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The *Gardens' Bulletin, Singapore* is a peer-reviewed journal publishing original papers and reviews on a wide range of subjects: plant taxonomy (including revisions), phytogeography, floristics, morphology, anatomy, as well as horticulture and related fields, such as ecology and conservation, with emphasis on the plant life of the Southeast Asian-Pacific region.

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A hundred years of the Gardens' Bulletin, Singapore

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ABSTRACT. Historical developments are traced pertaining to the founding and transformation of the *Agricultural Bulletin of the Malay Peninsula*, 1891–1900, the *Agricultural Bulletin of the Straits and Federated Malay States*, 1901–1911, the first two periodicals of the Singapore Botanic Gardens, and the *Agricultural Bulletin of the Straits and Federated Malay States, Third Series*, which began in 1912. This third series soon continued as the *Gardens' Bulletin, Straits Settlements* when in 1913 it was decided to continue the journal from the Botanic Gardens with a name change to avoid confusion with an *Agricultural Bulletin* separately begun for the Federated Malay States, as their new Department of Agriculture developed and economic activities around agriculture intensified. After World War II, this continued as the *Gardens' Bulletin, Singapore*, which achieved its centenary in 2012. The early focus on the *Hevea* rubber crop and industry during the time of H.N. Ridley, its founding editor, and the re-orientation of the *Gardens' Bulletin* into a journal with increased original content in the botanical (especially taxonomic) sciences from the period of I.H. Burkill, Ridley's successor, are described. Historical events, especially the administrative divergence between the Straits Settlements and the Federated Malay States, the impact of World War II and post-war political development, the development of administrative organisation within the newly independent Singapore; and the integration of botanical science over the Malesian botanical region wherein the Malay Peninsula is located, have contributed to shaping the focus and scope of the *Bulletin*. The development phases of the Singapore Botanic Gardens—home of the *Bulletin*—as well as the pivotal roles of its leading botanists, are examined, through stages of scientific transformation from an essentially “Malayan” perspective largely maintained by a small botanical home team, to a more regionally relevant research programme, and finally an international outlook that continues to sustain its Southeast Asian emphasis.

Keywords. *Agricultural Bulletin*, botanical journal, Federated Malay States, Flora Malesiana, Gardens' Bulletin, *Hevea* rubber, Malaya, Malay Peninsula, Malesia, plant taxonomy, Ridley, Singapore Botanic Gardens, Straits Settlements

A centenary measures not just antiquity, but also continuity, progress and outlook. Its arrival makes us take stock of developments and the many phases that would have naturally accrued. Even though centenaries are now much more commonly observed than previously, still each arriving occasion never fails to be evocative, for a hundred years of history yield a great many interactions and events that would have touched very many aspects of life and society. This year, 2012, the *Gardens' Bulletin, Singapore* turns a hundred years old.

Scientific publishing at the Singapore Botanic Gardens began when the organisation was part of a larger entity called the Gardens and Forest Department,

Straits Settlements. The Straits Settlements were a British Crown Colony made up of Malacca, Penang, Province Wellesley, Singapore, and Pangkor and the Sembilan Islands off the Perak (mid-western) coastline of the Malay Peninsula. The Gardens and Forest Department was created in 1883 under the Superintendent of Gardens, Straits Settlements, a position occupied by Nathaniel Cantley from 1880 to 1888. Although the Singapore Botanic Gardens had been inceptioned in 1859 at its present site in Tanglin by the Singapore Agri-Horticultural Society, its maintenance was passed onto the Straits Settlements Government in late 1874, and by 1878 the legislation was approved for the Gardens to be officially managed by the colonial government (Burkill 1918a, b). Its main role then was to serve agricultural and economic development for its territories as well as the rest of Malaya (Burkill 1983), a geographical designation that referred to the main part of the Malay Peninsula (including Singapore) which came under British influence. Cantley was only the second full-time horticultural superintendent recruited from the Royal Botanic Gardens, Kew, following James Murton (1875–1880).

Prelude as an agricultural bulletin

In 1888, Henry Nicholas Ridley became the first Director of the Singapore Botanic Gardens and was intricately linked to the development of the Gardens' periodicals that followed. In fact, two other series preceded the present *Bulletin*. The first was called the *Agricultural Bulletin of the Malay Peninsula*, with No. 1 (pages 1–17) issued in April 1891 and No. 9 (pages 239–289), the last, issued in May 1900. The front page for each of the first five issues (up to May 1896) declared its prospectus:

It is proposed to publish from time to time, as occasion may serve, Bulletins on subjects connected with Agriculture and Horticulture in the Malay Peninsula. It is hoped that planters will send to the Director of the Botanic Gardens, Singapore, notes and observations on the cultivations of the various crops under their care. Observations on insect and fungus-pests are specially requested, and these should always be accompanied by specimens of the injurious insect or fungi either alive, or preserved in spirits, except in the case of butterflies and moths which should be sent dry in envelopes.

Although most of the issues carried brief articles, the coverage included diseases of coffee, nutmeg and clove trees, pests and injurious fungi. There were interesting essays on crops of potentially wider cultivation, such as gambir, patchouli, sago, sugar cane, lemon grass oil, citronella oil, fibre plants, dye plants, spices, vegetables, and, of course, Para rubber. Ridley edited and wrote most of the material and was himself only occasionally credited at the end of an article from issue No. 5 (1896) onwards, with Charles Curtis (Assistant Superintendent of Gardens and Forests in Penang, 1884–1903) contributing two articles on the cultivation of pot plants and sugar cane plants developing from seed, and A.L. Butler (of the Selangor Museum), an account of an extensive bee-hawk moth caterpillar attack on a coffee plantation. The brevity of the issues was not surprising, as Ridley's time was also taken up for developing the Gardens, organising an improved herbarium and specimen exchange with, and contributions from, Kew, Calcutta, the British Museum and collectors of the Malayan

flora in general, besides himself conducting an active field survey and collecting programme into Malayan forests and starting many horticultural investigations.

The issuance of an agricultural bulletin made sense with the emphasis given to economic botany. The purview of the Singapore Botanic Gardens was not only to assist in introducing crops of economic benefit and making studies for enhancing their cultivation, but also to help explore and document what was then a very poorly known flora of Malaya. As it would turn out, Ridley's well-documented accomplishments were as incredible in consequence as they were wide in scope. He not only pioneered the cultivation and excision tapping techniques that helped to encourage the planting of *Hevea* as an economic crop (Fig. 1) (Wycherley 1959, Brockway 2000), but was probably the best known explorer and scribe of the Malayan flora (Ridley 1922–1925).

A distinct Department of Forests, Straits Settlements (S.S.) and Federated Malay States (F.M.S.), headquartered in Kuala Lumpur, was set up in 1901 after the urging of both Ridley and H.C. Hill (1900a, b) of the Indian Forest Service, the latter commissioned to report on forest administration in these territories. (The F.M.S. were formed by the states of Perak, Selangor, Negri Sembilan and Pahang, each of which had a British Resident.) Responsibility for forest administration was thus separated from the Gardens' function, with Alfred M. Burn-Murdoch transferred from the Burma Forest Service to be Chief Forest Officer of the S.S. and F.M.S. in 1901, this post becoming the Conservator of Forests from 1904 (Wong 1987). The Singapore Botanic Gardens continued to be the centre for disseminating information on agriculture (Burkill 1983), so the beginning of a new and more focussed bulletin was commensurate with this role. This second series of the bulletin was the *Agricultural Bulletin of the Straits and Federated Malay States*, with Vol. 1, No. 1 issued in October 1901 and carrying an introduction by Walter Fox, Acting Director of the Singapore Botanic Gardens when Ridley was away on leave:

...having regard to the large and increasing number of Agriculturists and others taking an interest in Agriculture, the time has now come when something more than the Bulletin mentioned above is required... It is now proposed to publish a monthly Bulletin, which shall incorporate the old one, and as far as possible enlarge its scope by making it the medium for the exchange and record of Planters' experiences in all that pertains to their interests ...in a word make it a Planters' Paper for Planters.

The march of the bulletins

Ridley continued to serve as editor. The monthly issues in this second series carried a few longer articles but had a good measure of attention given to potential, experimental or emerging crops, and commodity prices in London and Singapore. The products listed reflected market interest then and included cocaine, then used as a local anaesthetic and becoming more commonly known as a performance enhancer (Karch 1998). Mention on page 35 in No. 1 of Vol. 1 (October 1901) stated: "The exports of crude cocaine from Peru during 1900 amounted to 16,479 lbs., valued at \$563,625. Of this quantity the United States received 1,016 lbs. direct." Ridley's article on *Timbers*



Fig. 1. Henry Ridley (left) with a rubber-tapping experiment. From *Gardens' Bulletin, Straits Settlements* 1(8), facing p. 263.

of the Malay Peninsula anchored the inaugural number and subsequent instalments up to its conclusion in No. 8 (May 1902). His other contribution made in instalments was *Fruits of the Malay Peninsula, Wild or Cultivated* (Vol. 1 No. 10: 371–381, printed as July 1902 but hand-corrected to August), which continued into Nos. 11, 12 and 13. Shorter articles included such as *The World's Tea and Coffee Consumption* (No. 3: 115–117), *Notes on Gutta Percha Trees* by Charles Curtis (No. 6: 220–223), *A New Instrument for Tapping Rubber Trees* (No. 6: 230–231), *New Rubber in Saigon* (No. 7: 274), *Rubber vines in French Indo-China* (No. 9: 333–335) and *The Cultivation of Orchids for Amateurs* by Curtis (No. 14: 586–588). When authorship was not indicated, these were usually abstracts from other reports, notices or short notes; a number by Ridley himself were indicated with the initials “H.N.R.” at the end, such as his essay on *Volatile Oils* (No. 9: 335–342). The topics represented a healthy interest in all things possible to grow or transact in a tropical environment, and centred on commercial hevea and other types of rubber (with Gutta Rambong or *Ficus elastica*, the India Rubber, already mentioned in No. 5 as an interesting potential source of commercial rubber being tried in Malacca, and which later brought Ridley there to view trials set up by local businessman Tan Chay Yan).

The lack of a very large diversity of contributing authors probably led to E.B. Skinner's *The United Planters' Association, F.M.S. Report for 1901* (published in the *Bulletin* No. 10: 393–400) stating that the *Agricultural Bulletin* should benefit from an identified “band of contributors” that included Charles Curtis (Superintendent of Gardens & Forests, Penang & Province Wellesley), Robert Derry (then Assistant Superintendent of Forests, partly in Malacca, partly in Perak; subsequently also a Curator at the Botanic Gardens in Singapore), Leonard Wray (Curator of the Perak State Museum), Stanley Arden (an official of the Agricultural Department in Selangor), the Chief Forest Officer (Colony & F.M.S.) and E.V. Carey (Chairman of the Planters' Association). Aside from mentioning complaints on typographical errors, the report also recorded that the Governments of Colony and the F.M.S. “each promised a grant of \$300 per annum towards the expenses of publishing the Bulletin.”

Timeliness of the issues in this second series was generally well observed. As Vol. 1 began in October 1901, it went into No. 14 in December 1902; thereafter, from Vol. 2 onwards, each volume began with No. 1 in January and ended with No. 12 in December of a calendar year. In all, ten volumes were published, ending with Vol. 10, No. 12 in December 1911. Ridley was the editor in the main, although Volumes 5–7 were credited as being edited by H.N. Ridley (Director of Botanic Gardens, S.S.) and J.B. Carruthers (Director of Agriculture & Government Botanist, F.M.S.). Nonetheless, the editorial in Vol. 5 No. 1 (January 1906) still used the singular form:

The Editor would always be glad to receive correspondence or notes on Agricultural or Horticultural subjects...He would call the attention of planters and others to the fact that when the Bulletin was started in its present form, many were the promises of support in these matters. During the past year hardly a note has been sent for the Bulletin...

Following this lament, most of the writing was still Ridley's. Carruthers left the F.M.S. for a position in Trinidad in March 1909, returning the editorship solely to Ridley.

This *Bulletin* series recorded many notable snippets of information, such as

Ridley's *Malay Drugs* (Vol. 5 No. 6: 193–206, No. 7: 245–254, No. 8: 269–282) and others like *Fall of Hail in Ulu Langat*, *Pandan Hats*, *Note on the Method of Preparing Dragon's Blood*, *A Nest of *Termes malayanus* with many Queens*, etc. He had many agriculturally inclined articles too, among which were: *Pine-Apples* (Vol. 3: 1–6) and *Pineapple Cultivation* (Vol. 3: 37–40), the latter heralding an increasing interest in the crop that was eventually, in the 1970s and 1980s, to become a significant feature of the Johor agricultural landscape in south Peninsular Malaysia, before giving way to oil palm. As for the beginnings of commercial interest in oil palm, Ridley (1908: 4) noted that “There was a demand for seeds of the Oil Palm (*Elaeis guineensis*) due to an article in the ‘Agricultural Bulletin’ of this year [1907]” pointing out the value of this plant in cultivation. Articles such as *A remarkably prolific coconut* (Vol. 8 No. 7, July 1909) (Fig. 2) provided incomparable interest in the unusual, yet possible, obtainment of extreme productivity, of incredible attraction to the agriculturist's essentially insatiable expectations.

And Ridley did entertain all manner of agricultural correspondence, including offering advice on ridding soil of rhinoceros beetle larvae (Vol. 3 No. 1: 18–19). The Director's interest in his Gardens was not forgotten, and there were also articles of practical value there, such as *The Palm Collection of the Botanic Gardens, Singapore* (Vol. 3 No. 7: 249–266), which recorded 236 species in 90 genera, probably the finest in Malaya. Later (March 1910), there was occasion for disappointment, when Ridley reported *The Abolition of the Botanic Gardens of Penang* (Vol. 9 No. 3: 97–105): plans were afoot to convert the Gardens in Penang into a reservoir, which, however, did not materialise.

Undeniably, there was an overwhelming interest in rubber in the *Agricultural Bulletin* of that time. In May 1906 (Vol. 5 No. 5), *The United Planters' Association Report for 1905* declared for rubber thus—“The triumphant progress of this part of our Agricultural Industry has continued unslacked. The fame of the F.M.S. as a rubber producing country is spreading far and wide...” Many articles appeared that were concerned with the properties, cultivation and tapping of rubber, industrial processing and attendant machinery, and trade in the commodity. For the 2nd International Exhibition of Rubber and Allied Trades 1911 in London (24 June to 11 July, 1911), a major event, it was noted that “Mr Ridley promised to be responsible for the supply of stumps to show the methods of tapping” and “...to write a pamphlet dealing with the history of rubber in Malaya” (Vol. 10 No. 1: 11–12). In March 1911 (Vol. 10 No. 3), Ridley even describes the operation of his trial Rubber Smoking House: “...I will first describe the smoking house in the Botanic Gardens, which has proved quite satisfactory and economical. The building is 55½ feet long and 19 feet wide, oblong in shape, and made of ordinary planking with a high roof...”

So Mr Ridley was evidently kept rather busy. He was also editor of the *Journal of the Royal Asiatic Society, Straits Branch*, from 1889 to 1911, as well as secretary of the Society, and published many taxonomic papers in that journal as the *Agricultural Bulletin* was so devoted to economic botany. The *Agricultural Bulletin* included a lighter side with snippets that must have involved some straight-faced moments, such as with *The Mosquito Plant, Ocimum viride* (Vol. 3 No. 1: 24), in which Ridley



Fig. 2. A photo by W.J. Gallagher, Government Mycologist, F.M.S., showing "...an exceedingly prolific coconut tree grown on Klanang Estate, Jugra in Selangor...only eleven years old and the total number of nuts on the tree...was more than three hundred and sixty." From H.N. Ridley (1909) A remarkably prolific coconut, *Agricultural Bulletin of the Straits and Federated Malay States* 8(7), facing p. 318.

discusses his own simple observations:

The mosquitoes in fact quite ignored the mosquito plant and took no notice of it at all...A writer...rubbed his face and hands with the juice of the leaves. This he found effectively kept the mosquitoes off, but he found next day that he had developed a rash... and eventually for five days his face and hands were as if badly scalded, and he came to the conclusion that the evil was preferable to the remedy...*Editor.*

One or two inconsistencies were also not unexpected. In Ridley's *Curious root-development of Albizzia*, Vol. 7 No. 4 (erroneously printed as Vol. 6 No. 7), April 1908, the article starts by describing roots of *Aleurites moluccana* ascending an oil-palm tree, but ends by referring to the tree as an *Albizzia* as in the title of this short note. *Albizzia* (or '*Albizzia*') *moluccana* was the name used then for the leguminous tree we now know as *Falcataria moluccana* (with *Albizzia falcataria* and *Paraserianthes falcataria* to add to a colourful synonymy that keeps foresters in awe), and *Aleurites moluccana* is the candlenut tree known for its seed oil. Clearly, even the taxonomist must watch their very busy moments.

In April 1909, Vol. 8 No. 4: 169 carried Ridley's obituary note on Sir George King, late Director of the Botanic Gardens at Calcutta and Director of the Botanical Survey of India, who retired in 1898:

...Sir George King was also the Author of...Materials for a Flora of the Malay Peninsula, which is as yet unfinished...It was originally intended that he in collaboration with Sir Joseph Hooker should publish the complete Flora of the Malay Peninsula, but his death has prevented this from being carried out.

Ridley (1907) had, himself, treated the monocots in three volumes ('Parts'), although the rest of the *Materials* was never completed, comprising 25 instalments that appeared in the Journal of the Asiatic Society of Bengal between 1889 and 1915, with a 26th instalment only in 1936 (Ng & Jacobs 1983). Thus around this time, Ridley had already been active collecting botanical specimens (with many cited in the *Materials*) as well as compiling a flora. As it turned out, the *Materials* was to pave the way for Ridley's five volumes of *The Flora of the Malay Peninsula* (Ridley 1922–1925), which, although it does include a number of astute insights into the classification of Malayan plants, is considered by some scholars as having some apparently hastily written and poorly compiled parts. Given King's uncompleted account (continued to some extent by J.S. Gamble), Ridley's work pressures, the imperatives of having the rich Malayan flora surveyed as a taxonomic package, and the fact that he could only settle in to compile his *Flora* at Kew following retirement, a rapid pace of completion was probably not to be compromised. Even then, the onset of the 1st World War around 1914 had disrupted life. Whatever the criticisms—and awareness of many weaknesses came as soon as the *Flora* appeared: see Holttum (1959)—Ridley's completion of a primary documentation of the Malayan flora was a feat in itself and an accomplishment in discipline. He would be admired for a great many things (Purseglove 1955a, b, c). Purseglove (1959) also commented that Ridley "belongs to that great pre-specialised age of scientific natural history and he collected and studied many animals, as well as distributing specimens and writing about them."

Malaya entered a great rubber boom in 1910. Advertisements apparently made their debut in Vol. 8 No. 12 (December 1909), when four items were carried, from

Howarth Erskine Ltd., Singapore, "makers of rubber machinery"; The Borneo Co., Ltd.; the Journal d'Agriculture Tropicale; and the Sun Life Assurance Company of Canada. These were vignettes of what the region was getting busy with at the time: rubber and agriculture, development and business. In the last two volumes 9 and 10 of this second *Agricultural Bulletin* (1910 and 1911), advertisements had gained in number conspicuously. This was a notable change, a kind of culmination to a very regimented bulletin production that highlighted economic successes through the agricultural programme, more possibilities with potentially profitable crops, and a necessary brevity pervading throughout because of the need to bring issues out very frequently.

The Third Series: birth of the *Gardens' Bulletin*

Ridley retired officially on March 1st, 1912 but had gone on leave by January 18th (Burkill 1913). *The Agricultural Bulletin of the Straits and Federated Malay States, Third Series*, was introduced in this year, somewhat awkwardly, by its No. 1 comprising a 66-page Index for articles and topics of the past *Bulletins* from 1891 to 1911. In the Index, 'OS' stood for the 'Old Series' and '1' to '10' for volume numbers of the 'New' (i.e., Second) Series. Then No. 2 began anew with Page 1. The numbers 1–5 appeared monthly for January to May 1912 and had lead pages declaring *Founded by H.N. Ridley, C.M.G., M.A., F.R.S., & c., in 1891, and edited by him up to 1911*. The Assistant Curator of the Garden, J.W. Anderson, compiled Nos. 1, 2 and 5, and the Curator, R. Derry, compiled Nos. 3 and 4. But not long afterwards, the new Director of Gardens, Isaac Henry Burkill (1913) (Fig. 3) recorded that "In consequence of want of staff the 'Agricultural Bulletin' was suspended after five numbers had been issued."

In the *Planters' Association of Malaya Fifth Annual Report for the year ending 31st March, 1912* published in the *Bulletin* (3rd Series) Vol. 1 No. 4: 137–142, an appreciation of Ridley as well as new arrangements for the *Bulletin* itself were recorded:

MR. RIDLEY.—This gentleman, who was truly the Father of the Rubber Industry in this Peninsula, has retired and left the East, after having devoted many years of his life to benefitting the planting industry...

AGRICULTURAL BULLETIN.—It is a great satisfaction to hear that arrangements have been made for this paper to be edited and published in Kuala Lumpur, as it is one of great use to the Planting Community.

With the development of commercial activities increasing in much of Malaya, organisation to serve the F.M.S. better was being put into effect. The Singapore Botanic Gardens had been an instrument of the S.S. Government for supporting its agricultural development since 1875 and had practically been concerned with the whole of Malaya, but in 1905 the F.M.S. had set up a Department of Agriculture headquartered in its capital, Kuala Lumpur. Agriculture was enjoying a boom. It was only after I.H. Burkill arrived as the new Director on October 17th, 1912, that new arrangements for the publication of the journal were ironed out. This *Bulletin* would continue its No. 6



Fig. 3. The second Director, J.H. Burkill, who consolidated the *Gardens' Bulletin* as a botanical journal. (From the Singapore Botanic Gardens archives)

under a new name, based in Singapore, while the *Agricultural Bulletin of the F.M.S.* would be a different journal, with Kuala Lumpur as its centre of organisation.

Under these circumstances, No. 6 of the *Bulletin* in Singapore appeared as *The Gardens' Bulletin, Straits Settlements* "into which is incorporated all that has been published as the Third Series of the Agricultural Bulletin of the Straits and Federated Malay States" (Fig. 4). The Editor's Note at the start of Vol. 1 No. 6 (issued December 15, 1913) makes the clarification thus—

Since 1891 the Botanic Gardens have had a publication; at first it was an occasional publication, then in 1902 it became a monthly, by a joint agreement with the Governments of the Straits Settlements, and Federated Malay States and the United Planters' Association of Malaya. Now, again, the period of the agreement having terminated, it will be occasional...the title has been changed to avoid confusion with the Agricultural Bulletin of the Federated Malay States. It is thought that the title "Gardens' Bulletin, Straits Settlements" is satisfactorily descriptive, distinctive and conveniently short...The five parts published as the third series of the Agricultural Bulletin, Straits and Federated Malay States, become the first five parts of the Gardens' Bulletin...There will be more original matter...but no market reports and no proceedings of meetings...

Having taken over from his predecessor, Burkill's writing featured conspicuously in the pages of the *Bulletin* from 1913 into the 1920s. The immediate issue, No. 6, opened with his note on *The Coconut Beetles, Oryctes rhinoceros and Rhynchophorus ferrugineus*. Original material came to feature more prominently, mostly emphasising economic botany, including large summaries like *The treatment to which the Para Rubber trees of the Botanic Gardens, Singapore, have been subjected* (Vol. 1 No. 8: 247–295) and, conspicuously, Burkill's own research into yams, e.g., *Experimental cultivation of the Greater Yam Dioscorea alata* (Vol. 1 Nos. 9, 11–12; Vol. 2 No. 2), *Some cultivated Yams from Africa, and elsewhere* (Vol. 2 Nos. 3, 12), *A progress report on the cultivation of the greater yam, Dioscorea alata—in the Botanic Gardens, Singapore* (Vol. 2 No. 4), *Yields of the lesser yam and of some African yams* (Vol. 2 No. 5), and *A list of Oriental vernacular names of the genus Dioscorea* (Vol. 3 Nos. 4–6). Instalments on *The Oil Palm (Elaeis guineensis) in the East* by E. Mathieu appeared in Vol. 2 No. 7: 217–230 and No. 8: 265–275. Articles on lima bean acclimatisation trials, roselle and castor oil cultivation by E. Mathieu, on races of the coconut palm by Ahmed Bin Haji Omar, and the betel palm *Areca catechu* by F. Flippance were included. More notes and data were published on agri-horticultural pests (*Locusts in Malacca* by P.C. Cowley-Brown & I.H. Burkill, Vol. 1 No. 10; *Catochrysops pandava, a butterfly destructive to Cycads* by Burkill, Vol. 2 No. 1; and various notes on beetle pests of the coconut by Professor C.F. Baker, Vol. 2 No. 1) and fungi by Baker (*Host Index for fungi*, Vol. 2 No. 1; *Hevea versus fungi*, Vol. 2 No. 4) and T.F. Chipp (*The fungus flora of Hevea brasiliensis*, Vol. 2 No. 6; *A Host Index of Fungi of the Malay Peninsula*, Vol. 2 Nos. 7, 8; *A list of the fungi of the Malay Peninsula*, Vol. 2 Nos. 9, 10 & 11 combined).

Early on in his tenure as Director, Burkill gathered summaries of the development of the Botanic Gardens. He himself compiled *The establishment of the Botanic Gardens, Singapore* (Burkill 1918a) and *The second phase in the history of the Botanic Gardens, Singapore* (Burkill 1918b). Flippance contributed *A Guide to the*

THE
GARDENS' BULLETIN,
STRAITS SETTLEMENTS.

INTO WHICH IS INCORPORATED ALL THAT HAS BEEN PUBLISHED
AS THE THIRD SERIES OF THE AGRICULTURAL BULLETIN
OF STRAITS AND FEDERATED MALAY STATES.

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Fig. 4. The title page of the December 1913 issue No. 6 announcing the journal's name change to *Gardens' Bulletin, Straits Settlements*.

Palm Collection in the Botanic Gardens (Vol. 2 No. 6: 177–186 and No. 7: 246–258). Burkill's interest in more organised platforms for the continuing botanical survey of the Malayan flora is seen in his *Fragments of Malayan Geographic Botany No. 1. Enumeration of Pahang Plants collected by the late A.M. Burn-Murdoch* (Vol. 1 No. 9); *The as-yet botanically unexplored parts of the Malay Peninsula* (Vol. 3 Nos. 1–3); and the classic guide to *Botanical Collectors. Collections and Collecting Places in the Malay Peninsula* published in Vol. 4 Nos. 4 & 5 after retirement (Burkill 1927), which organised its content using a system of grid-square references systematically enumerating the collections known to have been made in particular localities in each state of Malaya.

A special interest in orchids was also noticeable. There were Malayan orchid notes by Burkill and Mohamed Haniff (Vol. 1 No. 10, July 1916), the latter a botanically experienced Overseer in charge of the Waterfall Gardens in Penang and under the Director in Singapore; a paper by Burkill discussing evidence produced to show that Pigeon Orchid (*Dendrobium crumenatum*) flowers about 8 days after heavy rain (Vol. 1, Nos. 11–12, March 1917), following Rutgers and Went's observations of its gregarious flowering in the *Annales du Jardin Botanique de Buitenzorg* (29: 129–160) the previous year; a general article on the flowering of orchids by Burkill (Vol. 2 No. 2); and notes on Southeast Asian orchids by Burkill (Vol. 2 No. 12, August 1921). These and the earlier orchid collections and notes by Ridley were precursor to the interest in Malayan and British North Borneo orchids taken up by the Malayan rubber planter C.E. Carr into the 1930s (Carr had been a frequent associate at the Singapore Botanic Gardens, visiting to study orchids and contributing specimens; he died in New Guinea while returning from an expedition in 1936) (Holttum 1959).

Burkill also put out articles on biological and ecological perspectives. These included *Some notes on the pollination of flowers in the Botanic Gardens, Singapore, and in other parts of the Malay Peninsula* (Vol. 2 No. 5: 165–176, September 1919); and his *The fertility of branched coconut palms* (Vol. 3 Nos. 1–3) was followed by C.X. Furtado's *A study of the coconut flower and its relation to fruit production and Branched coconut palms and their fertility* (Vol. 3 Nos. 7–8). Early ecological studies included *The composition of a piece of well-drained Singapore secondary jungle thirty years old* (Vol. 2 No. 5: 145–157, September 1919) that enumerated trees by species with height and girth data; and *Forests and their retention of rain water* (Vol. 2 No. 12: 419–421). Compiled together with Richard Eric Holttum, his Assistant Director who was appointed in 1922, *A botanical reconnaissance upon the Main Range of the Peninsula at Fraser Hill* (Vol. 3 Nos. 1–3, August 1923) would be an indispensable record of not just seed plants, but also ferns, lycophytes and mosses; this and the included survey of the largest tree sizes on forested ridges by the Semangkok pass (later to inspire the keeping of the so-called Big Tree Plot as a Virgin Jungle Reserve by the Forestry Department; Wyatt-Smith 1950) thus comprise an excellent baseline study of the flora of Fraser Hill. Holttum continued this foray into floristics, as with *The vegetation of Gunung Belumut in Johore* (Vol. 3 Nos. 7–8). But Burkill's study with Murray Ross Henderson of *The flowering plants of Taiping, in the Malay Peninsula* (Vol. 3 Nos. 7–12) was considered by them as "the first local Flora for any area within

the Federated Malay States” and only the third after Charles Curtis’s *Catalogue of the Flowering Plants and Ferns found growing wild in the Island of Penang* (Curtis 1894) and Ridley’s *Flora of Singapore* (Ridley 1900).

Thus a conspicuous diversity of topics and authorship, both agri-horticultural and related to the natural history and botany of Malaya, much of it original contribution, began building up. The bulletin that Ridley founded had been developed into a fully scientific journal by I.H. Burkill, his successor. The earlier preoccupation with agri-horticultural news and developments and commodity reports, when the only agricultural bulletin serving Malaya was co-sponsored by a planters’ association and required Ridley to maintain that coverage, was now largely replaced by scientific notes, reports and papers on a wider range of subjects. The need to sustain monthly issues, and obligations to advertisers who no doubt expected consistent and regular circulation, had been relieved by the calmer, more research-based attitude with the change to the *Gardens’ Bulletin, Straits Settlements*. Perhaps also the development of the F.M.S. Department of Agriculture in the beginning 20th century, with a growing specialisation in technical subjects, was as important as the reformulated objectives of the new *Gardens’ Bulletin* in bringing greater opportunities for organised research and scientific publishing for both the agricultural and botanical sciences. The agricultural component had all but disappeared from the *Gardens’ Bulletin* by 1924.

Colonial reorganisation, economic slump, War, and another name change

In 1918, F.W. Foxworthy, who had served with the Bureau of Science in Manila, was appointed the first Forest Research Officer of the F.M.S. and S.S., stimulating further growth of the fledgling Forest Herbarium in Kuala Lumpur (Wong 1987). Around this time also, other developments pressed for centralisation of botanical research in Kuala Lumpur but this did not materialise, as discussed by Humphrey Morrison Burkill (1983), late Director of the Singapore Botanic Gardens, and summarised here. A proposal to the Colonial Office in London for recruiting a Systematic Botanist in the Museum Department in Kuala Lumpur was made in 1920 by Sir George Maxwell, Chief Secretary of the F.M.S. and in 1921, M.R. Henderson was appointed to this post. As the development of both agriculture and forestry became more organised and important in Malaya, the colonial government decided to centralise botanical research in Kuala Lumpur to better support these areas. A meeting in December 1923 attended by G.E.S. Cubitt (Conservator of Forests, S.S. and F.M.S.), A.S. Haynes (Secretary for Agriculture, S.S. and F.M.S.) and I.H. Burkill discussed arrangements to move the Singapore Herbarium and the research of the Singapore Botanic Gardens to new premises in Kuala Lumpur, to absorb the botanical research of the Museum Department and its Systematic Botanist into the new botanical department, and to develop the Public Gardens in Kuala Lumpur as a botanic garden with the existing ones at Singapore and Penang as branch gardens. In the F.M.S., administrative dithering led to a delay in implementation and Maxwell only agreed to the new botanical department

in Kuala Lumpur in 1926. The rubber slumps of 1921 and 1924 preceded a more serious worldwide slump in 1929 and brought adverse consequences for government spending in colonial Malaya. The Museum Department's Systematic Botanist post was abolished and by I.H. Burkill's intervention, Henderson was brought to the Botanic Gardens, Singapore as Curator of the Herbarium in 1924. No further planning for the development of the Kuala Lumpur Public Gardens appears to have been undertaken, and the move to bring Singapore-based botanical resources to Kuala Lumpur was abandoned (Burkill 1983).

The effort to provide more specialist services in forestry research in Malaya, meanwhile, was assisted when in 1925 the Regent of Selangor approved the allocation of 800 acres at Kepong, near Kuala Lumpur, for the establishment of the Forest Research Institute (Watson 1950, Menon 1969). Its nursery and experimental plantations were begun on site in 1926, and the main building was constructed in 1929. Parallel to these developments, Ridley's *Flora of the Malay Peninsula*, in five volumes (Ridley 1922–1925), was published, having occupied his main attention based at the Kew Gardens following retirement. I.H. Burkill, the second Director who so ably crafted a more focussed scientific direction for the Singapore Botanic Gardens, retired in February 1925, and concentrated on writing and compiling *A Dictionary of the Economic Products of the Malay Peninsula* (Burkill 1935), which would appear a decade following Ridley's *Flora* (Furtado & Holttum 1960). Even so, in the years that followed, Burkill's notes and papers continued to appear in the *Gardens' Bulletin*, including more notes on yams and various other plants, with taxonomic notes and revisions, and even ethnobotanical notes on *The Chinese Mustards in the Malay Peninsula* and *Cosmos in the East* (Vol. 5 Nos. 3–6, June 1930).

R.E. Holttum, Assistant Director to I.H. Burkill, became Director in 1925 and there was some expectation that his work on ferns would lead the preparation of a cryptogam flora for Malaya to complement Ridley's seed plant flora. Indeed, work by Holttum and the Danish Carl Christensen on ferns began appearing during this period, including an account of Mt Kinabalu ferns in Vol. 7 Part 3, June 1934. But in the tropics it is seldom possible to stay on one study and not notice the many other manifestations of nature and life. Holttum's classic studies of plant phenology, *On periodic leaf-change and flowering of trees in Singapore* (Vol. 5 Nos. 7 & 8, June 1931; Vol. 11 Part 2, November 1940) and *The flowering of Tembusu trees (Fagraea fragrans Roxb.) in Singapore 1928–1935* (Vol. 9 Part 1, December 1935) were thus inevitable.

Also, new work in any part of the flora being re-examined was accruing additions and changes easily. This was certainly true with specialist work on the Dipterocarpaceae, the predominant big-tree family in Malayan forests, by C.F. Symington, who joined the Forest Research Institute in 1929 (his *Notes on Malayan Dipterocarpaceae* I to V in the *Bulletin* spanning 1933 to 1939). It also applies to the research on palms and aroids by C.X. Furtado (who joined the Singapore Botanic Gardens as Field Assistant in 1923, then later was Botanist) (Alphonso 1980); new discoveries or revisions of orchids by C.E. Carr; and the research on ferns and orchids by Holttum; and their other colleagues. Henderson also compiled *The Flowering*

Plants of Kuala Lumpur, in the Malay Peninsula (Vol. 4 Nos. 6–10, January 1928) and specially conducted surveys of the Malayan limestone flora. As botanical work intensified and got the attention of more specialists, not least because Ridley's *Flora* provided an accessible and organised overview, the Malayan flora was fast gaining additional interest. Henderson, who re-arranged the Herbarium following Ridley's *Flora*, had *Additions to the Flora of the Malay Peninsula* in Vol. 4 Nos. 2 & 3 (March 1927) and Nos. 11 & 12 (January 1929) (with Furtado), and further additional listings in Vol. 5 Nos. 3–6 (June 1930) and Vol. 7 Part 2 (May 1933). E.D. Merrill, too, had *Additions and corrections to Ridley's Flora of the Malay Peninsula* (Vol. 8 Part 2, January 1935).

E.J.H. Corner, who arrived in Singapore as Assistant Director of the Botanic Gardens in 1929 and a mycologist, would not be able to resist an interest in the palms and trees of Malaya. His *Notes on the systematy and distribution of Malayan phanerogams* and taxonomic work on *Ficus* began appearing in the *Gardens' Bulletin* Vol. 10 (1939) and continued 1960–65 from the University of Cambridge. His debut publication in the *Bulletin* was *The identification of the Brown-root fungus* (Vol. 5 No. 12, June 1932). In this paper, Corner's special acumen for graphical representations showed clearly in his diagrams of microscopic structures. His later work would show a special talent for watercolour illustration of mushrooms to represent subtle differences in tone, as well as the classic line-drawings of plant parts, trees and other figures made famous through his *Wayside Trees of Malaya* (Corner 1940), and even landscapes (Corner 1965, Mandalam 2011).

The *Gardens' Bulletin* was fast taking on a distinct systematic slant. Furtado added an interest in botanical nomenclatural matters, fuelled by his interaction with Professor H. Harms from Berlin, editor-in-chief of the *International Rules of Botanical Nomenclature*, ed. 3. There was an apparent burst of productivity over Vol. 5 (August 1929–June 1932) and Vol. 6 (1929–1930). The overlap is unusual and is likely due to the availability for the latter volume of three sizeable specialist accounts on medicinal plant use coordinated by I.H. Burkill after settling into his retirement: David Hooper's *On Chinese Medicine: Drugs of Chinese pharmacies in Malaya*, Burkill & Mohamed Haniff's *Malay Village Medicine*, and J.D. Gimlette's edition of an 1886 translation of *The Medical Book of Malayan Medicine* with botanical determinations by Burkill. Still, the frequency of volumes was essentially occasional. Volume 7, for example, had three parts, one each in 1932, 1933 and 1934. Furtado was on half-pay for a year from April 1933 to May 1934, travelling through Europe to work on the palm collections of key institutions. He was mainly at the Berlin Botanical Garden in conjunction with Professor M. Burret (then the leading palm specialist, who assembled the type specimens of Martius from Munich and other material for Furtado's studies); and then London, Vienna, Florence and Paris (Johnson & Tay 1999).

Vol. 9 Part 1 (December 1935) was dedicated to Ridley for his 80th birthday (Fig. 5): "...Few men have accomplished so much in 23 years of tropical service, and few have been able to complete their work after retirement as Mr. Ridley has completed it." B.J. Eaton, Director of the Rubber Research Institute of Malaya, observed that "In addition to continuing his publications on the flora of Malaya, he [Ridley] is still

a member of the Technical Sub Committee of the London Advisory Committee for Rubber Research (Ceylon & Malaya) and thus continues at the age of 80 to maintain his interest in an industry of which he may be said to have witnessed the birth.”

The “War volume”, Vol. 11, is of special significance. It had Parts 1–4, spanning May 1939 to September 1947. World War II arrived with the Japanese military in Singapore in 1942, so the first three parts (Part 1, May 1939; Part 2, November 1940; Part 3, August 1941) were still issued as the *Gardens' Bulletin, Straits Settlements*. Following the Japanese surrender and the return of Allied forces to Singapore, the political push for a Malayan Union (comprising Penang and Malacca from the former S.S., the F.M.S. and other states of Malaya, but excluding Singapore) was consolidating. It was only in September 1947 that Part 4 was issued to complete the volume, under the new name *Gardens' Bulletin, Singapore*. An insert, taking the place of pages 261–262, before the start of Part 4 proper on page 263, announced the consequence of the new political imperative:

CHANGE OF TITLE

The Colony of the Straits Settlements has ceased to exist. The title of this Bulletin is now therefore changed, but the present issue is a direct continuation of the former *Gardens' Bulletin, Straits Settlements*, of which the last issue was Vol. XI, part 3, published 30 August 1941.

Part 4 of Vol. 11 opened with a crisp record of events at *The Singapore Botanic Gardens during 1941–46*. At the time of the War, J.L. Pestana (Laboratory Assistant), J.C. Nauen and G.H. Addison (Horticultural Officers) joined the defence forces, were taken prisoner and sent to the Siam-Burma railway, where Nauen died in 1943. Henderson was evacuated from Singapore and later worked in the National Botanic Garden at Kirstenbosch in South Africa. Holttum, Corner and Furtado remained in Singapore during the Japanese occupation. The Herbarium and most of the Gardens remained undamaged, as Professor Hidezo Tanakadate of the Tohoku Imperial University assumed control of the Gardens and Holttum was retained in executive charge. In December 1942, Kwan Koriba, who had served as Professor of Botany at the Imperial University of Kyoto, was made Director of the Singapore Botanic Gardens. [Koriba was interested in physiological and ecological factors influencing plant morphology, especially flower and leaf disposition, and had done some work on orchids previously, although this was not highlighted in Singapore then (Arditti 1989).] Following Japanese surrender, the Gardens were placed under British Military Administration between September 1945 and March 1946, and in May 1946, Holttum returned to duty as Director, a post he held until 1949, when he became the inaugural Professor of Botany in the University of Malaya. Henderson became his Assistant Director. After war ended, Corner left for Latin America in 1947 on UNESCO service (thence to a lectureship in taxonomy at the Botany School in Cambridge University, becoming professor in 1965).



Fig. 5. Ridley close to his 80th birthday. *Gardens' Bulletin, Straits Settlements* Vol. 9 Part 1, facing page 1.

Koriba had returned to Japan in 1946 and retired to publish two books, then became the President of Hirosaki University in 1954. Koriba's research undertaken while at Singapore, *On the periodicity of tree growth in the tropics*, was published in the *Gardens' Bulletin, Singapore* Vol. 17 Part 1, November 1958, following his death in December 1957. In an obituary note, Holttum (1958b) wrote:

At Singapore...[Koriba] was dependent on the military organization for funds and supplies of all kinds, and took every opportunity of securing such amenities as were possible for the gardens staff. On several occasions he took energetic action to prevent encroachment on the Nature Reserves of Singapore...He was also greatly concerned that the herbarium and library at the Gardens should be maintained intact. To his single-minded devotion to botanical science the Singapore Botanic Gardens owes much...

In the author's preface to *A Revised Flora of Malaya, Vol. I. Orchids of Malaya* (Holttum 1953), Holttum recorded:

The main part of the work of the preparation of this book was carried out during the Japanese occupation of Singapore...The fact that I was able to undertake the work in the years 1943–1944 was due to the courtesy of Dr. Kwan Koriba, who was sent...to take charge of the Botanic Gardens here. I wish to express my most grateful thanks to Dr. Koriba, for the courtesy with which he allowed me complete freedom to continue my studies, and for much personal kindness during that period.

The sanction of Koriba's authority and that of his superiors, and the wealth of research materials already at the Botanic Gardens, had permitted some intensive preparation for botanical accounts that included *The Zingiberaceae of the Malay Peninsula* (Holttum 1950) and *Ferns of Malaya*, which appeared as Vol. 2 of the *Revised Flora* series (Holttum 1954).

The botanical spirit was refired at the Gardens. There was a great deal more to understand about the flora of Malaya and the region, and plenty to discover. To this renewal James Sinclair arrived at the Singapore Botanic Gardens in 1948, as Curator of the Herbarium, a post that was re-titled Keeper of the Herbarium in 1955 and Botanist (Keeper of the Herbarium) in 1960. The research programme when Sinclair arrived was to prepare a revised Flora of Malaya, for which he was asked to research the Annonaceae.

There is no telling how well a centralised botanical research facility of the S.S. and F.M.S. in Kuala Lumpur would have withstood the War, had earlier colonial plans been realised for bringing Singapore-based resources to Kuala Lumpur, given the looting and other damage inflicted on the Forest Research Institute during the Occupation (Wong 1987). In contrast, the research facilities of the Singapore Botanic Gardens were reasonably well preserved (Corner 1946, 1981; Holttum 1958b). On hindsight, it does seem fortunate that the merger never took place, as otherwise the overall damage to herbarium resources could have been even greater. And, of course, the *Gardens' Bulletin, Singapore* may never have seen its naming as such and its continuity into the present time.

The 1950s and 1960s: two centenaries and increasing regional focus

Ridley's hundredth birthday was celebrated by the Botanic Gardens on 10th December, 1955. According to the Director John William Purseglove (1959), there was "an exhibition of Ridleyana and current work, while the Gardens were floodlit for one week. A special brochure for private circulation was produced for the occasion [Purseglove 1955c]." Ridley wrote "It is a great delight to me to have lived to see the Gardens, the best tropical Gardens in the world," and that his hundredth birthday was one of the most enjoyable days of his life (Purseglove 1959).

In the *Bulletin* issue marking a hundred years of the Singapore Botanic Gardens (Vol. 17 Part 2, December 1959), messages and reflections from former Directors I.H. Burkill (1912–1925), R.E. Holttum (1925–1949), J.W. Purseglove (1954–1957), and the then Director H.M. Burkill (who first was Assistant Director from 1954), the son of I.H., the father then 89, were presented alongside those from many other botanical figures (Purseglove's was reprinted from a 1957 article). It would appear to be something of a feat that four Directors had their writings in the same issue, including both Burkills. H.N. Ridley, the first Director, had died just three years before in 1956, aged 101. And M.R. Henderson, Director during 1949–54 and having retired, had severed most professional contacts and gone to live in the Scottish hills (Burkill 1983).

Although the Gardens were a hundred years old, Purseglove (1959) saw it fit to reiterate their essential features, aware of the risk of repeated opportunities for their erosion. He took the trouble to emphasise—

...botanic gardens, to merit the name, are gardens maintained for the scientific study of the plants. As soon as this vital function is neglected botanic gardens change to public parks...The Singapore Botanic Gardens are the last gardens in the British tropics which function as a separate and self-contained department and have never been under the control of any Agricultural Department, Municipality or University...The southern end of the Gardens was probably abandoned gambier land, a haunt of tigers, while the north was still virgin tropical evergreen rain forest, 11 acres of which are still preserved...a most valuable asset in the centre of a great city.

This article by Purseglove (1959) was brought up to date by a footnote inserted by H.M. Burkill, who recorded thus:

The penultimate constitutional step in the introduction of full internal autonomy of Singapore (effected in May 1959) was operative from April 1955. As befits a country in charge of its own affairs, the Singapore Government adopted a policy of "malayanisation" of the public service from January 1st, 1957. J.W. Ewart retired in March 1957 in accordance with this policy, and A.G. Alphonso, who had returned in 1956 from a two year course of training in horticulture at the Royal Botanic Gardens, Kew, England, was promoted Curator. J.W. Purseglove retired voluntarily in March 1957, and H.M. Burkill became Director. H.H. Addison retired in February 1959. Chew Wee Lek was appointed Botanist in 1956 and went to Cambridge, England, in 1957 for three years to study for a higher degree. Lam Hin Cheng was appointed Horticultural Assistant in July 1957 and went to the Royal Botanic Gardens, Kew, for a two year course in horticulture. The new post of Librarian was eventually filled in April 1958, and Tan Kim Ho went to Melbourne, Australia, in 1959 for training in library management on an Australian

Government award under the Colombo Aid Programme. Attempts to fill the post of Assistant Director were unavailing, and finally Miss Chang Kiaw Lan was appointed Botanist (vice Assistant Director) to take up a study of mycology...The last three years, 1957 to this centenary year of 1959 have been a period of transition characterised by an acute shortage of senior personnel through loss of qualified staff and temporary loss of the services of officers sent overseas for training...Thus will close a century of expatriate know-how in the senior botanical and horticultural posts, and there will open the second century of the Gardens' history, every bit as promising in the comity of international botany as the first has been successful, with the majority of the senior posts held by Malayan personnel.

Following emergence from the war, reorganisation had been intense in the Botanic Gardens, where "garden work deteriorated generally, as more than half of the out-door staff (49 men) were sent to work on the Siam-Burma Railway...22 of them lost their lives" (Purseglove 1959). With senior staff having to attend to all sorts of duties, it was then that publication lapses were especially evident and the *Gardens' Bulletin* was not issued during the years 1948, 1952, 1954 and 1957, even though it was following an occasional mode.

It was the period after the war that saw an even wider involvement in the botany of the Southeast Asian region: this would have been reinforced as a necessity with the consolidation of the *Flora Malesiana* project encompassing much of the Malay Archipelago (Stenis 1948):

...the *Flora Malesiana* should embrace as wide an area as possible...no species can be properly defined, until it has been examined in all variations induced by the differences in climate, locality, and soil, which an extensive area affords. Also, the flora of an area cannot be worked out thoroughly without a knowledge of the botany of the surrounding countries (these have many plants in common), and so the greater the area encompassed, the better it will illustrate habits, forms, and variations of the species comprised within it. For this reason we have extended the limits of our *Flora* from Sumatra to New Guinea and from Luzon to Christmas Island, Timor and New Guinea.

Although the work of Ridley had not entirely focussed on Malayan botany in isolation, and there was in fact a fascination and interest in the plant life of the surrounding region, the priority then was to complete a Malayan account. A wider, regional botanical perspective became more visible and important with the work of I.H. Burkill (who revised the Dioscoreaceae regionally for the *Flora Malesiana*: Burkill (1951), in retirement and at age 81, based on earlier monographic work undertaken with Sir David Prain) (Holtum 1967) and his colleagues.

Holtum's concentrated experience during wartime internment in working out the orchids and gingers was reasonably successful only because of the availability of good living collections and specially collected specimens with good field notes and flowering parts in spirit; these were not available to the older accounts, causing much inaccuracy and taxonomic confusion. He was interested to research further monocot groups in which study was similarly disadvantaged. Bamboos are notoriously difficult because botanists have tended to name species based on flowering material, most often produced when the living plants are lacking fresh shoots with more easily seen features. As bamboos may tend to be in entirely vegetative (non-flowering) states

for prolonged periods, the early accounts that did not record adequate features were essentially useless as identification tools. Incorporating the missing information for an improved understanding demands specialised collecting and recording of features, a feat much aided by the existence of special living collections for a region's bamboo flora. His revision of Malayan bamboos (Holttum 1958a) had sought perspectives from the surrounding region, including living bamboos maintained in the more established Calcutta and Bogor collections. This seminal account in the *Bulletin* also included his perspective that the historical migration of peoples through Southeast Asia could have brought selected clones (especially the larger, more useful *Dendrocalamus* and *Gigantochloa* taxa) to Java and Peninsular Malaysia, where they are apparently known only in cultivation without any documented wild conspecifics. These are now recognised as “ancient enduring clones” (Muller 1999) and there is now evidence that some must have been selected from hybrid swarms that do naturally occur in our landscape (Muller 1998, Goh et al. 2011). This situation is especially relevant to the region from India and Myanmar through South and Indo-China, into the Malesian area. Understanding these basic premises point the way to more careful approaches in conserving valuable genetic materials selected through the ages.

There are *G. robusta* clumps planted in the Bogor Botanical Garden in 1844 during the time of the botanist Hasskarl that have remained alive for over 150 years (at least, they did not die from flowering, if any) and so are good subjects for agriculture (Wong 2004). Likewise, in discussing *Orchids, gingers and bamboos: Pioneer work at the Singapore Botanic Gardens and its significance for botany and horticulture* in the *Bulletin*, Holttum (1959) mentions a village bamboo from northern Malaya introduced to the Singapore Botanic Gardens that has persisted in vegetative state for decades; this is *G. ridleyi*, distinctive yet named without flowers (by Holttum to commemorate Ridley, who introduced it). This bamboo lives even now, over a century since its introduction, continuing its flowerless state. Holttum (Fig. 6) died in 1990, at the age of 95.

Steenis (1959) and Lam (1959) have further highlighted the virtues of a *Flora Malesiana* approach. Similarly, Corner settled into deeper research with Asian and Australasian *Ficus* at Cambridge, beginning on a worldwide perspective in *The Classification of Moraceae* (Corner 1962), and later led two Royal Society expeditions to Mt Kinabalu in 1961 and 1964 (Mandalam 2005). At the same time that Sinclair worked on Malayan Annonaceae, he reviewed material from India, Burma, Thailand, Borneo and New Guinea, publishing papers on interesting taxa. After his monograph of Malayan Myristicaceae (Sinclair 1958a), the taxonomic emphasis in Singapore began shifting towards closer collaboration with the Flora Malesiana Foundation (Burkill 1968). This was reflected in his *Florae Malesianae Precursores* XX, XXXI, and XLII published in the *Gardens' Bulletin, Singapore*, on *Gymnacranthera* (Sinclair 1958b), *Knema* (Sinclair 1961), and *Myristica* (Sinclair 1968, posthumously), respectively. Sinclair was retired prematurely in 1963 because of the “malayanisation” programme but re-engaged on contract until 1965, then stayed on at the Botanic Gardens as an honorary researcher until 1967. He also completed manuscript work on *Horsfieldia*, which was only retrieved from the Kew Herbarium following his death in 1968 and

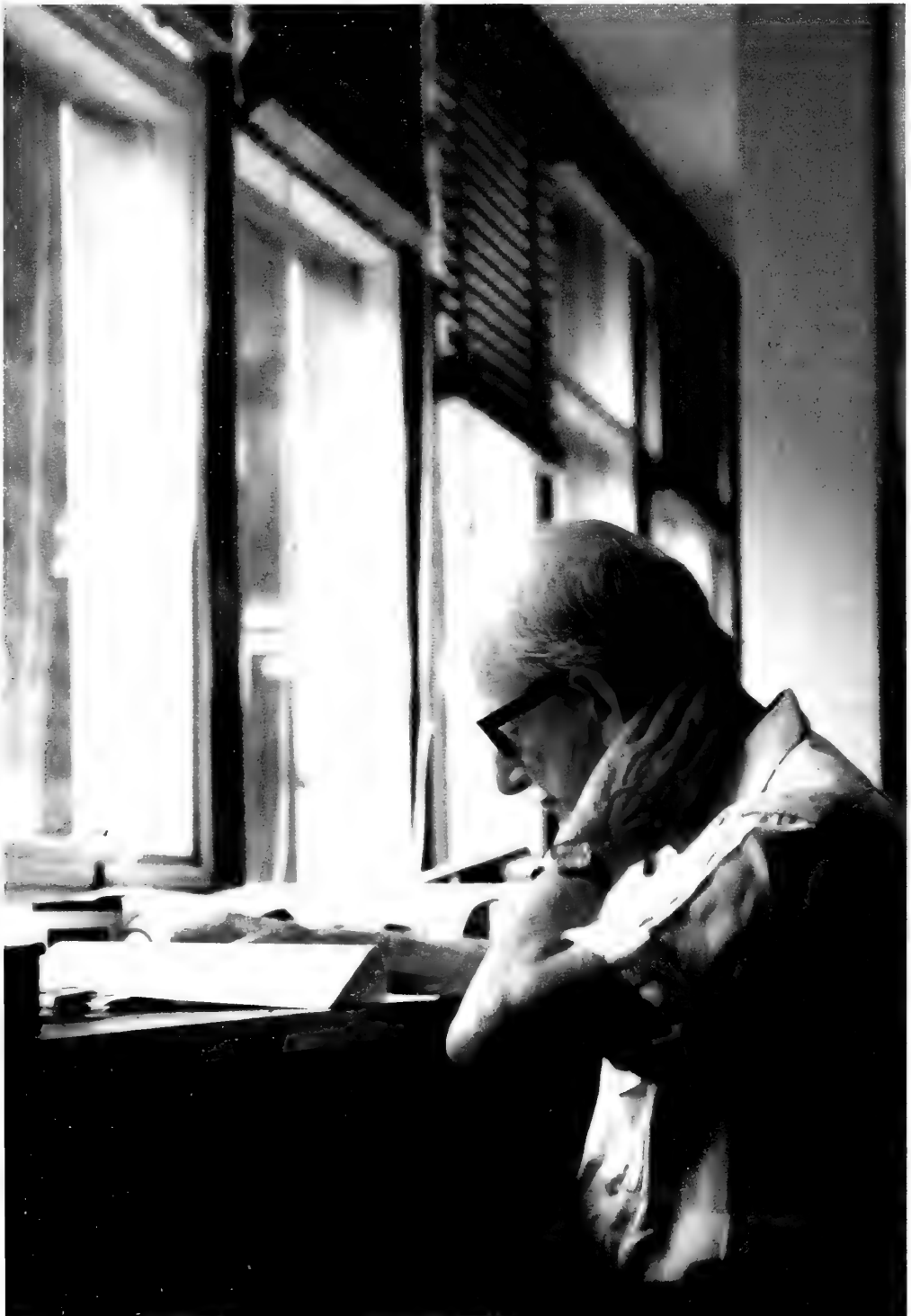


Fig. 6. R.E. Holttum in 1981. (Photo by K.M. Wong)

subsequently published in the *Bulletin* (Sinclair 1974, 1975). Chew Wee Lek's doctoral dissertation work supervised by Corner resulted in the latter's *Florae Malesianae Precursores XXXIV* on *Poikilospermum* (Chew 1963). The *Flora Malesiana* effort was also able to attract the participation of Hsuan Keng, based at the University of Singapore, resulting in *A revision of Malesian Labiatae* (Keng 1969).

Possibilities for participating in reciprocal research support with other countries probably became better established during this period, when H.M. Burkill was Director of the Singapore Botanic Gardens. Chew's research on *Laportea* and allied genera (Chew 1965, 1969a, b) was enhanced by the opportunity in 1964 to visit the herbaria of Cambridge, Kew, British Museum, Paris, Geneva, Leiden and Utrecht on a Royal Society Nuffield Foundation Commonwealth Bursary gained through Corner's support. This worldwide survey even enabled Chew's diagnosis of the new Central American genus *Discocnide*! On the other hand, revisions of *Petraeovitex* (Munir 1965) and *Symphorema* (Munir 1967) by Munir Ahmad Abid from the University of Sind, Pakistan, were possible with a Colombo Plan Fellowship through a Government of Singapore award to visit the Singapore Botanic Gardens in 1964 and 1965.

A very broad range of papers—from cryptogamic to seed plant subjects, covering taxonomy, morphology, evolution, physiology, ecology and conservation, and including country-specific or more regional geographical scopes—was now carried in the *Gardens' Bulletin, Singapore*. Thus, just about anyone working consistently with the botany of the Southeast Asian region, and occasionally elsewhere, began to publish with the journal. Somewhat opposite in direction, there was a "malayanisation" programme that sought to fill key positions with as many locally domiciled persons as possible, but meanwhile, the research scope (in tune with the imperatives of new scientific development) was going towards regionalisation and fast gaining an international dimension.

The Gardens in a Garden City

Less than 20 years after the admonishment by Purseglove (1959) regarding maintaining the close relationship between botanic gardens and science, further challenges were to appear when taxonomic research waned. Chang Kiaw Lan, who obtained her doctorate in mycology working under Corner at Cambridge, had returned as Botanist to the Gardens in 1965 but what would be her office in the new Herbarium building completed in 1964 was still occupied by James Sinclair (Wong 2003). Work on orchid culture was already underway with Hardial Singh, another Botanist engaged in 1963, but the development of facilities for Chang's experimental work in basidiomycete fungal development also needed to wait. In 1967, as Sinclair left, the Garden City Campaign was emphasised and Chang was asked to take charge of advisory work under this programme. Less than a year later she was seconded to the Primary Production Department, who wanted to begin mushroom cultivation research. Just over a year later, July 1969, after Chew Wee-Lek signalled there was an "acute shortage of botanists in the Botanic Gardens" with the retirement of H.M. Burkill, Chang was returned to the

Gardens: Chew succeeded Burkill and Chang became Keeper of the Herbarium in 1970. Unprecedented for a Director of the Gardens to serve just several months, Chew himself left Singapore in 1971.

In 1973 it was decided to merge the Botanic Gardens with the Parks and Trees Branch of the Public Works Department to form the Parks and Recreation (P & R) Division (Anonymous 1974); this became a full department in 1976 (Ministry of National Development 1977). There was more reorganisation. Geh Siew Yin, who trained under Hsuan Keng at the University of Singapore and was employed as Botanist in 1971, was moved to more administrative duties as Assistant Commissioner of the Garden in 1973. After Geh, no new taxonomists were recruited for another two decades (Kiew 1999). By 1975, Hardial Singh was also transferred to non-research duties in P & R and only Chang was left to keep the Herbarium going. All this was an incredible rate of flux in the Botanic Gardens research outfit, which had, in the first place, run on only a skeleton staffing of a handful of mainly taxonomic botanists. H.M. Burkill (1993) deplored this decline and the notion that a botanic gardens of standing could function effectively without strong research support for its collections, education and conservation programmes.

Chang (Fig. 7) had a superb command of languages, was an able editor and prolific correspondent who kept in touch with a great number of botanists worldwide and their requests for information and assistance (Wong 2003), and ably coordinated the stay and activities of visiting scientists at the Singapore Herbarium. This encouraged many botanists internationally to contribute to the *Gardens' Bulletin*. There was still an inflow of manuscripts from former Gardens staff members, including Corner and Holttum, and a number from Keng, Wee Yeow Chin and A.N. Rao and their students from the University of Singapore. Corner's *The Freshwater Swamp-Forest of South Johore and Singapore* (Corner 1978) became the first supplementary issue of the *Gardens' Bulletin*, simply enumerated as "Supplement no. 1". Also at around this time, Keng's series on the *Annotated list of seed plants of Singapore*, which would become the longest-spanning series published entirely in the *Bulletin* by a single author, appeared in 1973 (instalment I); subsequent instalments were published in 1974 (II and III), 1976 (IV), 1978 (V), 1980 (VI), 1982 (VII), 1983 (VIII), 1985 (IX), 1986 (X), and 1987 (XI). [Furtado's series from a different time, *Palmae Malesicae* (with 19 instalments spanning 1934–1956) was longer but the first part was published in the Berlin-based *Feddes Repertorium*, not the *Gardens' Bulletin*.] The *Limestone hill flora of Malaya* by S.C. Chin of the University of Malaya, which updated and extended Henderson's work previously, appeared in four instalments beginning 1977 and continuing in 1979 (Part II) and 1983 (Parts III and IV). Chang's co-editing or editing, respectively, of the festschrifts for Corner (Vol. 29; Mabberley & Chang 1977) and Holttum (Vol. 30), came out admirably and on these occasions a special taxonomic shine returned to the Gardens. At this time, because of a greater research emphasis by P & R on horticultural matters, there was also an increase in papers reporting experimental horticultural investigations (both in the laboratory and field).

Abrupt changes came to the management of the *Gardens' Bulletin* for Vol. 31 Part 2 (December 1978). Asked to manage other aspects, Chang left the editorship



Fig. 7. Chang Kiaw Lan at her editing desk in December, 1974. (Photographer unknown, courtesy of Christina Tan)

and was succeeded, for short periods, by Hardial Singh (Vol. 31 Part 2, Vol. 32), Y.S. Choo (Vol. 33 Parts 1 and 2), and J.F. Maxwell (Vol. 34 Part 1). Then when Geh chaired the editorial committee in place of the head of department who resigned, she also had to take over as editor from Vol. 34 Part 2 (December 1981) and brought back Chang's expertise to assist with the *Bulletin*. Chang became managing editor from 1982 until 1987, when she retired, whereupon the editorship was managed by Geh until Chin See Chung was appointed Keeper of the Herbarium and jointly edited from 1993 (Vol. 45) to 1996 (Vol. 48), when he became Director and Geh relinquished her role to concentrate on another responsibility. T.W. Foong was also co-editor of the *Bulletin* for 1995–1996. The *Bulletin* had literally gone through thick and thin, through a difficult period when taxonomic productivity in its own home was at an ebb, and it was Chang and Geh who plodded on with the work that kept the journal reasonably well. As it turned out, this perseverance was significant because it brought the *Bulletin* through a phase when in-house contribution was much lower than ever before. This remarkable survival has developed a distinctly international flavour that has kept up with scholarly expectations in scientific publishing: a significant volume of the contributions coming from an international field of authors attracted to good standards in editing, peer review of material, printing quality and timeliness of production.

Besides the broadened array of international contributions, several lines of work brought out through the *Bulletin* are of special note for the Malay Peninsula and for Singapore. Ian Turner, a taxonomist and ecologist and sometime Assistant Director in charge of Horticulture at the Singapore Botanic Gardens, published *A*

Catalogue of the Vascular Plants of Malaya (Turner 1995), summarising efforts as far as possible to present Malayan taxa with their most currently accepted names. Two series of contributions mainly coordinated by National University of Singapore botanists became visible, *The angiosperm flora of Singapore* (Tan et al. 1992a, and onwards) and *Additions to the flora of Singapore* (Tan et al. 1992b, and onwards). A *Field Guide to the Grasses of Singapore* (Duistermaat 2005) was published as Supplement to Vol. 57 of the *Bulletin*, a departure from separate numbering of earlier supplements. Taxonomic work on orchids was re-emphasised somewhat with J.J. Vermeulen (2000, and onwards) on the staff for some years, and Peter O'Byrne having taken up residence in Singapore. Also, Ruth Kiew's research on *Begonia*, besides her other work that is often reported in the *Bulletin*, culminated in a Peninsular Malaysian account (Kiew 2005).

There was redoubled interest in the biodiversity of Singapore itself. Greater attention was focussed on the ecology of trees at the Bukit Timah Nature Reserve (Wong 1987, Swan 1988) and the Central Catchment Nature Reserve (Wong et al. 1994), and a wider stocktaking of biological communities with *Rain Forest in the City: Bukit Timah Nature Reserve, Singapore* (Chin et al. 1995). In 1993, a 2-ha permanent ecological plot was set up in Bukit Timah that joined a long-term network of research plots in tropical forests around the world coordinated by the Center for Tropical Forest Science (CTFS) of the Smithsonian Tropical Research Institute, in partnership with the Nanyang Technological University's National Institute of Education and the National Parks Board (LaFrankie et al. 2005). Chan & Corlett (1997) edited a special part on *Biodiversity in the Nature Reserves of Singapore*. Turner et al. (1996) continued a long-standing interest in local ecology in the *Bulletin* with a new appraisal of the freshwater swamp forest in Singapore.

The effort to resuscitate the taxonomic sciences at the Singapore Botanic Gardens only gained in pace when the orchidologist Tan Wee Kiat became Director of the Singapore Botanic Gardens in 1989. Around this time, the opportunity for reorganisation identified a National Parks Board as an ideal body for incorporating a larger emphasis on environmental and biodiversity conservation in its management of Singapore's green spaces and biological resources. With all the reorganisational flux, the *Gardens' Bulletin* was not issued during 1990, the only time since the Second World War period when issues missed some years! When Tan became Executive Director of NParks (as the organisation came also to be known) in 1990 (concurrently still Director of the Gardens), taxonomic activity was restored. Tay Eng Pin, a taxonomist and morphologist who trained with Francis Hallé and had served in various capacities with P & R and then NParks, was asked to take charge of the Keeper's duties as Senior Research Officer (Taxonomy) from 1990 until 1993, when he left and Chin, an ethnobotanist and forest botanist who had studied with D.M. Smith, H.C. Conklin and Benjamin C. Stone, was appointed Keeper and Senior Research Officer (Plant Introduction). Tan became Chief Executive Officer of NParks in 1996, and Chin was made Director of the Gardens. Ruth Kiew (another student of Corner's) was appointed Keeper of the Herbarium and concurrently was Editor of the *Bulletin*, 1997–2006; succeeded by Benito Tan, 2006–2010, and the present author from 2010.

Hindsight a hundred years on

The development of the *Gardens' Bulletin, Singapore* can be traced from its roots as a monthly bulletin. It provided reports of agricultural development and commodities and occasional notes and articles of interesting crop and wild plants of its immediate region, which was actively opening up for agricultural and other industries through colonial development. Its transformation has been mediated by historical events, from the enlargement of administrative and economic divergence between the Straits Settlements and the Federated Malay States, to World War II, and the “malayanisation” period during which the post-war British administration gave way to independence and much reorganisation.

The *Bulletin* was reoriented as a scientific periodical during the time of I.H. Burkill. Scientifically, the scope has diversified from an essentially “Malayan” perspective painstakingly documented and refined through the primary efforts of a small team of in-house botanical personnel at the Singapore Botanic Gardens, to a more regionally relevant publication avenue in parallel with the larger floristic insights of *Flora Malesiana*, and finally a journal with an international outlook. This development appears inevitable, as at first, British Malaya was a natural unit largely flanked by Dutch-held territories across the Malay Archipelago, and as the unfolding science revealed much more about the region’s floristic limits and extreme biological richness, a greater regional and then international perspective was necessary for meaningfully continuing both science and development. The key ingredients that fuel this development have, at all stages, involved persons with specialised botanical training who had an unusual appetite for their science and steadfastness of scholarship and purpose. Above all, they had a great respect for continuing a heritage accrued through the changing fortunes of boom and ebb, and between prosperity and adversity.

‘We have a vision for our time, but we can be certain that it will not be the last.’

Richard Fortey, *Earth* (2005)

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A revision of *Nepenthes* (Nepenthaceae) from Gunung Tahan, Peninsular Malaysia

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ABSTRACT. The *Nepenthes* from Gunung Tahan in Peninsular Malaysia are revised. We recognise four species from this mountain: *N. alba*, *N. benstonei*, *N. gracillima* and *N. sanguinea*. The reinstatement of *N. alba* is based on a consistent difference in upper pitcher colouration between it (typically evenly pale yellowish to ivory white) and *N. gracillima* (dark green with purple-brown speckles). Material from Gunung Tahan that was identified in previous treatments as *N. macfarlanei* belongs to *N. gracillima* and the former species is absent from Gunung Tahan. *Nepenthes alba* and *N. gracillima* are very similar to *N. macfarlanei*; and further examinations of the relationships among these taxa are warranted.

Keywords. *Nepenthes alba*, *N. benstonei*, *N. gracillima*, *N. macfarlanei*, Gunung Tahan, Malaysia

Introduction

Eleven species of *Nepenthes* (Nepenthaceae) have been recorded from Peninsular Malaysia, including five montane species, which are generally found in habitats above 1000 m altitude (Cheek & Jebb 2001; Clarke 2001; McPherson 2009). All of the montane species have been recorded from Gunung Tahan which, at 2187 m above sea level (asl), is the highest mountain on the Malay Peninsula. Situated in the Timur Range, Gunung Tahan is isolated from the main Titiwangsa Range of Peninsular Malaysia by at least 100 km. To date, eight *Nepenthes* taxa have been recorded from the mountain, including *N. alata* Blanco, *N. bongso* Korth., *N. singalana* Becc., *N. macfarlanei* Hemsl., *N. alba* Ridl., *N. gracillima* Ridl., *N. sanguinea* Lindl. and *N. benstonei* C. Clarke. The *Nepenthes* of Gunung Tahan have been reviewed on a number of occasions (Ridley 1924; Danser 1928; Kiew 1990; Jebb & Cheek 1997; Clarke 2001; McPherson 2009), but uncertainty about the correct identity and status of several taxa persists. Most confusion relates to *N. gracillima* and its relationships to *N. macfarlanei* and *N. alba*. In this paper, we demonstrate that the source of much of this confusion arises from a failure by previous researchers to properly delineate *N. gracillima*. As a consequence, many collections of this species have been misidentified as *N. macfarlanei*. We argue that *N. macfarlanei* is absent from Gunung Tahan, where

it is replaced by *N. gracillima*, but that these taxa are very closely related, exhibiting few significant morphological differences. We conclude that only four *Nepenthes* species are extant on Gunung Tahan. These are *N. alba* (also a very close relative of *N. gracillima* and *N. macfarlanei*), *N. benstonei*, *N. gracillima* and *N. sanguinea*. Our interpretations are based on both detailed field observations and examinations of herbarium material. As all previous descriptions of *N. gracillima* have included material that we consider to belong to other taxa, and a detailed description of *N. alba* has never been published, we present revised descriptions of these taxa and a key to the *Nepenthes* of Gunung Tahan.

