

THE PLAGIOGYRIA OF TAIWAN<sup>(1)</sup>CHARLES E. DEVOL<sup>(2)</sup>

**Abstract:** Eight taxa of *Plagiogyria* are reported from Taiwan. *P. hoidezumii* is reported for the first time. Two species are reduced to varietal status, *P. formosana* to *P. glauca* var. *philippinensis*, and *P. grandis* to *P. euphlebia* var. *grandis*.

*P. japonica* is not found in any of our herbaria but it is included since Nakaike reports it (1971:261).

The following topics are briefly discussed: dwarf species, intermediate forms, mutants and stipe anatomy.

## INTRODUCTION

This paper is another in the series on our study of the Taiwan Pteridophytes. When Misses Lu Chin-yi<sup>(3)</sup> and Chu Yu<sup>(4)</sup> were seniors in our Botany Department they made a study under my direction of the *Plagiogyria* of Taiwan. I am much indebted to them for their help in this study.

The genus *Plagiogyria* was set up by Mettenius (1858: 275) to include a section of *Lomaria* which Kunze (1849: 867) had recognized as being distinct. The most important characters of this genus being the lack of scales and true hairs, the swollen base of the stipe, the presence of aerophores (pneumatophores) on the stipe, and a complete, oblique annulus. Bower raised this genus to the rank of a family in 1924 and considered it as consisting of 11 species (Bower, 1926, 2: 275-281.).

Many have studied this genus and their contributions have added much to our knowledge of these ferns, yet very much remains unknown. Since these ferns grow in the high mountains in the tropics and subtropics, it is not easy to work with living materials and there is much that herbarium specimens cannot tell us.

The *Plagiogyria* are so different from other ferns that even amateurs quickly recognize them. The only ferns with which they might be confused are some species of *Blechnum* (*Lomaria*) and these always have scales on their stipes.

While the *Plagiogyria* are easily recognized, their species are not so easily distinguished, one reason for this is because there are many intermediate forms and hybrid species.

Ching suggested (1958: 144) that *P. japonica* might be a cross between *P. euphlebia* and *P. distinctissima* (*P. adnata*) as it was "exactly intermediate" between them.

Ching described 3 species from Mainland China that differ from *P. euphlebia* in only minor details. He recognized 9 species in the *P. adnata* group and described 5 new species from that group (Ching, 1958).

Nakaike (1971) has recently described three new hybrids:

1. *Plagiogyria* × *neointermedia* which is a hybrid between *P. euphlebia* (Kunze) Mett. × *P. rankanensis* Hayata

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2. *Plagiogyria* × *sessifolia*.

*P. euphlebia* (Kunze) Mett. × *P. japonica* Nakai

3. *Plagiogyria* × *wakabae*

*P. japonica* Nakai × *P. rankanensis* Hayata

Nakaike considers *P. adnata* and *P. rankanensis* as distinct species, I had considered recognizing *P. rankanensis* as a variety of *P. adnata* but there is such a wide range of variation in these ferns that I find no way to separate them (Nakaike, 1971: 257-258).

Copeland (1929) considered *P. euphlebia*, *P. grandis* and *P. christii* as three distinct species. Nakaike considers *P. christii* as a synonym of *P. euphlebia* and with this I agree, but he maintains *P. euphlebia* and *P. grandis* as distinct species. The difference between these being that *P. euphlebia* does not have aerophores on the rachis and upper stipe, while *P. grandis* does have aerophores on the upper stipe, and rachis (other wise these two ferns look alike). There is no question that aerophores are an important distinguishing character, but it seems to me that this should be treated as a varietal difference.

*P. glauca* and *P. pycnophylla* differ only in that *P. glauca* has farinose white powder on the underside of the sterile fronds. This matter of being glaucous beneath is usually a good distinguishing character but needs careful checking because plants that are dried with heat often lose their white color, so some herbarium specimens which appear green on the underside were really glaucous. Ching (1958) described a new intermediate species, *P. glaucescens*, which is common in Southwest China, Northern India and Burma, which differs from the above two species in being bluish-white on the undersurface. These 3 species have sterile fronds with a pinnatifid apex. Christ found some ferns in the Philippines much like *P. glauca*, but with a terminal pinna like the lateral ones, which he named *P. glauca* var. *philippinensis* (Christ 1898: 150-151). Nakai thought a similar form from Taiwan was different so named it *P. formosana* (Nakai, 1928: 205). Nakaike (1971:263) finds no marked difference between *P. glauca* and *P. formosana* with respect to venation or shape of pinnae, the only difference being as to whether the frond has a pinnatifid apex or a terminal pinna, similar to the lateral ones, so he concluded it was best to arrange these taxa as subspecies of one species, and I consider this a good solution. He then sets up the taxa *P. glauca* subsp. *glauca* for those with a pinnatifid apex and *P. glauca* subsp. *formosana* for those with a terminal pinna, but this is exactly why Christ set up the variety *P. glauca* var. *philippinensis* and so I am adopting Christ's name for this taxon, as I see no difference between *P. glauca* subsp. *formosana* and *P. glauca* var. *philippinensis*.

Another problem which occurs in *Plagiogyria* is that of "dwarf species". Many small ferns have been described as distinct species which look exactly like larger ones, except for their very small size. These "dwarfs" appear fully grown and fertile. Here on Taiwan we have found "dwarfs" of the following species:

*P. euphlebia* var. *grandis* from Ilan Co., Taipingshan, Mururoohu, S. Sasaki s.n. IX. 3, 1925.

