed beneath with woolly intestiniform long gray hairs, often glabrescent afterward, chartaceous in texture; pinnae to about 30 on each side, rather remote, linear or linear-lanceolate, obtuse or acute, entire, 3–5 mm. wide at the middle, strongly dilated at the base, the lower pinnae usually considerably remote, often free; veins indistinct on both surfaces, the posterior and anterior ultimate veinlets of contiguous groups bending somewhat downward and upward respectively. Sori round, medial, to 1.5 mm. in diameter when mature, without paraphyses; spores bilateral, hyaline, tuberculate.

(4) **Polypodium niponicum** METT. Ann. Lugd. Bat. **2**: 222. 1866; MAKINO, Phan. Pter. Jap. Ic. Ill. pl. 32. 1899; OGATA, Ic. Fil. Jap. **3**: pl. 140. 1931; CHING, Contr. Inst. Bot. Nat. Acad. Peiping **2**: 41. 1933; Ic. Fil. Sin. **2**: pl. 98. 1936.— *Marginaria niponica* (METT.) NAKAI ex H. ITO, Journ. Jap. Bot. **11**: 95. 1935.

Not uncommon particularly in warm districts of Japan, at low elevations, usually on mossy rocks or tree trunks in mountain forests.

Continuously spread from Japan to South-west China. It is interesting to note that *P. niponicum* is replaced by several related species in adjoining regions,

that is, in the Ryukyus by *P. amamianum* TAGAWA, in Taiwan by *P. transpianense* YAMAM., *P. raishaense* ROS. and *P. formosanum* BAK., and in Burma and Tonkin by *P. wattii* (BEDD.) TAGAWA.

(5) ***Polypodium transpianense*** YAMAM. Journ. Soc. Trop. Agr. **3**: 236. 1931; TAGAWA, Acta Phytotax. Geobot. **10**: 286. 1941.— *Marginaria transpianensis* (YAMAM.) H. ITO, Journ. Jap. Bot. **11**: 95. 1935. Pl. 1, fig. 1, right.

Central mountains of Taiwan, rare, at 500–2000 m. elevations, usually on mossy rocks.

Not known elsewhere. This species resembles most *P. niponicum* METT. from Japan and China in having a thick carnose blue-green glaucous rhizome and densely puberulous blades, the hairs are so dense that the epidermis is sometimes completely concealed. It can be, however, easily distinguished from *P. niponicum* by the thicker rhizome with much larger scales, the puberulous stipe, and by the basal pinnae which are more or less shortened and almost always horizontally patent. *P. wattii* (BEDD.) TAGAWA (Journ. Jap. Bot. **22**: 163. 1948) from Burma, Yunnan (after CHING, Contr. Inst. Bot. Nat. Acad. Peiping **2**: 42. 1933, as *P. niponicum* METT. var. *wattii* BEDD.) and Tonkin (after C. CHR. et TARDIEU-BLOT, Not. Syst. **8**: 183. 1939, as *P. niponicum* METT. var. *wattii* BEDD.) resembles *P. transpianense* in having puberulous stipe and almost horizontal basal pinnae, but it differs in the less hairy blades and the glabrous rhizome.

(6) ***Polypodium amamianum*** TAGAWA, Journ. Jap. Bot. **23**: 78. 1949.

Pl. 1, fig. 1, left.

Known only from Isl. Amami-Osima in the Ryukyu Islands, habitat unknown, at low elevations.

Mt. Yuwan, KODZUMI, holotype; *ibid.*, TASIRO; *ibid.*, SONOHARA; Mt. Naon, UCHIYAMA (Herb. Tokyo Univ.); without accurate locality, ITO (Herb. Tokyo Univ.).

This fern was first referred to *P. raishaense* ROS. by H. ITO (Bot. Mag. Tokyo **53**: 27. 1939). Indeed it resembles to that species, but it is distinguished by the more densely puberulous blades and the brown narrower and shorter scales on rhizome. In general appearance this species resembles also *P. niponicum* METT. and *P. transpianense* YAMAM., but differs from the former in the thicker rhizome with much larger scales, and from the latter it is separable by the glabrous stipe and the somewhat deflexed basal pinnae.

(7) ***Polypodium formosanum*** BAK. Journ. Bot. **23**: 105. 1885; type from Tamsui, Taiwan; OGATA, Ic. Fil. Jap. **3**: pl. 135. 1930; CHING, Contr. Inst. Bot. Nat. Acad. Peiping **2**: 43. 1933.— *Marginaria formosana* (BAK.) NAKAI ex H. ITO, Journ. Jap. Bot. **11**: 94. 1935.— *Polypodium liukiense* CHRIST, Bull. Herb. Boiss. sér. 2. **1**: 1014. 1901, type from Isl. Yakusima.

