

# Contributions to the Knowledge of the Asiatic Polypodiums, with special reference to the Chinese Species.

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IN order to make my position quite clear, a few explanatory words at the beginning of the paper will perhaps not be out of place. While examining some Japanese Ferns at Kew, it was found necessary to compare them with certain Chinese species. Thus a good opportunity was afforded to the writer of studying a large number of Chinese Ferns which are not known from Japan. Carrying the investigation still further, and with a view to arrive at a definite conclusion, it was thought advisable for the writer to extend his investigation to East India and to some other parts of Asia. Accordingly, a vast number of specimens from different parts of Asia, and also, in certain cases, from extra-Asiatic regions, has been examined. In the present study, however, the writer has confined himself to the sub-genus *Pleopellis* (*in sensu* Christensen).

Attention has been directed particularly towards the Chinese species, this being the original intention of the paper. Several botanists have recently studied Chinese Ferns; especially Dr. H. Christ and Mr. J. G. Baker, F.R.S., have made valuable contributions in various papers, and Fleet-Surgeon C. G. Matthew, R.N., has laboriously indexed all the Ferns known from China up to 1910.\*

Now, the species of *Pleopellis* occurring in temperate and subtropical Asia amount, according to Christensen's useful Index, to about seventy in number. Of these the writer has taken the liberty of examining particularly those that required a careful revision. As a result of the investigation, it has been found that a considerable reform in nomenclature as well as in conception of certain species is unavoidable.

It is surprising and much to be regretted that many a species has received more than one name either from different botanists or from the same authors. Consequently, about one-third of

\* Journ. Linn. Soc. xxxix (1911).

[Notes, R.B.G., Edin., No. XXXIX, Jan. 1915.]

the known species have been either reduced as varieties or entirely suppressed. On the other hand, a few species which have long been regarded as synonyms have been revived.

As to the classification, there have been put forward divergent views by different pteridologists. In recent years there seems to be a tendency to hold a wider view than was the case forty or fifty years ago. While Hooker and Baker regard *Pleopeltis* as a synonym of *Phymatodes* and consider it as a section of the genus *Polypodium*, Beddome retains it as a distinct genus. In the more recent classifications, such as of Diels and of Christensen, it is also treated as a subgenus of *Polypodium*; and this appears to be in accordance with the modern conceptions of systematic botany. As to the subdivision of *Pleopeltis*, Diels' system is apparently very convenient. However, if the actual plants are studied, his system at once proves to be exceedingly unnatural. Thus if such a species as *Polypodium hastatum* is considered, one and the same species would fall into two distinct sections, or again if it is placed in his § *Pinnatifidae*, it would still be widely separated from the closely allied *P. Engleri* or *P. Griffithianum*. Moore's system seems to me far better in this respect. Yet, as he laid too much stress on the venation, *P. rhynchophyllum* and *P. Griffithianum* have been placed in § *Phymatodes* instead of § *Phlebodiopsis*. J. Smith has amended this defect in establishing a genus *Phymatopsis*, but his separating certain allied species under the generic names of *Anapeltis* and *Lopholepis* does not seem to be justifiable. Christ mentions in his *Farnkräuter* a few species of this group. He, however, places them under the subgenus *Craspedaria*, which he characterises by the dimorphic fronds and by the nervation between *Goniophlebium* and *Pleopeltis*. The study of the nervation of ferns is very interesting and necessary. However, one has to be cautious not to be carried away too far by the notion that the nervation is of fundamental importance and the only way of classification. As a matter of fact, the nervation is liable to variation even within one species. *P. rhynchophyllum* would furnish a good example of modification of the venation from a comparatively simple and regular type to a more irregular and in some degree more complicated. In this way the type of the venation found in this species passes to that of another species and is finally connected, through several species, with the much more compound, different-looking venation of *P. venosum*. If, however, actual plants are examined, it would be quite clear how *P. rhynchophyllum*, *P. accedens*, *P. lycopodioides*, *P. salicifolium*, *P. drymoglossoides*, *P. soridens*, *P. oodes*, *P. simplicissimum*, *P. pilosellum*, *P. squamulosum*, *P. vacciniifolium*, *P. stenophyllum*, etc., are closely allied to each

other, and how these are quite naturally connected with *P. Griffithianum* and *P. trifidum* through *P. hastatum*. Yet these members of one natural group have been classed in several different sections of a certain subgenus, or even into different subgenera, on account of different nervations. It is impossible to understand why different types of nervation should not occur within one group of ferns. It is almost absurd to establish genera on a slight difference in nervation alone. The case above mentioned is only an instance to show how natural groups of ferns have been unnaturally systematised. It is much to be desired that a more natural classification of ferns based upon sound judgment and careful observations on actual plants in nature should be undertaken.

As to the distinction of species, the writer is of opinion that the ramenta on the rhizome generally afford a good distinguishing character, though their colour may vary to a certain extent. However, it should be remembered that in some cases, such as in *Phymatopsis*, closely related species possess ramenta of very slight difference. The position of sori, as to whether they are marginal or intramarginal, etc., seems to be subject to little variation, and particularly in *Eupleopeltis* one can usually rely upon it. In the pinnate forms, the direction of pinnae, especially of the lowermost pair, can be commonly taken into consideration. The margin of the frond, whether entire, notched, or toothed, etc., is not to be neglected in many cases. Lastly, I may mention that the consistency of the frond can also frequently be utilised. However, one has to be very careful in regard to the age of the frond and also to the circumstances of the habitat, whether sunny or shaded; young fronds of thick-leaved species have repeatedly been described by herbarium-botanists as "membranaceous."

The present investigation has been carried out in the Kew Herbarium, while a few specimens in the British Museum have also been examined. The writer wishes to take this opportunity of thanking the authorities of both establishments for their courtesy in allowing him to use the herbarium and library.

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#### 1. *P. lineare*, Thunberg.

Owing to its wide distribution over various parts of the Old World and to its polymorphic nature, this species has several varieties, the majority of which have been described as distinct species. Although the different varieties are connected with each other by intermediate forms, they are fairly well fixed, so that

their extreme forms really appear, in some cases, as if distinct species. There is, consequently, a great difference of opinion amongst botanists as to the specific limit of *P. lineare*. In addition to the fact just mentioned, this species has, from time to time, been confounded with other species of a similar appearance, especially with *P. nudum* and *vice versa*. The confusion in nomenclature of the species belonging to this group has been further accentuated by the fact that different authors, and in some cases even the same botanists, have described the same species under several specific names, whilst several species of the group have been incorrectly reduced by others.

The *modus operandi* of botanists dealing with the plants of this group is either to include all the species under the all-embracing *P. lineare*, or to regard each form as a distinct species. The latter method more clearly shows, in a flora or a work of similar nature, which species or forms occur in certain districts, and is more valuable than the other, which gives us only a vague idea of the geographical distribution of this group of ferns. The practice of disregarding subordinate forms, which is usually adopted, having been handed down to us from the past, does not carry one far, and is in every respect at variance with the modern conceptions of systematic and geographical botany.

It is, however, by no means an easy task to clear up all the misconceptions and confusions in connexion with *P. lineare*, and to arrange the members of this group. As I have been in the fortunate position of examining the type or co-type specimens of most of the plants referred to *P. lineare* by different botanists, together with several others described as varieties of or closely allied to *P. lineare*, I propose to systematise all the varieties and forms of *P. lineare* known to me, and to make some remarks upon each one of them, together with the allied species.

### *Polypodium lineare*, Thunb. amplif.

#### a. *Thunbergianum*, (Kaulf.) Takeda.

Syn. :—*P. lineare*, Thunb. Fl. Japon. p. 335 (1784); Makino, Phan. et Pter. Japon. Ic. Illus. sub tab. ix (1899).

*Pleopeltis Thunbergiana*, Kaulf. Wesen d. Farrnkr., p. 113 (1827).

*Pl. elongata*, Kaulf. Enum. Fil. p. 246 (1824).

*P. atropunctatum*, Gaudich. Freyc. Voy. Bot. p. 346 (1828); Mett. Polyp. n. 160 (1857); Hook. et Arn. Bot. Beechey's Voy. p. 103 (1832).

*P. lineare a typicum Makino*, in Tôkyô Bot. Mag. xv, p. 61 (1901).

Fronde plerumque subcaespitosae vel sparsae, 10–30 cm.



vulgo 15 cm. lg., 5-11 mm. vulgo 8 mm. lt., coriaceae, rigidae, supra atropunctatae, apice longe acuminatae, basin versus in stipitem brevissimum vel breve sensim attenuatae, margine in sicco saepius revolutae. Sori rotundi vel ovales, adproximati, et adulti saepe subconfluentes, supremam frondis partem (saepius apice excepto) occupantes, medii inter costam et marginem. Rhizoma paleis nigris, clathratis, e basi cordato-ovata longissime acuminatis, margine ciliato-dentatis vestitum.

Distr.—Japonia media et australis, Formosa, Corea, China, Tibet, Ins. Hawaii, et Java.