*P. glauca* var. *philippinensis* from Kaohsiung Co., Shih Shan, C. M. Kuo 761 and Taipei Co., Saukan, T. Suzuki 7017; Ilan Co., Taiping Shan, Shieh 395.

*P. adnata* from Pingtung Co., Ku-tze-lun shan C. M. Kuo 1282.

*P. dunnii* from Taichung Co., Pa-hsien shan, T. C. Huang 1323; Nantou Co., Shuili, T. F. Chen.

*P. stenoptera* from Hualien Co., Mu-kua-shan, T. Nakamura 4463.

We have a "dwarf" specimen specimen in our herbarium collected by T. Nakamura from Muh-kwa-shan, Hualien Co., in Aug. 7, 1940 that I had intended to describe as a new species as I have never seen any other like it, but it is no doubt a hybrid or mutant and giving a name to this rare plant would serve no useful purpose.

Table 1. A comparison of the normal species with dwarf species

species	average size of normal sterile fronds		dwarf sterile fronds	
	length	width	length	width
<i>P. euphlebia</i> v. <i>grandis</i>	75.0 cm	26.0 cm	17.0 cm	8.5 cm
<i>P. glauca</i> v. <i>philippinensis</i>	72.0	19.0	18-23.0	7-9
<i>P. adnata</i>	64.0	15.0	14.0	4.4
<i>P. dunnii</i>	44.0	12.0	18.0	3.5
<i>P. stenoptera</i>	52.0	10.0	15.0	4.0

Mutant and abnormal fronds are occasionally seen. Plate 2 shows a specimen of *P. glauca* var. *philippinensis* from Yuan Yang Lake in Taoyuan County collected by Dr. T. C. Huang<sup>(1)</sup> which has a frond in which the lower half is sterile and the upper half is fertile (*T. C. Huang 5501*). Recently Dr. Huang has collected 2 similar specimens of the same species from Tun-chih in Kaohsiung Co. M. T. Kao collected a specimen from Mt. Amma, Taichung Co., of a frond with fertile pinnae on the lower part and sterile pinnae above, however the tip ends of many of the lateral pinnae and of its terminal pinna had sporangia (*Kao 4405*).

Mutant fronds of *P. dunnii* with the lower half sterile and upper half fertile have been collected by Dr. C. C. Hsu<sup>(2)</sup> from Peng-lai-shan in Miaoli Co. (*C. C. Hsu 12565*) and by M. T. Kao<sup>(3)</sup> from Mt. Amma, Taichung Co., (*Kao 4453a*) C. M. Kuo<sup>(4)</sup> found a small specimen of *P. glauca* var. *philippinensis* from Yuan-yang Lake, Ilan Co., that is not glaucous on its undersurface. (*C. M. Kuo 1494*).

Cross sections of the stipe are valuable in taxonomic studies of this genus because the species vary widely in regard to a number of features: some stipes are triangular at the base, other are tetragonal; some are quite different in shape at the upper part of the stipe from what they are at the base; some have prominent wings on the ridges of the stipe and others do not. The shape of the vascular bundle differs considerably among the species. Plate 1 shows several sections of stipes. Figure 1 is from the upper part of the stipe and Figure 2 is from the base of the same stipe. Figure 3 is triangular and has wings on each of its 3 ridges. Figure 6 is tetragonal and has wings on 2 of its four ridges.

The c. s. of the stipe shows a distinct epidermis, under which is usually a broad band of sclerenchyma tissue, the rest of the ground tissue is of parenchyma cells. The vascular bundle is widely v-shaped (Fig. 4) or widely u-shaped and winged, (Fig. 2) The vascular bundle is surrounded by a sclerenchyma band. Details differ with the species.

Four species of *Plagiogyria* have been described from Taiwan. The geographical range of these four species is as follows: *Plagiogyria stenoptera* was collected in northern Taiwan by William Hancock and described by Hance in 1883. This same specimen was again described by Baker in 1885 under the name *P. concinna*. This

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fern is now known from Southern Japan to the Philippines, in Vietnam, and from 4 provinces in south China. *P. rankanensis* was collected by B. Hayata from Ilan County on the east coast at Rankanzan (near Nan-ao) in May 1916 and described by him in 1919. This turns out to be the common fern known as *P. adnata* from northern India to Japan. *P. hayatana* was collected in Nantou County at Rakurkusha by G. Nakahara (458) in Aug. 1905 and at Mushazan by T. Kawakami and U. Mori (2402) in 1906 and described by T. Makino in 1909. This is the same of fern as was collected by T. S. Dunn near Yenping, Fukien and described by Copeland in 1908 under the name *P. dunnii*. It is now known from 6 provinces on Mainland China as well as Taiwan. It looks a lot like *P. falcata* Copel. and was usually identified as such by Japanese botanists.

In Taiwan *Plagiogyria* usually grow on mountains between 1000 to 2000 meters. They are seldom seen below or much above these altitudes. They usually grow on the forest floor of broad-leaved forests, and where found are often in large patches. This is especially true for *P. glauca* var. *philippinensis*, but some species are found growing singly and scattered among other ferns.

Paraphyses occur in the sori of many if not all species of *Plagiogyria*. Ogata refers to these as sporangiasters but I do not find that term used by others (Ogata, 1931, 4: 184). These are glandular, multicellular hairs of various shapes (Plate 4, Fig. 8)

This study was based on field observations and herbarium specimens deposited in the following four herbaria: Herbarium of the Botany Department of the National Taiwan University (TAI), the Herbarium of the Forestry Department of the National Taiwan University (NTUF), the Herbarium of the Taiwan Forestry Research Institute (TAIF), and the Herbarium of the Botany Department of Chung Hsin University in Taichung.

