

## THE TREE-FERNS OF THE MALAY PENINSULA

By R. E. HOLTUM

The tree-ferns of the Malay Peninsula all belong to the family Cyatheaceæ. Dicksoniaceæ is represented only by *Cibotium*, which, with its creeping stem, can hardly be called a tree-fern. *Dicksonia Blumei* occurs in Borneo and in Sumatra, but has not so far been found in the Peninsula. It is hardly likely to be found now, as fairly intensive collecting has been done in localities where it might be expected to occur. It is only during the past few years, however, that so widely distributed and conspicuous a fern as *Osmunda javanica* has been found in the Peninsula, so it is just possible we may still find *Dicksonia Blumei*, which can be as large and handsome as our largest Cyatheas.

In this paper I follow Copeland in including *Alsophila* and *Hemitelia* in *Cyathea*. It is quite clear that no natural separation of this group of ferns can be made on indusial characters, and to decide what other characters might be used as a basis of division would require the study of the genus *Cyathea* as a whole, a task which I cannot attempt. Of the genus *Cyathea* in the broad sense, sixteen species are here described as occurring in the Peninsula, and also a new variety of one of them (*C. latebrosa*). Of these species, one is described as new (*C. excavata*), and one (*C. ampla*) has not previously been reported. One (*C. obtusata*) is rather a dubious species, not adequately known, and two others (*C. obscura* and *C. Burbridgei*) ought possibly to be reduced to varieties. The status of all the species has been critically considered, and type specimens of almost all have been examined. Special attention has been given to *C. glabra*, a very variable species. The new combination *Cyathea gigantea* is made.

A comparative survey of all species of *Cyathea* in the Malayan region is certainly needed, but I cannot at present undertake that task; the number of species is very large, and for an effective survey the types of all would have to be examined. Many of the published descriptions are such that one cannot be reasonably sure of the identity of specimens from them; and indeed the best descriptions are hardly adequate when one is dealing with so great a number of species, which yet have all a very similar general aspect, and where considerable variation in one character or another may occur. One can find variable characters only by examining a number of specimens of the same species. I have therefore come to the conclusion that it is better in the first place to deal as adequately as possible with the Peninsula species, of which I have a considerable number



of specimens for examination, and almost all of which I know in the field. A careful description of these may be helpful to others working on this group; and for local use the collecting of the available information into one paper will be of value.

The large number of species in this family of ferns, which there is every reason to regard as relatively primitive, is very remarkable, and a study of their individual distribution would be instructive. Unfortunately, before this can be effectively undertaken, a full systematic survey (as above indicated) is necessary. It is fairly clear that a number of the species are of restricted distribution, and it is probable that most of these are confined to mountains, while the species that will tolerate lowland conditions are of wider distribution. The great wealth of species, and the variation which occurs in the widely distributed species, are indications that the family is still a vigorous one. An analysis of the family from a phylogenetic standpoint has never been attempted, and the great majority of the species have never been examined further than the barest external features such as are usually found in systematic descriptions. How much variation in soral development may occur is not known; a casual inspection suggests that there is not much, but a thorough examination might reveal some interesting points hitherto overlooked. My own impression is that the scales on the stipe-bases are likely to be the best single character for discrimination of phyletic relationships within the group, venation probably coming next.

Sixteen species probably represent less than 10% of the number of Cyatheas described as occurring in the Malayan region; and even allowing for a fair proportion of the latter being reduced, we still have a poor representation of the family as compared with Sumatra. This is no doubt largely due to the lack of high mountains in the Peninsula. In Sumatra there is a large area of good forest between 6,000 and 8,000 feet above sea level, a forest exceedingly rich in ferns of all kinds, whereas there is very little high forest in the Peninsula at a similar altitude. There may yet be a few more species of tree ferns still to be found in the Peninsula, but I think the number will not be greatly increased.

Tree ferns are not numerous and conspicuous objects in the landscape except in rather open places on the hills, especially near streams; and here the gregarious and conspicuous species is *C. contaminans*, which is the largest of all our tree ferns, with very massive erect trunks and large crowns of fronds. All the other species are smaller in stature. The other really common species is *C. latebrosa*,



which is quite abundant in low country and mountains alike, at least up to 4,000 feet. It has a more slender trunk than *C. contaminans* and does not usually grow in quite such exposed places. It is often found near streams in fairly open forest or in secondary growth, but not often in large numbers, so that it never gives massed effects like *C. contaminans*. *C. squamulata* is not uncommon in rather more moist and shady lowland forest; also *C. brunonis*, which is so small as hardly to be called a tree fern. Species which only occur in mountain forest are *C. recommitata*, *C. Kingii*, *C. excavata* and *C. obscura*. *C. glabra* is found both in lowland and mountain forest, and varies much in degree of incision of the pinnules; perhaps altitude and other environmental factors may be partly responsible for this variation. *C. gigantea* is only found in the extreme north of the Peninsula, and is there at the southern limit of its distribution. *C. tripinnata*, found on Pulau Tioman, but not yet on the mainland of the Peninsula, was first found in Luzon, and then North Borneo; Pulau Tioman is perhaps its most westerly position. On Mt. Kinabalu it is frequent and very massive in growth at about 5,000 feet altitude, so that it might quite possibly find a suitable home in the Peninsula.

It is not possible to give complete information about the distribution beyond the Peninsula of the species here concerned, as the published data are inadequate. The following summary is of a general nature only.

- C. latebrosa* is widely distributed from India throughout the Malayan region.
- C. squamulata*, *C. contaminans* and *C. glabra* have a wide distribution within the Malayan region.
- C. Brunonis* and *C. recommitata* are known to occur in Borneo and Sumatra.
- C. obscura* and *C. Kingii* are known to occur in Sumatra.
- C. alternans*, *C. Burbidgei*, *C. ampla* and *C. polypoda* are known to occur in Borneo.
- C. tripinnata* has been found in Luzon, British North Borneo and Pulau Tioman.
- C. glabra* is distributed from the Himalayas southwards to Penang.
- C. obtusata* and *C. excavata* are only known to occur in the Peninsula.

Of the last species, *C. obtusata* is apparently closely allied to *C. latebrosa*, but is incompletely known. *C. excavata* appears to be a very distinct species, and has so far been found only in the neighbourhood of Cameron's Highlands, on the Main Range.



The distinction of the commoner Peninsula species of *Cyathea* is not difficult. One has only to look at the base of the stipe to be able to recognise at a glance *C. contaminans*, *C. latebrosa* and *C. squamulata* (including its near allies *C. obscura* and *C. Burbridgei*). The presence or absence of thorns, the characters of the scales and the colour of the stipes are indeed always important in distinguishing species of *Cyathea*, and without the base of the stipe it is often difficult to be sure of a species. The abundance and character of scales and hairs on the rachises, costæ and costules are also important, and a rather high magnification, beyond the scope of the pocket lens, is necessary to distinguish clearly the smallest scales. As regards the lamina, characters of the base and apex may be useful, but for most purposes I find that the only safe method of comparison is between the largest pinnæ of full-size fronds. In some species, particularly *C. glabra* among those here described, the variation in cutting of the pinnules is considerable; in others, other characters may be variable, such as the indusium in *C. Brunonis*. Venation, texture, colour and characters of the paraphyses and indusium (if present) are also important.

In most cases, I have examined considerable numbers of specimens of each species, nearly all from within the Peninsula, but in some cases from a wider area. I have been led on the whole to a rather broad interpretation of the species, on account of the obviously considerable variation in some cases, notably in *C. glabra* and *C. squamulata*. If one could choose a few isolated specimens, it would be easy to make several species from each of these, but having regard to the whole range of variation, I cannot see where to draw lines of division. I am sure that environmental conditions have a good deal to do with characters of size and texture. I may add that I have myself examined nearly all the species concerned in the field, and some of them in cultivation.

*Cyathea* plants do not usually bear sporangia until they have reached their fully adult size of frond, but there are exceptions to this rule. It may occasionally happen that small simply pinnate fronds of young plants are fertile. I have seen this condition in *C. squamulata* and *C. obscura*. *C. parvifolia* Holttum, described before I realised that such a thing could occur, is an immature form, probably of *C. squamulata*. I believe that *C. bipinnatifida* Copel. (Phil. Journ. Sci. 56: 97. 1935) is a similar case.

The limitation of certain species to mountains may be due to the specialised conditions necessary for the development of their gametophytes. I have now in cultivation in Singapore, growing reasonably well, *C. contaminans*, *C.*



*recommutata* and *C. tripinnata*, none of which have ever been found in lowland localities, at least in the south of the Peninsula; it is therefore not because they cannot exist in the lowlands. The conditions for the germination of the spores and growth of prothallia are evidently more specialised than those necessary for the growth of the mature sporophytes. Similarly, *Platyserium grande*, not uncommon in the extreme north of the Peninsula, grows quite well in the Singapore Botanic Gardens but, though it must produce countless spores, no young plants of it have ever been found; the reason is probably climatic. Other species will grow well here when introduced as mature plants, but never have spores; among these is *Polypodium ellipticum*.

The descriptions in this paper are taken from specimens in the Singapore Herbarium, except where otherwise indicated. An attempt has been made to make them as comprehensive as possible.

The Peninsula specimens which I have examined are listed at the end of each description. Recent collections made by the staff of the Singapore Botanic Gardens are numbered in a series of *Singapore Field Numbers*; these are cited as *SFN* with the collector's name in brackets afterwards. Similarly, the Forest Department's collections are cited *Forest*, with the collector's name in brackets. Ridley had his own series of numbers, and so had the Federated Malay States Museums. For reference to other Collectors and localities, the reader is referred to Burkill's paper in this Bulletin, Vol. IV pp. 114-202 (1927).

### Key to the Species described in this Paper

This key is intended primarily for the assistance of field workers, and the characters chiefly used in separating the main divisions of the key are those of the stipe-base; these are easily recognised in the field, and are also very distinctive. A key based chiefly or only on pinnæ would be much less certain of application.

The field worker is advised to look for and collect fronds which have just reached maturity, as old fronds often lose their scales. In some species (e.g. *C. excavata*) the scales fall very early, and it is necessary to look for them on unexpanded fronds. When the scales fall, they usually leave small raised bases, which give a roughness to the base of the stipe; in some species these rough bases are prolonged into short thorns. The important characters



of the scales can easily be distinguished with a pocket lens: those of the *C. squamulata* group have very short stiff hairs or setæ regularly arranged along their edges; the scales of *C. latebrosa* and others have smooth edges; and the scales of the *C. glabra* group are dark with thin pale edges. The characters of the small scales on the costæ (pinnule midribs), costulæ and veins can only be seen when more highly magnified.

The inclusion of *C. obtusata* under the heading "base of stipe shortly thorny" is conjectural, but in view of its agreement with *C. latebrosa* in other respects, one may reasonably expect an agreement in stipe characters also.