This is the form which was first described in 1784 by Thunberg from Japan as *Polypodium lineare* and later by Kaulfuss from Oahu under the name of *Pleopeltis elongata*.\* Kaulfuss, probably unaware of the identification of Thunberg's plant with his species, and in order to distinguish it from his *Pleopeltis linearis*\* (= *P. lanceolatum*, L. = *Pl. lanceolata*, Kaulf.), proposed, in 1827, to call it *Pl. Thunbergiana*.† The same form again received a fourth name, *P. atropunctatum*, Gaud., which was given to an Hawaiian specimen, and in recent years it has been distinguished by Makino as *P. lineare a. typicum*.

The frond is thick and persistent, and the colour is a deep green on the upper surface, and paler on the under side. In the dry season the fronds curl up, and unroll again in damp weather. This form is very common in Japan, and is found growing on trunks or rocks, and sometimes also on old thatched roofs.

Outside Japan, Formosa, and the Sandwich Islands, I have seen the following specimens:—

COREA. Quelpaert (Taquet, n. 3656).

CHINA. Kwantung: Lo Fou Shan (ex hb. bot. Hongk., n. 140); Fukien: Amoy (Hance, n. 1410. Swinhoe, 1870); Chekiang: in ins. parva Toon doon ding san lacus Taihu (Forbes, n. 1874); Kiangsi: Kiukiang (Forbes, n. 541; Shearer, 1873); Szechwan: Mt. Omei (Faber, n. 1069); Yunnan: Mao-kontchang (Delavay, 1883); Szemao (Henry, n. 10,062), Mengtsh (Henry, n. 10,087A).

TIBET. Yatung, 27° 51' N., 88° 35' E. (H. E. Hobson, 1897).

JAVA. No precise locality (J. H. Walker, 1876).

Forma **caudato-attenuatum**, Takeda.

Fronde apice longissime caudato-attenuatae saepe elongatae, 20-30 cm. lg., ceterum uti in typo.

JAPAN. Yokosuka (Savatier, n. 1541, part.); Ôshima (C. Wright, 1853-56, ex hb. U.S. Pacif. Expl. Exped.).

\* Kaulf. Enum. Fil. p. 246 (1824).

† Kaulfuss (Das Wesen der Farnkräuter, p. 115 [1827]) regards *Pl. nuda*, Hook. (1823), as a synonym of *Pl. elongata*, Klf. (1824). Besides this case, he disregards older names and prefers using new names of his own.

CHINA. Yunnan: Szemao, N.W. mts., 5000 ft. (Henry, n. 10,062A).

Forma *contortum*, (Christ) Takeda.

Syn.:—*P. lineare* var. *contortum*, Christ, in Nuovo Giorn. Bot. Ital. n. ser. iv, p. 98, tab. i, fig. 3, 3, 3, 3 (1897); Makino, Phan. Pter. Japon. Icon. Ill. ii, tab. xcvi-c. (1903).

*P. contortum*, Chr. in sched.

Quoad staturam ut in *a*, sed frondibus plerumque sparsis, saepe tenuioribus, distincte et breviter stipitatis, in sicco admodum revolutis et irregulariter contortis.

A form, when dry, becoming extraordinarily contorted, otherwise same as *a*. Christ is inclined to separate this form as a distinct species on account of the contorted condition and the cuspidate apex of the frond. He places the present plant between the type form of *P. lineare* and *P. Lewisii*, but what he takes for *P. Lewisii* Bak. is, in fact, *P. involutum* Bak. As I have pointed out above, the typical form of *P. lineare*, and also its var. *ussuriense* and *loriforme* (v. *infra*), as well as *P. nudum* and other persistent species, roll up their fronds when the atmosphere becomes very dry. If specimens are collected and pressed in this condition, they all will appear exactly like Christ's *contortum*. The only difference of the *contortum* from other forms of *P. lineare* is, so far as I can decide from the herbarium material, that the frond is thinner in texture, more or less scattered on the rhizome, distinctly stipitate, and shows a stronger tendency to roll up than the others. It would be more natural to regard this plant as a mere form of *P. lineare a*.

JAPAN. Yokosuka (Savatier, n. 1541, part.).

CHINA. Shensi: Zulu Mts. (Giraldi, 1894); Kuan-tou-san (Giraldi, 1896).

SANDWICH ISL. Oahu (Beechey; D. Nelson; Menzies).

*β. subspathulatum*, (Hook.) Takeda.

Syn.:—*Drynaria subspathulata*, Hook. Kew Journ. Bot. ix, p. 356 (1857).

*P. Onoei*, Fr. et Sav. Enum. Pl. Japon. ii, pp. 246, 644 (1879).

*P. lineare* var. *Onoei* Makino, in Tôkyô Bot. Mag. xi, p. 282 (1897); Ej. Phan. Pter. Japon. Ic. Ill. i, sub tab. x (1899).

*P. lineare* var. *abbreviatum*, Christ, in Bull. Acad. Intern. Geogr. Bot. xi, p. 208 (1902).

*P. Wightianum*, Benth. Fl. Hongk. p. 458, part. (1861).

Frondes vulgo sparsae, 2-7 cm. lg., 2.5-5 mm. lt., subcoriaceae vel coriaceae, apice rotundatae vel anguste obtusae, basi breviter in stipitem brevissimum attenuatae, margine saepissime re-

volutae. Sori in parte frondis apicali continentes. Paleae rhizomatis ut in *a*, sed plerumque breviores.

Distr.—Japonia, Corea, et China.

This variety is characterised by the small frond with roundish apex. It is sometimes difficult to distinguish it from a dwarf form of *a*. This plant was described from Japan by Franchet and Savatier as *P. Onoei*, and has been rightly reduced by Makino to *P. lineare* as a variety.

This variety had not been recorded from China until 1902, when Christ described it as *P. lineare* var. *abbreviatum*. There are at Kew and in the British Museum specimens of the identical plant collected by Harland in Hongkong, and labelled *Drynaria subspathulata*, Hook. Although these particular specimens did not form the basis of Hooker's description, they agree very well with the diagnosis. Harland's specimens are referred to by Benthams in his Flora Hongkongensis, but this author, instead of using Hooker's name, regards it as a synonym of *Polypodium Wightianum*, Wall. His description given for *P. Wightianum* in his book is, however, partly of *P. Wightianum*, Wall. (= *P. nudum*, Kze.) and partly of our plant.

From China I have seen the following specimens :—

Hongkong (Harland, 1857) ; Chekiang : hill west of Huchow (Carles, n. 188) ; Kiangsu : Shanghai (Maingay, n. 452).

*γ. ussuriense*, (Rgl. et Maack) C. Christ. Ind. Fil. p. 572 (1906) ;  
id. in Bull. Acad. Intern. Geogr. Bot. xxi, p. 71 (1911).

Syn. :—*Pleopeltis ussuriensis* Rgl. et Maack, Tentam. Fl. Ussur. p. 175 (1861).

*P. ussuriense*, Rgl. in Acta Hort. Petr. vii, p. 663 (1881).

*P. leiopteris*, Makino in Tōkyō Bot. Mag. xii, p. 88 (1898), non Kze.

*P. sesquipedale* forma *leiopteris*, Makino, Phan. Pter. Japon. Ic. Ill. sub tab. viii, excl. syn. (1899).

*P. lineare* var. *distans*, Makino, in Tōkyō Bot. Mag. xv, p. 60 (1901).

*P. distans*, Makino, l.c. xx, p. 33 (1906).

*P. annuifrons* var. *distans*, Nakai, Fl. Kor. ii, p. 44 (1911).

*P. lineare* var. *coraiense*, Christ, in Fedde, Repert. v, p. 10 (1908).

*P. coraiense*, Christ, l.c. p. 285 (1908).

*P. Schraderi*, Milde, Fil. Eur. Atl. etc. p. 16, part. (1867).

Frondes plerumque distantes, sed raro caespitosae, vulgo distincte stipitatae, stipite 5–30 mm. lg., raro nullo, 7–20 cm. lg. cum stipite, 5–10 mm. lt., subcoriaceae, tenues, apicem versus sensim attenuatae, acutae, margine minus revolutae. Sori parvi (diam. infra 3 mm.), saepe in parte apicali et ultra

medium frondis occurrunt, adproximati, sed vix confluentes. Rhizoma gracile, paleis ovatis, acuminatis, distincte reticulatis, parce ciliato-denticulatis tenuiter obtectum.

Distr.—Japonia occidentalis et borealis (ubi rarior), Corea, et Manchuria.

This variety is fairly invariable, and is distinguished from the others by the fronds of thinner texture, distantly arranged on the rhizome, and generally stalked, as well as by the sori and the ramenta on the rhizome smaller than in the others. The margin of the frond does not roll up very strongly, but I have seen a specimen collected by Ross in Manchuria, which at first glance appears as if it were a *Thunbergianum* forma *contortum*.

I have examined the following specimens from Manchuria:—

Fenghwangcheng, shady rocks (Ross, Apr. 1876); Lao yeh Ling, near Moukden (James, 1886); Changpaishang (do.); Tang-ho-ko, Sungari R. to Hui Fa R. (do.).

♂. *loriforme*, (Wall.) Takeda.