### Plagiogyria Mett.

Mostly medium sized terrestrial ferns, very rarely up to a meter tall, occasionally dwarf forms found; rhizome short, stout, erect, cylindrical, covered with overlapping leaf bases, except one species with a thick horizontal rhizome; stipes swollen, triangular or tetrahedral at base, often narrowly winged, without scales or true hairs but bearing glandular twisted hairs on young stipes, which soon become dry; aerophores usually present on base of stipe; fronds dimorphous, usually tufted at growing tip of erect rhizomes; sterile fronds usually taller than fertile ones, the latter with much constricted pinnae; lamina of sterile frond deeply pinnatifid or pinnate, the veins free, simple or once forked; sori protected when young with scariosus reflexed margins; sporangium with a complete oblique annulus, and a stalk of 5-6 rows of cells, lip cells borne near base of sporangium; paraphyses usually intermingled with the sporangia; spores trilete, rounded-triangular in shape, laesurae open or closed, exine usually with gemmate processes, sexine usually granulate.

### Key to species

- |   |   |
|---|---|
| 1. Lower pairs of pinnae petiolate.....                   | 2   |
| 1. Lower pairs of pinnae adnate.....                      | 5   |
| 2. Fronds glaucous beneath.....                           | 3 <i>P. glauca</i> var. <i>philippinensis</i> |
| 2. Fronds without white powder beneath.....               | 3   |
| 3. With aerophores on upper part of stipe and rachis..... | 2 <i>P. euphlebica</i> var. <i>grandis</i>    |
| 3. Without aerophores on upper stipe and rachis.....      | 4   |

4. Sterile frond shorter than fertile; only uppermost pair of pinnae adnate at base, all other upper pinnae much constricted at base .....1. *P. euphlebia*  
 4. Sterile frond longer than fertile, upper 1/3 of frond with adnate pinnae.....8. *P. koidzumii*  
 5. Lower pinnae suddenly reduced to auricles .....7. *P. stenoptera*  
 5. Lower pinnae not reduced to auricles .....6  
 6. Lower pinnae much deflexed.....6. *P. dunnii*  
 6. Lower pinnae widely spreading, may be slightly shortened .....7  
 7. Apex of sterile frond pinnatifid, or often with a much lobed terminal segment, lower pinnae narrowed on abaxial side, recurrent on adaxial side.....4. *P. adnata*  
 7. Apex with a terminal segment much like the lateral pinnae, lower pinnae narrowed on both sides .....5. *P. japonica*

characters	species							
	<i>P. euphlebia</i>	<i>P. euphlebia</i> var. <i>grandis</i>	<i>P. glauca</i> var. <i>philippinensis</i>	<i>P. adnata</i>	<i>P. japonica</i>	<i>P. dunnii</i>	<i>P. stenoptera</i>	<i>P. koidzumii</i>
Glaucous beneath			+					
Stem erect	+ P	+ P	+	+	+	+	+	
Stem horizontal								+
Stipe base triangular	+	+	+	+	+	+		+
Stipe base tetrahedral							+	
Upper stipe triangular						+		
Upper stipe tetrahedral				+			+	
Upper stipe oval	+	+	+		+			+
Wing on stipe at base	S1	S1			S1	+	+	
Wing at middle section						+	+	
Wing at upper end						+	+	
Aerophores at base of stipe	+	+	+	1-3	+			
Aerophores on upper stipe and rachis		+						
Apex sterile frond pinnatifid				+		+	+	
Apex sterile frond with terminal pinna	+	+	+	S	+			+
Lower pinna much deflexed						+		
Lower pinna slightly deflexed			+					
Lower pinna much shortened							+	
Lower pinna slightly shortened			+			+		
Lower pinna widely spreading, lanceolate	+	+		+	+			+
Lower pinnae narrowed at base on both sides	+	+	+		+			+
Lower pinnae narrowed only on abaxial side				+				
Vascular bundle at base:								
Broadly V-shaped	+	+		+	+			+
U-shaped with wings			+			+	+	

P=often prostrate at base; S1=slightly; S=Sometimes with terminal segment.

**1. *P. euphlebia*** (Kunze) Mettenius, 1858: 10 (6); Beddome, 1892: 129; Makino, 1894: 334; Rosenburgh, 1908: 343; Hayata, 1914, 4: 239; T. Ito, 1928: 99 pl; Copeland, 1929: 387; Handel-Mazzetti, 1929, 6: 38; Ogata, 1931, 4: 184 pl; Wu, Wong and Pong, 1932: 224, 224, pl 103, Masamune, 1936: 21; H. Ito, 1938, 5: 586; 1944: 443 pl; DeVol, 1945: 57; Ohwi, 1957: 51; 1965: 49; Hatusima, 1971: 143.

*Lomaria euphlebia* Kunze, 1848: 521; Hooker, 1860, 3: 20; 1868: 183.

*P. cristii* Copeland, 1906: 153; 1929: 388; 1960: 194; (Reduced to a synonym by Nakaike 1971: 250)

*P. triquetra* Mettenius 1858: 274; Nayar and Kazmi, 1962: 23-27, see pl 10.

**Rhizome** short, stout, erect or somewhat prostrate, covered with old leaf bases, without scales; fronds dimorphic; aerophores restricted to leaf bases, without aerophores on upper stipe.