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|--|--------------------------|
| Pinnæ simple, subentire .. .. .  | 1. <i>C. Brunonis</i>    |
| Pinnæ pinnatifid, or pinnate at base only ..   | 2. <i>C. alternans</i>   |
| Pinnæ pinnate or bipinnate—  |                          |
| Base of stipes strongly thorny, stipes glaucous (purple when old) .. ..                          | 3. <i>C. contaminans</i> |
| Base of stipes shortly thorny, stipes not glaucous—  |                          |
| Pinnules pinnate over most of their length .. .. .   | 4. <i>C. tripinnata</i>  |
| Pinnules with at most lowest one or two segments free—   |                          |
| Sori with minute scale on inner side only .. .. .  | 5. <i>C. latebrosa</i>   |
| Sori with complete cup-shaped indusium, costæ very scaly beneath ..                              | var. <i>indusiata</i>    |
| Sori with large scale on inner side, costæ with very few scales beneath .. .. .                  | 6. <i>C. obtusata</i>    |
| Base of stipes often rough when old, but not thorny—   |                          |
| Base of stipes subglabrous; below them a V-shaped row of large depressions in caudex .. .. .     | 7. <i>C. excavata</i>    |
| Base of stipes covered with a dense mass of medium brown scales, edges of scales with dark setæ— |                          |
| Secondary rachises and costæ scaly but not hairy beneath—  |                          |
| Texture distinctly coriaceous, scales at base of stipe only                                      | 8. <i>C. polypoda</i>    |
| Texture rather thin, scales throughout stipe—  |                          |
| Pinnæ to about 1.5 cm. wide—   |                          |
| Sori when mature distinct, not coalescing  | 9. <i>C. squamulata</i>  |
| Sori when mature coalescing and filling pinnules almost completely ..                            | 10. <i>C. obscura</i>    |
| Pinnæ to 2.5 cm. wide ..   | 12. <i>C. ampla</i>      |



- Secondary rachises and costæ very hairy beneath .. .. 11. *C. Burbidgei*
- Base of stipes rather sparsely scaly, the scales very dark, with pale edges—
- Base of stipes bearing a few small pinnæ .. .. 13. *C. recommutata*
- Base of stipes without pinnæ—
- Lobes of fertile pinnæ much narrower than sterile .. 14. *C. Kingii*
- Lobes of fertile and sterile pinnæ similar—
- Pinnules distinctly stalked, veins 3-5 pairs .. .. 15. *C. glabra*
- Pinnules sessile, veins 5-6 pairs .. .. 16. *C. gigantea*
1. *Cyathea Brunonis* Wall. Hook. Spec. Fil. 1: 15. 1844.  
*Schizocaena Brunonis* J. Sm. Hook. & Bauer Gen. Fil. t. II. 1838.

*Stock* usually short, occasionally 50 cm. or more high. *Stipes* rather dark, slightly roughened when scales have fallen, with numerous scales at the base; *scales* to about 3 cm. long by 3 mm. broad, medium brown, the edges with short oblique dark setæ. *Fronde* pinnate, the apical pinna usually like the others, and all pinnæ articulate to the rachis. *Pinnæ* sessile or on stalks to about 4 mm. long (occasionally to 7 mm.), 12 to 28 cm. long and 2 to 4 cm. wide, the base rather unequally cuneate or truncate, the apex acuminate, the edges entire, toothed towards the apex, occasionally the edges somewhat lobed; the edges almost parallel for the greater part of their length, or converging gradually over half the length; *veins* in groups of 3 to 5, the basal one on the side towards the rachis often springing directly from the midrib of the pinna, occasionally a single simple vein about half-way between two groups; *scales* on lower surface of midribs of pinnæ, and occasionally also on veins, few, small, narrow, ciliate; *sori* in 2 or 3 irregular rows on each side of midribs of pinnæ, indusia thin, covering young sori, usually appearing cup-shaped in mature sori, sometimes forming only a narrow ring at the base of the sori; *paraphyses* dark, shorter than the sporangia.

TYPE: Penang, Wallich 179.

In Christensen's *Index Filicum* the species *C. Brunonis* is referred to *C. moluccana* R. Br. (an earlier name). I have not seen the type of the latter species, which came from the Moluccas. In view of the fact that there are a group of species of simply pinnate habit, it is quite likely that Peninsula and Molucca plants are different, and I prefer to use the name *C. Brunonis*, the type of which is from the Peninsula, pending further evidence of the status of *C. moluccana*.



I have examined the type of *C. Brunonis*, in the Kew Herbarium. The upper pinnæ are sessile, the lower stalked; the indusia are fully developed; there is a single vein between the groups; the apical pinna is like the rest.

Several closely allied species have been described from Borneo, but in view of the undoubtedly considerable variation of *C. Brunonis* in the Peninsula it appears probable that these species (except *C. capitata*, which is very distinct) will have to be reduced in number when fuller collections are available. Without examination of representative collections of ferns of this alliance over a wide area, it is not possible to say exactly what is the range of *C. Brunonis*.

PENANG: Wallich 179 (Type, at Kew). Bishop Hose, s.n. April 1879; Top of hill, Ridley 7036.

KELANTAN: Batu Panjang, S. Keteh, SFN 12091. (Md Nur).

PAHANG: Tahan River, Ridley s.n. 1891; Wray's Camp, G. Tahan, Ridley 16214; G. Tahan 3,300 feet Wray & Robinson 5379; Teku, G. Tahan, SFN 8038 (Haniff & Nur); near Kota Glanggi S.F.N. 22508 (Henderson); The Gap, 3,000 feet SFN 8826, 11399 (Holtum).

PERAK: near Taiping 1,000 feet Scortechini 239; Gopeng, King's Coll. 475; Larut 300-1,000 feet King's Coll. 4885; Bidor near Tapah Ridley s.n.; Maxwell's Hill 2,500 feet SFN 13217 (Burkill); Taiping hill 1,000 feet F.M.S. Mus. 10201 (Henderson), 600 feet F.M.S. Mus. 10098 (Henderson).

SELANGOR: Kuala Lumpur, Native Coll. 3540 (Ridley); Ginting Sempah F.M.S. Mus. 9547, 9548, 9562, 9793 (Hume); Rantau Panjang F.M.S. Mus. 7617, 7673 (Hume); Semenyih F.M.S. Mus. 7889 (Hume); Sungei Buloh F.R. Forest 13907, 14610 (Strugnell); Sungei Lalang, Kajang, Forest 22813 (Symington).

NEGRI SEMBILAN: Sungei Ujong, Hullett s.n. Aug. 1880; Bukit Kayu Arang, Alvins s.n. Jan. 1894; Perhentian Tinggi, Ridley s.n. Dec. 1898; G. Angsi 1,500 feet SFN 11535, 1,000 feet SFN 11519 (Md. Nur).

JOHORE: Woods, Batu Pahat, Ridley 11061; 7th mile from Kluang SFN 9263 (Holtum).

MALACCA: Cuming 378; Sungei Udang Reserve, Derry 92; Bukit Bruang, Ridley s.n. Apr. 1891; Jasin to Chabau, Ridley s.n. 1892; Bukit Toongull Ridley 4403.



2. *Cyathea alternans* (Wall.) Pr. Abh. Bohm. Ges. V. 5: 347. 1848. *Polypodium* Wall. Cat. (nomen).

*Stipes* dark, scaly at the base, the scales to 3 cm. long by 2 mm. wide, dark brown, the edges with short oblique setae. *Rachises* dark to medium brown, almost glabrous below, appressed hairy above. *Middle pinnæ* to about 40 by 9 cm., more often about 25 by 5 cm.; lowest pinnule (or a few pinnules) free, sessile, others with the lamina more and more broadly joined to the costa; distal part of pinnæ (almost the whole pinnæ of smallest fronds) lobed about  $\frac{3}{4}$  to costa, the segments or pinnules about 7 to 8 mm. wide, entire or the largest crenate or toothed towards the apex, slightly oblique, slightly or hardly falcate, the apex rounded or in the largest fronds sometimes acute, usually very close, sometimes slightly overlapping; *veins* in each lobe or pinnule about 10 pairs or more, forked or the basal ones often more copiously branched; on costae and veins beneath are a few *hairs* and also narrow to ovate acuminate usually pale *scales* with setose edges; *sori* in a single row on each side of costae, rather nearer costae than edge, indusium a thin cup, sometimes reduced to a narrow ring at the base of the sorus; *paraphyses* numerous, hardly exceeding the sporangia.

TYPE: Wallich 329, Penang.

This is a fern of lowland forest, not known in the extreme south of the Peninsula, and apparently rather local in its occurrence. In some places, as on parts of Penang Hill, it is fairly abundant. I have never seen a plant with a trunk more than 1.50 m. high. The species also occurs in Borneo. A collection from Mt. Kinabalu (Clemens 29160) appears to be quite without indusium.

PENANG: Hullett s.n. Dec. 1881; Curtis 10139; Government Hill, Road to Penara Bukit, Curtis s.n. Oct. 1898, Ridley 7152; Penara Bukit, Ridley 7151; Penang Hill 2,000 feet SFN 19341 (Holttum).

PERAK: G. Bubu, Cantley s.n. Jan. 1885.

KELANTAN: Ulu Sungei Keteh SFN. 12269 (Md. Nur).

SELANGOR: Kuala Lumpur Ridley 10173; Petaling 10 mile, Ridley s.n. June 1889; Ginting Sempah F.M.S. Mus. 9635 (Hume).

NEGRI SEMBILAN: G. Angsi 2,600 feet SFN 11635 (Md. Nur): G. Angsi, SFN 9919 (Holttum).

3. *Cyathea contaminans* (Wall.) Copel. Phil. Journ. Sci. 4C: 60. 1909. *Polypodium contaminans* Wall. Cat. (nomen); *Alsophila* Hk. Spec. Fil. 1: 52. 1844. *Chnoophora glauca* Bl. (not *Cyathea glauca* Bory).



*Stipes* stout, strongly thorny, purplish, glaucous, glabrous when mature; very young stipes clothed with pale narrow scales with dark short setæ on edges. *Rachises* as stipes, the upper parts less strongly thorny, but even secondary rachises somewhat prickly, hairy on the upper surface. *Middle pinnæ* to about 60 cm. long by 25 cm. wide. *Pinnules* of middle pinnæ to about 15 by 2 to 3 cm., sessile, the base truncate, the apex acuminate, the edges lobed almost to the costæ, the basal lobe free; lobes about 3 mm. wide, slightly oblique and slightly falcate, edge entire or slightly crenulate, apex rounded; *veins* about 10 to 12 pairs, forked or the basal ones with 3 branches; *texture* thin but firm; lower surface glaucous; costæ, costules and veins beneath quite glabrous, or occasionally with a few hairs or a few pale bullate fimbriate scales; *sori* near costules; no indusia; short *paraphyses* present among the sporangia, those at the base forming a ring somewhat resembling an indusium.

TYPE: Penang, Wallich 320.

This is the common tree fern on the hills, growing especially in open places and by streams. It is the largest of all the tree ferns in the Peninsula, in thickness and height of trunk and in size of fronds. It is widely distributed in the Malayan region.

PENANG: Penang Hill 1,000 feet June 1885 coll.?; Hullett s.n. Dec. 1880; 2,500 feet King's Coll. 1280.