Syn.:—*P. loriforme*, Wall. List, n. 271 (1828); Mett. Polyp. p. 92 (1857); Hooker, Gard. Ferns, sub tab. 14, excl. syn. (1862).

*P. excavatum* var. *loriforme*, C. Christ. Ind. Fil. p. 541 (1906).

Luxurians. Frondes saepe subcaespitosae, ultra 30 cm. vulgo 20 cm. lg., 2 cm. lt., coriaceae, anguste oblanceolatae, longe acuminatae, basin versus in stipitem breve sensim attenuatae, costa prominenti, in sicco plerumque longitudinaliter tenuiter rugosae. Sori partem frondis apicalem occupant et saepe ultra medium occurrunt, distantes, inter costam et marginem medii vel leviter ad marginem dispositi; in sicco frondis margo revoluta, atque sori marginales videntur. Rhizoma crassum, paleis ovatis longissime acuminatis, ciliato-dentatis, nigro-clathratis, patentibus dense vestitum.

Distr.—India, China, et Ins. Hawaii.

This is a very luxuriant form, and is easily distinguished by the thick texture and the peculiar longitudinal wrinkles, which are more prominent than in the others. In dried specimens the margin of the frond rolls up as far as the line of the sori, so that the sori appear as if marginal. The sori are large and not very close together as in *a*, but sometimes some of them become confluent.

In the Wallichian Herbarium there are specimens of *P. loriforme* (n. 271) from two localities. Those from Nepal (1823) are fine representatives of our plant, reaching over a foot in length, while those from Ladakh, collected by Moorcroft (1822) and named *P. loriforme* by Wallich himself, are, however, not the real *P. loriforme*. The Ladakh specimens are 5-7.5 cm. in length, and possess the sori nearer the midrib than the margin.

As far as the writer can judge from the insufficient material, they belong to *P. nudum*.

Christensen considers that the *P. loriforme* figured and described by Hooker in Garden Ferns, tab. 14, differs from Wallich's plant. Though the sori are delineated too near to the midrib, it undoubtedly represents Wallich's *loriforme*. Hooker is, however, not correct in referring certain specimens of *P. nudum* and *P. lineare* α to this figure, and in giving *Pl. nuda*, Hook., *P. Wightianum*, Wall., and *P. gladiatum*, Wall. for synonyms.

This variety occurs abundantly in India,\* whilst it is rarely found in China. I have seen one or two specimens of *P. lineare* from the Sandwich Islands, collected by Beechey, which possibly represent the *loriforme*. From China the following specimens have come under my observation :—

Yunnan : without precise locality (Henry, n. 9194, part.) ; Yunchang (Henry, n. 13,339) ; Mengtsz (Hancock, 1894) ; Szechwan : Mt. Omei (Wilson, n. 5318).

Forma **steniste**, (Clarke) Takeda.

Syn. :—*P. lineare* var. *steniste*, Clarke, Ferns of Northern India, p. 559 (1880) ; Bedd. Handb. Ferns Br. Ind. p. 347 (1883).

Differt tantum frondibus angustissimis, 6–9 mm. lt., in sicco margine revolutis, atque frondes latitudine 5 mm. non excedere videntur.

Only a narrow-leaved form of the var. *loriforme*. It is known from Sikkim, Assam, and Khasia.

ε. **elongatum**, (Schrad.) Takeda.

Syn. :—*P. elongatum*, Schrad. in Gött. gel. Anz. (1818), p. 915 ; Schltd. Adumbr. Pl. p. 16, tab. vii (1825).

*P. Gueintzii*, Mett. Polyp. p. 91, tab. iii, fig. 18, 19 (1857).

*P. Schraderi*, Mett. ibid. p. 98, tab. ii, fig. 11 ; Hook. and Bak. Synop. Fil. p. 354 (1874) ; Milde, Fl. Eur. Atl. etc. p. 16, part. (1867).

*P. lineare* et var. *Schraderi*, Sim, Ferns of S. Africa, pp. 197, 199, tab. cxiv, cxv (1892).

Frondes subcoriaceae vel coriaceae, plerumque oblanceolatae, 10–30 cm. vulgo 20 cm. lg., 12–26 mm. lt., stipitatae, stipite 12–25 mm. lg. Sori in parte superiore frondis occurrunt, magni, adproximati. Palea rhizomatis ut in ♂.

Distr.—Africa australis et orientalis, et Ins. Madagascar.

This is a broad-leaved variety, and is the sole representative of this species in Africa. The specimens collected by A. A.

\* Nepal, Sikkim, Assam, Khasia, and Bhotan.



Heller in the Sandwich Islands (n. 2533) may possibly be referred to this variety.

It is highly interesting to find this Asiatic species in Madagascar and other parts of Africa. Similar geographical distribution is also shown by certain other species of this genus.

I have examined the following specimens of this variety:—

S. AFRICA. Natal (M'Ken, n. 23, 174; M'Ken and Buchanan, n. 66, 67; W. T. Gerrard, n. 504); near King Williamstown (Sim, n. 1588, 1589); British Kaffraria (T. Cooper, n. 386; D'Urban; R. Baur, n. 2, 942); Transvaal/Natal (Van Reenen; R. Schlechter, n. 6914); Orange Free State (T. Cooper, n. 1202); East Griqualand: Mt. Zuurberg (W. Tyson, n. 1779); Cape Colony (R. Schlechter, n. 1); Cape of Good Hope (T. Cooper, n. 958).

E. AFRICA. Ruwenzori: Mau Forest (Scott-Elliot, n. 9198).

MADAGASCAR. Tanala (Kitching, 1880); Antananarivo (Pool, 1876).

Besides those varieties mentioned above, there have been described two others, namely var. *glaucosorum*, Christ\* and var. *caudatum*, Makino.† The writer has been unable to examine any authentic specimen of either of them. As far as can be made out from the descriptions, the former may belong to *P. excavatum*, while the latter represents *P. nudum*. At any rate, neither of these appears to the writer to be a variety of *P. lineare*.

## 2. *P. eilophyllum*, Diels.

This species is closely allied to the preceding; it differs, however, above all, in the sori being situated quite close to the midrib and oblong in shape.

Christ has mistaken this species for *P. Lewisii*, Bak., and has given a description and figures in the Nuovo Giornale Botanico Italiano, n. ser. vol. iv, 1897, under the latter name. He also considers the present species to be an extreme form of *P. lineare*,‡ an opinion not to be approved.

This plant was first described as *P. involutum*, Bak.,§ and, as the same name had been used already, has been altered by Diels to *P. eilophyllum*.|| I have seen the following specimens:—

Hupei: without precise locality (Henry, n. 6859); Shensi: Mt. Thae-pei-san (Giraldi, Aug. 1876); Yunnan: Mengtsz, woods 6000 ft., on tree (Henry, n. 9249B).

\* Bull. Acad. Intern. Geogr. Bot. xi, p. 209 (1902).

† Tôkyô Bot. Mag. xvii, p. 78 (1903).

‡ Farnkräuter der Erde, p. 102 (1897), under *P. lineare*, as *P. Lewisii*.

§ Journ. Bot. xviii, p. 177 (1889).

|| Engl. Bot. Jahrb. xxix, p. 204 (1900).

3. *P. Lewisii*, Baker.

This is a very small fern measuring about 4-10 cm. in length. It is undoubtedly related to the preceding species; it differs, however, in the main, by the margin of the frond being strongly revolute, so that it completely conceals the sori, while in the other plant the sori are, at all events, quite visible.

This seems to me a rare species, having been found by Dr. Shearer in Kiukiang, Kiangsi, in 1873, and described by Mr. Baker in 1875; \* it has not been collected since.

4. *P. oblongisorum*, Christensen.

When describing this species under the name of *P. subintegrum*, Baker,† the author states that his plant comes very close to *P. soridens*, Hook. He seems to have noticed only the position of the sori, which, in the mature condition, appear to project beyond the margin of the frond, in consequence of the free parts of the margin becoming strongly revolute. These two species are, however, not closely related at all, since *P. soridens* belongs to J. Smith's *Phymatopsis*, while Baker's plant is a *Eupleopeltis*. As a matter of fact, *P. oblongisorum*, C. Chr. is allied to *P. eilophyllum*, Diels, from which it can easily be distinguished by the narrower and less revolute frond and the marginal sori.

Only the type specimen from Yunnan (Henry, n. 9194, part.) has been examined.

The name has been altered to *P. oblongisorum*, C. Chr.,‡ because *subintegrum* has been occupied by another plant.

5. *P. subimmersum*, Baker.

This species somewhat resembles *P. lineare* var. *loriforme*, Takeda, from which it differs in having the margin slightly sinuate, with a sinus near each sorus.

This fern from China was first described by Mr. Baker in 1895 under the name of *P. subimmersum*. In 1906 the same author gave a second name, *P. xiphopteris*, to an identical form, and another name, *P. mengtzeanum*, to a broad-leaved form of the same species.

In regard to the width, the frond is liable to variation. While the usual breadth of the fronds is 10-15 mm., there sometimes occurs a frond not exceeding 8 mm. or even less broad. The plant described as *P. mengtzeanum* possesses an exceptionally broad frond attaining 2 cm. in width.