Discovery and description of *Nepenthes* from Gunung Tahan

The first botanist to describe *Nepenthes* from Gunung Tahan was H.N. Ridley, who was Director of the Singapore Botanic Gardens from 1888–1911. He based his initial identifications and descriptions (Ridley 1908) upon specimens collected by H.C. Robinson and L. Wray on an expedition to Gunung Tahan made in 1905. The first species he recorded was identified as *N. bongso*, a species that was previously known only from Sumatra. This identification was made on *Wray & Robinson 5411* (SING), which comprises a fragment of a climbing stem of a diminutive plant that bears four upper pitchers and a male inflorescence (Note: *Nepenthes* are generally dimorphic, producing two types of pitchers that are usually referred to as “lower” and “upper”. For a review of plant architecture, see Clarke (2001)). Ridley (1908) also described a new species, *N. gracillima*, based upon *Wray & Robinson 5309* (SING). This specimen consists of a fragment of a climbing stem bearing three upper pitchers and an infructescence, which is badly damaged. The lower pitchers of *N. gracillima* were not described by Ridley (1908), nor were any specimens bearing lower pitchers equated with *N. gracillima* by him. The descriptions for both taxa are very brief and lack sufficient detail to make objective comparisons. The pitchers, leaves and stems of the two specimens are very similar in structure – the primary difference between them appears to be the colour of the pitchers. Those of *Wray & Robinson 5411* were said to be white, tinted pale green at base and spotted with pink, whereas those of *Wray & Robinson 5309* were stated to be “pale green, tinted in places with dull crimson and mottled with dull purple”. Ridley (1908) also noted that the “neck and lamina” of the pitcher lid of *N. gracillima* was pubescent.

In the same year, Macfarlane (1908) identified *Wray & Robinson 5411* as *N. singalana* (another Sumatran species), but did not explain his interpretation. Macfarlane (1908) also provided a more detailed description of *N. gracillima* and stated that the pitchers were monomorphic (i.e., only one type is produced; thereby implying that lower pitchers had not been collected because they are not produced). Of the indumentum of the pitcher lids, he wrote, *extus et intus sparse pubescens...* (= “sparsely pubescent inside and out”). At the time of Macfarlane’s revision, the only other species from Peninsular Malaysia that was known to have hairs on the lower surface of the pitcher lid (referred to hereafter as “lid hairs”) was *N. macfarlanei*,

which had been recorded from a number of mountains in the Titiwangsa range, in addition to the type locality on Gunung Bubu in Perak. Neither Ridley (1908) nor Macfarlane (1908) discussed this distinctive, shared characteristic further, nor was any mention made regarding the presence of lid hairs on *Wray & Robinson 5411*.

In 1909, Ridley described *N. ramispina* Ridl., a species that bears strong similarities to *N. gracillima*, but which occurs in the main Titiwangsa Range, to the west of Gunung Tahan (Ridley 1909). This species lacks lid hairs, but in most other respects, its pitchers are very similar to those of *N. gracillima*. Ridley (1909) distinguished this species from *N. gracillima* on the basis of the large, branched spurs at the apices of the pitchers (the spurs of *N. gracillima* are simple).

In 1911, Ridley climbed Gunung Tahan and made several further collections, one of which (*Ridley 16097* (SING (1 sheet), K (2 sheets))) he identified as *N. singalana*. The sheet at SING consists of a fragment of a climbing stem bearing two upper pitchers and two female inflorescences. The leaf structure differs from that of *N. gracillima* in two important ways: (a) the leaf blades are subpetiolate instead of sessile, and (b) the margins of the leaf blades are decurrent along the internodes for up to 1.5 cm. The sheet at K that is barcoded *K000651565* contains a fragment of a climbing stem with an immature female inflorescence, but no pitchers. The leaf structure of this specimen is the same as that of the sheet at SING and these clearly belong to the same taxon. However, the sheet at K barcoded *K000651564* contains a fragment of a climbing stem that bears sessile, non-decurrent leaves and small, squat aerial pitchers that resemble those of *Wray & Robinson 5411*. Clearly, this is a mixed collection involving two different taxa, neither of which were equated with *N. gracillima* by Ridley.

Ridley (1924) eventually corrected his mis-identification of *Wray & Robinson 5411*, noting that it was not the same as *N. bongso* (or *N. singalana*) and instead described it as a new species, *N. alba*. Once more, the description was very brief, but Ridley clearly mentioned the distinctive colour of living plants of *N. alba*, as follows: "pitcher...ivory white, sometimes spotted with rose pink in the mouth and lid, rarely canary yellow.

Danser (1928) revised the genus for the Netherland's Indies (now Indonesia), along with a few outliers from adjacent regions, including the Malay Peninsula. With regard to the *Nepenthes* of Gunung Tahan, Danser re-determined *Ridley 16097* (SING) as *N. alata*. Prior to Danser's revision, *N. alata* was known only from the Philippines, but Danser also reduced *Nepenthes eustachya* Miq. from Sumatra to a synonym of *N. alata*, thereby extending its geographical range substantially. This interpretation also broadened the degree of morphological variation encompassed by *N. alata* and as Peninsular Malaysia lies between Sumatra and the Philippines, it is perhaps not surprising that Danser felt that *Ridley 16097* also represented this species. However, no other collections that can be equated with *N. alata* have ever been made in Peninsular Malaysia, casting doubt over the validity of his interpretation of this specimen (Kiew 1990; Clarke 2001; see below).

Danser (1928) also reduced *N. ramispina* and *N. alba* to synonyms of *N. gracillima*, stating that the differences among them were "of very little importance". He noted that herbarium material of *N. gracillima* was not always easily distinguished

from *N. macfarlanei* and *N. sanguinea*. Furthermore, he tentatively identified two specimens (*Wray 339* (BO) and *Ridley 16174* (SING)) as belonging to a natural hybrid, *N. gracillima* × *N. macfarlanei*. *Ridley 16174* was collected from Gunung Tahan, near Wray's Camp (the type locality for *N. gracillima*) and of these specimens, Danser (1928) wrote,

The pitchers are too wide for *N. gracillima* and the underside of the lid in the number *Wray 339* bears the bristles typical of *N. macfarlanei*. I should prefer to mention this specimen under the latter species, the pitchers of which vary extraordinarily, when the inner margin of the peristome were not entire. The other number, *Ridley 16174*, bears much more dense and delicate hairs on the underside of the lid, a character that is also often found in *N. sanguinea* and *N. macfarlanei*.

Below, we demonstrate that *Ridley 16174* belongs to *N. gracillima*, and that Danser was the first to confuse material of *N. gracillima* with *N. macfarlanei*, due to the presence of lid hairs. It has since been demonstrated that *N. sanguinea* lacks lid hairs, but that a few hairs may be present on lids of *N. macfarlanei* × *N. sanguinea* pitchers (Jebb & Cheek 1997; Clarke 2001). Danser's (1928) revised description of *N. gracillima* included material of *N. ramispina* and *N. alba*, and made no mention of lid hairs in this taxon, indicating that he was of the opinion that lid hairs were found only in *N. macfarlanei*.

Kiew (1990) was the first since Ridley to combine examinations of herbarium material from Gunung Tahan with field observations (Macfarlane and Danser never visited the mountain). She re-determined *Ridley 16097* as *N. gracillima* and explained that Danser's (1928) determination was a simple misidentification (Clarke 2001). It is however intriguing that neither Ridley nor Danser equated this specimen with *N. gracillima*; suggesting that the reasons for their misidentifications were not necessarily straightforward. Kiew (1990) noted that the first *Nepenthes* to be encountered on the southern route to Gunung Tahan (from Kuala Tahan) is *N. macfarlanei*, near Wray's Camp at approximately 900 m asl (where *Ridley 16174* was collected). She distinguished it from the other species on the basis of the underside of the pitcher lid, which is covered in coarse hairs, and by the inner edge of the peristome, which is toothed. She then discussed *N. gracillima*, referring to it as the most conspicuous pitcher plant of the padang, festooning

...every bush with its small, ivory-white pitchers, which from afar look like candles.

Plants begin life producing deep purple leaves and pitchers that are almost black in colour. Once a climbing stem develops the leaves produced are green and the pitchers ivory-white with rosy spots in the upper part. It is still possible to find on the same plant purplish pitchers, which are usually hidden within the crown of the supporting shrub.

Kiew (1990) indicated that Ridley (1915) was of the opinion that the white-pitchered plants belonged to *N. alba* (although the latter name was not published until 1924), whereas the purple/black-pitchered plants belonged to *N. gracillima*. However, she argued that since both pitcher types can be found on the same plant, this was not the case and all plants belonged to *N. gracillima*. This concept of *N. gracillima* is contingent on how the type specimen (*Wray & Robinson 5309*) is interpreted: if the gracile, dark-coloured pitchers of this specimen are considered to be the same as the lower pitchers of *N. alba*, then Danser's (1928) decision to reduce *N. alba* to a

synonym of *N. gracillima* is justified. However, *Wray & Robinson 5309* bears upper pitchers on a climbing stem—their shape and colouration are not consistent with the corresponding pitcher type in *N. alba*.

Kiew's (1990) observations of *N. gracillima* on Gunung Tahan also showed that clear morphological differences exist between this taxon and Ridley's *N. ramispina*, which seems to be confined to the Titiwangsa Range. As a consequence, Jebb & Cheek (1997) reinstated *N. ramispina*, thereby ending some of the confusion surrounding *N. gracillima* and limiting any persistent uncertainty to populations from the Timur Range. Jebb & Cheek (1997) retained Danser's (1928) concept of *N. gracillima*, with *N. alba* as its synonym and, like Kiew (1990), treated *Ridley 16097* as belonging to *N. gracillima* (they also reinstated *N. eustachya*, thereby removing much of the confusion about the status, morphological variation and geographical distribution of *N. alata*, which is now known to be endemic to the Philippines (Jebb & Cheek 1997)).

Clarke (2001) adopted Jebb & Cheek's (1997) interpretations of *N. gracillima* and *N. ramispina*, but rejected Kiew's (1990) interpretation of *Ridley 16097*, considering this specimen to be *N. benstonei*, a recently-described species from Bukit Bakar in Kelantan, approximately 120 km to the north of Gunung Tahan (Clarke 1999, 2001). Clarke (2001) provided a detailed explanation of the differences between *N. benstonei* and *N. gracillima*, noting that the leaf blade structure (in particular, the sub-petiolate leaf bases and decurrent leaf margins), indumentum and pitcher characteristics of *Ridley 16097* correspond with those of *N. benstonei*. Clarke's (2001) treatment of *N. gracillima*, *N. alba* and *N. ramispina* was limited to herbarium material and followed that of Jebb & Cheek (1997).

Cheek & Jebb (2001) provided a revised description and illustration of *N. gracillima*, based almost entirely on specimens at SING and K that are representative of Ridley's concept of this species (e.g., *Ridley 16174* (SING, K), *Haniff 7890* (SING), *Pannell 1132* (K) and *Ridley 16090* (K), rather than *N. alba*. For the first time, specimens bearing lower pitchers (*Pannell 1132*) were included. In terms of size and colour, the lower pitchers of *Pannell 1132* are similar to those of the upper pitchers on the type (*Wray & Robinson 5309*). Both the description and illustration of *N. gracillima* (Fig. 8) indicate that the pitcher lids have hairs on the lower surface, yet this feature was not discussed further.

McPherson (2009) climbed Gunung Tahan via the western route from Sungai Relau in 2008. He considered *N. alba* to be distinct from *N. gracillima*, stating that the taxa he observed were consistent with Ridley's original descriptions of them. Several differences in morphology were used to distinguish these taxa; these are summarised in Table 1.

McPherson (2009) placed considerable emphasis on variations in pitcher size and colour (especially the colour of the upper pitchers of *N. alba*). Although these characteristics may differ substantially between these taxa, it is worth noting that the types of both *N. gracillima* (*Wray & Robinson 5309*) and *N. alba* (*Wray & Robinson 5411*) bear upper pitchers of roughly equivalent structure and dimensions and are not atypical for their respective taxa, indicating that the types cannot be reliably or consistently distinguished on the basis of size or gross morphology: the only apparent

Table 1. Morphological characteristics that distinguish *N. alba*, *N. gracillima* and *N. macfarlanei*.

Characteristic	<i>N. alba</i>	<i>N. gracillima</i>	<i>N. macfarlanei</i>
Geographical range	Timur Range	Timur Range, Gunung Tapis	Titiwangsa Range, Gunung Bubu
Altitudinal range	1400–2150 m	900–1700 m	900–2100 m
Habitat	Terrestrial in highly stunted, open padang vegetation	Terrestrial or epiphytic in closed upper montane forest	Terrestrial or epiphytic in mossy forest
Lid hairs	Very fine, up to 1 mm long	Very fine, up to 2 mm long	Fine, up to 3 mm long, except on Gunung Bubu, where they are coarse, up to 5 mm long
Tendrils of rosette leaves	0.8–1.5 times the length of pitcher height and leaf length	2–5 times longer than pitcher height	2–5 times longer than pitcher height
Tendrils of leaves on climbing stems	Equal to or shorter than pitcher height and leaf blade length	Longer than both leaf blade length and pitcher height	Longer than both leaf blade length and pitcher height
Size of lower pitchers	Up to 12 cm tall and 4.5 cm wide, but usually much smaller	Up to 22 cm tall and 7 cm wide, often reaching these dimensions	Up to 22 cm tall and 7 cm wide, often reaching these dimensions
Colour of lower pitchers [on rosettes of mature plants]	Predominantly purplish brown, with a lighter interior and dark purple or black peristome. Colouration very consistent.	Predominantly yellow-green, with dark red or purple blotches. Interior light yellowish-green. Peristome green or reddish, often striped with bands of dark red or purple.	Predominantly yellow-green, with dark red or purple blotches. Interior light yellowish-green. Peristome red.
Lid of lower pitchers	Orbiculate or elliptic	Elliptic or ovate	Sub-orbiculate
Production of intermediate pitchers	Rare	Dominant form of pitcher on climbing stems	Occasional on climbing stems in dense forest
Intermediate pitchers	Broadly infundibular in the lower half, hip distinct, cylindrical above	Narrowly infundibular in the lower half, hip present but not pronounced, narrowly infundibular above	Narrowly infundibular in the lower half, hip present, infundibular above
Upper pitchers	Infundibular in the lower 1/2–2/3, sharply contracted at the hip, cylindrical to narrowly infundibular above	Very narrow throughout, infundibular in the lower 1/3, gradually contracted above the hip, cylindrical above	Infundibular from base to hip, hip located anywhere from immediately beneath peristome to 1/3 of the way up from the base; cylindrical to slightly infundibular above the hip

Characteristic	<i>N. alba</i>	<i>N. gracillima</i>	<i>N. macfarlanei</i>
Colour of upper pitchers	Conspicuous white colouration often with red blotches and flecks	Uniformly black, strongly speckled bright green.	White with red flecks and bands on the peristome, to green, with dark purple speckles and peristome bands.
Lid of upper pitchers*	Orbiculate or elliptic	Elliptic or ovate	Sub-orbiculate
Size of intermediate pitchers on mature plants	Up to 9 cm tall by 2 cm wide	Up to 22 cm tall by 4 cm wide	Up to 18 cm tall by 5 cm wide
Size of upper pitchers on mature plants	Up to 12 cm tall by 3 cm wide	Up to 10 cm tall by 1.5 cm wide	Up to 20 cm tall by 6 cm wide
Colour of lower pitchers on seedling rosettes	Reddish-purple throughout, overlain with dark purple flecks; peristome dark pink-purple	Dull green, heavily overlain with dull red-brown flecks; peristome dull brown throughout	Variable: greenish white, heavily overlain with brown, pink or red flecks; peristome dark red or pink throughout
Colour of lower pitchers	As in the seedling rosettes	Dark to light green, moderately to heavily overlain with dark red-brown flecks throughout; peristome green with red-brown stripes or dark red-brown throughout	As in the seedling rosettes
Colour of the intermediate pitchers	Whitish-green, heavily overlain with thin, dark red-brown flecks throughout	As in the rosette pitchers	As in the rosette pitchers
Colour of the upper pitchers	Ivory white throughout, sometimes overlain with rose to red specks, to varying degrees of intensity	As in the rosette pitchers	As in the rosette pitchers, or ivory white throughout, usually with some rose pink flecks

* This characteristic is informative, but we found the lids of *N. alba* pitchers to be orbiculate and cordate at the base, whereas those of *N. gracillima* are ovate and not cordate.

differences between them relate to colour (which the collectors' label annotations on the type specimens and the species descriptions (Ridley 1908, 1924) clearly record). Furthermore, there are specimens of *N. alba* from 2100 m asl on the padang (e.g., *Strugnell & Sow 42878* (KEP)) that bear heavily speckled pitchers that strongly resemble *N. gracillima*. Variation in pitcher size and colour in most *Nepenthes* species is considerable and Danser (1928) commented on its lack of taxonomic value (although

Clarke (2001) demonstrated that in some taxa, pitcher colour can be both a stable and informative characteristic).

Several characteristics of *N. gracillima* that were used by McPherson (2009) to distinguish it from *N. alba* are not consistent with Ridley's (1908) or Jebb & Cheek's (2001) descriptions of this species: these describe a small, slender plant that is very similar in most respects to *N. alba*, not the robust, large one discussed by McPherson (2009). In fact, the plant that McPherson treats as *N. gracillima* bears a very strong resemblance to *N. macfarlanei*. McPherson (2009) provided two photographs of *N. gracillima*. His Fig. 316 is a photograph of a lower pitcher that is broadly ovoid, with a peristome that is flattened and expanded towards the rear, and which bears distinct teeth. The ovate lid is densely covered with simple white hairs – these cause the central part of the lid to appear out of focus in this photograph, even though both the front and rear margins are in focus. His Fig. 317 is a photograph of an upper pitcher. Again, the ovate lid is covered with hairs on the underside, while the peristome is narrower and mostly cylindrical throughout, but small teeth are still apparent towards the apex of the orifice at the rear. The pitcher has a distinct hip approximately 1/3 of the way up from the base and appears in most respects to represent an intermediate pitcher of *N. macfarlanei*.

Thus, there is a distinct disparity between the published descriptions of *N. gracillima* and McPherson's (2009) interpretation of it. There are two possible explanations for this: (a) he confused plants of *N. macfarlanei* with *N. gracillima*; or (b) he correctly identified *N. gracillima*, but this species is more similar to *N. macfarlanei* than anyone has previously realised, possessing some morphological traits that have generally been considered diagnostic of that species. McPherson (2009) noted that "significant populations [of *N. macfarlanei*] occur in.... Taman Negara", indicating that he identified some plants that he saw on the mountain as this species. As a consequence, McPherson's (2009) arguments for reinstating *N. alba* have merit, but *N. gracillima* is yet to be clearly defined and delimited with regard to its putative close relatives. Against this background, we visited Gunung Tahan to study its *Nepenthes* flora and attempt to resolve some of the uncertainties about *N. benstonei*, *N. gracillima*, *N. macfarlanei* and *N. alba*.

Materials and methods

We conducted detailed examinations of herbarium material at the following herbaria: Singapore (SING), Forest Research Institute Malaysia (KEP) and Bogor (BO). Although relevant material at K and L has been seen by one of us (CC), the detailed examinations required to make a contribution in this paper have not been made, although digital images of some specimens that are available online were consulted. We conducted field observations on Gunung Tahan from March 29 to April 1, 2011, ascending the mountain by the western route, from Sungai Relau. Waypoints and locations were recorded using a Garmin Dakota 20 GPS receiver (Garmin Corporation, Kansas), using the WGS84 geodetic system.

Results

The first *Nepenthes* we encountered on the western route to Gunung Tahan was *N. benstonei*, which is common on steep ridge tops between approximately 800 and 1200 m altitude. This species is clearly abundant and widespread on Gunung Tahan, even though no other researchers have recorded it there.

From about 1350–1700 m asl, in dense vegetation up to 6–10 m tall along ridge tops, we encountered a second species, growing as both an epiphyte or terrestrially in mossy embankments. This taxon resembles *N. macfarlanei* in virtually all respects, with the lower surfaces of the pitcher lids being covered with short, simple white hairs. The lower pitchers of these plants frequently resemble those of *Ridley 16174*, which Danser (1928) thought could have been a natural hybrid between *N. macfarlanei* and *N. gracillima*. At about 1500 m asl (N 4.6354°, E 102.2051°), we encountered a *Nepenthes* that climbs into the forest canopy (up to 5 m) and produces very slender, small upper pitchers that match those of the type of *N. gracillima*. We traced the stems of this taxon to the ground and found they belong to the same plants that we had previously thought were *N. macfarlanei*. We repeated this exercise on many occasions throughout the range of the plants that resemble *N. gracillima* and *N. macfarlanei* that we saw on Gunung Tahan and determined that they all belonged to the same taxon. These plants also correspond well with the photographs and description of *N. gracillima* provided by McPherson (2009). Several plants at the location produce pitchers that closely match the large, robust “upper” pitcher of *N. gracillima* illustrated in Fig. 317 of McPherson (2009). These are exclusively borne on climbing stems that are 1–3 m in length. Longer stems produce the smaller, more gracile type of upper pitchers seen on the type. We observed this growth pattern (and production of two types of pitchers on climbing stems) to be common to virtually all mature plants of *N. gracillima* that we observed on Gunung Tahan.

On the basis of our findings, we concluded that McPherson (2009) did correctly identify *N. gracillima*, but that he mis-identified some plants of this species as *N. macfarlanei*, and that the origin of this error can be traced back to the early years of the 20th century. As a consequence, McPherson's (2009) concept of *N. gracillima* overlooks some important characteristics of this species, particularly the presence of lid hairs and the production of two types of pitchers on the climbing stems. In distinguishing *N. alba* and *N. gracillima*, he compared the upper pitchers of the former to the intermediate pitchers of the latter. In most instances, this oversight would be of little consequence, but in the case of *N. alba* and *N. gracillima*, it is the principle reason for the lack of clarity surrounding *N. gracillima*.

We tentatively support McPherson's (2009) decision to reinstate *N. alba*. However, McPherson (2009, p.567) is incorrect in stating that:

...with its white upper pitchers, *N. alba* could be confused with populations of *N. macfarlanei* that exhibit similar colouration, such as those from Mount Berincang (or Brinchang) in the Cameron Highlands. *Nepenthes alba* can be distinguished from that species by the lack of simple white hairs on the lower surface of its lid, which are a consistent feature of *N. macfarlanei*.

Lid hairs are present and prominent on both the lower and upper pitchers of *N. alba*, emphasising its close relationship with *N. gracillima* and *N. macfarlanei*. For some reason, these have not been detected or emphasised previously, even though they are easily seen, both in the field and on herbarium specimens. Table 1 presents the morphological and ecological characteristics that we consider to be stable and informative for distinguishing *N. alba*, *N. gracillima* and *N. macfarlanei*, but we contend that these three species are very closely related and exceptions to these character combinations are likely to occur. Further comments on the features of individual specimens that assist in delineating the species are provided below.

The montane *Nepenthes* species of Gunung Tahan

The four montane *Nepenthes* species from Gunung Tahan that we recognise are presented below. Revised, comprehensive descriptions for *N. alba* and *N. gracillima* are provided, for the first time in the case of *N. alba*. Our description of *N. gracillima* is the first since Macfarlane (1908) that does not include material of other taxa.

Key to montane *Nepenthes* of Gunung Tahan

- 1a. Lower surface of pitcher lid always lacking hairs 2
- b. Lower surface of pitcher lid with short, simple white or red hairs 3

- 2a. Margins of the leaf blade not decurrent along the internode, margins of rosette leaves glabrous *N. sanguinea*
- b. Margins of the leaf blade decurrent along the internode, margins of rosette leaves lined with short red or white hairs *N. benstonei*

- 3a. Lower pitchers funnel shaped above the hip; pitcher lids circular, strongly cordate at the base; spur < 5 mm long on mature plants; peristome teeth indistinct or very short, < 0.2 mm; upper pitchers ivory white in colour with pink specks or occasionally pale yellow..... *N. alba*
- b. Lower pitchers only slightly contracted at the hip, cylindrical above; pitcher lids ovate, not strongly cordate at the base; spur up to 12 mm long on mature plants; peristome teeth distinct 0.5–5.0 mm; upper pitchers green, heavily marked with dark purple/brown specks *N. gracillima*

Nepenthes alba Ridl.

Nepenthes alba Ridl., Fl. Mal. Pen. 3 (1924) 22; McPherson, Pitcher Plants of the Old World 1 (2009) 557–567, f. 300–306. TYPE: *Wray & Robinson 5411* (lecto SING, isolecto BO), Peninsular Malaysia, Pahang, G. Tahan, 1500 m, 3 June 1905.

Nepenthes singalana auct. non Becc.: Macfarl. in Engl., Pflanzenr. 4, 3 (1908) 47, *partim*; Macfarl., J. As. Soc. Beng. 75, 3 (1914) 282. — *Nepenthes bongso* auct. non Korth.: Ridl., J. Linn. Soc., Bot. 38 (1908) 320. — *Nepenthes gracillima* auct. non Ridl.: Danser, Bull. Jard. Bot. Buitenz. III, 9 (1928) 296; Shivas, Pitcher Plants of Peninsular Malaysia and Singapore (1984) 31; Kiew, J. Wildlife and National Parks 10 (1990) 36; Jebb & Cheek, Blumea 42 (1997) 43; Cheek & Jebb, Fl. Malesiana 15 (2001) 69; Clarke, *Nepenthes* of Sumatra and Peninsular Malaysia (2001) 131, *partim*.

Terrestrial climber to 5 m tall. **Stems** cylindrical, 3–6 mm diameter. **Rosette leaves** coriaceous, sessile, blade narrowly oblong-elliptic, up to 6 cm long × 1.5 cm wide, apex acute, base cuneate, margins sometimes decurrent for 2–3 mm; tendrils up to 6 cm long, without a curl. Leaves of the short shoots coriaceous, sessile, blade oblong-elliptic, up to 8 cm long × 2 cm wide, apex acute, base cuneate, clasping the stem for 3/4 of its circumference, margins not decurrent; tendrils up to 10 cm long, without a curl. **Leaves of the climbing stems** coriaceous, sessile, blade oblong to lanceolate, up to 9 cm long, up to 2 cm wide, apex generally acute, base cuneate, clasping the stem for 1/2–1/3 its circumference, margins not decurrent; tendrils up to 9 cm long, usually curled or with a kink in the middle. Longitudinal nerves of all leaf types obscure, three on each side of the midrib; pennate nerves numerous, reticulate, often indistinct; tendril insertion simple. **Pitchers of seedling rosettes** arising gradually from the tendril, ovate in cross section, infundibular in the lower 1/3–1/2, abruptly contracted at the hip, which is pronounced; upper parts cylindrical to slightly infundibular throughout; up to 5 cm tall × 1 cm wide; two wings, up to 2 mm wide, bearing multicellular fringe elements up to 4 mm long, run from the top to the bottom of the pitcher at the front; mouth ovate, acute near the lid, oblique, concave; peristome loosely cylindrical at the front and sides, flattened and slightly expanded towards the rear, 2–3 mm wide, ribs distinct, 0.2 mm apart, outer edge entire, inner edge with distinct, but minute teeth up to 0.1 mm long; lid circular, base cordate, no appendages, lower surfaces covered with simple, white or red hairs, up to 2 mm long, nectar glands large, numerous, round to elliptic, crater-like, 0.5–0.7 mm diameter; spur simple, or simple with two short, thick bristles as the apex, up to 3 mm long. **Lower pitchers** arising abruptly from the tendril, infundibular in the lower 1/3–1/2, abruptly contracted at the hip, which is pronounced, slightly infundibular above; up to 9 cm high × 2 cm wide; mouth round, up to 2 cm long × 2 cm wide, oblique, concave; peristome broadly cylindrical at the front and sides, expanded towards the rear, up to 5 mm wide; teeth distinct but very short, up to 0.2 mm long near the apex; lid circular, slightly larger than the mouth up to 2.5 cm long × 2.5 cm wide, strongly cordate at the base; spur simple, up to 6 mm long, usually bent downwards; other parts as for the rosette pitchers. **Upper pitchers** arising abruptly or gradually from the tendril, narrowly infundibular in the lower 1/4–1/3, with a pronounced hip; *upper parts slightly infundibular*; up to 12 cm tall × 3 cm wide; mouth ovate, oblique, not extended into a pronounced neck at the rear; peristome loosely cylindrical, up to 5 mm wide, slightly wider towards the apex, teeth distinct but short, up to 1 mm long; lid circular, *strongly cordate at the base, lower surface covered with short, simple hairs*; spur simple, bent downwards, up to 5 mm long; other parts

as for the rosette pitchers. **Male inflorescence** a raceme, peduncle up to 10 cm long, rachis up to 15 cm long; partial peduncles 2 flowered at the base, 1–2 flowered above, 3–4 mm long, with a filiform bract, up to 5 mm long; tepals elliptic, 3.5 × 2 mm; androphore 2.5 mm long; anther head 1.5 × 1.5 mm. **Female inflorescence** a raceme, peduncle up to 10 cm long, rachis up to 8 cm long; fruit valves 18 × 3 mm approx. **Indumentum** of very simple, short hairs, up to 0.05 mm long, in the axils, around the exterior apex of the pitchers, and inflorescence; simple red or white hairs, up to 1 mm long, on the lower surface of the lid. **Colour of living rosette pitchers** dark purple throughout, overlain with darker purple flecks; **intermediate pitchers** light greenish-white, overlain with dark brown-purple flecks; **upper pitchers** ivory white throughout, sometimes with variable amounts of rose coloured flecks, sometimes heavily suffused with red pigment on the outer surfaces.

Observations on Gunung Tahan. Along the western trail to the summit of Gunung Tahan, March 30–31, 2011. An isolated population occurs at N 4.6355°, E 102.2050°, 1520 m asl. Substantial populations were observed between N 4.6304°, E 102.2142°, 1656 m asl (near Bonsai Camp) and N 4.6288°, E 102.2268°, 1930 m asl (Bukit Botak Camp).

Comments. This is the only *Nepenthes* that is abundant in the short padang vegetation on the uppermost parts of Gunung Tahan. The white upper pitchers are distinctive among the taxa from Gunung Tahan and on the basis of the characteristics in Table 2, this species can be reliably distinguished from *N. gracillima*. However, the differences between the taxa are slight, and there is merit to the argument that both *N. gracillima* and *N. alba* are derived from *N. macfarlanei* and have diverged due to their isolation and exploitation of different habitats on Gunung Tahan.

Kiew's (1990) statement that pitchers on rosettes of *N. alba* are purple, then switch to white as the plant climbs into the canopy, is correct. However, when it switches from producing lower to upper pitchers, the first few upper pitchers are effectively an intermediate form that is richly coloured with dark and light pigments, like the upper pitchers of *N. gracillima*. These "intermediate" *N. alba* pitchers are well preserved in *Strugnell & Sow 42878* (KEP), but are not readily observed on Gunung Tahan as few plants produce them at any given time. They are difficult to distinguish from the upper pitchers of *N. gracillima*, but they are produced at a different stage in the plants' growth cycle – *N. gracillima* produces these pitchers for extended periods at the tops of the longest climbing stems, whereas in *N. alba* they are an intermediate form that is only produced for a very short time; the plant soon switches to producing the distinctive, ivory white upper pitchers that it is noted for.

Like McPherson (2009), we saw no obvious examples of natural hybrids between *N. alba* and *N. gracillima*. Although natural hybrids of *Nepenthes* have received considerable attention from researchers (see Clarke 1997, 2001), they are generally rare in undisturbed vegetation such as occurs on Gunung Tahan, even in open areas. The two species appear to be reproductively isolated (possibly by flowering times, as there are several sites where they grow together, indicating a lack of spatial

isolation). *Nepenthes* hybrids are generally common in sites that have been recently disturbed, such as landslips or sites of human activities. In such places, plants often flower at unusual times, causing the breakdown of temporal isolation mechanisms.

Collections from Gunung Tahan examined: Chua 41539 (KEP), Haniff 7890 (SING), 7891 (BO), Holttum 20666 (BO, SING), 20644, fragment bearing smaller pitchers (SING); Kiew 2450 (KEP, SING), 4064 (KEP), Kloss 12227, 12134 (BO), Lim 56340, 56344 (KEP), Ng 020915 (KEP), Ng 1478 (KEP, SING), Ng 020954 (KEP), Noramly: Muslim s.n., 4603 second sheet, s.n. (KEP), Ridley 16097 (K. sheet barcoded K000651564), Wray & Robinson 5411 (SING), Strugnell & Sow 42878 (KEP), Wong & Wyatt-Smith W58 (KEP).

Nepenthes benstonei C. Clarke

Nepenthes benstonei C. Clarke, Sandakania 13 (1999) 79, f. 1–3; Cheek & Jebb, Fl. Malesiana 15 (2001) 40; Clarke, *Nepenthes of Sumatra & Peninsular Malaysia* (2001) 108, f. 105–107; McPherson, Pitcher Plants of the Old World I (2009) 568, f. 307–311. TYPE: Clarke s.n., (holo KEP, iso BO, K, L, SAN, SING), Peninsular Malaysia, Kelantan, Bukit Bakar, 450–550 m, 24 July 1998.

Nepenthes alata auct. non Blanco: Danser, Bull. Jard. Bot. Buitenz. III, 9 (1928) 258, *partim*. — *Nepenthes gracillima auct. non* Ridl.: Kiew, J. Wildlife and National Parks 10 (1990) 36; Jebb & Cheek, Blumea 42 (1997) 43; Cheek & Jebb, Fl. Malesiana 15 (2001) 69, *partim*. — *Nepenthes sanguinea auct. non* Lindl.: Jebb & Cheek, Blumea 42 (1997) 79, *quae* = *N. benstonei* C. Clarke *et N. sanguinea* Lindl.

Description. See Clarke (1999, 2001); Cheek & Jebb (2001).

Observations on Gunung Tahan. N 4.6524°, E 102.1875°, 895 m asl, and surrounding areas, March 30, 2011.

Comments. *N. benstonei* is abundant in dense vegetation on steep ridges, at 800–1350 m asl. On the western route to Gunung Tahan, it grows at the edges of open, disturbed sites, such as landslips, and along the trail itself. Some plants also grow in dense forest; these are generally inconspicuous and produce few pitchers.

Collections from Gunung Tahan examined: Holttum 20643 (SING), Ridley 16097 (SING, K (sheet barcoded K000651565 only).

Nepenthes gracillima Ridl.

Nepenthes gracillima Ridl., J. Linn. Soc., Bot 38 (1908) 320; Macfarl. in Engl. Pflanzenr. 4, 3 (1908) 38; J. As. Soc. Beng. 75, 3 (1914) 282; McPherson, Pitcher Plants of the Old World I (2009) 581–586, f. 316–317. TYPE: Wray & Robinson 5309

(lecto SING, isolecto BO), Peninsular Malaysia, Pahang, Gunung Tahan, 990 m, 29 May 1905.

Nepenthes gracillima auct. non Ridl., Danser, Bull. Jard. Bot. Buitenz. III, 9 (1928) 296; Shivas, Pitcher Plants of Peninsular Malaysia and Singapore (1984) 31, *quae pro parte* = *N. ramispina* Ridl., *N. gracillima* Ridl., *N. alba* Ridl. et *N. macfarlanei* Hemsl. — *Nepenthes gracillima* auct. non Ridl., Kiew, J. Wildlife and National Parks 10 (1990) 36; Jebb & Cheek, Blumea 42 (1997) 43; Cheek & Jebb, Fl. Malesiana 15 (2001) 69, *quae pro parte* = *N. gracillima* Ridl., *N. alba* Ridl. et *N. benstonei* C. Clarke.

Terrestrial or epiphytic climber to 6 m tall. **Stems** cylindrical, 3–6 mm diameter. **Rosette leaves** thin-coriaceous, sessile, blade narrowly oblong-elliptic, up to 6 cm long × 1.5 cm wide, apex acute, base cuneate, margins sometimes decurrent for 3–4 mm; tendrils up to 10 cm long, without a curl. Leaves of the short shoots coriaceous, sessile, blade elliptic to sub-spathulate, up to 18 cm long × 5 cm wide, apex acute, base cuneate, clasping the stem for 3/4 of its circumference, margins not decurrent; tendrils up to 35 cm long, without a curl. **Leaves of the climbing stems** coriaceous, sessile, blade oblong or narrowly elliptic-oblongate, apex generally acute, base cuneate, clasping the stem for 1/2–1/3 its circumference, margins not decurrent; tendrils up to 30 cm long, usually curled or with a kink in the middle. Longitudinal nerves of all leaf types obscure, three on each side of the midrib; pennate nerves numerous, reticulate, often indistinct; tendril insertion simple. **Pitchers of seedling rosettes** arising abruptly from the tendril, ovate in cross section, infundibular in the lower 1/6, ovoid for the next 1–2/6, with a pronounced hip; upper parts cylindrical throughout; up to 8 cm tall × 1.5 cm wide; two wings, up to 3 mm wide, bearing multicellular fringe elements up to 8 mm long, run from the top to the bottom of the pitcher at the front; mouth ovate, acute near the lid, oblique, concave; peristome loosely cylindrical at the front and sides, flattened and slightly expanded towards the rear, 2–3 mm wide, ribs distinct, 0.3 mm apart, outer edge entire, inner edge with distinct, but minute teeth up to 0.2 mm long; lid broadly ovate, slightly peaked towards the apex, base simple or sometimes slightly cordate, no appendages, lower surfaces sparsely to densely covered with simple, white or red hairs, up to 3 mm long, particularly towards the margins, nectar glands large, numerous, round to elliptic, crater-like, 0.5–0.7 mm diameter; spur flattened, simple or sometimes with two short, thick bristles at the apex, or divided into two or three branches, up to 5 mm long. **Lower pitchers** ovoid or broadly cylindrical with a pronounced hip 1/3–1/2 way up from the bottom, up to 18 cm high × 7 cm wide, mouth ovate up to 5 cm long × 4 cm wide, oblique; peristome flattened, expanded towards the rear, up to 25 mm wide; teeth distinct, up to 5 mm long near the apex; lid ovate, up to 5 cm long × 3.5 cm wide, barely or not cordate at the base; spur simple, up to 12 mm long, straight; other parts as for the rosette pitchers. **Intermediate pitchers** arising abruptly from the tendril, narrowly infundibular in the lower half, with a pronounced hip; upper parts cylindrical or slightly infundibular; up to 22 cm tall × 4 cm wide; mouth ovate, oblique, not extended into a pronounced neck at the rear; peristome

loosely cylindrical, up to 8 mm wide, slightly wider towards the apex, teeth distinct but short, up to 3 mm long; lid ovate, not cordate at the base, lower surface covered with short, simple hairs, particularly towards the margins, spur simple, straight, up to 12 mm long; other parts as for the rosette pitchers. **Upper pitchers** similar to the intermediate ones but much smaller and narrower, up to 10 cm long \times 1.5 cm wide. **Male inflorescence** a raceme, peduncle up to 10 cm long, rachis up to 20 cm long; partial peduncles 2 flowered at the base, 1–2 flowered above, 3–4 mm long, with a filiform bract, up to 5 mm long; tepals elliptic, 3.5 \times 2 mm; androphore 2.5 mm long; anther head 1.5 \times 1.5 mm. **Female inflorescence** a raceme, peduncle up to 10 cm long, rachis up to 8 cm long; fruit valves 18 \times 3 mm approx. **Indumentum** of simple, very short hairs, up to 0.05 mm long, in the axils, around the exterior apex of the pitchers, and inflorescence; simple red or white hairs, up to 1 mm long, on the lower surface of the lid, particularly towards the margins. **Colour** of living pitchers dark green, heavily marked with dark purple-brown speckles, occasionally suffused with dark pink colouring throughout.

Observations on Gunung Tahan. Between N 4.6456°, E 102.1926°, 1276 m asl. below Belumut Camp, and N 4.6287°, E 102.2183°, 1694 m asl. above Bonsai Camp, on the western route to Gunung Tahan, March 30–31, 2011.

Comments. *Nepenthes gracillima* is one of a small number of species that is consistently trimorphic with regard to pitcher structure. Nearly all *Nepenthes* are dimorphic and plants of many species occasionally produce one or two “intermediate” pitchers as they switch from producing lower to upper pitchers (Clarke 1997, 2001), but it is very unusual for intermediate pitchers to be the predominant form on climbing stems, as in this species. Prior to Cheek & Jebb’s (2001) revised description of *N. gracillima*, all previous treatments were based on either upper pitchers alone, or specimens of both *N. alba* and *N. gracillima*. Good collections of lower and intermediate pitchers of *N. gracillima* were made, but due to the presence of lid hairs, all of these were identified as *N. macfarlanei*. For instance, Cheek & Jebb (2001, Fig. 8a, e & f) used Ridley 16174 (K) in their illustration of *N. gracillima*. The components of the drawing derived from this specimen include a fragment of a climbing stem bearing an upper pitcher, and show detail of the pitcher lid. However, the duplicate of this collection at SING is a basal rosette bearing a lower pitcher of *N. gracillima*, but Danser (1928) identified it as *N. gracillima* \times *N. macfarlanei*, whereas Jebb & Cheek (1997) identified it as *N. macfarlanei*. As a consequence, taxonomists based their concepts of *N. gracillima* on the least common pitcher type that this species produces, and which bears a strong resemblance to the upper pitchers of *N. alba*. It is therefore unsurprising that confusion about these taxa arose, particularly among researchers who only examined herbarium specimens, as these are comprised of stem fragments that bear only one type of pitcher, making it impossible to associate the lower, intermediate and upper pitchers of any given taxon with confidence (particularly when collections comprising several sheets with the same number are split among different herbaria).

Regardless of any shortcomings in the herbarium material, it is perplexing that no researchers who visited Gunung Tahan prior to us traced the climbing stems of *N. gracillima* to the ground. Had this been done, it is possible that much of the recent confusion surrounding *N. alba*, *N. gracillima* and *N. macfarlanei* could have been avoided. Clarke & Moran (2011) stress the importance of making complete collections of *Nepenthes* for herbaria, and our findings in this study emphasise the need for detailed and accurate field observations in interpreting closely related taxa.

Collections from Gunung Tahan examined: Chua 26664 (KEP), Haniff 7890, 8306 (SING), Holttum 20644 (BO, SING, fragment bearing larger pitchers), Kloss 12211, 12212 (BO), 12259 (SING), 12297 (BO), Lim 56363 (KEP), Ng 1448, 020961 (KEP), Noramly Muslim 4603 first sheet (KEP), Ridley 16096 (SING), 16098 (SING), 16174 (K, SING), Wong & Wyatt-Smith 60 (KEP).

Nepenthes sanguinea Lindl.

Nepenthes sanguinea Lindl., Gard. Chron. (1849) 580; Danser, Bull. Jard. Bot. Buitenz. III, 9 (1928) 366, f. 20; Shivas, Pitcher Plants of Peninsular Malaysia and Singapore (1984) 43, f. 4–5, 27–28; Kiew, J. Wildlife and National Parks 10 (1990) 36; Cheek & Jebb, Flora Malesiana 15 (2001) 40; Clarke, *Nepenthes* of Sumatra & Peninsular Malaysia (2001) 108; McPherson, Pitcher Plants of the Old World I (2009) 568. TYPE: *Griffith 4411* (K) Malaysia, Johor, Gunung Ledang.

Nepenthes pumila Griff., Post. Papers 4 (1854) 349; Jebb & Cheek, Blumea 42 (1997) 79, *quae pro parte* = *N. benstonei* C. Clarke *et N. sanguinea* Lindl.

Descriptions. See Lindley (1849), Jebb & Cheek (2001), Clarke (2001).

Observations on Gunung Tahan. Near Belumut Camp on the western route to Gunung Tahan, N 04.6401°; E 102.1964°, 1450 m asl, on Gunung Tahan on April 1, 2011.

Comments. This is probably the only *Nepenthes* species from Gunung Tahan that has not been the subject of some taxonomic confusion. Kiew (1990) states that this species is not particularly common on Gunung Tahan, but several collections have been made and conform with Lindley's description of this species. We observed only one plant of *N. sanguinea* on the western route to Gunung Tahan (see above), but were in no doubt that it belonged to this species. We suspect that it may not be that rare on Gunung Tahan, but as neither the southern or western trails pass through suitable habitats for *N. sanguinea* and most plants appear to be epiphytic, there are few specimens or visual records.

Collections from Gunung Tahan examined: Wong & Wyatt-Smith 59 (KEP), Holttum 20643 (SING).

Summary and conclusions

The montane *Nepenthes* of Peninsular Malaysia are among the most difficult to interpret, due to their collective similarities, but also minor differences that appear to reflect recent reproductive isolation of populations on different mountains. More than any other group within the genus, accurate identifications depend on both detailed field observations and careful examinations of herbarium material. The present study, along with those of Kiew (1990), Jebb & Cheek (1997), Cheek & Jebb (2001) and McPherson (2009), represents an important step towards a resolution of the confusion surrounding the montane *Nepenthes* of Peninsular Malaysia. This will facilitate a better understanding of the ecology, biogeography and conservation of these species, most of which are found nowhere else.

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A taxonomic revision of *Amischotolype* (Commelinaceae) in Asia

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ABSTRACT. A taxonomic revision of the Indomalayan part of the paleotropical genus *Amischotolype* Hassk. (Commelinaceae) reveals 22 species in Asia, of which eight are described as new (*A. barbarossa* Duist., *A. divaricata* Duist., *A. dolichandra* Duist., *A. lobata* Duist., *A. parvifructa* Duist., *A. pedicellata* Duist., *A. strigosa* Duist., *A. welzeniana* Duist.), and three are new combinations (*A. hirsuta* (Hallier f.) Duist., *A. leiocarpa* (Hallier f.) Duist., *A. rostrata* (Hassk.) Duist.). The status of the closely related genus *Porandra* Hong is discussed although results of a molecular study are required to make a final decision on its generic status. For now the genera are kept separate, but the species of *Porandra* are included in the key to the species of *Amischotolype*.

Keywords. *Amischotolype*, Commelinaceae, *Forrestia*, morphology, *Porandra*, revision, taxonomy

Introduction

Amischotolype is a genus of the Commelinaceae (Spiderwort family), a family of about 650 species in 41 genera with a cosmopolitan distribution (although with no native species in Europe; Faden 1998). Faden and Hunt (1991), in their Commelinaceae classification based upon morphology, anatomy, palynology and cytology, placed *Amischotolype* in the subtribe Coleotrypinae Faden & D.R.Hunt with the African genus *Coleotrype* and Asian genus *Porandra*. Important characters of the subtribe included leaf epidermal cells with silica, axillary inflorescences, flowers with 6 fertile stamens and seeds with a linear hilum. Faden & Hunt's classification was later supported by cladistic analysis of morphological data (Evans et al. 2000) and by *rbcL* sequences combined with morphology (Evans et al. 2003). The chromosome numbers ($2n = 18, 36$ with a basic chromosome number $x = 9$) and the karyotype of several species of this subtribe are very similar (Yuan & Yang 2006).

Generic delimitation

The first species were described from Java by Blume (1827) in *Campelia*, as *C. mollissima* and *C. marginata*. *Campelia* was described by Richard (1808) based on a

species from tropical America. A third Old World species was discovered in New Guinea and described by Richard (1834) as a new genus associated with the Colchicaceae and Asparagaceae. He named it *Forrestia* (with a single species *F. hispida*), after the British explorer who was the first to visit New Guinea, Thomas Forrest (1729–1802) of the East India Company. Hasskarl (1852), unaware of A. Richard's work, added another species from Java to *Campelia* (though with an illegal name, see discussion under *A. glabrata*). Several years later, when Hasskarl received material on loan from Berlin, he realised that the Asian species of *Campelia*, with sessile inflorescences, were very different from the American species which had pedunculate inflorescences. Comparison of the Javanese species with Richard's description of *Forrestia* (1834; in Kunth 1843) which states "*flores rubri, supra vaginam exerti...*" led Hasskarl to translate this as "inflorescence terminal", which was manifestly different from his species that had axillary inflorescences. Hasskarl (1863) transferred the Asian species of *Campelia* to a new genus next to *Forrestia*: *Amischotolype*. The name refers to the sessile glomerules of flowers, the character that immediately distinguishes it from the American species of *Campelia* (which are now united with *Tradescantia*, see Hunt 1986). A year later, after having studied the type material of *Forrestia*, Hasskarl (1864) transferred his three species of *Amischotolype* to *Forrestia*. He also added two new species, one from India (*F. hookeri*) and one from Java (*F. rostrata*), bringing the total number of species in Asia to six. In the following years, more than 10 species were described from Asia, the latest *A. sphagnorrhiza* Cowley (Cowley 1996). The first African species was described by Clarke (1881, in *Buforrestia* C.B. Clarke), followed by three more species (Schumann 1897, Clarke 1901, De Wildeman 1909).

From Hasskarl (1864) onwards, the generic name of *Forrestia* was commonly (but not exclusively) used, until Pichon (1946: 235) pointed out that the *Forrestia* of Richard (1834) was a later homonym of *Forrestia* of Rafinesque (1806), the latter a genus in the Rhamnaceae, and argued that the correct genus name should be *Amischotolype* Hassk. While Richard (1834) did mention the existence of a genus *Forrestia* Schweack. in the Rhamnaceae (see De Jussieu 1820; the author name is a mystery and perhaps refers to Rafinesque's mother's name: Schmaltz), he considered the name available for use in the Commelinaceae because *Forrestia* Raf. was united with *Ceanothus*. A proposal to conserve *Forrestia* A. Rich. in the Commelinaceae (Babu & Dutta 1968) was rejected (see discussion by Rao 1971).

Hong (1974) described the genus *Porandra* from China as closely related to *Amischotolype*, differing by its climbing habit with branched and basally 'woody' stems, and by having thecae opening by apical pores (hence the name). These characters, however, are not unique for *Porandra*, as noted by Faden (1998: 112). This present revision reveals that *A. rostrata* (Hassk.) Duist. shares with *Porandra* both the branched and scrambling stem and thecae opening by an apical pore. A straggling habit also occurs in *A. divaricata* Duist., *A. dolichandra* Duist., *A. glabrata* Hassk. and *A. hispida* (A. Rich.) D.Y. Hong, while the opening of the thecae by an apical pore also occurs in *A. gracilis* (Ridl.) I.M. Turner (but there also by a longitudinal slit) and *A. griffithii* (C.B. Clarke) I.M. Turner. Faden (1998) argues that the two genera should be united based on the morphological evidence, and he is probably correct. However,

pending results from on-going molecular studies, the genera are here kept separate, as in Thitimetharoch et al. (2003). Nonetheless, it is interesting to note that the few field observations of anther colour in *Porandra* state violet (but sometimes only so at the margins: *R. Geesink 6850*), whereas in *Amischotolype* they seem to be white to yellow (with rare exceptions in *A. marginata* (Blume) Hassk.). For 10 out of the 22 Asian species, however, this information is lacking.

Need for revision

Amischotolype has a paleotropical distribution and the species typically grow in a forest environment, even surviving for a long time after disturbance of the forest, on rather dry to swampy soils. The most recent monographic revision of the genus was that of Clarke (1881). Since then, 12 more species have been described. For Asia, local flora treatments exist for the Himalaya (Hara 1966: 1 sp.), China (Hong & DeFilipps 2000: 2 spp.), Taiwan (Wang et al. 2000: 1 sp.), Japan and the Ryukyu Islands (Walker 1976: 1 sp.), Indo-China (Cherfils 1937: 7 spp.), Vietnam (Ho 1993: 3 spp., one species with two forms and two varieties), Peninsular Malaysia (Ridley 1924: 7 spp.; these all accepted in the checklist by Turner 1997), Singapore (Keng et al. 1998: 2 spp.), Philippines (Merrill 1925: 1 sp.), Borneo (Hallier 1916: 4 spp., one species with four varieties and one with two varieties), Java (Backer & Bakhuizen van den Brink 1968: 1 sp. with three forms), and New Guinea (Hallier 1913: 1 sp. with three varieties; Lauterbach 1913: 1 sp. with two forms). Nomenclature and species delimitation in these treatments differ considerably. Identification of species is further complicated because most authors provide no key to their taxa. Several authors (e.g., Hasskarl 1864, Backer & Bakhuizen van den Brink 1968) considered the amount of indument on the sheath and the lower surface of the leaf blade of high taxonomic importance, but this later proved to be variable within many species.

Most problematic is the application of the name *A. hispida* (A. Rich.) D.Y. Hong, now regarded as an East-Malesian species not reaching the Asian continent. Hooker (1864), who had not seen the type material, matched several collections from Java, Sumatera, Penang, Singapore, Sikkim and Assam with Richard's description of *F. hispida* and concluded that the distribution of the species ranged from NE India to New Guinea. Only few collections were cited precisely by Hooker, but those included specimens of at least *A. marginata* (Wallich s.n., Penang) and *A. gracilis* (Walker 155, Singapore). The epithet *hispida* is now erroneously used for continental Asian material (e.g., Hong & DeFilipps 2000), most of which is correctly *A. glabrata*. Owing to this confusion, and because a number of species are quite variable, especially in the amount of indument on the leaves, estimations of the number of species for the genus differ considerably, ranging from six (Walker 1976) to 20 (Hong 1974). A revision of the genus seemed therefore much needed. The African species are excluded from this revision. There is no overlap in species between Africa and Asia.

Characters that have proved valuable for the delimitation of Asian species of *Amischotolype* include the indument of the internodes, and upper surface and margin of the leaf blade, the inflorescence position, the (relative) length and indument of the sepals, the length of anthers, and size and indument of the capsules. The present revision

of *Amischotolype* recognises 22 species for Asia, of which eight are new species (*A. barbarossa* Duist., *A. divaricata* Duist., *A. dolichandra* Duist., *A. lobata* Duist., *A. parvifructa* Duist., *A. pedicellata* Duist., *A. strigosa* Duist., *A. welzeniana* Duist.). Three new combinations are made (*A. hirsuta* (Hallier f.) Duist., *A. leiocarpa* (Hallier f.) Duist., *A. rostrata* (Hassk.) Duist.). *Amischotolype glabrata* is the most widespread species, occurring from E Pakistan through China to S. Japan (Ryukyu Islands) and south to Nusa Tenggara (Lombok), excluding the Philippines and Sulawesi.

Amischotolype Hassk.

Amischotolype Hassk., Flora 46: 392 (1863); Pichon, Notul. Syst. 12: 233 (1946); Hara, Fl. East. Himalaya 1: 399 (1966); Morton, J. Linn. Soc., Bot. 60: 167–221 (1967); Ho, Ill. Fl. Vietnam 3: 477 (1993); Keng, Chin & Tan, Conc. Fl. Singapore 2: 23 (1998); Hong & DeFillips in Wu & Raven (eds.), Fl. China 24: 23 (2000); Wang, Chen & Peng in Huang (ed.), Fl. Taiwan, ed. 2, 5: 153 (2000). TYPE SPECIES: *A. glabrata* Hassk. (designated by Pichon 1946).

Forrestia A.Rich. in Dumont d'Urville, Voy. Astrolabe 2: 1 (1834); Miquel, Fl. Ned. Ind. 3: 547 (1855); Hasskarl, Flora 47: 625 (1864); Hasskarl, Commelin. Ind.: 83 (1870); Hooker f., Fl. Brit. India 6: 383 (1894); Ridley, Fl. Malay. Penins. 4: 359 (1924); Merrill, Enum. Philipp. Fl. Pl. 1: 197 (1925); Brückner in Engler & Prantl, Nat. Pflanzenfam. ed. 2, 15a: 169 (1930); Cherfils in Lecomte, Fl. Gen. Indo-Chine 6: 852 (1937); Backer & Backh. f., Fl. Java 3: 15 (1968); Walker, Fl. Okinawa S. Ryukyu I.: 298 (1976); *non* Rafin. (1806). TYPE SPECIES: *F. hispida* A.Rich. (= *A. hispida* (A.Rich.) D.Y.Hong)

Campelia auct., e.g., Blume, Enum. Pl. Javae 1: 7 (1827); Kunth, Enum. pl. 4: 109 (1843), *p.p.*; Hasskarl in Miquel, Pl. Jungh.: 154 (1852); Miquel, Fl. Ned. Ind. 3: 546 (1855); *non* L.C.M. Rich. (1808).

Plant perennial, herbaceous, rather succulent, exudate sticky and colourless. **Stem** solid, nodes very short and not thickened. **Leaves** with involute vernation, alternate in two ranks on erect part of the stem but at apex spirally arranged, herbaceous to somewhat coriaceous. **Sheath** tubular, closed, tightly covering the internode (loose dry material owing to shrinkage of the stem), the lower withering and deciduous as the plant matures, generally green (in species description mentioned only if otherwise coloured), longitudinally veined, more weakly transversely veined, apex truncate. **Leaf blade** (rather) thickly herbaceous, oblong to linear-lanceolate (2.3–7.4 times as long as wide), smooth or bullate, generally green (in species description mentioned only if otherwise coloured), longitudinally veined often with veins alternately thickened and more obvious on lower surface than on upper surface (except in *A. lobata* where they are very obvious on both surfaces), oblique transverse veins present (though not always distinct), base attenuate, apex acuminate to caudate, submarginal hairs (a row of hairs on the upper or lower surface of the leaf blade along the entire margin and here not included as leaf blade indumentum) present or absent. **Inflorescence**

a more-or-less condensed thyrses, strictly axillary, breaking through the base of the sheath if leaf is present; bracts broadly to narrowly triangular to rhomboid, 2–25 by 2.5–10 mm, thick herbaceous to coriaceous, glabrous to ciliate or hispid, pale green to purplish, midvein keeled, semiamplexicaulous, more-or-less decurrent on branchlet, apex obtuse to acuminate. **Flowers** almost actinomorphic, bisexual. **Sepals** 3, free, succulent, imbricate, outermost the longest (size given in species description refers to the longest sepal) and overlapping the inner two, innermost the shortest, persistent, midvein more-or-less keeled, apex obtuse. **Petals** 3, free, subequal, membranous, oblanceolate, obtuse, deliquescent soon after anthesis. **Stamens** 6, (sub-) equal, inserted on the receptacle; filaments free, tortuose; anthers basifixed, subglobose to oblong (deltoid in *A. glabrata*). **Ovary** 1, locules 3, equal; style 1, simple; stigma 1, capitate, apical. **Fruit** a (usually) dehiscent, succulent, white, pink, red, lilac, (brown-) purple or green capsule with 3 locules and (1–)2 seeds per locule, 3-lobed at apex or not, valves finally free to fused for up to 4/5 of length. **Seeds** uniseriate, reniform, surface coarsely rugose, hilum linear; aril fleshy.

Chromosomes. Basic chromosome number $x = 9$ (Morton 1967); mitotic counts: $2n = 18, 36$. Published counts of $2n = 20$ and $2n = 30$ are considered doubtful (see Yuan & Yang 2006, and references therein).

Distribution. Paleotropic, few (1 to 4) species in tropical Africa, 22 species in S. E and SE Asia (including India, China, Taiwan, Japan and New Guinea, but not Sri Lanka, Australia or Oceania).

Ecology. Primary forest and along forest streams, surviving a long time after disturbance, on rather dry to swampy soils, also on limestone. Altitude: 0–1980 m asl.

Notes. 1. Hasskarl's (1863) name *Amischotolype* (Greek, *amischos* = without stalk; *tolupe* = cluster) refers to the sessile glomerules of flowers.

2. The species delimitation in the work of Cherfils (1937), presenting seven species, is very different from the one presented here. I have seen 24 specimens (P) that he identified; of these all his *F. glabratus*, *F. hookeri*, *F. monosperma* and *F. mollis* belong to *A. divaricata*, whereas specimens he identified as *F. marginatus* are in fact *A. glabrata* and *A. divaricata*. In his *F. hispida* I saw specimens of *Pollia* sp., *A. hispida* and *A. glabrata*. His species descriptions can in no way be related to mine or any other. Moreover, it seems that measurements have been taken from material belonging to other genera (e.g., sepals 5–35 mm long, 2–13 mm wide for *F. glabratus* whereas maximum sepal length in *Amischotolype* is 18 mm, and maximum width 5.5 mm). Ho (1993) seems largely based on Cherfils (1937). Both these accounts are largely ignored in the species protologues below. The new combinations made by Ho (1993) are all invalid, as he did not cite the basionym (McNeill et al. 2006, Art. 33.4).

3. It greatly helped that I had the opportunity, while based in Singapore, to study living material, both in the field and in cultivation, and make my own collections. The descriptions are based on my observations on living material of *A. glabrata*, *A.*

gracilis, *A. hookeri*, *A. irritans*, *A. marginata*, *A. monosperma* and *A. parvifructa*, supplemented with many observations on herbarium material. Unless mentioned otherwise, the stem is not scrambling and aerial (stilt-) roots have not been observed. The area between the horizontally creeping rhizome and the erect stem is called the knee. Hairs on different organs are colourless unless stated otherwise. Whether the surface of the leaf blades is bullate or smooth cannot be observed from herbarium material, and is here mentioned only for the species for which field observations are available. An inflorescence with more than 40 flowers is considered many-flowered. In some species sepals elongate after anthesis and change colour from whitish or green to pink or violet. As the colour is lost in herbarium material, it is unknown unless annotated by collectors. Petals and stamens are difficult to study because they are lost soon after anthesis. Herbarium material of some species have capsules with three 0.5–1.5 mm long lobes at the apex of the valves. As I have not seen fresh material of these species, I do not know if these lobes are artifacts, e.g. the result of the drying of fruits with very deeply depressed apex. The colour of the ripe fruit can vary in a single species from white to green, pink, red or purple. As far as the colour of the aril is known for the species, it is orange (to dark red) and strikingly contrasting with the colour of the capsule.

4. The dichotomous key to the 22 Asian species presented below uses characters in leaves, inflorescence position, sepals, petals, stamens and fruits. The characters that separate the two leads best are mentioned first, followed by characters with more overlap (if present). Not infrequently all characters cannot be observed in a single specimen. Character synopses are included in several Appendices in tabular form to allow comparison of species.

5. As I have seen in the field, mixed populations of two or three species do occur. Evidence from herbarium material suggests the same, e.g., mixed in a single accession or collections with successive numbers from identical locations. The combinations involve at least the following species: *A. barbarossa*, *A. gracilis*, *A. hirsuta*, *A. irritans*, *A. laxiflora*, *A. leiocarpa*, *A. marginata*, *A. mollissima*, *A. monosperma*, and *A. parvifructa*.

6. The genus is, for the time being, considered separate from *Porandra* (see Introduction). I have not seen type material of the three species that have been described in this genus. Based on 47 collections, 17 of which were cited by Thitimetharoch et al. (2003) as belonging to the genus *Porandra*, I recognise two species, *P. ramosa* Hong and *P. scandens* Hong. They are included in the key to the species below. Based on the descriptions, I consider *P. microphylla* Wan to be a synonym of *P. scandens*.

Key to the species

- 1a. Leaf blade hairy on both surfaces, hairs (0.5–)1–4 mm long and often yellow; if hairs on one surface less than 1 mm long, then hairs on the other surface at least 1.5 mm long; submarginal hairs present on upper surface 2
- b. Leaf blade hairy on one surface or glabrous, if hairy on both surfaces then hairs

- shorter than 1 mm long and either at least one surface with hairs up to 0.5 mm long (excluding submarginal hairs and hairs near or on midvein), or submarginal hairs present on lower surface 6
- 2a. Sheath (except at mouth) glabrous or with a few hairs at base 3
- b. Sheath with several lines of 2–4(–10) mm long hairs 4
- 3a. Sheath 7–13 mm diameter. Sepals in flower and fruit 4.5–7.5 mm long, sparsely to moderately (rarely densely) hairy with hairs 0.5 mm long. Petals glabrous. Capsule exceeding sepals by (1.5–)3.5–6 mm 6. *A. griffithii*
- b. Sheath 10–20 mm diameter. Sepals in flower 6.5–10.2 mm long, in fruit 10.5–13 mm long, moderately to rather densely (dark-)red spiny-hairy with hairs 1.5–2.5 mm long. Petals on dorsal surface subapically with a 2 mm long spot of 1–1.5 mm long red spiny hairs. Capsule shorter than sepals by 3–4.5 mm 10. *A. irritans*
- 4a. Sepals 10.5–16(–18) mm long. Capsule shorter than sepals by 4–9 mm, hairs soft; valves fused for 1/4 to 1/2 of length. [Philippines, New Guinea] 8. *A. hispida*
- b. Sepals (4.5–)6–10 mm long. Capsule 2 mm shorter to 4 mm longer than sepals, hairs stiff; valves free (almost to the base). [Sumatera, Borneo] 5
- 5a. Sepals glabrous or margins and keels ciliate with colourless hairs 0.5–1 mm long. Capsule (equaling or) exceeding sepals by up to 4 mm, hairs yellow 7. *A. hirsuta*
- b. Sepals rather densely hairy with red, spiny hairs 2 mm long. Capsule shorter than sepals by 2 mm, hairs red 21. *A. strigosa*
- 6a. Inflorescence on the creeping, leafless part of the stem (rhizome) on the ground or at the (leafy) knee just above the ground; peduncle (0–)2–40 mm long 7
- b. Inflorescence on the erect, leafy part of the stem well above the ground, peduncle 0–5 mm long; if at the knee then peduncle absent 10
- 7a. Stem with many above-ground sphagnum-like orange branched roots. Sheath glabrous. Leaf blade smooth, lacking submarginal hairs 20. *A. sphagnorrhiza*
- b. Stem with above-ground roots absent or simple and whitish to brownish. Leaf blade bullate. Either sheath with lines of 1–6 mm long hairs and/or leaf blade with submarginal hairs present 8
- 8a. Sheath with lines of orange to orange-brown or red hairs. Leaf blade green on upper surface, (usually) red to purple on lower surface, (6.5–)9–16 cm wide. Sepals with margins and keel sparsely to rather densely (0.5–)1–2 mm long orange- to red-brown-hairy. Capsule with orange to red-brown hairs 1–2 mm long 16. *A. monosperma*
- b. Sheath usually with lines of (pale) yellow(-brown) hairs, rarely glabrous or with red, appressed hairs 0.1–0.5 mm long. Leaf blade (2.7–)4–8(–10.6) cm wide.

- Sepals glabrous to rather densely hairy with 0.2–0.5(–1) mm long colourless- to red hairs. Capsule glabrous or with colourless hairs 0.1–0.5(–1) mm long 9
- 9a. Sepals (9–)10–14 × 1.5–2.5 mm, white, green, pinkish or red-purple in flower and red, (deep) purple (and green), magenta or violet in fruit. Capsule shorter than sepals by 2–5 mm 11. *A. laxiflora*
- b. Sepals (6–)7–10 × (2–)3–4(–5.5) mm, cream to beige or yellow-brown in flower, pink to (red-) purple in fruit. Capsule 1.5(–2) mm shorter to 1.5(–3) mm longer than sepals 14. *A. marginata*
- 10a. Sepals and capsule with orange to dark-red or brown hairs 1. *A. barbarossa*
- b. Sepals glabrous or with colourless, white or yellow hairs. Capsule glabrous or with colourless, white, yellow or rarely brown hairs 11
- 11a. Capsule shorter than sepals by (1–)2–9 mm 12
- b. Capsule equalling or exceeding sepals by up to 9 mm 17
- 12a. Capsule 3-lobed at apex when dried, lobes 0.5–1.5 mm long 13
- b. Capsule not lobed at apex when dried 15
- 13a. Anthers 2–2.2 mm long. Capsule glabrous; valves fused for 4/5 of length. [Myanmar, Thailand] 22. *A. welzeniana*
- b. Anthers 1–1.3 mm long. Capsule covered in 0.2–2 mm long hairs; valves free to fused for 1/3 of length. [Sumatera, Java, Borneo] 14
- 14a. Leaf blade with veins distinct on upper surface, base very abruptly narrowed, pseudopetiole 3.5–9.5 cm long and 0.5–1 mm wide winged. Capsule hairs 1–2 mm long, bristly. [Borneo] 13. *A. lobata*
- b. Leaf blade with veins indistinct on upper surface, base very gradually to abruptly narrowed, pseudopetiole indistinct or up to 4 cm long with wings 1.5–2 mm wide. Capsule hairs 0.2–1 mm long, soft. [Sumatera, Java] 15. *A. mollissima*
- 15a. Flowers with pedicel 2–6 mm long. Leaf blade (19–)28–48 cm long. Capsule apex slightly depressed 8. *A. hispida*
- b. Flowers without pedicel. Leaf blade 15–28 cm long. Capsule apex obtuse 16
- 16a. Sepals 7.5–9 mm long. Filaments glabrous. Anthers 3 mm long. Capsule valves free. [India] 3. *A. dolichandra*
- b. Sepals (9–)10–14.5 mm long. Filaments with 1–3 mm long hairs in upper half. Anthers 0.6–1.0 mm long. Capsule valves fused for 1/3 to 1/2 of length. [Pakistan, E through India and China to Japan, and S to Nusa Tenggara] 4. *A. glabrata*
- 17a. Submarginal hairs absent or on lower surface (and sometimes margin) of leaf blade 18

- b. Submarginal hairs present on upper surface (and sometimes margin) of leaf blade 21
- 18a. Inflorescence 4–10-flowered. Anthers opening by an apical pore. Stem simple or branched. Leaf blade 13–23 cm long 19
- b. Inflorescence 10–30-flowered. Anthers opening by a longitudinal slit in upper half or along the length of anther. Stem simple. Leaf blade 18–35 cm long 20
- 19a. Inflorescence 4–7(–10)-flowered. Anthers drip-shaped to deltoid, purple. [India, China, Myanmar, Lao P.D.R., Vietnam, Thailand] *Porandra ramosa*
- b. Inflorescence 7–10-flowered. Anthers subglobose to oblong, white. [Sumatera, Java, Maluku] 19. *A. rostrata*
- 20a. Leaf blade on lower surface glabrous or hairy only between the veins. Sepals 4.5–6.5 mm long. Capsule 6.5–8.5 mm long. [Borneo] 12. *A. leiocarpa*
- b. Leaf blade on lower surface hairy on the veins. Sepals 7–10 mm long. Capsule 9–14 mm long. [India, Bangladesh] 9. *A. hookeri*
- 21a. Submarginal hairs 0.1–0.4(–1) mm long, if longer than 0.5 mm, then sheath with a ring of 0.5–1 mm long hairs at node, anthers 2–2.5 mm long and capsule valves fused for 1/4 to 1/2 of length 22
- b. Submarginal hairs (0.7–)1.2–2.5 mm long. Sheath glabrous or with hairs evenly scattered or in lines. Anthers 1.0–1.8 mm long. Capsule valves free 24
- 22a. Sepals 4.5–6.5 mm long, glabrous or rarely sparsely 0.2–0.3 mm long hairy. Capsule glabrous 12. *A. leiocarpa*
- b. Sepals 7–10.5 mm long, glabrous or 0.2–1.5 mm long hairy. Capsule 0.5–2.0 mm long hairy 23
- 23a. Sheath with a few lines of hairs and/or a ring of hairs at the node, hairs 0.5–3 mm long. Capsule 11.5–16 mm long, dark green to pink or reddish, bristle-hairy with hairs 1.5–2 mm long. [Myanmar, Cambodia, Lao P.D.R., Thailand, Sumatera]
..... 2. *A. divaricata*
- b. Sheath with scattered hairs 0.1–0.2 mm long. Capsule 7–9 mm long, white to pink, rather soft-hairy with hairs 0.5–1 mm long. [Peninsular Malaysia–Cameron Highlands] 17. *A. parvifructa*
- 24a. Sepals 4.5–7 mm long. Inflorescence 4–15-flowered. [SE Asia mainland, Sumatera, Borneo] 25
- b. Sepals (7–)8.5–11.5 mm long. Inflorescence 10–40-flowered. [Borneo] 26
- 25a. Sheath glabrous or rarely with 1 or a few lines of 0.5–2 mm long hairs. Anthers white to pale yellow. Capsule 0.7–1.5 mm long hairy, valves free. [Peninsular Malaysia, Singapore, Sumatera, Borneo] 5. *A. gracilis*

- b. Sheath with a single line of 1–3 mm long hairs. Anthers at least at margin violet to purple. Capsule glabrous or 0.3–0.7 mm long hairy, valves fused in basal 1/2 to 2/3. [China, Laos, Vietnam, Thailand, Sumatera] *Porandra scandens*
- 26a. Leaf blade abruptly narrowed into a 3.5–9.5 cm long pseudopetiole, veins very distinct on upper surface. Capsule 3-lobed at apex when dried, lobes 1–1.5 mm long, style remnant absent 13. *A. lobata*
- b. Leaf blade gradually to rather abruptly narrowed with pseudopetiole indistinct or up to 5 cm long, veins not distinct on upper surface. Capsule not lobed at apex when dried, style remnant 0.7–1 mm long and persistent 18. *A. pedicellata*

1. *Amischotolype barbarossa* Duist. sp. nov. (Fig. 1 & 11A–B)

Amischotolype mollissimae et *A. hispidae* similis, internodiis pilis 0.5–1 mm longis, vaginis capsulisque pilis aurantiacis ad rubris vel raro fulvis, laminis praecipue infra pilis submarginalibus differt. TYPUS: Ridley 2950, Peninsular Malaysia, Perak, Larut Hills (holo SING).