**Sterile fronds** 30 to 75 cm tall, 20 to 25 cm broad; stipe usually 20 to 30 cm long, tufted, without scales, triangular in c. s. at base (Pl. 1, Fig. 5); oval in upper stipe (Pl. 1, Fig. 4); lamina pinnate, lower and medial pinnae petiolate, upper pairs sessile, or occasionally with one or more of the uppermost pinnae adnate, terminal pinna similar to the lateral pinnae, usually with one or two lobes at base; pinnae 8 to 20 cm long, 1.2 to 1.8 cm broad, linear-lanceolate, narrowed at base, margins serrate towards apex, nearly entire towards base, apex acuminate, base rounded or acute; veins free, nearly parallel, simple or once forked; midrib strongly raised on underside, rounded, slightly raised on upper side.

**Fertile fronds** 50 to 80 cm; stipes usually 20 to 50 cm long; lamina pinnate; fertile pinnae 6.5 to 12 cm long, narrowly linear; sporangia somewhat covered by reflexed leaf margin on young fronds.

Korea, Japan (Honshu, Shikoku, Ryushu), Ryukyu, Taiwan, Mainland China (Kiangsi, Kwangsi), Burma, Philippines.

**Taipei Co.**, A-yu, *H. Simizu* 2740; Chutzuhu, *Nakamura* 4345; Mt. Kara, *S. Suzuki* 6208; Mt. Lala, *T. Suzuki* 11725, 11729; Siraku, *Nakanura* 551; Sendanyama, *T. Suzuki* 7453; **Ilan Co.**, Nan-hu-ta-shan, *Masamune* 2991; Tapingshan, *S. Sasaki* s. n. IX. 3. 1925; **Hsinchu Co.**, Chutung, *T. I. Chuang* 1396; Kwai-shen, *S. Sasaki* s. n. VII. 17. 1932; Luchang-ta-shan, *Fukuyama* 3394; **Taichung Co.**, Mt. Amma, *Feung and Kao* 4425; Tung Shih, *Simozawa* 564; **Nantou Co.**, Musya, *Masamune* 2303; Chitou, *M. T. Kao* 7740; Feng-hun-shan, *C. M. Kuo* 352; **Pingtung Co.**, Paiwan, *Matuda* s. n. V. 1917; **Hualien Co.**, Feng-shen, *T. S. Liu* 43; Mt. Chingshau, *Nakamura* 3859; Tarokokyo, *S. Sasaki* s. n. VI. 15. 4933.

**2. *P. euphlebia*** (Kunze) Mett. var. ***grandis*** (Copel.) DeVol, stat. nov.

*P. grandis* Copeland, 1929, 38: 389; Christensen, 1933: 13; Ching, 1958: 138; Nakaike, 1971: 260.

Very much like *P. euphlebia* but usually considerably larger and differing chiefly in bearing aerophores on upper stipe and on the rachis at the base of the petioles; pinnae usually end in a caudate tip.

**Sterile fronds** up to 60-85 cm tall; stipe up to 20-45 cm long, with aerophores at base and also along upper stipe, and on rachis at base of petioles; lamina pinnate, terminal pinna 12-18 cm long, lateral pinnae lanceolate or lower ones falcate, serrulate, 12-27 cm long, 1.5-2.0 cm wide, uppermost pairs of pinnae adnate, lower and medial ones petiolate; lowermost pinnae somewhat shortened (10 cm); midrib raised beneath; pinnae usually ending in a caudate tip; basal portion of stipe triangular, winged, often brown and polished on outside, upper part of stipe nearly oval in c. s.

**Fertile fronds** taller than sterile, up to 60-85 cm tall; stipe 25-50 cm long; fertile pinnae much contracted, 10-12 cm long, with pointed apex.

Mainland China (Kwangsi, Kweichow, Yunnan), Vietnam (Tonkin), Taiwan.

**Taipei Co.**, Mt. La-la, *R. Kanehira* s. n. IX. 24. 1922; **Ilan Co.**, Mt. Tayen, *C. C. Kou*, 3207; Mt. Ta-ping, *S. Sasaki* s. n. IX. 3. 1925; *S. Suzuki* s. n. VIII. 11. 1928; Mt. Bonbon, *M. T. Kao* 5911; Nan-hu-ta-shan, *M. T. Kao* 8561, *H. C. Liu* 928; **Hsinchu Co.**, Chutung, *Liu, Kao* and *Chang* 1396; **Taichung Co.**, Mt. Amma, *T. S. Liu* s. n. X. 10. 1957; Mt. Pabsien, *T. I. Chuang* 2761; **Nantou Co.**, Ching-shiu-kao, *Huang, Kao & Kou*, 1020; **Chiayi Co.**, Mt. Ali, *B. Hayata* s. n. XII. 1927; **Kaohsiung Co.**, Tun-chih, *C. M. Kuo* 2405; **Taitung Co.**, Wushan, *T. Hosokawa* 5361a; **Hualien Co.**, Mt. Muh-kwa, *M. T. Kao* 4189; Pingtung Co., Tunchih, *Shieh* 160.

**3. *P. glauca*** (Bl.) Mett. var. ***philippinensis*** Christ, 1898: 150-151; Copeland, 1905: 98; 1929, 38: 393; Hayata, 1906: 21-22; Matsumura & Hayata, 1906, 22: 615; Rosenburgh, 1908: 342; T. Ito, 1928: 200 pl.

*P. formosana* Nakai, 1928: 205; Makino & Nemoto, 1931: 83; Masamune, 1936: 21; Ogata, 1940, 8: 387 pl; H. Ito, 1944: 445 pl. Ching, 1958: 149; 1959: 100 (Type in Herbarium TI).