Taiwan throughout, rather common, from level land to 1000 m. or more elevations, also on Isl. Yakusima in Kyusyu, on mossy rocks or tree trunks in mountain forests.

Also known from Fokien in South China. The largest species of the group of

P. niponicum METT. The thick, carnose, practically glabrous rhizome with a few minute adpressed blackish scales at the growing tip and the ample thin glabrescent or sometimes quite glabrous blades are very characteristic of this species. *P. liukiense* CHRIST based on FAURIE 4570 from Isl. Yakusima is identical with the Taiwan type.

(8) **Polypodium raishaense** ROS. Hedwigia **56**: 346. 1915, type from Taiwan; TAGAWA, Acta Phytotax. Geobot. **5**: 108. 1936.— *Marginaria raishaensis* (ROS.) NAKAI ex H. ITO, Journ. Jap. Bot. **11**: 95. 1936.— *Marginaria pseudoformosana* TAGAWA, Acta Phytotax. Geobot. **3**: 94. 1934, type from Taiwan.

Pl. 1, fig. 2.

Central mountains of Taiwan, rather rare, at 500–2000 m. elevations, usually on mossy tree trunks or rocks in mountain forests.

Prov. Taihoku: inter Doba et Ekizyukei, Rato-gun, TAGAWA 10. Prov. Taitu: Keitao, H. ITO (Herb. Tokyo Univ.). Prov. Tainan: Bunkikiyo in arboribus, FAURIE 480; *ibid.*, FAURIE, *avril* 1914. Prov. Takao: between Masuhoaru and Nakanoseki, Kizan-gun, TAGAWA 1317; Keinanzan, Kizan-gun, OKAMOTO; Yosida, Kizan-gun, TAGAWA 1551; between Kuwarusu and Mt. Daibu, Tyosyu-gun, TAGAWA 2145; Raisha, FAURIE 219, isotype of *P. raishaense* (Herb. Tokyo Univ.); between Daizyurin and Sinsuiei (Prov. Taito), Tyosyu-gun, TAGAWA 2244. Prov. Kwarenko: near Sakadan, Kwaren-gun, TAGAWA 3523. Prov. Taito: between Kaimosu and Hariposon, Kwanzan-gun, TAGAWA 3024; near Kakayo, Kwanzan-gun, TAGAWA 3172; between Syussuiha and Daizyurin (Prov. Takao), Taito-gun, OHWI 364, holotype of *M. pseudoformosana* TAGAWA.

Not known elsewhere. This species comes near *P. formosanum* BAK., but it is easily distinguished by the rhizome clothed sparsely with much larger scales. The scales are subulate-lanceolate from a broad-ovate base, 5–7 mm. long, fuscous-brown, shining, clathrate, hair-pointed, nearly entire, the base deeply cordate with strongly imbricate lobes. The blades are constantly sparsely puberulous above and glabrous or nearly so beneath.

(9) **Polypodium microrrhizoma** CLARKE ex BAK. in HOOK. et BAK. Syn. Fil. ed. 2. 511. 1874, type from Sikkim; C. CHR. Contr. U. S. Nat. Herb. **26**: 315. 1931; CHING, Contr. Inst. Bot Nat. Acad. Peiping **2**: 47. 1933; Ic. Fil. Sin. **2**: pl. 96, 1934; TAGAWA, Acta Phytotax. Geobot. **4**: 145. 1935; Journ. Jap. Bot. **13**: 183. 1937.— *Polypodium deorsipinnatum* COP. Phil. Journ. Sci. **38**: 152. 1929, type from Taiwan.

Known only from Taiwan on the basis of

Prov. Tainan: Arisan, 2500 m., in rupibus, FAURIE 581.

The range is from the Himalayas to Yunnan, Szechuan and Taiwan. I have never collected this fern in Taiwan, nor seen any except FAURIE 581, its habitat unknown to me. COPELAND based on it a new species, *P. deorsipinnatum* COP., which is in no way different from continental *P. microrrhizoma*.

(10) **Polypodium amoenum** WALL. List n. 290. 1828, nom. nud., type

from Nepal; METT. Pol. 80. 1857; CHING, Contr. Inst. Bot. Nat. Acad. Peiping 2: 43. 1933; Ic. Fil. Sin. 2: pl. 99. 1934; TAGAWA, Acta Phytotax. Geobot. 8: 234. 1939; OGATA, Ic. Fil. Jap. 8: pl. 391. 1940.— *Polypodium arisanense* HAYATA, Ic. Pl. Form. 4: 243. f. 170. 1914, type from Arisan, Taiwan. — *Marginaria arisanensis* (HAYATA) NAKAI ex H. ITO, Journ. Jap. Bot. 11: 94. 1935.