\* Journ. Bot. iv, p. 201.

† Kew Bull. (1898), p. 231.

‡ Ind. Filicum (1906).

A careful examination of the type specimens of the above-mentioned three recognised species has led the writer to arrange them as under :—

**P. subimmersum**, Baker, in Kew Bull. (1895), p. 55.

Syn. :—*P. xiphiopteris*, Bak. l.c. (1906), p. 13.

Yunnan : Mengtsz (Hancock, n. 92, Henry, n. 11,826, 11,826A).

Forma **angustifrons**, *mihi*.

Frondes latitudine 8 mm. non excedentes, saepe angustiores.

Yunnan : Yungchang (Henry, n. 13,425).

Forma **mengtzeanum**, (Bak.) *mihi*.

Syn. :—*P. mengtzeanum*, Bak. l.c. (1906), p. 14.

Yunnan : Mengtsz (Henry, n. 11,827B).

The name *subimmersum* is rather inappropriate, since the sori are superficial.

6. **P. sublineare**, Baker, in sched. sp. nov.

*P. oligolepido*, Baker affine, sed frondibus subfasciculatis nec distantibus, sessilibus nec stipitatis, ramentis longe acuminatis, clathratis, ciliato-dentatis, nec integris, fusco-brunneis differt.

Rhizoma crassum, ramentis oblongo-ovatis, longissime acuminatis, clathratis, ciliato-dentatis obtectum. Frondes subfasciculatae, 12–42 cm. vulgo circa 30 cm. lg., 2–5 cm. vulgo 3 cm. lt., lanceolatae, apice longe acuminatae, basin versus longe decurrentes, subcoriaceae, nervis inconspicuis, utrimque glabrae, pagina superiore minutissime copioseque nigropunctata, margine plus minus repandae, costa prominenti. Sori plerumque inter costam et marginem medii, rotundi, globosi, 2–3 mm. diam., superficiales, juveniles paleis peltatis tecti.

CHINA. Yunnan : Tengchwan Lin Mt. forest, 9000 ft. (Henry, n. 9062A) ; Mengtsz, E. mts., 6000 ft. (Henry, n. 11,827, 11,828) ; Yungchang, 6000 ft. (Henry, n. 13,603).

Henry's no. 9062A has been determined and reported by Christ as *P. simplex*.\* However, the locality given by that botanist is not identical with that of our plant, so that the writer presumes that there may have been some error in connexion with his specimen.

7. **P. oligolepidum**, Baker.

Rhizoma crassum, 2–3 mm. diam. fusco-nigrum, paleis deltoideis, anguste acuminatis, integris, dorso nigro-brunneis et reticulatis, margine late hyalinis vestitum. Frondes distantes,

\* Bull. Herb. Boiss. vi, p. 875 (1895).

distincte stipitatae, stipite 2 ad 4 cm. lg., crasso, levi, nigricanti, lamina 10–23 cm. lg., 1–2 cm. lt., lanceolata, apice anguste acuminata, subcoriacea, costa prominenti, nigrescenti, nervis inconspicuis, pagina superiore nigro-punctata, pagina inferiore paleis minutis cuspidato-ovatis nigris parce vestita. Sori inter costam et marginem medii, globosi 3–4 mm. diam., superficiales, in parte superiore frondis vel saepe ultra medium occurrunt.

This is perhaps a rare species, or has been confounded with some other species of the *P. lineare* group. It was first described by Mr. Baker in the Gardeners' Chronicle, n. ser. xiv, p. 494 (1880), from two imperfect, unusually small fronds. In 1905 Christ reduced this species to *P. lineare* as a variety,\* but, as I have not seen the specimens referred to, I am not quite certain if his name can be regarded as a synonym of our plant.†

This species is characterised by the thick, almost black stipe, lanceolate frond, and large globose sori arranged in a row between the midrib and the margin, or slightly nearer the midrib.

I have seen the following specimens :—

Kwantung : Lo Fou Shan, alt. 3100 ft. (ex hb. Hongk., n. 13) ; Kiangsi : Kiukiang (Maries) ; Yunnan : Mengtze, mt. woods to S.E., 6000 ft. (Henry, n. 10, 192).

The last-referred specimen has been determined by Christ as *P. simplex*.‡

#### 8. *P. nudum*, Kunze.

For nearly a century *P. nudum* has been confused with *P. lineare*, and sometimes with *P. excavatum*. Hooker's first description, accompanied by a beautiful plate, of this plant under the name of *Pleopeltis nuda* was published in the Exotic Flora, tab. 63, 1823. Kaulfuss may have been the first to reduce this name§ to his *Pl. elongata*, which was published in 1824. Later, Hooker himself confused his plant with others. In Garden Ferns || and in Species Filicum he uses the name *P. loriforme*, Wall. (= *P. lineare* var. *loriforme*, Takeda) for the present plant, and gives for synonyms, amongst others, *Pl. nuda*, Hook., *Pl. elongata*, Kaulf., *P. lineare*, Thunb., *P. Gueintzii*, Mett., *P. excavatum*, Willd., and *P. phlebodes*, Kze.¶ Thus he evidently held a very wide view, which has given rise to much confusion in later years.

\* Soc. Bot. France, Mém. i, p. 15 (1905).

† The specimen collected by Giral di in Thae-pei-san in Aug. 1895, and determined by Christ as *P. oligolepidum* (Nuov. Giorn. Bot. Ital. n. ser. iv, p. 99 [1897]) is not Baker's plant, but *P. clathratum*, C. B. Clarke. See also under *P. excavatum*.

‡ Bull. Herb. Boiss. vi, p. 875 (1895).

§ Das Wesen der Farnkräuter, p. 115 (1827).

|| Gard. Ferns, sub tab. 14 (1862).

¶ Species Fil. v, p. 57 (1864).

*P. nudum* has received more names from Wallich, namely *P. gladiatum* and *P. Wightianum*. An examination of the Wallichian Herbarium, now in possession of Kew, together with other specimens distributed by Wallich, has convinced the writer that *P. Wightianum* is exactly identical with the typical *P. nudum*, while the other name was given to a narrow-leaved form of the same species.

In addition to this complication in nomenclature, Kunze described in 1850 *P. nudum* under the name of *P. leiopteris*.<sup>\*</sup> This name was accepted by Mettenius in 1856,<sup>†</sup> but in the following year was reduced to *P. sesquipedale*, Wall.<sup>‡</sup>

In 1851, Kunze published another new species called *P. nudiusculum*.<sup>§</sup> According to the author, this fern is closely allied to *P. nudum*, while Christensen || tells us that it is partly *P. lineare* and partly *P. simplex*. As far as the writer has been able to make out from the original description, *P. nudiusculum*, Kze. seems to be conspecific with *P. nudum*, as several other botanists consider.

The confusion of *P. nudum* with *P. excavatum* may be excusable, but how this species has been confounded with *P. lineare*, *P. loriforme*, or *P. Gueintzii* is almost inconceivable. *P. nudum* can easily be distinguished from any form of *P. lineare* by the rammenta on the rhizome being ovate, acuminate, entire, and brownish in colour, while the rammenta of *P. lineare* are subulate, long-acuminate, ciliate-dentate, and black in colour. The second point of distinction is that the sori of *P. nudum* are situated close to the midrib and usually reach more than half way down the frond, whereas those of *P. lineare* are generally between the midrib and the margin or slightly nearer the margin, and extend but seldom to the base of the frond. The texture of the frond varies to some extent; it is usually subcoriaceous and thinner than in *P. lineare*, or in some cases still thinner. However, the veins are always hidden, as in *P. lineare*. Since the frond persists through the winter, it rolls up in the dry weather, as may often be seen in the herbarium specimens in the margin being revolute. When a specimen is collected in the dry season and pressed as it is, the plant assumes the condition of *P. contortum*, Christ.

The dimension of the frond is extremely variable. In a small specimen the frond may be about 10 cm. long and 7-10

<sup>\*</sup> Linnaea, xxiii, p. 319 (1850).

<sup>†</sup> Fil. Hort. Lips. p. 36, tab. 25, fig. 37-39 (1856).

<sup>‡</sup> Polypod. p. 91 (1857). Mettenius is certainly wrong in using Wallich's name for this plant. His description and the synonyms given apply to *P. nudum*, but not to *P. sesquipedale*, Wall.

<sup>§</sup> Linnaea, xxiv, p. 253 (1851).

|| Ind. Fil. p. 548 (1906).



mm. wide. In a luxuriant form it may attain 40 cm. long and over 15 mm. wide. The form of the frond is generally linear, or sometimes linear lanceolate, and often tapering into a narrowly acuminate apex. The stipe also varies from half a centimetre up to 6 cm.

As in *P. lineare* the frond forks two to several times. Such a monstrosity is not uncommon amongst ferns. Where it is fairly well fixed, it may be distinguished as monst. *ramifrons*, otherwise it is not worth while to discriminate it as a special form.