Amischotolype mollissima auct., sensu Turner, Gard. Bull. Sing. 47 (1997) 515; non (Blume) Hasskarl., Flora 46 (1863) 392.

Forrestia mollis auct., sensu C.B. Clarke in A. Candolle & C. Candolle, Monogr. Phan. 3 (1881) 236, p.p. [*A.C. Maingay 1712* p.p.; see note under *A. griffithii*]; Hooker f., Fl. Brit. India 6 (1894) 383, p.p.; Ridley, Mat. Fl. Malay. Penins. 2 (1907) 124; J. Malayan Branch Roy. Asiat. Soc. 1 (1923) 103; Fl. Mal. Pen. 4 (1924) 360; non Hasskarl, Flora 47 (1864) 628, nom. superfl. (= *A. mollissima* (Blume) Hassk.); non Ridley, J. Straits Branch Roy. Asiat. Soc. 33 (1900) 170 (= *A. gracilis*).

Forrestia mollissima auct., sensu Brückner in Engler & Prantl, Nat. Pflanzenfam. ed. 2 (1930) 169; non (Blume) Koord.

Stem ascending from short creeping rhizome; erect part 50–200 cm long, simple; internodes (moderately to) densely (0.5–)1 mm long hairy. **Sheath** 10–17 mm diam., with at least a few frontal lines of 1.5–4 mm long, yellow to orange or brown hairs, in between glabrous to moderately 0.1–0.5 mm long hairy, mouth ciliate. **Leaf blade** 21–45 × (5–)7–13 cm, 2.9–4(–5) times as long as wide, base gradually to rather abruptly narrowed into a winged pseudopetiole 3–4 cm long and 1.5–3 mm wide; lower surface moderately to densely 0.5–1 mm long yellow- to reddish brown-hairy, upper surface glabrous or rarely sparsely to moderately 0.1–0.2 mm long hairy; submarginal hairs on lower surface, rarely also on margin and upper surface, 1–2 mm long, dense, yellow to yellow-brown. **Inflorescence** on erect stem and at knee, sessile, 2–3.5 cm diam., (very) dense with branches obscure, 15–30-flowered. **Pedicel** 0.5 mm long. **Sepals** 7.5–12.5

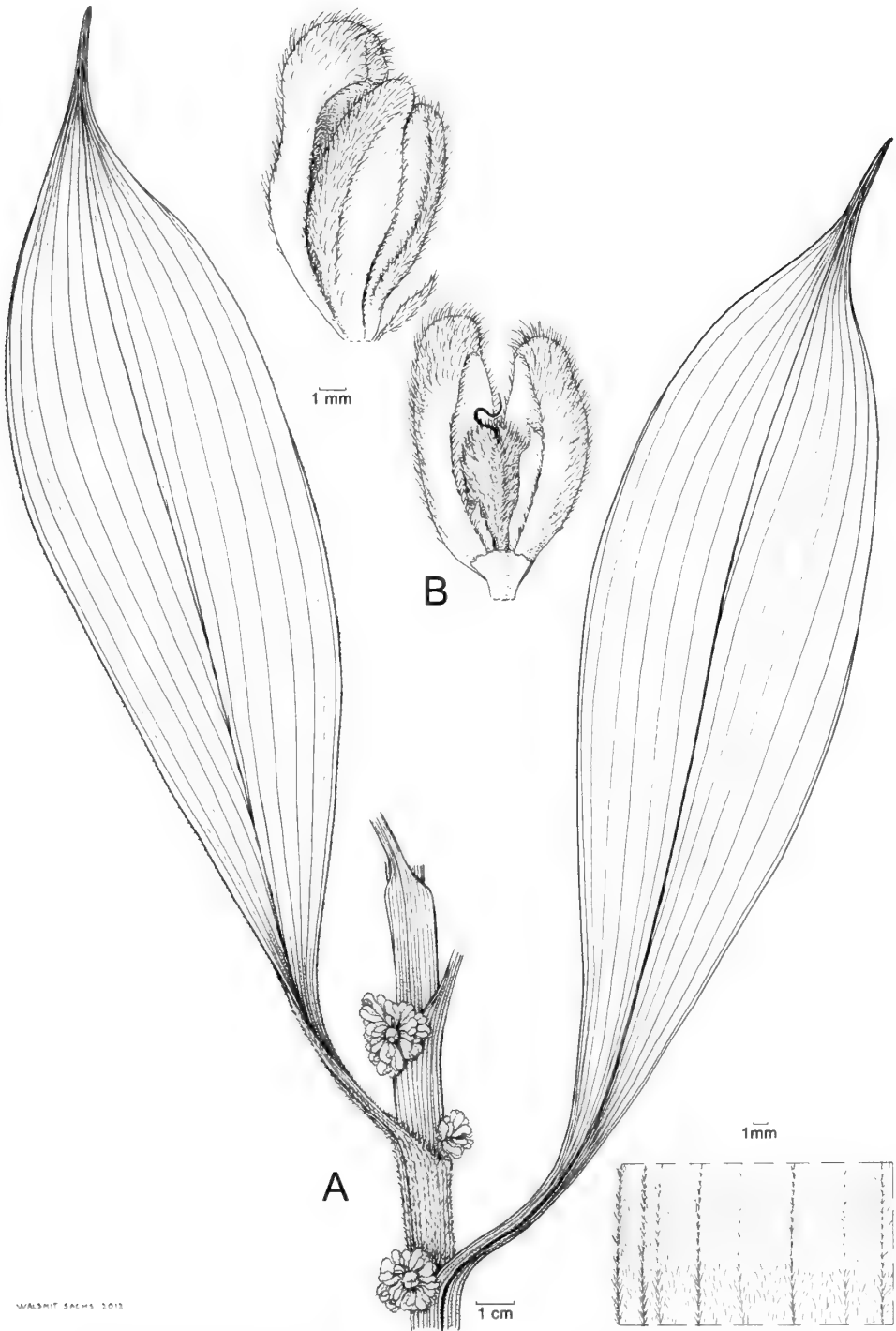


Fig. 1. *Amischotolype barbarossa* Duist. **A.** Habit. **B.** Immature fruit with persistent sepals. Drawing by A. Walsmit Sachs, from *Kiah* 31743 (L).

× 2.5–3.5 mm, not or little elongating in fruit, (pale) pink, moderately to densely 0.5–1.0 mm long orange- to dark red- or brown-hairy at least in upper half, tip hooded. **Petals** 7–8 × 2 mm, much shorter than sepals, translucent (greenish) white, glabrous, margin minutely fringed. **Stamens** with filaments c. 7 mm long, white, in upper part with many 2–2.5 mm long hairs; anthers 1.5 × 0.5 mm, white, thecae opening by a longitudinal slit. **Capsule** 7–10 × 5.5–7 mm, ovoid, 2 mm shorter to 1.5 mm longer than sepals, white to red or lilac, entirely or upper half (rarely only at apex) moderately to rather densely covered in 1–1.5 mm long orange- to red-brown hairs; valves free; apex slightly depressed, lobes absent or up to 0.3 mm long; style remnant 0.5–1.5 × 0.3–0.5 (base) mm, finally deciduous. **Seeds** 2 per locule, aril red.

Distribution. Thailand (Peninsular Thailand: Nakhon Si Thammarat), Peninsular Malaysia (Kedah, Perak, Pahang, Negeri Sembilan, Malacca, Johor), Sumatera (Riau, Jambi).

Ecology. In primary dipterocarp forest, in lighter shaded areas, on dry sandy soil or moist to wet or swampy places. Altitude: 30–250(–800) m asl.

Notes. 1. This species was never recognised as different from *A. mollissima* (Blume) Hassk. Differences from *A. mollissima* and *A. hispida*, both unknown from the Asian mainland, include the 0.5–1 mm long hairs on the internodes, the orange to red (or rarely yellow) hairs on the sheaths, sepals, and capsules, and the submarginal hairs predominantly on the lower surface of the leaf blade.

2. Ridley (1907) gave an accurate morphological description of the species, but unfortunately did not realise the difference from *F. mollis* Hassk., a synonym for *A. mollissima*. He cited only one specimen which is chosen here as the type specimen. The epithet *barbarossa* means red beard and refers to the red hairs on the sheaths, sepals and capsules.

Specimens examined: THAILAND. **Peninsular Thailand:** Nakhon Si Thammarat, Khao Luang, May 1968, *C.F. van Beusekom & C. Phengkhlai* 920 (L).

PENINSULAR MALAYSIA. **Kedah:** Gunung Baling, Nov 1929, *G.A. Best* (SF) 21261 (SING); Baling, Ulu Legong, Kampung Keda, Water Catchment Area, Apr 2006, *K. Imin et al.* FRI 50644 (KEP). **Perak:** Maxwell's Hill, Mar 1892, *H.N. Ridley* 2950 (SING); Temango, Jul 1904, *H.N. Ridley* 13472 (SING); Belum, Sg Sara above Orang Asli village of Ciong, Sept 1993, *I.M. Turner & J.W.H. Yong* 111 (SINU). **Pahang:** Temerloh, Krau GR, Bkt Rengit, Nov 1999, *S. Damahuri et al.* FRI 45316 (KEP); Temerloh, Kemasul FR, Feb 1936, *Ja'amat* 40872 (KEP); near Kuala Teku, Jul 1936, *Kiah* SF 31743 (K, L, SING); Teku river, Gunong Tahan, Jun 1922, *Md.Haniff & Md.Nur* SF 8092 (SING); Bukit Belar, Ulu Sungai Tembeling, Mar 1968, *Md.Shah* 1635 (K, KEP, L, SING); Jenka FR, May 1964, *M.E.D. Poore* 1420 (KLU); Jerantut, Gng Aais FR, Sg Lurut, Jul 2004, *Y.Y. Sam* FRI 49056 (KEP); Bentung, Lintang FR, Jun 1934, *C.F. Symington* 40515 (KEP); Jenka FR, Oct 1963, *E.A. Turnau* 908 (K, KLU). **Negeri Sembilan:** Pasoh FR, Nov 1976, *K. Jong s.n.* (KLU); Pasoh F.R. 12 1979, *R. Kiew* 824 (SING); *J.V. LaFrankie* 2024 (KEP, L), Oct 1987, *J.V. LaFrankie* 2530 (KEP); 1989, *J.V. LaFrankie* 4284 (KEP); Jelebu, Pasoh Forest Reserve, Sept 1977, *Mat Asri* FRI 25737 (K, KEP,

L); Petasik Jelebu, Triang Forest Reserve, Jul 1927, *E.A. Strouts 13024* (KEP, SING). **Malacca:** *A.C. Maingay 1712*, p.p. (L); base of Ophir, Jun 1982, *H.N. Ridley s.n.* (SING). **Johor:** north of Gunung Belumat, May 1923, *R.E. Holttum SF 10617* (SING); Gunong Lombak, Nov 1922, *R.E. Holttum SF 9394* (K, SING); Path to Bukit Tangga Tujoh via Kota Tinggi, Aug 1970, *Md.Shah et al. 2085* (L, SING); Genuang, Mar 1915, *H.N. Ridley s.n.* (BM); Seduok, Aug 1908, *H.N. Ridley 14374* (BM, SING); Sungei Juasseh, Labis, Jun 1970, *Samsuri Ahmad 268* (L, SING); Mersing, Endau-Rompin, Ulu Endau, Sept 1985, *R. Kiew s.n.* (KEP). **SUMATERA.** **Riau:** Tigapulu Mountains, Nov 1988, *J.S. Burley et al. 1318* (K, KEP, L, SING); Anak Talang, Oct 1939, *P. Buwalda 7129* (L). **Jambi:** Sri Mengopeh, Sept 1938, *T.W. Rutten-Kooistra 32* (U); P.T.IFA concession, Pasir mayang, Feb 1982, *M.J. Vreeken-Buijs 4* (L).

2. *Amischotolype divaricata* Duist. sp. nov. (Fig. 2)

Amischotolype hookeri similis, internodiis glabris, laminis supra pilis submarginalibus plerumque brevioribus, infra in venibus non conlectis, filamentis (fere) glabris differt. **TYPUS:** *Larsen et al. 31476*, August 1972, Thailand, NE, Chaiyapum Province, near Chulaphorn Dam, 16°30'N, 101°50'E (holo L; iso KLU).

Stem ascending or decumbent from rhizome, scrambling or winding; erect part 50–300(–600) cm long, simple; internodes glabrous. **Sheath** 7–12 mm diam., at the node with a few or ring of 0.5–1 mm long hairs and/or few lines of 1–3 mm long hairs, mouth ciliate. **Leaf blade** 19–36 × 3.5–6.5 cm, 4.2–6.6 times as long as wide, lower surface (light) green, tinged with purple or striped brown, base gradually narrowed into a winged pseudopetiole 0.5–1.5 cm long and 2 mm wide; lower surface glabrous to moderately 0.2–0.3 mm long hairy or rarely with 2 mm long hairs along midvein, upper surface glabrous or rarely sparsely to moderately 0.2 mm long hairy; submarginal hairs on upper surface, rarely also on margin, 0.2–0.5(–1) mm long, dense, yellow. **Inflorescence** on erect stem, sessile, 2–4.5 cm diam., dense with branches obscure, (10–)15–20(–30)-many-flowered. **Pedicel** absent. **Sepals** 7 10.5 × 3–4.5 mm, not elongating in fruit, light green with pink or violet tip (in flower) to greenish red or purple (in fruit), glabrous or very sparsely 0.2–1.5 mm long ciliate keel and margins, tip hooded. **Petals** c. 8 × 2.5 mm, distinctly shorter than sepals, white, glabrous, margin minutely fringed. **Stamens** with filaments 8.5–10 mm long, white, glabrous or upper 3 mm with 1 mm long hairs; anthers (1.5–)2–2.5 × 0.6–1 mm, white, thecae opening by a longitudinal slit (rarely in upper 2/3 only). **Capsule** 11.5–16 × 6–8 mm, ovoid, longer than sepals by 5–9 mm, dark green to pink or reddish, in upper half to 2/3 sparsely to rather densely 1.5–2 mm long bristle-hairy; valves fused for 1/4 to 1/2 of length; apex acute to obtuse and slightly depressed, lobes absent; style remnant 0.5 × 0.3 mm, persistent. **Seeds** 2 per locule, aril orange.

Distribution. Myanmar (Tenasserim), Lao P.D.R. (Xiangkhouang, Vientiane, Khammouan, Champasak), Vietnam (Central Highlands: Kon Tum; South Central Coast: Khanh Hoa; Southeast: Dong Nai), Cambodia (Pursat, Kampong Speu, Kampot), Thailand (N: Chiang Mai, Phayao; E: Chaiyaphum; C: Nakhon Nayok; SE: Chantaburi, Trat; Peninsular Thailand: Songkhla), Sumatera (N).

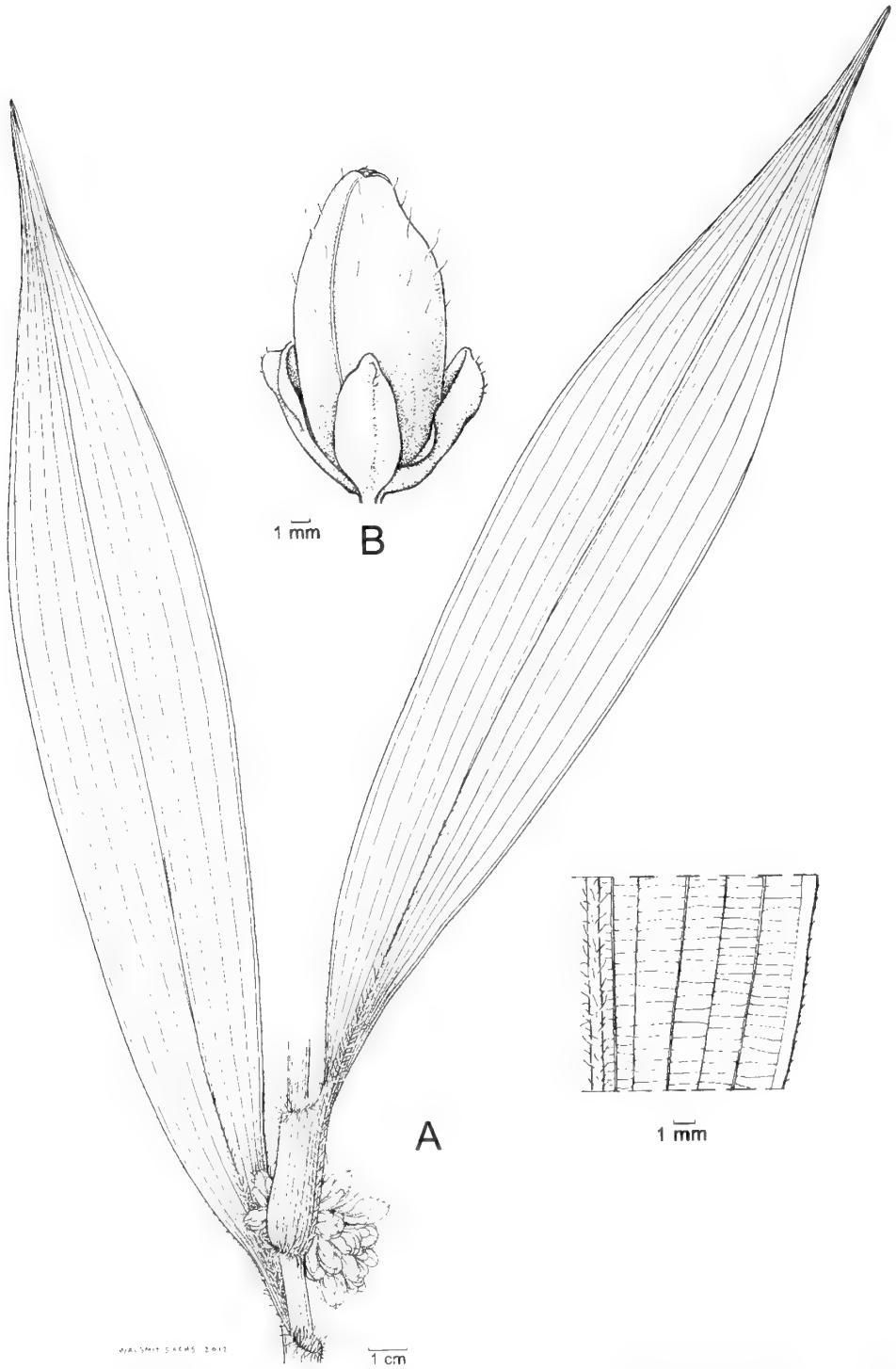


Fig. 2. *Amischotolype divaricata* Duist. **A.** Habit. **B.** Fruit with persistent sepals. Drawing by A. Walsmit Sachs, from *K. Larsen et al.* 31476 (L).

Ecology. Rather open primary, disturbed or secondary evergreen (bamboo) or seasonal forest, on damp or moist to marshy places near streams, shaded to almost in full sun: on white sand with large rocks, sandstone, granite or shale bedrock. Altitude: 50–1225 m asl.

Notes. The epithet refers to the scrambling habit of the plant. The species is similar to and until now (mis)identified as *A. hookeri*, but differs in the glabrous internodes, the generally shorter submarginal hairs on the upper surface (and margin) of the leaf blade, the hairs on the lower surface of the leaf blade not concentrated on the veins, and the (almost) glabrous filaments. Hara (1966), Hong (1974, 1997) and Hong & DeFilipps (2000) mention *A. hookeri* for the Chinese province of Yunnan. I have not seen their specimens and their descriptions are wide enough to include both species. Study of the specimens from Yunnan is needed to elucidate which of the two taxa are present.

Specimens examined: MYANMAR. **Tenasserim**: Tavoy distr. Oct 1961, *Keenan et al.* 1604 (E);

LAO P.D.R. **Xiangkhouang**: Xieng-Khouang, 1926, *M. Delacour s.n.* (P). **Vientiane**: Phon Kheng, Apr 1953, *J.E. Vidal* 2301 (P); route du Phou Khao Khouay, Oct 1965, *J.E. Vidal* 4041 (P); Phou Khao Khouay, Oct 1971, *J.E. Vidal* 5547 (P). **Khammouan**: Boneng-Thakhek, Apr 1950, *J.E. Vidal* 1274 (P); Nyalak, Oct 2005, *M.F. Newman et al.* LAO 530 (L); Tha Phabat Distr., Path to Tad Leuk Waterfall, May 2006, *M.F. Newman et al.* LAO 1539 (L, P); Nakai Oudom Souk, Apr 2005, *B. Svengsuksa et al.* BT 32 (L). **Champasak**: Boloven plateau, entre Noug Bok Kao et Phong, Oct 1928, *E. Poilane* 15837 (P).

VIETNAM. **Central Highlands**: Kon Tum, nr Kontum, entre Ta Bai et Giang Lo, Sep 1930, *E. Poilane* 18284 (P). **South Central Coast**: Khanh Hoa, sur le bas Song Cao et le Song Cay, pres Nhatrang, Jul 1921, *F. Evrard* 571 (P); **Southeast**: Dong Nai, Bien Hao, ?Gioray, Jul 1919, *E. Poilane* 186 (P); Dong nai, nord de Blao Kil, Haut Donai, Oct 1931, *E. Poilane* 19869 (P); Dong nai, Blao, du Haut-Donai, Apr 1933, *E. Poilane* 22419 (P). Cochinchine. Déon bu., Apr 1866, *L. Pierre s.n.* (P); Cochinchine, Camchoy, *L. Pierre* 11 (P); Cochinchine, 1862–1866, *Thorel s.n.* (several in P); MeKong, Sep 1874, *Harmand* 1920 (P); Dalat, Oct 1924, *F. Evrard* 1467 (P).

CAMBODIA. **Pursat**: 1876, *Harmand* 3366 (P). **Kampong Speu**: Kompong Spen, Sep 1870, *L. Pierre s.n.* (several in P). **Kampot**: Phnom Bokor, Dec 1965, *M.A. Martin* 815 (P). Mt. Kam Chay, Poporkville waterfall, Mar 1970, *B.C. Stone* 9302 (KLU).

COCHINCHINE. 1862–66, *Thorel* 1139 (P).

THAILAND. **N**: Chiang Mai, Doi Sutep, east side, Pah Laht, Jul 1987, *J.F. Maxwell* 87-729 (L); Phayao, Doi Luang NP, E-side, Jahm Bah Tawng Falls, May 1997, *O. Penmitr* 15 (L). **E**: Chaiyaphum, nr Chulaphorn Dam, Aug 1972, *K. Larsen et al.* 31476 (KLU, L). **C**: Nakhon Nayok, Muang, Kow Yai NP, summit ridge E-side, Kow Kieo, Jul 2003, *J.F. Maxwell* 03-160 (L). **SE**: Chantaburi, western slopes of Kao Sabab, Feb 1935, *G. Seidenfaden* 2825 (SING); Chantaburi, foot of Khao Soi Dao, Nov 1969, *C.F. van Beusekom & T. T. Smitinand* 2064 (E, L); Trat, Klawng Yai, *T. Smitinand* 269 (E); Trat, Haui raeng, Dong tapit, *T. Smitinand* 1378 (E). **Peninsular Thailand**: Songkhla, Na Tawee, Jul 1928, *G. Rahil* 81 (L). Sapi foot, Apr 1922, *Put* 798 (L); Chantaboon?, 1936?, *A. Vesterdal* 7-P (SING).

SUMATERA. **Sumatera Utara**: ENE Sibajak, Oct 1928, *J.A. Loerzing* 14103 (L).

3. *Amischotolype dolichandra* Duist. sp. nov. (Fig. 3)

Amischotolype glabrata similissima, sepalis 7.5–9 mm longis, filamentis glabris, antheris 3 mm longis, capsulae valvibus liberis differt. TYPUS: Koelz 26448, 1950, India, Manipur, Karong, 1050 m alt., in deep forest, scandent (holo L).

Stem rhizome unknown, scrambling; erect part c. 90 cm long, with c. 40 cm long aerial (stilt) roots, simple; internodes glabrous. **Sheath** 8–11 mm diam., with 0.3–0.5 mm long hairs in upper third to half of the frontal part, mouth ciliate. **Leaf blade** 18–19 × 2.7–4.1 cm, 4.6–6.7 times as long as wide, base gradually narrowed into an indistinct winged pseudopetiole to 0.5 cm long and 2 mm wide; lower surface glabrous or moderately 0.5 mm long hairy, upper surface glabrous; submarginal hairs on upper surface, 0.8–1.5 mm long, dense, yellow. **Inflorescence** on erect stem, sessile, 1.6–1.7 cm diam., dense with branches obscure, 5–10-flowered. **Pedicel** absent. **Sepals** 7.5–9 × 3–3.5 mm, possibly slightly elongating in fruit, pink, glabrous or sparsely 0.3 mm long ciliate margins, tip hooded. **Petals** c. 9.5 × 3 mm, slightly longer than sepals, colour unknown, glabrous, margin minutely fringed. **Stamens** with filaments c. 9 mm long, colour unknown, glabrous; anthers 3 × 0.7 mm, colour unknown, thecae opening by a longitudinal slit. **Capsule** 6.5 × 5 mm, obovoid, shorter than sepals by c. 2 mm, pink, moderately 1.5 mm long hairy; valves free; apex obtuse, lobes absent; style remnant 1.2 × 0.4 mm, persistent. **Seeds** 2 per locule, aril colour unknown.

Distribution. India (NE: Meghalaya, Mizoram, Manipur).

Ecology. Deep forest. Altitude: 1050–1200 m asl.

Notes. The epithet refers to the strikingly long anthers. The species most closely resembles *A. glabrata* which has a much wider distribution, and has longer sepals, stamens with hairy filaments and much shorter anthers, and capsules with basally fused valves.

Specimens examined: INDIA. NE. **Meghalaya:** Khasi Hills, Cherapunjee, Jun 1952, *Thakur Rup Chand* 5921 (L) & 5944 (L). **Mizoram:** Tengawl, Lushai Hills, Nov 1927, *N.E. Parry* 286 (K). **Manipur:** Karong, Oct 1950, *W.N. Koelz* 26448 (L).

4. *Amischotolype glabrata* Hassk. (Fig. 9A & 11C–D)

Amischotolype glabrata Hassk., *Flora* 46 (1863) 392; Coode et al., *Checklist Fl. Pl. Gymn. Brun. Dar.* (1996) 352; Turner, *Gard. Bull. Sing.* 47 (1997) 515; Beaman & Beaman, *Plants of Mount Kinabalu*, 3 (1998) 109. — *Campelia glabrata* auct., *sensu* Hasskarl in Miquel, *Pl. Jungh.* (1852/53) 154; Miquel, *Fl. Ned. Ind.* 3 (1855) 546; *non* Kunth, *Enum. pl.* 4 (1843) 109 (see note 2). — *Forrestia glabrata* (Hassk.) Hassk., *Flora* 47 (1864) 630; *Commelin. Ind.* (1870) 94; Clarke, *Commelyn. Cyrtandr. Bengal.* (1874) 62, tab. XLII; Clarke in A.Candolle & C.Candolle, *Monogr. Phan.* 3 (1881)

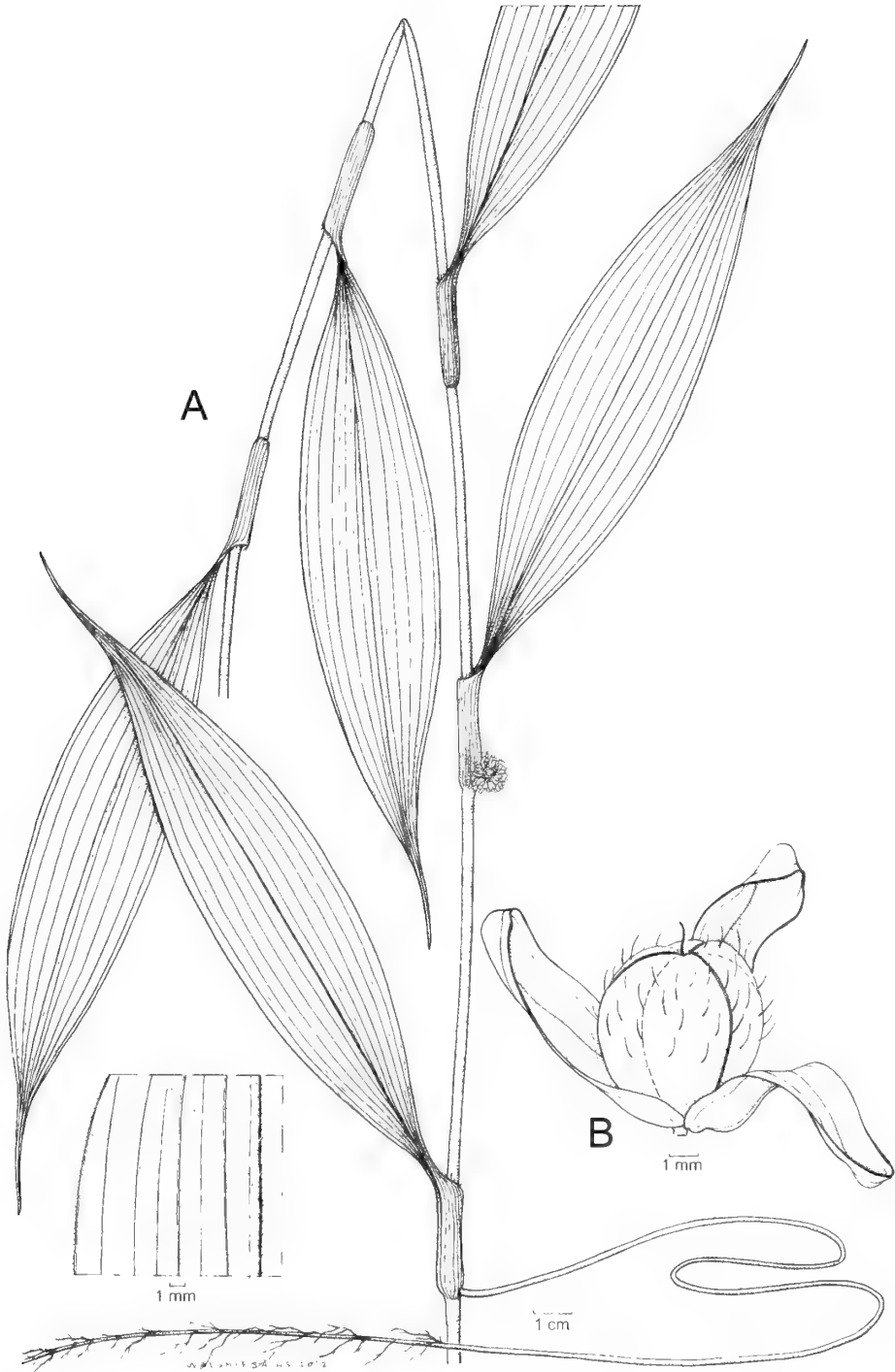


Fig. 3. *Amischotolype dolichandra* Duist. **A.** Habit. **B.** Fruit with persistent sepals. Drawing by A. Walsmit Sachs, from *W.N. Koelz* 26448 (L).

238; Hooker f., Fl. Brit. India 6 (1894) 384; Koorders, Excursionsfl. Java 1 (1911) 282; Hallier f., Nova Guinea 8 (1913) 906; Ridley, Fl. Malay. Penins. 4 (1924) 360; Ridley, J. Bot. 63 (1925) 124; Brückner in Engler & Prantl, Nat. Pflanzenfam. ed. 2 (1930) 169. — *Forrestia mollissima* (Blume) Koord. forma *glabrata* (Hassk.) Backer, Handb. Fl. Java I, 3 (1924) 33, p.p.; Backer & Bakhuizen van den Brink, Fl. Java 3 (1968) 15, p.p. — *Forrestia mollissima* (Blume) Koord. var. *glabrata* (Hassk.) Subba Rao & Kumari, Bull. Bot. Surv. India 12 (1970) 209 (*nom. inval.*: Vienna Code Art. 33.4, no full reference to basionym). LECTOTYPE (designated here): *Junghuhn s.n.*, Java: Ungaran prope Medini (L: L0041658). Other syntypes: *Junghuhn s.n.*, Java: Merapi (L), Gede et Tangkuban prau (L).

Campelia marginata var. B Blume, Enum. Pl. Javae (1827) 7; Kunth, Enum. Pl. 4 (1843) 109; Miquel, Fl. Ned. Ind. 3 (1855) 547 ('var. *foliis minoribus margine subtus tantum ciliolatis*'). TYPE: *Zippelius s.n.*, Java (L).

Forrestia glabrata (Hassk.) Hassk. forma *minor* Hassk., Flora 47 (1864) 631; Hasskarl, Commelin. Ind. (1870) 94. — *Campelia* n. sp., Moritz, Syst. Verz. (1845–46) 93; Zollinger, Syst. Verz. (1854) 65. SYNTYPES: *Nagler s.n.*, 1858, Java (photo B: Barcode: B 10 0296343 / ImageId: 302936); *Blume s.n., s.d.*, Java, Preanger ad ped. mnt. Pangerangoh prop. Tjipanwar (L); *Zollinger 305, Java, Tjapus* (photo B: Barcode: B 10 0296344 / ImageId: 302937); *Zollinger s.n.*, 23 Oct 1858, Java, Idjen (L).

Forrestia chinensis N.E.Br. in Forbes & Hemsley, J. Linn. Soc., Bot. 36 (1903) 158; Walker, Fl. Okinawa & S Ryukyu Isls. (1976) 298. — *Amisכותolype chinensis* [E.H. Walker ex Hatusima, Fl. Ryukyus (1971) 771, *nom. inval.*: see note 4] ex K.-S. Hsu, Fl. Taiwan 5 (1978) 158, t. 1305. SYNTYPES: *Oldham 578/1* (P); *Henry 149, 1618A, 8670* (all BM or K, *n.v.*); *Ford 256* (BM or K, *n.v.*).

Tupistra cavaleriei H.Lév., Repert. Spec. Nov. Regni Veg. 10 (1912) 372; McKean, Notes Roy. Bot. Gard. Edinburgh 45, 1 (1988) 153, in syn. *A. hispida*. SYNTYPES: *Jul. Cavalerie 2565, 3517*, China, Guizhou ('Kweichow'), Lo-Fou (photo: E).

Forrestia sumatrensis Ridl., J. Malayan Branch Roy. Asiat. Soc. 1 (1923) 102. TYPE: *Ridley s.n.*, 8 Feb. 1921, Sumatera, Berastagi Woods (holo K). (See note 5).

Forrestia hispida auct., sensu C.B. Clarke in A. Candolle & C. Candolle, Monogr. Phan. 3 (1881) 236, p.p. — *Amisכותolype hispida* auct., sensu Hong, Acta Phytotax. Sin. 12, 4 (1974) 461; McKean, Notes Roy. Bot. Gard. Edinburgh 45, 1 (1988) 153; Hong in Wu, Fl. Reipubl. Pop. Sin. 13, 3 (1997) 71; Hong & DeFilipps, Fl. China 24 (2000) 22; Wang, Chen & Peng, Fl. Taiwan, 2nd ed., 5 (2000) 153; Yang, Liu & Lin, Man. Fl. Taiwan 5 (2001) 56, pl. 103; Yuan and Yang, Bot. J. Linn. Soc. 152 (2006) 400; *non* A. Rich. (See note 3).

Stem ascending from short rhizome or basally decumbent and with long roots, scrambling; erect part 50–200 cm long, sometimes with aerial (stilt) roots, simple; internodes glabrous or moderately to densely 0.1–0.3 mm long hairy. **Sheath** (6–)8–12 mm diam., glabrous or at its front moderately 0.3–0.5(–1) mm long hairy or with one or a few lines of 1–3 mm long hairs, mouth ciliate or rarely glabrescent. **Leaf blade** 15–28 × 3.2–6.5(–8.3) cm, 3–4.5(–6.3) times as long as wide, smooth, lower surface sometimes red, base gradually to abruptly narrowed into a winged pseudopetiole up to 2.5 cm long and 1 mm wide; lower surface glabrous or rarely sparsely to densely 0.1–0.5(–2) mm long hairy or 2 mm long hairy on midvein, upper surface glabrous or rarely very sparsely to moderately 1 mm long hairy; submarginal hairs on lower surface, rarely (also) on margin or upper surface, 0.2–0.5(–1) mm long, rather dense, colourless to yellowish. **Inflorescence** on erect stem, sessile, 1.5–4 cm diam., dense with branches obscure, (5–)10–20(–25)-flowered. **Pedicel** absent. **Sepals** (9–)10–14.5 × (1.5–)2–3(–4.5) mm (in fruit), (dark) green, pinkish purple or dark violet, sometimes base white, probably not elongating in fruit, sparsely to moderately 0.2–1.5 mm long colourless- or orange-ciliate keel or rarely glabrous, tip hooded. **Petals** c. 8 × 3 mm, as long as sepals, white, glabrous, margin entire. **Stamens** with filaments c. 11 mm long, white, upper half with 1–3 mm long hairs; anthers 0.6–1 × 0.5–1 mm, deltoid, white, thecae opening by a longitudinal slit. **Capsule** 5–8 × (3.5–)4.5–6.5 mm, obovoid, shorter than sepals by (1–)2.5–5(–6) mm, at first white and later turning to green and finally red, upper half sparsely to moderately 1–2.5 mm long hairy or rarely glabrous; valves fused for 1/3 to 1/2 of length; apex obtuse, lobes absent; style remnant 1–3 × 0.3–0.5 mm, persistent. **Seeds** 2 per locule, aril orange.

Chromosomes. $2n = 36$ (Yuan & Yang 2006).

Distribution. Pakistan (E: Sind), India (Sikkim, Meghalaya, West Bengal, Assam), China (Guizhou, Yunnan, Guangxi Zhuang, Hainan), Taiwan, Japan (Ryukyu Isl.), Vietnam (Tonkin, Lang Giu, Ninh Binh), Myanmar (Tenasserim), Thailand (N: Chiang Mai, Chiang Rai, Lampang), Peninsular Malaysia (Kedah (Bukit Telim), Pahang (Cameron Highlands), Selangor (Ulu Langat)), Sumatera (Toba, Talang, Karo plateau, Sago, Singalang, Asahan), Borneo (Sabah: West Coast), Java (West: Preanger, Salak, Bandoeng, Batavia, Bogor, Talaga-bodas, G.Patoeka, G.Tiloe; Central: Ungarang; East: Mount Idjen, Besoeki, Pasoeroean), Nusa Tenggara: Lombok (Rindjani-vulcano).

Ecology. Primary or disturbed (mountain, oak-laurel) evergreen, mixed or deciduous (monsoon) forest, often near stream, on dry to moist sandy or loamy soil, limestone, granite or andesite breccia, shaded. Altitude: (75–)210–1850 m asl.

Notes. 1. This is the most widespread species of the genus. It is the only species occurring in Pakistan, China, Taiwan, and Japan.

2. As Hasskarl (1863) noted, *Campelia glabrata* as used in Asian literature is not based on Kunth (1843). The inflorescence in Kunth's original material in B

(Barcode: B 10 0184765 / ImageId: 245454), *Kunth s.n.* (Febr. 1833, Hortus Berol.), has a long peduncle with two leaf-like bracts at the apex enclosing the flowers, whereas the Asian material has very condensed inflorescences. The genus *Campelia* is restricted to the American continent, and is now united with *Tradescantia* (Hunt 1986).

3. This species has often been referred to as *A. hispida*, a confusion that started with Hooker (1864) who mentioned the species is distributed from New Guinea to India. Since that time onward, the name *hispida* has been in use for continental Asian material (e.g. Hong & DeFilips 2000), most of which should be identified as *A. glabrata*. Both *A. hispida* and *A. glabrata* have capsules distinctly shorter than the sepals with valves fused in the basal part. Differences include position and length of submarginal hairs (with slight overlap), presence of pedicel, length of hairs on capsule (with some overlap), length of anthers, shape of capsule apex, and length of style remnant. The species co-occur only on Borneo. However, *A. hispida* has been found only in E and SE Kalimantan, whereas *A. glabrata* has only been found in the mountainous areas of Sabah.

4. *Amischotolype chinensis* E.H. Walker ex Hatusima is invalid because reference to the basionym was incomplete and indirect (McNeill et al. 2006, Art. 33.4). Hsu (1978) was the first to validate the name. Of the type material I have only seen *Oldham 578/1*, which has submarginal hairs on the upper surface, a state that is only rarely seen in other specimens of *A. glabrata*. However, Brown's original description in Forbes & Hemsley (1903) agrees with the present delimitation of *A. glabrata*. The illustration in Hsu (1978) clearly shows the persistent style remains; the fruit, however, is depicted with four valves instead of three.

5. Ridley (1923) did not cite specimens when he described *F. sumatrensis*, he just mentioned that it was found in Berastagi woods (Sumatera). There is only one collection of Ridley (K) that fits his description with matching locality, which should therefore be the holotype. Ridley (1923) mentioned that the stamens are "apparently quite glabrous". Unfortunately, these could not be checked from the photo. The filaments of other Sumatran material (*Bartlett 6612*) are not glabrous, but compared to material from other regions they are much less hairy and with shorter hairs. In the present treatment this is regarded as variation within the species.

Specimens examined: PAKISTAN. **E:** Chittagong Hill Tracts, between Langlagklopara and Kairwa, Jan 1965, *M.S. Khan 952* (K).

INDIA. **Sikkim:** *J.D. Hooker f. & T. Thompson s.n.* (K, L); E. Himalaya, Rongbe, Jul 1913, *G.H. Cave s.n.* (E). **Meghalaya:** Khasia, Shillong, Oct 1872, *C.B. Clarke 19048* (BM); Shillong, Aug 1886, *C.B. Clarke, 44390A* (BM). **West Bengal:** Darjeeling, Rishap, Aug 1870, *C.B. Clarke 12518* (K, BM); Darjeeling, Oomong, Oct 1870, *C.B. Clarke 13645* (K); Darjeeling, Jun 1893, *Cowan s.n.* (E). **Assam:** Garo Hills, Tura Mountain, 1929, *N.E. Parry 809* (K).

CHINA. **Guizhou:** Lo-Fou, Aug 1909, *J. Cavalerie 2565* (E) & *3517* (P, E); 1936, *S.W. Teng 90984* (L). **Yunnan:** *A. Henry 10884* (E) & *12204* (E) & *13377* (E). **Guangxi Zhuang:** Na Pao Kou, San Chiang Hsien, Sep 1933, *A.N. Steward & H.C. Cheo 1101* (P). **Hainan:** Fung Sheung Tsuen, Ngai distr, Aug 1932, *Lau 427* (P, E); Chim Fung Mt., Feb 1935, *Lau 5422* (E); Yaichow, Aug 1933, *Liang 62393* (E).

TAIWAN. Mt Arisan, Aug 1914, *S. Kawagoe s.n.* (L); Tamsui, 0, 1864, *R. Oldham 578/1* (P);

Taipei Hsien, Pingling Hsiang, Taiyuku, Nov 1992, *Liu et al.* 21 (E).

JAPAN. **Ryukyu Isl.**: Okinawa, Kunigami, Taminato Ugan, Jul 1951, *E.H. Walker et al.* 6130 (L); Okinawa, Motobu Peninsula, foot of Mt Awa, Dec 1953, *E.H. Walker* 7607 (L); Nantou Co., Sun-Moon-lake, Aug 1972, *C.-S. Kuoh* 3882A (L).

VIETNAM. ?Dalat, ?Adran, Nov 1953, *N. Schmid s.n.* (P). **Tonkin**: Mont-Baui(?), Jun 1886, *B. Balansa, B.* 4100 (P); Tien-yen, Ho Yung Shan and vicinity, 1940, *W.T. Tsang* 30748 (E, P, SING). **Lang Giu**: Than Mai, 1916, *Eberhardt* 3277 (P). **Ninh Binh**: Cuc Phuong NP, Nov 1998, *D.D. Soejarto et al.* 10380 (L); Cuc Phuong NP, site CP71, Jul 1999, *N.M. Cuong* 300 (L); Nho Quan District, Cuc Phuong NP, Dec 1999, *D.D. Soejarto et al.* 11318 (L).

MYANMAR. 1885, *R.H. Beddome* 8001 (BM). **Tenasserim**: Tavoy distr, Aug 1961, *J. Keenan et al.* 715 (E); Aug 1961, *J. Keenan et al.* 1048 (E).

THAILAND. N: **Chiang Mai**: Doi Angka, E. slope nr rivulet, Oct 1927, *H.B.G. Garrett* 483 (L); Doi Chiang Dao, E foothills, Pa Blawng Cave area, Oct 1989, *J.F. Maxwell* 89-1287 (L). **Chiang Rai**: Ban Pa Deuah, Bah Sahng subdistrict, Feb 1991, *J.F. Maxwell et al.* 98 (L). **Lampang**: Jae Sawn NP, Wahng Die, Pah Ngahm (Nahn Kaht) cave, Jan 1996, *J.F. Maxwell* 96-76 (L).

PENINSULAR MALAYSIA. **Kedah**: Bukit Telim, Nov 1908, *H.N. Ridley* 13892 (BM, K, SING). **Pahang**: Cameron Highlands, Boh plantation, Apr 1937, *Md.Nur SF* 32944 (SING). **Selangor**: Ulu Langat, 1912, *C.B. Kloss s.n.* (K).

SUMATERA. *P.W. Korthals s.n.* (L). **Sumatera Utara**: Berastagi Woods, Feb 1921, *H.N. Ridley s.n.* (K); Brastagi, Dec 1921, *E.M. Burkill* 30 (SING); N of Berastagi, Deleng Sing., Feb 1927, *H.H. Bartlett* 6612 (L); plateau above Berastagi, Jan 1929, *J.A. Loerzing* 15073 (L); Asahan, East Coast, Aek Si Tamboerak, Oct 1936, *Rahmat Si Boeea* 10647 (L); vic. Taloen na Oeli, nr headwaters Aek Mandosi, Nov 1936, *Rahmat Si Boeea* 10952 (L). **Sumatera Barat**: G.Singalang, May 1918, *H.A.B. Buennemeyer* 2588 (L); Mt.Talang, Jul 1953, *J. van Borssum Waalkes* 2796 (L, SING). N slope of Mt Sago, Pajakumbuh, Air Kesimbultan, Mar 1955, *W.J.C. Meijer* 3654 (L).

BORNEO. **Sabah**: West Coast: Kinabalu, Menteki River, *J.H. Beaman et al.* 10785 (K); Kota Belud, Kinabalu, Golf Course Site, Oct 1983, *J.H. Beaman et al.* 7205 (L); Kota Belud, Mount Kinabalu, Penibukan, Dahobang falls, Jan 1933, *J. & M.S. Clemens* 30681 (L, BM); Kota Belud, Mt Kinabalu, Penataran basin, Jul 1933, *J. & M.S. Clemens* 34200 (L, BM); Kota Belud, Kinabalu, Penataran River, Jul 1933, *J. & M.S. Clemens* 34272 (BM); Ranau, Kundasan, Nov 1957, *Kidinan Cox* 951 (L); Ranau, S slope Kinabalu, Penosok plateau, Sungai Mesilau, Jul 1963, *H.P. Fuchs et al.* 21111 (L); Ranau, Mt.Kinabalu, Mesilau camp, Jan 1964, *W.L. Chew & E.J.H. Corner* 4001 (SING, L); Ranau, Kinabalu, Pinosok plateau, 1964, *M.E.D. Poore* 3863 (L); Kota Belud, Kinabalu NP, along road between HQ and Tenumpok, Jan 1969, *S. Kokawa & M. Hotta* 3095 (L); Ranau, Mesilau trail few trails from road, Sep 1972, *J.L. Chow SAN* 76433 (L, SING); Ranau, Kinabalu, West Mesilau River, Nov 1983, *J.H. Beaman et al.* 7452 (L, K); Ranau, Kinabalu, West Mesilau River, Feb 1984, *J.H. Beaman et al.* 8637 (L); Penampang, Penampang: Crocker Range, Mar 1984, *J.H. Beaman et al.* 8849 (L); Tambunan, km 63 KK-TambunanRd, Jul 1984, *Amin et al. SAN* 60351 (SAN, L); Ranau, Kundasang, Melisau, Mar 1985, *A. Zuraidah bt* 0027/7195 (SAN); Ranau, S.Bambangan, Sep 1988, *Amin et al. SAN* 123564 (SAN); Tambunan, Kawasan simpanan Rafflesia, Jul 1989, *Norhayati Sandapali* 03 (SAN); Ranau, Kampong Bundu Tuhan, Sep 1992, *S. Doinis* 24 (KEP); Kota Belud, Mt.Kinabalu, halfway along Liwagu Trail, Feb 1995, *K.M. Cameron s.n.* (K); Kota Belud, Kinabalu Park, Mountain Garden, Jul 2005, *H. Duistermaat* 392 (L, SING).

JAVA. *Kuhl & v.Hasselt s.n.* (L). **Jakarta**: Pasir Limoes (Boerangrang), Jul 1920, *R.C. Bakhuizen van den Brink sr.* 4367 (L). **Jawa Barat**: *A. Zippelius s.n.* (L); Salak, *A. Zippelius*

s.n. (2269a) (L); Gedeh, *F.W. Junghuhn s.n.* (L); Pangerangoh, nr Tjipanjawar, *C.L. Blume s.n.* (L); Tjibodas, *J.G. Boerlage s.n.* (L); tussen Tjibodas en Tjikeureum, *S. Bloembergen 86* (L); G.Patoeka, *P.W. Korthals s.n.* (L); Pangerango, supra Tjibodas, Apr 1894, *V. Schiffner 1692* (L); Tjibodas, Oct 1896, *S.H. Koorders 26031B* (K); Tjigenteng, Jan 1897, *S.H. Koorders 26329B* (L); Tjibodas, Oct 1898, *S.H. Koorders 31912B* (L); Tjibodas, 1905, *R.H.C.C. Scheffer s.n.* (L); WZW van Buitenzorg, Nirmala, Dec 1913, *C.S. Backer 10673* (L); Tjiboden, 1915, *Sapiin 450* (SING); Tjibodas, 1915, *Sapiin 2037B* (L, U); G.Beser, May 1917, *W.F. Winckel, W.F. 28* (L); Tjadas, Malang-Tjidadap, Tjibeber, Jun 1917, *R.C. Bakhuizen van den Brink sr. 1935* (L); Talaga-bodas, *P.W. Korthals s.n.* (L); G.Djaja, Mar 1920, *H.J. Lam 166* (L); G. Perbakti, Sep 1922, *R.C. Bakhuizen van den Brink Jr. 1729* (U); G.Tiloe, Rioeng goenoeng, Jan 1927, *J.H. Coert 575* (L); Tjibodas, Dec 1932, *W.J.C. Kooper s.n.* (U); Gedeh, Tjibodas, Apr 1932, *A. Kloos 38* (L); voetpad Tjibodas-Tjibeurum, Jan 1939, *C. Holstvoogd, C. 210* (L); Tjisaroea, Feb 1950, *S.J. van Ooststroom 12843* (L). **Jawa Tengah:** Ungarang, prope Medini, *F.W. Junghuhn s.n.* (L); Djati-Kalangan, *Waitz (845')* (L). **Jawa Timur:** Banyuwangi: Mount Idjen, Oct 1858, *H. Zollinger s.n.* (L); Besoeki, Banjoelinoe-Kalibendo, Jul 1916, *S.H. Koorders & A. Koorders-Schumacher 40490B* (L); Pasuruan. N...kadjadja, May 1923, *J. Dorgelo 513* (L); Ranse Pani near Sendoero, Feb 1934, *J.H. Coert 1120* (L). NUSA TENGGARA. **Lombok:** Rindjani-vulcano, SO-seite, Sappittal, Pussu, Jun 1909, *J. Elbert 1799* (L); Rindjani-Vulkangebirge, Sapittal, S-side Pussuk, Jun 1909, *J. Elbert 1839* (L, SING).

5. *Amischotolype gracilis* (Ridl.) I.M.Turner (Fig. 9B, 11E–F & 12A–D)

Amischotolype gracilis (Ridl.) I.M. Turner, Gard. Bull. Sing. 45 (1993) 53, 47 (1997) 515. Keng et al., Conc. Fl. Sing. Volume II: Monocotyledons (1998) 23. — *Forrestia gracilis* Ridl., J. Straits Branch Roy. Asiat. Soc. 41 (1904) 37; Mat. Fl. Malay. Penins. 2 (1907) 123; Fl. Malay. Penins. 4 (1924) 359; Brückner in Engler & Prantl, Nat. Pflanzenfam. ed. 2 (1930) 169; Keng, Gard. Bull. Sing. 40 (1987) 124. LECTOTYPE (designated here): *Ridley 2381*, Pulau Tijau (SING). Other syntypes: *Cantley's Coll.* (*Curtis s.n.*, Kwala Lumpor; *Alvins Y.H. 2020*, Gunong Bumbon) (SING); *Ridley 2382, 6320, 10512* (all SING); *Ridley 4130 (n.v.)*, *Walker 155* (BM, *n.v.*).

Forrestia hispida auct., *sensu* Hooker f., Bot. Mag. 90 (1864) t. 5425; *non* A.Rich.

Forrestia mollis auct., *sensu* C.B.Clarke in A.Candolle & C.Candolle, Monogr. Phan. 3 (1881) 236, *p.p.* (*Walker 155*); Hooker f., Fl. Brit. Ind. 6 (1894) 383, *p.p.*; Ridley, J. Straits Branch Roy. Asiat. Soc. 33 (1900) 170; *non* Hasskarl, Flora 47 (1864) 628, *nom. superfl.* (= *A. mollissima* (Blume) Hassk.); *non* Ridley, Mat. Fl. Malay. Penins. 2 (1907) 124; J. Malayan Branch Roy. Asiat. Soc. 1 (1923) 103; Fl. Malay. Penins. 4 (1924) 360 (= *A. barbarossa* Duist. sp. nov.).

Stem ascending from short creeping rhizome; erect part 90–250(–300) cm long, often with short or long stilt roots, simple; internodes glabrous. **Sheath** (4–)6–11(–13) mm diam., glabrous or rarely with 1 or a few lines of 0.5–2 mm long hairs, mouth ciliate or rarely glabrous. **Leaf blade** (16–)20–35(–45) × (3.5–)4–7(–8.7) cm, (3.3–)4–6(–7.3)

times as long as wide, smooth, lower surface green to dark purple, upper surface green or variegated with silver-white (see note 3), base gradually to abruptly narrowed into a winged pseudopetiole up to 5.5 cm long and 1–3 mm wide; lower surface glabrous or sparsely to densely 0.1–1 mm long hairy; upper surface glabrous or rarely sparsely 0.1–0.3(–0.5) mm long hairy; submarginal hairs on upper surface, (0.7–)1.5–2.5 mm long, (rather) dense, (yellow-)orange to red-brown. **Inflorescence** on erect stem, sessile, 1.5–3.5 cm diam., (rather lax to very) dense with branches obscure or up to 3(–6) mm long, 5–15-flowered. **Pedicel** 0–1 mm long. **Sepals** 4.5–7 × 2.5–4.5 mm, not elongating in fruit, white to green in flower, green to purplish in fruit, margins and keel or entirely sparsely to moderately (0.1–)0.2–0.5 mm long hairy or rarely glabrous, tip hooded. **Petals** 4–7 × 2–3 mm, not to slightly longer than sepals, white, glabrous or with few 0.2 mm long hairs at midvein near apex, margin entire or minutely fringed at apex. **Stamens** with filaments 3–7 mm long, white to pale yellow, in upper 0.5–3 mm with many 1.5–2 mm long, white hairs; anthers 1.0–1.8 × 0.5–0.7 mm, white to pale yellow, thecae opening by an apical pore or a longitudinal slit 0.3–1.8 mm long. **Capsule** 7–11(–14) × 4.5–8 mm, obovoid, white to purplish red, purple or rarely green, longer than sepals by (2.5–)4–6(–7) mm, upper 1/3 partially to entirely rather sparse to moderately 0.7–1.5 mm long white- to yellow-hairy (hairs longest at apex); valves free; apex slightly depressed, lobes absent; style remnant 0.8 × 0.2–0.4 mm, finally deciduous. **Seeds** 2 per locule (rarely 1 and double-sized, or 1 abortive), aril orange, rarely containing 2 seeds.

Distribution. Peninsular Malaysia (Kedah, Kelantan, Terengganu, Perak, Pahang, Selangor, Negeri Sembilan, Malacca, Johor), Singapore, Sumatera (Aceh, Anambas Natuna Islands, Jambi, Palembang), Borneo (Sarawak: Kuching; see note 2).

Ecology. In rather dry to wet or swampy, primary or recently logged-over, lowland, mixed, dipterocarp or montane rain forests, rarely in *kerangas* or peat swamp forest, in dry streambeds and on slopes; partly shaded; on granite, clay, and alluvial soil. **Altitude:** 0–1350(–1500) m asl.

Notes. 1. As Ridley (1904) noted, this is the most common species of the genus in Peninsular Malaysia and Singapore. Earlier authors included it in *Forrestia mollis* (but see also *A. barbarossa*), an illegitimate name as Hasskarl (1864) based it on *Campelia mollissima* Blume. It is most obviously different from *A. gracilis* in having capsules much shorter than the sepals and with apical lobes.

2. The species is known from Borneo from only two collections, both from Sarawak. Another specimen is close to this species but deviates from the above description in having 2 mm long hairs on the upper surface of the leaf blade (*S* [*S.T.Lai*] 54495; SAR n.v., KEP, L).

3. Material from disturbed forest along Jalan Gombak, Selangor, Peninsular Malaysia, has silver-white variegated leaf blades (*Duistermaat* 353; Fig. 1E). The variegation slowly disappeared when the plant was grown in the greenhouse.

Specimens examined: PENINSULAR MALAYSIA. **Kedah:** Sungai Batang, Mar 1938, *Sow 34656* (KEP); Baling, Lata Mengkung, Dec 1990, *Khairuddin Hj. Itam 8* (KEP); Baling, Ulu Legong, Kampung Keda, Water Catchment Area, Apr 2006, *K. Imin et al. FRI 50645* (KEP, L); Baling, G. Inas FR, Bkt Iboi, Apr 2008, *M. Kamarul Hisham et al. FRI 59170* (KEP). **Kelantan:** Chaning Woods, Feb 1917, *H.N. Ridley s.n.* (K); Ulu Sungei Ketil, Mar 1972, *Md.Shah 2588* (KEP, SING); Bukit Berangkat Reserve, via Kpg. Perak Bertam, Feb 1973, *Md.Shah & Md.Ali 2862* (KEP, SING); Sg. Lebir, Eastern bank opp. Jentah, Apr 1976, *B.C. Stone 12549* (KEP, KLU); Jeram Pasu, May 1982, *B.C. Stone et al. 15211* (KLU); Merapoh, near base camp, Jun 1995, *Ong 654* (KLU); Merapoh, bird trail forest near base camp, Jun 1995, *Ong 572* (KLU). **Terengganu:** Rantau Panjang F.R., Jun 1921, *H.L. Hume 7589* (SING); Kemaman, Bukit Kojang, Nov 1935, *E.J.H. Corner s.n.* (SING, K); Kemaman, Ulu Bendong, Nov 1935, *E.J.H. Corner s.n.* (SING); Ulu Brang, Jul 1937, *L.M.J. Moysey & Kiah SF 33726* (SING); Dungun, Jambu Bongkok F.R., Aug 1964, *Kassim M. s.n.* (KLU); Dungun, May 1968, *Soepadmo KLU 9151* (KLU); Bukit Yong, Jerteh, Mar 1975, *Md.Shah et al. 3542* (KEP, KLU, SING); Dungun, Bukit Bauk Forest Reserve, Feb 1998, *Tham S.M. 56* (KEP); Besut, Bukit Bintang, Hilltop around Telekom station, Sep 2006, *Yao T.L. et al. FRI 53122* (KEP, L). **Perak:** Telok Sera, Mar 1896, *H.N. Ridley s.n.* (SING); Bukit Kapayang, 1904, *H.N. Ridley s.n.* (SING); Ulu Temango, Jul 1904, *H.N. Ridley 14376* (BM, SING); Taiping Hill, Jan 1923, *M.R. Henderson 10413* (SING); Taiping Hill, Feb 1923, *M.R. Henderson SF 10451* (SING); Kuala Kangsar, Babu Forest Reserve, Apr 1933, *C.F. Symington 29943* (KEP); Batu Kurau, Apr 1968, *Sidek bin Kiah S 331* (SING); Maxwell Hill, Nov 1980, *Keng Wee et al. 58* (SINU); Kuala Kangsar, Kledang Saiong Forest, 1987, *S. Anthony 769* (KEP). **Pahang:** Pulau Tijau, Pahang River, 1891, *H.N. Ridley 2381* (SING); Tahan River, 1891, *H.N. Ridley 2382* (SING); Titi Bangor, Temerloh, Mar 1923, *M.R. Henderson SF 10631* (SING); Fraser's Hill, Aug 1923, *Md.Nur SF 11039* (SING); Pulau Tioman, Gunong Rokam, May 1927, *Md.Nur SF 18773* (SING); base Gunong Senyum, Aug 1929, *M.R. Henderson SF 22335* (SING); Raub, Bilut FR, Apr 1932, *Osman 28480* (KEP); Bentung, Lentang FR, Jun 1935, *Symington 40519* (KEP); Raub, Bukit Kajang, Jun 1935, *C.F. Symington 40535* (KEP); Fraser's Hill, Ring Road, Apr 1955, *J.W. Purseglove 4173* (K, L, SING); Jengka For. Res., Nov 1963, *E.A. Turnau 909* (KLU); Pekan, Bukit Chini FR, Oct 1968, *P.S. Bray FRI 11652* (KEP); Ulu Sungai Sepia, near Kuala Aur, Jul 1970, *Md.Shah & Md.Noor 1905* (KEP, L, SING); Aug 1970, *Rao et al. s.n.* (SING); Ginting Highlands Road, May 1972, *B.C. Stone 10761* (KLU); Taman Negara, Kuala Trenggan, path to salt lick, Aug 1972, *B.C. Stone 10839* (KLU); Fraser's Hill, path to the Lodge, Aug 1972, *Md.Shah 2731* (SING); Kuala Tahan, Taman Negara, 1973, *B.C. Stone 11545* (KLU); Fraser's Hill, Nov 1973, *Keng et al. 34* (SINU); nr basecamp at Ulu Sungei Kinchin, Rompin-Endau, Aug 1996, *I.M. Turner 96-103* (SING); Temerluh, Krau Game Reserve, Oct 1999, *Chua L.S.L. FRI 40873* (KEP); Nenasi FR, Nov 2005, *Shamsul Khamis et al. N-42* (KEP); Temerloh, Bukit Rengit, Krau wr, Rentis Tualang, Mar 2006, *K. Imin et al. FRI 50603* (KEP); Rompin, P.Tioman, Kpg.Paya, Mar 2007, *K. Imin et al. FRI 50949* (KEP, L). **Selangor:** KL, Univ. Malaya Bot. Garden Greenhouse, *Khatijah 103* (KLU); Bukit Kuda, Jun 1889, *H.N. Ridley s.n.* (SING); Kwala Lumpor, Feb 189x, *C. Curtis s.n.* (SING); Batu Tiga, Feb 1904, *H.N. Ridley 11878* (SING); Klang Gates, Aug 1908, *H.N. Ridley s.n.* (SING); Ulu Langat, Feb 1912, *C.B. Kloss s.n.* (BM); Kwala Lumpur, Welds Hill, Mar 1915, *H.N. Ridley s.n.* (BM, K, SING); Selangor, Ulu Gombak, Sep 1921, *H.L. Hume 8625* (SING); Selangor, Ulu Gombak, Oct 1921, *H.L. Hume 9152* (SING); Ginting Simpah, Oct 1921, *H.L. Hume 9328* (SING); Petaling, Sungai Buloh, Feb 1928, *E.J. Strugnell 13939* (KEP); Hulu Langat, Sungai Lalang Forest Reserve, Mar 1930, *C.F. Symington 22671* (KEP); Ginting Simpah, Oct 1937, *Md.Nur SF 34263* (K, SING); Gombak, Ulu Gombak, Apr 1958, *Abdullah b.I. & A.H. Willard*

304 (KEP, S INU); Ulu Gombak. Jun 1962. *B.L. Burt & P.J.B. Woods 1632* (E); Genting Simpah rd. 22nd mile. Ulu Gombak FR. May 1965. *B.C. Stone 5751* (KLU); Ulu Gombak 16th mile, UM Field Studies Centre. Nov 1965. *Soh Kim-Gai 111* (KLU); Templer Park forest reserve, Jun 1971, *Teo L.E. 406* (L, SING); Ulu Lanlat, Sungei Serai water shed, Mar 1976, *Lee D.W. 23338* (KLU); Petaling, Air Hitam Forest Reserve, Sep 1978, *S. Anthony 208* (KEP); Klang Gates Ridge. Jan 1982, *R. Kiew 1180* (SING); Teluk Selangor, Dec 1990, *Khairuddin Hj. Itam 7* (KEP); Jln Gombak km48 47(Bentong). FRIM-examination plot. Jun 2005, *H. Duistermaat 348* (L, SING); N. of Kuala Lumpur, Jln Gombak km 36 37(KL), Jun 2005, *H. Duistermaat 355* (L, SING); Gombak. Ulu Gombak FR. Miles 15, Mar 2006, *K. Imin et al. FRI 50567* (KEP). **Negeri Sembilan:** Gunong Bumbon. Jun 1885, *Y.H. Alvins 2020* (SING); Gunong Tampin, Nov 1922, *R.E. Holtum SF 9536* (K, SING); Gunong Angsi, N.W.side, Nov 1923, *Md.Nur SF 11587* (SING); Gunong Telepak Burok, Seremban, Mar 1977, *J.F. Maxwell 77-155* (L, SINU); Pasoh FR, Aug 1987, *J.V. LaFrankie 2457* (KEP); Pasoh FR, Sep 1987, *J.V. LaFrankie 2483* (KEP); Pasoh FR, 1989, *J.V. LaFrankie 4253* (KEP); Gunung Angsi. Jun 2005, *H. Duistermaat 343* (SING) & *344* (L, SING); Seremban, Berembun FR. Air Pantai, Sg Batang Benar, Apr 2008, *M.A. Mohd Hairul et al. FRI 60040* (KEP); Jelebu, Berembun FR, G. Telapak Buruk, Apr 2008, *K. Imin et al. FRI 63020* (KEP); Jelebu, Berumbun FR. Jeram Toi, forest trail to ridge, Apr 2008, *Yao T.L. et al. FRI 65283* (KEP). **Malacca:** Sungai Buloh, Oct 1899, *H.N. Ridley 10512* (SING). **Johor:** Tanjong Bunga, 1894, *H.N. Ridley 6320* (BM, SING); between K.Tinggi and Rombon, K.T., Sep 1929, *Z. Teruya 1027* (SING); S.Rhu Reba, Jason Bay, Jun 1934, *E.J.H. Corner s.n.* (SING, K); Lengor F.R. Mersing, Jul 1957, *Whitmore 406* (SING); Kuala Sedili, New Road, Jun 1959, *Kadim Md.Noor 163* (SING); Lombong Batu, Mersing, Sep 1966, *Jumali & E.H. Heaslett s.n.* (SINU); Kluang, path to Gunung Blumut, Sep 1970, *Md.Shah & Sanusi 2123* (SING); Gunung Panti top westside, Oct 1972, *Samsuri Ahmad Shukor 784* (SING); Mt.Ophir, Apr 1972, *R.B. Phillips 1637* (KLU); Endau State Park, Pantai Burung, Apr 1998, *Damahuri S. & Mustapa D. s.n.* (KEP); Gunung Panti, top, May 2005, *H. Duistermaat 336* (L, SING); Segamat, Ulu Sg.Segamat, trail up the ridges, Aug 2007, *Chew M.Y. & Kueh H.L. FRI 55597* (L); Kota Tinggi, Panti FR, G.Panti, Jul 2008, *Yao T.L. et al. FRI 65379* (KEP).