Central mountains of Taiwan, rather rare, at 1500–3000 m. elevations, on mossy tree trunks or rocks in mountain forests.

The range is from the Himalayas to China and Taiwan. The blades of Taiwan plants are quite glabrous on both surfaces, terminating in a lanceolate acuminate subentire segment. *P. arisanense* HAYATA represents rather small plant, blade about 25 cm. long by 10 cm. wide, with distinct terminal segment, pinnae about 1 cm. wide at base.

(11) *Polypodium someyae* YATABE, Bot. Mag. Tokyo 5: 245. t. 27. 1891, type from Mt. Myogi, Japan.— *Marginaria someyae* (YATABE) NAKAI ex H. ITO, Journ. Jap. Bot. 11: 95. 1935.

Endemic in Japan. The affinity of this species to *P. amoenum* WALL. is positive as supposed by CHING (Contr. Inst. Bot. Nat. Acad. Peiping 2: 47. 1933). Its most aberrant feature is its costa of pinna which is decurrent at base. The frond is thinner and much less scaly beneath, costal areolae larger and more oblique and the upper ones mostly open. Pinnae are irregularly and largely crenate-serrate or, in a variety occurring in Sikoku, entire and provided with minute incisions one between each pair of lateral main veins. Thus the species may be distinguished into two varieties.

var. *someyae*. Excellently illustrated in OGATA, Ic. Fil. Jap. 3: pl. 143. 1930. Pinnae irregularly and largely crenate-serrate.

Known only from a few restricted localities in Kanto District and in Sikoku, usually on mossy rocks in mountain forest at low elevations.

Pref. Gunma: Mt. Myogi, HISAUCHI; *ibid.*, MOTIZUKI; *ibid.*, OGATA; *ibid.*, OKUYAMA 5207 (Herb. Nat. Sci. Mus.); *ibid.*, HAYASI (Herb. Nat. Sci. Mus.); Ozawa-mura, KOGURASI (Herb. Tokyo Univ.). Pref. Tokyo: Nippara, KUBOTA (Herb. Nat. Sci. Mus.). Pref. Tokushima: Kito-mura, INOBE (Herb. Tokyo Univ.).

var. *awaense* TAGAWA, var. nov. Pinnis integris, sed incisionibus remotis minutissimis instructis; stipite 10–12 cm. longo, lamina oblonga vel elongato-oblonga, 12–20 cm. longa, 6–8 cm. lata, pinnis 10–20 utrinque.

Pref. Tokushima: Higasisemitani, Kamikito-mura, Kaibu-gun, on mossy rocks in mountain forest, alt. ca. 500 m., G. NAKAI 4088, holotype in Herb. Kyoto Univ.

II. *Goniophlebium* (BL.) PR.

(12) *Goniophlebium argutum* (WALL.) J. SM. in HOOK. Gen. Fil. ad t. 51. 1840.— *Polypodium argutum* WALL. List n. 308. 1828, nom. nud., type

from Himalaya; HOOK. Sp. Fil. 5: 32. 1863; C. CHR. Contr. U. S. Nat. Herb. 26: 316. 1931; CHING, Contr. Inst. Bot. Nat. Acad. Peiping 2: 51. 1933; TAGAWA, Acta Phytotax. Geobot. 7: 188. 1938.— *Polypodium taiwanianum* HAYATA, Bot. Mag. Tokyo 23: 80. 1909, type from Taiwan; OGATA, Ic. Fil. Jap. 7: pl. 333. 1936.— *Marginaria taiwaniana* (HAYATA) NAKAI ex H. ITO, Journ. Jap. Bot. 11: 95. 1935.

Central mountains of Taiwan throughout, rather common, at 1000–3000 m. elevations, on mossy tree trunks in mountain forests. Specimens from Taiwan, contributed to our Herbarium since the publication of my earlier paper (1938), are:

Prov. Taityu: Noko, FUKUYAMA 4766. Prov. Tainan: Bunkikiyo, 1500 m., FAURIE 482; Arisan, 2500 m., FAURIE 484; Numanohira in Arisan, OGATA. Prov. Takao: Raisha, 1200 m., FAURIE 220; between Daizyurin and Sinsuiei (Prov. Taito), Tyosyu-gun, TAGAWA 2163. Prov. Taito: between Asahi and Izumo, Kwanzan-gun, TAGAWA 3192.