*P. nana* Copeland, 1909: 114, 1960: 195. A dwarf form of *P. glauca* (Copeland, 1960: 195).

*P. glauca* subsp. *formosana* Nakalke, 1971: 264.

**Caudex** stout, erect, densely covered with old persistent overlapping stipe bases.

**Sterile fronds** glaucous beneath (specimens dried with excessive heat lose their white color) 25 to 85 cm tall, 7 to 25 cm wide; stipes 5 to 30 cm long, much dilated at base, bearing one or 2 pairs of aerophores on the basal part of stipe and a few scattered aerophores further upwards (larger fronds have more aerophores); c.s. of stipe triangular at base, the back side of stipe rounded, margins of stipe very narrowly winged towards base; c.s. of upper stipe tetragonal; lamina pinnate, apex with a distinct terminal pinna similar to lateral ones; lateral pinnae, straight, widely divergent, acuminate, 7 to 12 cm long, 0.8 to 1.3 cm wide, lower pairs petiolate, upper pairs sessile; margins of pinnae sharply serrate from base to apex; veins simple or once forked.

(Pl. 1, Figs. 1, 2).

**Fertile fronds** 40 to 120 cm tall; stipes 20 to 60 cm long, fertile pinnae straight or somewhat falcate, 3.5 to 9 cm long, upper pairs adnate, most pinnae petiolate, margins revolute when young, apex acute or obtuse.

Philippines, Taiwan.

**Taipei Co.**, Kubo-san, *T. Suzuki* 12810; Takaiyama, *T. Suzuki* 18632; Saukan, *T. Suzuki* 7017 (dwarf); **Ilan Co.**, Nan-hu-ta-shan *M. T. Kao* 8559, *C. C. Chuang* 2516, *C. M. Kuo* 532, *C. S. Kuoh* 1876; Mt. Taiping, *M. T. Kao* 4751, *N. Fukuyama* 5015, *S. Suzuki* 128, 564, 834, 925, 3893. Mt. Tayen, *C. C. Kuo* 195; Nanshan, *C. C. Hsu* 6069; **Minoli Co.**, Hii-shui-shan (Mt. Sensui *Mori* 1497); **Taichung Co.**, Mt. Pabsien, *T. I. Chuang* 2693; *T. Simozawa* 566. Mt. Amma, *C. S. Feung* 4405; Mt. Sin-shan, *T. C. Huang* 1322; **Nantou Co.**, Luantashan (Mt. Randai), *Kawahami & Mori* 1498; Nantassan (Noko) *Simada* 1499; **Chiayi Co.**, Mt. Ali, *Kawahami* 1496, *M. T. Kao* 154, 168, *J. M. Chao* 153, *H. Simada* 787, *T. Tanaka* 365, *S. Suzuki* 16209, *T. C. Huang* 1699. *C. E. DeVol* 3394 *C. S. Kuoh* 8033; **Kaohsiung Co.**, Mt. Kuai, *Yamanoto* 599; Shih Shan, *C. M. Kuo* 761 (dwarf) 2406, *T. Tanaka* 10428; Tun-chih, *T. C. Huang* 6498, 6499, 6528 (all three with abnormal fronds); **Pingtung Co.**, Mt. Daibu, *S. Suzuki* 6910 *Matuca* 119; **Taitung Co.**, Mt. Daikwanxan, *S. Sasaki* s. n. X. 20. 1933; **Hualien Co.**, Mt. Muh-kwa, *M. T. Kao* 4131; Tarokotaisan *S. Sasaki* s. n. I. 15, 1933; Mt. Chingshui, *T. Nakamura* 3679.

**4. *P. adnata*** (Bl.) Beddome, 1865: 51; 1892: 127-128, pl. 65; Hooker, 1860 (3): 19, pl. 147; 1868: 182; Christ 1898: 150; Rosenburgh, 1908: 342; Hayata, 1914, 4: 239; Nakai, 1928, 42: 207; T. Ito, 1928: 98 pl; Copeland, 1929, 38: 396; Masamune, 1936: 21; Ogata, 1940, 8: 385, pl; H. Ito, 1938, 52: 586; 1944: 444 pl; Holttum, 1954: 111; Ching, 1959: 96; Copeland, 1960: 2: 195; Wu, Wong & Pong, 1932: 220, pl. 101; Ohwi, 1965: 49; Hatusima, 1971: 143.

*P. rankanensis* Hayata, 1919, 8: 151 figs. 79,80. (Isotype in Herb. TAIF collected at Rankanzan, (Nan-ao Shan, Alt. 4900 ft; May 1916 by B. Hayata); Makino & Nemoto, 1925: 1641; Nakai, 1928: 208; T. Ito, 1928: 129 pl; Nakaike, 1971, 14: 257-259.

*P. distinctissima* Ching, 1930: 145; 1958: 141, pl 31, fig: 2; 1959: 92; Nayar B. K. & F. Kazmi, 1962: 20, pl 9.

*P. triangularis* Hayata in Herb.

**Caudex** erect, covered with overlapping leaf bases, rather stout, bearing a mass of fibrous roots, young roots covered with straight, brown, glandular hairs.