SINGAPORE. MacRitchie Res. *Sinclair 4931* (E); Tampines, 189x, *J.S. Goodenough s.n.* (SING); Reservoir Woods, 1893, *H.N. Ridley s.n.* (SING); Pulau Ubin, 1893, *H.N. Ridley 4810* (SING); Chan Chu Kang, 1894, *H.N. Ridley s.n.* (SING); Reservoir woods, 1906, *H.N. Ridley s.n.* (SING); Bukit Timah Forest Reserve, Sep 1959, *Md.Shah 747* (SING); Bukit Timah Nature Reserve, Sep 1965, *Hesslett 3468* (SINU); Bukit Timah Nature Reserve, May 1967, *Jumali s.n.* (SINU); SW of MacRitchie Reservoir, May 1993, *W.S. Chee et al. 2158* (KEP); Bukit Timah, Fern Valley, Jun 1998, *L.M.J. Chen 245* (SING) & *246* (SING); Bukit Timah Nature Reserve, 2000, *C.F. Teo D.H.L. 25* (SINU); Nee Soon, Jun 2003, *Samsuri et al. 27* (SING); Bukit Timah Nature Reserve, Tiup Tiup path, Mar 2004, *Samsuri et al. 41* (SING); SBG, rainforest off Liana Rd close to Cluny Rd, Apr 2005, *H. Duistermaat 328* (L, SING); Bukit Timah, Fern Valley, Apr 2005, *H. Duistermaat 331* (L, SING) & *333* (SING); Bukit Timah NR, Rangas Path, May 2005, *H. Duistermaat 340* (SING); MacRitchie Reservoir, patch behind Gardenia Rd, May 2005, *Gwee A.T. et al. 2005-142* (SING).

SUMATERA. Aceh: Jul 1939, *A.H. Batten Pooll s.n.* (SING); W.van Kroeng Loeas, O van Troemon, Aug 1941, *Asdat 41* (L); Bukit Lawang-Bohorok-Langkat, Feb 1973, *R. Soedarsono 262* (L, SING) & *307* (L); Gng Leuser NP, G.Mamas, Feb 1975, *W.J.J.O. de Wilde & B.E.E. de Wilde-Duyffes 14789* (L); Gng Leuser NP, Alas river valley, Jul 1979, *W.J.J.O. de Wilde & B.E.E. de Wilde-Duyffes 18480(vel 1)* (L); Gng Leuser NR, Sikundur FR, Aug 1979, *W.J.J.O. de Wilde & B.E.E. de Wilde-Duyffes 19293* (L); Kloet NR, along Krung (=river) Lembang, Jul

1985, *W.J.J.O. de Wilde & B.E.E. de Wilde-Duyffes 19740* (L); Kloet NR, along Krung (=river) Lembang, Jul 1985, *W.J.J.O. de Wilde & B.E.E. de Wilde-Duyffes 19904* (L). **Sumatera Barat:** Afd.4 Kota S.Koeriman, May 1918, *H.A.B. Buennemeyer 3312* (SING, L); Afd. Agam Brani, May 1918, *H.A.B. Buennemeyer 3355* (L). **Kepulauan Riau:** Anambas / Natuna Islands, Terempak, Siantan, Apr 1928, *M.R. Henderson SF 20254* (SING); Siantan Isl., E of Terompa, Apr 1928, *C.G.G.J. van Steenis 918* (L, SING, U). **Jambi:** S Kejasung Tabin, Jambi Sunake, Mar 1980, *Y. Laumonier 804* (L); P.T. IFA Concession, Pasir Mayang, Feb 1982, *M.J. Vreeken-Buijs. 45* (L). **Sumatera Selatan:** Palembang, Rawas, Jun 1917, *J.M. Dumas 1598* (L). **BORNEO. Sarawak:** Kuching: Lundu, Jalan Lundu, *Othman et al. S 61977* (E); Kuching, Lundu, Sentunggan, Dec 1995, *Lai S.T et al. S 54495* (cf; KEP, L).

6. *Amischotolype griffithii* (C.B.Clarke) I.M.Turner (Fig. 9C)

Amischotolype griffithii (C.B.Clarke) I.M.Turner, Novon 6 (1996) 221; Coode et al., Checklist Fl. Pl. Gymn. Brun. Dar. (1996) 352 (see note 2); Turner, Gard. Bull. Sing. 47 (1997) 515. — *Forrestia griffithii* C.B.Clarke in A.DC. & C.DC., Monogr. Phan. 3 (1881) 236; Hooker f., Fl. Brit. India 6 (1894) 383; Ridley, Mat. Fl. Malay. Penins. 2 (1907) 123; Fl. Malay. Penins. 4 (1924) 360; Brückner in Engler & Prantl, Nat. Pflanzenfam. ed. 2 (1930) 169; non Cowley & Furness, Kew Bull. 52 (1997) 469; non Beaman & Beaman, The Plants of Mount Kinabalu 3 (1998) 109 (= see note 2). LECTOTYPE (designated by Turner (1996)): *Maingay 1712*, p.p. (K), Peninsular Malaysia, Malacca.

Stem ascending from rhizome; erect part c. 100 cm long, simple; internodes glabrous. **Sheath** 7–13 mm diam., glabrous, mouth (sparsely) ciliate. **Leaf blade** (18–)25–35 × 4.5–7.5 cm, 3.3–5.6 times as long as wide, base gradually to rather abruptly narrowed into a winged pseudopetiole 1–3 cm long and c. 2 mm wide; lower surface sparsely to densely (0.5–)1–2 mm long hairy, upper surface sparsely to moderately 1–2 mm long yellow-hairy; submarginal hairs on upper surface, (0.8–)1–3 mm long, (rather) dense, yellow to reddish gold or rarely red. **Inflorescence** on erect stem, sessile, 2–3.5 cm diam., (rather) dense with branches obscure, 10–20-flowered. **Pedicel** 1–1.5 mm long. **Sepals** 4.5–6.5(–7.5) × 2.5 mm, not elongating in fruit, (white or) red to purplish, sparsely to moderately (rarely densely) 0.5 mm long ciliate margins and keel or hairy all over, tip hooded. **Petals** 4–4.5 × 1.5 mm, slightly shorter than sepals, white, glabrous, margin entire. **Stamens** with filaments c. 8 mm long, colour unknown, upper half with 1.5 mm long hairs; anthers 1.1 × 0.7 mm, yellow, thecae opening by an apical pore. **Capsule** (7–)8–12 × 5–8.5 mm, pyriform, longer than sepals by (1.5–)3.5–6 mm, white to purple, upper half only to entirely sparsely to moderately (0.7–)1(–2) mm long hairy; valves free; apex depressed, lobes absent; style remnant 0.5–0.7 × 0.2–0.3 mm, deciduous. **Seeds** 2 per locule, aril colour unknown.

Distribution. Peninsular Malaysia (Penang, Kelantan, Perak, Pahang, Negeri Sembilan, Malacca, Johor), Sumatera (Riau).

Ecology. Moist to wet or swampy primary or regenerating (dipterocarp) forest, by streams or riversides; shaded or rarely unshaded. Altitude: 60–1310 m asl.

Notes. 1. *Maingay 1712* is a mixture (see Clarke, 1881), with one specimen (L) which is *A. barbarossa*, and another (K; only seen from a photo) which is the present species. Two specimens at SING [*Holmberg 856* and *Ridley s.n.* (Perhantian Tinggi)] identified by Ridley as *F. griffithii* are in accordance with the above description.

2. According to Ridley (1907) this species is endemic to Peninsular Malaysia. Today it is also known from Sumatera where it has been found only twice. It has been mentioned for Borneo (Coode et al. 1996, Beaman & Beaman 1998), but specimens available for study are all *A. hirsuta* Hallier f., a closely similar species with hairy internodes and hairy sheaths (J. & M.S. Clemens 26039, 26476; Cowley 19), and *A. lobata* (Shea & Aban SAN 76938), a species with distinctly lobed capsules.

Specimens examined: PENINSULAR MALAYSIA. **Penang:** 189x, *H.N. Ridley s.n.* (SING). **Kelantan:** Sungei Merkeh, Bukit Baka, Machang, *Md. Shah & Ahmad Shukor 3186* (KEP, KLU, SING); Sungei Sat FR, Bukit Baka, base, May 1982, *B.C. Stone in Chin S.C. 3200* (KLU); Kuala Krai, Gua Bogo, track to G. Stong and camp Ba, Feb 2007, *Yao T.L. et al. FRI 55864* (KEP, L). **Perak:** Kinta, Ulu Sungai Kinta, Jun 1938, *Sow 47255* (KEP). **Pahang:** Tras, May 1903, *A.D. Machado s.n.* (SING); Fraser's Hill, upon the Selangor border, Sep 1922, *H.M. Burkill & R.E. Holttum 8869* (SING); Gunung Lesong FR, May 1939, *Fontian Forester 31645* (KEP); Fraser's Hill, near Selangor Residency, Aug 1959, *Md. Shah & Md. Noor 731* (SING); Fraser's Hill, Aug 1969, *B.C. Stone 8753* (KLU); Temerluh, Krau GR, Kuala Lompat, Sep 1981, *R.W. Kiew 1049* (KEP). **Negeri Sembilan:** Perhantian Tinggi, 18xx, *H.N. Ridley s.n.* (SING); Gunong Tampin, Sep 1913, *H.C. Robinson s.n.* (K); Tebong FR, Dec 1959, *M.E.D. Poore 134* (KLU); Port Dickson, Sungai Menyala Forest, Oct 1978, *R.W. Kiew 675* (KEP); S. Menyala F.R., Oct 1978, *R.W. Kiew 688* (SING). **Malacca:** Ager Punnus (Ayer Panas), *W. Griffith 5485*, p.p. (K); *A.C. Maingay 1712*, p.p. (K); 1891, *D.F.A. Hervey s.n. A* (SING) & *s.n. B* (SING); Selandor, Jan 1885, *Y.H. Alvins 473* (SING); Sep 1885, *Y.H. Alvins 2102* (SING); Bukit Singei, Mar 1886, *Y.H. Alvins s.n.* (SING); base of Mount Ophir, Aug 1888, *R.W. Hullett s.n. (844)* (K); Jasin, Apr 1890, *Anon. 499* (SING); Bukit Sidanan (Sadan), Aug 1891, *P.J. Holmberg 856* (BM, K, SING). **Johor:** Gunung Pulai, 1892, *Mat. s.n.* (SING); Gunung Pulai, Dec 1904, *H.N. Ridley s.n.* (SING); Bukit Semanau, Aug 1915, *H.M. Burkill SF 1337* (SING); 192x, *Y.H. Alvins 1587* (SING); Endau Rompin, nr Jasin River just S of junction Endau River, Mar 1992, *J.S. Klackenberg & R. Lundin 587* (L).
SUMATERA. **Riau:** Muara Padjanki, Apr 1939, *P. Buwalda 6485* (L); Tigapulu Mts, Bukit Karampal area, Nov 1988, *J.S. Burley et al. 1237* (L, SING).

7. *Amisshotolotype hirsuta* (Hallier f.) Duist. **comb. nov.** (Fig. 9D & 13A)

Forrestia hirsuta Hallier f., Beih. Bot. Centralbl. 34 (1916) 47; Merrill, J. Straits Branch Roy. Asiat. Soc. (1921) 113; Brückner in Engler & Prantl, Nat. Pflanzenfam. ed. 2 (1930) 169. TYPE: *Winkler 2617*, 28 Jun 1908, SE Borneo, Hayup (holo B, photo (Barcode: B 10 0296342 / Image Id: 302935); iso L).

Amischotolype griffithii auct., sensu Coode et al., Checklist Fl. Pl. Gymn. Brun. Dar. (1996) 352; Beaman & Beaman, Plants Mount Kinabalu 3 (1998) 109; non C.B. Clarke (= *A. griffithii*).

Amischotolype mollissima auct., sensu Cowley & Furness, Kew Bull. 52 (1997) 469; Beaman & Beaman, Plants Mount Kinabalu 3 (1998) 110; non Blume (= *A. mollissima*).

Forrestia mollis auct., sensu C.B. Clarke in A. Candolle & C. Candolle, Monogr. Phan. 3 (1881) 236, p.p. [Beccari 827]. non Hasskarl, Flora 47 (1864) 628, nom. superfl. (= *A. mollissima* (Blume) Hassk.); non Ridley, Mat. Fl. Malay. Penins. 2 (1907) 124; J. Malayan Branch Roy. Asiat. Soc. 1 (1923) 103; Fl. Malay. Penins. 4 (1924) 360 (= *A. barbarossa* Duist. sp. nov.).

Stem ascending from short rhizome; erect part 50–200 cm long, sometimes scrambling, simple; internodes sparsely to densely (0.3–)1–2.5 mm long hairy or rarely glabrous. **Sheath** (8–)10–15(–22) mm diam., with at least several frontal lines of hairs and a single line of hairs at its back, hairs 2–4(–7) mm long, yellow, mouth ciliate and sometimes glabrescent. **Leaf blade** 20–35(–42) × (4–)5–7(–11) cm, 3.5–6.0(–7.4) times as long as wide, lower surface red tinged or not, base (very) gradually to rather abruptly narrowed into a winged pseudopetiole up to 3 cm long and c. 3 mm wide; lower surface sparsely to densely (0.5–)1–4 mm long white- to yellow-hairy, upper surface sparsely (mostly near midvein) to rather densely (1.5–)2–4 mm long yellow-hairy; submarginal hairs on upper surface, 1.5–2.5 mm long, (rather) dense, yellow or rarely orange. **Inflorescence** on erect stem or rarely at knee, sessile, 1.8–4.5 cm diam., dense with branches obscure, 15–40-flowered. **Pedicel** 1.5–3 mm long. **Sepals** (4.5–)6–10 × 2–4(–5) mm, not elongating in fruit, green (in flower) to lilac or purple (in fruit), glabrous to margins and keels 0.5–1 mm long ciliate, tip hooded. **Petals** c. 8 × 2.5 mm, as long as sepals, pale pink, glabrous, margin minutely fringed. **Stamens** filament c. 8 mm long, colour unknown, upper 1 mm with (0.5–)2 mm long hairs; anthers 1–1.3 × 0.8–1 mm, colour unknown, thecae opening by a longitudinal slit. **Capsule** 6–9 × 3.5–6 mm, ovoid to pyriform, equalling or exceeding sepals by up to 4 mm, (pale) green or pinkish to reddish- or deep purple, narrowed part of apex to upper 1/3 1–2 mm long, yellow bristle-hairy; valves (almost) free; apex depressed, lobes absent; style remnant c. 0.5 × 0.4 mm, finally deciduous or rarely persistent. **Seeds** 2 per locule, aril orange.

Distribution. Sumatra (Padang), Borneo (Brunei; Sabah: West Coast, Interior, Sandakan, Tawau; Sarawak: Kuching, Samarahan, Sri Aman, Sibul, Bintulu, Miri; Kalimantan: Dusun, Central, West, East, SE).

Ecology. Primary, disturbed, logged-over or secondary, lowland, mixed dipterocarp, swamp, alluvial, beach or montane forest, on flat land, river bank, hill side or ridge, on damp, rich dark or yellow sandy soil, shale or sandstone. Altitude: 6–1400 m asl.

Notes. 1. Hallier (1916) described *Forrestia hirsuta* as being very close to Ridley's *F. irritans* but with hairy sheaths and with smaller and almost glabrous inflorescences. However, it shows more resemblance to *A. griffithii* with which it has been confused (see there, note 2), and which is almost confined to Peninsular Malaysia.

2. This species is almost restricted to Borneo, with only two specimens known from Sumatera (*Beccari 827*, Padang, near Ajer mantjur; *Korthals s.n., s.loc.*).

Specimens examined: SUMATERA. *P.W. Korthals s.n.A* (L). **Sumatera Barat:** Padang, Abita, nr Ajer mantjur, Aug 1878, *O. Beccari 827* (K, L).

BORNEO. **Brunei:** Belait: Labi, Rampayoh, *J. Cowley 157* (K); Belait, Labi, Rampayoh, Jul 1993, *Cowley et al. 19* (L); Belait: Labi, Mendaram, Wasai Wong Kadir, Jun 1995, *Ariffin Kalat BRUN 16792* (K). **Sabah:** West Coast: Kota Belud, Mt. Kinabalu, Dallas, Sep 1931, *J. & M.S. Clemens 26476-26039* (BM, L); Mount Kinabalu, Penibukan, near camp, Mar 1933, *J. & M.S. Clemens 35012* (BM); Ranau, about 8 miles E of Kampung Merungin, Nov 1975, *Leopold & Saikah SAN 82649* (SAN); Ranau, Kampong Nalumad, Aug 1996, *A. Daim 566* (KEP); Interior: Tambunan, Mnt Trusmadi, Mar 1969, *H.P. Nootboom 1444* (L); Tambunan distr: Crocker Range, Oct 1983, *J.H. Beaman et al. 7272* (K, L); Sipitang, Lumaku FR, L39, Mondolong SFI Concession, Aug 1988, *Muhammad Saedi et al. 64* (SAN); Tambunan, Trusmadi, Loloposon (Gua), Jul 2005, *J.J. Vermeulen in H. Duistermaat 398* (L, SING). Sandakan: Dagat Camp, Apr 1963, *Wing J.Ah SAN 35497* (K, SAN); mile 32 Labok Rd, agric.stat, Mar 1970, *H.P. Nootboom 1605* (L); Ulu Dusun, oil palm Res. Sta., Mar 1977, *B.C. Stone 12875* (KLU); Kinabatangan, Kampong Ulu Menanam, Sep 1978, *S. Dewol & T. Kodoh SAN 89259* (KEP); Beluran, Ulu Sg. Muanad, Nov 1984, *Irang Ak. Angi SAN 67433* (L, SAN); Beluran, Jan 1985, *Amin et al. SAN 69486* (KEP, L, SING); Kinabatangan, Tongod, Pinangah FR, Feb 1985, *S. Dewol & Mansus SAN 67483* (SAN); Kinabatangan, Ulu Sungai Melikop, Jun 1985, *S. Dewol & T. Langkap SAN 109288* (KEP, L); Lahad Datu, Ulu Segama, Danum Valley, at entrance to west trail, Mar 1987, *G. Argent et al. GA 681987* (E, SAN); Sepilok FR, Jan 1989, *P. Kessler SAN 118180* (SAN); Lahad Datu, Base Gunung Nicola, Feb 1992, *A. Berhaman SAN 134457* (SAN); Kinabatangan, Lake Linumunsut, Oct 2001, *Sidkan A. MB 1063* (SAN); Lahad Datu, Danum Valley, May 2004, *T.M.A. Uteridge et al. 486* (KEP); R.I.C. Sepilok, Sep 2004, *S. Dewol et al. SAN 142184* (SAN); Tawau: Elphinstone Province, 1922-23, *A.D.E. Elmer 20507* (BM, L, SING, U); Apas, May 1948, *Kadir A 2084* (KEP, SING); Kalabakan, Ulu Sungai Kalabakan, May 1984, *Fedilis & Matin SAN 103611* (L, SAN). **Sarawak:** Kuching: Meatang, Aug 1884, *R.W. Hullett s.n.* (SING); Setapok, Kuching, Sep 1955, *J.W. Purseglove & Md. Shah P 4394* (L, SING); Lundu, Sematan Beach, Sep 1987, *Abg. Mohtar et al. S 54298* (K, L); Bau, Bukit Kho Ze San, Bau subdistrict, Dec 1994, *Rantai Jawa et al. S 70126* (cf: KEP); Bau, Gg. Lanyang, Apr 2002, *S. Julia et al. SBC 2908* (SING); Samarahan: Gng Buri, Ulu Simunjan, Sep 1975, *P. Chai S 36723* (L); Serian, Bukit Rawang, Tebakang area, Apr 1983, *Dyg. Awa & I. Paie S 45586A* (L); Sri Aman: Abok, Apr 1990, *G. Rena et al. S 58955* (K, KEP, L); Sibui: Kanowit, Sana, Sungei Tau, May 1956, *J.W. Purseglove 5120* (L, SING); Bintulu: Oct 1985, *I. Paie S 50161* (K, KEP, L); Miri: Marudi, Gng Mulu NP, Jul 1977, *B. Lee S 38062* (L); Marudi, G. Mulu NP, Apr 1978, *R. Kiew RK 283* (KEP); Marudi, 4th Div, Route to Bt Lawi, Bario, Aug 1985, *Dyg. Awa & L. Bernard S 50535* (K, L); Marudi, Sungei Tutoh, Bt Pelamau, Apr 1997, *R.M.A.P. Haegens et al. 408* (K, L). **Kalimantan C:** Duson-area, *P.W. Korthals s.n.* (L); Kuala Kuayan 112 28E 2 00S, Mar 1984, *C. Hansen 1323* (L). **Kalimantan W:** Liang Gagang, *H. Hallier B2956* (L); Pontianak, Sep 1948, *Moh. Enoch 355* (L); Gn Palung NP, Oct 1996, *T.G. Laman et al. 51* (K, L). **Kalimantan E:** Nunukan, N. of Tarakan, Nov 1953, *W. Meijer 1978* (L); Kebun raya univ. Mulawarman Samari, Aug 1974, *H. Wiradinata 298* (L); Jelini, along

Sungai Belayan, NW of Tabang, Jan 1979, *G. Murata et al. B 1139* (L); Tabang, West Kutai, Dec 1980, *M. Kato & H. Wiradinata B 6098* (L); Long Bawan-Panado, Jul 1981, *R. Geesink 9061* (L); P.T.ITCI, Kenangan-G.Meratus km 69, Mar 1995, *P. Kessler et al. 944* (K, L); PT KEM ENVIR. Lingau plateau, Jun 1996, *Arbainsyah AA 1870* (L); Berau Forest, Swakelola, Labanan, Oct 1996, *P. Kessler et al. Berau 145* (K, L); PT Kelian, Mar 1997, *P. Kessler 2091* (L); Wartono Kadri, Mar 2005, *C. Bernard et al. 7362* (L). **Kalimantan SE**: Hayup, Jun 1908, *H. Winkler 2617* (L).

8. *Amischotolype hispida* (A.Rich.) D.Y.Hong (Fig. 9E & 13B)

Amischotolype hispida D.Y.Hong, Acta Pytotax. Sin. 12, 4 (1974) 461, *pro nomen*. — *Forrestia hispida* A.Rich. in Dumont d'Urville, Voy. Astrolabe 2 (1834) 2; Miquel, Fl. Ned. Ind. 3 (1855) 547; Hasskarl, Flora 47 (1864) 629; Commelin. Ind. (1870) 86; C.B.Clarke in A.Candolle & C.Candolle, Monogr. Phan. 3 (1881) 236, *p.p.* (See note 2); Lauterbach, Bot. Jahrb. 50 (1913) 64; Merrill, J. Straits Branch Roy. Asiat. Soc. (1921) 113, *p.p.* (see note 3); Brückner in Engler & Prantl, Nat. Pflanzenfam. ed. 2 (1930) 169. — *Forrestia hispida* A.Rich. var. *typica* Hallier f., Nova Guinea 8 (1913) 906; Beih. Bot. Centralbl. 34 (1916) 46, *p.p.* (See note 3). — *Forrestia mollissima* (Blume) Koord. forma *hispida* (A.Rich.) Backer, Handb. Fl. Java I, 3 (1924) 33. TYPE: *Lesson s.n.*, August 1827, *crescit in sylvis Novae-Guineae* (holo P, in herb. Franquaville, *n.v.*; klepto L in hb Hasskarl).

Forrestia nigricans A.Rich. ex Steud., Nomencl. Bot. ed. 2 (1840) 644. TYPE: not indicated (see note 5).

Forrestia philippinensis Merr., Publ. Bur. Sci. Gov. Lab. 35 (1906) 5; Philipp. J. Sci. 2, 4 (1907) 266; Brückner in Engler & Prantl, Nat. Pflanzenfam. ed. 2 (1930) 169. — *Forrestia hispida* A.Rich. var. *glabrior* Hallier f., Nova Guinea 8 (1913) 906; Beih. Bot. Centralbl. 34 (1916) 46. — *Forrestia hispida* A. Rich. var. *philippinensis* (Merr.) Merr., Enum. Philipp. Fl. Pl. 1 (1925) 197. TYPE: *Merrill 4051* (holo PNH, *n.v.*; iso K, photo).

Forrestia hispida A.Rich. forma *glabrescens* Lauterb., Bot. Jahrb. 50 (1913) 64; Hallier f., Nova Guinea 8 (1913) 906 (*forma dub.*). SYNTYPES: *Moszkowski 205*, 11 July 1910, Tana, Flussufer, c. 90 m alt. (B, *n.v.*; L?, *n.v.*); *Moszkowski 302*, October 1910, Naumoni (B, *n.v.*; L?, *n.v.*).

Forrestia hispida A.Rich. var. *calva* Hallier f., Nova Guinea 8 (1913) 906; Beih. Bot. Centralbl. 34 (1916) 46. SYNTYPES: *Atasrip 32* (L), *Gjellerup 4* (L).

Stem ascending from long rhizome; erect part 45–250 cm long, often trailing or scrambling, lower part occasionally with many stilt roots, simple; internodes glabrous to densely 0.1–0.3 mm long hairy. **Sheath** (9–)11–20(–24) mm diam., with several frontal lines of 2–4 mm long, colourless to straw-coloured hairs, rarely glabrous or

0.1–0.2 mm long hairy; mouth ciliate or rarely glabrous. **Leaf blade** (19–)28–48 × (4.1–)5.2–10.3 cm. (3.2–)4–6.5(–7.3) times as long as wide, lower surface purplish tinged or not, base very gradually to rather abruptly narrowed into an indistinct winged pseudopetiole to 8 cm long and 2 mm wide; lower surface glabrous to densely 0.1–0.5(–1) mm long white-hairy; upper surface glabrous to densely 0.2–0.7 mm long white-hairy and or with 1.5–3.5 mm long yellow hairs; submarginal hairs on upper surface. (0.5–)1–2 mm long, dense, yellow. **Inflorescence** on erect stem, sessile, 3–6 cm diam., dense with branches obscure. (10–)20–many-flowered. **Pedicel** 2–6 mm long. **Sepals** 10.5–16(–18) × 2–5 mm, unknown elongating in fruit, pink to pale purple in flower, violet or reddish blue to brilliant (dark) red-purple in fruit, glabrous to moderately 0.2–0.5(–1) mm long ciliate margins and keel or rarely sides moderately 0.5 mm long appressed red-hairy, tip hooded. **Petals** 9–11.5 × 2 mm, shorter than sepals, white or with purple base or flushed with purple, glabrous, margin at apex minutely fringed. **Stamens** with filaments 10–12 mm long, colour unknown, upper part up to 1 mm below apex with 1–2 mm long hairs; anthers 1.2–2 × 0.5–1 mm, white to yellow, thecae opening by a longitudinal slit. **Capsule** 5–8 × 3.5–6.5 mm, ovoid, shorter than sepals by 4–9 mm, (pale) purple or red, glabrous or apex to upper half moderately 0.1–0.5(–1) mm long soft-hairy; valves fused for 1/4 to 1/2 of length; apex slightly depressed, lobes absent; style remnant 0.5–0.7 × 0.2–0.4 mm, finally deciduous. **Seeds** 2 per locule, aril orange.

Distribution. Philippines (Luzon, Polillo, Catanduanes, Mindoro, Negros, Samar, Leyte, Mindanao), Borneo (Kalimantan: W, E, SE), Sulawesi (North, Central), Maluku (Sula, Ceram, Buru, Ambon, Kai), New Guinea (Irian Jaya: Cendrawasih, Yapen Island, NE, Central, Bomberai, S; Papua: Sepik, Madang, Morobe, Central, Gulf).

Ecology. Primary or secondary (mixed dipterocarp or *Terminalia*) rain forest, on ridges, (steep) slopes, in periodically inundated or riverine areas, gullies or (sagopalm-) swamps, also in old *Araucaria* and cacao plantations; partially shaded; on clay, alluvial or volcanic soil or limestone. Altitude: 0–1000(–1500) m asl.

Notes. 1. This species was the first described in the genus *Forrestia*. Hong (1974) legally transferred it to *Amischotolype*, but the taxonomic use of the name has been different (see note 2).

2. *Amischotolype hispida* has an East-Malesian distribution, reaching as far north and west as the Phillipines and Borneo. It is absent from continental Asia and it is the only species of the genus present in New Guinea. It has been mentioned for Taiwan (Clarke 1881: Formosa; Wang et al. 2000, Yang et al. 2001) and China (Hong 1974, 1997; McKean 1988), but characters in the descriptions and all material studied for these areas (*Cavalerie*, Jul. 2565, 3517; *Henry* 10884, 12204, 13377; *Kawagoe s.n.*, 8-1914; *Kuoh*, C.-S. 3882A; *Lau* 427, 5422; *Liang* 62393; *Liu et al.* 21; *Teng*, S.W. 90984) are referable to *A. glabrata*.

3. Hallier (1916) and Merrill (1921) included material of *A. pedicellata* in this species (*Hallier B2600*). For differences see note under that species.

4. This species is fairly variable with respect to indument of vegetative parts, sepals and capsule. Hallier (1913) described three varieties, based on the amount of indument on the sheath, occurring on New Guinea, Borneo and the Philippines. I see no use in maintaining these entities. Likewise, in Sulawesi and Maluku the internodes are always glabrous, but otherwise not different and therefore material from these places are included in the present species.

5. Steudel (1840) claims that [A.]Rich. described *F. nigricans*. However, I have not been able to find a publication with this name. It is most likely an 'in sched.' name. As it was mentioned for 'N. Guinea' it must refer to *A. hispida*, the only species of this genus on New Guinea.

6. I have seen only a photo of the type specimen, and none of the other specimens that Merrill (1906) cited of *F. philippinensis*, which he described with filaments glabrous. A specimen in SING (*Baker 3357*) identified by Merrill as *F. philippinensis* is possibly *A. hispida*. Unfortunately, this specimen is a fruiting one and has lost all of its stamens. However, the original description of Merrill's *F. philippinensis* is otherwise very similar to *A. hispida* and it is therefore treated as a synonym of the latter.

Specimens examined: PHILIPPINES. **Luzon:** Atimonan, Tayabas, Mar 1905, *E.D. Merrill 4007* (E); Tayabas, Lucban, May 1906, *A.D.E. Elmer 7410* (E, L); Laguna Province, Mt. Maquiling, Nov 1912, *V. Servinas BS 16877* (L); Mt Mabilang, May 1914, *C.F. Baker 3357* (SING); Sorsogon province, Irosin (Mt Bulusan), Aug 1916, *A.D.E. Elmer 14101* (L, U); Laguna Province, Los Banos, Mt Maquiling, 1917, *A.D.E. Elmer 17973* (L, U); Laguna, Mt. Maquiling, Dec 1935, *C.F. Symington 40928* (KEP); Sorsogon Prov., Mt. Bulusan, 1947, *M.D. Sulit PNH 2791* (cf; SING); Albay Province, Mayon Volcano, Jun 1953, *D.R. Mendoza PNH 18305* (L); Sorsogon Province, Mt Juban, Jun 1956, *G.E. Edano PNH 37124* (L); Irosin, Sorsogon Province, Mt Bangko, May 1957, *G.E. Edano & H. Gutierrez PNH 37820* (L); Albay, Mt Malinao, Brgy. Tagoytoy, So. Sadurong, Oct 1995, *E.J. Reynoso et al. PPI 21180* (L). **Polillo:** Aug 1909, *C.B. Robinson BS 6935* (L); Oct 1909, *R.C. McGregor BS 10387* (L). **Catanduanes:** 1928, *M. Ramos & G. Edano BS 75694* (cf; SING); San Miguel, Brgy Sulung, Mt Saan, Nov 1991, *Barbon et al. PPI 2362* (L); So. Boradan, Brgy. Summit, Nov 1996, *E.J. Reynoso & Majaducon PPI 24872* (L). **Mindoro:** Baco River, Mar 1905, *E.D. Merrill 4051* (K); Provident tr. Fms. San Teodoro, Feb 1985, *C.E. Ridsdale 802* (L). **Negros:** May 1908, *A.D.E. Elmer s.n.* (E). **Samar:** Mtuguinao, Jan 1952, *F.S. Gachalian PNH 15500* (L); Rawis, Sohoton, National Park, May 1971, *University of San Carlos 220* (L). **Leyte:** Dagami, Jul 1957, *G.E. Frohne PNH 35671* (L). **Mindanao:** Davao, Todaya, Mt. Apo, Jul 1909, *A.D.E. Elmer 11156* (cf; E, L); Agusan Province, Cabadbaran (Mt Urdaneta), Sep 1912, *A.D.E. Elmer 13914* (E, L, U); Surigao Province, Mt Kabatuan, Mar 1949, *D.R. Mendoza & P. Convocar PNH 10320* (L); Surigao del Sur, Aras-asan (Logging area), May 1975, *University of San Carlos 793* (L); Dinagat, Agusan del Sur, Sitio Campo Sies, Agusan, Oct 1991, *F.J.M. Gaerlan et al. PPI 4825* (KEP, L). **BORNEO. Kalimantan W:** Bukit Blitang, *J.E. Teysmann 8244* (cf; L). **Kalimantan E:** Boengaloen, Nov 1912, *L. Rutten 736* (U); W. Koetai, no 9, nr M Antjaloeng, Jul 1925, *F.H. Ender 2134* (L); E. Kutei, Sg Susuk region, Jun 1951, *A. Kostermans 5553* (L). **Kalimantan SE:** Duson, Muara Larran, *P.W. Korthals s.n.* (L); Hayup (Hayocp), May 1908, *H. Winkler 2120* (BM, L). **SULAWESI. North:** Rec. Menado, sub div. Paloe, Aug 1937, *Eyma 1721* (SING, U); Rec.

Menado, subd. Loewoek, betw Boenta-Gonohop I, Sep 1938. *Eyma* 3736 (L, U); Toraut Dam, Mar 1985. *E.F. de Vogel & J.J. Vermeulen* 6625 (KEP, L); tributary of Sg Ilanga, Feb 1990. *J.S. Burley et al.* 3519 (SING). **Central:** E. peninsula, Pinapoean, Dec 1920. *T.G. Kaudern* 481 (L); Mt Nokilalaki area, Apr 1975. *W. Meijer* 9627 (L); rd to Lake Lindu, 60 km SSE of Palu, May 1979, *M. van Balgooy* 3566 (L); E. of Tongoa, Feb 1981, *J.T. Johansson et al.* 37 (L); Batui R., Oct 1989, *M.J.E. Coode* 5941 (L); Lore Lindu NP, Feb 2008, *D. Cicurra* 596 (cf; L).

MALUKU. Sula: Taliaboe, Kp. Likitobi, *Atjeh (Exp. v. Hulstijn)* 354 (L); kampung Mangoli, kali Waj Mana, Sep 1939, *S. Bloembergen* 4672 (L, SING); Taliaboe, Samoeja, Z van kampung, Oct 1939, *S. Bloembergen* 4780 (L). **Ceram:** Proho, Nov 1917, *Kornassi (Exp. Rutten)* 518 (L); weg Kairatoe-Honiteto, Sep 1918, *L. Rutten* 1617 (L). **Buru:** Waeha, betw Waelanga-Lake Kunturun, Nov 1984, *M. van Balgooy* 4625 (L); Wae Langa, km14, Nov 1984, *H.P. Nootboom* 5101 (L); Wae Duna river, N of Bara, Nov 1984, *H.P. Nootboom* 5213 (L); c.10 km S of Bara, Dec 1984, *M. van Balgooy* 5063 (L). **Ambon:** 1792, *Lahaie* 933 (P); Beresih, Nov 1895, *H.G. Botter s.n.* (L); 1913, *C.B. Robinson* 1831 (L). **Kai:** Groot Kei, Goenoeng Daal, Apr 1922, *H.G. Jensen* 114 (L).

NEW GUINEA. P.A. Lesson ex J.K. Hasskarl s.n. (L). **Irian Jaya:** Ayambori bei Dore, *J.E. Teysmann* 6774 (L); Lorentz river nr Alkmaar, Aug 1907, *B. G. Versteeg* 1587 (L); 'Papuarand' am Tal des Noord-Flusses, Oct 1909, *L.S.A.M. von Römer* 397 (L); Moeraira, east coast Geelvink bay, Jun 1912, *R.Fr. Janowski* 1 (L); Beaufort River, Nov 1912, *A. Pulle* 379 (L); near Pionier biv. Forest, Jun 1920, *H.J. Lam* 450 (L) & Jul 1920, 659 (L); near Prauwen biv., Aug 1920, *H.J. Lam* 952 (L); Meervlakte, Batavia biv., Nov 1926, *W.M. Docters van Leeuwen* 11179 (L); Bernhard bivouac, Aug 1938, *E. Meijer Drees* 563 (L); Roode river, Aug 1938, *E. Meijer Drees* 663 (L, SING); Idenburg R, Bernhard Camp, Apr 1939, *L.J. Brass* 13874 (L); Yapen Island, Jappen-Biak, Sg. Soemboi near Seroei, Aug 1939, *Aet & Idjan (exp. L.J.v.Dijk)* 505 (L); Yapen Island, Jappen-Biak, Seroei, Sep 1939, *Aet & Idjan (exp. L.J.v.Dijk)* 824 (L); Sg Si-era (djera) nr Oeta, Jun 1941, *Aet (exp. Lundquist)* 261 (L); Vogelkop, Warsui, nr Ransiki (S of Manokwari), Jul 1948, *A. Kostermans* 2734 (L); Sorong, nr Klamono, Aug 1948, *D.R. Pleyte* 592 (L); N Bird Head Peninsula, steenkool-Temboeni, Apr 1954, *P. van Royen* 4036 (L); Hollandia, Nemo, Mar 1956, *C.F. Kalkman BW* 3471 (L); Manokwari, Rendani, Oct 1959, *V.W. Moll BW* 9549 (L); Manokwari, Feb 1961, *C. Versteegh BW* 10450 (L); Hollandia, Cycloop mountains, Baimoen Creek-Klifon, Aug 1961, *P. van Royen & H. Sleumer* 6535 (L); Vogelkop Peninsula, Manokwari, Tafelberg, Oct 1961, *P. van Royen & H. Sleumer* 6687 (L); Vogelkop Peninsula, Aifat R valley, nr Sururem, Oct 1961, *P. van Royen & H. Sleumer* 7029 (L); Wandammen Peninsula, Wondiwoi Mts., Feb 1962, *C.F. Koster BW* 13643 (L); Bomberai Peninsula, Sjuga-Wagura area, Armina, May 1962, *V.W. Moll BW* 13034 (L); Kabupaten Manokwari, Arfak Plains Apr 1994, *M.J.S. Sands et al.* 6258 (L); Kabupaten Manokwari, Kecamatan Kebar, May 1994, *M.J.S. Sands et al.* 6575 (L); Kabupaten Manokwari, Arfak Mupi Dessa, Apr 1995, *Mahyar et al.* 321 (L); Bird's Head Peninsula, surr Ayawasi, Nov 1995, *C.E. Ridsdale* 2178 (L); Mimika Reg., PT-Freeport Ind Conc Area, toKaliKopi, Dec 1998, *M.J.S. Sands* 7217 (L); Mimika Reg., PT-Freeport Ind Conc Area, KualaKence, Mar 1999, *F.R. Willis et al.* 129 (L); Mimika Reg., PT-Freeport Ind Conc Area, NewEast lev, Apr 1999, *P.J. Rudall* 107 (L). **Papua:** Tami-Fluss zwischen den Eti- und Arson-Flüssen, Mar 1910, *K. Gjellerup* 4 (L); Dieni, Ononge Road, 1933, *L.J. Brass* 3870 (L); Gogol R., Ninam logging area, *Verdcourt et al.* 5133 (L); nr Horata village, Aug 1953, *R.D. Hoogland* 3571 (L); Naiesonge (Rawa), nr Gogol R nr Mawan village, Jun 1955, *R.D. Hoogland* 4929 (L); Sepik, Aitape, Pieni R nr Walwali vill., Jun 1961, *P.J. Darbyshire & R.D. Hoogland* 7989 (L); Morobe, Kalapit, Umi River, Jan 1963, *A.N. Miller & P. van Royen NGF* 15638 (L); Tymne-Wago track, Mar 1963, *T.G. Hartley* 11447 (L); Ossima village, Mar 1964, *D. Sayers NGF* 13209 (L); W bank of

Vailala R, c. 3 miles S of jnct w Lohiki R, Feb 1966, *R. Schodde & A.L. Craven 4429* (L); nr Ambunti, May 1966, *R.D. Hoogland & L.A. Craven 10149* (L); Tumam, c. 4 km E of Dreikikir, Jul 1966, *P.C. Hsylimers 1395* (L); Garagos, Nov 1966, *H. Streimann NGF 27962* (L, SING); Wampit, Bupu village, Jul 1967, *A.N. Millar NGF 22925* (L); Ramu, tiver nr Aiome, Mar 1968, *M.J.E. Coode NGF 32759* (L); Vanimo subd., Ossima, Jan 1969, *H. Streimann & A. Kairo NGF 39199* (L); Amanab subd, Bedwani mts, nr Kilifas on rv Yenabu, Mar 1970, *M.J.S. Sands 1047* (L); Vanimo, Vanimo-hinterland, Dec 1971, *H. Streimann LAE 53820* (L); Kerema, Vailala Riv, nr Lohike vill, Jun 1980, *E.E. Henty & P. Katik LAE 72498* (L); Vanimo, Blackwater creek logg. area, Sep 1982, *K. Kerenga LAE 56478* (L); Mawan, 1km E of Baku, Apr 1983, *A.N. Vinas AV 226* (L); Angoram, Jul 1985, *L.J. Harkink 15* (L); Amanab, above Aimane vill., Oct 1986, *O.G. Gideon LAE 57565* (L); Bismarck Range, Ikil R tributary, Oct 1995, *W. Takeuchi 10989* (L); Mt Jaya, Mimika Regency, Ecol.Plot 5, 1, 1998, *R.J. Johns et al. 8748* (L, SING); Josephstaal FMA area, nr Kumamdeber, Jul 1999, *W. Takeuchi et al. 13578* (L).

9. *Amischotolype hookeri* (Hassk.) H.Hara (Fig. 9F)

Amischotolype hookeri (Hassk.) H.Hara, Flora Eastern Him. I (1966) 399; Hong, Acta Pytotax. Sin. 12, 4 (1974) 461; Fl. Reipubl. Pop. Sin. 13, 3 (1997) 71; Hong & DeFilippis, Fl. China 24 (2000) 23 (See note). — *Forrestia hookeri* Hassk., Flora 47 (1864) 629; Commelin. Ind. (1870) 89; Clarke, Commelyn. Cyrtandr. Bengal. (1874) 61, tab.XLI; Clarke in A.Candolle & C.Candolle, Monogr. Phan. 3 (1881) 237 (see note); Hooker f., Fl. Brit. India 6 (1894) 384; Brückner in Engler & Prantl, Nat. Pflanzenfam. ed. 2 (1930) 169; Rao et al., Proc. Indian Sci. Congr. (1960) 366. SYNTYPES: *Hooker & Thomson s.n., s.d.*, India contin. regionem tropicam montium Khasiae (inter 1–4000') (W, K, M, G-DC, P, all *n.v.*; B photo (Barcode: B 10 0296341 / ImageId: 302934), L); *Hooker & Thomson s.n., s.d.*, reg. trop. Sikkim (G-DC, K, all *n.v.*).

Stem rhizome unknown; erect part 120–210 cm long, simple; internodes moderately 0.5 mm long hairy. **Sheath** 9–14 mm diam., 0.5(–1) mm long hairy and/or with one to several lines of 1.5–2 mm long, pale-yellowish hairs, mouth ciliate. **Leaf blade** 20–35 × 7–10.4 cm, 2.9–4.4 times as long as wide, smooth, base gradually to rather abruptly narrowed into indistinct pseudopetiole; lower surface on veins densely 0.1–0.5 mm long hairy, upper surface glabrous; submarginal hairs on lower surface and on margin, (0.5–)1.5–2 mm long, dense, whitish to yellow. **Inflorescence** on erect stem, sessile, 2–3.5 cm diam., dense with branches obscure, 10–25-flowered. **Pedicel** 0–0.7 mm long. **Sepals** 7–10 × 3–3.5 mm, not elongating in fruit, green to deep purple, glabrous or rarely sparsely 0.5 mm long ciliate margins and keel, tip hooded. **Petals** c. 9 × 2.5–3.5 mm, c. as long as sepals, white to pale pink, glabrous, margin unknown. **Stamens** filament c. 9 mm long, colour unknown, in upper 1 mm with 2 mm long hairs; anthers (2–)2.2–3 × 0.7–0.9 mm, colour unknown, thecae opening by a longitudinal slit. **Capsule** 9–14 × 5.5–7 mm, ovoid, longer than sepals by (1–)3.5–5 mm, whitish to red or purple, sparsely 0.5–1(–1.5) mm long hairy; valves free to fused in basal half; apex acute, lobes absent; style remnant 0.3–0.5 × 0.4 mm long, persistent. **Seeds** 2 per locule, aril colour unknown.

Chromosomes. $2n = 36$ (Kammathy 81236: L, E; unpublished but in agreement with Rao *et al.* 1960).

Distribution. India (Assam, West Bengal, East Bengal, Meghalaya, Sikkim), Bangladesh (Moulavi Bazar).

Ecology. Along stream in forest. Altitude: 1–600(–1500) m asl.

Notes. The species is only known from NE India and Bangladesh. Several authors included Yunnan in the distribution of this species (Hara 1966, Hong 1974, 1997 and Hong & DeFilipps 2000). However, I have not seen their specimens and their descriptions are wide enough to include also *A. divaricata*. Study of the specimens from Yunnan is needed to elucidate which of the two taxa are present.

Clarke (1881) mentioned the species for the island of Pinang (*Campelia marginata*, Wallich *Cat.* 8977 p.p., non Blume). In the Wallich collection at K-W (studied on microfiche), three sheets of *Cat* 8977 exist: one is 8977b, from Singapore (= *A. gracilis*); two are 8977a, from Pinang, one of them without doubt *A. marginata*; the identity of the second sheet cannot be ascertained from the microfiche. A fourth photo of Wallich *Cat* 8977 in K-W has been found on the Kew-website. The sheet has three branches, so is not entirely similar to the ones on microfiche (perhaps remounted?), and not indicated *a* or *b*: one with a creeping stem with inflorescences agreeing with *A. marginata*, one sterile, and one with inflorescences on the erect part of the stem. The latter two cannot be identified with certainty. If, however, one of the collections of Pinang is indeed *A. hookeri*, man must have brought it there, probably unintentionally with planting material for, for instance, the spice gardens (species of the genus are often found growing together with wild gingers) that were established on the island in 1794. Likewise, in Singapore it has only been found growing in the rain forest in the Botanic Gardens where it was undoubtedly introduced, either by accident or as an ornamental. It has not been observed in flower, and has not been collected for the herbarium. Clarke 37582 from Brunei is most likely mislabelled.

Specimens examined: INDIA, cult., Bot. Gardens of Calcutta and Serampore, 1834–1841, J.O. Voigt s.n. (P). **Assam:** W. Griffith 1345 (BM); Jenkins s.n. (L, P); Jenkins 9383 (BM); Naga hills, Masters s.n. (L, P); Naga Hills, Pereumi, Aug 1935, N.L. Hor 6454 (K); Khasi Hills, Nongpoh, Jun 1949, W.N. Koelz 23015 (L); K.&J. Hills Dist., nr Exp. Plot 2, Nongpoh, Feb 1962, R.V. Kammathy 81236 (BM, E, K, L). **West Bengal:** Darjeeling, Selim, Sep 1869, C.B. Clarke 9082 (K, SING); Darjeeling, Rishup, Oct 1870, C.B. Clarke 13629A (K); Darjeeling, Garidoora, May 1884, C.B. Clarke 35539B,F (BM, K); Tista, Jun 1913, G.H. Cave s.n. (E); Darjeeling, Jun 1923, J.M. Cowan s.n. (K). **East Bengal:** (1864), W. Griffith 5487 (L, P). **Meghalaya:** montium Khasiae, J.D. Hooker & T. Thompson s.n. (BM, E, L, P, U); Khasia, Bhorlasa, Aug 1886, C.B. Clarke 44469E (BM). **Sikkim:** J.D. Hooker s.n. (BM, K, P); J.D. Hooker & T. Thompson s.n. (BM, E, L, P, U); Jun 1870, C.B. Clarke 11805 (SING) & 11806B (BM); Mongpo, Oct 1884, C.B. Clarke 36264B (K); Dulkajhar, Oct 1884, C.B. Clarke 37048 (BM).

BANGLADESH. Moulavi Bazar: Adampur forest, Rajkandi range, Jun 2000, A.M. Huq &

M.K. Mia 10748 (L).

SINGAPORE. grown in Hort.Kew, 1904, *Anon. 461-95* (K).

BORNEO. **Brunei:** Mar 1885, *C.B. Clarke 37582* (BM).

10. *Amischotolype irritans* (Ridl.) I.M.Turner (Fig. 9G & 13C)

Amischotolype irritans (Ridl.) I.M.Turner, Novon 6 (1996) 221 & Gard. Bull. Sing. 47 (1997) 515. — *Forrestia irritans* Ridl., J. Straits Branch Roy. Asiat. Soc. 41 (1904) 38; Mat. Fl. Malay. Penins. 2 (1907) 124; Fl. Malay. Penins. 4 (1924) 361; Brückner in Engler & Prantl, Nat. Pflanzenfam. ed. 2 (1930) 169; *non* Beaman & Beaman, The Plants of Mount Kinabalu 3 (1998) 109 (see note 1). LECTOTYPE (designated by Turner (1996)): *Ridley s.n.*, Peninsular Malaysia, Selangor, on the Tras Route at the 15th mile (SING).

Stem ascending from a creeping or scrambling rhizome up to 200 cm long; erect part 50–120 cm long, simple; internodes rather sparsely to densely 0.2–0.5 mm long red-hairy, hairs easily caducous, rarely glabrous. **Sheath** 10–20 mm diam., glabrous or rarely with a few 0.5 mm long hairs basally at the back, mouth glabrous or (towards pseudopetiole) ciliate. **Leaf blade** 23–44 × (4–)5–9 cm, 3.8–6.2 times as long as wide, smooth, base rather gradually narrowed into c. 5.5 cm long and 2–3 mm wide winged pseudopetiole; both surfaces moderately 1–2 mm long yellow- to orange-hairy; submarginal hairs on upper surface, 1–1.5 mm long, rather dense, yellow. **Inflorescence** on erect stem, sessile, 2.5–5 cm diam., very dense with branches obscure, 20–many-flowered. **Pedicel** c. 1.5 mm long. **Sepals** 6.5–10.2 (in flower), elongating in fruit to 10–13 × 1.5–2 mm, yellow-white or pale green (before and in flower) to pink or reddish purple (in fruit), moderately to rather densely 1.5–2.5 mm long spiny red-hairy, tip not hooded. **Petals** 9–10 × 1.8–2 mm, slightly longer than sepals, white, dorsal surface subapically with 2 mm long spot of 1–1.5 mm long, red-spiny hairs, margin at apex minutely fringed. **Stamens** with filaments 11–12 mm long, white, glabrous or in an upper part up to 2–3 mm below apex with few 2–3 mm long hairs; anthers 1.5–2 × 0.5–0.7 mm, white or yellowish, thecae opening by a longitudinal slit. **Capsule** 5.5–6 × 3.5–4 mm, narrowly ovoid, shorter than sepals by 3–4.5 mm, bright purple, apex 1–2 mm long, red spiny-hairy; valves free; apex slightly depressed, lobes absent; style remnant 0.5 × 0.2 mm, finally deciduous. **Seeds** 2 or rarely 1 per locule, aril colour unknown.

Distribution. Thailand (Peninsular Thailand: Pattani), Peninsular Malaysia (Kedah: Langkawi, Kelantan, Terengganu, Perak, Pahang, Selangor, Negeri Sembilan), Sumatera (N: Leuser, Asahan).

Ecology. Primary to rather disturbed, riverine or lowland dipterocarp forest, forest margin or forest regrowth, dry to wet (alluvial) soil. Altitude: 15–750 m asl.

Notes. 1. Ridley (1904, 1907) described it as a rather rare endemic of Peninsular Malaysia from mountain forests (2000 feet alt.). It has since been found at lower altitudes, in Sumatera (three times) and in Thailand (once). The species has been cited for Borneo (Beaman & Beaman 1998: *Clemens* 26141) but this is based on a misidentification of *A. monosperma*.

2. Ridley (1904, 1907) mentioned he had never seen fruits and he did not mention them in 1924. However, based on the number of collections with fruits, they are normally formed, and were for the first time collected in 1921 (SING: *Hume* 9382, Peninsular Malaysia: Selangor). The colour of the aril has never been annotated and, unfortunately, I have only seen them in flower in the field.

Specimens examined: THAILAND. **Peninsular Thailand:** Pattani, Aug 1923, *A.F.G. Kerr* 7516 (L, P).

PENINSULAR MALAYSIA. **Kedah:** Langkawi, Dec 1990, *Khairuddin Hj. Itam* 10 (KEP). **Kelantan:** path to Bukit Berangkat, via Kampong Perak, Bertam, Feb 1973, *Md. Shah & Md. Ali* 2867 (KEP, SING); Gua Musang, Relai Forest Reserve, Sep 1992, *Hamid* 13 (KEP). **Terengganu:** Kemaman, Bukit Kajang, Nov 1935, *Corner* SF 30238 (K, SING); Hulu Terengganu, Tasik Kenyir, Sg. Cicir, Aug 2007, *K. Imin et al.* FRI 58335 (KEP). **Perak:** 188x, *H.N. Ridley s.n.* (SING); Bujong Malacca, 1898, *H.N. Ridley* 9784 (SING); Pondok Tanjong Forest Reserve, Feb 1939, *G.H. Spare* SF 36220 (K, KEP, SING). **Pahang:** 7 mile Raub Road, Jul 1924, *G.A. Best* SF 14132 (SING); Sungai Tahan, near Kuala Teku, Sep 1928, *R.E. Holtum* SF 20810 (SING); Gunung Serudom, Kuantan, Oct 1975, *Md. Shah et al.* 3762 (KEP, KLU, SING); Jerantut, Taman Negara, Gunung Tahan, Sungai Kelam, Aug 1996, *R. Kiew* 3991 (L); Temerloh, Krau GR, Sg. Perlok, Nov 2000, *S. Damahuri & K. Ayau* FRI 43603 (L). **Selangor:** on the Tras route at the 15th mile, 1897, *H.N. Ridley s.n.* (SING); Semempik, Jul 1921, *H.L. Hume* 8093 (SING); Ginting Simpak, Oct 1921, *H.L. Hume* 9382 (SING); 16 mile Ulu Gombak, Oct 1937, *Md. Nur* SF 34211 (SING); Ulu Gombak, Jun 1966, *J.C. Carrick* 1485 (K, L, SING); Lalang FR, Semenyih, Kajang, Oct 1967, *J. Dransheld s.n.* (KLU); Pahang border, Gentiang Sempah trail, Sep 1973, *B.C. Stone* 11661 (KLU); Gombak, Ulu Gombak Forest Reserve, Sep 1974, *Tho Yow Pong* FRI 21544 (KEP, L); Ulu Langat, road to JKR Quarry, Jul 1984, *R. Kiew* 1335 (SING); N. of Kuala Lumpur, Jln Gombak km36 (KL), Jun 2005, *H. Duistermaat* 351 (L, SING). **Negeri Sembilan:** Sungei Ujong, Kupayang, Nov 1885, *Y.H. Alvins* 2202 (SING); Gunung Angsi, Jun 2005, *H. Duistermaat* 346 (L, SING).

SUMATERA. **Aceh:** Leuser, Kluet NR, along Krung Lembang, Jul 1985, *W.J.J.O. de Wilde & B.E.E. de Wilde-Duyfjes* 19846 (L). **Sumatera Utara:** Asahan, East Coast, Vale of Tangga, May 1927, *H.H. Bartlett* 7707 (L); East Coast, vicinity of Tomoean Dolok, Aug 1936, *Rahmat Si Boeea* 10005 (L).

11. *Amisshotolype laxiflora* (Merr.) Faden (Fig. 10A & 14A–B)

Amisshotolype laxiflora (Merr.) Faden in Coode et al., Checklist Fl. Plants & Gymn. Brunei Dar. (1996) 352, 434; Cowley & Furness, Kew Bull. 52 (1997) 469. — *Forrestia laxiflora* Merr., Philipp. J. Sci. 29 (1926) 354. TYPE: *Castro & Melegrito* 1618, August 1923, Malaysia, Sabah, Banguay Island, in forests, altitude about 30 m (holo UC, *n.v.*; iso K, BO).

Forrestia marginata auct., sensu Hallier f., Beih. Bot. Centralbl. 34 (1916) 47, p.p. (see note 1); non Blume.

Stem ascending from trailing, 100–150 cm long rhizome; erect part 20–75 cm long, simple; internodes glabrous or sparsely to moderately 0.1–0.3 mm long hairy. **Sheath** 6–14 mm diam., with several moderate to dense lines of (2–)3–5 mm long, yellow(-brown) hairs, mouth ciliate. **Leaf blade** 15–32 × (2.7–)4–8(–9.7) cm, 2.6–4(–5.2) times as long as wide, bullate, lower surface often purple, base gradually to rather abruptly narrowed into an indistinct winged pseudopetiole to 4 cm long and 4 mm wide; lower surface glabrous or midvein in lower half with 1–2 mm long yellowish hairs or rarely 0.1 mm long colourless- to brownish-hairy, upper surface glabrous or rarely 0.1 mm long hairy; submarginal hairs on upper surface or rarely absent, 0.1–0.5(–0.8) mm long, sparse to rather dense, colourless or yellow. **Inflorescence** on rhizome or at knee, peduncle (0–)3–15 mm long, 2–5 cm diam., rather dense to very lax with branches obscure or the longest 0.8–3 cm long, 15–many-flowered. **Pedicel** 1.5–2.5 mm long. **Sepals** (9–)10–14 × 1.5–2.5 mm, slightly elongating in fruit, white, green, pinkish or red-purple (in flower) and purple (and green), red, magenta or violet (in fruit), glabrous or sparsely 0.5 mm long ciliate margins and keel, tip hooded. **Petals** c. 6 × 2 mm, shorter than sepals, white to yellow, glabrous, margin entire. **Stamens** with filaments c. 5 mm long, white, upper 2 mm with many 2 mm long hairs; anthers 1 × 0.9 mm, cream-coloured or yellow, thecae opening by a longitudinal slit. **Capsule** 5.5–8.5 × 3.5–5.5 mm, obovoid, shorter than sepals by 2–5 mm, red or purple, glabrous or apex to upper half sparsely 0.2–0.5 mm long hairy; valves (almost) free; apex depressed, lobes absent; style remnant 0.3 × 0.3 mm, deciduous. **Seeds** 2 per locule, aril orange.

Distribution. Borneo (Sabah: West Coast, Interior, Kudat, Sandakan, Tawau, Sarawak: Kuching, Sri Aman, Kapit, Bintulu, Miri; Kalimantan: W, C, E, S), Sulawesi (S).

Ecology. Primary or disturbed mixed dipterocarp, riparian or swamp forest, along streams, in wet or swampy places, on loam soil, often on limestone. Altitude: 0–800 m asl.

Notes. 1. The species was originally described from Banguay Island (N Sabah). It has been collected outside Borneo only once, in Sulawesi (*van Balgooy 3910*). It is often identified as the widespread *A. marginata*, which also occurs on Borneo, and from which *A. laxiflora* differs as mentioned in the key (lead 9). *Kessler et al. 938* appears to be a mixture of the two species, showing that the species can even grow in mixed populations: the specimen in L is *A. laxiflora*, in US it is *A. marginata* (n.v.; pers. comm. R.B. Faden).

2. The roots are said to have medicinal value (*Forman 452*, E. Kalimantan, Gunung Sahari).

Specimens examined: BORNEO. **Sabah:** West Coast: Ranau, Sungai Lakus, Kg. Segindai, Aug 1983, *S. Dewol et al. SAN 100162* (L, SAN); Interior: Pensiangan Kayu FR, Jul 1992, *K.*

Fidilis SAN 136002 (KEP, L); Pensiangan, Pun batu, along the path to limestone, Oct 1996, *A. Berhaman et al.* 139 (SAN); Kudat: Banguay Island, 1923, *P. Castro & F. Melegrito* 1618 (BM, BO, K); Sandakan: Bettotan, near Sandakan, Jul 1927, *Boden-Kloss* SF 18736 (K, SING); Kabili FR, May 1935, *H.G. Keith* 38907 (KEP); Kabili forest reserve, May 1935, *H.G. Keith* 4531 (L, SING); Gomantong, Feb 1960, *W. Meijer* SAN 20549 (SAN); Sepilok FR, Aug 1968, *K. Ogata* 10790 (L); Sepilok FR, Dec 1975, *P.F. Stevens et al.* 328 (KEP, L); Sepilok FR, Oct 1979, *R. Kiew* 786 (KEP); Sepilok FR, Oct 1981, *Kwiton Jong* SAN 93914 (SAN); Kinabatangan, Sungai Menanggul, Feb 1985, *Amin & Matin* SAN 69950 (SAN); Lahad Datu, Danum Valley, West Trail, Feb 1986, *S. Andrews* 725 (E, SAN); Lahad Datu, Ulu Segama, Danum Valley, at entrance to west trail, Mar 1987, *G. Argent et al.* GA 671987 (E, L, SAN); Lahad Datu, Danum valley, Sep 1987, *Campbell* 23/9/4 (E); Lahad Datu, Lahad Datu, Tabin Wildlife Sanctuary, Aug 1991, *L. Madani* SAN 132613 (KEP, L); Lahad Datu, Lahad Datu, Tabin WR, trail to Lipad mudvolcano, May 1998, *F. Borchsenius* 513 (SAN); Tawau: floodplain of Tawau River, Tawau Hills Park, Jun 1984, *J.H. Beaman* 10210 (K); Tawau Hills NP, path to waterfall, May 2005, *J.J. Vermeulen in H. Duistermaat* 357 (L); **Sarawak**: Kuching: lower slopes gng Lundu, *B.L. Burt & P.J.B. Woods* 2723 (E); Sri Aman: Bukit Danau, Aug 1938, *Daud & Tachun* SF 35750 (KEP, SING); Kapit: Belaga, hills behind airfield, Apr 1963, *P.S. Ashton* S 18262 (L); Sungai Apa, Mar 1975, *P.C.K. Chai* S 36195 (KEP, L); Belaga, Ulu Belaga, Sungai Semawat, Oct 1981, *C. Hansen* 716 (KEP, L, SING); Ulu Sg. Balleh, Sungei Sedupak, *Yii P.C. et al.* S 52067 (KEP, L); Belaga, Ulu Batang Balui, Ulu Sungai Kebhor, Mar 1989, *Yii P.C.* S 62338 (L); Song, Ulu Katibas, trib. Sg. Beloh, Sg. Joi, Jun 1993, *Yii P.C. et al.* S 64900 (L); Bintulu: Tatau, Bukit Sarang group, Bukit Lebik, Aug 2005, *J.J. Vermeulen in H. Duistermaat* 401 (L, SING); Miri: Subis, Niah., Oct 1954, *Ahmad* 5 (SING) & 5 (B) (SING); Marudi, Gng Api, gorge on S side, Feb 1966, *J.A.R. Anderson* S 24025 (L); Marudi, C. Mulu NP, Sg. Mendalam, Oct 1977, *J.A.R. Anderson* S 39393 (L); Marudi, Dulit Range, Sg. Sirui, Oct 1983, *Dyg. Awa & Yii P.C.* S 46611 (L); valley in front of Niah Caves, *B.L. Burt & P.J.B. Woods* B 2008 (E); **Kalimantan W**: Liang Gagang, "Oberlauf des Manddeistromes", Mar 1894, *H. Hallier* B3001 (L); Sungei Pary, 1896/97, *Jaheri (Exped. Nieuwenhuis)* 1136 (BO); Gn Palung NR, 100 km S of Pontianak, Jun 1986, *M. van Balgooy & A.K. van Setten* 5618 (L). **Kalimantan C**: Bukit Raya, Tumbang Tapi, Jan 1983, *H. Wiriadinata* 3357 (L). **Kalimantan E**: W. Koetai, n.5 nr Lahoen, Jun 1925, *F.H. Endert* 1768 (L, SING); W. Koetai, Aug 1925, *F.H. Endert* 2790 (L); E. Kutei, Sg. Susuk region, Jul 1951, *A. Kostermans* 5744 (L); Gunung Sahari, Belajan river, Aug 1956, *L.L. Forman* 452 (L); Balikpapan, Wanariset, Sep 1982, *Ramlanto* 8 (L); Wanariset area, Samboja-Semoi km 11, Feb 1991, *Ambri & Arifin* W 647 (L); PT. ITCI, Kenangan-G. Meratus km 69, Mar 1995, *P. Kessler et al.* 938 (L). **Kalimantan S**: Kabupaten Tabalong, Jul 2000, *K. Sidiyasa & Z. Arifin* 2137 (L). SULAWESI. **S**: Soroako-Wasuponda Road, km 19, Jul 1979, *M. van Balgooy* 3910 (K, KLU, L).

12. *Amischotolype leiocarpa* (Hallier f.) Duist. **comb. nov.** (Fig. 10B)

Forrestia rostrata Hassk. var. *leiocarpa* Hallier f., Beih. Bot. Centralbl. 34 (1916) 49; Merrill, J. Straits Branch Roy. Asiat. Soc. (1921) 113. TYPE: *Hallier f. B3002*, 29 March 1894, W. Borneo, Liang Gagang (holo BO, *n.v.*; iso L).

Stem rhizome unknown; erect part 90–200 cm long, stilt roots sometimes present, simple; internodes glabrous or moderately to densely 0.2–0.3 mm long hairy. **Sheath** 5–9 mm diam., glabrous or moderately 0.2–0.5 mm long hairy, mouth (sparsely)

ciliate. **Leaf blade** 18–28 × (3.3–)4–7(–10) cm, (2.4–)3–6(–7.6) times as long as wide, base rather to very abruptly narrowed into 1.5–5 cm long and 1 mm wide winged pseudopetiole; lower surface glabrous or rarely moderately 0.2 mm long hairy, upper surface glabrous; submarginal hairs absent or on lower surface, rarely on upper surface, 0.1–0.3 mm long, sparse. **Inflorescence** on erect stem, peduncle 0–5 mm long, 1.6–3.5 cm diam., (rather) lax or rarely dense with longest branches 0.3–1.3 cm long, 10–30-flowered. **Pedicel** 1–1.5 mm long. **Sepals** 4.5–6.5 × 2–3 mm, not elongating in fruit, green or reddish, glabrous or very sparsely 0.2–0.3 mm long ciliate keel and margins, tip hooded. **Petals** unknown. **Stamens** with filaments unknown; anthers with thecae opening by a longitudinal slit in upper half only, otherwise unknown. **Capsule** 6.5–8.5 × 3.8–6.5 mm, short-pyriform, longer than sepals by 1.5–4.5 mm, (light) green to reddish or purplish, glabrous; valves (almost) free; apex (slightly) depressed, lobes absent; style remnant 0.5–1.5 × 0.2–0.3 mm, persistent. **Seeds** 2 per locule, aril orange.

Distribution. Borneo (Sabah: West Coast, Interior, Sandakan; Sarawak: Kapit, Miri; Kalimantan: W).

Ecology. Primary or logged over mixed dipterocarp (hill or riparian) forest, on hillside or along stream, moist, rocky or on granite. Altitude: (230–)500–1200(–1500) m asl.

Notes. 1. Described as a variety of *A. rostrata* by Hallier (1916), said to differ from the species only in the entirely glabrous capsules. However, this study revealed differences in the number of flowers per inflorescence, the length and shape of the capsule, and the valves being free or fused, warranting its recognition at species level. It is endemic to Borneo.

2. Most collections are in fruit. The single collection with anthers was returned from loan before all details were described (*Kokawa & Hotta 4846*, SAN; in L without anthers).

Specimens examined: BORNEO. **Sabah:** West Coast: Dallas, Sep 1931, *J. & M.S. Clemens 26396* (BM); Mount Kinabalu, Dallas, Oct 1931, *J. & M.S. Clemens s.n.* (BM); Mount Kinabalu, Penibukan, Jan 1933, *J. & M.S. Clemens s.n.* (BM); Kota Belud, Mt Kinabalu, Mahandui river, Mar 1933, *C.E. Carr SF 26297* (SING); Mt Kinabalu, Penibukan, Mar 1933, *J. & M.S. Clemens 32085* (BM, L); Ranau, Kinabalu NP, along Sg. Mamut, nr Poring, Feb 1969, *S. Kokawa & M. Hotta 4846* (L, SAN); Kinabalu, Penibukan, Bahandoi (Sg Tahubang), Mar 1970, *H.P. Nootboom & Aban 1503* (L, SAN); Ranau, Langanan Fall, Poring, Feb 1989, *E.P. Tay et al. 247* (KEP, SING); Kota Belud, Kinabalu P, Kg. Sayap, end rd to Wariu Waterfall, Jan 1991, *Jamili Nais SNP 4674* (SAN); Kota Belud distr, Kpg Sayap, Kemontis, May 1996, *Yalin Surunda 101* (KEP); Kota Belud, Kinabalu P, Sayap, Lumangis trail, Jun 2000, *A.D. Poulsen et al. 1620* (SAN); Ranau, Ulu Tungud FR, Jul 2005, *L.G. Saw et al. SAN 146080* (KEP); Interior: Tambunan, Mt. Trusmadi, Mar 1969, *H.P. Nootboom 1475* (L, SAN); Tenom, Kaang, Mar 1987, *Asik Mantor SAN 120105* (SAN); Keningau, Hs. Trusmadi, May 1988, *J. Bousi et al. SAN 123971* (SAN); Trus Madi FR, May 1988, *B. Joseph et al. SAN 124017* (E, KEP, L); Sandakan: Lahad Datu, Ulu Segama, Dec 1982, *K. Fidilis SAN 95555* (KEP, L, SING). **Sarawak:** Kapit: Belaga, Batang Balui, Ulu sg Penuan, NWsl BtTasu, Mar 1987, *Yii P.C. S*

53627 (L): Miri: Marudi, Mulu National Park, May 1985. *A.P. Abang Mohtar & I. Othman S 49695* (KEP): Marudi, Sg Silat Bassin, Sg Palutan, Mar 2003. *N. Normaya et al. S 91072* (KEP). **Kalimantan W**: Liang Gagang, Mar 1894. *H. Hallier B3002* (L): Serawai, Feb 1995. *A.C. Church et al. 1971* (L).