The range is from the Himalayas and South-west China to Tonkin, Taiwan and Luzon. *G. subauriculatum* (BL.) PR. was recorded from Taiwan by HAYATA (*l. c.* 79, as *Polypodium subauriculatum* BL.) on the basis of KAWAKAMI & MORI 2387 and 2394 from Musha in Taiwan, and hence it appears that CHING (*l. c.*, as *Polypodium subauriculatum* BL.) mentioned Taiwan for one of the localities of this species. These two specimens represent nothing more than *G. argutum*. *P. taiwanianum* HAYATA, based upon KAWAKAMI & MORI 2361 from Daironkosha, Taito in Taiwan, is the same, only the frond is larger (stipe 15 cm. long, blade 50 cm. long by 25 cm. wide), with the pinnae more distant.

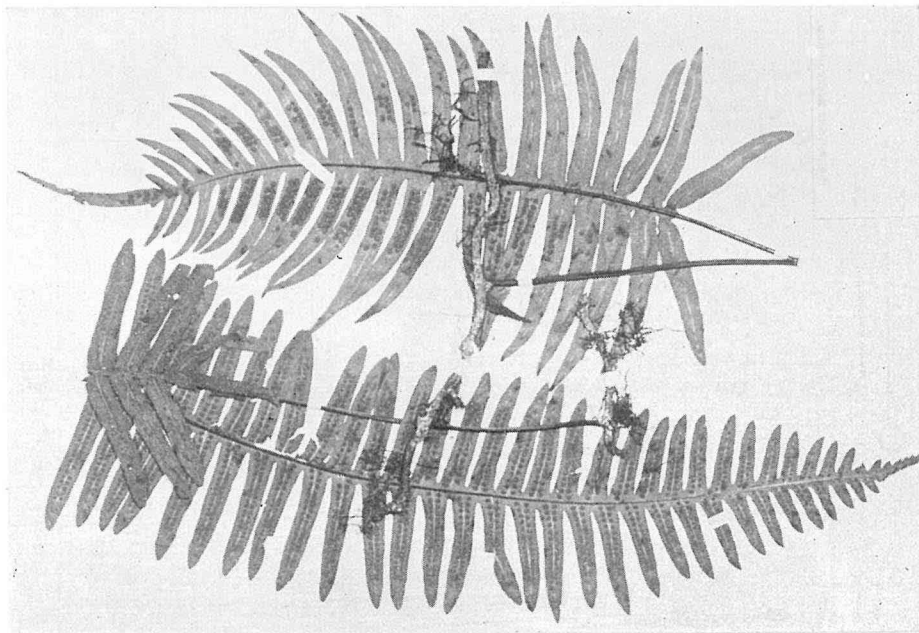


Fig. 2. *Polypodium raishaense* Ros.; TAGAWA 2244.

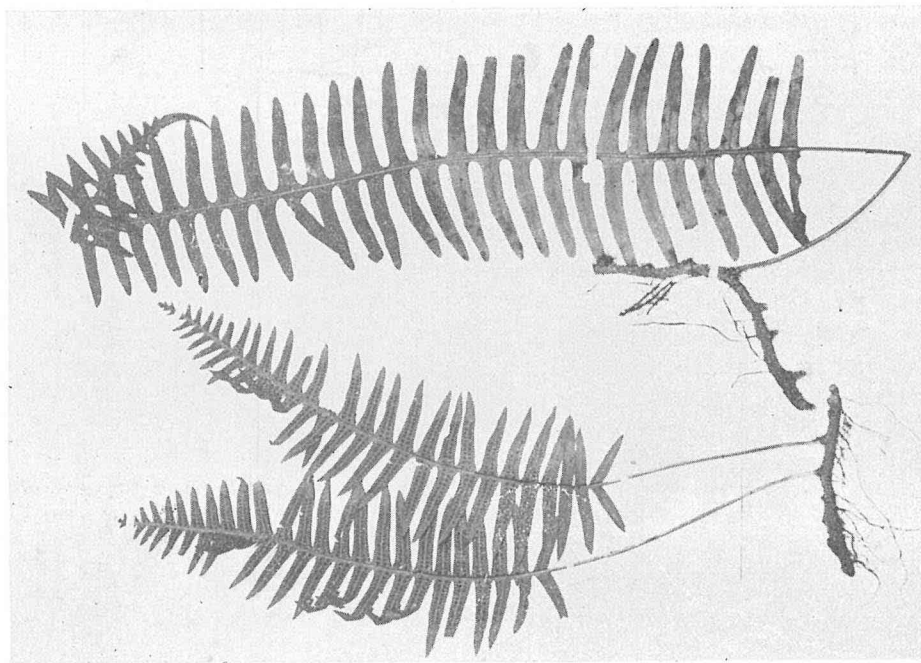


Fig. 1. Left: *Polypodium amamianum* TAGAWA; holotype.
Right: *Polypodium transpianense* YANAM.; TAGAWA 3668.