This species is widely distributed in India, occurring in Punjab, Nepal, Kumaon, Sikkim, Khasia, Madras, Nilghiri (abundant), and in Ceylon. It is also distributed over Sumatra (Tuschemacher, n. 29, 30) and China. The only Chinese specimen I have examined was collected by Henry (n. 13, 129) in Yunnan: "Szemao, N.W. mts., 6000 ft., on tree." It is quite unknown from Japan; any information as to its occurrence in Japan is due to the mistake of *P. lineare* a *Thunbergianum* for *P. nudum*.

The synonymy of our plant is as follows:—

*P. nudum*, Kze. in Linnaea, xxiii, p. 281 (1850).

Syn.:—*Pleopeltis nuda*, Hook. Exct. Fl. sub tab. 63 (1823).

*P. gladiatum*, Wall. List, n. 279 (1828).

*P. Wightianum*, Wall. List, n. 2222 (1829).

*P. leiopteris*, Kze. l.c. pp. 279, 319 (1850).

*Drynaria Zeylanica*, Fée, Gen. Fil. p. 272 (1850-52).

*P. nudiusculum*, Kze. l.c. xxiv, p. 253 (1851).

*P. sesquipedale*, Mett. Polyp. p. 91 (1857), nec Wall.

*P. lineare*, Blauf. in Journ. As. Soc. Bengal, lvii, p. 312, tab. xix (optim.).

*P. lineare* var. *Elysianum*, Blauf. Ann. List Ferns of Simla, p. 14 (no date).\*

#### 9. *P. excavatum*, Bory.

This species is so closely allied to the preceding that it has been sometimes confounded with it. It has also been confused with *P. lineare*, as has been pointed out by more modern workers.†

Like *P. lineare*, this fern has a wide range of distribution; consequently there have been proposed several names which will be enumerated below. Christensen regards some of the synonyms as varieties, but I cannot agree with him in this respect.

\* The type specimens from Simla have narrow fronds not exceeding 10 mm. or less and longly stalked. I do not deem it necessary to separate it as a form.

† Bedd. Handb. p. 347 (1883); Blauf. in Journ. As. Soc. Bengal, lvii, p. 313 (1888); Hope, in Journ. Bombay Nat. Hist. Soc. xv, p. 91 (1903).

As the characteristic features of this species we may mention that the frond is very thin, herbaceous, distinctly showing the veins and venules; the sori are arranged in a row quite close to the midrib and immersed, and the ramenta are ovate, acuminate, and entire. The sorus is, when young, completely covered with a number of large peltate scales, which are usually pale brown, or in the variety, dark in the centre.

*P. excavatum* can readily be distinguished from *P. nudum* by the very thin frond, which, being deciduous, does not roll up on the margin, and by the sori, which are situated nearer the midrib than in the other species, often larger, and obliquely oval in shape, while those of *P. nudum* are strictly round.

The ramenta on the rhizome vary in colour from pale brown to dark brown, or in the case of the variety, they are light brown in the margin, and black in the centre.

The synonymy of this species is as follows:—

*P. excavatum*, Bory, apud Willd. Sp. Pl. v, p. 158 (1810).

Syn.:—*P. simplex*, Sw. in Schrad. Journ. 1800, p. 158 (1810), non alior.; Blauf. in Journ. As. Soc. Bengal, lvii, p. 313, tab. xx (optim.)

*P. lineare*  $\beta$  *simplex*, Bak. in Hook. Bak. Syn. Fil. p. 345 (1883).

*P. scolopendrium*, Ham. apud Don, Prodr. Fl. Nepal. p. 1 (1825).

*P. sesquipedale*, Wall. List, n. 275 (1828).

*Drynaria phlebodes*, Fée, Gen. Fil. p. 270 (1850-52).

*P. phlebodes*, Kze. apud Mett. Polyp. p. 92 (1857).

*P. bullatum*, Bak. in Journ. Linn. Soc. xv, p. 420 (1876).

*P. lineare* et forma *major* Christ, in Bull. Acad. Intern. Geogr. Bot. xvi, p. 105 (1906), non Thunb.

*P. maculosum*, Christ, l.c. nec Christ, 1898.

$\alpha$ . *concolor*, Takeda.

Ramenta rhizomatis concoloria fusca vel nigro-fusca, margine pallidiora.

$\beta$ . *bicolor*, Takeda.

Ramenta laete brunnea et medio nigra.

Monstr. *polymorphum*, (Clarke) Takeda.

Syn.:—*P. lineare* var. *polymorphum*, Clarke, Ferns N. India, p. 559 (1880).

Distr. spec.—India (Punjab, Nepal, Kumaon, Sikkim, Assam, Khasia), Ceylon, China, Africa trop., Madagascar, Ins. Mascar.

As in *P. nudum*, the frond of this species is extremely variable

in size. The smallest one examined does not exceed 10 cm. in length, while the largest one would reach 40 cm. The width also varies from less than a centimetre up to over 4 cm. It is almost impossible to distinguish different varieties or forms based on the dimensions of the frond. The rammenta in the var. *bicolor* give a peculiar appearance, somewhat resembling those in *P. sinuosum*. This variety is found in China, together with the typical form, and also occurs in India.\* The following specimens from China have been examined:—

*a. concolor*:—

Yunnan: Szemao, W. mts., 6000 ft. in forests, on trees (Henry, n. 13,070A); Mengtsz, N. mts. forests, on tree, 8500 ft. (Henry, n. 10,087), on wind-blown rhododendron trunk at 6000 ft. (Hancock, n. 104). Tibet: Yatung (Hobson, 1897).

*β. bicolor*:—

W. China: without locality (Wilson, n. 5317, 5317A); Hupeh: Patung District (Henry, n. 1739, 2465); Yunnan: Mengtsz, N. mt. forests, 8500 ft., on tree (Henry, n. 10,088 †); Montagne de Mao ku chang (Delavay, Jul. 1883).

Any information as to the occurrence of this species in Japan does not apply to this fern, but to *P. annuifrons*, Makino.‡

# 10. *P. annuifrons*, Makino.§

Although this species has been taken for *P. excavatum*,|| it is not closely akin to that plant. The frond is thin, chartaceo-coriaceous, slightly repand on the margin, and the veins and venules are hidden. Unlike those of *P. excavatum*, the sori are round and, when young, covered with small peltate scales with black reticulation. They also do not reach more than half-way down the frond. The rammenta on the rhizome show quite a distinct feature; they are ovate-lanceolate, acuminate, laciniato-denticulate, and are marked with black reticulation.

This species is exclusively Japanese, being widely distributed over various parts of the country. According to Christensen,¶ it has also been found in Quelpart, the flora of which possesses a large proportion of Japanese elements.

# 11. *P. clathratum*, C. B. Clarke.

The extremely thin texture of the frond and the characteristic clathrate scales in the sorus and on the rhizome

\* Kumaon (Strachey and Winterbottom, n. 2); Darjiling (Griffith).

† Christ has erroneously determined this number to be *P. oligolepedum*, Bak. See Bull. Herb. Boiss. vi, p. 875 (1898).

‡ Cf. the present paper, p. 306.

§ Phan. Pter. Japon. Ic. Ill. i, sub tab. vii (1899); Id. in Tōkyō Bot. Mag. xiii, p. 48 (1899).

|| Christ in Bull. Herb. Boiss. vi, p. 673 (1896).

¶ Bull. Acad. Intern. Geogr. Bot. xxi, p. 72 (1911).

readily distinguish this species from any allied members of this genus.

The frond is perhaps the most polymorphic of its kind, so that if extreme forms are compared, they at first glance appear as if distinct species. A comparatively small form with narrow and pointed fronds, as delineated by Clarke,\* was first described by himself in 1880 under the name of *P. clathratum*, while a still smaller form with very obtuse frond was described by Regel soon afterwards as *P. Alberti*.† A much larger form than Clarke's type, but similar to it, has been distinguished by Blanford as var. *jakonense*.‡ Through the kindness of Dr. T. Nakai I have been able to make out that *P. Uchiyamae*, Makino § is also a synonym of *P. clathratum*. As a matter of fact, the dimensions of fronds vary from 3 cm. up to over 30 cm. in length (exclusive of the stipe), and 5 mm. to 25 mm. in width. The apex may assume any form between roundish-obtuse to caudato-acuminate. The stipe is also subject to variation; the shortest examined measures 5 mm., while the longest one reaches 7 cm. In such circumstances it is quite impossible to draw any line between these varieties of shape. There is, however, an interesting variety of this species found in Tibet, which possesses small fronds more or less shortly three- to five-lobed at the base. The writer proposes to call this form var. *lobatum*.||

Some forms of this species resemble *P. nudum*, and others are similar in appearance to *P. excavatum*; from the former our plant can be distinguished by the thin membranaceous frond and the clathrate scales, and from the latter by the superficial sori and also by the nature of the scales.

The ripe sporangia are of a bright orange colour, and intermingled with them are often seen the peculiar black clathrate and strongly dentate scales. The sori are oblong or elliptical, and are often confluent.

This species is widely distributed over Turkestan, Afghanistan, Kashmir, Punjab, Nepal, and China. It is very interesting to note that it also occurs in the Loochoo Islands and in the province of Tosa, in Shikoku, Japan. The following specimens from China have been examined:—

Peking Mountains, shady rocks at 5000 ft., rare (Hancock,

\* Ferns N. Ind. p. 559 (1880), tab. lxxxii, fig. 1.