13. *Amischotolype lobata* Duist. sp. nov. (Fig. 4)

Cum Amischotolype mollissima capsulae apicis lobis longis congruens, pseudopetiolo angustissime alatis, laminis supra venis distinctis, capsulis calyce superantibus pilis setosis differt. TYPUS: *Argent et al. SAN 108301*, March 1985, Malaysia, Sabah, Lahad Datu, Ulu Sg. Segama (holo SAN, iso E).

Stem ascending from rhizome; erect part 50–150 cm long, simple; internodes glabrous or rather sparsely to moderately 0.3–0.7 mm long hairy. **Sheath** 6–13 mm diam., moderately 0.3–0.5 mm long hairy at least at the front in upper half and or with a few lines of 2–4 mm long, yellow-brown hairs, mouth (sparsely) ciliate. **Leaf blade** (17–)25–33 × (3.7–)5.6–7.5 cm, 3.7–5.7 times as long as wide, lower surface purplish or not, base very abruptly narrowed into 3.5–9.5 cm long and 0.5–1 mm wide winged pseudopetiole; lower surface sparsely to densely 0.2–0.5(–1) mm long hairy or rarely glabrous, upper surface with veins very distinct, glabrous or sparsely to moderately 0.2 mm long hairy or rather sparsely 1.5–3 mm long hairy near midvein; submarginal hairs on upper surface, 1.2–2 mm long, dense, yellow. **Inflorescence** on erect stem, sessile, 2–3 cm diam., dense with branches obscure, 10–40-flowered. **Pedicel** 1–1.5 mm long. **Sepals** 9–11.5 × 3–4.5 mm, not elongating in fruit, white and purplish tinged or pale green (in flower) to magenta or purple (in fruit), glabrous or sparsely to moderately 0.5–0.7 mm long ciliate margins and keel, tip hooded. **Petals** c. 8 × 2 mm, shorter than sepals, colour unknown, glabrous, margin unknown. **Stamens** with filaments c. 6 mm long, colour unknown, upper 2 mm with 0.5–1 mm long hairs; anthers 1.2 × 0.6 mm, colour unknown, thecae opening by a longitudinal slit. **Capsule** 7.5–10 × 5.5–6 mm, obovoid, 1 mm shorter to 0.5–1 mm longer than sepals, green, upper 1/3 to half moderately 1–2 mm long, yellowish bristle-hairy; valves (almost) free; apex depressed, lobes 1–1.5 mm long lobes; style remnant absent. **Seeds** 2 per locule, aril colour unknown.

Distribution. Borneo (Sabah: West Coast, Interior, Kudat, Sandakan, Tawau; Kalimantan: E).

Ecology. Primary, severely logged-over or secondary dipterocarp hill or riverine forest, on sandstone. Altitude: 90–800 m asl.

Notes. The species is endemic to the northeastern part of Borneo, mostly Sabah, and only one collection is from East Kalimantan (*Geesink 9284*). Even vegetatively, this species is readily recognised by the distinct and only very narrowly winged pseudopetioles and the distinct veins on the upper surface of the leaf blade. In fruit, the

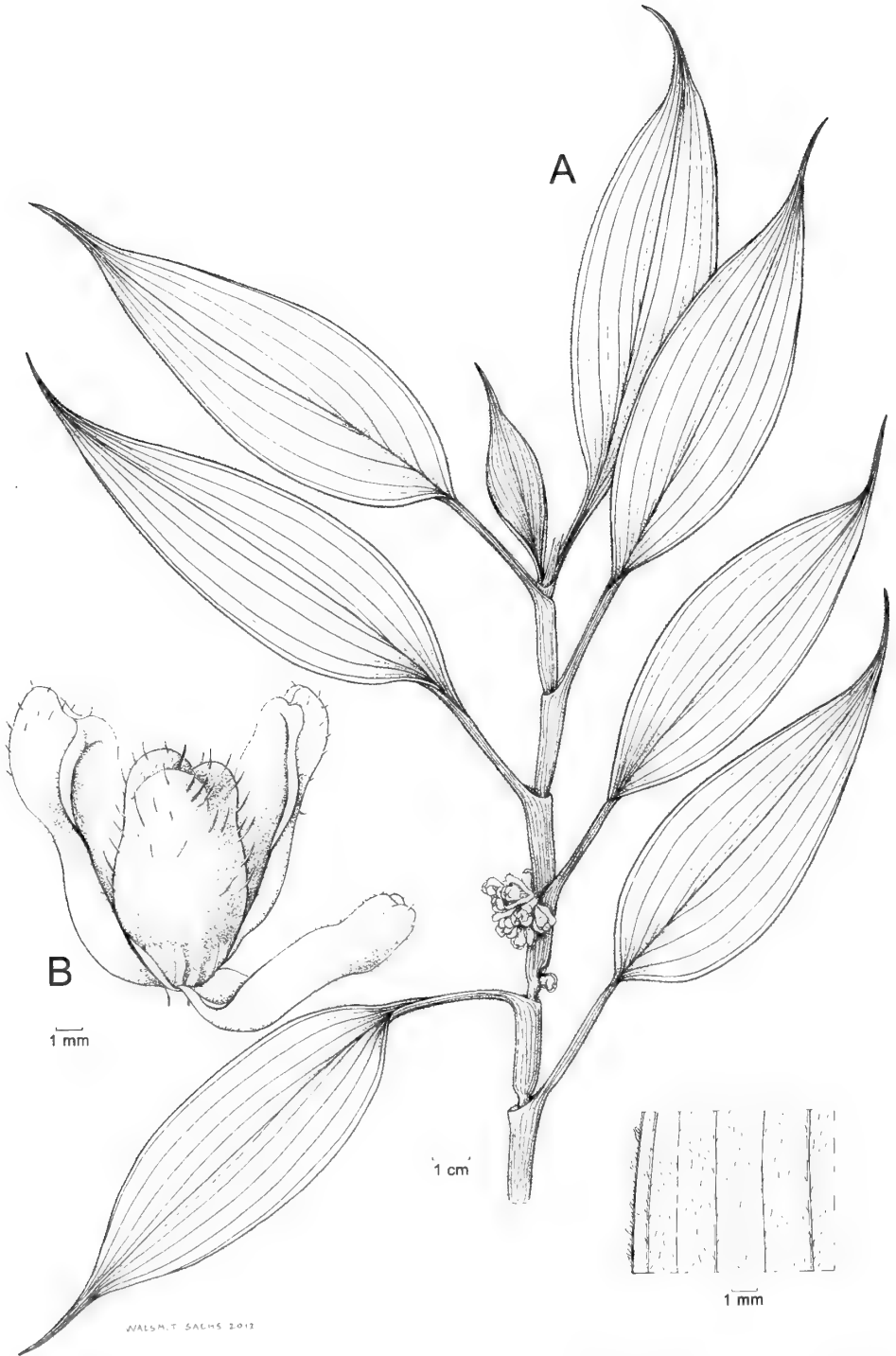


Fig. 4. *Amischotolype lobata* Duist. A. Habit. B. Immature fruit with persistent sepals. Drawing by A. Walsmit Sachs, from *R. Geesink 9284* (L).

long lobes at the apex of the capsule are striking (hence the name): this is a character it shares only with *A. mollissima*. Differences from *A. mollissima* include the shape of the leaf blades, the bristly hairs on the capsules, and the capsules generally exceeding the sepals.

Specimens examined: BORNEO. **Sabah**: West Coast: Ranau, NW of Kampong Pinawantai, May 1973, G. Shea & Aban SAN 76938 (SAN); Ranau, c. 8 miles from Kampung Merungin, Nov 1975, Leopold & Saikeh SAN 82580 (SAN); Interior: Tenom, Crocker Range, Melalap, Sg Losong, Nov 1968, K. Ogata 11466 (L); Sipitang, G. Lumaku, Mar 1969, H.P. Nootboom 1119 (L); Kudat: Kota Marudu, Kampong Monggis, May 1996, M. Rumutom 287 (KEP); Sandakan: Labuk Sugut, W-side of Bt Doji and Telupid-UluKaram, Oct 1968, S. Kokawa & M. Hotta 485 (L); Kinabatangan, Sungai Kuamut, Jan 1976, P.F. Stevens et al. 439 (KEP, L); Lahad Datu, N. of camp 3 Ulu Sg. Danum, Sep 1976, B.C. Stone et al. SAN 85248 (KLU); Mt. Tawai FR Karamuak, Jul 1978, S. Dewol & M. Alexius SAN 88695 (SAN); Lahad Datu, Ulu Sg. Segama, Mar 1985, G. Argent et al. SAN 108301 (E. SAN); Lahad Datu, Danum Valley W1355, Oct 1985, M.J. Still SAN 112110 (SAN); Lahad Datu, Danum Valley, Palum Tambun Nature Trail, Jul 1990, Campbell EG 109 (E); Kinabatangan, Sungai Imbak, Jun 2000, A.D. Poulsen & K. Kjeldsen 1609 (AAU, KEP); Tawau: Tawau hill park, Apr 1992, A. Berhaman et al. SAN 134514 (SAN). **Kalimantan E**: Papadi-Pamilau, Aug 1981, R. Geesink 9284 (L).

14. *Amischotholype marginata* (Blume) Hassk. (Fig. 10C, 14C D, 15A F & 16A–B)

Amischotholype marginata (Blume) Hassk., Flora 46 (1863) 392; Turner, Gard. Bull. Sing. 45 (1993) 53; Coode et al., Checklist Fl. Pl. Gymn. Brun. Dar. (1996) 352; Turner, Gard. Bull. Sing. 47 (1997) 515; Beaman & Beaman, The Plants of Mount Kinabalu 3 (1998) 110; Keng et al., Conc. Fl. Sing. Volume II: Monocotyledons (1998) 23. — *Campelia marginata* Blume, Enum. Pl. Javae (1827) 7; Kunth, Enum. pl. 4 (1843) 109; Moritz, Syst. Verz. (1845–46) 93; Zollinger, Syst. Verz. (1854) 65; Miquel, Fl. Ned. Ind. 3 (1855) 547. — *Forrestia marginata* (Blume) Hassk., Flora 47 (1864) 630, *p.p.* (see note 5); Commelin, Ind. (1870) 90, *p.p.*; Clarke in A. Candolle & C. Candolle, Monogr. Phan. 3 (1881) 237; Hooker f., Fl. Brit. India 6 (1894) 383; Ridley, J. Straits Branch Roy. Asiat. Soc. 33 (1900) 170; Mat. Fl. Malay. Penins. 2 (1907) 123 (see note 3); Koorders, Exkursionsfl. Java 1 (1911) 282; Hallier f., Beih. Bot. Centralbl. 34 (1916) 47, *p.p.*; Merrill, J. Straits Branch Roy. Asiat. Soc. (1921) 113; Ridley, Fl. Malay. Penins. 4 (1924) 360; Brückner in Engler & Prantl, Nat. Pflanzenfam. ed. 2 (1930) 169; Cherfils in Lecomte, Fl. Gen. Indo-Chine 6 (1937) 856, t.85, f. 1–3 ('*marginatus*'); see note 4); Keng, Gard. Bull. Sing. 40 (1987) 124 (see note 3). — *Forrestia mollissima* (Blume) Koord. forma *marginata* (Blume) Backer, Handb. Fl. Java I, 3 (1924) 33; Backer & Bakhuizen van den Brink, Fl. Java 3 (1968) 15. — *Amischotholype mollissima* (Blume) Hassk. forma *marginata* P.H.Hô, CÂYCO Vietnam 3, 1 (1993) 478, illus. ('*Amischotholype*'), *nom. inval.*, no basionym (see note 4). TYPE: Blume *s.n.*, '*In umbrosis montium Gede, Salak, etc.*' (holo L).

Forrestia hispida auct., *sensu* Hook.f., Bot. Mag. 90 (1864) t.5425; *non* A.Rich.

Stem finally ascending from creeping and branched, up to 300 cm long rhizome; erect part 30–100 cm long, simple; internodes glabrous to rather densely 0.2–0.5 mm long (red-)hairy. **Sheath** (6–)10–20(–24) mm diam., with a purple tinge or not, with few to many lines of 1–6 mm long, yellowish hairs, rarely glabrous or densely 0.1–0.5 mm long red-hairy, mouth ciliate. **Leaf blade** (15–)20–35(–46) × (3.4–)4.5–7(–10.6) cm, (3.1–)4–6(–7) times as long as wide, bullate, lower surface purple or not, base gradually to rather abruptly narrowed into an indistinct or 2–3 cm long and 2–3 mm wide winged pseudopetiole; lower surface glabrous or sparsely to very densely 0.1–0.5(–1) mm long hairy or rarely midvein in lower half with 2–3 mm long hairs, upper surface glabrous or rarely sparsely to moderately 0.1–0.5 mm long hairy; submarginal hairs on upper surface, 0.1–0.5(–1) mm long, rather sparse to moderately dense, colourless or yellowish. **Inflorescence** on rhizome and knee, peduncle 2–15 mm long, (1–)2.5–5(–6.5) cm diam., rather dense to very lax with branches obscure or longest 0.3–3 cm long, 20–many-flowered. **Pedicel** 0–0.5 mm long. **Sepals** (6–)7–10 × (2–)3–4(–5.5) mm, not or slightly elongating in fruit, cream to beige or yellow-brown in flower, pink to (red-)purple in fruit, glabrous to rather densely 0.2–0.5(–1) mm long colourless- or red-hairy mostly on keel, tip hardly to distinctly hooded. **Petals** 5.5–8.0 × 2.5–4.2 mm, slightly longer than sepals, white, glabrous, margin entire or minutely fringed. **Stamens** with filaments c. 8 mm long, white, in upper 2–3 mm with many 3–4 mm long hairs; anthers 1–1.6 × 0.8–1.4 mm, yellow, rarely pink, red, blue or purple, thecae opening by a longitudinal slit. **Capsule** 6–8.5 × 3.5–4.5 mm, narrowly obovoid, 1.5(–2) mm shorter to 1.5(–3) mm longer than sepals, pink to red-purple, glabrous or apex to upper half sparsely 0.1–0.5(–1) mm long hairy; valves free; apex depressed, lobes absent; style remnant 0.5 × 0.2 mm, finally deciduous. **Seeds** 2 per locule, rarely 1 abortive, aril orange.

Distribution. Myanmar (Tenasserim), Thailand (SW: Kanchanaburi, Petchaburi; Peninsular Thailand: Ranong, Nakhon Si Thammarat, Trang, Satun, Pattani, Narathiwat), Peninsular Malaysia (Kedah: Langkawi and mainland, Penang: Pulau Pinang, Kelantan, Terengganu, Perak, Pahang, Selangor, Negeri Sembilan, Malacca, Johor), Singapore, Sumatera (Aceh, Sumatera Utara, Sumatera Barat: Kepulauan Mentawai, Riau, Kepulauan Riau, Jambi, Palembang: Bangka Island, Lampung), Java (West: Bogor, Bandung, Priangan), Philippines (Palawan: Puerto Princesa, Brooke's Point), Borneo (Brunei; Sabah: West Coast, Interior, Sandakan, Tawau; Sarawak: Kuching, Samarahan, Sri Aman, Betong, Bintulu, Miri, Limbang, Kapit; Kalimantan: W, C, SE, E), Sulawesi (Central).

Ecology. Lowland dipterocarp, peat swamp or montane primary, disturbed or old secondary, evergreen or (semi-)deciduous forest, in deep to partly shaded or open vegetation in valley, along streams, in forest clearings or margins or on roadsides, on rather dry to wet, rocky or clayey (volcanic) soils with humus absent or present, on sandstone, shale, granite or limestone (terra rossa). Altitude: 0–1500 m asl.

Notes. 1. This species is variable with respect to sheath indumentum and width, and leaf blade indumentum and dimensions. Whether this is ecologically induced variation

could not be established from herbarium material alone.

2. Cleistogamy is suspected in at least one collection (*Duistermaat 350*, Peninsular Malaysia, Selangor, Gombak), in which the anthers shed their pollen in tightly closed flowers.

3. In Singapore, there is only one record from the wild (*Ridley 6433*, 1892, Bukit Timah, Fern Valley). Despite serious attempts we were unable to re-find the population. Ridley (1907, 1924) and Keng (1987) cited *Wallich 8977b* for Singapore, but as seen from microfiche (K) this is *A. gracilis*; although *Wallich 8977a* is *A. marginata*, this specimen is from Penang. At present, the species is growing in the rain forest of the Singapore Botanic Gardens, but the origin of that population is at best uncertain.

4. Although the species has been reported for Lao P.D.R. and Vietnam (Cherfils 1937; Ho, 1993), I doubt its presence there. Material identified by Cherfils as *F. marginatus* are *A. glabrata* (*Balansa 4100*, *Eberhardt 3277*) and *A. divaricata* (*Thorel s.n.*). I have not seen any material of *A. marginata* from Lao P.D.R. nor Vietnam. The description by Cherfils (1937) includes long rhizomes, and inflorescence in the part of the stem where the leaf blade has been shed, i.e., the rhizome. These characters agree with *A. marginata*. However, the illustrations and other parts of the description conflict with this species. Both cited sources illustrate a plant with the inflorescence on the node that also bears a leaf with the leaf blade still attached, i.e., flowering on the erect stem. Also, sepals are reported as 4.5–9 mm long and thecae as opening in the apical region, whereas in fact sepals are at least 6 mm long and the thecae open by a longitudinal slit only. It seems that a description of *A. marginata* was copied, supplemented with characters from material of at least one other species. (See also note 2 under *Amischotolype*.)

5. *A. laxiflora* and *A. monosperma* are quite similar in habit with inflorescences on the rhizome, but differ in width of sepals, and colour of indumentum.

Specimens examined: MYANMAR. **Tenasserim**: Tavoy distr, Aug 1961, *J. Keenan et al.* 972 (E); Tawer distr, Yebyu Township, E of Kanbauk, Oct 1998, *J.F. Maxwell 98-1092* (L).

THAILAND. **SW**: Kanchanaburi, Between Khao Yai and Khao Ngai, E of Sangkhla, Apr 1968, *C.F. van Beusekom & C. Phengkhilai 411* (E, L, P); Petchaburi, Kaeng Krachan NP, Khao Phanoen Thung, km no 30, May 2008, *P. Phonseua et al.* 6006 (L). **Peninsular Thailand**: Pattani, Bachaw, Jul 1923, *A.F.G. Kerr 7181* (P); Trang, Chawrij, Apr 1928, *A.F.G. Kerr 15185* (L); Ranong, Khao Saideng, near Ranong, May 1968, *C.F. van Beusekom & C. Phengkhilai 542* (E, P); Nakhon Si Thammarat, Khao Luang area, May 1968, *C.F. van Beusekom & C. Phengkhilai 846* (E, P); Waterfall at Yala, Oct 1970, *Ch. Charoenphol et al.* 4132 (KLU); Khao Khlong Yang at Khao Phra Mi, Jul 1972, *K. Larsen et al.* 30655 (KLU, L); Satun, Kuan Kah Long, Tong Sgui subdistr, nr Nam Rah vill, Aug 1984, *J.F. Maxwell 84-100* (SINU); Nakorksitapararat, Lansagah, Gahrome Falls, Khao Luang Nat.Park, Apr 1985, *J.F. Maxwell 85-400* (SINU); Trang, Kao Chong Nat.Park, Jul 1987, *Samsuri Ahmad 35* (SINU); Narathiwat, Khao Chana, Kaluwotai, Narathiwat, Sep 1995, *C. Niyomdham 1047* (P).

PENINSULAR MALAYSIA. **Kedah**: Kedah Peak, Jun 1893, *H.N. Ridley s.n.* (SING); Langkawi, Gunung Raya Forest Reserve, Mar 1939, *Md.Nor 31378* (KEP); Gunung Bongon Forest Reserve, Jun 1941, *G.H. Spare 3786* (SING); Langkawi, G.Raya, ascent from SE near

the base, Aug 1972, *B.C. Stone 10932* (KLU); Langkawi, N base of G.Raya, due S of Kg.Sg. Itau, Nov 1979, *B.C. Stone 14314* (KLU); Langkawi, Dec 1990, *Khairuddin Hj. Itam 3* (KEP) & 5 (KEP); Kuala Muda, Gng Jerai FR, Titi Hayun, compt 20., Jul 2006, *K. Imin et al. FRI 50747* (L, KEP, SING). **Penang:** Pulau Pinang, *N. Wallich 8977a* (BM, E, K); Pulau Betong, Aug 1884, *C. Curtis 1948 (A)* (SING) & *1948 (B)* (SING); Pulau Betong, 189x, *Guard (Ridley) 2* (BM); Governement Hill, May 1898, *C. Curtis s.n. (A)* (SING) & *s.n. (B)* (SING). **Kelantan:** Ulu Sg. Lebir, 1.5 mi S of Sg. Ternya, Sep 1967, *B.C. Stone 7317* (KEP, KLU, L). **Terengganu:** Kemaman, Bukit Kajang, Nov 1935, *E.J.H. Corner s.n.* (SING); Kemaman, Sungai Nipah FR, Cptmt 56, Sungai Ayam, May 2006, *A.R. Rafidah et al. FRI 51647* (KEP, L, SING); Hulu Terengganu, Ulu Telemong FR, Jul 2006, *S.N. Phoon et al. FRI 51960* (KEP); Hulu Terengganu, Petuang FR, Jul 2006, *S.N. Phoon et al. FRI 51977* (KEP); Hulu Terengganu, Tasik Kenyir, Sg. Cendana, Aug 2007, *K. Imin et al. FRI 58538* (L, KEP). **Perak:** Taiping Hill, Dec 1892, *H.N. Ridley 11422* (K, SING); Maxwell's Hill, 1892, *H.N. Ridley s.n.* (SING); Taiping Hills, Feb 1904, *H.N. Ridley s.n.* (SING); Temango, Jul 1904, *H.N. Ridley s.n.* (SING); Lenggong, Aug 1904, *H.N. Ridley 14375* (BM, SING); Gunong Bujang Malaka, Aug 1959, *Kadim bin Tassim 457* (SING); Bukit Kinta FR, Apr 1987, *R. Kiew 2588* (KEP); Hulu Perak, Temenggor FR, Sungai Halong, Aug 1993, *M. Abdul Latiff et al. 3943* (KEP, L); Belum, near Sg. Halong, Sep 1993, *I.M. Turner & J.W.H. Yong 31* (SINU); Hulu Perak, Belum FR, Sungai Kejar, Sg. Kejar, Jun 2007, *S. Syahida Emiza & Kueh H.L. FRI 55186* (KEP, L). **Pahang:** Pulau Tioman, Aug 1889, *H.N. Ridley s.n.* (SING); Telom, Nov 1901, *H.N. Ridley 13813* (BM, K, SING); Telom, Nov 1908, *H.N. Ridley 13812* (BM, K, SING); Pulau Tioman, Juara Bay, Tawa Valley, Jun 1915, *H.M. Burkill s.n.* (SING); 7th mile Raub Road, Jul 1924, *G.A. Best SF 14128* (SING); Pulau Tioman, G.Kajang, Ayer Surin, May 1927, *M.R. Henderson SF 18443* (SING); Tembeling, Jul 1929, *M.R. Henderson SF 21782* (SING); Sungei Lemoi, Sep 1931, *Jaamat 28172* (KEP, SING); Lipis, Sungai Serambun, Oct 1931, *Osman 27998* (KEP); Tekek to Joara, May 1974, *B.C. Stone 11984* (KLU); Genting Highlands Road, Jun 1974, *B.C. Stone & T. Hattink 12013* (KLU); Fraser's Hill, Nov 1976, *H. Keng et al. s.n.* (SINU); Fraser's Hill, Bishop's Trail, Apr 1992, *R. Kiew & S. Anthonysamy 3525* (SING); Pulau Tioman, G. Kajang, *Saw L.G. et al. FRI 40117* (KEP); Pulau Tioman, 1km W of Kg Juara, track to Kg Tekek, Jul 2005, *H. Duistermaat 394* (L, SING); Maran, Jengka FR, Hutan Lipur Jebak Puyuh, Gua kap, Oct 2008, *M.A. Mohd Hairul et al. FRI 60076* (KEP). **Selangor:** Telok Reserve, Klang, Sep 1918, *H.M. Burkill SF 3135* (SING); Talik reserve, Klang, Mar 1921, *H.M. Burkill SF 7034* (SING); Hulu Langat, Sungai Lalang Forest Reserve, Mar 1930, *C.F. Symington 24057* (KEP); Kuala Lumpur, Univ. Malaya, fern plot, *Khantijah 102* (KLU); Telok *Khantijah 107* (KLU); Telok FR (nr Klang?), Nov 1971, *K. Jong 9025* (KLU); N of Kuala Lumpur, Jln Gombak km36(KL), Jun 2005, *H. Duistermaat 350* (L, SING); Kepong, FRIM, forest trail behind herbarium, Jun 2005, *H. Duistermaat 356* (L, SING); Gombak, Kanching FR, along waterfall main trail, Sep 2006, *H. Duistermaat et al. FRI 51935* (KEP, L); Gombak, Kanching FR, lower part of quartz ridge, Mar 2007, *Chew M.Y. et al. FRI 53665* (L). **Negeri Sembilan:** Gunong Angsi, near bungalows, Nov 1923, *Md.Nur SF 11645* (SING); Pasoh FR, Oct 1987, *J.V. LaFrankie 2529* (KEP); Pasoh FR. nr Simpang Pertang, Jul 1989, *A. Gentry & J.V. LaFrankie 66983* (L); Gunung Angsi, Jun 2005, *H. Duistermaat 342* (L, SING); Jelevu, Berembun FR, Jeram Toi, forest trail, Apr 2008, *Yao T.L. et al. FRI 57936* (KEP, L); Jelevu, G.Telapak Buruk, Peak nr Telekom/Celcom tower, Apr 2008, *S.N. Phoon et al. FRI 60645* (L). **Malacca:** *Maingay 1713* (L); Bukit Kedongong, May 1890, *R. Derry 602* (SING); Bt. Ledondong, May 1890, *H.N. Ridley 602* (BM); Jasin, Bkt Senggeh FR, Cpt.3, Jul 2008, *Y.M. Chan FRI 64724* (KEP). **Johor:** Tanjong Kopang, 1892, *H.N. Ridley s.n.* (SING); Gunung Panti, Dec 1892, *H.N. Ridley s.n.* (SING); Kukub., 1909, *H.N. Ridley 14168* (SING); Sg.Endau near Kg.Peta, Aug 1973, *Khantijah 104* (KLU).

SINGAPORE. Bukit Timah, 1892, *H.N. Ridley s.n.* (K); Bukit Timah, nr Fern Valley, 1892, *H.N. Ridley 6433* (SING); Bukit Timah, Jun 1948, *J. Sinclair 4840* (E); SBG, rainforest, nr 'rattan-entry' at palm valley, Apr 2005, *H. Duistermaat 329* (L, SING); SBG, Liane Rd nr path to greenhouses, Aug 2005, *H. Duistermaat 395* (L, SING).

SUMATERA. **Aceh:** Ketambe, valley of Lau Alas, May 1972, *W.J.J.O. de Wilde & B.E.E. de Wilde-Duyffes 12419* (L); Gng Leuser NP, Alas river valley, Jul 1979, *W.J.J.O. de Wilde & B.E.E. de Wilde-Duyffes 18480* (L). **Sumatera Utara:** Sibolangit, May 1917, *J.A. Lörzing 5125* (L); Sibolangit NR, Dec 1927, *J.A. Lörzing 12746* (L); Bukit Lawang-Bohorok-Langkat, Feb 1973, *R. Soedarsono 309* (K, L). **Sumatera Barat:** Afd. Agam Brani, Jun 1918, *H.A.B. Buennemeyer 3344* (L); G.Sago, Jul 1918, *H.A.B. Buennemeyer 3649* (L); Padang, nr Ajer mantjur, Aug 1878, *O. Beccari 828* (L); Kepulauan Mentawai, Island of Siberut, Aug 1924, *C. Boden Kloss SF 14497* (SING); Sipora Isl., Sioban omgeving, Oct 1924, *Iboet 417* (SING). **Riau:** Indragiri, Sg. Gaung, Sep 1940, *E. Polak 546* (L). **Kepulauan Riau.** Anambas/Natoena, Boengoeran eiland, Apr 1928, *C.G.G.J. van Steenis 1397* (L). **Jambi:** Pesisip river, nr Dusun Pasirmayang, Dec 1980, *N.A.P. Franken & M. Roos 363* (L). **Bangka-Belitung:** Bangka Island, Soengai Selan, Nov 1917, *H.A.B. Buennemeyer 2106* (L). **Lampung.** Gunung Sugi, Jan 1908, *J. Elbert s.n.* (L); Kalianidoea, Dec 1921, *C.J.M. Sloet 435* (L); Mt. Tanggamus, Apr 1968, *M. Jacobs 8117* (KEP, L, SING).

JAVA. *C.L. Blume 2047* (L). **Jawa Barat:** Bogor, *C.L. Blume s.n.* (L); Preanger, nr Gadongang (Bandong), *H. Zollinger 540, p.p.* (E, L); Priangan, Tjampaka near Tjidadap, Dec 1937, *P. Buwalda 3436* (L); road Pelabuhan Ratu-Kiara-Lengkong., Sep 1985, *E.F. de Vogel 7649* (L). PHILIPPINES. **Palawan:** Brooke's Point, Addison Peak, S slope, Jan 1991, *D.D. Soejarto & O. Fernando 7356* (L); Munic. Brooke's Point, S range of Mantlingajan Rang, Jun 1994, *D.D. Soejarto et al. 8330* (L); Mt. Cleopatra Ranges, Co. Calabayog, Puerto Princesa, Jun 1996, *E. Reynoso & R. Majaducon PPI 24356* (L); Irawan forest, Puerto Princesa, Aug 1996, *E. Romero et al. PPI 38462* (L).

BORNEO. **Brunei:** Belait, Labi, Kampong Tenajor, Sep 1988, *A. Mohd. Haslami 17* (KEP, L, SING); Tutong District, track from Panchong to Benutang, Oct 1989, *L.L. Forman & J.B.J. Blewett 983* (L, SING); Belait District, Labi, path to Rampayoh waterfall, Oct 1989, *L.L. Forman & J.B.J. Blewett 1046* (L, SING); Belait, Labi, Rampayoh, Jul 1993, *J. Cowley 101* (L) & *11* (L); Temburong, Amo, Apan, Sungai Baki, Jul 1993, *J. Cowley 87* (K). **Sabah:** West Coast: Mount Kinabalu, Penibukan, Jan 1933, *J. & M.S. Clemens 30889* (BM); Kota Belud, above Sg. Dahobang S-side nr Kinabalu Park, Sep 1965, *A. Kanis 51478* (L, SAN); Ranau, Sungai Nabutan, Mar 1982, *Aban Gibot SAN 94552* (L, SAN); Kota Belud, NW side Mt Kinabalu, May 1984, *J.H. Beaman et al. 9754* (L); just outside Kinabalu Park along rd to Marai-Parai, Sep 1993, *J. Nais et al. SP 5321* (KEP); Ranau, Kampung Bundu Tuhan, Lugas, Kg. Himba, Sep 1993, *Doinis Soibeh 423* (SAN); Ranau, Kampong Takutan, Apr 1995, *T. Lomudin 221* (KEP); Ranau District, Kampung Takutan, 5km dari kpg, Jun 1995, *T. Lomudin 378* (KEP); Kota Belud, Kinabalu P, Sayap, Lumangis trail, Jun 2000, *A.D. Poulsen et al. 1619* (SAN); Interior: Tenom, Oct 1961, *A. Buntar SAN 27364* (L); Keningau, Keningau, Ulu sg. Matud, Jun 1987, *K. Fidilis SAN 119541* (SAN); Keningau, Nabawan, via Tenom, Feb 1989, *Tay E.P. et al. 89-0409* (SING); Tambunan, Sunsuron Km 54 Jln Tambunan/Penampang, Aug 1989, *K. Fidilis SAN 127872* (SAN); Sipitang, Melakis FR, Oct 1989, *S. Awang Amin S 114838* (K, KEP, L); Sandakan: Lahad Datu, Timbun Mata Is. F.R., Aug 1940, *H.G. Keith 34* (SING) & *55500* (KEP); Lahad Datu, S. Pangaruanan, K. Bay, Dec 1959, *D. Brand 20061* (L, SING); Labuk Sugut, Beluran, Sg. Baba, Mar 1980, *Aban Gibot SAN 90037* (L, SAN); Sepilok FR, Jun 1981, *T. Sato & S. Dewol SAN 93160* (SAN); Kinabatangan, Keruak FR, Feb 1985, *K. Amin et al. SAN 108160* (SAN); Lahad Datu, Ulu Sg. Segama, Dec 1985, *G.C.G. Argent et al. SAN 108225*

(E, SAN); Lahad Datu, N-trail Danum Valley, Jul 1986, *Lee et al. SAN 109039* (SAN); Lahad Datu, Danum Valley, Mar 1987, *K. Amin & R. Joseph SAN 110020* (L, SAN); Sepilok FR, May 1987, *Jurimin Ebin SAN 116477* (SAN); Lahad Datu, Kunak, km 79 Tawau/Lahad Datu road, Jun 1987, *E. Suali & Muhamad SAN 117141* (SAN); Lahad Datu, Danum Valley FC, Begonia Cliff, Feb 1992, *E.J.F. Campbell-Gasis 234* (E, SAN); Kinabatangan District, Bukit Garam, mile 5, Nov 1994, *Reza Azmi 68* (SAN); Lahad Datu district, Madai-BaturongFR, Madai Hill, Jun 1996, *S.P. Lim et al. 656* (SAN); Kinabatangan D, Sukau, PangiFR, Temangong Besar Hi, Sep 1996, *S.P. Lim et al. 1266* (SAN); Lahad Datu, Tempadong, Borneo Marble Quarry, Aug 1999, *R. Kiew 4793* (KEP); Lahad Datu District, Tabin Wildlife Res. near headquarter, Mar 2000, *K.H. Kjeldsen 94* (SAN); Lahad Datu, Madai Baturong, Jul 2000, *S. Dewol SAN 133042* (KEP, SING); Tawau: Elphinstone prov., 1922–23, *A.D.E. Elmer 20864* (L); Luasong Centre old logging area, Ikea plant, Jul 2001, *M. Postar et al. SAN 144083* (KEP, L, SAN); Tawau Hills NP, path to Bombalai, May 2005, *J.J. Vermeulen in H. Duistermaat 358* (L, SING). **Sarawak:** Kuching: Matang, Mar 1955, *W.M.A. Brooke 9756* (BM, L); Lundu, Gunong Gading, Sep 1955, *J.W. Purseglove & Md. Shah 4522* (K, L, SING); Lundu, Gunong Pueh, Sep 1955, *J.W. Purseglove 4816* (L, SING); Lundu, G.Gading, Sep 1974, *James et al. S 35087* (L); Kuching, Bau, Gg. Meraja, May 2002, *S.B. Raymond et al. 3134* (SING); Samarahan: Serian, Bukit Rawang, Tebakang area, Apr 1983, *Dyg. Awa & I. Paie S 45586B* (L); Serian, Bukit Majung, Tebakang, Dec 1998, *P. Kessler 221* (L); Sri Aman: Simanggang, Oct 1955, *W. Brooke 10730* (BM, L, SING); Ulu Sungai Silantek Kiri, Aug 1980, *I. Paie S 42477* (KEP, L); Betong: up Layar river, Grajih, Mar 1954, *W.M.A. Brooke 8241* (BM, L); Bintulu: Tatau, Bukit Naong, Apr 1995, *J. Lai et al. S 71032* (cf; KEP); Ulu Sg. Kakus, Bkt Sarang, Batu Anyi, Jan 2005, *S. Lee S 94752* (KEP); Tatau, Ulu Merirai, Gua Naga, Jul 2005, *S. Julia S 95712* (KEP, SING); Tatau, Bukit Sarang group, Bukit Anyi SE-side, Aug 2005, *J.J. Vermeulen in H. Duistermaat 400* (L, SING); Miri: Baram district, E...River, Mar 1894, *C. Hose 370* (BM); Bukit Subis area, Aug 1963, *H.P. Fuchs 21281* (L); S slopes of Gg. Subis, nr Sekaloh river, Nov 1966, *Sonny Tan & E. Wright S 27258* (L, SING); Bakam, Oct 1983, *A.P. Abang Mohtar S 47201* (KEP, L); Marudi, Mulu National Park, May 1985, *A.P. Abang Mohtar & I. Othman S 49692* (KEP); Limbang: Tg. Long Amok, Sg. Ensungei, Sep 1960, *R. George et al. S 42352* (L); Kapit: Teneong, Sep 1954, *W.M.A. Brooke 9121* (BM, L). **Kalimantan W:** Landak, Ngabang, 1851, *J.E. Teysmann 11551* (BO); ridge SW of G. Bentuang Jul 1989, *J.S. Burley et al. 3340* (L); Gn Palung NP Oct 1996, *T.G. Laman et al. 97* (E, L). **Kalimantan C:** Kahayan, Mar 1988, *J.S. Burley et al. 472* (KEP, L, SING). **Kalimantan SE:** *P.W. Korhals s.n.* (L); Tanahboemboe, G. Mangis, N v Batoelitjin, Oct 1928, *D.F. van Slooten 2184* (L); km 14 Bandjermasin-Martapoera, Oct 1939, *B. Polak 503* (L). **Kalimantan E:** Boelongan, 1914, *L. Rutten 112* (U); *A. Kostermans 5418* (L); E. Kutei, G. Tepian Lobang, Jun 1951, Loa Djanan, W of Samarinda, Apr 1952, *A. Kostermans 6415* (L); Balikpapan distr, Mentawir region, Jul 1954, *A. Kostermans 9708* (L); Kutei Reserve N. of Samarinda, Mentoko, May 1970, *Soegeng Reksodihardjo 11* (L); Teluk Sanggan, W of Malinau, Jul 1981, *K. Iwatsuki et al. B 7213* (L); Wartono Kadri, km 3.5 along Samboja-Semai Rd, Mar 2005, *C. Bernard 3* (L); Meratus, Mului, Nov 2005, *N. Raes et al. 698* (L).

SULAWESI. Central: Lore Lindu NP, Feb 2008, *D. Cicurra 483* (L).

15. *Amischotolype mollissima* (Blume) Hassk. (Fig. 10D)

Amischotolype mollissima (Blume) Hassk., Flora 46 (1863) 392. — *Campelia mollissima* Blume, Enum. Pl. Javae (1827) 7; Kunth, Enum. Pl. 4 (1843) 109; Moritz,

Syst. Verz. (1845–46) 93; Zollinger, Syst. Verz. (1854) 65; Miquel, Fl. Ned. Ind. 3 (1855) 546; Fl. Ned. Ind., Eerste Bijv. (1860) 609. — *Forrestia mollis* Hassk., Flora 47 (1864) 628, *nom. illeg.* (see note 1); Commelin, Ind. (1870) 84; Clarke in A.Candolle & C.Candolle, Monogr. Phan. 3 (1881) 236, *p.p.*; Hooker f., Fl. Brit. India 6 (1894) 383, *p.p.* — *Forrestia mollis* Hassk. var. *blumeana* Hassk., Flora 47 (1864) 628; Commelin, Ind. (1870) 84. — *Forrestia mollissima* (Blume) Koord., Excursionsfl. Java 1 (1911) 282. — *Forrestia hispida* A.Rich. var. *mollis* (Hassk.) Hallier f., Nova Guinea 8 (1913) 906; Beih. Bot. Centralbl. 34 (1916) 47. — *Forrestia mollissima* Koord. forma *typica*, Backer, Handb. Fl. Java I. 3 (1924) 33. — *Forrestia mollissima* (Blume) Koord. forma *mollissima* Backer & Bakh.f., Fl. Java 3 (1968) 15. LECTOTYPE (designated here): *Blume s.n.*, Java (L. barcode L 0041655). Other syntypes: *Blume s.n.*, in sylvis montosis Javae insulae (L: 3 sheets); *Reinwardt s.n.*, Tjampea (L).

Forrestia mollis Hassk. var. *korthalsii* Hassk., Flora 47 (1864) 628; Commelin, Ind. (1870) 86. TYPE: *Korthals s.n.*, Java (L).

Forrestia mollis Hassk. var. *teysmannii* Hassk., Flora 47 (1864) 628; Commelin, Ind. (1870) 86. TYPE: *Teymann s.n.*, Sumatera, Lubu alang (BO).

Forrestia bicolor Hallier f., Bull. Herb. Boissier 6 (1898) 360, t. XI. SYNTYPES: *Burck s.n.*, *s.d.* 'Sumatra' (BO, *n.v.*), *Jaheri s.n.*, 1895 'Deli, Tandjung Gunung' (BO?, *n.v.*).

Stem rhizome absent, erect part 100–160 cm long, basally sometimes with some stilt roots, simple; internodes glabrous or rarely moderately 0.2 mm long hairy. **Sheath** 10–19 mm diam., glabrous or with one to few lines of (0.5–)3–4.5 mm long, white to yellow or brownish hairs, mouth ciliate. **Leaf blade** 27–44 × 5.7–10.6 cm, 3.4–5.9 times as long as wide, base very gradually to abruptly narrowed into an indistinct winged pseudopetiole to 4 cm long and 1.5–2 mm wide; lower surface moderately to densely (0.1–)0.5–1 mm long colourless- to white-hairy or rarely glabrous, upper surface glabrous (rarely with 0.2 mm long hairs near margin); submarginal hairs on upper surface, (0.5–)1–1.5 mm long, dense, yellow. **Inflorescence** on erect stem, sessile, 3.2–5.7 cm diam., dense with branches obscure, 20–many-flowered. **Pedicel** 2–3 mm long. **Sepals** (8.5–)12–15.5 × 2.5–4.5 mm, probably slightly elongating in fruit, light violet, lilac or red, sparsely 0.5–1.5 mm long ciliate margins and keel or rarely glabrous, tip hooded. **Petals** 9–10 × 3 mm, c. as long as sepals, colour unknown, glabrous, margin minutely fringed at apex. **Stamens** filament 8–10 mm long, colour unknown, upper 2 mm with many 3 mm long hairs; anthers 1–1.3 × 0.6–0.7 mm, colour unknown, thecae opening by a longitudinal slit. **Capsule** 6–10 × 4.5–6 mm, obovoid, shorter than sepals by 3–6 mm, whitish or dark carmine, apex to upper half 0.2–1 mm long hairy; valves free to fused for 1/3 of length; apex depressed, lobes 0.5–1.3 mm long; style remnant 0.5–1.2 × 0.3 mm, finally deciduous or persistent. **Seeds** 2 per locule, aril orange.

Distribution. Sumatera (Aceh, Sumatera Utara, Sumatera Barat), Java (W: Bogor, Preanger, Tjisaroea; C: Banjoemas; E: Besuki).

Ecology. Primary and secondary (riverine) rain forest, along stream, in gorge, on roadside, on alluvial, fertile soil. Altitude: 60–600(–1420) m asl.

Notes. 1. Hasskarl (1864), when he transferred species of *Amischotolype* to *Forrestia*, choose for *A. mollissima* the illegitimate name *F. mollis* (illegal because an autonym is required in the absence of a preoccupied earlier homonym in the recipient genus), based on *Tradescantia mollis* Reinw. in sched., with *Campelia mollissima* Blume appearing in the synonymy. Clarke (1881) and Hooker (1894) included in their concept specimens of *A. gracilis*, *A. hirsuta* and *A. barbarossa*, these only later recognised as distinct separate species. Ridley (1907, 1924: sub *F. mollis*) and Turner (1997: sub *A. mollissima*) used the name for *A. barbarossa* exclusively.

2. The species is limited in its distribution to Java and Sumatera. In Java it is not known above 600 m asl, whereas in Sumatera it occurs up to 1420 m asl. Beaman & Beaman (1998) cited *A. mollissima* for Borneo (*Daim Andau* 566), but this collection is *A. hirsuta*.

3. *A. mollissima* is very similar to *A. hispida* in size and shape of the leaf blade, inflorescence and flowers. However, *A. hispida* differs in having long rhizomes, capsules without apical lobes and with valves fused for 1/4 to 1/2 of the length. The two species are geographically disjunct: *A. hispida* ranges from Borneo and the Philippines eastward to New Guinea.

4. I have not seen the type of *Forrestia bicolor* (it is unclear if Jaheri's collection in the Hortus Bogoriense ended as a collection in any herbarium). Nevertheless, there can be no doubt that this is a synonym for *A. mollissima*, because the combination in the description of sepals 13–15 mm long, inflorescence opposite the leaves (leaves thus present), and the capsule apex distinctly depressed (“...apice umbilico profundo triquetro praedita...”) is unique for this species.

5. The only other species that have apical lobes on the capsule are *A. barbarossa* (absent to 0.3 mm long; see there, note 1), *A. welzeniana* (0.5 mm long; sheath, sepals and capsule glabrous) and *A. lobata* (1–1.5 mm long; distinctly pseudopetiolate leaf blades, and capsules exceeding the calyx and bristly-hairy).

Specimens examined: SUMATERA. *P.W. Korthals s.n.* (L). **Aceh:** Ketambe, valley of Lau Alas, May 1972, *W.J.J.O. de Wilde & B.E.E. de Wilde-Duyffes* 12036 (L); Gn Leuser NR, Ketambe, valley of Lau Alas, May 1974, *H.D. Rijkssen* 050574 (L); Gng Leuser NR, c. 5 km S of Ketambe, Alas riv. Jun 1979, *W.J.J.O. de Wilde & B.E.E. de Wilde-Duyffes* 18035(A) (L); foot of Mt Biak Mentelang Koacane, Feb 1980, *Afandi Ma'Roef* 371 (L); Kloet NR, along Krung (river) Lembang, Jul 1985, *W.J.J.O. de Wilde & B.E.E. de Wilde-Duyffes* 19908 (L). **Sumatera Utara:** Karohoogvlakte bij Lingga, Jan 1919, *J.A. Lörzing* 6272 (L); Gajo, 1921, *G.C.E. van Daalen* 367 (L); Sebolangit, Bukit Senia..., Aug 1921, *Md.Nur SF* 7365 (K, SING); Sibolangit NR, Dec 1927, *J.A. Lörzing* 12747 (L); Biang valley nr Sarinembah, Karo plat nr Lingga, Oct 1928, *J.A. Lörzing* 14432 (L); Kaban Djahe, May 1939, *A.H. Batten Pooll s.n.* (SING). **Sumatera Barat:** Lubu Abang, *J.E. Teysmann s.n.* (BO); above Telug Kabung, Jun

1953, *J. van Borssum Waalkes 1507* (K, L).

JAVA. *C.L. Blume s.n.* (L); *P.W. Korthals s.n.* (L); *C.G.C. Reinwardt s.n.* (L); *J.C. van Hasselt s.n.* (L); *J.C. Ploem s.n.* (L); *Mumutean s.n.* (L). **Jawa Barat:** Salak *C.L. Blume 2249* (L); Vogelberg, Tjampea, *J.C. van Hasselt s.n.* (L); nr Bogor, foot of mnt Salak, 1821, *C.L. Blume s.n.* (L); Tjisaroea, Oct 1870, *R.H.C.C. Scheffer s.n.* (L); Buitenzorg, Bandungan, Apr 1900, *Soegandiredja 198* (L); G.Karang bij Klappa-Noenggal, NO van Buitenzorg, Dec 1912, *Backer 5968* (L); Bogor, Preanger, Tjisaroea; Preanger, Tjibadak o d Halimoen, Jan 1920, *R.C. Bakhuizen van den Brink Sr. 3150* (L); Br. Tjiomas, Aug 1922, *R.C. Bakhuizen van den Brink Sr. 1678* (U); Preanger: Z van Radjamandala, May 1924, *C.A. Wisse 1089* (L); boschweg van Tjipannas naar Wijnkoopsbaai, Jun 1932, *A. Kloos 371* (L); Bogor, Tjiburial, Feb 1951, *Nedi & Idjan 398* (K, L). **Jawah Tengah:** Banjoemas, Pasir Salam bij Madjenang, Jan 1915, *C.A. Backer 18755* (L); **Jawa Timur:** Besuki, Tjoeraman, *S.H. Koorders 20664b* (L).

16. *Amischotolype monosperma* (C.B.Clarke) I.M.Turner (Fig. 10E, 17A–C & 18)

Amischotolype monosperma (C.B.Clarke) I.M.Turner, Novon 6 (1996) 221; Gard. Bull. Sing. 47 (1997) 516. — *Forrestia monosperma* C.B.Clarke in Hallier f., Bull. Herb. Boissier 6 (1898) 359; Ridley, Mat. Fl. Malay. Penins. 2 (1907) 124; Fl. Malay. Penins. 4 (1924) 360. LECTOTYPE (designated here, see note 1): *Curtis s.n.*, 1890, Waterloo Estate, Perak; 'this specimen flowered in the Botanic Garden of Penang' (SING).

Amischotolype irritans auct., sensu Beaman & Beaman, The Plants of Mount Kinabalu 3 (1998) 109. *non* Ridley.

Forrestia marginata auct., sensu Hasskarl, Flora 47 (1864) 630, *p.p.*; Commelin. Ind. (1870) 90, *p.p.*; Hooker f., Fl. Br. India 6 (1894) 383, *p.p.*

Tradescantia sp., Griffith, Not. Pl. Asiat. 3 (1851) 235.

non Forrestia monosperma auct., sensu Cherfils in Lecomte, Fl. Gen. Indo-Chine 6 (1937) 855. — *Amischotolype mollissima* (Blume) Hassk. var. *monosperma* (C.B.Clarke) P.H.Hô, Càyco Vietnam 3, 1 (1993) 478, illus. ('Amischotolype'), *nom. inval.*, no basionym. (see note 3, and note 2 under *Amischotolype*).

Stem ascending from creeping and branched, c. 70 cm long rhizome; erect part c. 60 cm long, simple; internodes sparsely to densely 0.1–0.5 mm long red- to redbrown-hairy. **Sheath** (7–)12–30 mm diam., reddish green, many (rarely only at front or in lower half) dense lines of 2.5–4 mm long, orange to orange-brown or red hairs, in between glabrous to sparsely 0.1 mm long hairy, mouth glabrous to ciliate. **Leaf blade** (21–)30–50(–68) × (6.5–)9–16 cm, 2.3–5.1 times as long as wide, bullate, lower surface usually red to purple, base gradually to rather abruptly narrowed into a winged pseudopetiole up to 13 cm long and 3–7 mm wide; both surfaces glabrous or rarely sparsely 0.1 mm long hairy; submarginal hairs on upper surface, 0.2–0.7 mm long,

rather sparse, colourless or yellow-brown. **Inflorescence** on rhizome and around knee, peduncle (0–)3–20 mm long, (2.5–)3.5–9 cm diam., dense to very lax with branches obscure or longest 0.5–4.5 cm long, 20–many-flowered. **Pedicel** absent. **Sepals** (8–)9–14(–18) × 2–4.5 mm, not elongating in fruit, red or reddish brown to purple (in flower and fruit), rarely creamy yellow at upper half. margins and keel sparsely to rather densely (0.5–)1–2 mm long orange- to redbrown-hairy, in between glabrous or 0.3–0.5 mm long hairy, tip hooded. **Petals** 8–9.5 × 2.5–3 mm, slightly shorter than sepals, white, glabrous, margin at apex minutely fringed. **Stamens** with filaments 9–12.5 mm long, white, in upper 2–3 mm with 3.5–4 mm long hairs; anthers 1–1.5 × 0.9–1 mm, white, thecae opening by a longitudinal slit. **Capsule** 7.5–8.5 × 3.5–4 mm, obovoid, shorter than sepals by 1.5–5(–8) mm, magenta red or purple, apex to upper half sparsely to densely 1–2 mm long orange- to red-brown-hairy; valves unknown; apex depressed, lobes absent; style remnant 0.7 × 0.3 mm, deciduous. **Seeds** 2 per locule, 1 rarely abortive, aril orange.

Distribution. Myanmar (*n.v.*, see note 2), Thailand (Peninsular Thailand: Yala), Peninsular Malaysia (Kedah, Kelantan, Terengganu, Perak, Pahang, Selangor, Negeri Sembilan), Borneo (Sabah: West Coast, Interior).

Ecology. Primary forest or forest margin, often on stream or river banks, often in wet areas and on limestone. Altitude: 30–1000(–1500) m asl.

Notes. 1. The species required lectotypification (see Turner 1996). The original description mentioned the following locality (Clarke in Hallier 1898): “*Aus Perak in den botan. Garten zu Pinang und von hier in die Gärten zu Singapur, Buitenzorg u. s. w. eingeführt.*” This is very similar to the annotation on the label of *Curtis s.n.*, 1890, Waterloo Estate, Perak (SING), which is therefore selected here as the lectotype.

2. The authors who mentioned *Tradescantia* sp. of Griffith (1851a), including Hasskarl (1864), Hooker (1894), and Ridley (1907), placed it in *A. marginata*. Unfortunately, I did not see Griffith’s material (Merg. Herb. 185, August 1834, in sylvis Kyouklag), collected in the Mergui Archipelago, Myanmar. Griffith (1851b) provides no illustration of any Commelinaceae species. However, Griffith’s (1851a) description (‘*infra florifero foliorumque vaginarum reliquis obtectis*’—flowering on the part covered with remnants of leaf sheaths, and ‘*sepalis rubro-aurantiaceus dorso pilosa*’ sepals with red-golden hairs on the back) can only refer to *A. monosperma*. It is the only known record for Myanmar.

3. Although the species has been reported for Lao P.D.R. and Vietnam (Cherfils 1937; Ho 1993, Fig. 8427), I doubt its presence there. I have not seen material from Lao P.D.R. or Vietnam referable to *A. monosperma*. Material determined by Cherfils as *F. monosperma* is *A. divaricata* (Harmand 1920, *Pierre s.n.*, and *Poilane 186*, all P). Further, the description by Cherfils (1937) cannot refer to *A. monosperma*: the leaf blades are too narrow, the sheaths have white appressed short hairs, and the sepals are sparsely hairy near the apex only. Lastly, the illustration in Ho (1993) shows a plant flowering at the erect stem with leaf blades present, and capsules that are much

longer than the sepals. Both the description of Cherfils (1937) and the illustration in Ho (1993) could refer to *A. divaricata*.

4. In Peninsular Malaysia normally found at low altitudes, only once (in Perak) at 960 m asl.; in Thailand found only once, and probably in mountainous area. In Borneo, on the other hand, only found at around 1000 up to 1500 m alt.

Specimens examined: THAILAND. **Peninsular Thailand**: Yala, waterfall, Oct 1970, *Ch. Charoenphol et al.* 4129 (KLU, L. P. SING).

PENINSULAR MALAYSIA. **Kedah**: Langkawi, Jan 1991, *Khairuddin Hj. Itam* 9 (KEP). **Kelantan**: Gua Batu Goh, 0.5 mile S of Gua Musang, *T.C. Whitmore FRI 4043* (KEP, L); Gua Panjang, Ulu Kelantan, Aug 1962, *UNESCO 534* (SING); Gua Ninik, Gua Musang, May 1990, *R. Kiew & S. Anthomysamy 2963* (SING); Gua Musang, Gua Batu Boh, Mar 2008, *Chew M.Y. et al. FRI 60153* (KEP). **Terengganu**: Ulu Brang, Jul 1937, *L. Moysey & Kiah SF 33855* (SING); Hulu Terengganu, Petuang FR, Jul 2006, *S.N. Phoon & R. Kiew FRI 51981* (KEP). **Perak**: Waterloo Coffee Estate, 18xx, *C. Curtis s.n.* (SING); Waterloo Perak, May 1890, *C. Curtis s.n.* (SING); Cenderiang, 1961, *M.P.M. Castle-Smith 30* (K); Tapah Hills, Along Sg. Who, Jul 1966, *F.S.P. Ng FRI 1350* (KEP, SING); Belum, nr Sungei Remai, Apr 1994, *I.M. Turner 94-49* (SINU). **Pahang**: Tahan River, 1891, *H.N. Ridley s.n.* (K, SING); Tembeling, Jul 1929, *M.R. Henderson SF 21796* (SING); at Gap of Fraser's Hill Rd., Jul 1960, *M.E.D. Poore 230* (K, KLU); Gua Musang, Ulu Kelantan, Aug 1962, *UNESCO 428* (SING); Ulu Sg. Sat near Kuala Kelepah, Jul 1970, *Md.Shah & Md.Noor 1883* (KEP); Taman Negara, nr Kuala Tahan, Gua Rimau limes outcrop, Aug 1971, *Chin S.C. 12754* (KLU); Taman Negara, path from Kuala Tahan to Batu Linga, Aug 1972, *B.C. Stone 10860* (KLU); base of Bt.Terseh, Taman Negara, Aug 1973, *B.C. Stone 11582* (KLU); Batu Luas, Taman Negara, Oct 1984, *R. Kiew 1352* (KEP, SING); Kampong Woh, *A. Vogel 960236* (L); Jerantut, Taman Negara, Camp Melantai, May 2008, *Chew M.Y. et al. FRI 60260* (L). **Selangor**: Gua Batu, Apr 1889, *H.N. Ridley 4599* (K, SING); Ulu Gombak, Oct 1937, *Md.Nur SF 34206* (L, SING); Gombak, Oct 1979, *S. Anthony SA 262* (KEP); Gombak Valley, stream to waterfall, Oct 1981, *R. Kiew 1096* (SING); Kuala Lumpur, Rimba Ilmu Garden (KLU), May 2005, *H. Duistermaat 341* (L, SING); N. of Kuala Lumpur, Jln Gombak km 36 (KL), Jun 2005, *H. Duistermaat 349* (L, SING). **Negeri Sembilan**: Pasoh FR, Oct 1987, *J.V. LaFrankie 2528* (KEP).

BORNEO. **Sabah**: West Coast: Kota Belud, Mount Kinabalu, Dallas El., 1931 32, *J. & M.S. Clemens 26141* (BM, K, L); Kota Belud, Mount Kinabalu, Penibukan, Kinitaki R, Jun 1933, *Clemens 50405* (BM); Interior: Tambunan, Tontolob Liwan, Oct 1989, *Somin et al. SAN 124990* (KEP); Tambunan, Crocker Range NP, Oct 1999, *A.D. Poulsen et al. 1514* (KEP); Tambunan, Trusmadi, Loloposon (Gua), Jul 2005, *J.J. Vermeulen in H. Duistermaat 397* (L, SING).

17. *Amischotolype parvifructa* Duist. sp. nov. (Fig. 5 & 13D)

Amischotolype divaricatae similis in foliis supra pilis submarginalibus brevibus capsulis calyce superantibus, sed vaginis pilis 0.1–0.2 longis, capsulis 7–9 mm longis albis ad roseis pilis 0.5–1 mm longis satis mollis differt. TYPUS: Chew W.L. 837, October 1963, Peninsular Malaysia, Pahang, Cameron Highlands, Bukit Ruil, 1800 m a.s.l. (holo SING; iso L).

Stem ascending from a rhizome up to c. 60 cm long; erect part 90–150 cm long and scrambling or not, simple, at base with few stilt roots; internodes moderately 0.1–

0.3 mm long hairy. **Sheath** 8–10 mm diam., moderately to densely 0.1–0.2 mm long hairy, mouth ciliate. **Leaf blade** 18–31.5 × 5.5–8.0 cm, 3–4.4 times as long as wide, smooth, base rather abruptly narrowed into 3–4 cm long and 1–2 mm wide winged pseudopetiole; both surfaces glabrous or moderately 0.1 mm long hairy; submarginal hairs on upper surface, 0.2–0.4 mm long, (rather) sparse, white. **Inflorescence** on erect stem, sessile, 2–2.7 cm diam., dense with branches obscure, 10–15-flowered. **Pedicel** 0–0.5 mm long. **Sepals** 7.3–8.5 × 3–3.5 mm, not elongating in fruit, green or whitish turning purplish, sparsely to rather densely 0.3–0.6 mm long hairy especially in upper half, tip hooded. **Petals** c. 7 × 2 mm, slightly shorter than sepals, pale green on outer surface, white on inner surface, glabrous, margin entire. **Stamens** with filaments hairy, anthers white, otherwise unknown. **Capsule** 7–9 × 4.5–6 mm, obovoid, longer than sepals by 3–5 mm, white to pink, moderately to rather densely 0.5–1 mm long hairy; valves fused for 1/4 of length or finally free; apex distinctly depressed, lobes absent; style remnant 0.5–1.5 × 0.2–0.4 mm, persistent. **Seeds** 2 per locule, aril colour unknown.

Distribution. Peninsular Malaysia (Pahang: Cameron Highlands).

Ecology. Hill or (lower) montane forest. Altitude: 1350–1980 m asl.

Notes. The epithet refers to the rather small fruits compared to *A. divaricata* with which it could be confused because of the sometimes scrambling habit, the short submarginal hairs on the upper surface of the leaf blade and the capsule exceeding the calyx. Differences between them are mentioned in the key (lead 23). Also, the distribution is disjunct: *A. divaricata* has been collected from Myanmar, Cambodia, Lao P.D.R., Thailand and Sumatera whereas the present species is endemic to Cameron Highlands in Peninsular Malaysia.

Specimens examined: PENINSULAR MALAYSIA. **Pahang:** Ulu Telom, Aug 1931, *Jaamat* 27271 (KEP); Cameron Highlands: below Robinsons Falls, Oct 1961, *H.M. Burkill* 2852 (SING); Bukit Ruil, Oct 1963, *Chew W.L.* 837 (L, SING), Aug 1975, *Rao et al. s.n.* (SINU); path no 4 (nr Tanah Rata?), Apr 1980, *S. Anthony* SA 305 (KEP); Tanah Rata, Robinson waterfall, Sep 1985, *A. Latiff et al.* 867 (L), Mar 2010, *R. Kiew et al.* FRI 70474 (KEP).

18. *Amischotolype pedicellata* Duist. sp. nov. (Fig. 6)

Amischotolype hispida arte similis, capsulis calyce superantibus, pilis longioribus setosioribus, capsulae valvis fere ad basin liberis differt. TYPUS: *Hallier* B2600, March 1894, Indonesia, S. Kalimantan, S of Banjarmasin, Liang Gagang (holo L).

Forrestia hispida A.Rich. var. *typica* auct., sensu *Hallier* f., *Beih. Bot. Centralbl.* 34 (1916) 46, p.p. (see note); non *Hallier* f. (= *A. hispida*).

Forrestia hispida auct., sensu *Merrill*, *J. Straits Branch Roy. Asiat. Soc.* (1921) 113, p.p. (see note); non *A. Rich.* (= *A. hispida*).

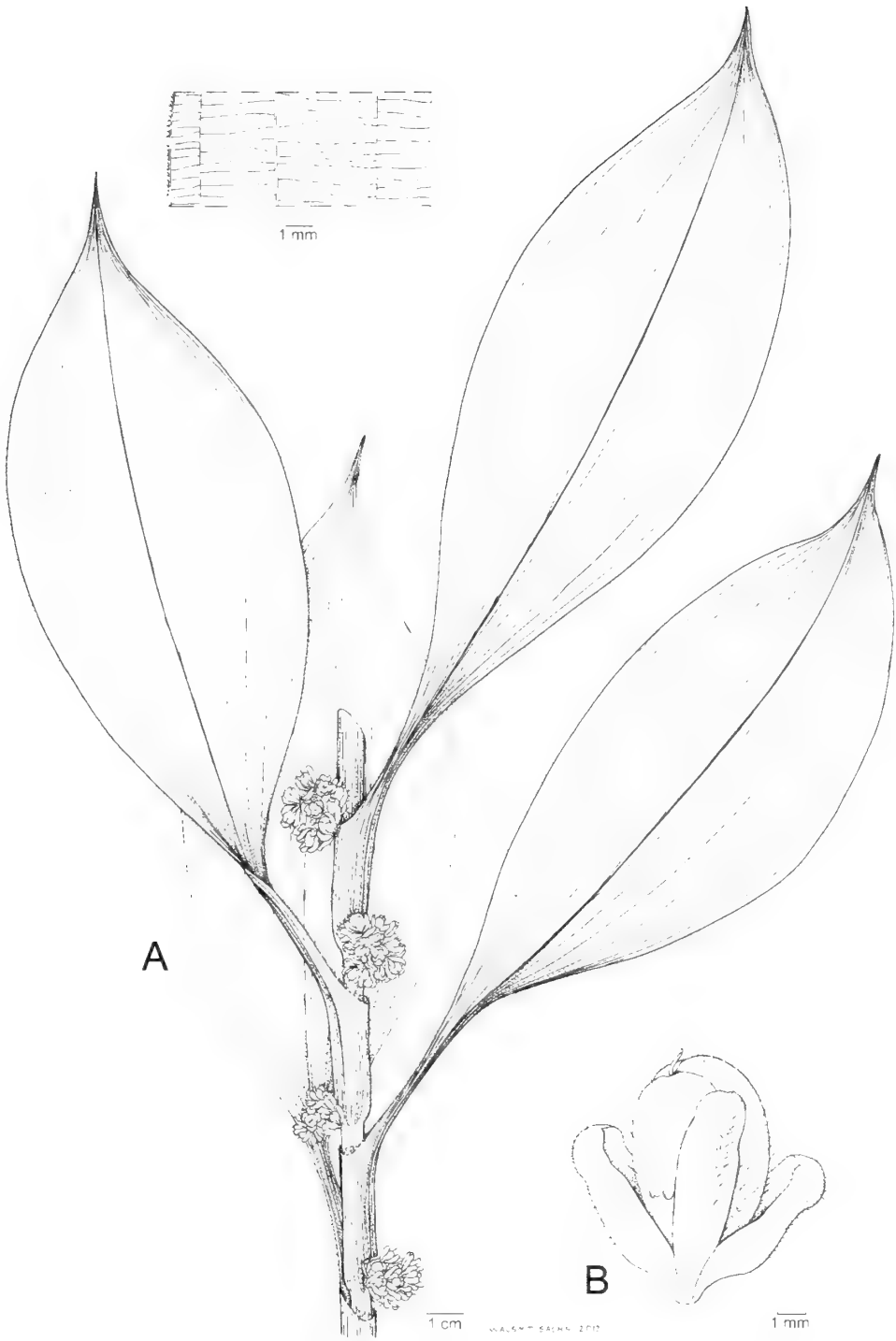


Fig. 5. *Amischotolype parvifructa* Duist. **A.** Habit. **B.** Fruit with persistent sepals. Drawing by A. Walsmit Sachs, from *Chew W.L.* 837 (L).

Stem ascending from short to more than 20 cm long rhizome; erect part 70–200 cm long, simple; internodes glabrous or very sparsely to moderately 0.2–0.3 mm long hairy. **Sheath** 9–15 mm diam., with several lines of 3–4 mm long, yellow or brown hairs, mouth ciliate. **Leaf blade** 29–47 × 5–9.1 cm, 4.3–6.2 times as long as wide, base gradually to rather abruptly narrowed into indistinct to 5 cm long and 2–3 mm wide winged pseudopetiole; both surfaces glabrous or sparsely 0.2 mm long hairy; submarginal hairs on upper surface, 1.5–2.5 mm long, dense, yellow. **Inflorescence** on erect stem, sessile, 2–4 cm diam., dense with branches obscure to 3 mm long, 20–30-flowered. **Pedicel** 2–5 mm long. **Sepals** 8.5–9.5 × 2.5–4 mm, not elongating in fruit, pink to purple or magenta, glabrous or (very) sparsely 0.2–1.5 mm long ciliate keel, tip hooded. **Petals** c. 8 × 2 mm, white or yellow (in bud), glabrous, margin entire. **Stamens** filament c. 7 mm long, colour unknown, upper 1 mm with 0.5–1.5 mm long hairs; anthers 0.9–1 × 0.4–0.5 mm, colour unknown, thecae opening by a longitudinal slit. **Capsule** 7–8.5(–10) × 4–6 mm, ovoid, equalling or exceeding sepals by up to 1.5 mm, bright lilac to purple, at least at apex rather sparsely to moderately 1–2.5 mm long bristle-hairy, hairs yellow to brown; valves almost free; apex depressed, lobes absent; style remnant 0.7–1 × 0.3–0.5 mm long, persistent. **Seeds** 2 per locule, aril orange.

Distribution. Borneo (Sabah: West Coast, see note; Sarawak: Limbang; Kalimantan: W, C, S).

Ecology. Primary or newly disturbed mixed dipterocarp rain forest, hill forest, streambanks, on (red) clayey soil. Altitude: 120–150(–1500) m asl.

Notes. The name refers to the presence of a pedicel of at least 2 mm long, a character this species shares with six more species. The species most closely resembles *A. hispida*, but is different in the capsule exceeding the calyx and with longer and more bristly hairs, and with valves free almost to the base. It is endemic to Borneo, growing in lowland rain forest and only on Mount Kinabalu up to 1500 m altitude.

Specimens examined: BORNEO. **Sabah:** West Coast: Kota Belud, Mount Kinabalu, Penibukan, Feb 1933, *J. & M.S. Clemens s.n.* (BM) & 31295 (BM). **Sarawak:** Limbang, 1/2 day from Lawas, 1954–55, *W.M.A. Brooke 10227* (L). **Kalimantan W:** Kabupaten Sanggau, Feb 1994, *W. de Jong 743* (L); Serawai, Jan 1995, *A.C. Church et al. 1544* (L). **Kalimantan C:** Bukit Raya & Upper Katinabatan R., Upper Samba River, Nov 1982, *J.P. Moge & W.J.J.O. de Wilde 3681* (L); Tumbang Tubus, Jan 1983, *J.F. Veldkamp 8193* (L); Sintang, Apr 1994, *A.C. Church et al. 929* (L); Sintang HPH km70–72, SW along logging road, Apr 1994, *U.W. Mahyar et al. 929* (SING). **Kalimantan S:** S of Banjarmasin, Liang Gagang, Mar 1894, *H. Hallier B2600* (L).