KEDAH: G. Raya, Langkawi, 2,500 feet Haniff 15543.

KELANTAN: Kuala Bedong SFN 10393 (Haniff & Nur).

PERAK: Scortechini, no locality, several sheets; Lumut, Ridley 7272 (young plant); Cottage, Ridley s.n. (small plant, fasciated frond); Larut 300-800 feet King's Coll. 4032. G. Hijau, summit, 4,750 feet SFN 12883 (Burkill).

PAHANG: P. Tioman; Bukit Surin, 1,000-2,000 feet SFN 21711 (Henderson), Tanah Runto 1,300 feet SFN 18871 (Henderson), Path across island 1,100 feet Burkill s.n. June 1915. Fraser's Hill 4,000 feet SFN 8812 (Burkill & Holttum).

SELANGOR: 15th mile Pahang Track, Ridley 8633; Ginting Bidai, Ridley 7868; Ampang Reservoir, Forest 13984 (Strugnell).

JOHORE: Bukit Soga, Ridley 11066.

4. *Cyathea tripinnata* Copeland, Phil. Journ. Sci. Suppl. 1 p. 251. 1906.

*Stipe* dark, copiously short-thorny, the thorns about 2 mm. long, covered with a dense mat of small closely





*Cyathea latebrosa*. Two plants from Penang Hill: (above on left) Haniff 9109, (right) Hullett, Dec. 1881,  $\times 1.25$ .



appressed scales, the smallest ones pale irregular, the larger ones lanceolate with dark acuminate tip, stiffly ciliate laterally or not. *Rachises* dark, shortly thorny (including the secondary rachises), with short appressed hairs on the upper surface, on the lower surface dense closely appressed irregular pale scales and larger medium brown scales with dark setose edge towards tip, the larger scales not appressed. *Middle pinnae* to about 60 by 18 cm. *Pinnules* of middle pinnae to about 9 by 2 cm., on stalks 2 to 3 mm. long, base slightly unequal, apex shortly pointed, about 10 pairs of segments free and stalked, gradually grading into sessile ones; the *free segments* about 2.5 mm. wide, on stalks about 1 mm. long, base slightly unequal, truncate to subcordate, of basal segments slightly broadened, apex blunt, edges crenate (basal segment with basal lobe sometimes almost free), almost at right angles to costae, the higher ones somewhat oblique; *veins* about 9 pairs, mostly forked, distinct; *texture* thin but firm; *scales* on costae beneath as on the rachises, scales on the costules rather pale with edges towards apex dark-setose, grading into pale bullate scales, fairly numerous; *sori* subcostular, indusia of the old sori thin, irregular.

TYPE: Mt. Mariveles, Luzon, Copeland 2068.

This species has not yet been found on the mainland of the Peninsula, but occurs on Pulau Tioman, the largest of the adjacent islands in the China sea. It has been found on Mt. Kinabalu in British North Borneo, where it is a very massive plant; the Pulau Tioman specimens are rather smaller, and were found at a much lower altitude.

PULAU TIOMAN: Bukit Telang, 800 feet, SFN 18584 (Henderson); Sedagong, 800 feet, a young plant, SFN 18617 (Henderson).

5. *Cyathea latebrosa* (Wall.) Copel. Phil. Journ. Sci. 4C: 52. 1909. *Alsophila latebrosa* Wall. Hook. Spec. Fil. 1: 37. 1844. *Alsophila brevifoliolata* v.A.v.R. Bull. Jard. bot. Buitenz. II ser. XX: 3. 1915. Plate 29.

*Stipe* dark, the base spiny, the spines numerous short stout; *scales* few except on young fronds, dark, rather narrow and thick, edge entire. *Rachises* dark to medium brown, subglabrous below, hairy above. *Middle pinnae* to about 60 by 20 cm. *Pinnules* of middle pinnae to about 11 by 1.5 cm., sessile or very shortly stalked, base broadly cuneate, slightly unequal, apex gradually narrowed, acuminate, or sometimes more shortly pointed, lobed to about 1 mm. from costa, lobes separated by 1/4 to 3/4 of their own width, 2.5 to 3 mm. wide, slightly oblique, slightly to moderately falcate, the apex rounded, edges slightly crenulate to sharply



toothed; *veins* about 10 pairs, mostly forked, all springing from the costule, slightly prominent below but not above; *texture* thin; *colour* varying from dark to pale, more usually dark; *scales* on costæ beneath lanceolate to ovate acute, edges entire, thin, medium brown to pale, sometimes quite abundant, sometimes few; scales on costules ovate flat to bullate, pale, entire, varying in abundance but never very numerous; *sori* close to costules, sometimes very crowded, the indusium a small dark scale on the inner side; *paraphyses* brownish, shorter than sporangia.

TYPE: Penang, Wallich 318.

This is the common tree-fern throughout the lowlands of the Peninsula; it occurs also on the mountains up to 4,000 feet or more. Ridley and Beddome give the name var. *ornata* to a form with pinnules up to 3 cm. wide, the segments deeply toothed and widely separated. This grades into the typical form, and in my opinion should not be separated. It is probably not the same as *Cyathea ornata* (Scott) Copel. from Sikkim. Possibly *C. inciso-serrata* Copel. is the same as Ridley's var. *ornata*.

I have seen at Kew a specimen of the type collection of *A. brevifoliolata* v.A.v.R., and in my opinion it is only a small plant of this species.

KEDAH: Langkawi Islands: Curtis s.n. Sept. 1890; G. Raya, SFN 7127 (Haniff & Nur). G. Jerai (Kedah Peak): 2,500–3,000 feet, Evans & Gordon 108; Native Coll. 4183, 4699. Gurun, Native Coll. 5163; Yan, Ridley 5177.

PENANG: Hullett s.n. Dec. 1881; Ridley 7080, 12599; Curtis 537, 3074, 10141; Top of Hill, Ridley 7150; Western Hill, 2,500 feet, SFN 9109 (Haniff).

PROVINCE WELLESLEY: Tasek Gelugur, Ridley 6965.

PERAK: Larut 3–4,000 feet, King's Coll. 2359; 4,500–5,300 feet, King's Coll. 7317. Kinta, 1,500–2,000 feet, King's Coll. 7154. Maxwell's Hill 3,000 feet, Scortechini 222,223. Taiping, Curtis 10134. G. Hijau, Fox s.n. Oct. 1899. Waterfall Hill, Taiping, Ridley 3060. Bujong Malacca, Ridley 9551. G. Keledang, Ridley 9548. Temengoh, Ridley 14207. Taiping Hill; 600 feet F.M.S. Mus. 10258, 1,400 feet F.M.S. Mus. 10198 (Henderson). Jor Camp, 1,800 feet F.M.S. Mus. 10802 (Henderson). Dindings: Lumut, Ridley 10295.

KELANTAN: Kuala Pertang, SFN 10367 (Haniff & Nur). Foot of G. Stong, SFN 12266 (Md. Nur). S. Ketch at Gua Ninek, SFN 19579 (Henderson).

PAHANG: Fraser's Hill, 4,000 feet: SFN 8794, 8825 (Burkill & Holttum); Eryl Smith 814, 901. Teku, G. Tahan, SFN 8040 (Haniff & Nur). Ulu Chineras, K. Lipis,



SFN 15683 (Burkill). Pekan, SFN 17124 (Burkill). G. Gedong (Tahan), 5,000 feet, Holttum s.n. Sept. 1928.

SELANGOR: Bukit Kutu, Ridley 7865, 7866. 15th mile Pahang Track, Ridley 8663. Batang Berjuntai, Ridley 7879 (or 7870 ?). Dusun Tua, Ridley 7862; Jackson's Estate, Gua Batu, Ridley 8141. Klang Gates, Ridley 13439. Rantau Panjang F.R., F.M.S. Mus. 7629 (Hume). Ginting Simpah 1,800 feet, F.M.S. Mus. 8797 (Hume). Kajang, Forest 24107 (Symington).

NEGRI SEMBILAN: Sungei Ujong, Hullett s.n. Aug. 1880. G. Angsi 1,000 feet, SFN 11523 (Md. Nur).

MALACCA: Ayer Keroh, Ridley 10785. Ayer Panas, Ridley 1659.

JOHORE: Tanjong Kupang, Ridley 6551 (var. *ornata*), 4400. Batu Pahat, Ridley 10981, 11068. Haji Senawi, Ridley 10966. G. Panti, Ridley s.n. Dec. 1892. Temoh River, Kota Tinggi, Ridley 15969. Tempayan River, Ridley 13279. Kluang SFN 9352, 9450, 9452 (Holttum). G. Pulau, SFN 7839 (Best).

SINGAPORE: Bukit Timah, Cantley s.n. July 1885. Ang Mo Kio, Ridley 6550. S. Morei, Ridley 6552. Chua Chu Kang, Ridley 6029. Chan Chu Kang, Ridley 6123. Macpherson Road, Ridley 8936. Bukit Panjang, Ridley 12535.

*Cyathea latebrosa* (Wall.) Copel. var. *indusiata* Holttum var. nov.

A typo differt: costulis dense squamulatis, soris indusiatis, indusiis cupuliformibus.

So far as I can see, this fern is quite identical with typical *C. latebrosa* except for the two points mentioned in the above diagnosis. The costæ of var. *indusiata* are very scaly instead of sparsely scaly, but the scales are identical. The indusia are thin and cup-shaped in mature sori, equally wide all round, or deeper on the costular side. *Cyathea longipinna* Copel. seems to be exactly like var. *indusiata* in scaliness, but without the large indusia; I would include it also as a variety of *C. latebrosa*. It is possible that *C. latebrosa* var. *indusiata* has already been described, but it is not among the many species I have examined, nor can I find it among the descriptions which I have consulted.

This variety seems to be a mountain plant in the Peninsula. It has been found at two localities on the Main Range at 4,000 and 5,000 feet, and on the summit of Gunong Muntahak in Johore. Owing to its similarity to typical *C. latebrosa*, it may have been neglected by collectors.



PAHANG: Cameron's Highlands, Path to Telom, 5,000 feet, SFN 23539 (Holtum). Fraser's Hill, 4,000 feet: F.M.S. Mus. 11315 (Henderson), SFN 11005 (Md. Nur).

JOHORE: G. Muntahak, 2,000 feet, SFN 19910 (Holtum).

6. *Cyathea obtusata* Rosenstock, Med.'s Rijks Herb. Leiden 31: 1. 1917. Plate 30.

*Stipes* unknown. *Rachises* pale, subglabrous below, appressed hairy above. *Middle pinnæ* to 50 by 18 cm. *Pinnules* of middle pinnæ 6 to 9 by 1.5 to 2.2 cm., sessile or the lowest slightly stalked, base truncate slightly unequal, apex shortly acute, lobed almost to costa; lobes very close together, 2.5 to 3.5 mm. wide, slightly oblique and slightly falcate, the apex rounded and very slightly toothed; veins about 7 to 10 pairs, mostly forked, all springing from costules; texture thin; colour of both surfaces rather pale when dry; scales on costæ beneath very few, on costules bullate, dark, not numerous, all entire; sori close to costules, indusia rather large, thin, irregular, flattened, usually broadest on the costular side.