**Sterile frond** 35 to 45 cm tall (sometimes up to 70 cm tall), 10 to 15 cm wide; stipes 12 to 20 cm long, base not much dilated, bearing a few (1-3) aerophores; c. s. of stipe triangular at base, and tetrahedral in upper stipe; lamina deeply pinnatifid, rachis narrowly winged; apex pinnatifid or with an elongated terminal segment being somewhat lobed near base and serrate towards apex; lateral pinnae adnate, 6 to 10 cm long, widely spreading, somewhat falcate, acuminate or occasionally caudate at apex; margins strongly serrate near apex; basal pairs of pinnae not shortened or only slightly so, cut away on abaxial side, and recurrent on adaxial side; veins simple or more often once forked, occasionally one of the veinlets again forked.

**Fertile fronds** 45 to 75 cm tall; stipes 35 to 45 cm long; fertile pinnae straight or falcate, 5 to 10 cm long, lower pairs longest, becoming gradually shorter upwards with the terminal pinna frequently lobed at base and being somewhat longer than the upper pairs of lateral ones.

Northern India, Malaysia, Thailand, Vietnam, Philippines, Mainland China (Fukien, Szechuan), Hainan, Taiwan, Ryukyu, Japan.

**Taipei Co.**, Shen-keng (Sirakku.) *Mori 1477* (*P. triangularis* Hay.); Chih-hsin-shan, *C. C. Chuang 2765*; Ta-tun-shan, *C. M. Kuo 1360*; Urai *Matuda 1505*; *Kudo 444*, *S. Sasaki s. n.* VII. 10. 1918. Ta-tung-shan, *C. M. Kuo 1431*; **Ilan Co.**, Rankanzan, *B. Hayata 1509*; **Hsinchu Co.**, Cha-li-chien-shan (Mt. Karizenzan) *T. Ito 1508*; **Kaohsiung Co.**, Wu-wei-shan, *Matuda s. n. I.* 1. 1919; **Pingtung Co.**, Ku-tzu-lun-shan, *C. M. Kuo 1282* (dwarf), *1280, 1285*; **Taitung Co.**, Chinshuiying, *Simizu s. n.* VII. 16. 1937.

Nakaike (1971: 257) distinguishes *P. rankanensis* from *P. adnata* by the difference in the way the lower pinnae are attached to the rachis. In *P. adnata* from Java, the lower pinnae are adnate and scarcely if at all recurrent on their adaxial (across) sides, while those of *P. rankanensis* are strongly recurrent on their adaxial sides. Most of the specimens of *P. rankanensis* from Taiwan fit into Nakaike's concept but not all, some are scarcely if at all recurrent on their adaxial sides and I cannot distinguish them from true *P. adnata*.

5. ***P. japonica*** Nakai, 1928, 42: 206; H. Ito, 1938, 52: 586; 1944: 442 pl; Makino, 1940: 924 fig; DeVol, 1945: 56; Ching, 1958: 143; 1959: 94; Ohwi 1965: 49; Tagawa, 1959: 69, pl 21, fig 126; Nakaike, 1971, 14: 260-261 (Type in TI).

*P. adnata* (non Bedd.) sensu Makino, 1894, 8: 333; Ogata, 1931, 4: pl 183.

*P. adnata* var. *distans* Rosenstock, 1913, 13: 122 (Type from Kweichow, Kuy-yang, *Cavalerie s. n.* Oct. 1912).

*R. intermedia* Copeland, 1929, 38: 390 pl 2.

**Caudex** stout, erect, covered with persistent leaf bases.

**Sterile fronds** 32-42 cm tall, 10-16 cm wide; stipes 10-25 cm long, slightly dilated at base, aerophores few; lamina pinnate, rachis not winged on lower half of frond; lower pinnae nearly sessile, upper pinnae adnate, lowest pairs narrowed on both



sides; all pinnae widely spreading, somewhat falcate; margins finely serrate; veins simple or once forked; terminal pinna 8 cm long by 1.3 cm wide, similar to the lateral ones, adnate at base to the uppermost lateral pinna.

**Fertile fronds** 70-80 cm tall; stipes about 40 cm long; fertile pinnae straight, about 10 cm long, lower and medial ones petiolate, uppermost ones sessile.

Mainland China (Anhui, Chekiang, Fukien, Hunan, Kiangsi, Kwangsi, Kwangtung, Kweichow, Szechuan), Korea, Japan (Honshu, Shikoku, Kyushu, Yagashima), Ryukyu, Taiwan, Northern India (Assam).

Mt. Bui-san, Takao, *S. Sasaki s. n.* Feb. 10, 1916 (TNS).

**6. *P. dunnii*** Copeland, 1908: 281; Christensen and Ching, 1933: 13; Copeland, 1929: 402; Ching, 1958: 153, pl 40 fig. 2; 1959: 104;

*P. hayatae* Makino, 1909: 245; Copeland, 1929: 401 (Type in Herb. TI).

*P. falcata* (non Copel.) sensu Hayata 1914: 4: 239; Makino & Nemoto, 1931: 83; Nakai, 1928, 42: 208; T. Ito, 1928: 201 pl; Masamune 1936: 21; Ogata, 1940, 8: 386 pl.

*P. matsumureana* (non Makino sensu Hayata, 1907, 21: 14; Wu, Wong & Peng 1932: 222, pl 102.

*P. adnata* var *angustata* Rosenst. 1913, 13: 122.

**Caudex** stout, erect, densely covered with the old overlapping stipe bases.

**Sterile fronds** 30 to 16 cm tall, 8 to 16 cm wide; stipes 8 to 23 cm long, without aerophores at base, triangular in c. s., narrowly winged on ridges; lamina deeply pinnatifid to pinnate, apex of frond pinnatifid, basal one or more pairs of pinnae slightly shortened, much deflexed; all pinnae adnate, widely spreading, often somewhat falcate, 5 to 10 mm wide, strongly serrate at apex, nearly entire towards base; veins usually once forked. (Pl. 1, Fig. 3).