19. *Amischotolype rostrata* (Hassk.) Duist. **comb. nov.** (Fig. 10F)

Forrestia rostrata Hassk., Flora 47 (1864) 631, Commel. Ind. (1870) 94; Hallier f., Beih. Bot. Centralbl. 34 (1916) 48; Merrill, J. Straits Branch Roy. Asiat. Soc. (1921) 113. —

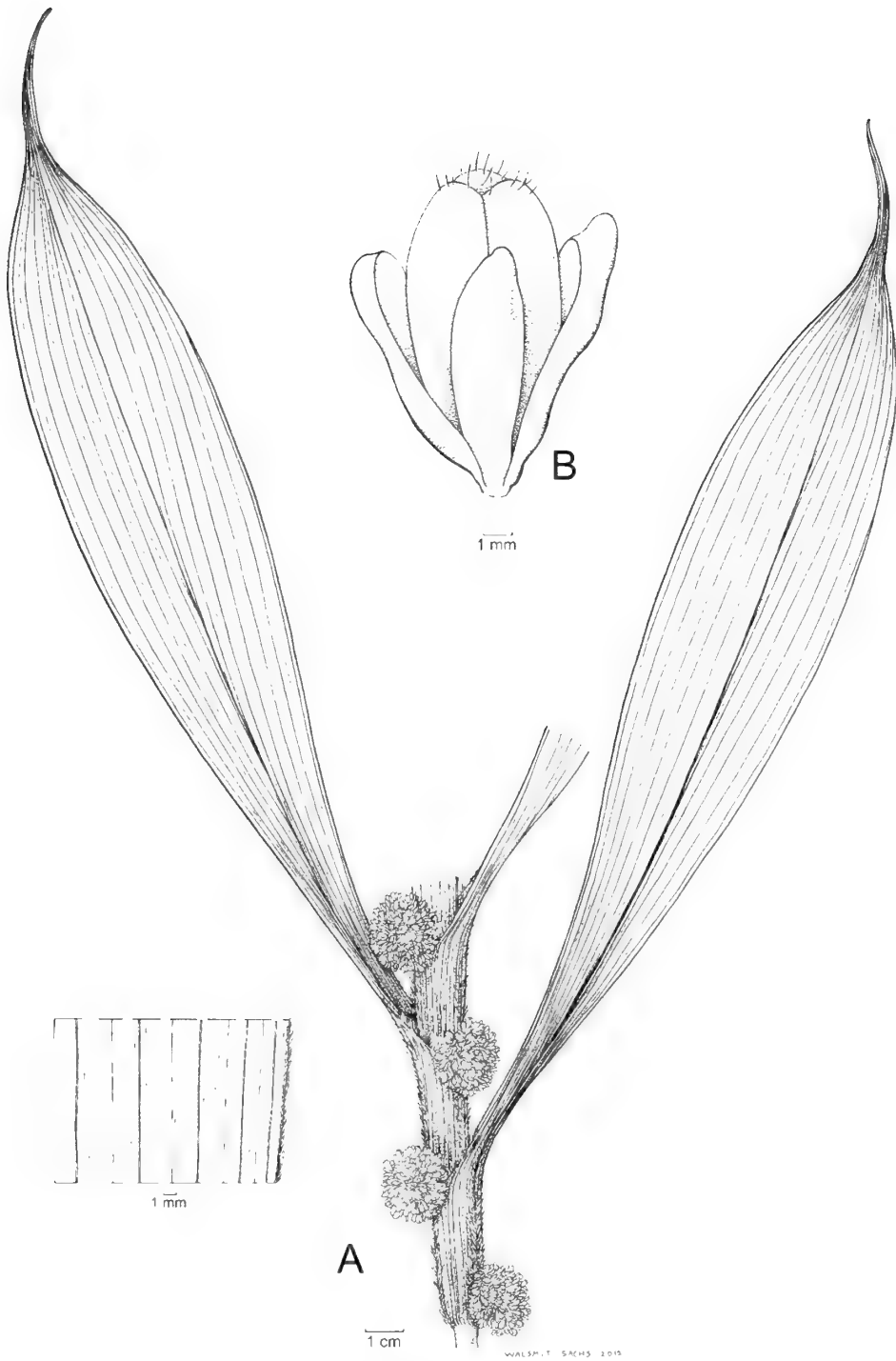


Fig. 6. *Amischotolype pedicellata* Duist. **A.** Habit. **B.** Fruit with persistent sepals. Drawing by A. Walsmit Sachs, A. from *H. Hallier B2600* (L), B. from *J.P. Moge & W.J.J.O. de Wilde 3681* (L).

Campelia glabrata auct. β *acuminatissima* Hassk. in Miquel, Pl. Jungh. (1852/53) 155. — *Campelia* sp., Zollinger, Syst. Verz. (1854) 65. — *Forrestia marginata* (Blume) Hassk. var. β *rostrata* (Hassk.) C.B. Clarke in A. Candolle & C. Candolle, Monogr. Phan. 3 (1881) 237; Hooker f., Fl. Brit. India 6 (1894) 384. LECTOTYPE (designated here): *Junghuhn s.n., s.d.*, Java, Medinie, Ungarang (L, barcode L 0928865). Other syntypes: *Blume s.n., s.d.*, Java, Preanger, near Lembang (L); *Zollinger 503* (B, *n.v.*; P in hb Franqueville, *n.v.*).

Forrestia rostrata Hassk. var. *zollingeri* Hassk., Commel. Ind. (1870) 96. SYNTYPES: *Zollinger 540 p.p.*, Java, Bantam prope Tjikoya in silvula humida (G-DC, B, *n.v.*); *Anon. s.n.* Java (L in hb Hasskarl).

Forrestia porrecta Ridl., J. Malayan Branch Roy. Asiat. Soc. 1 (1923) 102. LECTOTYPE (designated here; see note 3): *Ridley s.n.*, February 1921, Sumatera, Berastagi Hill Woods (K).

Forrestia distans Ridl., J. Bot., Suppl. 63 (1925) 124; Backer & Bakhuizen van den Brink, Fl. Java 3 (1968) 15 (see note 4). TYPE: *Forbes 612*, Java, Mt. Waringin, 5000 ft (holo BM, *n.v.*).

Stem ascending from a rhizome up to 200 cm long; erect part up to 200 cm long, scrambling, simple or branched; internodes glabrous or rarely sparsely 0.2–0.3 mm long hairy. **Sheath** 3–9 mm diam., 0.2–0.5 mm long hairy, rarely glabrous, mouth ciliate. **Leaf blade** 13–23 \times 3–6 cm, 3.5–4.9 times as long as wide, base gradually to rather abruptly narrowed into an indistinct or 0.5–1 cm long and 0.5–2 mm wide winged pseudopetiole; both surfaces glabrous; submarginal hairs on lower surface or rarely absent, 0.2–0.5(–1.5) mm long, rather sparse. **Inflorescence** on erect stem, sessile, 1.3–2.8 cm diam., (rather) dense with branches obscure, 7–10-flowered. **Pedicel** absent. **Sepals** (5–)6–8.5 \times 2–4.5 mm, not elongating in fruit, colour unknown, glabrous or moderately 0.2–0.7(–1) mm long colourless- to yellowish-hairy in upper half, tip slightly hooded. **Petals** 6–7 \times 2–2.5 mm, as long or longer than sepals, white, glabrous, margin at apex minutely fringed. **Stamens** filament 8–10 mm long, white, in upper 1–2 mm with 2 2.5 mm long hairs; anthers 0.9–1.6 \times 0.6–0.9 mm, white, thecae opening by a apical pore. **Capsule** 8.5–11 \times (5.5–)7–8.5 mm, ovoid, longer than sepals by 3–7 mm, colour unknown, entirely to upper 1/3 sparsely to rather densely 0.8–1.5 mm long hairy (longest hairs at apex), hairs colourless to yellowish; valves fused for (1/4 to) 1/2 of length; apex obtuse, lobes absent; style remnant (0.3–)1(–2.5) \times 0.2–0.4 mm, persistent. **Seeds** 2 per locule, aril colour unknown.

Distribution. Sumatera (Berastagi), Java (West: Priangan, Bogor, Tasikmalaya; Central: Semarang; East: Madiun, Pasuruan, Besuki), Maluku (unspecified).

Ecology. Moist secondary forest. Altitude: (200–)700–1600 m asl.

Notes. 1. This species is very similar to the genus *Porandra*, with the thecae opening by an apical pore and the scrambling habit often with branched stems (see Introduction). However, species of *Porandra* differ from *A. rostrata* in having purple anthers, *P. ramosa* has teardrop-shaped anthers, while *P. scandens* has sheaths with a line of at least 1 mm long hairs and submarginal hairs on the upper surface of the leaf blade. Species of *Porandra* are hitherto recorded only from mainland Asia, but I have identified specimens from Sumatera as *P. scandens* (Lesger 206, Lörzing 6273, van Steenis 6201). *Amischotolype rostrata*, on the other hand, is known only from the Indonesian Archipelago, mainly Java, with only two collections from Sumatera and one from Maluku. Hasskarl (1864) mentioned *A. rostrata* for the island of Pinang (Peninsular Malaysia). However, the collection he cited (Wallich 8977a) contains a specimen of *A. marginata* and a specimen that cannot be identified with certainty from microfiche (see *A. hookeri*, note). *Amischotolype rostrata* has also been mentioned for India (Griffith 5486: East Bengal, Mishmee Mountains; Clarke 1881), but this specimen is *P. ramosa*.

2. Although I have not seen the types of *F. rostrata* var. *zollingeri*, Hasskarl (1870) described it as different from the species in having more robust stems which are creeping and then ascending and branched, and larger leaves (but he also describes smaller ones that are present as well). This variation is part of a continuum that does not merit distinction at any level.

3. Ridley (1923) did not cite specimens when he described *F. porrecta*, stating only that it was found in the Berastagi hill woods (Sumatera). His description mentions the typical long creeping stems lying prostrate on the ground or creeping up the trunk of a tree, and the remarkably small heads of flowers. I have seen only one collection of Ridley (K) that fits his description and the locality. I have designated this as the lectotype of *F. porrecta*.

4. Ridley (1925) mentioned that *F. distans* is most nearly allied to *F. porrecta* which is a synonym for *A. rostrata* (see note 3), whereas Backer & Bakhuizen van den Brink (1968) thought it is identical with *F. mollissima* forma *glabrata* (= *A. glabrata*). The description of *F. distans* nicely fits that of *A. rostrata*. Therefore it is accepted as a synonym of the present species. Differences between *A. glabrata* and *A. rostrata* include the number of flowers per inflorescence, the length of the sepals (absolute, and relative to the length of the capsule), and the opening of the thecae.

Specimens examined: SUMATERA. **Sumatera Utara:** Berastagi, (1918), C.D. Ouweland 372 (L); Berastagi Hill Woods, Feb 1921, H.N. Ridley s.n. (K, L).

JAVA. *Anon.* (in Hb. Hasskarl) s.n. A (L); F.W. Junghuhn s.n. (L). **Jawa Barat:** prope Lembang haud procula a Bandung, C.L. Blume s.n. (L); Tjibodas, J.G. Boerlage s.n. (L); Limbang, P.W. Korthals s.n. (L); M.Tjiseroea, Oct 1870, R.H.C.C. Scheffer s.n. (L); m.Gedeh, 1895, H. Hallier 533 / 51 (L); inter Tjibodas et Tjibeureum, 1895, H. Hallier 533 / 71 (L); Preanger, Tjibodas, 1915, Sapiin 2037A (L, U); Preanger, Tjidadap, Tjibeber, Apr 1917, R.C. Bakhuizen van den Brink Sr. 2174 (L); Preanger, Pendjaloe, Jul 1917, S.H. Koorders & A. Koorders-Schumacher 44374B (L); Tjibodas, Pantjuran emas, May 1948, D.R. Pleyte 262 (L); Dago (waterval), Feb 1949, S.M. Popta 723/71 (L); Gede, dal van de Tji Bodas, Mar 1950, S.J. van Ooststroom 13206 (L); **Jawa Tengah:** Medinie, Ungarang, n-helling, F.W. Junghuhn s.n. (L); **Jawa Timur:**

Madioen, Ngebel, May 1896, *S.H. Koorders 23266B* (K, L); Pasuruan, Tangkil, Zuidergeb., Jun 1896, *S.H. Koorders 23384B* (L) & *23887B* (L); Besuki, Pantjoer, Idjen, Aug 1897, *S.H. Koorders 28526B* (L); Tengger, 1912, *J.P. Mousset 431* (L); O.Wilis, 1914, *J.A. Lörzing 914* (L).

MALUKU. 1859–60, *G.H. de Vriese & J.E. Teijsmann s.n.* (L).

20. *Amischotolype sphagnorrhiza* Cowley (Fig. 10G)

Amischotolype sphagnorrhiza Cowley in Coode et al., Checklist Fl. Plants & Gymn. Brunei Dar. (1996) 352 ('*sphagnorrhiza*'), 434; Cowley & Furness, Kew Bull. 52 (1997) 465. TYPE: *Coode et al.* 7062 (holo K, photo; iso BRUN, *n.v.*)

Stem ascending from a rhizome 19–50 cm long; erect part 10–30 cm long, with up to 45 cm long aerial roots with *Sphagnum*-like rootlets, simple; internodes unknown. **Sheath** 8–10 mm diam., glabrous, mouth glabrous. **Leaf blade** 18–25 × 4.5–7.3 cm, 2.6–4.8 times as long as wide, smooth, lower surface pale purple or not, base gradually narrowed into indistinct pseudopetiole; both surfaces glabrous; submarginal hairs absent. **Inflorescence** at knee, peduncle 5–40 mm long, up to 7 cm long, lax with branches up to 4.5 cm long, 10–25-flowered, at base with *Sphagnum*-like roots. **Pedicel** 2–6 mm long. **Sepals** 2–10 × 1–5 mm, elongating in fruit, white to greenish-cream or pink to purple, sparsely to moderately 0.5 mm long redbrown bristly hairy, tip hooded. **Petals** 2–6 × ? mm, as long or shorter than sepals, white, glabrous, margin entire. **Stamens** with filaments 1–7 mm long, white, upper part with 0.5–1 mm long, yellow hairs; anthers 1–1.2 × 0.5 mm, yellow, thecae opening by a longitudinal slit. **Capsule** 9.5–24 × 5–10 mm, ovoid, longer than sepals by c. 8 mm, deep red-purple or purple-brown, 0.5 mm long orange-hairy; valves free; apex slightly depressed, lobes absent; style remnant absent. **Seeds** 2 per locule, aril unknown.

Distribution. Borneo (Brunei: Belait; Sarawak: Sri Aman: Sri Aman).

Ecology. Low or relatively open mixed dipterocarp forest, river valleys, on yellow sandy clay. Altitude: 15–230 m asl.

Notes. A very peculiar species, in habit resembling *Palisota* spp. from Africa. According to Cowley & Furness (1997), based on pollen and flower morphology, it is best placed in *Amischotolype*. Apart from the *Sphagnum*-like rootlets, it is very different from the other species of the genus in the very short erect part of the stem and the very lax and elongated inflorescence (although those of *A. marginata* can be quite lax and elongated as well). Future studies as to the generic placement of this species requires a molecular analysis, and chromosome count. Described as an endemic for Brunei, it appears to be present in Sarawak as well (*Ilias Paie S 42752*).

Specimens examined: BORNEO. **Brunei:** Tutong, Rambai, Ulu Tutong, Bukit Bahak, *M.J.E. Coode et al. 7062* (K); Belait, Labi, Sungai Rampayoh, Jan 1994, *D.W. Kirkup & M.J.E. Coode 808* (KEP, L, SING); Belait, Bukit Sawat, Jalan Merangking-Buau, Sg.Sindum, May 1997, *Suhaili Hj. Zinin et al. BRUN 18020* (SING). **Sarawak:** Sri Aman, 99 mile Kuching Simanggang Road, Sep, 1980, *I. Paie S 42752* (L).

21. *Amischotolype strigosa* Duist. sp. nov. (Fig. 7)

Amischotolype irritanti similis in bracteis sepalis, petalis cum pilis rubris spinosis, sed caule repentiore, internodiis vaginisque pubescentibus, foliis capsulisque minoribus, capsulis pubescentioribus differt. TYPUS: *R. Soedarsono 349*, February 1973, Indonesia, Sumatera, N. Bukit Lawang-Bohorok-Langkat (holo SING: iso L).

Stem ascending from short rhizome: erect part c. 100 cm long, simple: internodes moderately 1.5 mm long yellow-hairy. **Sheath** 7–10 mm diam., with many lines of 4 mm long, yellow hairs, mouth ciliate. **Leaf blade** 17–18 × 2.5–3.6 cm, 5–6.8 times as long as wide, base gradually narrowed into indistinct pseudopetiole: both surfaces moderately 1.5–3 mm long yellow-hairy: submarginal hairs on upper surface, 1.5 mm long, moderately dense, yellow. **Inflorescence** on erect stem, sessile, 1.8–2.2 cm diam., very dense with branches obscure, 20–30-flowered. **Pedicel** 2–5 mm long. **Sepals** 7–8 × 1.5–2 mm in flower, elongating to 9 mm long in fruit, colour unknown, rather densely 2 mm long spiny (dark) red-hairy, tip not hooded. **Petals** c. 8 × 1.5 mm, as long to slightly longer than sepals, white, dorsal surface apically with 2.5 mm long spot of 1–1.5 mm long red spiny hairs, margin entire. **Stamens** with filaments c. 10 mm long, colour unknown, glabrous; anthers c. 1.2 × 0.7 mm, colour unknown, thecae opening by a longitudinal slit. **Capsule** c. 5 × 3.5 mm, obovoid, shorter than sepals by c. 2 mm, colour unknown, upper 1/3 1 mm long, red spiny-hairy: valves free: apex slightly depressed, lobes absent: style remnant 1 × 0.1–0.2 mm, deciduous. **Seeds** 2 per locule, aril colour unknown.

Distribution. Sumatera (Sumatera Utara: between Medan and Gunung Leuser).

Ecology. Marshy places in recently logged-over forest. Altitude: 50–200 m asl.

Notes. The epithet refers to the red spiny hairs on the bracts, sepals and petals, characters it shares with *A. irritans*. However, the internodes and sheaths are hairy, the leaf blades and capsules are smaller, and the capsules are more hairy, characters sufficient to warrant recognition of a new species.

Specimens examined: SUMATERA. **Sumatera Utara:** Bukit Lawang-Bohorok-Langkat, Feb 1973, *R. Soedarsono 349* (L, SING); Sikundur F.R., 75 km NW of Medan, Besitang River, Aug 1979, *W.J.J.O. de Wilde & B.E.E. de Wilde-Duyfjes 19490* (KLU, L).

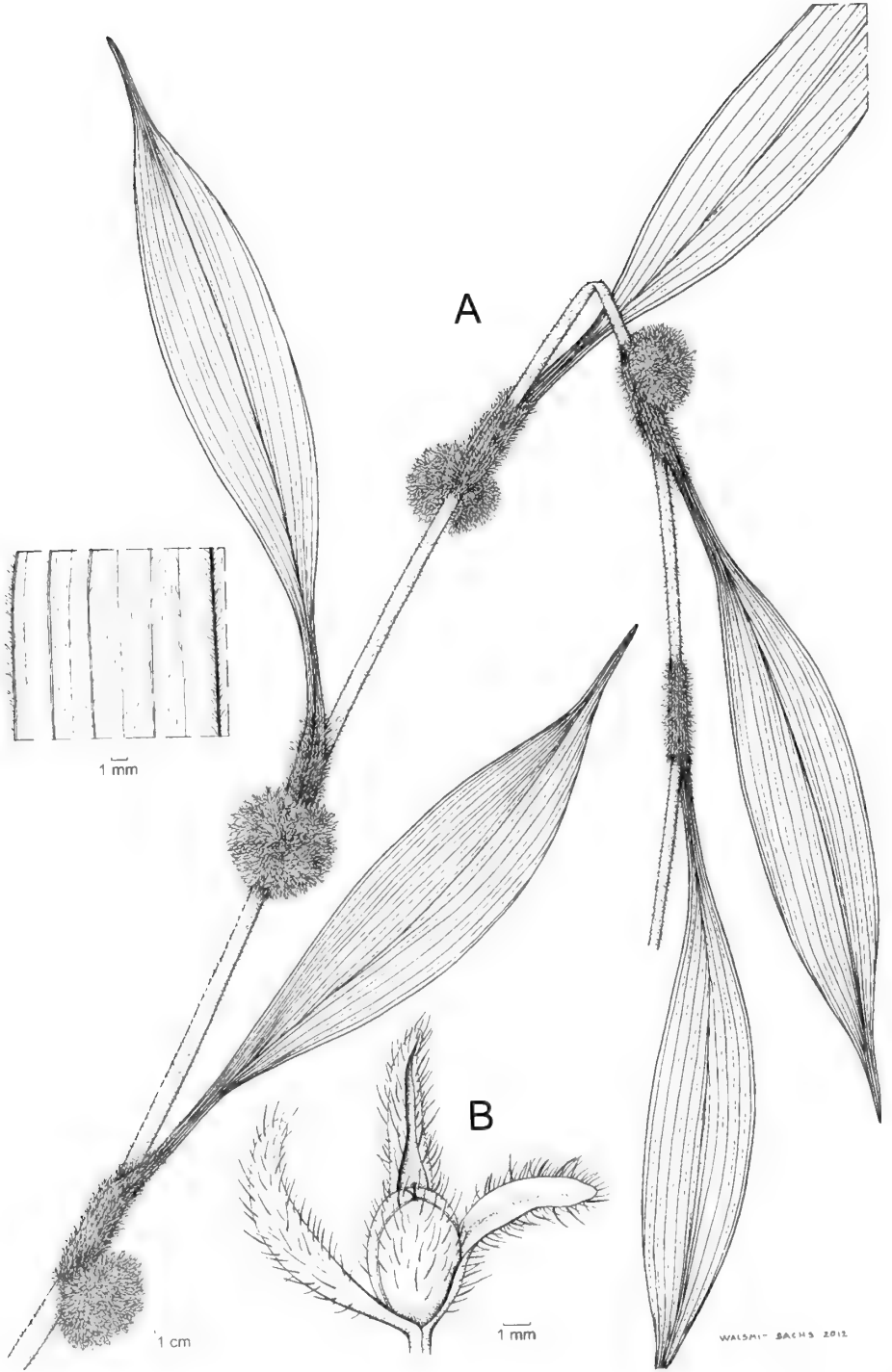


Fig. 7. *Amischotolype strigosa* DuRoi. A. Habit. B. Immature fruit with persistent sepals. Drawing by A. Walsmit Sachs, from R. Soedarsono 349 (L).

22. *Amischotolype welzeniana* Duist. sp. nov. (Fig. 8)

A congeneribus in vaginis laminis sepalis capsulis glabris differt. TYPUS: Maxwell 85-955, Peninsular Thailand, Trang, Khao Chong National Park, 300 m alt., somewhat disturbed thicket along trail in primary evergreen forest (holo L; iso SINU, E).

Stem ascending from creeping rhizome: erect part 50–100 cm long, simple; internodes glabrous. **Sheath** 7–11 mm diam., glabrous, mouth ciliate. **Leaf blade** 26–30 × 6–8.1 cm, 3.5–4.7 times as long as wide, lower surface green or tinged with purple, base very gradually narrowed into indistinct pseudopetiole; both surfaces glabrous; submarginal hairs on upper surface and margin, 1–1.5 mm long, dense, yellow. **Inflorescence** on erect stem, sessile, 1.5–3.4 cm diam., dense with branches obscure, 15–many-flowered. **Pedicel** absent. **Sepals** 7–13 × 2.5–3 mm, probably elongating in fruit, whitish (in flower) turning deep violet (in fruit), glabrous, tip hooded. **Petals** c. 8 × 2 mm, slightly longer than sepals, white, glabrous, margins unknown. **Stamens** with filaments cream-coloured, at apex with few 0.5 mm long hairs; anthers 2–2.2 × 0.4 mm, cream-coloured, thecae opening by a longitudinal slit. **Capsule** (immature) 9 × 4 mm, ovoid, shorter than sepals by c. 3.5 mm, mauve or green tinted with purple, glabrous; valves fused for 4/5 of length; apex depressed, lobes 0.5 mm long; style remnant 1 × 0.2 mm, probably persistent. **Seeds** 2 per locule, aril orange.

Distribution. Myanmar (Tenasserim: Tavoy), Thailand (C: Krung Thep Maha Nakhon (Bangkok); Peninsular Thailand: Trang, Surat Thani).

Ecology. Evergreen forest, on rocks, or in somewhat disturbed thickets along trails. Altitude: 210–300 m asl.

Notes. The species has been named after P.C. van Welzen on the occasion of his inauguration to professor (*Tropical Plantbiogeography*) on 19 Jan 2009. The plant is strikingly glabrous throughout (sheaths, leaf blades, sepals and capsules) which distinguishes it from all other species in the genus. The filaments are almost glabrous. I have not seen fully ripened fruits; the largest are those of the type specimen and they still seem to be immature. It is possible that ripe fruits are larger than described here.

Specimens examined: MYANMAR. **Tenasserim:** Tavoy, Aug 1961, *J. Keenan et al.* 785 (E). THAILAND. **C:** Krung Thep Maha Nakhon (Bangkok), Tung Song, Jul 1929, *Rahil* 96 (L); **Peninsular Thailand:** Surat Thani, Kao Nawng, Aug 1927, *A.F.G. Kerr* 13225 (L); Trang, Khao Chong National Park, Oct 1985, *J.F. Maxwell* 85-955 (E, L, SINU).

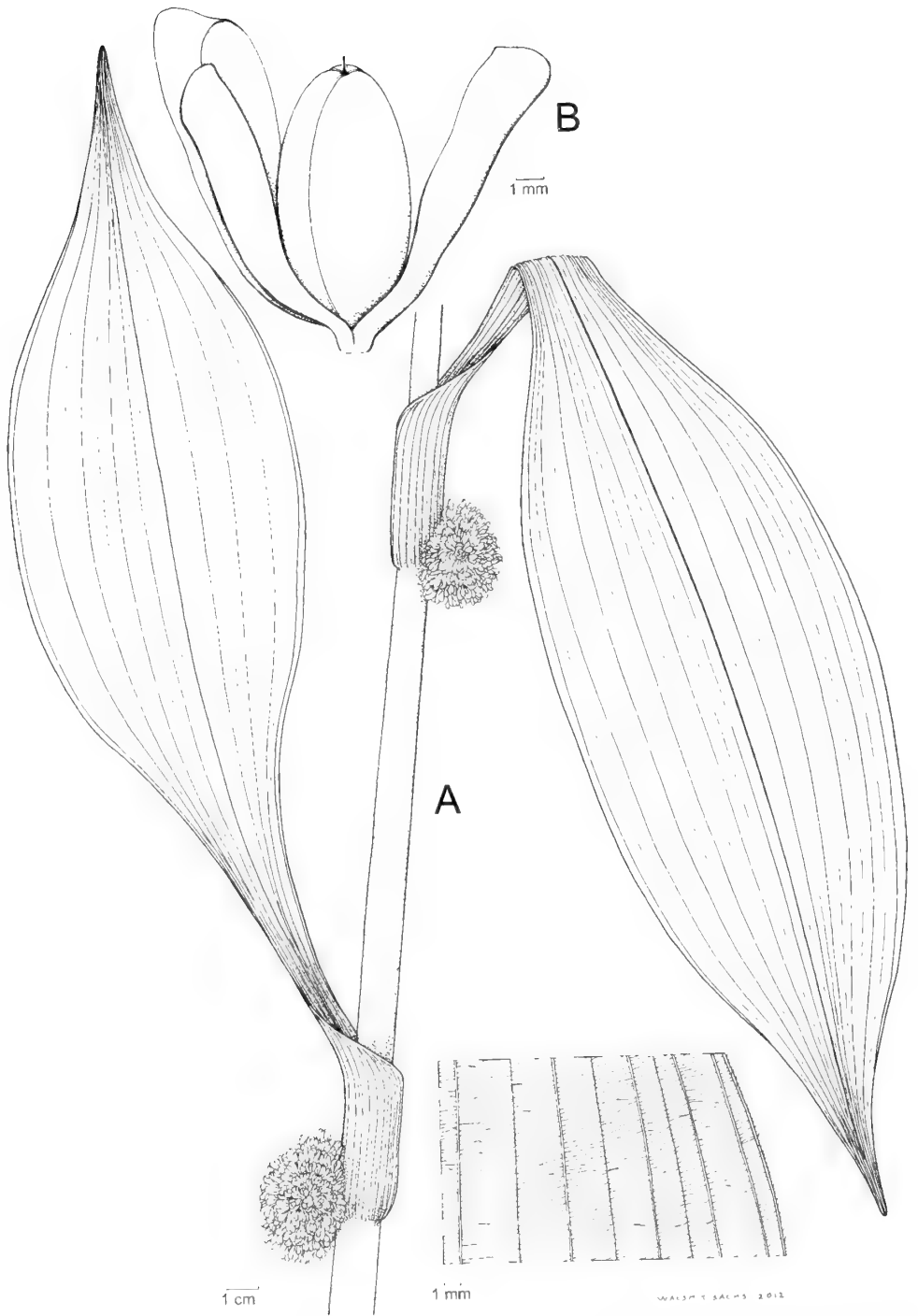


Fig. 8. *Amischotolype welzeniana* Duist. **A.** Habit. **B.** Immature fruit with persistent sepals. Drawing by A. Walsmit Sachs, from *J.F. Maxwell 85-955 (L)*.

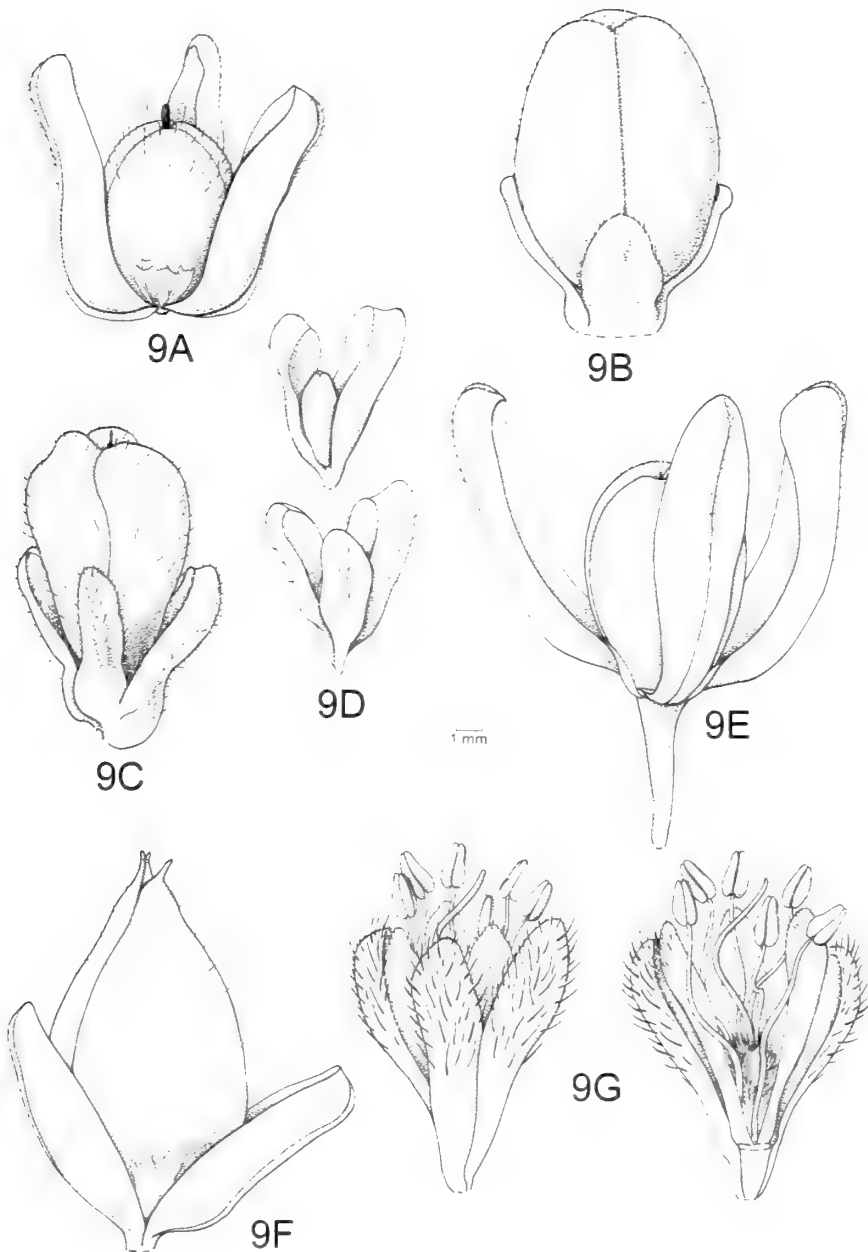


Fig. 9. Flower details. **A.** *Amischotolype glabrata* Hassk. Based on *F.W. Junghuhn s.n.* (L). **B.** *Amischotolype gracilis* (Ridl.) I.M.Turner. Based on *H. Duistermaat 348* (L). **C.** *Amischotolype griffithii* (C.B.Clarke) I.M.Turner. Based on *J.S. Burley et al. 1237* (L). **D.** *Amischotolype hirsuta* (Hallier f.) Duist. Based on *H. Winkler 2617* (L). **E.** *Amischotolype hispida* (A.Rich.) D.Y.Hong. Based on *Lesson ex J.K. Hasskarl s.n.* (L). **F.** *Amischotolype hookeri* (Hassk.) H.Hara. Based on *J.D. Hooker & T. Thompson s.n.* (L). **G.** *Amischotolype irritans* (Ridl.) I.M.Turner. Based on *H. Duistermaat 346* (L). All drawings by Walsmit Sachs.

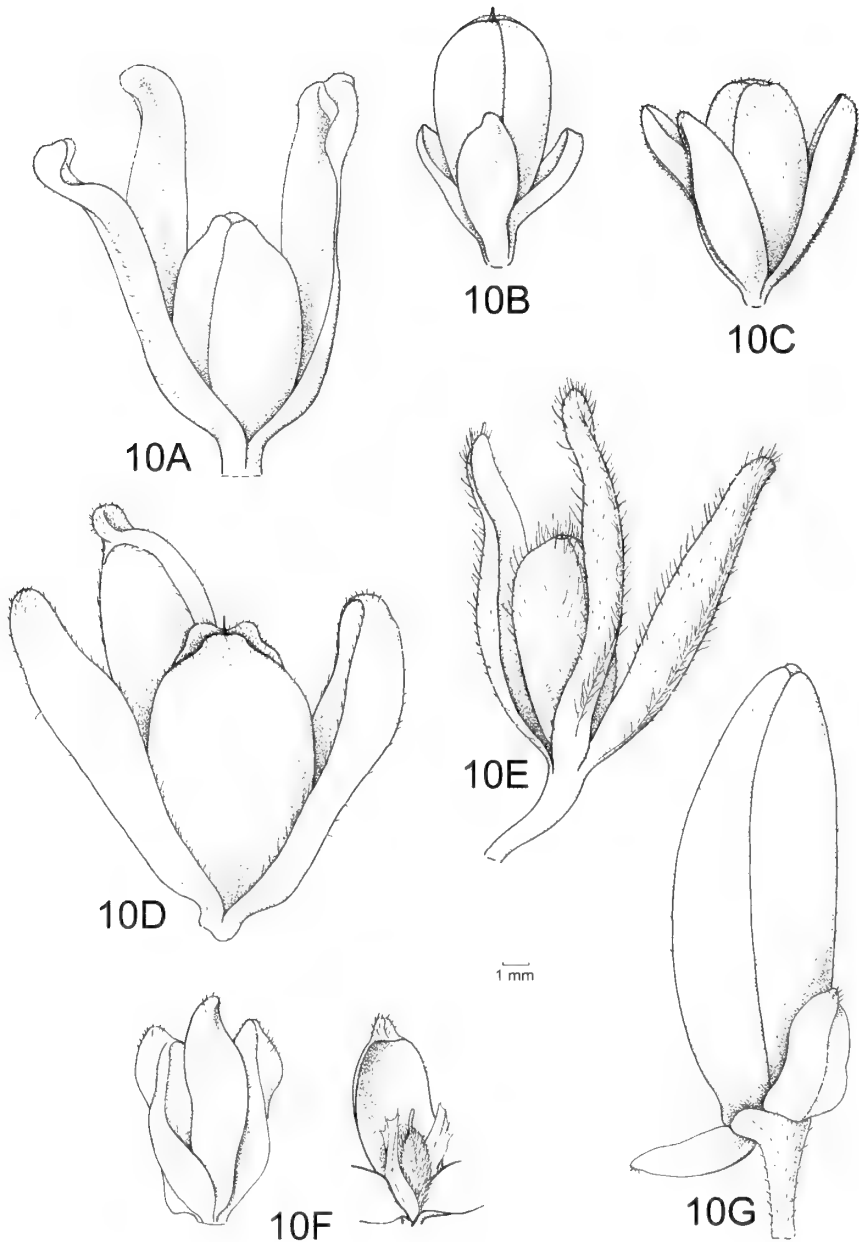


Fig. 10. Flower details. **A.** *Amischotolype laxiflora* (Merr.) Faden. Based on *Hallier f. B 3001* (L). **B.** *Amischotolype leiocarpa* (Hallier f.) Duist. Based on *H. Hallier B3002* (L). **C.** *Amischotolype marginata* (Blume) Hassk. Based on *C.L. Blume s.n.* (L). **D.** *Amischotolype mollissima* (Blume) Hassk. Based on *C.L. Blume s.n.* (L). **E.** *Amischotolype monosperma* (C.B.Clarke) I.M.Turner. Based on *Md.Nur SF 34206* (L). **F.** *Amischotolype rostrata* (Hassk.) Duist. Based on *F.W. Junghuhn s.n.* (L). **G.** *Amischotolype sphagnorrhiza* Cowley. Based on *D.W. Kirkup & M.J.E. Coode 808* (L). All drawings by Walsmit Sachs.

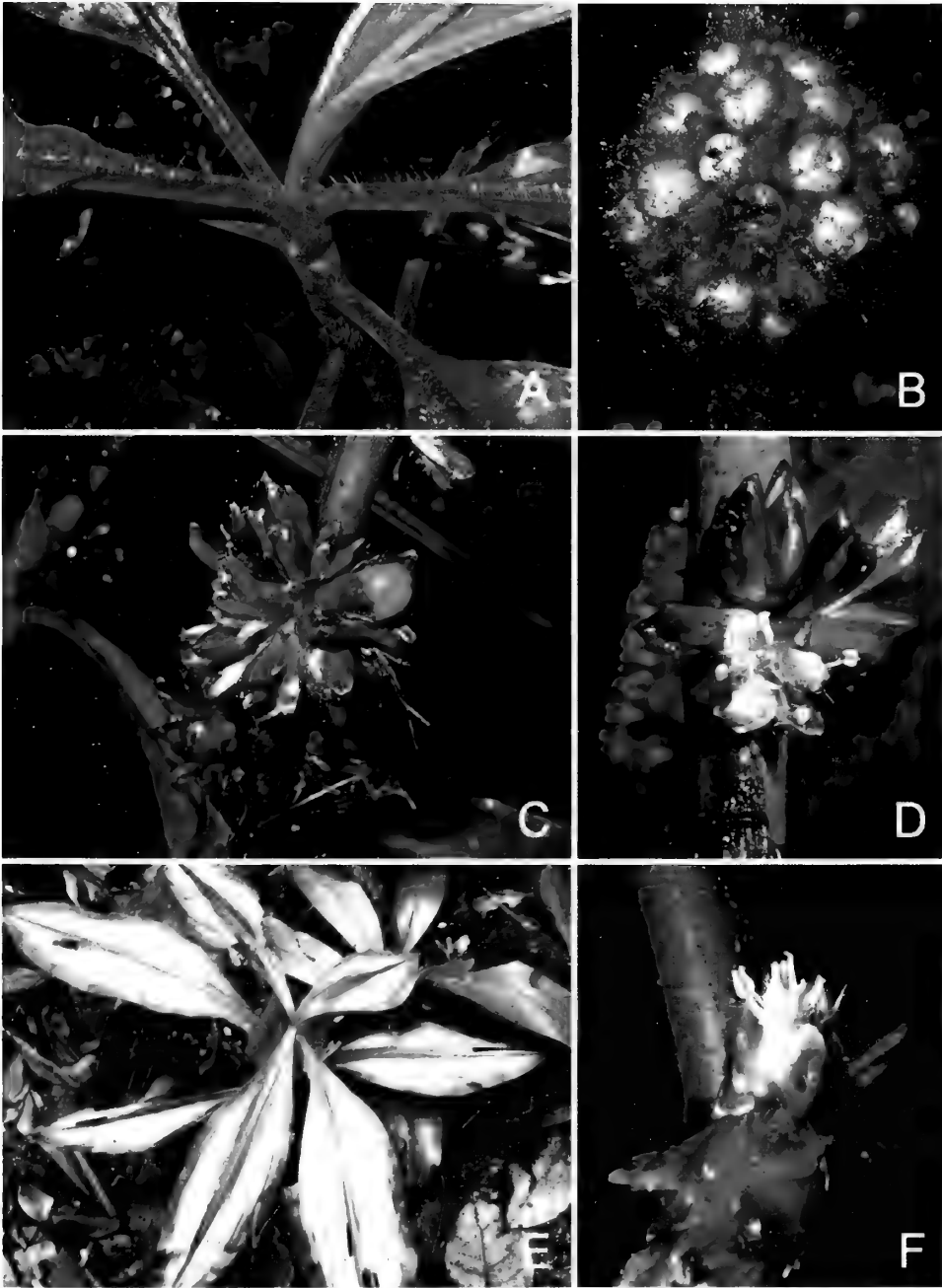


Fig. 11. A–B. *Amischotolype barbarossa* Duist. **A.** Stem with orange-hairy sheaths and leaf blades. **B.** Inflorescence with ripe, red-hairy fruits. From *FRI 57441*. C–D. *Amischotolype glabrata* Hassk. **C.** Inflorescence with opened fruit showing three seeds each with orange aril. **D.** Inflorescence with fully opened flower. From *Duistermaat 392*. E–F. *Amischotolype gracilis* (Ridl.) I.M.Turner. **E.** Plant with silvery-white variegated leaves. From *Duistermaat 353*. **F.** Inflorescence with opened flower. From *Duistermaat 336*. All photographs by J.J. Vermeulen, except E by H. Duistermaat.



Fig. 12. *Amisכותotype gracilis* (Ridl.) I.M.Turner. **A.** Stem with glabrous sheaths and leaf blades with red submarginal hairs on the upper surface. Photograph by J.J. Vermeulen from *Duistermaat 328*. **B.** Erect stem with leaves and at each node an inflorescence perforating the sheath at its base. Photograph by: H. Duistermaat from *Duistermaat 328*. **C.** Inflorescence with ripe purple fruit. Photograph by: H. Duistermaat from *Duistermaat 348*. **D.** Inflorescence with ripe white fruits. Photograph by Chew, M.Y., FRIM from *FRI 55597*.

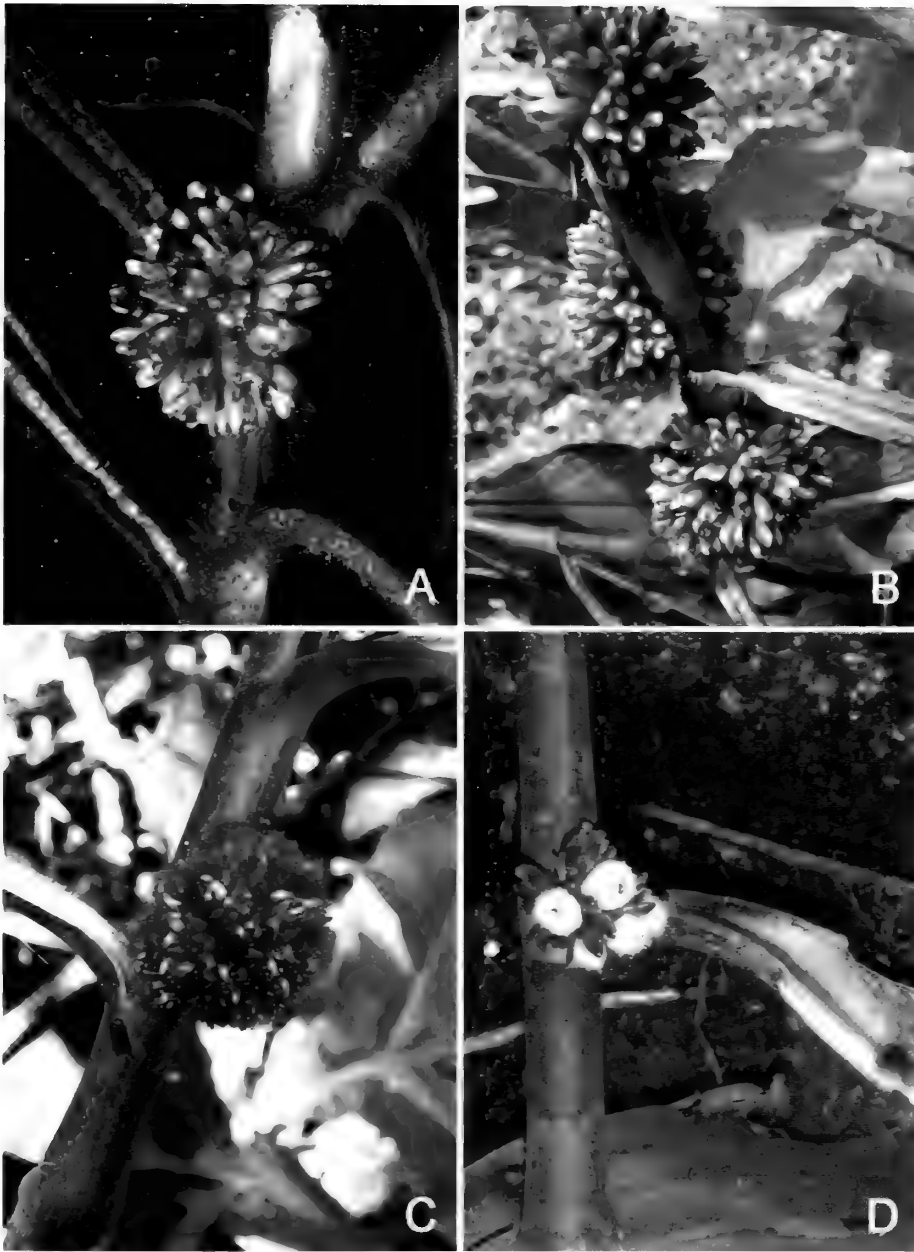


Fig. 13. **A.** *Amischotolype hirsuta* (Hallier f.) Duist. Erect stem with hairy leaves and fruiting inflorescence. Photograph by J.J. Vermeulen from *Duistermaat 398*. **B.** *Amischotolype hispida* (A. Rich.) D.Y.Hong. Erect leafy stem with inflorescences. Photograph by Serena Lee from *S. Lee 426*. **C.** *Amischotolype irritans* (Ridl.) I.M.Turner. Erect stem with glabrous sheaths and red-spiny-hairy inflorescence. Photograph by H. Duistermaat from *Duistermaat 346*. **D.** *Amischotolype parvifructa* Duist. Erect stem with leaves and inflorescence with white fruits. Photograph by H. Duistermaat from *FRI 70474*.

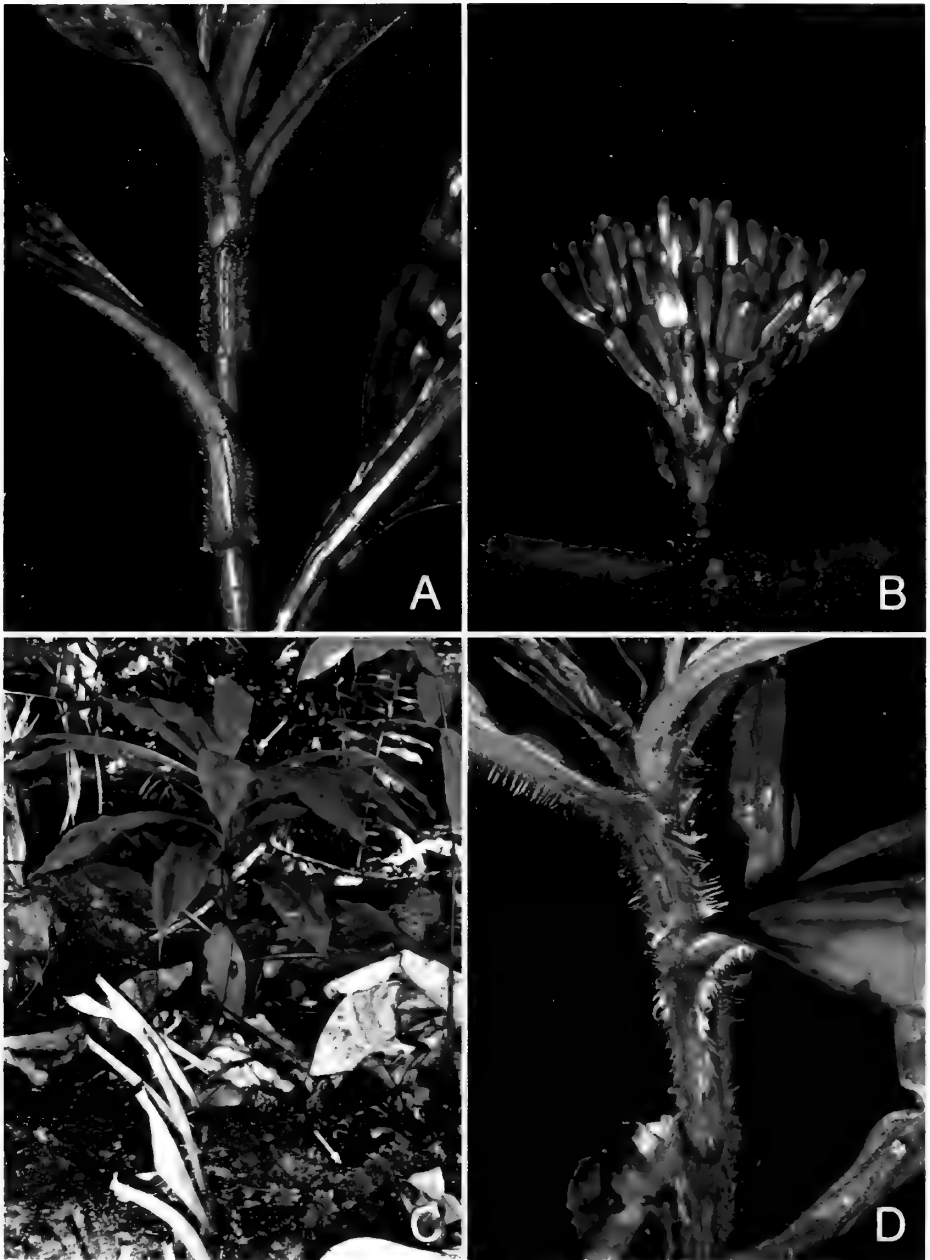


Fig. 14. A–B. *Amischotolype laxiflora* (Merr.) Faden. **A.** Stem with hairy sheaths. **B.** Inflorescence on leafless rhizome. Photographs by J.J. Vermeulen from *Duistermaat 401*. **C–D.** *Amischotolype marginata* (Blume) Hassk. **C.** Erect stem with leaves in the background, the leafless rhizome with purple inflorescences in the foreground, both indicated with a white arrow. Photograph by H. Duistermaat from *Duistermaat 342*. **D.** Stem with hairy sheaths. Photograph by J.J. Vermeulen from *Duistermaat 400*.

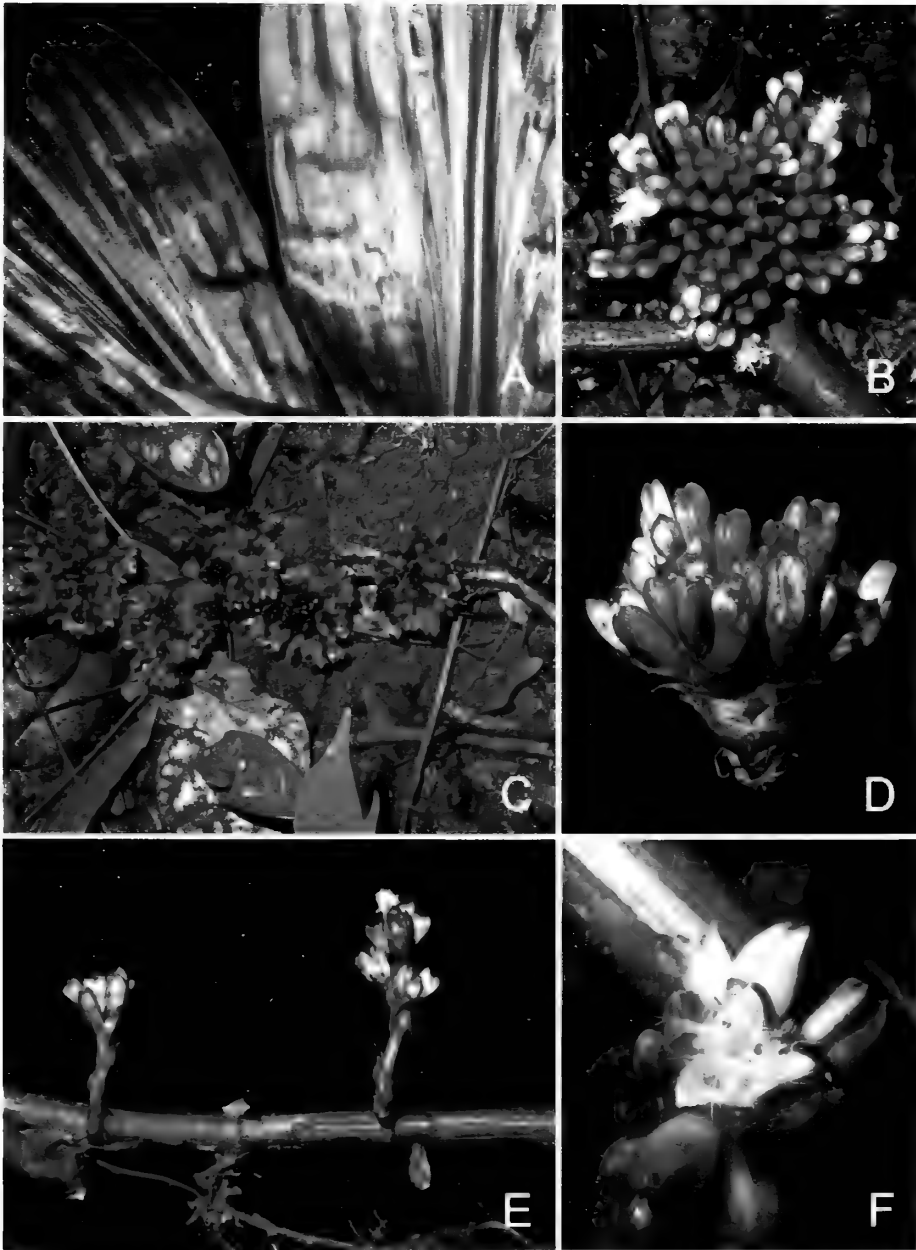


Fig. 15. *Amischotolype marginata* (Blume) Hassk. **A.** Plicate leaf blade with indistinct submarginal hairs. From *Duistermaat* 329. **B.** Inflorescence on rhizome with open flowers. From *Duistermaat* 395. **C.** Ripening purple inflorescences at the nodes of the leafless rhizome. From *FRI* 58591. **D.** Ripening inflorescence. From *Duistermaat* 395. **E.** Few-flowered inflorescences on long peduncles. From *Duistermaat* 400. **F.** Fully opened flower showing purple anthers. From *Duistermaat* 358. All photographs by J.J. Vermeulen, except A by H. Duistermaat.

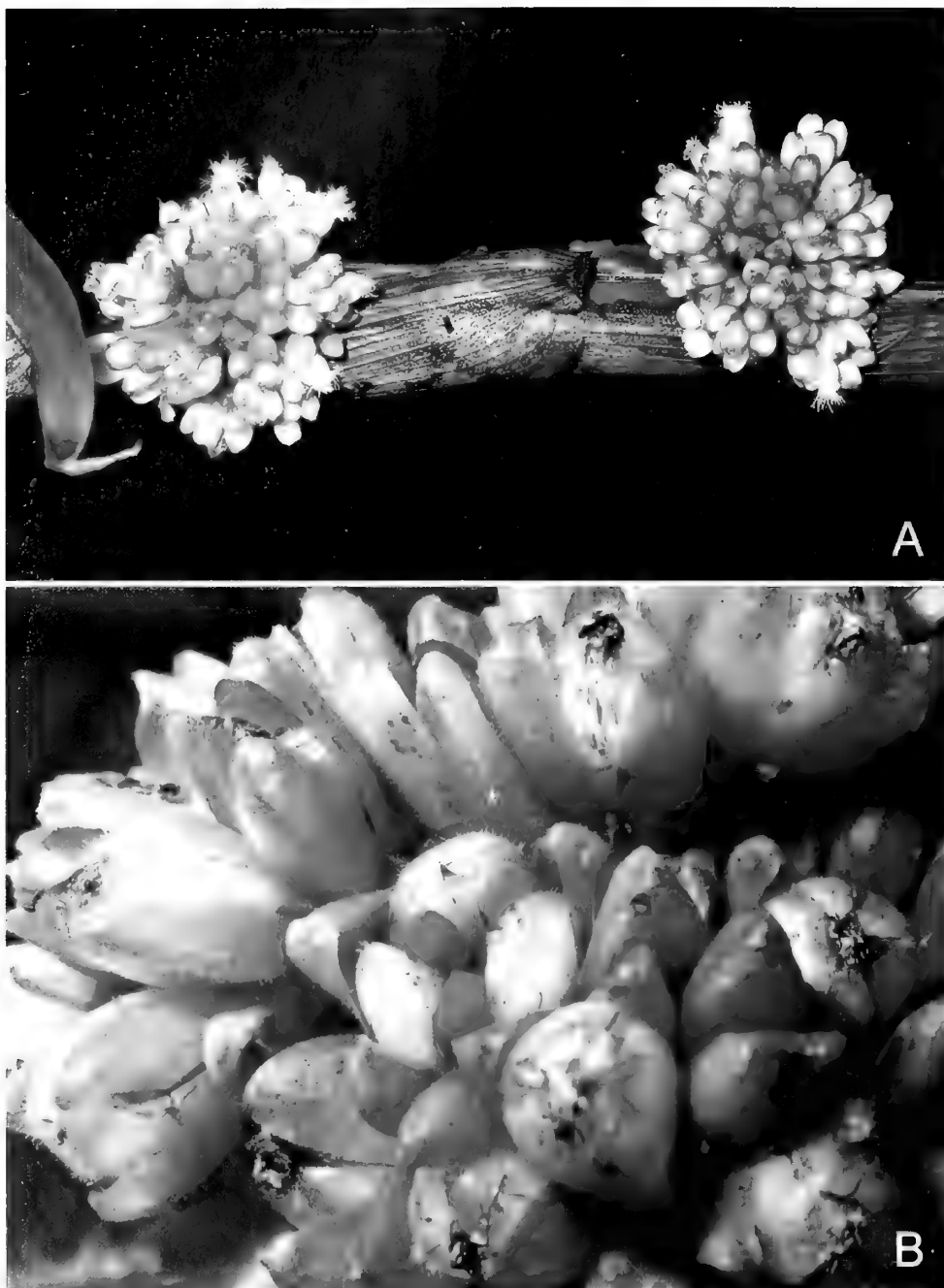


Fig. 16. *Amischotolype marginata* (Blume) Hassk. **A.** Flowering white to pale purple inflorescences on rhizome. Photograph by Paul K.F. Leong from *Duistermaat* 329. **B.** Inflorescence with purple sepals, white fruits and one opened fruit showing three orange arils covering the seeds. Photograph by J.J. Vermeulen from *Duistermaat* 358.



Fig. 17. *Amischotolype monosperma* (C.B.Clarke) I.M.Turner. **A.** 'Rosette' of leaves at the apex of the stem. From *HBL (Vogel) 960236*. **B.** Inflorescence with ripening fruits. From *Duistermaat 397*. **C.** Young inflorescence with first flower opened. From *Duistermaat 397*. All photographs by J.J. Vermeulen.



Fig. 18. *Amischotolype monosperma* (C.B.Clarke) I.M.Turner. Detail of inflorescence showing opened flower with cream-coloured red-hairy sepals. Photograph by André Schuiteman from HBL (Vögel) 960236.

Nomina dubiae

A. mollissima (Blume) Hassk. var. *marginata* (Blume) R.S.Rao, Maharashtra Vidnyan Mandir, Patrika 6, 2 (1971) 53, *nom. inval.*

A. mollissima (Blume) var. *glabrata* (Hassk.) R.S.Rao, *ibid.*

Notes. Rao (1971) made two new combinations for the flora of India: *A. mollissima* (Blume) Hassk. var. *marginata* (Blume) R.S.Rao, and *A. mollissima* (Blume) var. *glabrata* (Hassk.) R.S.Rao. He cited *Campelia mollissima* Blume for both, and *Forrestia mollis* Hassk. only for var. *marginata*. It may therefore be concluded that he considered this var. *marginata* the typical variety. Because an autonym is required, the combination *A. mollissima* var. *marginata* (Blume) R.S.Rao is invalid. Furthermore, both combinations should be considered as *nomina confusa*. For *A. mollissima* var. *marginata*, *C. marginata*, *C. mollissima* and *F. hispida* are cited, but these are not known to occur in India. For *A. mollissima* var. *glabrata*, both *C. glabrata* and *Forrestia hookeri* Hassk. are cited, which are here considered as distinct species both occurring in India. Rao (1971) neither gives descriptions, nor does he cite material for his varieties. However, the combination *Amischotolype mollissima* (Blume) Hassk. var. *glabrata* (Hassk.) R.S.Rao has been made validly.

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Appendix A. Character synopsis for the species of *Amischotolype* and *Porandra*: vegetative characters.

	1. <i>A. barbarossa</i>	2. <i>A. divaricata</i>	3. <i>A. dolichandra</i>	4. <i>A. glabrata</i>	5. <i>A. gracilis</i>	6. <i>A. griffithii</i>	7. <i>A. hirsuta</i>	8. <i>A. hispida</i>	9. <i>A. hookeri</i>	10. <i>A. irritans</i>	11. <i>A. laxiflora</i>	12. <i>A. leiocarpa</i>	13. <i>A. lobata</i>	14. <i>A. marginata</i>	15. <i>A. mollissima</i>	16. <i>A. monosperma</i>	17. <i>A. parviflucta</i>	18. <i>A. pedicellata</i>	19. <i>A. rostrata</i>	20. <i>A. sphagnorrhiza</i>	21. <i>A. strigosa</i>	22. <i>A. welzeniana</i>	P1. <i>Porandra ramosa</i>	P2. <i>Porandra scandens</i>
RHIZOME																								
absent/present	-	+	?	+	+	+	+	+	?	+	+	?	+	+	+	+	?	+	+	+	+	+	?	?
STEM																								
simple	+	-	+	+	+	-	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
branched																								
scrambling							(+)																	
INTERNODE HAIRS																								
absent							(-)			(+)														
0.1–0.5 mm long	(+)						(+)								(-)									
0.6–0.9 mm long	(-)						(-)																	
≥ 1 mm long	+						+																	
SHEATH HAIRINESS																								
glabrous								(-)						(-)					(-)					
scattered and < 1 mm long	+			+	+			(-)	+	(+)		+	-	(-)					+					
in lines and 0.5–1 mm long						(-)								(-)										
in lines and ≥ 1 mm long	+	+		+		(+)			+					(+)										
in ring at node, 0.5–1 mm long						(+)			+															
LEAF BLADE SURFACE																								
smooth	?	?	?	+	+	?	?	?	+	+		?	?		?		+		?	?		?	?	?
bullate	?	?	?			?	?	?			+	?	?		?			?	?	?		?	?	?
LOWER LEAF SURFACE																								
HAIRINESS*																								
glabrous				+	+						+		(-)		(+)		+	+	+	+	+	+	+	+
hairs < 0.5 mm long				(+)	-						(-)	(-)	-	+	(+)	+	+	+	+	+	+	+	+	+
hairs 0.5–1 mm long	+			(-)	+	+	+	(-)	+	+			(-)	(-)			+	+	+	+	+	+	+	+
hairs > 1 mm long		(+)		(+)		+	-			-														
UPPER LEAF SURFACE																								
HAIRINESS*																								
glabrous	+	+	+	+	+				+		+		-	+	-	+	+	+	+	+	+	+	+	+
hairs < 0.5 mm long	(+)	(+)				(+)					+		-	(-)	(+)	(+)	-	+	+	+	+	+	+	+
hairs 0.5–1 mm long				(+)		+		(+)		+				(+)	(+)	(+)	-	+	+	+	+	+	+	+
hairs > 1 mm long						+	-	(+)		+														
LEAF SUBMARGINAL HAIRS - PRESENCE																								
absent											(+)								(-)					
on upper surface	(+)	-	+	(+)	-	+	+	-				(-)		+	+	+	-	+						
along margin	(-)	(+)		(+)					+															
on lower surface	-			+					+			+												
LEAF SUBMARGINAL HAIRS - LENGTH																								
≤ 0.5 mm long				+	+			(-)	(+)		+	-		+	(+)	+	+							
> 0.5 < 1 mm long				(+)	(+)	(+)		(+)	(+)		(-)				(-)	(-)	-			(+)				
1–2 mm long	-		+		+	+	+	+	+	+			+	(+)										
> 2 mm long					+	+	+	+	+	+			+	(+)					(-)					
LEAF SUBMARGINAL HAIRS - COLOUR																								
colourless				+																				
white					(+)	+	-		+								+							
yellow to yellow-brown	-	+	+	+		+		+	-	+	+		-	+	+	+		+				+		
orange to red					+	+	(+)			+	+			+	+	+							+	+

*except near and on midvein.

First record of *Taeniophyllum* (Orchidaceae) in Myanmar

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ABSTRACT. *Taeniophyllum* Blume was recently discovered in northern Myanmar, a new generic record for the country. The Myanmar specimens are referred to the widespread species *T. glandulosum* Blume, characterised by terete roots, warty inflorescence axes, distichous bracts, sepals and petals basally fused into a tube about as long as their ovate-lanceolate free parts, and an ovate-lanceolate lip with a globose spur.

Keywords. Myanmar, *Taeniophyllum*

Introduction

While undertaking fieldwork near Lake Inndawgyi in Kachin State, Myanmar, the authors of this article came across a leafless epiphytic orchid and recognised it as member of the genus *Taeniophyllum* Blume. Subsequent studies revealed that this genus has not yet been recorded in Myanmar (Govaerts et al. 2011, Kress et al. 2003, P. Ormerod pers. comm.). The genus *Taeniophyllum* comprises about 120 species, which are distributed from Sri Lanka and India throughout tropical and subtropical Asia eastwards as far as Japan, Australia and several Pacific islands, with a single species found in tropical Africa. Given the fact that *Taeniophyllum* occurs in all surrounding countries, its newly discovered occurrence in Myanmar is not surprising.

Using recent orchid flora treatments (particularly Jayaweera 1981; Seidenfaden 1988, 1992; Seidenfaden & Wood 1992; Pearce & Cribb 2002; Chen & Wood 2009), the plants could be positively identified as *T. glandulosum* Blume. This species belongs to a taxonomically difficult complex of several closely related species, and several botanists have recently pointed out the need for further studies. The complex is most diverse in the Malay Islands.

Taeniophyllum glandulosum Blume

Bijdr. (1825) 356; Seidenf., Opera Bot. 95 (1988) 23; Comber, Orch. Java (1990) 363; Seidenf. & Wood, Orch. Pen. Malays. Singap. (1992) 575; Chen & Wood in Fl. China 25 (2009) 444. SYNTYPES: Indonesia, Java, Mount Gede and Pangurangu, *Blume* s.n. (repositories not known). Fig. 1 & 2.

Epiphytic herbs, entirely glabrous, leafless in the flowering stage. **Roots** creeping directly on the tree bark or in moss growing on it, whitish-green in the dry state, smooth, terete or semi-terete and hardly flattened, about 2–5(–10) cm long, 0.7–1 mm in diameter. **Inflorescences** solitary, erect or spreading at the base and arching

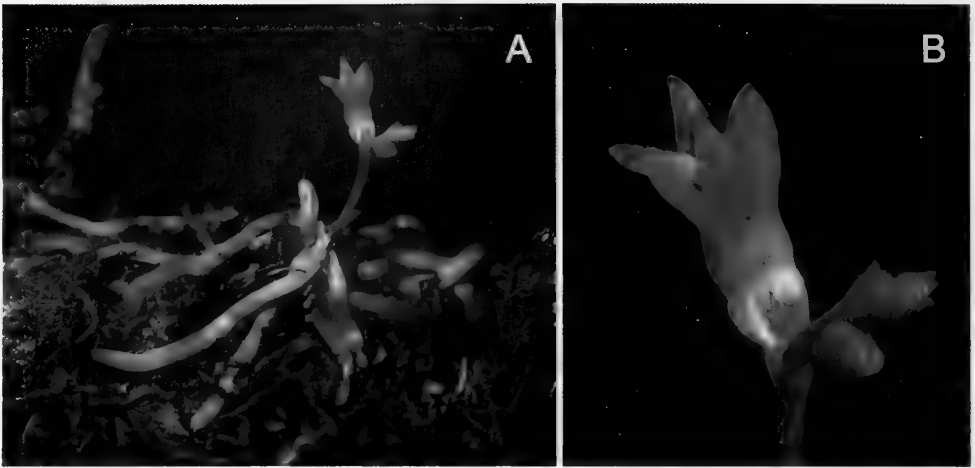


Fig. 1. *Taeniophyllum glandulosum* Blume. **A.** Whole plant. **B.** Flower. *Kurzweil & Lwin 2790*. Photo credits: Dr. E. Frei.

above, 7–10 mm long; peduncle and rachis brownish green, 0.2–0.4 mm in diameter, warty; rachis 3–7-flowered with one flower open at a time; floral bracts distichous, ovate-lanceolate, thickly textured, 0.9–1.2 × 0.7–0.9 mm when spread out, warts as on the rachis though somewhat denser. **Flowers** yellowish green. Pedicel and ovary indistinguishable, 1.5–2 mm long. Sepals and petals fused in their lower half forming a tube c. 1.5 mm long, free portions somewhat recurved, dorsally slightly carinate, apices subacute; free parts of median sepal lorate, 1.25 × 0.4 mm, free parts of lateral sepals ovate-lanceolate, c. 1.5 × 0.7 mm; free parts of petals broadly ovate-lanceolate, 1.3 × 0.5 mm; lip ovate-lanceolate, navicular with incurved margin, spurred, base with a septum at the spur entrance, c. 2.2 × 0.75 mm, apex acuminate, with a reflexed elongate appendage c. 0.5 mm long; spur a globose pouch, c. 1 × 0.95 mm, glabrous on the outside, distal part with a minute thickened gland on the inside. Gynostemium c. 0.5 long, with prominent steldia. Capsule not seen.

Illustrations. Seidenf., *Opera Bot.* 95 (1988) 23, Fig. 9a–c; Comber, *Orch. Java* (1990) 363, photo; Seidenf. & Wood, *Orch. Pen. Malays. Singap.* (1992) 575, Fig. 259 l–n; Chen et al. in *Fl. China* 25, *Illustrations* (2010) 589, Fig. 589.1–14 & 591, Fig. 591.2–4.

Specimens examined: MYANMAR. **Kachin State:** Inndawgyi Wildlife Sanctuary about 115 km SW of Myitkyina, western shore of Lake Inndawgyi, N 25° 10.329', E 96° 16.815', 5 May 2010, *Kurzweil & Lwin 2790* (SING spirit).