† Acta Horti Petrop. vii, p. 662 (1880, according to Christensen 1881).

‡ Ann. List of Ferns of Simla, p. 14 (no date).

§ In Tōkyō Bot. Mag. xx, p. 30 (1906).

|| Frondes aut longe (7 cm.) aut breviter (1 cm.) stipitatae, 3–6 cm. longae, 7–10 mm. latae, acutae vel obtusae, basi vel hastatae vel tri- (subquinque) lobatae, lobis brevibus, 5–25 mm. longis, acutis vel obtusis. Tibet, Lhassa (L. A. Waddell, Sept. 1904), Kyi chu Valley, 15 miles east of Lhassa (Walton, Aug. 1904); Gooring Valley, about 16,500 ft. (Littledale, July 1897).

n. 17); Thae-pei-san, Shenshi septentrional (Giraldi, Aug. 1896 \*).

It is quite possible that *P. Soulianum*, Christ,† none of the authentic specimens of which has been examined by the writer, is a form of *P. clathratum*, Clarke.

The writer prefers to leave out remarks upon the Indian specimens of this species, and only refer to Hope's paper.‡

## 12. *P. boninense*, Christ.§

This species probably comes midway between *P. excavatum* and *P. clathratum*. The frond is, however, thicker and more rigid. The sori are immersed, round or slightly oblong, and are situated almost midway between the midrib and margin. Despite the thick and coriaceous texture of the frond, the costules are prominent, at least in dried specimens.

The ramenta are ovate-lanceolate, dark brown, clathrate, and ciliate-denticulate on the margin.

So far, this species has not been known to occur except in the Bonin Islands. The writer has seen the specimens collected by Wright in 1853-56. Besides these there are at Kew a few specimens of this species sent from the Imperial Academy, St. Petersburg (n. 41), which bear no collector's name.

## 13. *P. asterolepis*, Baker.

There is some confusion in nomenclature of this species. The first name given to this species is *P. asterolepis*, Baker (1888). Baker erroneously reported this name in *Annals of Botany*, v, p. 474 (1891) as *P. aspidiolepis*, probably mixing it up with *P. aspidiolepis*, Bak. from Costa Rica. Christ, in 1905, when reducing this species to *P. simplex* (= *P. excavatum*), adopted Baker's misreported name, and called it *P. simplex* var. *aspidiolepis*, Christ. Meanwhile the same species was described by Baker as *P. macrosphaerum* in 1895, and again in 1906 as *P. intramarginale*. The full synonymy of this species will therefore be given in order to make the matter clearer:—

*P. asterolepis*, Baker in *Journ. Bot.* xxvii, p. 230 (1888).

Syn.:—*P. excavatum* var. *asterolepis*, C. Chr. Ind. Fil. p. 511 (1906).

*P. aspidiolepis*, Bak. in *Ann. Bot.* v, p. 474 (1891), by error.

\* The specimen has been determined by Christ as *P. oligolepidum*. See *Nuov. Giorn. Bot. Ital.* n. ser. iv, p. 98 (1897).

† *Soc. Bot. France, Mém.* i, p. 15 (1905).

‡ *Journ. Bombay Nat. Hist. Soc.* xv (1903).

§ Warburg, *Monsunia*, i, p. 61 (1900); Kodama, in *Matsum. Icon. Pl. Koishik.* ii, sub tab. 89 (1914).



*P. simplex* var. *aspidiolepis*, Christ, in Bull. Soc. Bot. France, Mém. i, p. 16 (1905).

*P. macrosphaerum*, Bak. in Kew Bull. 1895, p. 55.

*P. intramarginale*, Bak., Christ, in Bull. Herb. Boiss. sér. 2, iii, p. 509 (1903); Bak. in Kew Bull. 1906, p. 13.

The position of the sori of this species is subject to variation. In the typical case the sori are intramarginal, as one of the synonyms suggests. Sometimes, however, they are situated between the midrib and the margin,\* or even nearer the midrib.† In the description of *P. macrosphaerum* the sori are incorrectly said to be marginal. This is, however, due to the strong in-rolling of the margin of the frond. In any case, this species is characterised by the ramenta on the rhizome, which are short, ovate, very obtuse, convex, entire, and fuscous-brown in colour. The texture of the frond is subcoriaceous to coriaceous, probably according to different circumstances of habitat.

The following specimens have been examined:—

CHINA. Hupeh: Patung (Henry, n. 1273, 2556); Kiangsi: Kuling Ravine (Morse, n. 24); Szechwan: Mt. Omei (Faber, n. 1063; Wilson, n. 5321); Yunnan: Tseku (Mombeig); Mengtze (Henry, n. 9203, 10,042A, 13,363, part., 13,633; Hancock, n. 49); without locality (Ducloux, n. 438; Delavay, n. 4318).

INDIA. Khasia: Molim, 5800 ft. (Clarke, n. 43,627A).

#### 14. *P. megasorum*, Christensen.

First described as *P. macrosorum*, Baker,‡ but the name has been changed to that given above. This fern has a similar appearance to the foregoing; it differs, however, in the very thick texture and the obtuse apex of the frond, and the subulate, black, clathrate, ciliato-denticulate ramenta on the rhizome. The sori are always uniserial between the midrib and the margin. The dimensions of the frond vary from 5 cm. by 1 cm. or less to 20 cm. by 2 cm., and the stipe from 1 to 20 cm. in length.

This is an endemic species in Formosa, and appears to be not common. I have seen the following specimens:—

Kelung, on rocks (Wilford, n. 518); Tamsui (Hancock, n. 31).

#### 15. *P. Fortuni*, Lowe.

This species furnishes us with an instance of the enormous variation exhibited by ferns in the dimension of frond. The smallest frond (fertile) examined measures about 19 cm. long

\* In such specimens as Morse, n. 24; Wilson, n. 5321.

† Clarke, n. 43627A. This specimen is very poor, but probably belongs to this species.

‡ Journ. Bot. 1885, p. 106.

and 1 cm. broad, whereas the largest one attained 105 cm. in length and 7 cm. in breadth (both including the stipe, which also varies from 1 to 15 cm. in length). As the characteristic features of this species we may mention that the frond is linear lanceolate, gradually tapering towards both ends, acuminate at the apex, decurrent at the base, thin, chartaceo-subcoriaceous, light green or dark when dry, with prominent but fine veins and venules, sori 2-3 mm. in diameter, strictly round, uniseriate and costal or irregularly biseriate, often reaching more than half way down or even to the base of the frond. The rhizome is thick and covered with ovate, obtuse, entire, fuscous-brown rammenta, and produces fronds at an interval of a centimetre or so.

A stunted form with a narrow frond and uniseriate sori is not always easy to distinguish from *P. nudum*. However, in the present species the veins and venules are visible when the frond is dry, and the sori are strictly round, whilst in *P. nudum* veins and venules are hidden; the rammenta of *P. nudum* are more pointed.

This fern was first described by T. Moore in 1855 as *Drynaria Fortuni*, which was afterwards reduced to *Pleopeltis nuda* by the author himself. Unfortunately the specimens from which the description was drawn up do not represent the typical form of this species, but rather a meagre, narrow-leaved form with uniseriate sori. The more typical form has been described in 1868 as *P. Chinense*, Mett. and *P. Pappei*, Mett., in 1877 as *P. normale* var. *madagascarensis*, Bak., and finally in 1898 as *P. Henryi*, Christ, which has recently been altered to *P. austrosinicum*, Christ (1906). The references to those synonyms are as follows:—

**P. Fortuni**, Lowe, Ferns, British and Exot. i, sub tab. 42B (1856).

Syn.:—*Drynaria Fortuni*, Moore in Gard. Chron. 1855, p. 708.

*P. Chinense*, Mett. apud Kuhn in Seemann's Journ. Bot. vi, p. 270 (1868).

*P. Pappei*, Mett. apud Kuhn, Fil. Afr. p. 150 (1868).

*P. normale* var. *madagascarensis*, Bak. in Journ. Linn. Soc. xv, p. 420 (1877).

*P. Henryi*, Christ in Bull. Herb. Boiss. vi, p. 873 (1898), non Diels.

*P. austrosinicum*, Christ in C. Chr. Index Fil. p. 512 (1906), nec Christ in Bull. Acad. Intern. Geogr. Bot. xvi, p. 107 (1906).

I have examined the following specimens:—

FORMOSA. Tamsui (Hancock, n. 25); without locality (Oldham, n. 49; Swinhoe, 1862 \*); Taitung (Faurie, n. 611).

\* The type specimen of *P. Chinense*, Mett.