TYPE: Perak, King's Coll. 7148 (cited erroneously as 1148).

This species appears to be closely allied to *C. latebrosa*. The differences are the pale colour of the specimens and the presence of indusia. If the indusia were absent, I should refer them to *C. latebrosa*; the pale colour might be due to the preparation of the specimens. It is likely that they may eventually be regarded as a variety of *C. latebrosa*, comparable with var. *indusiata*, but with few scales.

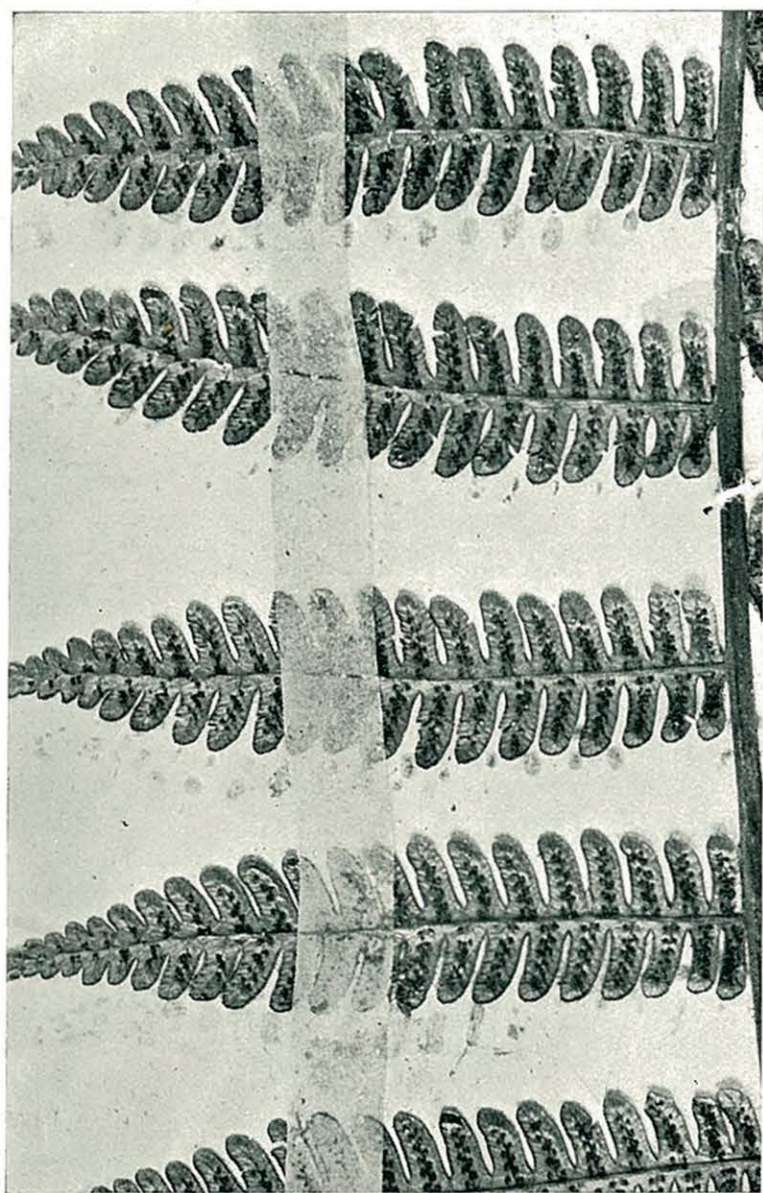
PERAK: Near G.M., 2,000 to 2,500 feet, King's Coll. 7148. Scortechini, no locality.

SELANGOR: Kajang, Forest 22874 (Symington); a doubtful specimen.

7. *Cyathea excavata* Holtum sp. nov. Plate 31.

*Caudex* sub stipitibus pneumatophoris magnis, profunde excavatis, c. 15, figura V instructis, præditus; pneumatophora stipitum distantiora, elongata, leviter excavata. *Stipites* in vivo virides, adulti fere glabri, frondium juveniliū circinatarum squamulati; squamæ fuscae, non nitidæ, tenues, integræ. *Rachides* in vivo virides, in sicco pallidæ, infra glabræ, supra pilosæ. *Pinnæ mediae* c. 50 cm. longæ, 16 cm. latæ; pinnæ infimæ reductæ. *Pinnulae* pinnarum mediarum c. 8 cm. longæ, 1.8 cm. latæ, sessiles vel brevissime stipitatae, basi inæquale, truncata, apice breviter acuto, marginibus fere ad costam lobatis; lobi intervallis latitudini





*Cyathea obtusata.* King's Collector 7148,  $\times 1.25$ .





*Cyathea excavata.* Holttum 23538,  $\times 1.25$ .





*Cyathea polypoda*. King's Collector 7129,  $\times 1.25$ .



suæ paribus collocati, c. 2.5 mm. lati, leviter obliqui, leviter falcati, apice rotundato, marginibus integris; *venulae* c. 10-12-jugatae, plerumque furcatae; *textura* tenuis; lamina supra et subtus glabra; *squamulae* costarum et costularum paucae, tenues, applanatae, irregulares, brunneae vel pallidae; *sori* ut videtur pauci, prope costam, in venulis infimis sedentes; indusia sororum senilium tenuia irregularia, late aperta.

PAHANG: Cameron's Highlands, 5,000 feet, SFN 23538 (Holttum, TYPE); Cameron's Highlands, 4,800 feet, SFN 17802 (Henderson). Telom, Ridley 13932.

This very distinct species has so far only been found in the neighbourhood of Cameron's Highlands. Fully fertile fronds are much to be desired; those so far obtained are only very sparsely fertile with old sori only. The deeply excavated pneumatophores at the base of each frond are a very striking feature in the field, but are not likely to be well represented in herbarium specimens; the thin entire sparse scales are also distinctive.

8. *Cyathea polypoda* Baker Trans. Linn. Soc. II Bot. 4: 250. 1894. *C. kemberangana* Copel. Phil. Journ. Sci. 12C: 52. 1917. Plate 32.

*Stipe* pale to medium brown, the base darkened and roughened; no scales on material from Malay Peninsula, but on Kinabalu specimens base of stipe densely clothed for a short distance with pale scales, the edges shortly dark-setose. *Rachises* smooth and pale beneath, with pale stiff appressed hairs above. *Largest pinnae* to about 40 by 16 cm. *Pinnules* to about 8.5 by 2 cm., on stalks 1 to 6 mm. long, articulated at base, the base truncate and slightly unequal, the apex rather shortly pointed, the edge lobed 2/3 or occasionally 3/4 to the costa, the lowest lobes the deepest and sometimes the lowest basal segment nearly free; the lobes 4 to 5 mm. wide, slightly oblique, slightly falcate, rounded at apex, edges slightly toothed; *texture* decidedly coriaceous; *veins* up to about 7 pairs, on the larger segments usually several pairs forked, lowest basiscopic vein springing directly from the costa. Upper surface usually drying dark, lower pale. *Scales* on costae and costules below linear-lanceolate, stiff, medium brown, shining, the edges provided with stiff setae; scales on costules bullate. Costae and costules hairy above like the rachises. *Sori* medial, exindusiate, with dark paraphyses about equal in length to sporangia, or a little longer.

TYPE: Kinabalu, Haviland 1479, at Kew.

I have examined the type of this species. It is a single pinna of a young frond. Indusia are lacking, although Baker states that small indusia are present. The form,



venation and scales are in exact agreement with specimens collected by me on Kinabalu and stated by Christensen to agree with *C. kemberangana* Copel. The Peninsula specimens are rather smaller than those from Kinabalu, but are otherwise identical. This species is clearly allied to *C. squamulata*, differing in the distinctly coriaceous texture, less falcate pinnule-lobes, longer pinnule-stalks and in the relatively small number of scales at the base of the stipe; the rather short brown paraphyses also distinguish it from most specimens of *C. squamulata*, but there are exceptions to this (see remarks under *C. squamulata*). *C. polypoda* is evidently a fern of exposed mountain tops and ridges, as opposed to the rather shade-loving and usually lowland *C. squamulata*.

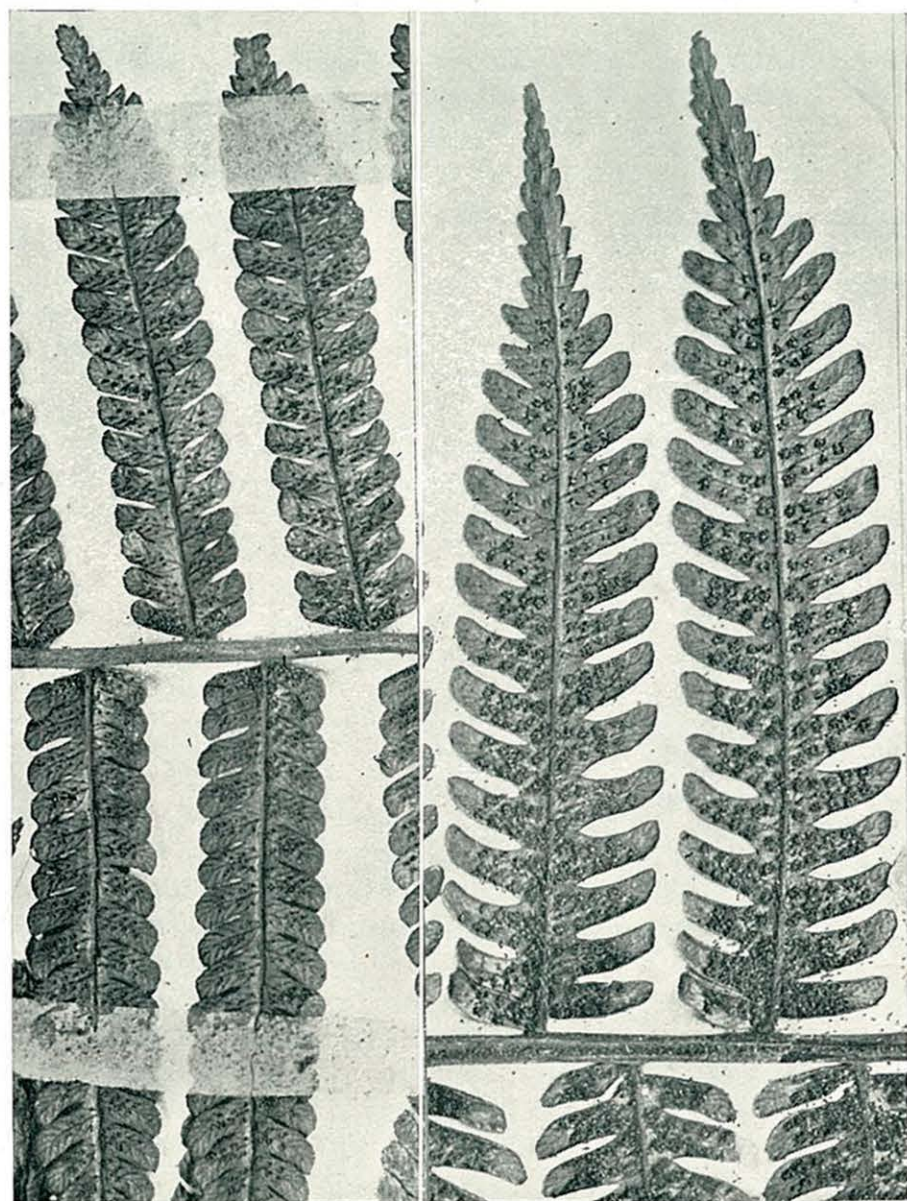
JOHORE: Mt. Ophir: Padang Batu, Ridley 9857; Top, Ridley 865; Hullett s.n. Dec. 1883. G. Bělumut 3,300 feet, SFN 10741, 10690 (Holttum).