Habitat, abundance and flowering time. The Myanmar specimens were growing as epiphytes in degraded forest and were locally common on tall trees of *Terminalia bellirica* (Gaertn.) Roxb. (Combretaceae). Plants were growing on twigs about 1 cm thick. Flowering specimens were found in the beginning of May and the presence of several plants in the bud stage suggests that flowering would still continue for many

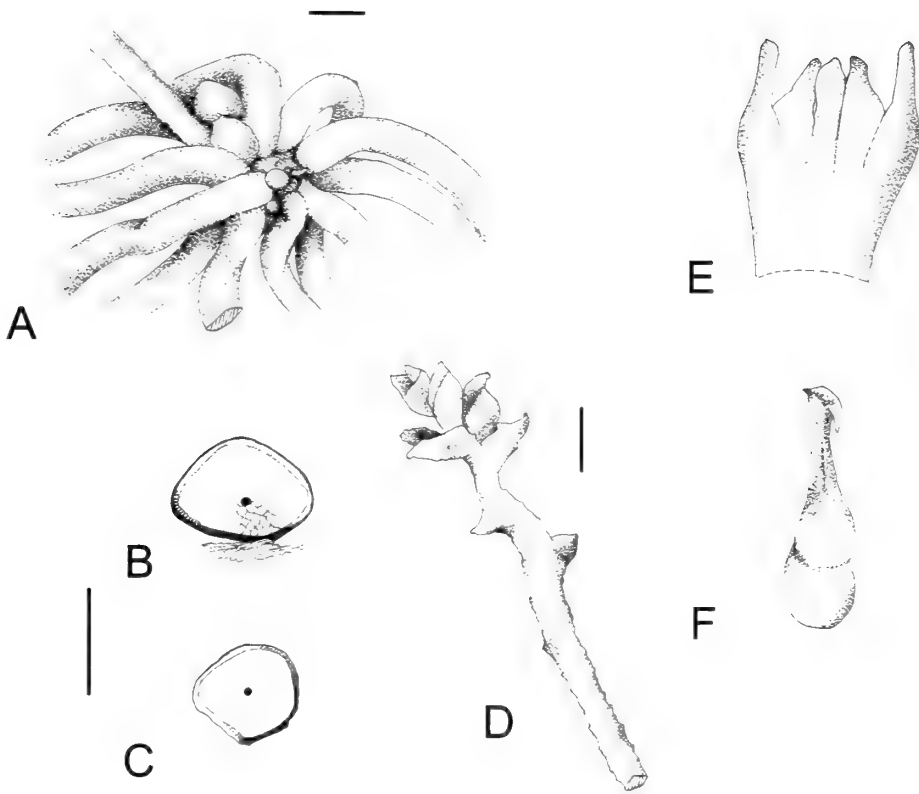


Fig. 2. *Taeniophyllum glandulosum* Blume. **A.** Roots and base of inflorescence. **B. C.** Cross-sections of roots. **D.** Inflorescence apex. **E.** Sepals and petals flattened out, showing the length of the floral tube. **F.** Lip. Scale bars: 1 mm. *Kurzweil & Lwin 2790*. Drawn from spirit material by Evonne Tay.

weeks. This corresponds well with a previous report from China where flowering was reported as occurring between April and August (Chen & Wood 2009). In other parts of the distribution area, *Taeniophyllum glandulosum* is generally reported as occurring in forest, and in Vietnam the species is common in primary mountain forest (Averyanov et al. 2003). Elevations differ significantly in this and previous reports. While the Myanmar plants were collected in a lowland forest about 185 m above sea level, altitudes were given as 400–1100 m in China (Chen & Wood 2009) and 1000–2500 m in Vietnam (Averyanov et al. 2003). In Java, this species is found in high-altitude forest at c. 2280–2700 m, and is sometimes also found growing on rocks (Comber 1990).

Distribution. India (Assam), Myanmar, Thailand, Vietnam, central and SW China (N Fujian, Guangdong, Hainan, Hunan, NE Sichuan, S Yunnan), Taiwan, Japan, Korea, Peninsular Malaysia, Java, Sulawesi, New Guinea.

Notes. Our specimens clearly match the descriptions and illustrations of *Taeniophyllum*

glandulosum Blume that we have consulted (Seidenfaden 1988, Seidenfaden & Wood 1992, Chen & Wood 2009, Chen et al. 2010). Distinctive characters of this species are the smooth, slender, terete roots; the short and few-flowered inflorescences with warty peduncles and rachis; the distichously arranged thick warty bracts; the minute yellowish green flowers; the basal fusion of the sepals and petals which is about as long as their ovate-lanceolate or lorate free parts; and the ovate-lanceolate lip with a reflexed elongate appendage near the tip and the basal globose spur. The eastern Himalayan *T. retrospiculatum* (King & Pantl.) King & Pantl. and *T. arunachalense* A.N.Rao & J.Lal share the general habit and the shape of the sepals and petals but differ in a relatively shorter sepal/petal tube with the free portions 3- or 4-times as long as the fused portion.

We suspect that *Taeniophyllum glandulosum* may be rather widespread in Myanmar. The orchid flora of this country is generally not well explored and a comprehensive inventory is not yet available. While searching for orchids in the wild, the few collectors usually focus on the large-flowered orchids which are horticulturally valuable and consequently *T. glandulosum* may have been overlooked because of its small size.

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Diversity of the tree flora in Semenggoh Arboretum, Sarawak, Borneo

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ABSTRACT. A 4-ha sample plot was established at the Arboretum, Semenggoh Forest Reserve to document tree species in this lowland mixed dipterocarp forest. The area assessed contains 2837 trees with diameter at breast height ≥ 10 cm belonging to 60 families, 160 genera and 541 species. Euphorbiaceae and Malvaceae (10 genera each) were the most diverse families at genus level and Dipterocarpaceae (61 species) is most diverse at species level. More than 25% of trees (720 individuals) were dipterocarps and contributed the highest basal area (cross-sectional area over-bark at breast height measured in m^2) of 16.7 m^2 ha. The most abundant species are *Shorea multiflora* (21 trees ha) and *Pouteria malaccensis* (31 trees ha) for dipterocarp and non-dipterocarp species, respectively. Semenggoh Arboretum has a rich and diverse flora and, being a natural primary forest in the middle of an increasingly developed area, Semenggoh is important as a genetic reservoir for threatened species (particularly the dipterocarps) and as an *in-situ* conservation site for Sarawak's lowland mixed dipterocarp forest.

Keywords. Borneo, Dipterocarpaceae, Sarawak, Semenggoh Arboretum, tree diversity

Introduction

Floristic composition studies or floristic analyses are a useful tool to understand the spatial pattern of plant composition and diversity. When combined with ecological, environmental, geological and historical variables, important information on mechanisms maintaining high levels of tree species diversity in tropical forest can be obtained (Slik et al. 2003). For that reason, a floristic composition study is the prerequisite study, in order to determine the species richness and diversity of a selected area. Conducting long-term studies is the only way to understand the dynamics of forest ecosystem due to slow-growing and long-lived trees and numerous long-term study sites were set up in many forests, including in Asia (Condit et al. 2000, Lee et al. 2004, Primack & Hall 1992).

Borneo, of which Sarawak is a part, is renowned for its rich and diverse flora comprising of about 3500–5000 tree species (Soepadmo 1995, Soepadmo & Chung 1997). Semenggoh Forest Reserve is Sarawak's oldest forest reserve constituted in 1920, comprising an area of 653 ha (Forest Department Sarawak 2000). It includes an arboretum, a wildlife rehabilitation centre and a botanical research centre. The Semenggoh Arboretum was established in 1951 to preserve in perpetuity a small

area of easily accessible natural primary lowland forest located at 1°23'50.0"N to 1°24'5.7"N and 110°18'53.1"E to 110°19'13.0"E, and less than 100 m elevation. It covers an area of approximately 14 ha and is one of the few least disturbed lowland mixed dipterocarp forests located about 20 km from Kuching City (Fig. 1A). In April 2000, the Reserve was gazetted as Semenggoh Nature Reserve, which is now legally protected in Sarawak. The arboretum is floristically rich and has attracted a large number of researchers and naturalists (Forest Department Sarawak 2003).

Generally, Semenggoh is more well-known for its orang-utan rehabilitation centre rather than its flora as very little information on the flora of Semenggoh has been published. Based on herbarium records, many local and overseas botanists have collected specimens from the Semenggoh Arboretum from the 1950s to 1970s. To date, about 700 species (from about 2000 herbarium specimens) from Semenggoh are represented at the Sarawak herbarium. Among these collections, about 40 species were described from this locality (e.g., *Shorea pubistyla* P.S.Ashton, Dipterocarpaceae; *Brownlowia ovalis* Kosterm., Malvaceae / Tiliaceae; and *Macaranga kingii* Hook.f., Euphorbiaceae) and nine species are endemic to Semenggoh (e.g., *Chionanthus rugosus* Kiew, Oleaceae; *Xanthophyllum ceraceifolium* Meijden, Polygalaceae; and *Areca ahmadii* J.Dransf., Arecaceae). A census of trees (girth 45 cm and above) carried out by the Sarawak Forest Department in the 1980s recorded 12,778 trees from Semenggoh (unpublished report).

Being one of the reserves located near Kuching City, Semenggoh continues to face pressure from social and economic development; therefore, it is critical to document the flora of the whole Nature Reserve in order to study its diversity. This paper is on the preliminary work carried out in Semenggoh Arboretum to investigate the tree flora diversity, with the long-term aim of fully documenting the flora of Semenggoh Nature Reserve. The objectives of this work are to study the tree flora composition and species richness and to investigate the current conservation value of Semenggoh Nature Reserve.

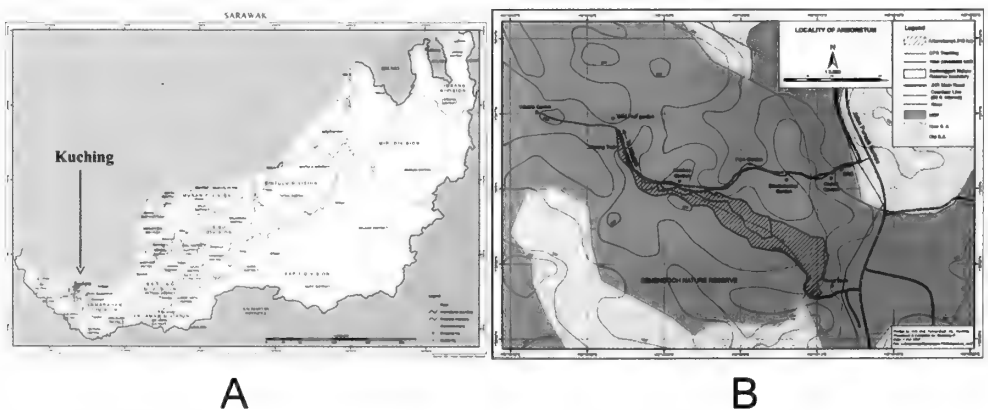


Fig. 1. Location of Kuching city (A) and Semenggoh Nature Reserve (B), showing the 4-ha study area along the eastern side of Masing Trail up to the Arboretum boundary, near the road leading to the Wildlife Rehabilitation Centre. (Courtesy of GIS Unit, Forest Department Sarawak.)

Methodology

Sample plot establishment

Sample plots were established following the method outlined in the “Manual for Establishment and Enumeration of Permanent Sample Plots in Peat Swamp Forest in Sarawak” (Tan 2002) with some modification to meet the objectives of the project at Semenggoh Arboretum. A total of 484 quadrats (each 10 m × 10 m) were established in an area of approximately 4.0 ha (Fig. 1B). All quadrats were numbered consecutively, line by line.

Field assessment

A 100% enumeration was carried out for trees with diameter ≥ 10.0 cm. The diameter of each tree was measured at 1.3 m above the highest ground level for non-buttressed trees, and 30 cm above the highest buttress for buttressed trees. Leaf samples from all trees were collected for botanical identification to species level. The collected leaf samples were identified using the Tree Flora of Sabah and Sarawak volumes I–VI (Soepadmo & Wong 1995; Soepadmo & Saw 2000; Soepadmo et al. 1996, 2002, 2004, 2006, 2007) and other monographs and publications (e.g., Airy Shaw 1975, Chung 2005, Julia 2005, Sugau 2005, Ashton 2006), as well as by comparison to specimens kept in the Sarawak Herbarium.

Data analysis

For data analysis, the number of trees, families, genera and species were transformed into their per ha equivalent. All data analysed were used to determine the floristic composition, species abundance, and diameter and basal area contribution by all tree species. Basal area for each tree was calculated by using the formula: Basal area = $(\text{DBH}/200)^2 \times \pi \text{ m}^2$, where DBH is the diameter at breast height in cm. To determine the stand density and basal area contribution, each tree was then grouped into six different diameter classes (10.0–19.9; 20.0–29.9; 30.0–39.9; 40.0–49.9; 50.0–59.9; ≥ 60.0 cm). Species richness was determined by a relative comparison method, comparing the trees/ha and species/ha of each plot between Semenggoh and four other plots from different sites established in Sarawak. No statistical method was used to calculate species richness, as no duplicates of different plot sites or forest types were taken into consideration in the initial purpose of this study.

Results and discussion

Tree diversity and density

A total of 2837 individuals from 60 families, 160 genera and 541 species were recorded from the sample plot (Appendix A). Euphorbiaceae and Malvaceae were the most diverse families at genus level, with 10 genera each. Relative comparison with four other sites showed that Semenggoh ranked fourth in terms of species richness after Lambir Hills National Park (NP), Batang Ai NP and Bako NP (Table 1). Batang Ai NP

has the highest number of trees recorded, with 813 trees/ha compared with 710 trees/ha in Semenggoh. Twenty eight families (46.7% of total number of families) were represented by a single genus and 13 families (21.7% of the total number of families) were represented by a single species. About 37% of the total species are represented by a single individual. Within the study area, two families (i.e., Icacinaceae and Salicaceae), each represented by a single species, had the lowest number of individuals and also basal area. Both trees are very small in size and may face local extinction from the plot in the future, due to natural disturbances or anthropogenic disturbances, as the mortality of only a few individuals will lead to total loss of representation in the plots. This may result in species turnover in the future. Furthermore, rare species demonstrate higher mortality rates than common species but, at the same time, contribute to high diversity in forests in Borneo (Primack & Hall 1992).

Of the 60 families recorded from the plot, Dipterocarpaceae is the main contributor in terms of total stems (720 individuals), total number of species (61 species), and total stand basal area (16.71 m²/ha) within the study area (Table 2). Myristicaceae is the most diverse family among non-dipterocarps, with 42 species recorded. Sapotaceae is the most dominant family with 66 trees/ha, followed by Myristicaceae (54 trees/ha) and Moraceae (40 trees/ha). In terms of basal area contribution, Sapotaceae, Moraceae, and Malvaceae contributed a total basal area of 3.32 m²/ha, 1.97 m²/ha, and 1.86 m²/ha respectively, while Fabaceae contributed the smallest total number of species, trees and basal area among the ten most abundant families. Dipterocarpaceae is the most dominant family in Semenggoh and other sites in Sarawak (Table 3). The occurrence of Dipterocarpaceae in Semenggoh is relatively high when compared with other similar sites in Sarawak (except the 52-ha plot in Lambir Hills NP) (Table 4).

At the generic level, *Shorea* (Dipterocarpaceae) contributed the highest number of trees with 129 trees/ha, followed by *Artocarpus* (Moraceae) with 38 trees/ha, *Pouteria* (Sapotaceae) with 31 trees/ha, and *Syzygium* (Myrtaceae) with 29 trees/ha (Table 5). *Shorea* also contributed the highest basal area with 44.73 m², followed by *Pouteria* (8.75 m²), *Hopea* (7.51 m²) and *Artocarpus* (7.29 m²). Tree composition in Semenggoh Arboretum is dominated by dipterocarp species with more than 25% of trees belonging to the Dipterocarpaceae. From the total of 2837 trees recorded, dipterocarp species contributed 180 trees/ha, compared with 529 trees/ha by non-dipterocarp species. This is a typical pattern for most evergreen rain forests on the Sunda Shelf region which encompasses the mainland of Peninsular Malaysia, Sumatra, Java and Borneo (Slik et al. 2003).

Among the dipterocarps, *Shorea multiflora* (Burck) Symington (Dipterocarpaceae) is the most abundant species represented by the highest number of individuals with 84 individuals, followed by *Shorea macroptera* Dyer (Dipterocarpaceae) with 74 individuals and *Shorea brunnescens* P.S.Ashton (Dipterocarpaceae) with 62 individuals, while *Pouteria malaccensis* (C.B.Clarke) Bakhni (Sapotaceae) is the most abundant species for non-dipterocarps, followed by other species as shown in Table 6. *Pouteria malaccensis* also contributed the highest basal area (2.19 m²/ha) for the non-dipterocarps. Interestingly, although a low number

Table 1. Species diversity of the 4-ha plot in Semenggoh compared with other sites. FDS: Forest Department Sarawak. N: Number of trees. S: Number of species.

Site	N	S	Area (ha)	N/ha	S/ha
Semenggoh	2837	541	4.0	710	135
Lambir Hills NP (FDS 1986)	1672	428	2.4	697	178
Bako NP (FDS 1996)	1901	390	2.4	792	162
Bukit Mersing (FDS 1996)	1584	266	2.4	660	111
Batang Ai NP (Diway et al., 2009)	1831	385	2.25	813	171

Table 2. Ten most abundant families recorded from the 4-ha study area in Semenggoh Arboretum. S: Number of species. N: Number of trees. BA: Basal Area. % Trees: $N/\text{Total number of trees} \times 100\%$.

Family	S	N	Trees/ha	% Trees	BA (m ² /ha)
Dipterocarpaceae	61 (11%)	720 (25%)	180	25.38	16.71 (39%)
Sapotaceae	27 (5%)	262 (9%)	66	9.24	3.32 (8%)
Myristicaceae	42 (8%)	216 (8%)	54	7.61	1.65 (4%)
Moraceae	11 (2%)	160 (6%)	40	5.64	1.97 (5%)
Malvaceae	29 (5%)	125 (4%)	31	4.41	1.86 (4.32)
Myrtaceae	29 (5%)	114 (4%)	29	4.02	1.43 (3%)
Burseraceae	28 (5%)	106 (4%)	27	3.74	1.28 (3%)
Anacardiaceae	18 (3%)	94 (3%)	24	3.31	1.69 (4%)
Clusiaceae	38 (7%)	84 (3%)	21	2.96	0.93 (2%)
Fabaceae	15 (3%)	73 (3%)	18	2.57	2.55 (6%)

Table 3. Five most dominant families in Semenggoh and other sites of Sarawak. FDS: Forest Department Sarawak.

Semenggoh	Lambir Hills NP (FDS 1986)	Bako NP (FDS 1996)	Bukit Mersing (FDS 1996)	Batang Ai NP (Diway et al. 2009)
Dipterocarpaceae	Dipterocarpaceae	Dipterocarpaceae	Dipterocarpaceae	Dipterocarpaceae
Sapotaceae	Euphorbiaceae	Myristicaceae	Euphorbiaceae	Euphorbiaceae
Myristicaceae	Burseraceae	Anacardiaceae	Verbenaceae	Myrtaceae
Moraceae	Anacardiaceae	Sapotaceae	Annonaceae	Clusiaceae
Malvaceae	Myristicaceae	Clusiaceae	Myristicaceae	Burseraceae

Table 4. The diversity of Dipterocarpaceae in Semenggoh (4-ha study area) and other sites of Sarawak. FDS: Forest Department Sarawak.

Site	Number of Genera	Number of species	Trees/ha
Semenggoh	7	61	180
Lambir Hills NP (FDS 1986)	7	55	180
Lambir Hills NP -52 ha plot (Lee et al. 2004)	8	78	119
Bako NP (FDS 1996)	7	49	215
Bukit Mersing (FDS 1986)	5	22	140
Batang Ai NP (Diway et al. 2009)	6	45	267

of trees was recorded for *Koompassia malaccensis* Maingay ex Benth. (Fabaceae) and *Dyera costulata* (Miq.) Hook. f. (Apocynaceae), both species contributed relatively high basal areas of 1.56 m²/ha and 1.05 m²/ha, respectively. As for dipterocarps, although *Shorea multiflora* contributed the highest number of individuals, *Shorea beccariana* Burck (Dipterocarpaceae) with only 6 trees/ha, contributed 2.07 m²/ha basal area and was 53.62% higher than *Shorea multiflora*, followed by *Hopea dyeri* F. Heim (Dipterocarpaceae) (1.46 m²/ha), *Shorea elliptica* Burck (Dipterocarpaceae) (1.41 m²/ha) and *Dipterocarpus genticulatus* Vesque (Dipterocarpaceae) (1.07 m²/ha).

Even though Semenggoh Arboretum is dominated by dipterocarp species, non-dipterocarp species (i.e., *Pouteria malaccensis*) contributed the highest number of trees and basal area. This circumstance may relate to the seed dispersal limitations of Dipterocarpaceae and Sapotaceae (Whitmore 1984). Dispersal limitation plays an important role in structuring floristic composition over distance of less than five km (Pyke et al. 2001). Dipterocarp seeds are dispersed by wind, but their heavy weight limits the seed dispersal range, resulting in their germinating closer to the mother tree. Sapotaceae seeds are dispersed by animals, and seedlings of Sapotaceae will eventually establish further from the mother trees, thus reducing competition between mother trees and seedlings for resources such as light, nutrients and space (Tan et al. 1998). Another possible reason is probably due to the mast-fruiting of Bornean species, which occurs at five to ten yearly intervals. In dipterocarp mast-fruiting events, a delay in timing of seedfall after the community fall peak is negatively correlated with seed survival and seedling establishment (Curran & Webb 2000).

Stand density and basal area by diameter classes

Six diameter classes were considered, ranging from 10.0 cm to ≥ 60.0 cm. The distribution of trees in the study area followed a normal reverse-J-shaped curve where the lower diameter classes were dominated by small trees and only few bigger trees dominated the higher diameter classes. Out of 2837 individuals recorded, 57.41% of trees were within the 10.0–19.9 cm diameter range (Fig. 2). Non-dipterocarp species

Table 5. Ten most abundant genera recorded from the 4 ha study area. N: Number of trees. BA: Basal area. % Trees: $N/\text{Total number of trees} \times 100\%$.

Genera	Family	N	Trees/ha	% Trees	BA (m ²)	BA (m ² /ha)
<i>Shorea</i>	Dipterocarpaceae	515	129	18.13	44.73	11.18
<i>Artocarpus</i>	Moraceae	150	38	5.28	7.29	1.82
<i>Pouteria</i>	Sapotaceae	122	31	4.30	8.75	2.19
<i>Syzygium</i>	Myrtaceae	114	29	4.01	5.73	1.43
<i>Gymnacranthera</i>	Myristicaceae	91	23	3.20	2.94	0.74
<i>Hopea</i>	Dipterocarpaceae	86	22	3.03	7.51	1.88
<i>Palaquium</i>	Sapotaceae	80	20	2.82	2.96	0.74
<i>Teijsmanniodendron</i>	Lamiaceae	72	18	2.54	1.24	0.31
<i>Madhuca</i>	Sapotaceae	59	15	2.08	1.57	0.39
<i>Xanthophyllum</i>	Polygalaceae	53	13	1.87	1.92	0.48

Table 6. Ten most abundant species according to number of trees recorded from the study area. N: Number of trees. BA: Basal area. % Trees: $N/\text{Total number of trees} \times 100\%$.

Species	Family	N	Trees/ha	% Trees	BA (m ²)	BA (m ² /ha)
<i>Pouteria malaccensis</i>	Sapotaceae	122	31	4.30	8.76	2.19
<i>Shorea multiflora</i>	Dipterocarpaceae	84	21	2.96	3.86	0.96
<i>Shorea macroptera</i>	Dipterocarpaceae	74	19	2.61	2.50	0.63
<i>Teijsmanniodendron havilandii</i>	Lamiaceae	64	16	2.26	0.74	0.18
<i>Shorea brunnescens</i>	Dipterocarpaceae	62	16	2.19	2.04	0.51
<i>Shorea subcylindrica</i>	Dipterocarpaceae	57	14	2.01	2.72	0.68
<i>Hopea dyeri</i>	Dipterocarpaceae	55	14	1.94	5.84	1.46
<i>Artocarpus integer</i>	Moraceae	49	12	1.73	2.87	0.72
<i>Allantospermum borneense</i>	Ixonanthaceae	44	11	1.55	1.94	0.49
<i>Palaquium leiocarpum</i>	Sapotaceae	41	10	1.45	1.23	0.31

dominated the lowest diameter class (10.0–19.9 cm), with 1315 individuals, compared with only 314 individuals from dipterocarp species in the same diameter class. In the largest diameter class (≥ 60.0 cm), dipterocarp species contributed 15 trees more than non-dipterocarp species (Fig. 3A). The same pattern was observed in basal area contribution of dipterocarps and non-dipterocarps, where dipterocarps dominated the highest diameter class and at the same time contributed the highest basal area (28.21 m²) with c. 30% higher than non-dipterocarps (Fig. 3B). The stand density by diameter

classes in the study area corresponds to the condition in natural forests (Faridah-Hanum & Philip 2006). This is considered as a general characteristic of many uneven-aged stands and has been observed in Semenggoh Arboretum, where smaller trees dominate the small diameter classes, and only fewer bigger trees dominated the higher diameter classes, mostly by Dipterocarpaceae. Only a few non-dipterocarp species will reach diameters over 60 cm, for instance *Dyera costulata* (Apocynaceae), *Koompassia malaccensis* Maingay ex Benth. (Fabaceae), and *Crudia wrayi* Prain (Fabaceae).

As for the non-dipterocarps, basal area distribution decreased while diameter increased, as most non-dipterocarps will not reach diameter ≥ 60.0 cm. The sudden increase of basal area in the highest diameter class is due to the non-dipterocarp species such as *Dyera costulata* (Miq.)Hook.f. (Apocynaceae), *Koompassia malaccensis* (Fabaceae), and *Pouteria malaccensis* (Sapotaceae) that have diameters over 1 m, thus contributing relatively high basal areas, although dipterocarp species dominated the highest diameter class. Through observation, most of the emergent trees with diameter over 100 cm are dominated by Dipterocarpaceae, where species such as *Shorea beccariana* (Dipterocarpaceae), *Shorea elliptica* (Dipterocarpaceae), *Shorea pubistyla* P.S.Ashton (Dipterocarpaceae), and *Upuna borneensis* Symington (Dipterocarpaceae) were recorded. However, there are some other species such as *Dyera costulata* (Apocynaceae), *Dialium* spp. (Fabaceae), *Koompassia malaccensis* (Fabaceae) and *Pouteria malaccensis* (Sapotaceae) among the non-dipterocarps that contributed to the high basal area in Semenggoh Arboretum. This is a general characteristic of lowland evergreen tropical rain forest, including lowland mixed dipterocarp forest (Whitmore 1984).

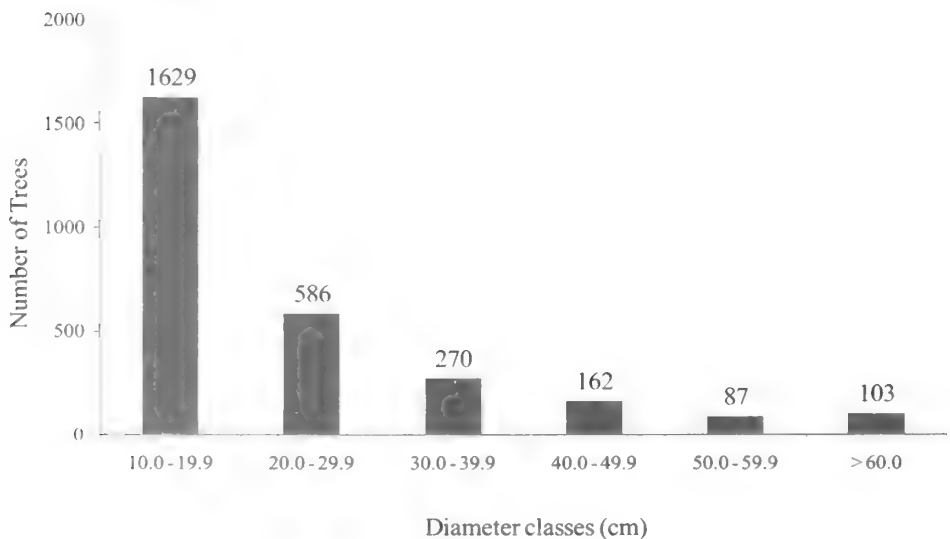


Fig. 2. Stand density by diameter classes of all recorded trees from the 4-ha study area, Semenggoh Arboretum.

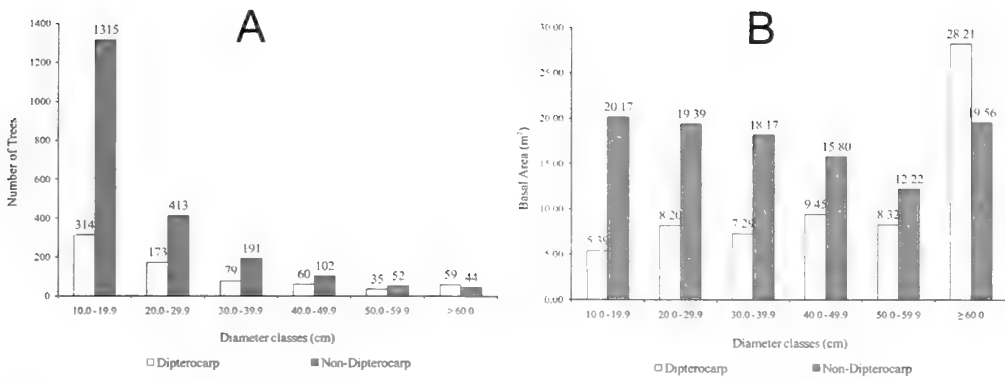


Fig. 3. Stand density (A) and basal area contribution (B) of dipterocarps and non-dipterocarps according to diameter classes (cm).

Furthermore, more than 57% of trees in the study area are in the 10.0–19.9 cm diameter class. In tropical forests, the general contribution of trees within this diameter class is about 50% of the total stand (Whitmore 1984). The high percentage of trees in the study area suggests that natural regeneration of trees species in Semenggoh is active. This may be due to the location of the sample plot which is near the roadside, and is exposed to more or direct overhead light compared to those trees within the Arboretum where relatively little light reaches the understorey seedlings and saplings. Besides, natural disturbances such as lightning and fallen dead trees have also created gaps within the Arboretum and promotes seedling establishment for light-demanding species.

Diversity of dipterocarp species within the study area

In the study area, most of the trees in the bigger diameter classes are dominated by dipterocarps. Within this family, seven genera were recorded, of which *Shorea* is the dominant genus with 515 trees (71.53% from total number of trees in Dipterocarpaceae), followed by *Hopea* with 86 individuals (11.91%). Both *Dipterocarpus* and *Vatica* were represented by almost the same number of trees (i.e., 48 and 47 individuals, respectively). The least abundant genera are *Anisoptera* and *Upuna*, each represented by two individuals (Fig. 4). Among the 9 genera and about 267 species of dipterocarps recorded from Borneo, 7 genera and 61 species were represented in the 4-ha study area, that is, about 70% and 22% of dipterocarps genera and species, respectively. According to Proctor et al. (1983) and Kochummen et al. (1991), the relative contribution of dipterocarps within the Sunda shelf forests is 3–10% of species, 8–18% of stem number and 20–56% for basal area. In the study area, the dipterocarps contributed more than 10% of the total species and more than 18% of the total stem number, but the basal area contribution is within the normal range, which is about 39% (Table 2). Hence, it can be concluded that the occurrence of dipterocarp species in the study area is relatively high and Semenggoh is an important area for research

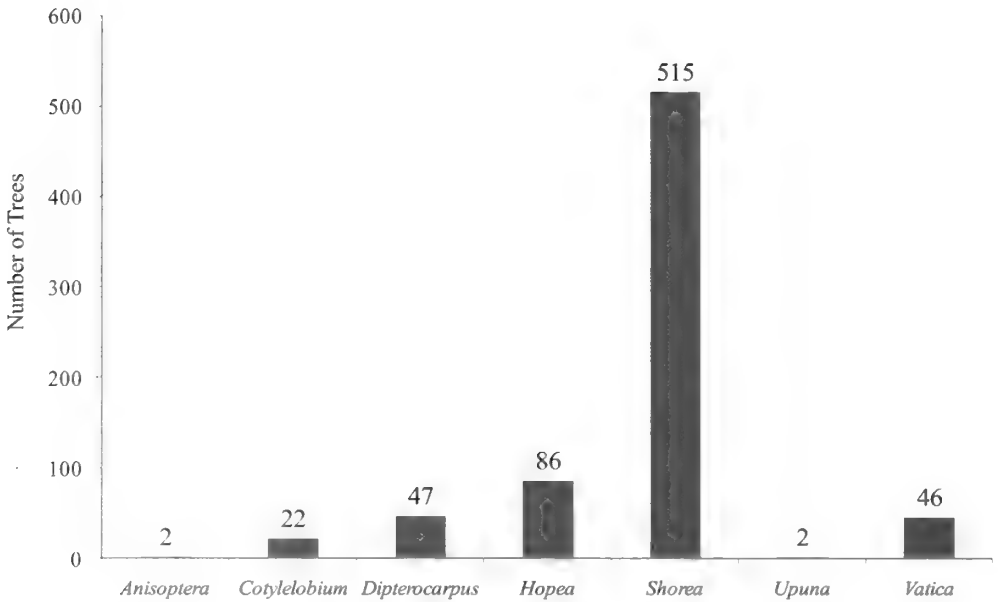


Fig. 4. Relative commonness of Dipterocarpaceae genera in the 4-ha study area.

on this family. Moreover, Dipterocarpaceae is the most important family economically in mixed dipterocarp forest, because the most valuable timbers belong to this family (Whitmore 1984).

The reverse-J-shaped distribution could only be observed in *Shorea* species while other genera had rather random distributions among the six diameter classes. *Shorea* species dominated both in the number of trees and basal area in all six diameter classes (Fig. 5A and 5B). The highest number of trees represented by this genus is in the 10.0–19.9 cm diameter range. However, for basal area distribution, *Shorea* species contributed the highest basal area in the diameter class ≥ 60.0 cm. Overall, the basal area of dipterocarp species increased with diameter class. This may be due to the different growth rates and shade tolerance among the species in other genera in the Dipterocarpaceae (Loewenstein et al. 2000). The distribution of *Shorea* species within the study area indicated that regeneration and recruitment of *Shorea* species into larger diameter classes were satisfactory (Maliondo et al. 2005). The diversity of dipterocarp species in the study area is also important to serve as a seed source for reforestation in the future. The Seedbank at Semenggoh is responsible for collecting seeds from the Seed Production Area established in the Arboretum. The seeds collected are important for supporting plantation, restoration, enrichment planting, urban forestry and greenery projects.

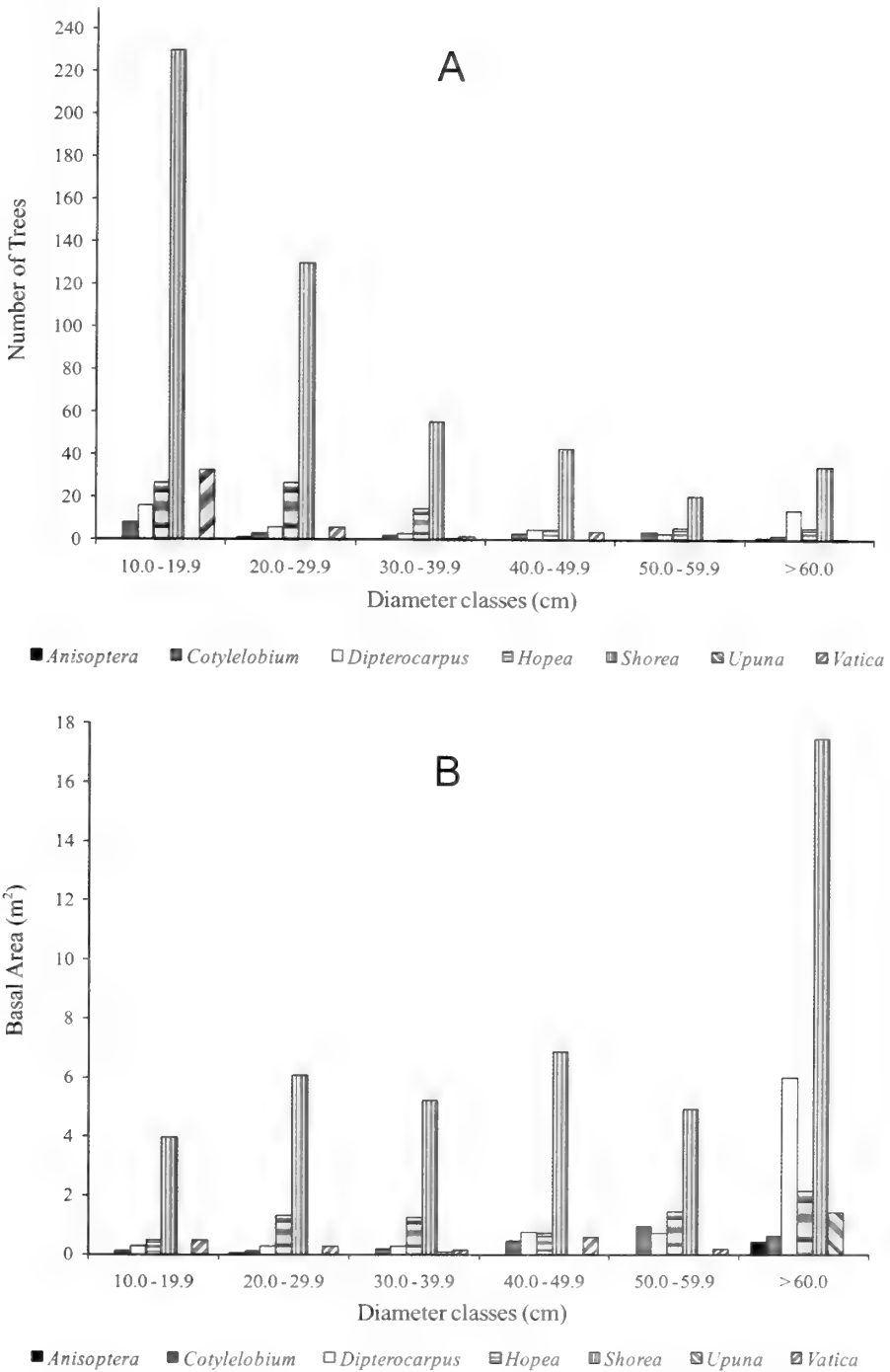


Fig. 5. Stand distribution (A) and basal area contribution (B) of dipterocarp species according to diameter classes in the study area.

Conservation value of Semenggoh

Semenggoh is an important habitat for many threatened, rare and endemic species. The conservation status of all tree species recorded from the study area was determined by using the *IUCN Red List of Threatened Species 2010* (IUCN 2010). Out of 541 species recorded from the study area, about 11% of the species are considered threatened, with 20 species listed as vulnerable (VU), 14 species endangered (EN), 24 species critically endangered (CR) and 1 species extinct. In addition, one species (*Shorea cuspidata* P.S.Ashton), which is considered extinct in the IUCN Red List, was recorded in the plot. Within the 4-ha study area, two individual trees of *Shorea cuspidata* with a basal area of 0.067 m² were documented.

In terms of endemism, 24 species out of the total species recorded are endemic to Sarawak, with 13 species considered rare and three species endemic to Semenggoh. These include species such as *Melanochyla borneensis* (Ridl.) Ding Hou (Anacardiaceae), *Actinodaphne semenggohensis* S. Julia (Lauraceae) and *Xanthophyllum ceraceifolium* Meijden (Polygalaceae) which are restricted to Semenggoh. Approximately 20% of the species recorded are endemic to Borneo, where 19 species are considered rare and only occurs in less than five localities in Sarawak; for instance, the Bornean monotypic species, *Upuna borneensis* (locally known as *penyau*) is the largest tree documented, with only two trees recorded in the study site. Other interesting findings include the presence of 10 species that are uncommon in Sarawak, for example, *Kibatalia maingayi* (Hook.f.) Woodson (Apocynaceae), *Sindora velutina* Baker (Annonaceae), *Pouteria malaccensis*, *Madhuca sericea* (Miq.) H.J.Lam (Sapotaceae), *Crudia wrayi* Prain, and *Madhuca pallida* (Burck) Baehni (Sapotaceae).

Besides the high endemism of tree species in the study plot, the primary lowland mixed dipterocarp forest of Semenggoh is in the vicinity of Kuching city, so this area is easily accessible by land transport and numerous herbarium collections have been made during earlier years by many taxonomists. In addition, more than 40 species with their type localities at Semenggoh have been described. During this study, 19 species with type specimens collected from Semenggoh were recorded. These include *Swintonia minutalata* Ding Hou (Anacardiaceae), *Hopea kerangasensis* P.S.Ashton (Dipterocarpaceae), *Shorea cuspidata* P.S.Ashton, *Shorea subcylindrica* P.S.Ashton (Dipterocarpaceae), *Actinodaphne semenggohensis*, and *Gonystylus micranthus* Airy Shaw (Thymelaeaceae).

Due to the uniqueness and richness of the tree species in the Semenggoh Arboretum, more detailed studies (e.g., phenology, plant development, flowering and fruiting onset) should be carried out in order to better understand its flora and to propose a proper conservation management of species and habitats.

Conclusion

With 541 species and 710 trees/ha contributing to a 43.04 m²/ha basal area, the 4-ha plot in Semenggoh can be considered a floristically rich area. As the only remaining primary lowland mixed dipterocarp forest in the vicinity of Kuching city, this area is

an important site for threatened, endemic and rare species; therefore, it is critical to protect and maintain the Arboretum in order to conserve this diverse primary mixed dipterocarp forest into the future. At the same time, due to its high level of endemism, the Arboretum can be an important site for future research into forest demographics and dynamics of endangered species, which will further enhance the conservation value of the area.

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Appendix A. Composition, stand density and basal area (BA) contribution of tree families from the 4-ha study site, Semenggoh.

No.	Family	Genus	Species	Total	BA (m ²)
1	Achariaceae	3	11	44	1.98
2	Anacardiaceae	9	18	94	6.74
3	Anisophylleaceae	1	3	15	0.54
4	Annonaceae	5	11	49	1.31
5	Apocynaceae	3	4	28	4.85
6	Araliaceae	1	1	2	0.04
7	Burseraceae	3	28	106	5.12
8	Cardiopteridaceae	1	1	18	0.39
9	Celastraceae	3	3	11	0.24
10	Chrysobalanaceae	3	4	6	0.10
11	Clusiaceae	4	38	84	3.74
12	Combretaceae	1	1	2	0.16
13	Cornaceae	1	2	2	0.05
14	Crypteroniaceae	1	1	1	0.04
15	Ctenolophonaceae	1	1	3	0.32
16	Dilleniaceae	1	5	21	0.65
17	Dipterocarpaceae	7	61	720	66.86
18	Ebenaceae	1	16	39	1.84
19	Elaeocarpaceae	1	6	7	0.20
20	Euphorbiaceae	10	16	61	1.41
21	Fabaceae	7	15	73	10.20
22	Fagaceae	3	8	14	1.79

No.	Family	Genus	Species	Total	BA (m ²)
23	Icacinaceae	1	1	1	0.01
24	Ixonanthaceae	2	2	50	2.75
25	Lamiaceae	2	6	73	1.26
26	Lauraceae	7	18	49	2.30
27	Lecythidaceae	1	2	7	0.41
28	Loganiaceae	1	1	37	3.28
29	Magnoliaceae	2	3	9	0.35
30	Malvaceae	10	29	125	7.46
31	Melastomataceae	2	2	11	0.16
32	Meliaceae	7	23	55	1.62
33	Memecylaceae	1	6	9	0.22
34	Moraceae	3	11	160	7.88
35	Myristicaceae	4	42	216	6.58
36	Myrtaceae	1	29	114	5.73
37	Ochnaceae	1	1	1	0.04
38	Olacaceae	2	3	11	0.55
39	Oleaceae	1	2	4	0.06
40	Oxalidaceae	1	1	4	1.45
41	Peraceae	2	2	13	0.37
42	Phyllanthaceae	3	16	42	0.64
43	Polygalaceae	1	12	53	1.92
44	Proteaceae	1	1	2	0.05
45	Putranjivaceae	1	4	10	0.30
46	Rhizophoraceae	2	2	3	0.07
47	Rosaceae	1	3	4	0.07
48	Rubiaceae	6	6	17	0.25
49	Rutaceae	3	3	10	0.22
50	Salicaceae	1	1	1	0.03
51	Sapindaceae	4	7	14	1.00
52	Sapotaceae	4	27	262	13.29
53	Simaroubaceae	1	1	3	0.39
54	Staphyleaceae	1	2	2	0.02
55	Stemonuraceae	2	3	3	0.21
56	Symplocaceae	1	3	4	0.04
57	Theaceae	3	4	8	0.32
58	Thymelaeaceae	2	5	14	0.43
59	Ulmaceae	1	2	35	1.79
60	Unidentified	1	1	1	0.04
	Total	160	541	2837	172.16

Appendix B. Checklist of trees from the 4-ha study site in Semenggoh Arboretum. (Only species that were listed in *The IUCN Red List of Threatened Species 2010* are specially indicated with conservation status in the notes.)

Achariaceae

- Hydnocarpus anomala* (Merr.) Sleumer
Hydnocarpus borneensis Sleumer
Hydnocarpus kunstleri (King) Warb. var. *tomentosa* (King) Sleumer
Hydnocarpus pinguis Sleumer
Hydnocarpus polypetala (Sloot.) Merr.
Hydnocarpus subfalcata Merr.
Hydnocarpus tenuipetala Sleumer
Hydnocarpus woodii Merr.
Ryparosa hirsuta J.J.Sm.
Ryparosa hullettii King
Trichadenia philippinensis Merr.

Anacardiaceae

- Androtium astylum* Stapf
Buchanania arborescens (Blume) Blume
Campnosperma squamatum Ridl.
Drimycarpus luridus (Hook.f.) Ding Hou .Notes: Rare in Sarawak (only from two other localities in Tatau & Belaga districts).
Gluta beccarii (Engl.) Ding Hou
Gluta oba (Merr.) Hou. Notes: Endemic to Borneo.
Gluta wallichii (Hook.f.) Ding Hou
Mangifera griffithii Hook.f. Notes: Uncommon in Sarawak.
Mangifera parvifolia Boerl. & Koord. Notes: Uncommon in Sarawak, usually from peat swamp forest.
Melanochyla angustifolia Hook.f. Notes: Uncommon in Sarawak.
Melanochyla beccariana Oliv. Notes: Endemic to Borneo but uncommon in Sarawak.
Melanochyla borneensis (Ridl.) Ding Hou Notes: Endemic to Sarawak and so far only known from Kuching districts.
Melanochyla elmeri Merr. Notes: Endemic to Borneo but uncommon in Sarawak.
Melanochyla fulvinervis (Blume) Ding Hou Notes: Uncommon in Sarawak.
Parishia insignis Hook.f. Notes: Not endemic but uncommon in Sarawak.
Parishia maingayi Hook.f.
Swintonia glauca Engl.
Swintonia minutalata Ding Hou Notes: Endemic to Borneo and uncommon in Sarawak (Semenggoh & Bako only); type specimen from Semenggoh.

Anisophylleaceae

- Anisophyllea beccariana* Baill Notes: Not endemic but in Sarawak, only found in Kuching & Bintulu district.
Anisophyllea corneri Ding Hou
Anisophyllea ferruginea Ding Hou Notes: Uncommon in Sarawak (only known from 4 districts in Sarawak).

Annonaceae

- Alphonsea javanica* Blume
Alphonsea johorensis J. Sinclair
Cyathocalyx biovulatus Boerlage
Cyathocalyx carinatus (Ridl.) J. Sinclair
Mezzettia parviflora Becc.
Polyalthia hookeriana King
Polyalthia lateriflora King
Xylopia caudata Hook.f. & Thomson
Xylopia elliptica Maingay ex Hook.f.
Xylopia ferruginea Baill.
Xylopia malayana Hook.f. & Thomson

Apocynaceae

- Alstonia angustifolia* Wall. ex A. DC.
Alstonia angustiloba Miq. *Notes:* Not endemite but only found in western part of Sarawak.
Dyera costulata (Miq.) Hook.f.
Kibatalia maingayi (Hook.f.) Woodson *Notes:* Not endemic but very localised in Sarawak (Semenggoh & Bau only).

Araliaceae

- Arthrophyllum diversifolium* Blume

Burseraceae

- Canarium apertum* H.J.Lam
Canarium dichotomum (Blume) Miq.
Canarium littorale Blume forma *littorale*
Canarium littorale Blume forma *rufum* (A.W.Benn.) Leenh. *Notes:* Less common in Sarawak.
Canarium megalanthum Merr.
Canarium merrillii H.J.Lam *Notes:* Endemic to Borneo.
Canarium odontophyllum Miq.
Canarium pilosum A. W. Benn. subsp. *pilosum*
Dacryodes costata (A. W. Benn.) H.J.Lam
Dacryodes incurvata (Engl.) H.J.Lam *Notes:* From 4 districts in Sarawak.
Dacryodes longifolia (King) H.J.Lam *Notes:* Less common in Sarawak.
Dacryodes macrocarpa H.J.Lam var. *patentinervia* Leenh
Dacryodes nervosa (H.J.Lam) Leenhouts *Notes:* Not endemic but in Sarawak, only found in Tubau, Bako, Bintulu & Sadong.
Dacryodes rostrata (Blume) H.J.Lam forma *cuspidata* (Blume) H.J.Lam
Dacryodes rugosa (Blume) H.J.Lam var. *rugosa*
Dacryodes rugosa (Blume) H.J.Lam var. *virgata* (Blume) H.J.Lam
Dacryodes sp. 1
Santiria apiculata A.W. Benn. var. *apiculata*
Santiria apiculata Benn. var. *pilosa* (Engl.) Kalkman
Santiria griffithii (Hook.f.) Engl.
Santiria laevigata Blume forma *glabrifolia* (Engl.) H.J.Lam
Santiria megaphylla Kalkman *Notes:* Endemic to Borneo but uncommon in Sarawak (Semenggoh & Dulit).

Santiria mollis Engl. *Notes*: Endemic to Borneo but uncommon in Sarawak (Semenggoh & Lambir, Niah, Bukit Raya).

Santiria oblongifolia Blume

Santiria sarawakana Kochummen *Notes*: Endemic to Sarawak and only from Miri & Sabal.

Santiria tomentosa Blume

Santiria sp. 1

Santiria sp. 2

Cardiopteridaceae

Gonocaryum minus Sleumer

Celastraceae

Bhesa paniculata Arn.

Kokoona littoralis Laws. var. *longifolia* Kochummen

Lophopetalum glabrum Ding Hou *Notes*: Endemic to Borneo.

Chrysobalanaceae

Atuna nannodes (Kosterm.) Kosterm. *Notes*: Not Endemic but uncommon in Sarawak (Bau & Kuching only).

Atuna sp. 1

Kostermantus heteropetalus *Notes*: Sarawak only recorded from 4 districts.

Licania splendens (Korth.) Prance

Clusiaceae

Calophyllum biflorum M.R.Hend. & Wyatt-Sm.

Calophyllum castaneum P.F.Stevens

Calophyllum elegans Ridley

Calophyllum lanigerum Miq. var. *austrocoriaceum* (Whitmore) P.F.Stevens

Calophyllum molle King

Calophyllum pulcherrinum Wall. ex Choisy

Calophyllum roseocostatum P.F.Stevens *Notes*: Type specimen from Semenggoh.

Calophyllum soulattri Burm.f. *Notes*: LR/lc ver 2.3

Calophyllum tetrapterum Miq. *Notes*: LR/lc ver 2.3

Calophyllum teysmannii Zoll. ex Planch. & Tiana

Calophyllum woodii P.F.Stevens

Calophyllum sp. 1

Cratoxylum arborescens (Vahl) Blume *Notes*: LR/lc ver 2.3

Cratoxylum formosum (Jack) Dyer *Notes*: LR/lc ver 2.3

Cratoxylum maingayi Dyer *Notes*: LR/lc ver 2.3

Garcinia beccarii Pierre

Garcinia blumei Pierre

Garcinia calophyllifolia Ridl.

Garcinia caudiculata Ridl.

Garcinia celebica L.

Garcinia cuspidata King

Garcinia dryobalanoides Pierre

Garcinia maingayi Hook.f. *Notes*: LR/lc ver 2.3

Garcinia mangostana L.

Garcinia myristicaefolia Pierre
Garcinia nervosa Miq.
Garcinia nitida Pierre
Garcinia parvifolia (Miq.) Miq.
Garcinia vidua Ridl.
Garcinia sp. '39'
Garcinia sp. 'AZ'
Mesua beccariana (Baill.) Kosterm.
Mesua borneensis P.F.Stevens
Mesua congestiflora P.F.Stevens
Mesua elmeri (Merr.) Kosterm.
Mesua macrantha (Baill.) Kosterm.
Mesua myrtifolia (Baill.) Kosterm.
Mesua variabilis P.F.Stevens

Combretaceae

Terminalia foetidissima Griff.

Cornaceae

Alangium javanicum (Blume) Wangerin var. *javanicum*
Alangium javanicum var. *meyeri* (Merr.) Berhaman

Crypteroniaceae

Crypteronia griffithii C.B.Clarke

Ctenolophonaceae

Ctenolophon parvifolius Oliv.

Dilleniaceae

Dillenia beccariana Martelli
Dillenia excelsa (Jack) Gilg
Dillenia excelsa (Jack) Gilg. var. *tomentella* (Martelli) Masamune
Dillenia reticulata King
Dillenia sumatrana Miq.

Dipterocarpaceae

Anisoptera grossivenia Slooten *Notes*: EN A1cd+2cd ver 2.3; endemic to Borneo.
Cotylelobium melanoxydon (Hook.f.) Pierre *Notes*: EN A1cd+2cd ver 2.3
Dipterocarpus confertus Slooten *Notes*: Endemic to Borneo.
Dipterocarpus geniculatus Vesque subsp. *geniculatus* *Notes*: Endemic to Borneo.
Dipterocarpus globosus Vesque *Notes*: CR A1cd+2cd, B1+2c ver 2.3; endemic to Borneo.
Dipterocarpus lowii Hook.f. *Notes*: CR A1cd+2cd, B1+2c ver 2.3
Dipterocarpus sarawakensis F.G.Browne ex Slooten *Notes*: Type specimen from Semenggoh.
Hopea beccariana Burck *Notes*: CR A1cd+2cd, B1+2c ver 2.3
Hopea bracteata Burck
Hopea dyeri F.Heim
Hopea griffithii Kurz *Notes*: VU A1c+2c ver 2.3
Hopea kerangasensis P.S.Ashton *Notes*: CR A1cd+2cd, B1+2c ver 2.3; type specimen from Semenggoh.

- Hopea latifolia* Symington *Notes*: CR A1c, B1–2c ver 2.3
- Hopea longirostrata* P.S.Ashton *Notes*: CR A1cd, B1–2c, C1, D ver 2.3; endemic to Sarawak.
- Hopea pachycarpa* (F.Heim) Symington *Notes*: VU A1cd–2cd, B1–2c ver 2.3
- Hopea sphaerocarpa* (F.Heim) P.S.Ashton *Notes*: CR A1c, B1–2c ver 2.3; endemic to Sarawak, first and second Division only.
- Hopea tenuinervula* P.S.Ashton *Notes*: CR A1c, B1–2c ver 2.3; endemic to Borneo.
- Shorea atrinervosa* Symington
- Shorea beccariana* Burck *Notes*: Endemic to Borneo.
- Shorea bracteolata* Dyer *Notes*: EN A1cd–2cd ver 2.3
- Shorea brunnescens* P.S.Ashton *Notes*: EN A1cd–2cd, C2a ver 2.3; endemic to Borneo.
- Shorea crassa* P.S.Ashton *Notes*: Endemic to Borneo; type specimen from Semenggoh.
- Shorea cuspidata* P.S. Ashton *Notes*: EX ver 2.3; endemic to Borneo, type specimen from Semenggoh.
- Shorea dasyphylla* Foxw. *Notes*: EN A1cd ver 2.3
- Shorea elliptica* Burck *Notes*: CR A1cd, C2a ver 2.3; endemic to Borneo, uncommon in Sarawak (Kuching & Lundu only).
- Shorea falcifera* Dyer ex Brandis *Notes*: EN A1cd ver 2.3
- Shorea flemmichii* Symington *Notes*: CR A1cd, C2a ver 2.3; endemic to Sarawak.
- Shorea isoptera* P.S.Ashton *Notes*: CR A1cd, C2a ver 2.3; endemic to Borneo.
- Shorea kunstleri* King *Notes*: CR A1cd ver 2.3
- Shorea ladiana* P.S.Ashton *Notes*: CR A1cd, C2a ver 2.3; endemic to Borneo, type specimen from Semenggoh.
- Shorea leprosula* Miq. *Notes*: EN A1cd ver 2.3
- Shorea lunduensis* P.S.Ashton *Notes*: CR A1cd, C2a ver 2.3; endemic to Borneo; uncommon in Sarawak (only from Lundu, Bau & Kuching Marudi districts).
- Shorea macrobalanos* P.S.Ashton *Notes*: CR A1cd, C2a ver 2.3; endemic to Borneo, uncommon in Sarawak (only from Kapit, Bintulu & Lundu districts).
- Shorea macrophylla* (de Vries) P.S.Ashton *Notes*: VU A1cd ver 2.3; endemic to Borneo.
- Shorea macroptera* Dyer
- Shorea macwelliana* King *Notes*: EN A1c ver 2.3
- Shorea multiflora* (Burck) Symington *Notes*: LR 1c ver 2.3
- Shorea myrionerva* Sym. ex P.S.Ashton *Notes*: CR A1cd, C2a ver 2.3; endemic to Borneo.
- Shorea obscura* Meijer *Notes*: EN A1cd ver 2.3; endemic to Borneo.
- Shorea ovalis* (Korth.) Blume subsp. *sarawakensis* P.S.Ashton *Notes*: Endemic to Borneo.
- Shorea parvifolia* Dyer subsp. *velutina* P.S.Ashton
- Shorea pubistyla* P.S.Ashton *Notes*: CR A1cd, C2a ver 2.3; endemic to Borneo, type specimen from Semenggoh.
- Shorea quadrinervis* Slooten *Notes*: EN A1cd ver 2.3; endemic to Borneo.
- Shorea richetia* P.S.Ashton *Notes*: CR A1cd, C2a ver 2.3; endemic to Borneo, uncommon in Sarawak (Kuching & Lundu only).
- Shorea rubra* P.S.Ashton *Notes*: Endemic to Borneo.
- Shorea scaberrima* Burck *Notes*: Endemic to Borneo.
- Shorea scabrida* Symington
- Shorea seminis* (de Vriese) Slooten *Notes*: CR A1cd ver 2.3
- Shorea slootenii* Wood ex P.S.Ashton *Notes*: CR A1cd, C2a ver 2.3; endemic to Borneo.
- Shorea subcylindrica* Slooten *Notes*: CR A1cd, C2a ver 2.3; endemic to Borneo, type specimen from Semenggoh.
- Upuna borneensis* Symington *Notes*: EN A1cd, C2a ver 2.3; endemic to Borneo.

Vatica badiifolia P.S.Ashton Notes: EN A1cd ver 2.3; endemic to Borneo.

Vatica coriacea P.S.Ashton Notes: CR A1c, C2a ver 2.3; endemic to Borneo, uncommon (in Sarawak known from Lundu & Kuching districts).

Vatica dulitensis Symington Notes: Endemic to Borneo.

Vatica granulata Slooten subsp. *granulata* Notes: Endemic to Borneo.

Vatica havilandii Brandis Notes: CR A1c, C2a ver 2.3

Vatica maingayi Dyer Notes: CR A1cd, C2a ver 2.3

Vatica micrantha Slooten Notes: Endemic to Borneo.

Vatica nitens (King) Kosterm.

Vatica oblongifolia Hook.f. subsp. *oblongifolius* Notes: Endemic to Borneo.

Vatica pedicellata Brandis Notes: EN A1c ver 2.3; endemic to Sarawak, in Kuching, Lundu, Simunjan only.

Ebenaceae

Diospyros borneensis Hiern

Diospyros curranii Merr.

Diospyros dictyoneura Hiern

Diospyros ferruginescens Bakh. var. *ferruginescens* Notes: Endemic to Borneo.

Diospyros lunduensis Ng Notes: Endemic to Borneo, uncommon in Sarawak (Lundu & Semenggoh only).

Diospyros maingayi (Hiern) Bakh.

Diospyros mindanaensis Merr.

Diospyros neurosepala Bakh. Notes: Endemic to Borneo.

Diospyros pendula Hasselt ex Hassk.

Diospyros pilosanthera Blanco var. *pilosanthera*

Diospyros puncticulosa Bakh. Notes: Endemic to Borneo.

Diospyros ridleyi Bakh.

Diospyros styraciformis King & Gamble

Diospyros venosa Wall. ex A. DC. var. *venosa*

Diospyros sp. 1

Diospyros sp. 2

Elaeocarpaceae

Elaeocarpus beccarii DC.

Elaeocarpus clementis Merr.

Elaeocarpus cristatus Coode

Elaeocarpus dolichobotrys Merr.

Elaeocarpus griffithii (Wight) A.Gray

Elaeocarpus petiolatus (Jack) Wall.

Euphorbiaceae

Blumeodendron calophyllum Airy Shaw

Blumeodendron tokbrai (Bl.) Kurz

Cephalomappa beccariana Baill. var. *beccariana* Notes: Endemic to Sarawak.

Croton argyratus Blume

Endospermum diadenum (Miq.) Airy Shaw

Macaranga bancana (Miq.) Muell.Arg.

Macaranga conifera Muell.Arg.

Macaranga lowii King ex Hook.f.
Macaranga recurvata Gage
Macaranga triloba (Thunb.) Muell.Arg.
Mallotus griffithianus (Muell.Arg.) Hook.f.
Mallotus penangensis Muell.Arg.
Neoscortechinia kingii (Hook.f.) Pax & Hoffm.
Pimeleodendron griffithianum (Muell.Arg.) Benth.
Ptychopyxis costata Miq. var. *oblanceolata* Airy Shaw
Sebastiania borneensis Pax & Hoffm.

Fabaceae

Archidendron borneense (Benth.) I.C. Nielsen
Archidendron microcarpum (Benth.) I.C. Nielsen
Crudia wrayi Prain *Notes*: Not endemic but uncommon in Sarawak (Kuching only).
Dialium indum L. var. *bursa* (de Wit) Rojo
Dialium indum L. var. *indum*
Dialium kunstleri Prain var. *kunstleri*
Dialium platysepalum Baker
Dialium sp. 1
Dialium sp. 2
Koompassia malaccensis Maing. ex Benth.
Parkia sumatrana Miq.
Pithecellobium kunstleri Prain
Sindora irpicina de Wit
Sindora leiocarpa Backer ex de Wit
Sindora velutina Baker
Sindora sp. 1

Fagaceae

Castanopsis costata (Blume) A. DC.
Castanopsis hypophoenicea (Seemen) Soepadmo *Notes*: Endemic to Borneo.
Castanopsis motleyana King
Lithocarpus andersonii Soepadmo *Notes*: Endemic to Borneo.
Lithocarpus coopertus (Blanco) Rehder
Lithocarpus gracilis (Korth.) Soepadmo
Lithocarpus pulcher (King) Markgr. *Notes*: Endemic to Borneo.
Quercus kerangasensis Soepadmo *Notes*: Endemic to Borneo; uncommon in Sarawak (in Ulu Baram, Kuching, Simunjan).

Icacinaceae

Platea latifolia Blume *Notes*: Endemic to Sarawak (4 localities only).

Ixonanthaceae

Allantospermum borneense Forman subsp. *borneense* *Notes*: Type specimen from Semenggoh.
Ixonanthes petiolaris Blume

Lamiaceae

Clerodendrum villosum Blume *Notes*: Endemic to Sarawak (6 localities only).

Teijsmanniodendron bintuluensis Moldenke

Teijsmanniodendron havilandii (Ridl.) G.Rusea *Notes:* Endemic to Sarawak (Sadong & Semenggoh only).

Teijsmanniodendron sarawakanum (H.H.W.Pearson) Kosterm. *Notes:* Endemic to Borneo.

Teijsmanniodendron simplicifolium Merr. *Notes:* Endemic to Borneo.

Teijsmanniodendron subspicatum (H.Hallier) Kosterm.

Lauraceae

Actinodaphne macrophylla (Blume) Nees

Actinodaphne semenggohensis S.Julia *Notes:* Endemic to Sarawak; only from Semenggoh, type specimen from Semenggoh.

Beilschmiedia kunstleri Gamble

Beilschmiedia maingayi Hk.f.

Cryptocarya ferrea Blume var. *ferrea*

Cryptocarya ferrea Blume var. *scortechinii* (Gamble) Ng

Cryptocarya griffithiana Wight var. *crassinervia* (Miq.) Ng

Endiandra clavigera Kosterm. *Notes:* Endemic to Sarawak.

Endiandra coriacea Merr.

Endiandra rubescens (Blume) Miq.

Lindera lucida (Blume) Boerl.

Litsea accedens (Blume) Boerl. var. *oblanceolata* (Gamble) Ng

Litsea gracilipes Hook.f.

Litsea grandis Hook.f.

Litsea lancifolia (Roxb. ex Wall.) Hook.f.

Litsea resinosa Blume

Notaphoebe sp. 1

Notaphoebe sp. 2

Lecythydaceae

Barringtonia lanceolata (Ridl.) Payson *Notes:* Endemic to Borneo.

Barringtonia sarcostachys (Blume) Miq.

Loganiaceae

Norrisia maior Soler.

Magnoliaceae

Magnolia ashtonii Dandy ex Noot.

Magnolia borneensis Noot.

Talauma beccarii Ridl.

Malvaceae

Brownlowia ovalis Kosterm. *Notes:* Type specimen from Semenggoh.

Durio grandiflorus (Most.) Kosterm. *Notes:* VU A1c ver 2.3

Durio graveolens Becc.

Durio kutejensis (Hassk.) Becc. *Notes:* VU A1c ver 2.3

Durio lanceolatus Mast.

Durio malaccensis Planch ex Ma

Durio oblongus Mast.

Durio testudinarius Becc. *Notes*: VU A1c ver 2.3
Grewia gracilis (Stapf ex Ridl.) P.S. Ashton
Heritiera albiflora Kosterm.
Heritiera aurea (Miq.) Kosterm.
Heritiera javanica (Blume) Kosterm.
Heritiera simplicifolia (Mast.) Kosterm.
Heritiera sumatrana (Miq.) Kosterm.
Microcos cinnamomifolia Burret *Notes*: Endemic to Borneo.
Microcos triflora (Blanco) R.C.K.Chung var. *triflora*
Neesia piluliflora Becc.
Pentace borneensis Pierre
Pentace curtisii King
Pentace polyantha Hassk.
Pentace rigida Kosterm.
Scaphium affine (Mast.) Pierre
Scaphium macropodium (Miq.) Beumée ex Heyne
Schoutenia accrescens (Mast.) C.H.Curtis
Schoutenia accrescens (Mast.) C.H.Curtis subsp. *stellata* Roekmowati-Hartono
Sterculia oblongata R.Br.
Sterculia parvifolia Wall. ex R.Br.
Sterculia scortechinii King
Sterculia sp. 1

Melastomataceae

Lijndenia laurina Zoll. & Moritzi
Pternandra hirtella (Cogn.) Nayar

Meliaceae

Aglaia argentea Blume
Aglaia exstipulata (Griff.) W.Theob. subsp. *brunneostellata* Pannell
Aglaia forbesii King
Aglaia hiernii King
Aglaia leucophylla King
Aglaia malaccensis (Ridl.) J.A.R.Anderson
Aglaia meliosmoides Craib
Aglaia odoratissima Blume
Aglaia ramotricha Pannell *Notes*: Endemic to Borneo.
Aglaia rubiginosa (Hiern) Pannell
Aglaia sexipetala Griff.
Aglaia speciosa Blume
Aglaia squamulosa King
Aglaia sp. 1
Chisocheton pentandrus (Blanco) Merr. subsp. *paucijugus* (Miq.) Mabb.
Dysoxylum densiflorum (Blume) Miq.
Dysoxylum magnificum Mabb.
Dysoxylum pachyrhache Merr. *Notes*: Endemic to Borneo.
Pseudoclausena chrysogyne (Miq.) T.P.Clark
Reinwardtiodendron humile (Hassk.) Mabb.

Sandoricum borneense Miq. Notes: Endemic to Borneo.
Sandoricum dasyneuron Baill. Notes: Endemic to Borneo.
Walsura sp. A

Memecylaceae

Memecylon amplexicaule Roxb.
Memecylon argenteum K.Bremer
Memecylon campanulatum C.B.Clarke
Memecylon durum Cogn.
Memecylon garcinioides Blume
Memecylon scolopacinum Ridl.

Moraceae

Artocarpus anisophyllus Miq.
Artocarpus integer (Thunb.) Merr.
Artocarpus kemando Miq.
Artocarpus longifolius Becc. Notes: Endemic to Borneo and rare.
Artocarpus nitidus Tréc.
Artocarpus obtusus Jarrett Notes: Endemic to Borneo and rare; in Sarawak only from 4 locations, type specimen from Semenggoh.
Artocarpus odoratissimus Blanco Notes: Endemic to Borneo.
Artocarpus peltatus Merr. Notes: Endemic to Borneo.
Artocarpus rigidus Blume
Parartocarpus venenosus (Zoll. & Moritzi) Becc. subsp. *borneensis* (Becc.) Jarrett Notes: Endemic to Borneo.
Prainea frutescens Becc. Notes: Endemic to Borneo and uncommon, Sarawak only from west & northern parts (4 localities only).