**Fertile fronds** 50 to 70 cm tall, stipes 28 to 45 cm long, fertile pinnae 3 to 5 cm long, all except uppermost pairs petiolate, margins reflexed when young, apex obtuse or acute; pinnae often coiled and contorted when old and dry.

Mainland China (Anhui, Chekiang, Fukien, Kwangsi, Kwangtung, Kweichow), Taiwan.

Taipei., Co., Mt. Sendan, *T. Suzuki 7415*; Miaoli Co., Mt. Luchang, *N. Fukuyama 3429*  
Taichung Co., Mt. Amma, *M. T. Kuo 4453a* (abnormal), *4453b* (normal), *4449*, *T. S. Liu 160*;  
Mt. Pa-hsien *1323a* (dwarf), *1323b* (normal), *S. Suzuki s. n. X. 23*, 1929; *I. Simozawa 563*;  
Nan-tou Co., Chitou, *T. C. Huang 1461*, *1488*, *C. M. Kuo 361*; Ching-shui-kou, *T. C. Huang 981*;  
Chung Hsin Forestry Station, *C. M. Kuo 228*; Wushe, *G. Masamune 2317*; Feng-huang-shan, *T. C. Huang 5988*; Chiayi Co., Mt. Ali, *Hayata, 1489*, *T. Kawakami 1493* Kachsiung Co., Tan-chih,  
*C. M. Kuo 2407*; Pingtung Co., Paiwan, *Matuda 118*; Ku-tzu-lun-shan, *C. M. Kuo 1280*, *1285*;  
Ta-shu-ling-shan, *C. M. Kuo 1308*; Pingtung Co., Hengchuan, *Kawakami 1490*.

**7. *P. stenoptera*** (Hance) Diels 1899: 282; Matsumura & Hayata, 1906, 22: 615; Rosenburgh, 1908: 341; Makino, 1909: 244; Hayata, 1914: 4: 239; Nakai, 1928, 42: 208; T. Ito, 1928: 203 pl; Copeland, 1929: 398; 1959: 196. Masamune, 1936: 21; H. Ito, 1938, 52: 596; 1944: 447 pl; Ogata, 1940, 8: 389 pl; Ching, 1958: 152, pl 32, fig. 2; Ohwi, 1965: 49.....**Plate 3.**

*Blechnum stenopterum* Hance, 1883: 268.

(Type in British Museum from Northern Taiwan collected by William Hancock, Nov. 1881.)

*Lomaria* (Plagiogyria) *conciens* Baker, 1885, 23: 103-104; Hooker, 1885, 17: 1644.

(Type from Northern Taiwan, collected near Tamsui in 1881 by William Hancock.)

*Plagiogyria Henryi* Christ, 1899, **7**: 9; Copeland, 1929, **38**: 399 pl 5; Hu & Ching, 1930, **1**: pl 30.  
*P. matsumyrensis* (non Makino) Hayata, 1909, **23**: 32.

**Caudex** stout, erect, densely covered with the old overlapping stipe bases.

**Sterile fronds** 25 to 45 cm tall, 6 to 12 cm wide; stipes 4 to 14 cm long, without aerophores at base, tetragonal in c. s. both at base and in upper section; winged on upper ridges to base; lamina deeply pinnatifid to nearly pinnate, apex of frond pinnatifid, lower 3 to 6 pairs of pinnae reduced to auricles; all pinnae adnate, borne at right angles to the rachis, acuminate, 1 cm wide at base, margins serrate towards apex, less so towards base of pinnae; veins mostly once forked, some simple; rachis and costae prominent beneath and with a distinct ridge. (Pl. 1, Fig. 6).

**Fertile fronds** 25 to 50 cm tall, stipes 15 to 30 cm long; fertile pinnae straight, 2 to 10 cm long, ending in a distinct tip, margins reflexed when young, upper pairs adnate, lower ones petiolate, basal 6 to 8 pairs reduced to auricles.

Japan (Kyushu, Yakushima), Ryukyu, Taiwan, Mainland China (Kwangsi, Kweichow, Szechuan, Yunnan), Vietnam, Philippines.

Taipei Co., Tamsan, *T. Suzuki 17913*; Han Co., Mt. Chilan, *M. T. Kao 7846*; Mt. Bonbon, *M. T. Kao 5955*; Lalashan, *T. Suzuki 11727*; Nan-hu-to-shan, *G. Masamune 2992*; C. S. Kuoh 1877, *M. T. Kao 8558*; Mt. Taiping, *C. C. Chuang 4711, 4098*; *S. Suzuki 524*; Mt. Tayen, *M. T. Kao 3206*; Nanshan to Chi-li-ting, *C. C. Hsu 6065*; Nantou Co., Chitou, *T. C. Huang 1514*; Chiayi Co., Mt. Ali, *B. Hayata s. n. X. 11, 1927*; *T. Ito 1512*; *T. Kawakami s. n. III. 23, 1908*; *C. C. Hsu 5751*; *Kao 6866*; Kaohsiung Co., Kaohsiung, *S. Sasaki s. n. X. 10, 1934*; Pingtung Co., Paiwan, *Metuda s. n. VI. 2, 1917*; Ta-shu-ling-shan, *C. M. Kuo 1309, 1324*; Taitung Co., Mt. Ramaramari, *M. T. Kao 6049*; Kaohsiung to Taitung, *S. Sasaki s. n. X. 13, 1934*; Chih-peng, *Shieh 1458*; Hualien Co., Mt. Muh-kwa, *T. Nakamura 4464, 4463* (dwarf); Kine bodaichi, *S. Sasaki s. n. I. 10, 1934*; Mt. Ching-shui-shan, *T. Nakamura 3682*.