PERAK: Near top of G.M. 3,500–4,000 feet, King's Coll. 7129, 7229.

9. *Cyathea squamulata* (Bl.) Copel. Phil. Journ. Sci. 4C: 37. 1909. *Gymnosphaera squamulata* Bl. Enum. 243. 1823. *Alsophila comosa* Wall. Hook. Spec. Fil. 1: 53, t. 20A. 1844. *Alsophila Ridleyi* Bak. Ann. Bot. 8: 122. 1894. *Cyathea Ridleyi* Copel. Phil. Journ. Sci. 4C: 36. 1909. *C. elliptica* Copel. Phil. Journ. Sci. 12C: 51. 1917. *C. paraphysata* Copel. Phil. Journ. Sci. 6C: 135, t. XV. 1911. *Cyathea Brooksii* Copel. Phil. Journ. Sci. 6C: 135, t. XVI. 1911. *Alsophila sarawakensis* C. Chr. Ind. Fil. Suppl. *Cyathea deuterobrooksii* Copel. Phil. Journ. Sci. 38: 131. 1929. Plate 33.

*Stipes* dark to medium brown, densely scaly at base, scales on lower side broader and more spreading, on upper side narrower and more appressed; largest scales about 3 cm. long by 2 mm. wide, medium brown, the edges minutely dark-setose. *Rachises* medium brown, with appressed hairs above, sparsely scaly below with minute strongly setose scales. *Middle pinnae* to about 50 by 20 cm., more usually about 15 cm. wide. *Pinnules* of middle pinnae to about 10 by 2 cm. (usually about 8 by 1.6 cm.), on stalks 1 to 2 mm. long, the base unequal truncate, the apex rather shortly acute, lobes cut  $\frac{2}{3}$  or sometimes  $\frac{3}{4}$  to the costa; lobes 3 to 4 mm. wide, slightly oblique, midrib strongly falcate towards apex of lobe, sides parallel, the lower one curved over at apex, apex bluntly pointed, entire or slightly toothed; veins about 6 pairs, basal ones usually forked, basal vein on side towards pinna-rachis springing





*Cyathea squamulata*. Two plants from Penang Hill: (left) Haniff 9123, (right) Ridley 7107,  $\times 1.25$ .



directly from the costa; texture thin; colour usually dark above and paler below; surfaces and veins glabrous except for occasional hairs on veins on upper surface; *scales* on costæ and costules below not very numerous, on costæ lanceolate with or without paler slightly bullate base, the edges strongly setose, gradually transitional to pale bullate scales with darker setose tips on the costules; *sori* median on the veins, distinct from each other at maturity, not occupying the whole surface, paraphyses long pale numerous, longer than the sporangia.

TYPE: Java, in Blume's Herbarium.

The typical form of this species, from Java, has rather pale paraphyses which are only a little longer than the sporangia. I have seen a considerable number of sheets from Java, and all agree in this character, which was noted by Mettenius (Ann. Lugd. Bat. 1: 52). In characters of size, texture, venation, width and cutting of pinnules, there is much variation in the Java specimens. They tend however to be more coriaceous than the Peninsula plants; this is perhaps due to their being mostly mountain plants whereas Peninsula specimens are mostly from shady lowland forest. Some of the Java specimens match typical Peninsula specimens except for the paraphyses.

Peninsula plants nearly all have long pale paraphyses, much longer than the sporangia. The additional length is due to additional elongation of the cells. A few specimens from Penang have rather dark brown paraphyses (not very easy to observe), about as long as the sporangia. These specimens vary in size and cutting of pinnules in exactly the same way as the specimens with long pale paraphyses; specimens with long paraphyses can be found to match exactly in all other characters those with short paraphyses. It appears to me therefore that all forms must be included in one species.

There is one specimen from Gunong Panti, Johore (Ridley 4150) which has short dark paraphyses and rather long-stalked lower pinnules, somewhat intermediate between *C. squamulata* and *C. polypoda*. In texture however it is very different from *C. polypoda*, and the segments are distinctly falcate.

The size of the pinnules of *C. squamulata* varies much in different pinnae of the same frond, and in smaller and larger plants growing side by side. The venation (number of veins and whether simple or forked) also varies considerably in different parts of the same frond. *Alsophila Ridleyi* Bak. was based on a small plant.



As normally found in the Peninsula, the species is easily distinguished by the densely scaly stipe (the scales thin and with minutely setose edges) and the pinnules cut not more than  $2/3$  to the costa. *C. Burbidgei* agrees in scaliness, but has densely hairy rachis and costæ beneath. In Singapore and the south of Johore *C. squamulata* is a fairly common plant near streams in forest. It has also been found in Penang, but not in the intervening parts of the Peninsula, from which further collections are needed.

The reduction of *C. elliptica* Copel. is due to Christensen (this Bulletin, Vol. VII, p. 219). I have seen specimens of the type collections of *C. Brooksii* Copel. and *C. paraphysata* Copel.; both appear to me to fall within the range of variation of this species. I have also seen the type of *Alsophila comosa* Wall.

PENANG: Without locality: Hullett s.n. Dec. 1881; Ridley 7040, 7076; Curtis 538, 10140; Bishop Hose s.n. June 1896. Penang Hill, Ridley 7017. Road to Penara Bukit, Curtis s.n. Oct. 1898. Above Ayer Itam, 1,000 feet, SFN 19339 (Holtum).

JOHORE: G. Panti, Ridley 4150 (paraphyses short dark). Mt. Austin, Ridley 12571. Sedenak, Ridley 13475. Pelepah Valley, SFN 24504 (Holtum).

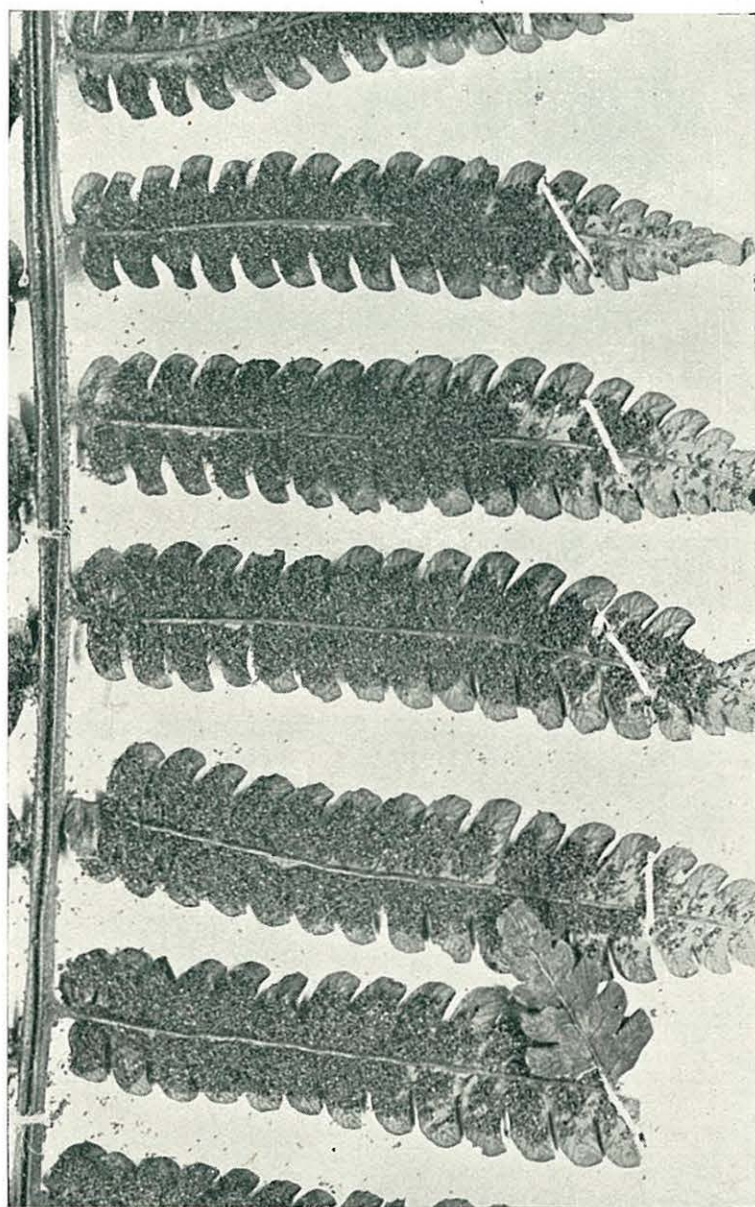
SINGAPORE: S. Morai, Ridley 4401 (type of *A. Ridleyi*). Chan Chu Kang, Ridley 4398, 6122. Chua Chu Kang, Ridley 6031, also s.n. May 1905. Bukit Mandai, Ridley 4402. Bukit Panjang, Ridley 12537, 13313. Bukit Timah, Ridley 12557, 6549, Matthew s.n. Jurong, Ridley 5756. No locality, Cantley s.n. Aug. 1881.

WITHOUT LOCALITY: King's Coll. 186.

10. *Cyathea obscura* (Scort.) Copel. Phil. Journ. Sci. 4C: 37. 1909. *Alsophila obscura* Scort. Bedd. Journ. Bot. 25: 321, pl. 278, f. 2. 1887. *A. subobscura* v.A.v.R. Bull. Jard. bot. Buitenz. II ser. XX: 1, t. 1. 1915. Plate 34.

*Stipes* dark (not black) to medium brown, densely scaly at base, the scales to about 3 cm. long by 2 mm. broad, medium brown, the edges shortly dark ciliate. *Rachises* medium brown with appressed hairs above and minute strongly setose scales beneath. *Middle pinnae* to about 50 by 15 cm. *Pinnules* of middle pinnae to about 8 by 1.5 cm., on stalks 1 to 2 mm. long, the base unequal and more or less truncate, the apex acute, rather shortly narrowed; *lobes* cut about  $1/2$  to  $2/3$  to costæ, about 3 mm. wide, slightly oblique, sides parallel, falcate at apex, apex bluntly pointed; *veins* about 6 pairs lowest usually forked, basal vein on side towards pinna-rachis springing directly from the costa; *texture* firm; colour dark above and paler beneath; surfaces





*Cyathea obscura.* Fraser's Hill, Holttum 21540,  $\times 1.25$ .



and veins glabrous; scales on costæ few except at base, lanceolate, brown with or without paler bullate base, edges setose, bullate scales on costules pale with dark setose apex; *sori* median on basal veins, becoming very crowded when mature, filling the whole surface except tips of lobes, the sporangia mixed with long pale paraphyses; no indusia.