CHINA: Fukien: Amoy (Swinhoe); Foochow (Swinhoe); Sansha Bay (no name of the collector); without locality (Hance, n. 6786 \*); Chekiang: Ningpo (Hancock, Oct. 1877); Hangchow (Macarthy, Aug. 1870); Hupeh: Changyang (Wilson, n. 436); Ichang (Henry, n. 2230, 3135); Nant'o (Henry, n. 1994); also Henry, n. 7842; Kiangsi: Kiukiang (Shearer, 1873); Szechwan: Mt. Omei (Wilson, n. 5319); Henry, n. 7247, part.; Yunnan: (Henry, n. 9780 †); Long-ki (Delavay, 1894); Mengtsz, limestone rocks (Hancock, n. 47); mts., 5000 ft. (Henry, n. 9780, 13,363, part., 13,634); Kwangsi: Lungchow (H. B. Morse, n. 77). Other specimens from China: Poo-too-san Island (Fortune, n. 18 ‡); ht. Chelsea (Moore, 1856); § ht. Wentworth. §

S. AFRICA. Natal (M'Ken, n. 6; Sanderson, n. 2500 ||); Kaffraria (Rawson ||).

MADAGASCAR. Pool, Apr. 1876 ¶; Baron, n. 3681, 5310.

#### 16. *P. normale*, Don.

As Clarke remarks,\*\* the present species can easily be distinguished from its congeners by the very peculiar rammenta on the rhizome, which bear on their back a tuft of long reddish-brown bristles.

Hooker distinguishes three varieties of this species: *a*, *normalis*, *β*, *latifrons*, and *γ*, *sparsisora*. †† However, there is no distinguishing character whatever between the first and the last, and these have to be regarded as the type form. The var. *latifrons* is to be distinguished by the uni- or semi-bi-seriate sori on each side of the midrib. This varietal name is, however, very inappropriate, since there occurs a very narrow form of this variety.

*P. normale a* occurs in various parts of India, including Nepal, Khasia, Assam, and Bhotan. Hooker mentions only Malacca and Moulmein for the localities of var. *latifrons* ††; it is, however, found also in Khasia and Bhotan. The references given by Hooker to China and Formosa as to the habitat of this variety are due to the mistake of *P. Fortuni*, Lowe for the present fern. ‡‡ Outside India the same variety is distributed

\* Referred to *P. normale* in Hook. Sp. Fil. v. p. 70.

† The type specimen of *P. Henryi*, Christ.

‡ The type specimens of *P. Chinense*, Mett. and *Drynaria Fortuni*, Moore.

§ The type specimens of *Drynaria Fortuni*, Moore.

|| The type specimens of *P. Pappei*, Mett., also referred to *P. normale* in Hook. and Bak. Syn. Fil. p. 358.

¶ The type specimen of *P. normale* var. *madagascarensis*, Bak.

\*\* Ferns of N. India, p. 558 (1880).

†† Spec. Fil. v. p. 70. His remarks upon these varieties are, however, rather unintelligible.

‡‡ Ibid., also see under *P. Fortuni*, Lowe, in the present paper.

over Burma (Lace, n. 4733, 5128), Sumatra (Curtis and Matthew), China, and Formosa.\* From China the following specimens have been examined :—

Yunnan : Szemao, S. mts., 4000 ft., on rocks ; (Henry, n. 12,947) ; Mengtsz, S. mts., 6000 ft., forest, on tree (Henry, n. 10,090 †) ; the same, forests of the Red River (Hancock, n. 198). Hongkong (Lamonti, 1875).

### 17. *P. hymenodes*, Kunze.

The identity of Wallich's *P. hymenodes* with *Leptochilus axillaris*, Kaulf. perhaps requires no comment.

Kunze's *P. hymenodes*, on the other hand, has long been unrecognised, and, according to Christensen's Index Filicum, it is regarded as a synonym of *P. superficiale* Bl.‡ It is, however, difficult to understand why such a mistake has arisen. Even a glance at Blume's excellent figures of *P. superficiale*, Bl. and Mettenius' careful illustrations of *P. hymenodes*, Kze. is sufficient to make out the distinction between these two totally distinct species.

Our plant resembles *P. normale*, Don in having a thin ob-lanceolate frond, which is acuminate at the apex and towards the base gradually decurrent into a very short stipe, and in having the sori irregularly scattered over the greater part of the under-surface of the frond. It can be, however, distinguished from the other by the nature of the rammenta on the rhizome, which are ovate-lanceolate, long-acuminate, ciliate-denticulate on the margin, and bear no bristles on the back.

The frond of the typical form of this species bears sori scattered over the whole under-surface, whilst that of the variety has sori situated near the margin, leaving a naked portion along the midrib.

This species is distributed over the northern parts of India, Western China, Melanesia, and Formosa. The synonymy and the specimens examined are as under :—

### *P. hymenodes*, Kunze.

#### *a. sparsisorum*, Takeda.

Syn. :—*P. hymenodes*, Kze., in Linnaea, xxiii, pp. 279, 319 (1850) ; Mett. Fil. Hort. Lips. p. 37, tab. xxv, fig. 40-41 (1856).

\* Oldham, 1864.

† This is the type specimen of *P. maculosum*, Christ, in Bull. Herb. Boiss. vi, p. 872 (1898). The specimen recorded by Christ as *P. maculosum*, Christ, in Bull. Acad. Intern. Geogr. Bot. xvi, p. 105 (1906) represents, however, *P. excavatum* var. *bicolor*, Takeda.

‡ Hooker (Sp. Fil. v, p. 71) reduces Wallich's *P. hymenodes* to *P. superficiale*, Bl. He also remarks that Mettenius' figures of *P. hymenodes*, Kunze is " sufficiently satisfactory for our plant " (i.e. *P. superficiale*, Bl.).

*P. superficiale* var. *semilinearis*, Clarke, Ferns of N. India, p. 558 (1880).

*P. subhemionitideum*, Chr. in Bull. Herb. Boiss. vii, p. 5 (1899).

Sori per totam aream frondis irregulariter dispersi.

INDIA. Nepal (Wallich. n. 274, partim, s.n. *P. longifrons*) ; Bhotan (Griffith).

MELANESIA. New Guinea : Bismarck Mt. (R. Schlechter, n. 13,920).

CHINA. Yunnan : Mengtsz (Hancock, n. 98 ; Henry, n. 9265B).

FORMOSA. Bankingsin Mts. (Henry, n. 1489).

Monstr. *anomalum*, (Christ) Takeda.

Syn. :—*P. anomalum*, Chr. in Bull. Herb. Boiss. vi, p. 201, tab. iii, fig. 3, a-d (1898).

*P. heterolobum*, C. Chr. Ind. Fil. p. 532 (1906).

LUZON. Mt. Data, 2250 met. (Loher).

This is only a monstrous form of this plant. The tendency to lobing of the frond is occasionally met with in several species of this genus such as *P. excavatum* (v. *supra*), *P. ovatum*, *P. leucosorum*, *P. trisectum*, *P. pteropus*, and *P. hastatum*. This phenomenon is very interesting, as it shows how the pinnatifid forms of *Polypodium* have been derived from the simple-leaved forms.

*β. marginale*, Takeda, var. nov.

Differt a typo sori marginem frondis versus aggregatis, ita frons secus costas nuda.

CHINA. Yunnan : Mengtsz (Henry, n. 9265A) ; Yung-chang, 5000 ft. (Henry, n. 13,340).

#### 18. *P. ensatum*, Thunberg.

This fern is not uncommon in the warmer parts of Japan, growing on rocks in wet shady localities. As is the case with *P. normale*, the sori are sometimes uniseriate, but sometimes bi-, tri- or multi-seriate on each side of the midrib, with the result that they become more or less irregularly distributed.

This species has several times been recorded from China in various floristic works.\* However, there seems to have been some confusion with *P. ovatum*, Wall., and the true *P. ensatum* appears to be of rather rare occurrence in China. So far as I know, the only specimens I can safely refer to *P. ensatum*, Thunb. were collected in Milé District, Yunnan (Henry, n.

\* Christ in Bull. Acad. Intern. Geogr. Bot. xi, p. 210 (1902) ; Diels, Fl. Centr. China, p. 203 (1900) ; Matthew in Journ. Linn. Soc. xxxix (1911).



9896). However, these particular specimens have been described as a distinct species under the name of *P. oligolepis*, Baker.\* Although that author considers his fern as allied to *P. hemionitideum*, Wall., it actually represents *P. ensatum*, Thunb. with uniseriate sori.

#### 19. *P. ovatum*, Wall.

This species gives an extraordinary case of variation in the shape of the frond, which has led Christ to create a new specific name—*phyllomanes*.† The writer does not, however, see any reason why a new name should be used instead of the well-known old name—*P. ovatum*. It is true that those peculiar forms have been described as different species, yet it is difficult to find any necessity to propose a new name when all those forms are united into one species. If such a practice be carried out, there would be introduced a great number of new names into the already complicated fern-nomenclature. However, I cannot doubt but that Christ is quite correct in uniting all those monstrous forms into one, notwithstanding the fact that the peculiar shape of the fronds has led other botanists to regard them as distinct species.