8. *P. koidzumii* Tagawa, 1933, **2**: 189; H. Ito, 1938, **52**: 586; Ogata, 1940, **8**: 388; pl; Masamune, 1951: 53; Hatusima, 1971: 143 (Type in Herbarium KYO).....Plate 4.

**Rhizome** horizontal, 5-7 cm long, about 1 cm thick, bearing a mass of fibrous roots from lower side, young roots covered with brown glandular hairs; stipes about 2 mm apart, without aerophores, nearly triangular in c. s. at base, about 2mm in diameter, upper part of stipe nearly terete.

**Sterile fronds** 40-50 cm tall, pinnate; lamina 15 to 20 cm long; stipes 12 to 25 cm long; lower 3 to 5 pairs of pinnae petiolate, medial pinnae sessile, upper pinnae adnate; frond ending in a terminal pinna, similar to lateral ones, about 3 cm long, margins serrulate, adnate at base to uppermost lateral pinna; lateral pinnae 6.5-10 cm long, 1-1.5 cm broad; widely spreading, lanceolate or somewhat falcate, margins unevenly serrulate, being subentire near base; veins nearly parallel, simple or once forked, ending in marginal teeth; narrow wing of upper petioles continuous with narrow wing of rachis.

**Fertile fronds** usually shorter than sterile, being 15 to 35 cm long, pinnate; lower 5 to 6 pairs of pinnae petiolate, upper pairs often sessile; lateral pinnae 2.5-3.5 cm long, obtuse at apices; terminal pinna often longer than upper lateral ones.

*P. koidzumii* differs from all our other *Plagiogyria* in having a horizontal rhizome instead of a short erect stem (Pl. 4, Fig. 1); its fertile fronds are shorter than the sterile, the leaves are not borne in a tuft but arise from the dorsal side of the creeping rhizome, in a series, the stipes are only slightly swollen at their bases, and no aerophores have been observed.

This is a new record for Taiwan and is a rare fern on Taiwan, as only a very

few specimens of it have been found. Its sterile fronds do not appear much different from those of *P. euphlebia* but in other respects it is quite different. Type is from Iriomoto-Zima, Ryukyu in Herbarium KYO.

Ryukyu, Taiwan.

Nantou Co., Ching-shui-kou, *T. C. Huang 943*.

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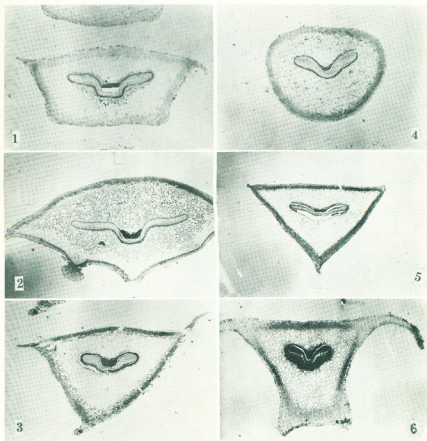


Plate I. Cross sections of stipes of Plagiogyria.

Figs 1, 2, *P. glauca* var. *philippinensis*. Fig. 3, *P. dunnii*; Fig. 4, 5, *P. euphlebia*; Fig. 6, *P. stenoptera*. Figs. 1, 3, 4, from upper part of stipe; Fig 2, 5 from base of stipe.



**Plate 2.** *Plagiogyria glauca* var. *philippinensis* Christ.

An abnormal frond collected by *T. C. Huang* 5501 from Yuan-yang Lake, Taoyuan Co., Sept. 1, 1970. The upper portion of the frond being fertile and the lower portion sterile.



**Plate 3. *Plagiogyria stenoptera* (Hance) Diels.**

The dwarf form has sterile fronds, 16 cm long by 4 cm broad, Collected by T. Nakamura 4462, from Hualien Co.

The normal form has fronds 44 cm long by 8 cm broad, Collected by C. S. Kao 5499 from Ilan Co.

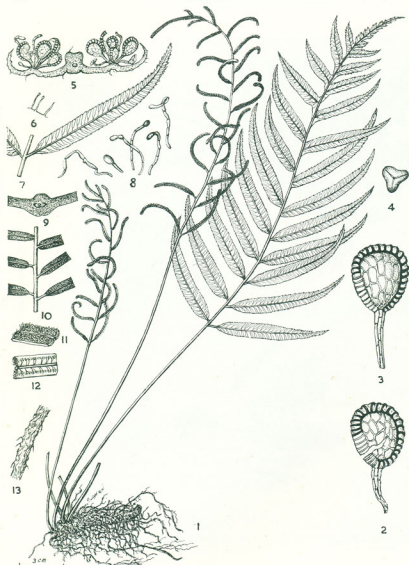


Plate 4. *Plagiogyria koidzumii* Tagawa

1. Habit sketch; 2, 3. sporangia; 4. spore; 5. c. s. of fertile frond; 6. hairs on upper surface of fertile frond; 7. lower pinnae; 8. paraphyses from among the sporangia; 9. c. s. through rachis; 10. base of fertile pinnae; 11. under surface of fertile pinnae; 12. upper surface of fertile pinna; 13. hairs on roots.

Drawn from specimen collected by *T. C. Huang* (1943) at Ching-shui-kou, Nantou Co.