TYPE: Perak, Scortechini.

The type of this species is presumably in Beddome's herbarium, and I have not seen it. At Singapore however there are specimens from Scortechini's herbarium labelled *A. obscura*, and also duplicates of Kunstler's collections named by Beddome. All these agree very well together, and I have little doubt that they represent this species. *C. obscura* is fairly common on the Main Range and the Taiping Hills at about 3,000 to 4,000 feet altitude. Specimens from Penang are rather intermediate between typical *C. obscura* and *C. squamulata*, and it may be that *C. obscura* should be regarded only as a variety of *C. squamulata*, differing in firmer texture, the pinnules never so deeply cut as in the largest plants of *C. squamulata*, and especially in the spreading of the sporangia to cover the whole lower surface of the pinnules. As in *C. squamulata*, young plants with only pinnate fronds may occasionally be fertile. I have seen two specimens of the type collection of *A. subobscura*, from Sumatra, and consider them identical with *A. obscura*.

PENANG: Road to Penara Bukit, Ridley 7153.

PERAK: Scortechini, s.n., 5 sheets. Larut, 3,500–4,000 feet, King's Coll. 6391. Larut, 3,000 feet, Bishop Hose s.n. March 1893. G. Hijau, W. Fox s.n. Octo. 1879. Maxwell's Hill: Ridley 5185, Curtis 2692, Anderson 140, SFN 12534 (Burkill; young plant).

PAHANG: Telom, Ridley 13930. Cameron's Highlands: Robinson's Falls, 4,400 feet, SFN 23453 (Holttum); Top of Falls, SFN 17760 (Henderson; sterile specimen); Fraser's Hill: 4,000 feet, SFN 8779, 8796 (Burkill & Holttum), 21540 (Holttum).

11. *Cyathea Burbidgei* (Bak.) Copel. Phil. Journ. Sci. 4C: 55. 1909. *Alsophila Burbidgei* Bak. Journ. Bot. 1879: 38. *Alsophila trichodesma* Scort. Bedd. Journ. Bot. 25: 321. 1887. *Cyathea mollis* Copel. Phil. Journ. Sci. 12C: 52. 1917. *C. poiensis* Copel. Phil. Journ. Sci. 6C: 362. 1911.

*Stipes* dark brown, roughened when scales have fallen, the base when young covered with numerous pale to medium brown scales; scales about 2.5 cm. long and 2 mm. broad, the edges with very short oblique dark setæ. Main *rachis*



dark, subglabrous below, smaller rachises covered with spreading hairs 2 to 3 mm. long on lower surface, and appressed hairs above. *Middle pinnae* to about 60 by 18 cm. *Pinnules* of middle pinnae to about 11 by 1.5 cm., the higher ones sessile, the lower on stalks 2 to 3 mm. long, the base unequal, rounded, the apex shortly acuminate, the sides lobed  $\frac{3}{4}$  or more to the costae, the basal segment often free; the lobes 3 to 4 mm. wide at their base, slightly oblique and gradually narrowed upwards, falcate, the apex subacute or rounded, subentire or slightly toothed; *veins* about 6 pairs, the lower ones forked, the basal one on side towards pinna-rachis springing directly from the costa; *texture* thin; colour rather pale; costae, costules and veins below covered with spreading pale hairs; a few lanceolate pale scales, more or less bullate at their base, mixed with hairs on the costae, pale bullate scales with setose apices on costules, not very abundant; *sori* median, no indusium; paraphyses numerous long pale, much exceeding the sporangia.

TYPE: Borneo, Burbidge.

Christensen has previously discussed this species (this Bulletin Vol. IV, p. 379). He has seen the type, and has identified with it some specimens from the Peninsula; also *C. mollis* Copel. I have examined the type number of *C. poiensis* Copel. in Brooks's Herbarium, and consider it to be a small plant of *C. Burbidgei*.

This species also is certainly closely allied to *C. squamulata*, and might possibly be regarded as a variety. It differs chiefly from typical *C. squamulata* in the extreme hairiness of the costae, costules and veins beneath, and appears also to be usually a larger fern with more deeply lobed pinnules. Young plants of *C. squamulata* are somewhat hairy, and could hardly be distinguished from young plants of *C. Burbidgei*. *C. Burbidgei* seems to be a species of lowland forests and the lower slopes of mountains; curiously enough, it has only been found (with the exception of a doubtful specimen of a young plant from Penang) in the middle part of the Peninsula, from which specimens of *C. squamulata* are lacking.

PENANG: No loc. or date, Forest Guard (young plant).

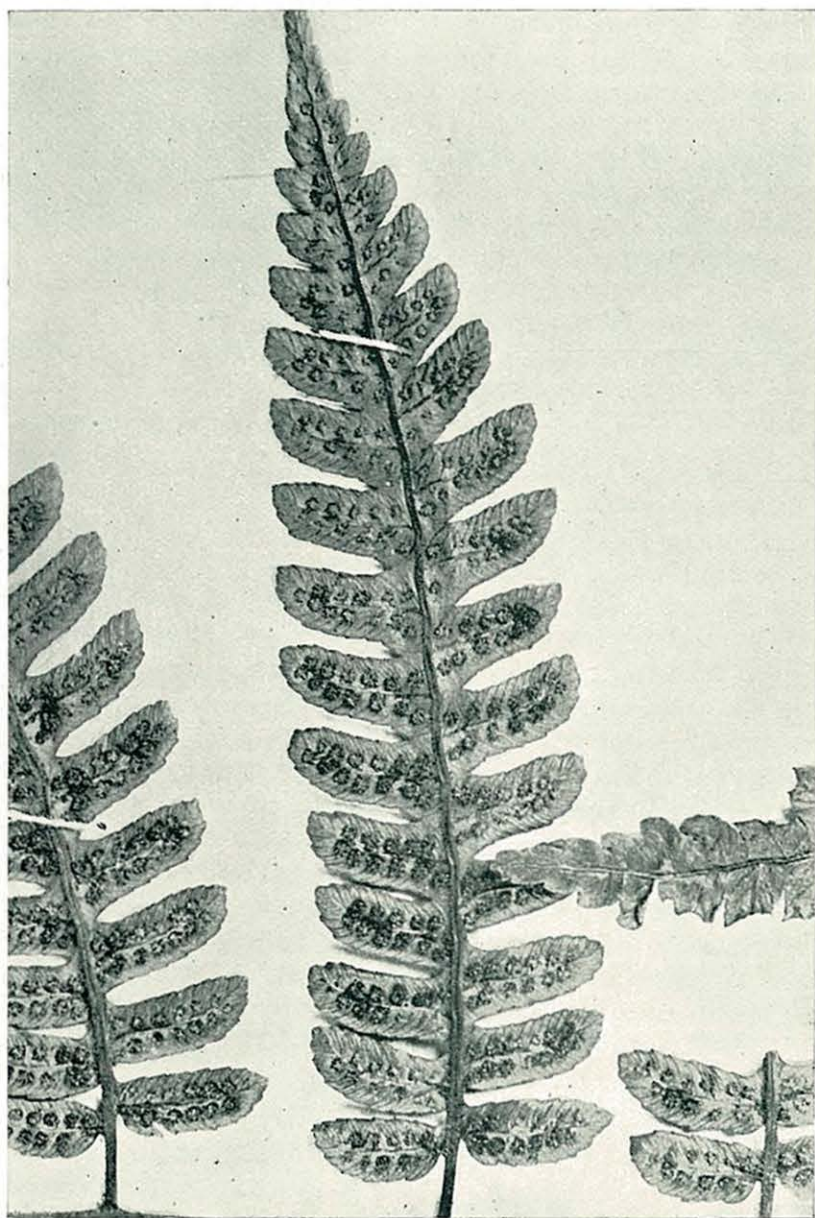
PERAK: Bujong Malacca, Wray (?), s.n. Scortechini, no locality.

PAHANG: Kuala Teku, 500 feet, SFN 20096 (Holttum).

SELANGOR: Semenyih, F.M.S. Mus. 7917, 8712 (Hume, young plant). Kajang, Forest 22867, 22930 (Symington).

NEGRI SEMBILAN: G. Angsi, SFN 9889 (Holttum). Bukit Tangga, SFN 11830 (Md. Nur).





***Cyathea ampla.*** Holttum 19883 (largest pinnule),  $\times 1.25$ .



12. *Cyathea ampla* Copel. Phil. Journ. Sci. 6C: 361. 1911.  
Plate 35.

*Stipes* dark brown, slightly roughened when scales have fallen; scales at base of stipe very abundant, medium brown, to about 3 cm. long by 2 mm. broad, the edges with minute stiff dark oblique setæ. *Rachises* dark brown in basal parts, paler towards apex of frond, sparsely minutely scaly below, appressed hairy above. *Pinnæ* distinctly articulated. Middle pinnæ to 60 by 22 cm. *Pinnules* of middle pinnæ to 11.5 by 2.7 cm., on stalks 6 to 8 mm. long, the base unequally cordate, the apex acuminate broadly toothed, the basal two segments on basal pinnules free, the rest cut  $\frac{3}{4}$  or more to the costa; *segments* 6 to 7 mm. wide at base, slightly oblique, slightly falcate (the lowest not falcate) the apex bluntly pointed, the edge shallowly toothed; *veins* 7 to 8 pairs, usually all forked except the highest, the basal one on the side towards the pinna-rachis springing directly from the costa, elevated on both surfaces, broader below and not darkened; *texture* firm; *scales* on base of costæ dark, narrow, with setose edge, mixed with very small scales of similar nature; scales at base of costules as on costæ, distal scales bullate, dark with setose tip, occasionally paler; *sori* nearer costules than edge, rather small and quite distinct; no indusia; paraphyses numerous pale, slightly exceeding the sporangia.

TYPE: Mt. Singgie, Sarawak, Brooks 106.

The above description is taken from the only specimens found in the Peninsula, namely SFN 19883, collected by me at 2,000 feet altitude (the summit) on G. Muntahak, Johore. I have compared these with the type number in Brooks's Herbarium, and believe them to be identical. The species is closely allied to *C. squamulata*, but decidedly larger in all its parts. The higher pinnæ of *C. ampla* would be difficult to distinguish from *C. squamulata*.

13. *Cyathea recommitata* Copeland Phil. Journ. Sci. 4C: 36. 1909. *Alsophila commutata* Mett. Ann. Lugd. Bat. 1: 53. 1863. *Cyathea Hewittii* Copel. Phil. Journ. Sci. 6C: 134, t. 14. 1911. *Alsophila heteromorpha* v.A.v.R. Bull. Jard. bot. Buitenz. II. ser. XVI: 1. 1914. *Cyathea Toppingii* Copel. Phil. Journ. Sci. 12C: 51. 1917.