*P. ovatum* occurs in N. India, including Bhotan, Nepal, Sikkim, Khasia, and Manipur. It is, however, in China that the monstrosity has been found.‡ All the specimens but one or two which I have examined from China are quite normal and do not show the tendency to produce lobes. This species is closely related to the preceding; it differs, however, in the broad base of the frond and the more commonly multiseriate sori. The following specimens from China have been examined:—

Chekiang: Ningpo (Hancock, n. 8, Faber, Aug. 1885); Hupeh: without special locality (Henry, n. 7879), Ichang (Henry, n. 3123, 3279 §), Changyang (Wilson, n. 437); Kiangsi: Kiukiang (Shearer, 1873); Szechwan: Mt. Omei (Wilson, n. 5320, Faber, n. 1095 ||); Yunnan: Szemao (Henry, n. 10,078E), Mengtsz, shady rocks at from 5500–6700 ft. (Hancock, n. 55); Feng-chen Lin Mts. forest, 6800 ft. (Henry, n. 10,078c); Kwangsi: Lungchow (Morse, n. 72).

This species occurs also, but seldom, in Madagascar; a specimen with young thin fronds has been described as *P. Lastii*, Bak.¶

\* Kew Bull. 1898, p. 231. Also cf. the present paper, p. 307.

† Bull. Acad. Intern. Geogr. Bot. xi, p. 210, cum fig. (1902).

‡ *P. Rosthornii*, Diels (Engl. Bot. Jahrb. xxix, p. 205 [1900]) is probably one of the forms.

§ The type specimen of *P. deltoideum*, Bak. in Journ. Bot. 1888, p. 230.

|| This specimen has been recorded by Diels as *P. ensatum*. See Engl. Bot. Jahrb. xxix, p. 203 (1900).

¶ Baker in Journ. Bot. 1891, p. 5 (fide spec. original. in hb. Kew.).

20. *P. Buergerianum*, Miquel.

This fern has been recorded from China simply because *P. brachylepis*, Baker, which had been described from China, was reduced to *P. Buergerianum*, Miq.\* Although this reduction was made by Mr. Baker himself, it is by no means correct, since his *P. brachylepis* was actually established on a specimen (probably young) of *P. superficiale*, Bl.†

The true *P. Buergerianum*, Miq. was really first recorded from China by Hooker,‡ but, unfortunately, since he mistook it for *P. superficiale*,§ the specimens were referred to as the latter plant; this has been confirmed by an examination of the original specimens.

Since Hooker's mistake the true *P. Buergerianum*, Miq. has always been called in Japan *P. superficiale*, Bl.; and the same error has been repeated by Luerksen.||

*P. Buergerianum* differs from *P. superficiale* above all by the rammenta on the rhizome, which are ovate-lanceolate, long-acuminate, ciliato-dentate, and more or less patent, by the frond gradually attenuated below, and by the stipe short, narrowly winged with the decurrent base of the frond.

So far I have not been able to discover any specimen of the true *P. Buergerianum* from any other locality in China, except Hongkong and Macao, but it occurs in several places in the south and south-west of Japan, and is also distributed as far as Tonkin, as will be seen in the following citation:—

*P. Buergerianum*, Miq. amplif.a. *stipitatum*, Takeda.

Syn.:—*P. Buergerianum*, Miq. Prol. Fl. Japon. pp. 334, 389; Bak. New Ferns, etc. p. 92, excl. syn. (1891).

*P. superficiale*, Hook. Sp. Fil. v, p. 71, quoad pl. ex Tsushima et Hongkong; Hook. Bak. Syn. Fil. p. 355, quoad pl. ex Tsushima et Hongkong; Luerksen, in Engl. Bot. Jahrb. iv, p. 360 (1883), et auct. Japon.

JAPAN. Tsushima (Wilford, n. 873); Hachijō (Dickins); Nagasaki (Faurie, n. 15,641).

FORMOSA. Tamsui District (Hancock, n. 28 ¶).

\* Baker, Summary of New Ferns, etc. in Ann. Bot. v, p. 475.

† Under the description of *P. brachylepis*, in Gard. Chron. n. ser. xiv, p. 494 (1880), the author states that his fern is "allied to *P. irioides* and *superficiale*." The plant has, however, no relationship with *P. irioides*.

‡ Species Filicum, v, p. 71.

§ Hooker, l.c. quoad pl. ex Hongkong et Tsushima, fide spec. in hb. Kew.

|| Engl. Bot. Jahrb. iv, p. 360 (1883).

¶ The specimen has been recorded by mistake as *P. normale* var. *sumatranum*, in Journ. Bot. 1885, p. 106, n. 25.

CHINA. Hongkong (Wilford, n. 38) Macao (Harland).

TONKIN. "Mont Bavi, au dessus de Van-Maou vers 800 mètr. d'altitude" (Balansa, Jul. 1880).

β. *ningpoense*, (Bak.) Takeda.

Syn.:—*P. ningpoense*, Bak. in Ann. Bot. v, p. 474 (1891).

Differt a typo solum frondibus sessilibus.

CHINA. Chekiang: Ningpo Mountains, on trunks of trees in deep shady glens (Hancock, n. 24); Kiangsi: Kiukiang (Shearer, 1873).

This variety, which was originally described as a distinct species, differs from the type merely by the strictly sessile frond; even in the type the length of the stipe varies to a certain extent.

## 21. *P. subhastatum*, Bak.

This interesting fern was described from China first by Baker, in 1889, under the name of *P. subhastatum*,\* and again by Christ, in 1902, as *P. hederaceum*.† When describing his fern, Baker pointed out that the species comes "midway between *P. rosstratum* and *P. Spectrum*." *P. subhastatum* has, however, no connexion with these two species whatever, but is, in fact, closely related to *P. Buergerianum*. Also his description of sori "placed in a single row midway between the midrib and margin in the upper part of the frond" requires correction. As a matter of fact, the sori are not regularly arranged as described, but are scattered sometimes over the whole under-surface of the frond. Christ rightly compares his *P. hederaceum* with *P. Buergerianum*, but from his statements I gather that the specimens of *P. Buergerianum* he had at his disposal must have been very poor, hardly representing the typical form, while his specimen from Higashiyama, Kyôto, appears to have been not the true *P. Buergerianum*, but a variety of the present species, known to the Japanese botanists as *P. Buergerianum*.

Franchet and Savatier cite on the authority of Ito Keiske, the Japanese name "Yanoneshida" under *P. Buergerianum*, Miq. enumerated in their publication.‡ This is certainly not correct; but how this mistake originated is not clear. However, the same mistake had been repeated by Makino §; this gave occasion to Japanese botanists to apply the wrong name to the fern with the local name of "Yanoneshida."

As has been said above, *P. subhastatum* is allied to *P. Buer-*

\* Journ. Bot. 1889, p. 177.

† Bull. Acad. Intern. Geogr. Bot. xi, p. 215 (1902).

‡ Enum. Pl. Japon. ii, p. 245 (1876-79).

§ Tôkyô Bot. Mag. 1896, p. 180; Ej. Phan. et Pter. Japon. Ic. Ill. sub tab. xxxiii (1899).

*gerianum*. It differs, however, from the latter above all by the frond, which abruptly narrows into a long, broadly-winged stipe, and also shows a tendency to become repand or more or less pinnatifid on the margin. The texture is thinner than in *P. Buergerianum*.

Our plant is distributed over Japan and China. There can be distinguished two forms as diagnosed below :—

*P. subhastatum*, Baker in Journ. Bot. 1889, p. 177, amplif.

*a. hederaceum*, (Christ) *mihi*.

Syn. :—*P. hederaceum*, Christ in Bull. Acad. Intern. Geogr. Bot. xi, p. 215, cum fig. (1902).

Frondes et steriles et fertiles ovato-deltoidae, basi dilatatae, plus minus cordatae, fertiles raro quam steriles angustiores.

CHINA. Hupeh : without special locality (Henry, n. 5450).

*β. longifrons*, *mihi*, var. nov.

Syn. :—*P. Buergerianum*, auct. Japon. non Miq.

Frondes steriles oblongo-ovatae, saepe minus cordatae, fertiles quam steriles plerumque multo longiores angustioresque, elongatae ad vel raro supra 20 cm. lg., basi plus minus cuneatae.

JAPAN. Without locality (ex hb. Coll. Sc. Imp. Univ. Tôkyô) ; in monte Higanesan (H. Takeda) ; also frequent in the south-west.

## 22. *P. superficiale*, Blume.

This fern was described and excellently figured by Blume in 1828. While all the records of the occurrence of this species in Japan have, without exception, been erroneous, the true *P. superficiale* is widely distributed over China, India, Java, Sumatra, etc.

This species resembles *P. Buergerianum* so strongly that these two have often been confused by not a few pteridologists. However, the larger size and thicker texture of the frond, the longer stipe with the basal portion quite unwinged, and, above all, the large pale brown, ovate, obtuse ramenta more or less appressed in the rhizome would readily distinguish the present species from *P. Buergerianum*, Miq.

The identity of *P. brachylepis*, Bak. with *P. superficiale*, Bl. has already been pointed out under *P. Buergerianum*, Miq. The same species has also been described by Baker in 1880 as *P. normale* var. *sumatranum*, and again in 1898 by Christ under the name of *P. nigrocinctum*. The latter author distinguishes his plant by means of the thicker texture, the shorter and broader, almost oval-shaped frond, and so forth. However, these