*Stipes* very dark (nearly black), slightly roughened by bases of fallen scales; scales at base numerous, to about 2 cm. long by 2 mm. wide, dark with thin irregular margins, also scattered small thin pale scales; base of stipe bearing a few or several reduced pinnæ 1.5 to 7.5 cm. long, 1 to 2 cm. wide, on stout stalks 1.5 to 2 cm. long, at right angles to stipe, pinnate at the base; the reduced pinnæ either in a small group at the base of the stipe only, or sometimes extending sparsely up to the normal pinnæ; reduced pinnæ



on old fronds spine-like owing to loss of leafy parts. *Rachises* sparsely minutely scaly below, appressed hairy above. *Middle pinnae* to about 40 by 15 cm., fertile pinnules contracted. *Fertile pinnules* 4 to 8 cm. long, 6 to 12 mm. wide, on stalks 2 to 3 mm. long, base truncate to cordate, apex acuminate, sides incised half-way to costa or a little more, lobes 3 to 4 mm. wide, oblique, bluntly acute, toothed; *sterile pinnules* about 9 by 1.8 cm., on stalks 2 mm. long, basal segment deeply cut, sometimes almost free, rest lobed about half-way to costa, lobes about 5 mm. wide, slightly oblique, apex rounded, slightly toothed, veins to about 7 pairs, simple, basal one not springing from costa; *scales* on costae lanceolate, dark with pale edge, on costules paler, sub-bullate, edges irregular, not setose; *sori* subcostular, exindusiate, sometimes completely filling the surfaces of the fertile segments; *paraphyses* short dark not numerous.

TYPE: Malacca, Cuming 396.

The species *Alsophila commutata* Mett. was based on *Gymnosphaera squamulata* Hk., Gen. Fil. 100, which is a description and illustration of Cuming's fern from Malacca, wrongly identified with *G. squamulata* Bl. In transferring the species to *Cyathea*, Copeland had to make another new name, owing to the prior publication of *C. commutata* Spr.

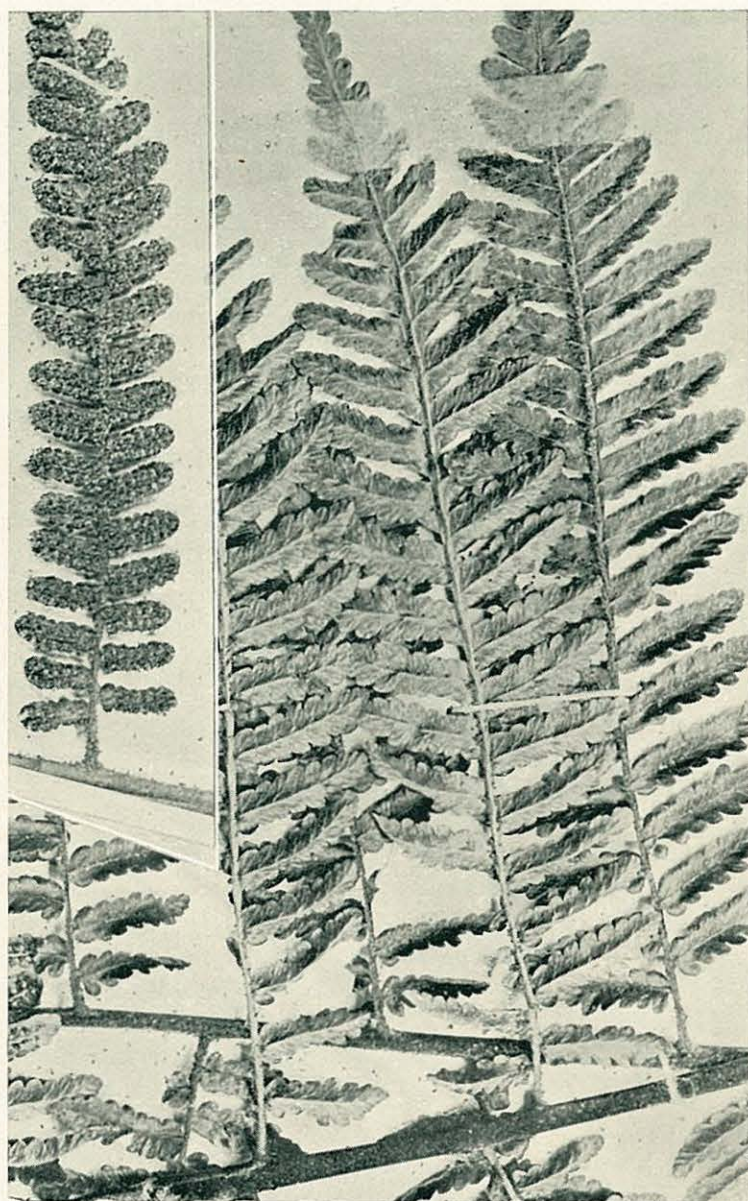
I have examined specimens of the type collection of *C. Hewittii* and *A. heteromorpha*; they appear to me quite identical with this species. The reduction of *C. Toppingii* is due to Christensen (this Bulletin, 7: 220).

This is a small, rather slender tree fern of mountain forests. The type doubtless came from Mt. Ophir, where it has been collected again. It has also been found on the Main Range, Taiping Hills, and G. Tahan, while outside the Peninsula it is known from Sumatra and Borneo. On the whole, this species is not so variable in the cutting of the pinnules as some others, but there is a rather unusual specimen (Maxwell's Hill, Haniff 9085) which has large deeply incised pinnules; the sterile pinnules are up to 11 by 2.3 cm., fertile to 9.5 cm. long, the basal segments in both sometimes free and the other segments cut nearly to the costae.

PERAK: Scortechini, without locality (2 sheets); Larut 1,800–2,000 feet, King's Coll. 1988; Larut, near G.M., 3,000–4,000 feet, King's Coll. 7130; Bujong Malacca, Ridley 9604; Maxwell's Hill 4,000 feet, SFN 9085 (Haniff).

PAHANG: G. Tahan: Wray's Camp, Ridley 16211; 3,000–3,500 feet, SFN 20572 (Holttum). Fraser's Hill, 4,000 feet, SFN 8793 (Holttum & Burkill), 11367, 21560 (Holttum).





**Cyathea Kingii.** Cameron's Highlands, Holttum 23537.  
Largest form of sterile pinnules; on right,  
a fertile pinnule,  $\times 1.25$ .



SELANGOR: Bukit Hitam, Ridley 7869 (see Beddome in Kew Bull. 1902, p. 423).

JOHORE: Mt. Ophir: Ridley 3319; 3,500 feet, SFN 23705 (Holtum).

14. *Cyathea Kingii* (Clarke) Copeland, Phil. Journ. Sci. 4C: 56. 1909. *Alsophila Kingii* Clarke, Bedd. Handbook Addenda 475. 1883. Plate 36.

*Stipe* almost black, roughened at base, scales about 1 cm. long, 1 to 1.5 mm. broad, dark with pale thin edges. *Rachises* almost black or sometimes purplish, subglabrous below, dark-hairy above. *Middle pinnæ* to about 75 by 20 cm., more often about 55 by 17 cm. *Fertile pinnules* much contracted, about 6-9 cm. long, 0.6 to 1.2 cm. wide, on stalks 1 to 3 mm. long, base truncate, apex shortly acute, basal segment on side towards main rachis sometimes free, rest of pinnule lobed almost to costa, segments about 3 mm. wide, slightly oblique, edges slightly toothed, veins about 6 pairs, usually simple, none springing direct from costa; *sterile pinnules* usually about 1.6 cm. wide, occasionally up to 2.5 cm., lobes with rounded apex and edge toothed towards apex, veins usually 6 to 8 pairs, mostly forked; occasionally several basal segments of sterile pinnules are free, these segments being up to 4 mm. wide and 15 mm. long, the edges strongly toothed, having up to 10 pairs of veins, some 3-branched; *scales* on costæ beneath about 1 mm. long, narrow, dark, edge thin and pale, towards apex and base with brown marginal setæ; smaller scales on costules of fertile pinnules not strongly bullate, medium brown to pale, with few to many rather pale marginal setæ; bullate scales especially on some sterile pinnules, rather pale, without dark setæ; *sori* close to costules, completely covering lower surfaces; no indusia; *paraphyses* flattened shorter than sporangia.

TYPE: King's Collector 2416, Larut, Perak.

Some plants at Fraser's Hill have very large fronds, the pinnæ to 75 cm. long, the rachises medium brown, occasionally dark and purplish, but not black, the fertile pinnules to 11 by 1.7 cm., many segments cut to costæ, the upper surfaces recurved.

This species has only been found on mountains, at about 4,000-5,000 feet, in forests, especially in rather open places. The characteristic feature is the much reduced fertile pinnules. The only specimen from outside the Peninsula which I have seen is Forbes 2562 from Sumatra.

PERAK: G. Bubu, 5,000 feet, Wray 3860, King's Coll. 7402; G. Hijau, Fox s.n. Oct. 1899; Larut 5,000 feet, King's Coll. 2416 (type).



PAHANG: G. Tahan: 3,300 feet, Wray & Robinson 5425; Ridley 15994; 5,500–7,000 feet, SFN 7954 (Haniff & Nur); Teku Woods, Ridley 15968 (young plant); 3,700 feet, in forest, SFN 20609 (Holtum). Fraser's Hill, 4,000 feet: Eryl Smith 833; SFN 8492 (Burkill & Holtum), 11401 (Holtum). Cameron's Highlands: Rhododendron Hill, 5,100 feet, SFN 23311 (Holtum); Path to Telom, 5,000 feet, SFN 23537 (Holtum). Kluang Terbang, Barnes 1900 (young plant).

SUMATRA: Forbes 2562 (no locality; date 1881).

15. *Cyathea glabra* (Bl.) Copel. Phil. Journ. Sci. 4C: 35. 1909. *Gymnosphaera glabra* Bl. Enum. 242. 1828. *Alsophila dubia* Bedd. Journ. Bot. 25: 1, t. 279a. 1883. *Alsophila vexans* Ces. Atti Acad. Napoli 7, pt. 8, 4. 1876.

*Stipes* dark purplish or almost black, with roughened base; scales fairly numerous but soon deciduous, dark with pale irregular edges. *Rachises* dark to medium purplish brown, subglabrous below, appressed hairy above. *Lowest pinnae* sometimes much reduced, especially on young lowland plants. *Middle pinnae* to 55 by 20 cm., more often about 45 by 15 cm. *Pinnules* of middle pinnae to 12 by 2 cm., more often about 9 by 1.5 cm. and occasionally smaller, on stalks 2 to 4 mm. long, base slightly unequal, broadly rounded or subtruncate, occasionally slightly auricled on upper side, apex rather shortly narrowed and broadly toothed, edge subentire or slightly lobed, occasionally lobed as much as half way to the costa; lobes where present usually about 5 mm. wide at base, rounded, almost entire; *veins* 3 to 5 pairs, usually all simple, the basal vein on the side towards the pinna-rachis not usually springing directly from the costa (occasionally so towards apex of pinnule); *texture* thin but firm; *scales* on costae and costulae beneath not very abundant; scales at base of costae narrow, dark, with pale edges, sometimes with a few setae; scales on costules very small, narrow, with usually pale setae on margins; no bullate scales; *sori* in one or more series on either side of costae, those on each vein-group being disposed in two close almost parallel rows, not or only slightly converging towards the margin; no indusia.

TYPE: Java, in Blume's Herbarium.

As here interpreted, this species is very variable in the extent to which the pinnules are lobed. I have examined Blume's specimens at Leiden and Kew, and also all specimens from Java in the Buitenzorg herbarium. Java specimens are much less variable than those from the Peninsula; their pinnules are usually lobed about 1/3 to the costa, occasionally almost 1/2. Of 33 Peninsula specimens



in the Singapore herbarium (counting only those with middle pinnæ), 16 have pinnules very slightly lobed, 10 lobed not more than  $1/4$ , and the remaining 7 lobed  $1/3$  to  $1/2$ . Some of those most deeply lobed seem to me quite indistinguishable from typical Java specimens, and as I can see no sharp dividing line between these and the less lobed specimens, I am of opinion that all should be regarded as one species. Beddome's *Alsophila dubia* was based on a slightly lobed specimen. These slightly lobed specimens are very similar to *Alsophila podophylla* Hk. from Siam and southern China. The most deeply lobed Peninsula specimen is King's Collector 2493 from Larut, Perak; this has the lowest lobes on many pinnules quite free (a condition not seen in Java specimens) and the remainder of the pinnules lobed half-way to the costa. The Peninsula specimen agreeing most nearly with those from Java is SFN 26110 (Corner) from Fraser's Hill.

A specimen from Java (Bakhuizen fil. 3121, from Soekamentri), approaches *C. gigantea* in having almost sessile pinnules, lobed fully half-way to the costa, the lobes rather deltoid and distinctly toothed; there are however never more than 5 pairs of veins.

The minute scales on the costæ and costules of this species are characteristic; in order to distinguish the setæ on their margins, a rather high magnification is necessary.

*Cyathea vexans* (Ces.) C. Chr. from Sarawak, of which I have examined the type, agrees closely with many Peninsula specimens.

*C. glabra* is a fairly common small tree fern in mountain forests; the only lowland specimens are from Singapore and southern Johore, and one from Perak. The lowland plants are usually thinner in texture, agreeing in other respects.

KEDAH: G. Jerai (Kedah Peak): Ridley 5156, 5157; 2,500–3,000 feet, Evans & Gordon 55; 2,800 feet, Robinson & Kloss 6042.

PERAK: G. Bubu, Cantley 2666. Near top of G. B. 3,500–4,000 feet, King's Coll. 7356. Larut, within 100 feet, King's Coll. 2493. Gopeng, King's Coll. 68. G. Kerbau 3,500 feet, Robinson s.n. (distr. Kew).

KELANTAN: G. Stong, 800 feet, SFN 12187 (Md. Nur).

PAHANG: Telom, Ridley 13931. G. Berumban, Ridley 13932. G. Tahan: Wray's Camp, Ridley 16206, 16204; Ridley 15993; 3,500–4,000 feet, SFN 8112 (Haniff & Nur); 3,500 feet, SFN 20570 (Holtum). Fraser's Hill: F.M.S. Mus. 11485 (Henderson); SFN 8797, 8813 (Burkill &



Holtum), 11199 (Md. Nur). Cameron's Highlands 5,000 feet, SFN 23367 (Holtum).

JOHORE: Tempayan River, Ridley 13282. G. Panti 1,600 feet, SFN 15042, 17698 (Holtum).

SINGAPORE: Stagmount, Ridley s.n. 1907. Bukit Mandai, Ridley s.n. 1907. Bukit Timah, Ridley 12554.

16. *Cyathea gigantea* (Wall.) Holtum, comb. nov.

*Alsophila gigantea* Wall. Hook. Spec. Fil. 1: 53. 1846.  
*Alsophila umbrosa* Ridley p.p. J.M.B.R. Asiatic. Soc. 4: 6. 1926.

*Stipes* black or very dark, slightly roughened, the scales rather small, dark with pale thin edges. Rachises dark to medium purplish brown, smooth and subglabrous below, rather sparsely appressed hairy above. *Middle pinnæ* to about 45 by 18 cm. *Pinnules* of middle pinnæ to about 14 by 2 cm., sessile or nearly so, the base slightly unequal, cuneate, narrowed gradually from the broadest part near base to the apex, apex acuminate, edge lobed, the basal lobes as much as  $\frac{2}{3}$  to costa; lobes deltoid, 5 to 6 mm. broad at their base, narrowed distally, slightly oblique, the apex rounded and toothed, the basal lobe occasionally almost free; veins 5 or 6 pairs in each lobe, simple, the basal one on the side towards the pinna-rachis usually springing directly from the costa; texture thin; scales on costæ and costules few, small, rather pale and irregularly lobed, the margins with short hairs but not stiff setæ except at apex of larger scales; no bullate scales; sori on basal veins distant from costules, the higher ones converging, thus forming groups of inverted V-shape; no indusia.

TYPE: Nepal, Wallich 321.

I have examined the types of both *A. gigantea* and *A. umbrosa* (from Penang) in Wallich's Herbarium at Kew, and in my opinion they represent the same species. The type of *A. umbrosa* has pinnæ 1.5 times as wide as those of the type of *A. gigantea*, but otherwise I can see little difference. *A. umbrosa* represents the species at its southern limit in Penang, and *A. gigantea* at or near its northern limit in Nepal.

The characters distinguishing *A. gigantea* from the more deeply lobed specimens of *A. glabra* are: the lobes of the pinnules more deltoid, distinctly toothed, pinnules sessile; veins in each lobe usually 5 or 6 pairs; small scales without stiff marginal setæ. For a clear comparison, middle pinnæ of well-developed fronds are necessary. Upper pinnæ often have narrower less deeply lobed pinnules.



Mr. Ridley cites a number of specimens under *A. umbrosa*; all of these, with the exception of Wallich 1336, are in my opinion *C. glabra*.

Beddome, following the *Synopsis Filicum*, regarded *Alsophila gigantea* as a synonym of *A. glabra*; his *A. glabra* from India is therefore *Cyathea gigantea*. When Beddome received the (rather aberrant) specimens of *C. glabra* from the Peninsula, he called them *Alsophila dubia*, as he had no knowledge of typical *C. glabra* from Java.

KEDAH: Langkawi Islands: Curtis s.n. Sept. 1890; G. Raya, Curtis s.n. Sept. 1890.

PENANG: Highland Hill, 500 feet, SFN 9094 (Haniff). Above Ayer Itam, 1,000 feet, SFN 19340 (Holtum).

LOWER SIAM: Kopah, SFN 2092 (Haniff & Nur).

#### Collectors' Numbers quoted in this Paper

The following lists give the collectors' numbers in numerical order, and in brackets after each the number of the species as arranged in this paper (e.g., 1 is *Cyathea Brunonis*). Unnumbered specimens are not quoted here.

##### Singapore Field Numbers—

2092 (16)	9263 (1)	12091 (1)	19883 (12)
7127 (5)	9352 (5)	12187 (15)	19910 (5 var.)
7939 (5)	9450 (5)	12266 (5)	20096 (11)
7954 (14)	9452 (5)	12269 (2)	20570 (15)
8038 (1)	9889 (11)	12534 (10)	20572 (13)
8040 (5)	9919 (2)	12883 (3)	20609 (14)
8112 (15)	10367 (5)	13217 (1)	21540 (10)
8492 (14)	10393 (3)	15042 (15)	21560 (13)
8779 (10)	10690 (8)	15683 (5)	21711 (3)
8793 (13)	10741 (8)	17124 (5)	22508 (1)
8794 (5)	11005 (5 var.)	17698 (15)	23311 (14)
8796 (10)	11199 (15)	17760 (10)	23367 (15)
8797 (15)	11367 (13)	17802 (7)	23453 (10)
8812 (3)	11399 (1)	18584 (4)	23537 (14)
8813 (15)	11401 (14)	18617 (4)	23538 (7)
8825 (5)	11519 (1)	18871 (3)	23539 (5 var.)
8826 (1)	11523 (5)	19339 (9)	23705 (13)
9085 (13)	11535 (1)	19340 (16)	24504 (9)
9094 (16)	11635 (2)	19341 (2)	
9109 (5)	11830 (11)	19579 (5)	



*Mr. Ridley's Series—*

865 (8)	6550 (5)	8633 (3)	12599 (5)
1659 (5)	6551 (5)	8663 (5)	13279 (5)
3060 (5)	6552 (5)	8936 (5)	13282 (15)
3319 (13)	6965 (5)	9548 (5)	13313 (9)
3540 (1)	7017 (9)	9551 (5)	13439 (5)
4150 (9)	7040 (9)	9604 (13)	13475 (9)
4398 (9)	7076 (9)	9857 (8)	13930 (10)
4401 (9)	7080 (5)	10173 (2)	13931 (15)
4402 (9)	7150 (5)	10295 (5)	13932 (7)
4403 (1)	7151 (2)	10785 (5)	13932 (15)
5156 (15)	7152 (2)	10966 (5)	14207 (5)
5157 (15)	7153 (10)	10981 (5)	15968 (14)
5177 (5)	7272 (3)	11061 (1)	15969 (5)
5185 (10)	7862 (5)	11066 (3)	15993 (15)
5756 (9)	7865 (5)	11068 (5)	15994 (14)
6029 (5)	7866 (5)	12535 (5)	16204 (15)
6031 (9)	7868 (3)	12537 (9)	16206 (15)
6122 (9)	7869 (13)	12554 (15)	16211 (13)
6123 (5)	7879 (5)	12557 (9)	16214 (1)
6549 (9)	8141 (5)	12571 (9)	

*F.M.S. Museums Series—*

7617 (1)	8712 (11)	9635 (2)	10258 (5)
7629 (5)	8797 (5)	9793 (1)	10802 (5)
7673 (1)	9547 (1)	10098 (1)	11315 (5 var.)
7889 (1)	9548 (1)	10198 (5)	11485 (15)
7917 (11)	9562 (1)	10201 (1)	

*King's Collector—*

68 (15)	2359 (5)	6391 (10)	7229 (8)
186 (9)	2416 (14)	7129 (8)	7317 (5)
475 (1)	2493 (15)	7130 (13)	7356 (15)
1280 (3)	4032 (3)	7148 (6)	7402 (14)
1988 (13)	4885 (1)	7154 (5)	

*Forest Department—*

13907 (1)	14610 (1)	22867 (10)	22930 (10)
13984 (3)	22813 (1)	22874 (6)	24107 (5)

*C. Curtis's Numbers—*

537 (5)	2692 (10)	10134 (5)	10140 (9)
538 (9)	3074 (5)	10139 (2)	10141 (5)

*Scortechini* 222 (5), 223 (5), 239 (1).

*Wray & Robinson* 5379 (1), 5425 (14).

*Evans & Gordon* 55 (15), 108 (5).

*Derry* 92 (1).

*Anderson* 140 (10).

*Wray* 3860 (14).

*Eryl Smith* 814 (5), 833 (14), 901 (5).

*Robinson & Kloss* 6042 (15).

*Forbes* 2562 (14).