Myristicaceae

Gymnacranthera bancana (Miq.) J. Sinclair
Gymnacranthera contracta Warb. Notes: Endemic to Borneo.
Gymnacranthera farquhariana (Hook.f. & Thomson) Warb. var. *eugeniifolia* (A.DC.) R.T.A.Schouten
Gymnacranthera farquhariana (Hook.f. & Thomson) Warb. var. *farquhariana*
Gymnacranthera forbesii (King) Warb. var. *crassinervis* (Warb.) J. Sinclair Notes: Endemic to Borneo.
Gymnacranthera ocellata Schouten Notes: Endemic to Borneo.
Horsfieldia androphora W.J. de Wilde Notes: Endemic to Borneo.
Horsfieldia borneensis W.J. de Wilde Notes: Endemic to Borneo; type specimen from Semenggoh.
Horsfieldia brachiata (King) Warb.
Horsfieldia grandis (Hook.f.) Warb.
Horsfieldia laticostata (J.Sinclair) W.J.de Wilde Notes: Endemic to Borneo.
Horsfieldia nervosa W.J.de Wilde Notes: Endemic to Sarawak and rare.
Horsfieldia pallidicaula W.J.de Wilde var. *pallidicaula* Notes: Endemic to Borneo.
Horsfieldia polyspherula (Hook.f. emend. King) J. Sinclair var. *maxima* W.J.de Wilde Notes: Endemic to Borneo.
Horsfieldia punctatifolia J.Sinclair

- Horsfieldia tenuifolia* (J.Sinclair) W.J.de Wilde *Notes*: Endemic to Borneo.
Horsfieldia wallichii (Hook.f. & Thomson) Warb.
Knema curtisii (King) Warb. var. *arenosa*
Knema curtisii (King) Warb. var. *curtisii*
Knema galeata J.Sinclair *Notes*: Endemic to Borneo.
Knema glaucescens Jack
Knema latericia Elmer subsp. *albifolia* (Sinclair) W.J.de Wilde *Notes*: Endemic to Borneo.
Knema latericia Elmer subsp. *ridleyi* (Gand.) W.J.de Wilde
Knema latifolia Warb.
Knema lunduensis (Sinclair) W.J.de Wilde *Notes*: Endemic to Borneo.
Knema membranifolia H.J.P.Winkler *Notes*: Endemic to Borneo.
Knema pedicellata W.J.de Wilde *Notes*: Endemic to Borneo.
Knema pericoriacea Sinclair forma *sarawakensis* *Notes*: Endemic to Borneo.
Knema rufa Warb. *Notes*: Endemic to Borneo.
Knema stenophylla (Warb.) J.Sinclair subsp. *longipedicellata* (Sinclair) W.J.de Wilde *Notes*:
 Endemic to Borneo.
Knema viridis W.J.de Wilde *Notes*: Endemic to Sarawak.
Knema sp. 1
Knema sp. 2
Knema sp. 3
Myristica beccarii Warb.
Myristica borneensis Warb. *Notes*: Endemic to Borneo.
Myristica cinnamomea King
Myristica crassa King
Myristica gigantea King
Myristica iners Blume
Myristica malaccensis Hook.f. subsp. *papillosa* W.J.de Wilde *Notes*: Endemic to Borneo.
Myristica villosa Warb. *Notes*: Endemic to Borneo.

Myrtaceae

- Syzygium acuminatissimum* A. de Camdolle
Syzygium adenophyllum Merrill & Perry *Notes*: Endemic to Borneo.
Syzygium borneense (Miq.) Miq.
Syzygium brachyrachis Merr. & Perry *Notes*: Endemic to Borneo.
Syzygium chloranthum (Duthie) Merrill & Perry
Syzygium durifolium Merrill & Perry *Notes*: Endemic to Borneo and rare, in Sarawak from
 Semenggoh only.
Syzygium glabratum Veldkamp
Syzygium gladiatum (Ridl.) Merrill & Perry *Notes*: Endemic to Borneo and rare; in Sarawak
 from Sabal & Semenggoh.
Syzygium glanduligerum (Ridl.) Merrill & Perry *Notes*: Endemic to Borneo.
Syzygium grande (Wight) Walpers
Syzygium hoseanum (King) Merrill & Perry
Syzygium incarnatum (Elmer) Merrill & Perry
Syzygium inophyllum A. de Candolle
Syzygium kunstleri (King) Bahadur & R.C. Gaur
Syzygium leptostemon (Korth.) Merrill & Perry
Syzygium longiflorum Presl.

- Syzygium napiforme* (Koord. & Valetton) Merrill & Perry
Syzygium nemestrinum (Henderson) I.M. Turner
Syzygium oligomyrum Diels *Notes*: Endemic to Borneo.
Syzygium pendens (Duthie) I.M. Turner
Syzygium polyanthum (Wight) Walpers
Syzygium pyriformis (Blume) A.de Candolle
Syzygium remotifolium (Ridl.) Merrill & Perry *Notes*: Endemic to Borneo.
Syzygium ridleyi (King) P. Chantaranothai & J. Pam
Syzygium rostratum (Blume) A.de Candolle
Syzygium rugosum Korth.
Syzygium urceolatum Merrill & Perry ssp. *kuchingense* (Merrill) P.S. Ashton *Notes*: Endemic to Borneo.
Syzygium urceolatum Merrill & Perry ssp. *palembanicum* P.S. Ashton
Syzygium sp. 1
Syzygium sp. 2

Ochnaceae

- Gomphia serrata* (Gaertn.) Kanis

Olacaceae

- Anacolosia frutescens* (Blume) Blume
Strombosia ceylanica Gardner

Oleaceae

- Chionanthus havilandii* Kiew *Notes*: Endemic to Sarawak (from 6 localities only).
Chionanthus lucens Kiew

Oxalidaceae

- Sarcotheca diversifolia* (Miq.) Hallier f.

Peraceae

- Chaetocarpus castanocarpus* (Roxb.) Thw.
Trigonopleura malayana Hook.f.

Phyllanthaceae

- Aporosa bullatissima* Airy Shaw *Notes*: Endemic to Borneo; type specimen from Semenggoh.
Aporosa elmeri Merr. *Notes*: Endemic to Borneo.
Aporosa illustris Airy Shaw *Notes*: Endemic to Sarawak.
Aporosa lucida (Miq.) Airy Shaw var. *lucida*
Aporosa nitida Merr. *Notes*: Endemic to Borneo.
Aporosa subcaudata Merr.
Baccaurea macrophylla (Muell.Arg.) Muell.Arg.
Baccaurea maingayi Hook.f.
Baccaurea minor Hook.f.
Baccaurea pyriformis Gage
Baccaurea racemosa (Reinw. ex Blume) Muell.Arg.
Baccaurea reticulata Hook.f.
Baccaurea sarawakensis Pax & Hoffm.

Baccaurea sumatrana (Miq.) Muell.Arg.

Cleistanthus coriaceus Airy Shaw *Notes*: Endemic to Sarawak, type specimen from Semenggoh

Cleistanthus pseudopodocarpus Jabl.

Polygalaceae

Xanthophyllum brevipes Meijden *Notes*: Endemic to Borneo; from 6 localities in Sarawak
(Type specimen from Semenggoh)

Xanthophyllum ceraceifolium Meijden *Notes*: Endemic to Sarawak; from Semenggoh only
(Type specimen from Semenggoh)

Xanthophyllum ecarinatum Chodat *Notes*: Endemic to Borneo.

Xanthophyllum ellipticum Miq.

Xanthophyllum ferrugineum Meijden *Notes*: Endemic to Borneo.

Xanthophyllum flavescens Roxb.

Xanthophyllum griffithii A.W.Benn. var. *angustifolium* Ng

Xanthophyllum parvifolium Meijden *Notes*: Endemic to Borneo.

Xanthophyllum rufum A.W.Benn.

Xanthophyllum stipitatum A.W.Benn.

Xanthophyllum trichocladum Chodat *Notes*: Endemic to Borneo; uncommon in Sarawak
(Kapit & Kuching only).

Xanthophyllum velutinum Chodat *Notes*: Endemic to Borneo.

Proteaceae

Helicia petiolaris Benn.

Putranjivaceae

Drypetes crassipes Pax & Hoffm.

Drypetes eriocarpa Airy Shaw *Notes*: Endemic to Sarawak, from Bukit Raya, Lambir, Sabal
& Semenggoh.

Drypetes longifolia Pax & Hoffm.

Drypetes macrostigma J.J.Sm. *Notes*: Endemic to Borneo.

Rhizophoraceae

Carallia brachiata (Lour.) Merr.

Pellacalyx lobii (Hook.f.) Schimp.

Rosaceae

Prunus arborea (Blume) Kalkman

Prunus arborea (Blume) Kalkman var. *stipulacea* (Blume) Kalkman

Prunus lamponga (Miq.) Kalkman

Rubiaceae

Canthium didymum Ridl.

Diplospora singularis Korth.

Pleiocarpidia capituligera (Ridl.) Bremek.

Porterandia anisophylla (Jack ex Roxb.) Ridl.

Tarenna winkleri Valetton

Timonius eskerianus W.W.Sm.

Rutaceae

- Acronychia pendunculata* (L.) Miq.
Maclurodendron porteri (Hook.f.) T.G.Hartley
Melicope incana T.G.Hartley

Salicaceae

- Flacourtia rukam* Zoll. & Mor.
Guioa diplopetala (Hassk.) Radlk.

Sapindaceae

- Nephelium cuspidatum* Blume var. *ophioides* (Radlk.) Leenh. subvar. *beccarianum* (Radlk.)
 Leenh. *Notes:* Endemic to Borneo.
Nephelium lappaceum L. var. *pallens* (Hiern) Leenh
Nephelium macrophyllum Radlk. *Notes:* Endemic to Borneo.
Pometia pinnata J.R.Forst & G.Forst.
Xerospermum laevigatum Radlk. subsp. *laevigatum*

Sapotaceae

- Madhuca barbata* T.D.Penn. *Notes:* Endemic to Sarawak.
Madhuca engleri (Merr.) Vink *Notes:* Endemic to Borneo and uncommon in Sarawak (only from Semenggoh).
Madhuca erythrophylla (King & Gamble) H.J.Lam *Notes:* Not endemic but uncommon in Sarawak (Semenggoh & Segan only).
Madhuca kingiana (Brace ex King & Gamble) H.J.Lam
Madhuca korthalsii (Pierre ex Burck) H.J.Lam
Madhuca kuchingensis Yii & P.Chai *Notes:* Endemic to Sarawak and confined to the western and central parts of Sarawak.
Madhuca lancifolia H.J.Lam *Notes:* Endemic to Borneo but uncommon; in Sarawak from Semenggoh only.
Madhuca oblongifolia (Merr.) Merr. *Notes:* Not endemic but in Sarawak only from Semenggoh & Bintulu.
Madhuca pallida (Burck) Baehni *Notes:* Not endemic but uncommon in Sarawak.
Madhuca proxila (Pierre ex Dubard) Yii & P.Chai
Madhuca sarawakensis (Pierre ex Dubard) H.J.Lam *Notes:* Endemic to Sarawak; Restricted to Kuching Division.
Madhuca sericea (Miq.) H.J.Lam
Madhuca sp. 1
Palaquium beccarianum (Pierre) P.Royen *Notes:* Endemic to Borneo, uncommon in Sarawak (Kuching Division only).
Palaquium calophyllum (Teijsm. & Binn.) Pierre
Palaquium cryptocariifolium P.Royen *Notes:* Endemic to Borneo; type specimen from Semenggoh.
Palaquium decurrens H.J.Lam *Notes:* Endemic to Borneo.
Palaquium gutta (Hook.f.) Baill.
Palaquium herveyi King & Gamble *Notes:* Endemic to Borneo; in Sarawak from Semenggoh only.
Palaquium leiocarpum Boerlage
Palaquium pseudorostratum H.J.Lam

***Palaquium ridleyi* King & Gamble**

Palaquium rigidum Pierre ex Dubard *Notes*: Endemic to Sarawak and confined to Matang, Semenggoh & Baram only.

Palaquium rufolanigerum P.Royen *Notes*: Endemic to Borneo, type specimen from Semenggoh.

Palaquium walsurifolium Pierre ex Dubard

Payena obscura Burck subsp. *havilandii* (King & Gamble) J.T.Pereira *Notes*: Endemic to Borneo; from first and second Division only.

Pouteria malaccensis (C.B.Clarke) Baehni *Notes*: Not endemic but uncommon in Sarawak (Semenggoh & Kelabit Highland only).

Simaroubaceae

Quassia borneensis Noot.

Staphyleaceae

Turpinia sphaerocarpa Hassk. var. *sphaerocarpa* Hassk.

Turpinia sp. 1

Stemonuraceae

Cantleya corniculata (Becc.) R.A.Howard

Stemonurus grandifolius Becc. *Notes*: Endemic to Sarawak.

Stemonurus secundiflorus Blume var. *lanceolatus* (Becc.) Sleum *Notes*: Endemic to Sarawak.

Symplocaceae

Symplocos goodeniacea Noot. *Notes*: Endemic to Borneo and uncommon in Sarawak. (Semenggoh & Usun Apau only)

Symplocos henschelii (Moritzi) Benth. ex C.B.Clarke var. *maingayi* (Benth. ex C.B. Clarke) Noot.

Symplocos rubiginosa Wall. ex DC.

Theaceae

Adinandra sarosanthera Miq.

Gordonia havilandii Burkill

Gordonia sarawakensis Keng

Ploiarium alternifolium (Vahl) Melchior

Thymelaeaceae

Aetoxylon sympetalum (Steenis & Domke) Airy Shaw *Notes*: Endemic to Borneo.

Gonystylus affinis Radlk. var. *elegens* Airy Shaw *Notes*: Endemic to Borneo, from Kuching, Lundu and Marudi District in Sarawak.

Gonystylus maingayi Hook.f.

Gonystylus micranthus Airy Shaw *Notes*: Type specimen from Semenggoh

Gonystylus stenosepalus Airy Shaw *Notes*: VU A1c-2c ver 2.3

Ulmaceae

Gironniera nervosa Planch.

Gironniera subaequalis Planch.

***Podocarpus orarius* (Podocarpaceae), a new species from the Solomon Islands and a taxonomic clarification of *Podocarpus spathoides* from Malaysia**

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ABSTRACT. *Podocarpus spathoides* de Laub. (Podocarpaceae) is revised and is restricted to material from Malaysia where the type was collected. An emended description is given because the protologue was based on a mixture of different taxa. Plants from the Solomon Islands, previously described as *Podocarpus spathoides* var. *solomonensis* Silba, are here raised to species rank as the new species *Podocarpus orarius* R.R.Mill & M.Whiting. This is currently believed to be endemic to the Solomon Islands where it has been wild-collected on Choiseul, San Jorge and Guadalcanal; cultivated material, apparently originating from the wild, has also been seen from the island of New Georgia. Similar plants occur on neighbouring islands of Vanuatu but require proper evaluation before they can be assigned to the new species. Illustrations of the habit and reproductive characters of *Podocarpus orarius* are provided. Material from Morotai in the Moluccas that has in the past been assigned to *Podocarpus spathoides* is also morphologically distinct from the type but is insufficient for formal naming. The leaf cuticle micromorphology of *Podocarpus spathoides* and *P. orarius* is described and illustrated.

Keywords. conservation assessments, cuticle micromorphology, Malaysia, new species, Podocarpaceae, *Podocarpus*, Solomon Islands, taxonomy

Introduction

Podocarpus spathoides de Laub. (Podocarpaceae) was originally described by de Laubenfels (1985) on the apparent basis of a single specimen, *de Laubenfels 600*, from Gunung Ledang (Mt. Ophir), Peninsular Malaysia, that was cited as its holotype (Fig. 1A). Three years later, in his treatment of *Podocarpus* for *Flora Malesiana*, de Laubenfels (1988) expanded the published concept and distribution of *Podocarpus spathoides* to encompass specimens from a range of scattered islets including Morotai in the Moluccas, Rossel Island in the Louisiades Archipelago between eastern Papua New Guinea and the Solomons, and the Solomon Islands themselves; a distribution that has been repeatedly quoted by later authors, most recently by Farjon (2010a, 2010b). However, examination of specimens received on loan from the Leiden Herbarium (L) has revealed that de Laubenfels had been using the name '*Podocarpus spathoides*' on *determinavit* slips as early as 1979, on specimens from all the above areas. Therefore, although the protologue (de Laubenfels 1985) appears to be based on a single collection from Mt. Ophir, de Laubenfels's description as given in it was actually based on all



Fig. 1. Type specimens of *Podocarpus spathoides* de Laub. from Malaysia and of some *Podocarpus* species occurring in the Solomon Islands. **A.** Holotype of *P. spathoides* de Laub. (Malaysia: *de Laubenfels* P600, L). **B.** Holotype of *P. orarius* R.R. Mill & M. Whiting (Solomon Islands, *Pitisopa et al.* 7, E). **C.** Iso-type of *P. salomoniensis* Wasscher (Solomon Islands, *Brass* 2881, L). **D.** Holotype of *P. insularis* de Laub. (Sudest Island, *Brass* 27987, L).

or nearly all, the material he had seen prior to 1985. This becomes evident when one compares it with his corresponding description in the later *Flora Malesiana* account (de Laubenfels 1988). In both descriptions of *P. spathoides* tree height is given as 3–20 m and bud length as 2–6 mm.

However, in his *Flora Malesiana* account de Laubenfels (1988) added a note that “In Malaya and Rossel I. the foliage buds are no more than 3 mm long, the others are twice as long. In Malaya the trees grow in a summit scrub and are no more than 3–4 m high, elsewhere collectors report 12–20 m high trees” and acknowledged that “more than one similar taxon may be involved here”. Female material was also described in the protologue of *Podocarpus spathoides* (de Laubenfels 1985). Curiously, however, the later *Flora Malesiana* account of that species (de Laubenfels 1988) did not include any female reproductive characters in its description. The label of *de Laubenfels P598* from Mt. Ophir said that the specimen was taken from a female tree but no cones are present on the sheet or in the packet and no other female material from Mt. Ophir could be located. The holotype of *Podocarpus spathoides* (*de Laubenfels P600*, L: Fig. 1A), from the same locality, was said to be male but again no cones are present on that sheet and none are visible on the images of the isotypes at RSA and US: the K isotype is also sterile (A. Farjon, *pers. comm.* 26 Jan 2011). In the description below, therefore, we state that both pollen cone and seed cone characters are not reliably known for *Podocarpus spathoides* at the present time, although we have given a translation of the brief description of female cones given by de Laubenfels (1985) in his protologue.

Some years later, Silba (2000) described *Podocarpus spathoides* var. *solomonensis* Silba from easternmost Choiseul (Solomon Islands), distinguishing it from typical Malayan *P. spathoides* by its larger bud scales and being a relatively large tree up to 20 m tall, in comparison to the Malayan plants that are typically only 3–4 m tall. Silba’s description was extremely brief and all of it is summarised above. The holotype of this variety (*Whitmore BSIP 5247* at L) has been examined by us and there is no evidence, such as a *determinavit* slip, that it was actually seen by Silba. It was originally identified as *Podocarpus neriiifolius* D. Don and later, by de Laubenfels in 1967, as *Podocarpus rumphii* Blume and subsequently as *P. spathoides* by de Laubenfels in 1979.

In October 2008 a joint expedition team from the Royal Botanic Garden Edinburgh and the Ministry of Forests, Honiara, Solomon Islands collected a large suite of specimens from most of the members of the Podocarpaceae known from the Solomon Islands. This included specimens of Silba’s taxon *Podocarpus spathoides* var. *solomonensis* which was found growing on the islands of Choiseul (including at the locality where Whitmore collected the specimen that Silba made the type of his variety) and San Jorge, off Santa Isabel, where a similar plant had previously been collected by E.J.H. Corner (see specimen citations). It was noted that, in stark contrast to the exposed mountain ridge-top habitat at altitudes above 1000 m above sea level (asl) favoured by *Podocarpus spathoides* in its *locus classicus* of Mount Ophir, the Solomon Islands plants located on this expedition were always found at very low altitudes (from 1 to 35 m asl) along the coastline. Examination of their gross morphology revealed many differences between these Solomon Islands plants and

Malay *P. spathoides* and it became obvious that, as surmised by de Laubenfels (1988), they were not the same species. This was later confirmed by examination of the cuticle micromorphology of the two taxa by Whiting (2009). Accordingly, these Solomon Islands specimens are described here as the new species *Podocarpus orarius* R.R.Mill & M.Whiting.

De Laubenfels (1985) divided *Podocarpus* L'Hér. ex Pers. into two subgenera, each of which had nine sections. The two subgenera have consistently been recovered with strong support in molecular phylogenies of Podocarpaceae (Conran et al. 2000, Sinclair et al. 2002, Biffin et al. 2011, Knopf et al. 2012). However, the present limits of the sections are, with one or two exceptions, not supported by molecular phylogenetics and they have not been recognised in the most recent world treatment of *Podocarpus* (Farjon 2010a). Consequently, until a new, more meaningful sectional classification is available, the new species is only assigned to subgenus.

Materials and methods

The taxonomic study reported here is based on the examination of twenty-four different collections, eighteen of which belong to the new species *Podocarpus orarius* described below. Four collections represent *Podocarpus spathoides* from the type locality and one each represent taxonomically unassigned specimens from Morotai (Moluccas) and Rossel I. (Lousiades Archipelago, New Guinea) as discussed below. Duplicates of all specimens gathered by *Pitisopa et al.* in 2008 and cited below as being conserved at E will be distributed to BSIP with all but one also duplicated at BISH. The intended allocations are listed in the specimen citations.

The cuticle micromorphology of *Podocarpus spathoides* from the type locality and of the new species *P. orarius* from the Solomon Islands was examined using scanning electron microscopy. Specimens used are indicated by an asterisk (*) in the specimen citations within the species accounts. The cuticle was isolated following the method of Alvin and Boulter (1974) with changes made to suit Podocarpaceae based on work by Kershaw (1997), Stockey et al. (1998) and Stark Schilling (2004). From each specimen, six leaf slices of around 0.8 cm² were placed in glass vials with 6 ml of 20% aqueous chromium trioxide solution. The vials were sealed and kept at room temperature for 96 hours. Isolated cuticles were removed from the solution, washed with distilled water and left to dry on filter paper. Cuticles were checked under the light microscope to check for homogeneity. Two cuticle slices were mounted on an aluminium specimen stub using carbon adhesive discs (Agar Scientific Ltd.). The external surface of the cuticle was observed on untreated leaf slices and leaf slices were placed in chloroform to remove wax. These samples were mounted on to a specimen stub as above. Specimens were sputter coated with 60% gold and 40% palladium for two minutes in an Emscope SC500 sputter coater. Examination of all cuticles was done using a Hitachi S-4700 II scanning electron microscope (SEM) at the University of Edinburgh. Accelerating voltage was 5 kilovolts (kV), working distance varied from 12.8 to 16.5 mm and it was found that optimal images were obtained by setting

LensMode to Analysis, instead of Normal. For the external surface of the cuticle, images were taken of the abaxial and adaxial surface with and without wax at $\times 250$ magnification. Close up pictures were taken of the stomatal complex with and without wax removed, a group of stomata and the guard cells. Images of the internal surface abaxial and adaxial surfaces of the cuticle were taken at $\times 250$ magnification. All stubs are deposited at the Royal Botanic Garden Edinburgh.

Conservation assessments have been applied to both species using the IUCN guidelines (IUCN 2001, IUCN Standards and Petitions Working Group 2010).

Taxonomy

Podocarpus spathoides de Laub., Blumea 30 (1985) 267, descr. emend. hoc loco. Subgen. *Foliolatus* de Laub. TYPE: Malaya, G. Ledang (Mt. Ophir), 3500 ft. [1067 m], 27 Jul 1978, small tree 4 m in mountain thicket. *D.J. de Laubenfels P600* ["male" according to field label; holo L (no cones seen!); iso RSA, image seen (no cones visible!), US, image seen (no cones visible!)]. (Fig. 1A)

Small **tree** up to 4 m tall. Characters of bark or branching not currently known. **Twigs** of first and second years greenish brown, of third year not seen. **Terminal buds** globose or depressed-globose, c. $3.5 \times c. 3$ mm, protected by at least 8 decussate scales in at least three series and at most equalling bud diameter; outermost scales c. 2.5×0.5 – 0.3 mm, lanceolate or ovate, middle ones c. 3.5×0.8 mm, longer and slightly narrower than the inner which are c. 2.7×1 mm; all scales lacking keels, outer ones purplish tinged, inner ones brownish, outer ones acute with recurved or reflexed tips, inner ones obtuse and erect, their margins entire, hyaline in distal half, the laminar part of the scale smooth. **Scale leaves** absent in reproductive zones. **Foliage leaves** spirally arranged, adult ones 3–8 mm apart and diverging from axis at 45 – 60° , juvenile ones 5–14 mm apart and diverging at 50 – 85° , all petiolate; petiole 5–8 mm, not distinctly twisted, decurrent; lamina crimson or purplish and glaucous when flushing, turning deep green (drying brownish green) and glossy above, paler and matt beneath with dark midrib, narrowly elliptic, elliptic, narrowly oblong-elliptic or oblong-elliptic, adult ones $(30\text{--})55$ – 85×9.5 – 13 mm, juvenile ones rather longer and wider, 65 – 100×14 – 20 mm, all straight (not falcate), thick and coriaceous, stiff, shallowly transversely convex or flat adaxially; margin not thickened (or only slightly so, when young) nor revolute, normally not undulating unless as a response to insect damage; midrib relatively broad (1.3–2 mm wide), with striate band on either side beneath, raised both above and beneath, on upper (adaxial) surface impressed in a broad channel equivalent to the striate bands of the lower (abaxial) surface, on abaxial surface darker than rest of lamina; apex obtuse or broadly rounded, not ending in a drip tip, sometimes blackening; base cuneate or shortly attenuate. Pollen and seed cones not seen. "**Female cones** on 2–6 mm peduncles; **basal foliola** 1.5 mm long; **receptacle** 5 mm long; **seed** 7×5 mm" (translated by R.R.M. from the Latin protologue of de Laubenfels 1985: 267).

Distribution. *Podocarpus spathoides* is here regarded as endemic to Peninsular Malaysia and known only from the type locality. Records from the Solomon Islands belong to the new species *Podocarpus orarius* R.R.Mill & M.Whiting described below. Other records from east of Wallace's Line (Rossel I., Morotai, Kepulauan Talaud) are considered in the Discussion but excluded from the species. A specimen (Paie 32883, K) has also been collected under the name *P. spathoides* from Lawas, Sarawak but is currently missing from the Kew herbarium so cannot be considered further at present; according to Farjon (*pers. comm.*, 26 Jan. 2011) it was from a tree 18 m tall bearing yellow (presumably unripe) female cones. If it is correctly named, it would truly extend the range of *P. spathoides* to Sarawak as stated by Farjon (2010a, 2010b).

Habitat and ecology. At the type locality *P. spathoides* occurs in low shrubby vegetation and stunted forest on exposed ridges from c. 1000 m asl to the summit (1276 m asl), above the altitudinal limit of *Podocarpus ridleyi* N.E.Gray (Farjon 2010b).

IUCN conservation assessment. In the present state of knowledge, *Podocarpus spathoides* is best regarded as DD (Data Deficient), the category assigned to it by Farjon (2010a, 2010b) albeit for different reasons. Farjon's assessment was based on the assumption that, given the very scattered distribution of the species as circumscribed by him, it could perhaps be more widespread. The much more restricted distribution accepted here paints a totally different picture about the possible threat to the species and the species is more likely to fall within one of the threatened categories. However, at present DD is still appropriate since more data concerning its current status at the type locality, the level of threat there, and the identity of the putative collection from Sarawak, are all required.

Local names. None recorded.

Other specimens seen (* denotes specimen utilised for examination of leaf cuticle).

MALAYSIA. G. Ledang (Mt. Ophir), 4000 ft [1219 m], 27 Jul 1978, "sprouts ½ m", *D.J. de Laubenfels P596* (L: juvenile); *ibid.*, 4000 ft. [1219 m], 27 Jul 1978, "young plant 2 m", *D.J. de Laubenfels P597* (L); *ibid.*, 4000 ft. [1219 m], 27 Jul 1978, *D.J. de Laubenfels P598* (L*; "female" according to label but no cones present).

Note. If the description of the female cones of *Podocarpus spathoides* given in the protologue by de Laubenfels (1985) can be relied upon (as noted above, no cones from the type locality have been seen to verify their morphology), the Malay plant differs from *P. orarius* in having considerably shorter peduncles and foliola, smaller receptacles and shorter, narrower seeds. These differences, should they hold true, are additional to those given below in the diagnosis of *P. orarius*.

Podocarpus orarius R.R.Mill & M.Whiting, **sp. nov.** Subgen. *Foliolatus* de Laub.
A Podocarpo spathoide de Laub. habitu multo altiore (usque ad 35 m haud 4 m tantum)

gemmis terminalibus in ramulis duplo longioribus anguste conicis non subglobosis squamis diametro gemmae multo longioribus haud aequalibus interioribus caudatis vel longe attenuatis nec exterioribus nec interioribus reflexis, foliis novellis pallide viridibus roseo tincto (haud purpurascentibus) herbaceis demum subcoriaceis tantum (non coriaceis) costa nec supra nec infra elevata inferne quam lamina distincte pallidior (haud atriore), ramulis cum foliis inferis persistentibus (haud caducis) differt. A Podocarpo insulari de Laub. foliis multo longioribus latioribusque et squamis gemmarum terminalium exterioribus haud valde reflexis insignis. A Podocarpo salomoniensi Wasscher foliis multo latioribus (12–19 mm non 6.5–8 mm) oblongo-ellipticis vel oblongis (haud anguste lineari-lanceolatis) ad marginem planis (haud valde revolutis) costa superne indistincto (haud prominenti) et non sulcato, receptaculo fructifero e bracteis duabus vel tribus (haud quattuor decussatis) composito facile distinguitur. Podocarpo rubenti de Laub. foliis novellis rubentibus similis a qua tandem foliis multo majoribus et receptaculo maturo rubro haud purpureo distincta. Podocarpo neriifolio D. Don foliis novellis rubentibus et foliis longis etiam similis a quo perulis gemmarum primariis longioribus 4–8 mm longis, amentis masculis pedicellatis haud sessilibus, receptaculo majore et seminibus subglobosis differt. TYPE: Solomon Islands, Choiseul Province, Choiseul, Loloko District, mainland opposite Bembalama Island, 07° 21' 11.4"S 157° 33' 39.6"E, 20 m, 4 Oct 2008, F. Pitsoa, M.F. Gardner, S. Herrington, P. Kosui, R. Olisae & P. Tofu 7 (ripe female: holotype, E; isotypes, to be distributed to BISH and BSIP). (Fig. 1B, 2 & 3)

Synonyms: *Podocarpus spathoides* de Laub. var. *solomonensis* Silba, J. Int. Conifer Preserv. Soc. 7:1 (2000) 39. — *P. spathoides* de Laub. subsp. *solomonensis* (Silba) Silba, J. Int. Conifer Preserv. Soc. 17:1 (2010) 19. TYPE: Solomon Islands, T.C. Whitmore BSIP 5247 (holo L, iso K).

Erect or sometimes leaning single- or less commonly multi-stemmed dioecious **tree** to 35 m tall, up to 20 cm dbh. **Crown** rather narrow and ellipsoid (Fig. 2A). **Bark** (Fig. 2B) smooth, flaking, shallowly fissured; outer bark medium brown, inner bark pinkish brown, wood straw-coloured. **Twigs** of first year pale grey green and herbaceous, of second year pale green or brownish green; growing tip purplish. **Terminal buds** narrowly conical, 4–8 × c. 1 mm, protected by about 8 decussate, narrowly lanceolate scales in two series and much longer than bud diameter; outer scales 4–8 × 0.2–0.3 mm, longer and slightly broader than the inner which are 3–5.5 × 0.1–0.25 mm; all scales lacking keels, purplish at base (purplish tinge fading with age), green towards tip, long-caudate or long-attenuate, obtuse at extreme tip, erect or the outer ones only slightly recurved, their margins hyaline in distal half, the laminar part of the scale rugose. **Scale leaves** present in reproductive zones with an abrupt transition to foliage leaves. **Foliage leaves** present on penultimate and lower axes as well as ultimate ones, those on the penultimate and lower axes long-persistent on young trees but caducous on older ones; juvenile and adult foliage leaves similar in shape and size; leaves spirally arranged, those of adult trees 6–25 mm apart and diverging at 60–85°, of juvenile trees 3–15 mm apart and diverging at 60–85°, all leaves petiolate; petiole 4–6

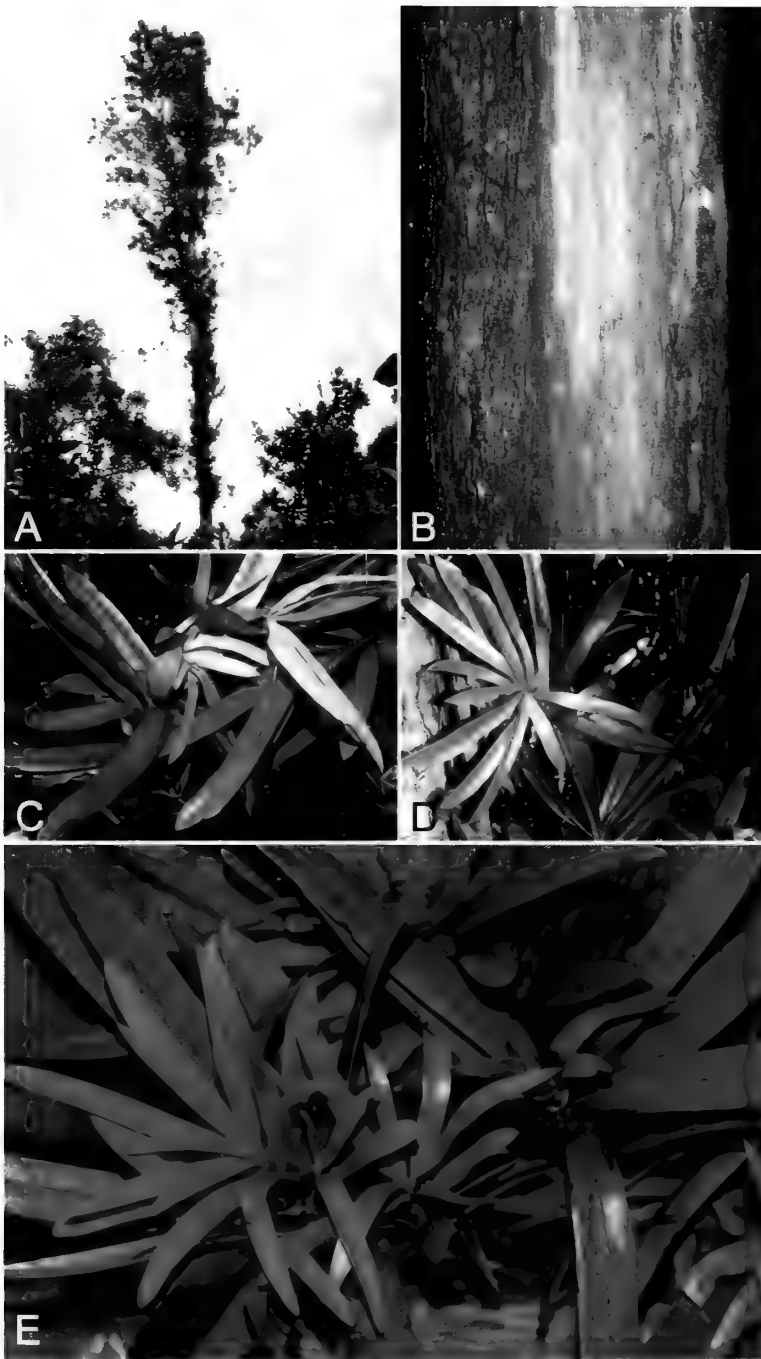


Fig. 2. *Podocarpus orarius* R.R.Mill & M.Whiting: vegetative features. **A.** Habit (*Pitisopa et al.* 78, in field). **B.** Bark (*Pitisopa et al.* 6, in field). **C.** Mature foliage, Choiseul (*Pitisopa et al.* 6, in field). **D.** Flushing leaves, Choiseul (*Pitisopa et al.* 6, in field). **E.** Flushing leaves, Santa Isabel (*Pitisopa et al.* 78, in field). (Photos: M.F. Gardner).

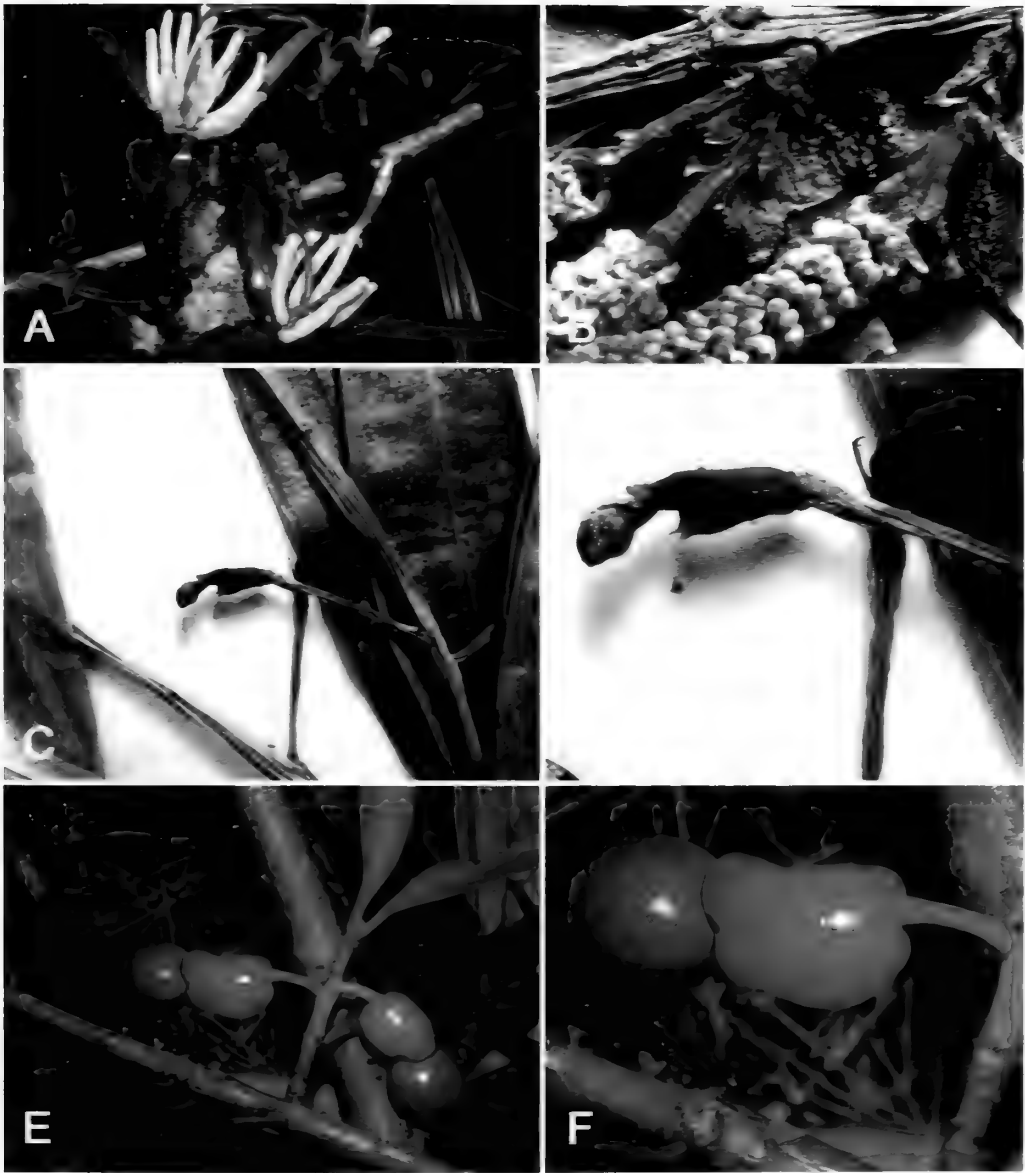


Fig. 3. *Ptilodagras worms* R.R. Mill & M. Whiting: reproductive features. A. Male cones (*Ptilodagras* sp. 5) in field. B. Lower part of male cones in close-up showing peduncle scales and microsporangia (*Ptilodagras* sp. 5). C. Two young female cones (*Ptilodagras* sp. 4). D. Detail of young female cones (*Ptilodagras* sp. 4). E. Ripe (left) and unripe (right) female cones (*Ptilodagras* sp. 7) in field. F. Ripe female cone in close-up (*Ptilodagras* sp. 7) in field. (Photos: A, E & F, M.F. Gardner; B, C & D, R.R. Mill).

mm, twisted, not or scarcely decurrent; lamina light green tinged pink on both surfaces when flushing (Fig. 2C & 2D) but not glaucous, turning deep glossy green above but much paler beneath (Fig. 2E), younger leaves held suberect but older ones becoming horizontally spreading, (sometimes narrowly) elliptic, oblong-elliptic or oblong, (50–)70–195 × (10.5–)12–20 mm with little difference in size between juvenile and adult leaves, straight, falcate throughout or not, thin, flexible and herbaceous at first becoming thicker, stiff and subcoriaceous with age, shallowly concave adaxially; margin scarcely thickened, very slightly undulating or not, not revolute; midrib narrow (0.2–0.3 mm wide), with indistinct striate band on either side beneath, not or only slightly raised on both surfaces, not impressed on upper (adaxial) surface, on lower (abaxial) surface markedly paler than rest of lamina; apex acute or subacute, not ending in a drip-tip, sometimes blackening; base cuneate or shortly attenuate. **Pollen cones** shedding pollen at same time as leaf flushing, shedding from base to tip, lateral, subtended by a scale leaf and arising on current growth just above bud scales of previous season, solitary or paired, up to 12 together but individual groups composed of not more than 3 (Fig. 3A); common peduncle absent; individual pollen cones (Fig. 3B) pedicellate, the pedicel 3–9 mm, shorter than cone, straight, erecto-patent, with spreading pedicel scales and surrounded by basal scales; basal scales c. 4, light brown, suberect and encircling base of pedicel, not keeled, ovate-lanceolate and rather narrow (outer ones c. 3 × 1.5 mm, inner ones c. 1 × 1 mm), acute, muticous, with very narrow entire scarious hyaline margins; scales on pedicels decurrent at base, 5 or usually 6, spirally arranged, c. 1.3–1.7 × 1 mm, pinkish-brown, subadpressed to erecto-patent, not keeled, oblong-ovate, subacute, muticous, with crenulate scarious hyaline margins; pollen cones erect, suberect or spreading outwards, 20–36 × 2–3.5 mm, cream or lemon-yellow, lighter than and contrasting with foliage, tapering slightly distally, narrowly cylindrical, curved from base or in distal half; microsporophyll phyllotaxis 13/34 with c. 32 short spirals of 3–4 microsporophylls and c. 26 long spirals of 5–6 microsporophylls per cone; **microsporophylls** c. 250 per cone, c. 1 mm; microsporophyll lamina greenish at base with pinkish tip, the free part at apex broadly triangular or deltate, c. 0.25 × 0.2 mm, not up-turned, with crenulate, somewhat hyaline and fimbriate margin, not scarious, truncate at apex; **microsporangia** slightly oblique and divergent, free, cream, ellipsoid, c. 0.7 × 0.5 mm, the stomium elliptic when open with hood at top, the microsporangial walls scarious-margined; pollen milky-white or hyaline. **Seed cones** borne on current growth, paired, lateral on a specialized reproductive shoot subtended by a leaf or bract; receptive cones (Fig. 3C & 3D) borne among leaves but presented on long peduncles (up to 16 mm, longer than both the receptive cone complex and the receptacle); subtending scale 1, c. 1 × 0.7 mm, light brown, not keeled, ± rectangular with a narrower, subacute muticous tip and very narrow scarious margin, falling before cone is ripe; peduncles horizontal both when receptive and when ripe, ridged, compressed, broadening distally; ripe cones (Fig. 3E & 3F) horizontal, the peduncle on cones seen 10–11 mm and now shorter than both the whole cone complex and the receptacle; **prophylls (foliola)** light green tipped purplish, narrowly lanceolate, c. 2.5 × 0.2 mm, erecto-patent at receptivity, soon caducous, if present when ripe then deflexed, straight throughout their life with acute, ± cucullate apex; **receptacle** fleshy

when ripe, composed of 1 fertile and 1 or 2 sterile bracts, asymmetrical, obovoid and infundibular at receptivity, rectangular-ellipsoid at maturity and then 10–13.5 mm along longest edge, 8.5–10.5 mm along shortest edge, 5.5–7.5 mm wide at top, greenish at receptivity (Fig. 3C & 3D), turning yellow and finally deep vermilion at maturity (Fig. 3E & 3F), not glaucous at any stage; fertile bract longer than both ovule and seed, erect at receptivity, with median longitudinal groove; receptacular scales all connate and \pm wholly fused, with short, broad, lip-like free tips that are erect *in vivo*, slightly bent outwards and $2\text{--}3 \times 4\text{--}5$ mm (fertile bract) and $1\text{--}2.5 \times 2\text{--}3$ mm (sterile bract) *in sicco*, swollen and fleshy at maturity; **seed** asymmetrically placed on receptacle, subglobose, $11\text{--}12 \times 9\text{--}9.5$ mm, laterally compressed, not crested at topographically distal (chalazal) end, without a notch or beak at micropylar end, the micropyle arch-like at receptivity, pinkish brown, 2-pronged; seed coat and epimatium olive green without purplish tinge even when fully ripe, glaucous at receptivity, wrinkled and rugose when dry; **cotyledons** unknown.

Phenology. Male and young female cones present in early October (and possibly earlier); new leaves flushing at same time. Ripe female cones (of previous year) also present in early October together with slightly unripe ones; therefore time from pollination to ripening is c. 12 months.

Distribution. At present only known with certainty from the Solomon Islands archipelago and therefore currently regarded as endemic there. However, images of similar material have been seen from Vanuatu (islands of Erromango and Aneityum) that are superficially similar to *Podocarpus orarius*. These sheets have been determined as *Podocarpus insularis* by de Laubenfels (in sched.) but are not that species, the type of which has much smaller leaves as noted above; nor are they *P. neriifolius* which was the only *Podocarpus* species recorded from those islands by Schmid (1975). They have the large, broad leaves of *Podocarpus orarius* but examination of the actual specimens will be necessary to determine whether they are conspecific with it or not. If they are conspecific, they would extend the geographic range of *Podocarpus orarius* to the neighbouring Vanuatu archipelago.

Habitat and ecology. *Podocarpus orarius* occurs on steep slopes of primary coastal rainforest, often with species of *Gymnostoma* L.A.S. Johnson (Casuarinaceae); also in secondary rainforest; 1–60(–460) m asl. Recent collections on the Solomons have all been by the coast below 40 m asl but, as indicated in the specimen citations below, it has in the past been collected on Guadalcanal up to an altitude of just over 450 m asl. The species should therefore also be searched for at higher altitudes and in the interior of the islands; on Guadalcanal and New Georgia at least, there is evidence (from the information on the labels of *Lipaqeto BSIP 3321* and *Waterhouse 209*) that trees of the species do (or did) occur away from the coast.

IUCN conservation assessment. NT (Near Threatened). There is no substantial evidence of decline although in some coastal areas there has been some forest destruction with a

few mutilated trees of *P. orarius*. Local information suggests that it is likely that these largely intact forests will be targeted for their timber in the near future, therefore this species will be vulnerable to any change in land use. The nearby nickel mines on the island of San Jorge are also a potential future threat. Previously listed as DD, under the name *Podocarpus spathoides*, by Pippard (2008, App. 2 p. 5) based on a 1998 assessment.

Notes. The type of *Podocarpus orarius* was collected at the same site as the type locality of *P. spathoides* var. *solomonensis*. We have chosen to describe a new species rather than raise Silba's varietal epithet to species rank for two reasons: the similarity of 'solomonensis' to 'salomoniensis' which is already in use for a completely different species of *Podocarpus*, and the brief and unsatisfactory nature of Silba's protologue which contained only the bare minimum of information required to validate the name. The type of Silba's name was also a sterile specimen, whereas both male and female specimens (the females at two different stages) as well as more juvenile specimens were collected in 2008, allowing the preparation of a much more complete description from these and the other available material.

Local names. Locally known on Choiseul and Guadalcanal as *Dengali* in the Kwara'ae language (*Whitmore 5247, Lipaqeto BSIP 3321*) and on Santa Isabel as *Graoragota* (female) in the Maringe dialect of the Cheke Holo language (*Pitisopa et al. 72, 73, 90, 91, 92, 95, 103, 104, 105*). *Graoragota* is also used for *Podocarpus salomoniensis* according to the notes on *Pitisopa et al. 96* (E).

Etymology. The epithet *orarius* is Latin for 'coastal' and alludes to what appears to be, from the majority of collections seen, the typical habitat of the species.

Other specimens examined (* denotes specimen utilised for examination of leaf cuticle): SOLOMON ISLANDS. **Choiseul Province:** Choiseul, ultrabasic hill on coast opposite Bembalama Island, 3 Mar 1964, *T.C. Whitmore BSIP 5247* (L, sterile, holotype of *P. spathoides* var. *solomonensis* Silba; K, isotype of *P. spathoides* var. *solomonensis*); Loloko District, mainland opposite Bembalama Island, 07° 21' 11.4"S 157° 33' 39.6"E, 20 m, 4 Oct 2008, *F. Pitisopa, M.F. Gardner, S. Herrington, P. Kosui, R. Olisae & P. Tofu 5* (E, BSIP, BISH; male); *ibid.*, *F. Pitisopa, M.F. Gardner, S. Herrington, P. Kosui, R. Olisae & P. Tofu 6* (E, BSIP, BISH; immature female). **Isabel Province:** Santa Isabel, Turungurungu Island, San Jorge, sea level, 25 Sep 1965, *E.J.H. Corner 2737* (K, L); Bughotu District, San Jorge, Turunghu Island, east of the village of Talise, 08° 27' 57.2"S 159° 38' 21.7"E, 35 m, 16 Oct 2008, *F. Pitisopa, M.F. Gardner, S. Herrington, P. Kosui, R. Olisae & P. Tofu 72* (E, BSIP, BISH); *ibid.*, *F. Pitisopa, M.F. Gardner, S. Herrington, P. Kosui, R. Olisae & P. Tofu 73* (E, BSIP, BISH); Bughotu District, San Jorge, Tupilla Island, 08° 27' 0.68"S 159° 38' 28.8" E, 1 m, 16 Oct 2008, *F. Pitisopa, M.F. Gardner, S. Herrington, P. Kosui, R. Olisae & P. Tofu 78* (E*, BSIP; immature female: cuticle of both young flushing leaf and adult leaf examined); Bughotu District, San Jorge, Ramahale Point, 08° 29' 34.8"S 159° 38' 59.8"E, 15 m, 17 Oct 2008, *F. Pitisopa, M.F. Gardner, S. Herrington, P. Kosui, R. Olisae & P. Tofu 83* (E*, BSIP, BISH; sterile: cuticle of adult leaf examined); Bughotu District, San Jorge, Gobu Bay, 08° 29' 37.7"S 159° 38' 47.5"E,

5 m, 17 Oct 2008, *F. Pitisopa*, *M.F. Gardner*, *S. Herrington*, *P. Kosui*, *R. Olisae* & *P. Tofu 90* (E, BSIP, BISH); Bughotu District, San Jorge, Gobu Bay, 08° 29' 37.7"S 159° 38' 47.6"E, 6 m, 17 Oct 2008, *F. Pitisopa*, *M.F. Gardner*, *S. Herrington*, *P. Kosui*, *R. Olisae* & *P. Tofu 91* (E, BSIP, BISH; young female); Bughotu District, San Jorge, Gobu Bay, 08° 29' 37.5"S 159° 38' 47.7"E, 6 m, 17 Oct 2008, *F. Pitisopa*, *M.F. Gardner*, *S. Herrington*, *P. Kosui*, *R. Olisae* & *P. Tofu 92* (E, BSIP, BISH; immature female); Bughotu District, San Jorge, Simia River c. 0.5 km from mouth of river, 08° 32' 31.7"S 159° 38' 45.4"E, 12 m, 18 Oct 2008, *F. Pitisopa*, *M.F. Gardner*, *S. Herrington*, *P. Kosui*, *R. Olisae* & *P. Tofu 102* (E, BSIP, BISH); Bughotu District, San Jorge, Kogaruta Bay, 08° 30' 14.4" S 159° 41' 1"E, 1 m, 18 Oct 2008, *F. Pitisopa*, *M.F. Gardner*, *S. Herrington*, *P. Kosui*, *R. Olisae* & *P. Tofu 103* (E, BSIP, BISH); Bughotu District, San Jorge, Tanegula, 08° 29' 51.1" S 159° 41' 4.8"E, 1 m, 18 Oct 2008, *F. Pitisopa*, *M.F. Gardner*, *S. Herrington*, *P. Kosui*, *R. Olisae* & *P. Tofu 104* (E, BSIP, BISH); Bughotu District, San Jorge, Turunghu Island, east of the village of Talise, 08° 27' 57"S 159° 38' 1.7"E, 1 m, 18 Oct 2008, *F. Pitisopa*, *M.F. Gardner*, *S. Herrington*, *P. Kosui*, *R. Olisae* & *P. Tofu 105* (E, BSIP, BISH). **Guadalcanal Province:** Guadalcanal, Eastern slopes of Mt. Gallego, 1500 ft. [457 m], 08 Aug 1965, *T. Whitmore 2079* (K). Rere River, c. 3 miles inland, 200 ft. [61 m], 19 Nov 1963, *Z. Lipaeto BSIP 3321* (K). **Western Province:** New Georgia, grown in garden on coast, originating from interior (Kusage), 26 Jul 1929, *J.H.L. Waterhouse 209* (K, 2 sheets: cited by Gray, 1958 under *P. neriifolius*).

Cuticle micromorphology

Podocarpus spathoides (Fig. 4A–H). **External surface.** Adaxial epidermal cells (Fig. 4A) indistinctly visible, abaxial ones (Fig. 4B) clearly visible on external surface of cuticle. Stomatal plugs present, forming a popcorn-like amorphous, very porous interconnected network (Fig. 4C inset). Stomata without Florin rings but surface upraised (Fig. 4C). **Internal surface: epidermal cells.** Adaxial epidermis cells (Fig. 4D & 4E) polygonal, square to elliptic or rectangular (either longitudinally or less commonly transversely); walls slightly undulating, no cavities along wall flanges; periclinal surfaces fibrous-granular with numerous small holes. Abaxial epidermal cells (Fig. 4F & 4G) narrowly rectangular to rectangular or oblong-polygonal; those adjoining stomata trapezoidal or arcuate, those within stomata rows transversely elliptic / rectangular or polygonal; walls straight or curved, not buttressed though edges irregularly frilled, cavities along wall flanges indistinct or absent; periclinal surfaces rather coarsely granular. **Internal surface: stomatal arrangement.** Stomata in discontinuous rows on abaxial surface (hypostomatic), parallel to long axis of leaf with \pm no deflection of individual stomata; stomatal chains developed (Fig. 4F). **Stomata** (Fig. 4G & 4H) brachyparacytic, close together within same row, separated by 1 or 2 epidermal cells; adjacent rows widely spaced, separated by (1–)2–3(–5) rows of epidermal cells; horizontal stomata rows absent. **Stomatal apparatus** (including subsidiary cells) suborbicular (Fig. 4G & 4H). **Stoma** (excluding subsidiary cells) suborbicular to \pm square, the opening elliptic and often wide (Fig. 4G & 4H). **Subsidiary cells:** 2 most common, 3 frequent, 4 rare; polar subsidiary cells absent; cuticle on outer flanges thick, with no groove but cuticle with a deep crease that is hidden by lateral

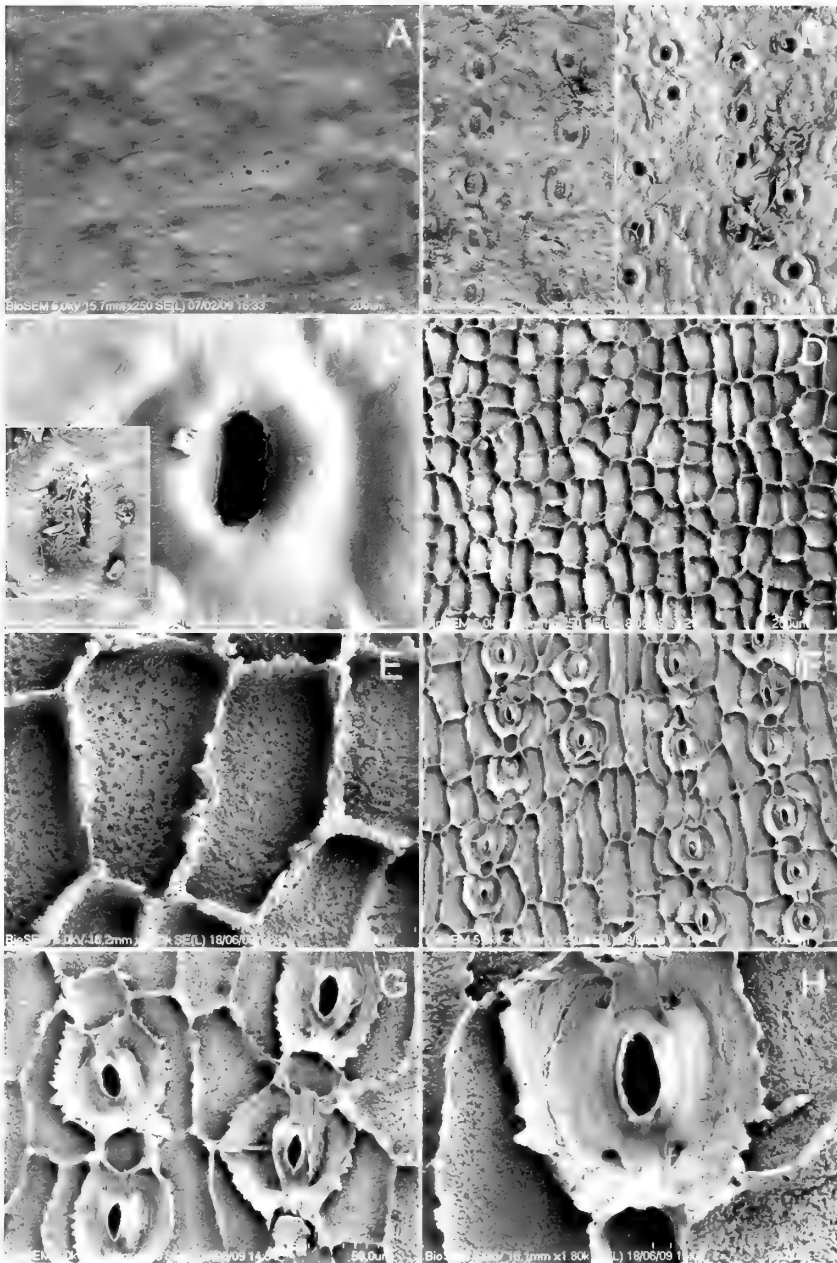


Fig. 4. *Podocarpus spathoides* de Laub.: cuticle micromorphology (all from *de Laubenfels P598, L*). **A.** Adaxial external surface. **B.** Abaxial external surface; composite image showing (left half) untreated cuticle with wax plugs covering stomata, (right half) cuticle treated with chloroform, stomata with wax plugs removed. **C.** external view of stoma; (inset) detail of wax plug before treatment. **D.** Adaxial epidermal surface. **E.** Adaxial epidermal cells. **F.** Abaxial epidermis with stomatal rows and epidermal cells. **G.** Group of stomata. **H.** Stomatal complex. Scale bars: A, B, D, F, 200 micrometres (μm); C, 20 μm ; E, 40 μm ; G, 50 μm ; H, 30 μm . (Photos: M. Whiting).

flange extensions (Fig. 4G, top left); margins of subsidiary cell wall flanges irregularly denticulate, the teeth incurving; thinning of cuticle present in an arc midway across the subsidiary cell; texture fibrous-granular. **Cuticle flange between guard cells** smooth towards outside of flange, slightly more rugose towards stoma, apparently not inrolled, not standing out laterally (Fig. 4H). **Polar extensions** always present, ribbon-like, thin and broad, wholly fused with subsidiary cells, longer than broad, with a central ridge, flaring outwards from the base (Fig. 4H). **Cuticle on guard cell surfaces** rugose.

Podocarpus orarius (Fig. 5A–H & 6A–F). **External surface.** Abaxial and adaxial epidermal cells clearly visible on external surface of cuticle (Fig. 5A, 5B, 6A & 6B). Stomatal plugs present (Fig. 5A & 6A), composed of dendroid or coralloid fibrous rodlets (Fig. 5C inset & 6C), porous. Stomata without Florin rings but surface somewhat upraised (Fig. 5C), especially when young (Fig. 6C & 6D). Developing lateral subsidiary cells forming ridges either side of stomata, these ridges continuing along the stomatal rows on young leaves, connecting one stoma with the next (Fig. 6A & 6B), this feature becoming much less evident on mature leaves (Fig. 5B, right). **Internal surface: epidermal cells.** Adaxial epidermis cells (Fig. 5D & 5E) rectangular, trapezoidal, square or transversely rectangular; walls straight or curved, not buttressed though edges irregularly frilled, cavities along wall flanges present, more distinct than in *P. spathoides*; periclinal surfaces granular with numerous small, rectangular pits. Abaxial epidermal cells (Fig. 5F & 5G) narrowly rectangular to rectangular or oblong-polygonal, those adjacent to stomata arcuate-rectangular or trapezoidal, those within stomata rows transversely elliptic or suborbicular-polygonal; walls straight, curved, or slightly undulating, not buttressed though edges irregularly frilled, distinct small cavities present along wall flanges; periclinal surfaces granular with scattered small \pm rectangular pits. **Internal surface: stomatal arrangement.** Stomata in discontinuous rows on abaxial surface (hypostomatic), parallel to long axis of leaf with some noticeably deflected; short stomatal chains sometimes developed. **Stomata** (Fig. 5G & 5H) brachyparacytic, close together within same row and separated by (1)–2(–3) epidermal cells; adjacent rows widely spaced and separated by (2)–3–6 rows of epidermal cells; horizontal stomata rows absent. **Stomatal apparatus** (including subsidiary cells) transversely oblong or elliptic. **Stoma** (excluding subsidiary cells) rectangular, the opening elliptic (Fig. 5H). **Subsidiary cells:** 2 most common, 3 or 4 occur; polar subsidiary cells absent; cuticle on outer flanges thick, with no visible groove or crease (Fig. 5G & 5H); margins of subsidiary cell wall flanges irregularly denticulate, the teeth incurving; thinning of cuticle present in an arc midway across the subsidiary cell (Fig. 5H); texture fibrous-granular. **Cuticle flange between guard cells** thick, smooth towards edge, finely rugose towards stoma, slightly inrolled or not, not standing out laterally. **Polar extensions** always present, ribbon-like, wholly fused with subsidiary cells, longer than broad, with a rather indistinct central ridge, flaring outwards only distally (Fig. 5H). **Cuticle on guard cell surfaces** rugose.

The cuticle micromorphology of *Podocarpus spathoides* (Fig. 4) and *P. orarius* (Fig. 5 & 6) at first sight appears very similar and indeed there are many characters

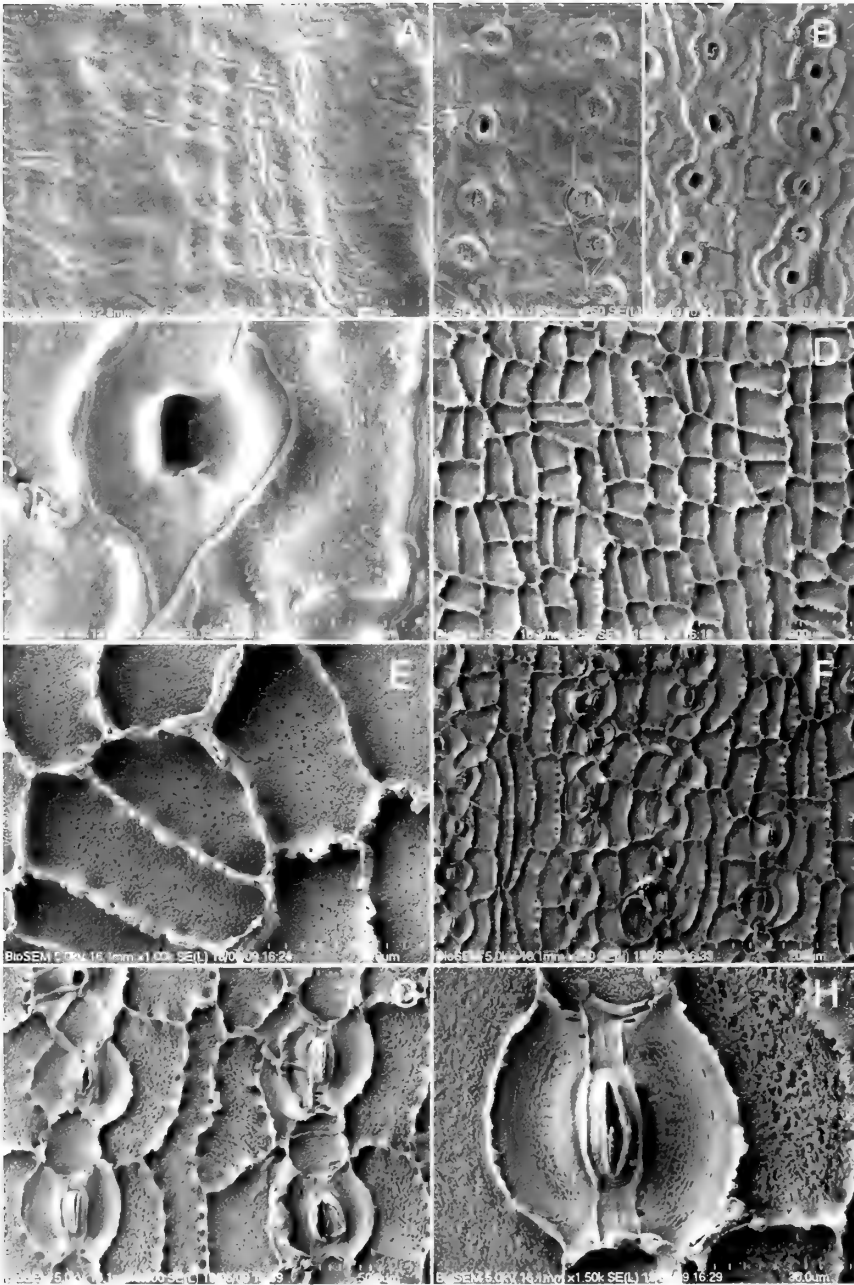


Fig. 5. *Podocarpus orarius* R.R.Mill & M.Whiting: cuticle micromorphology (adult leaves, fully developed, *Pitisopa et al.* 78 & 83). **A.** Adaxial external surface. **B.** Abaxial external surface: composite image showing (left half) untreated cuticle with wax plugs covering stomata, (right half) cuticle treated with chloroform, stomata with wax plugs removed. **C.** External view of stoma; (inset) detail of wax plug before treatment. **D.** Adaxial epidermal surface. **E.** Adaxial epidermal cells. **F.** Abaxial epidermis with stomatal rows and epidermal cells. **G.** Group of stomata. **H.** Stomatal complex. Scale bars: A, B, D, F, 200 μm ; C, 40 μm ; E, G, 50 μm ; H, 30 μm . (Photos: M. Whiting).

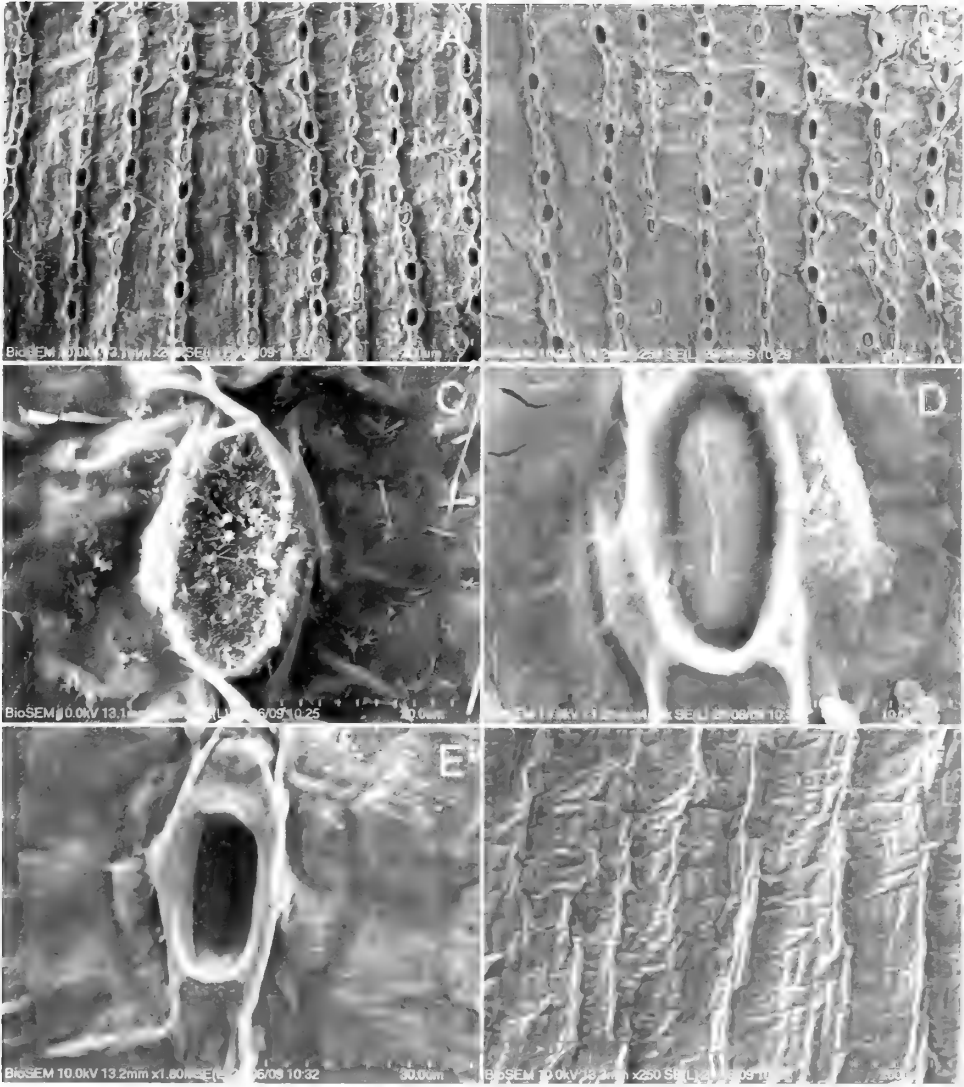


Fig. 6. *Podocarpus orarius* R.R.Mill & M.Whiting: cuticle micromorphology (very young, flushing leaf, *Pitisopa et al.* 78). **A.** external surface, abaxial cuticle, before treatment. **B.** external surface, abaxial cuticle, after treatment with chloroform to remove wax. **C.** Stoma before treatment, showing wax plug apparently sitting on guard cells within peristomatal chamber. **D.** Stoma after treatment with chloroform to remove wax; guard cells closed. **E.** Another stoma with wax removed showing peristomatal chamber. **F.** External surface, adaxial cuticle. Scale bars: A, B, D, F, 200 µm; C, 20 µm; D, 10 µm; E, 30 µm. (Photos: M. Whiting).

in common. However, closer examination of the images reveals some significant differences that, when combined with the gross morphological differences and the major disjunctions in both distribution and altitude, support separation of *P. orarius*. On the external adaxial cuticle, no obvious sculpturing is visible in *P. spathoides* (Fig. 4A) but *P. orarius* has a pattern of ridges and hollows that corresponds to the shapes of the adaxial cells as revealed from the inner cuticle surface (Fig. 5A, 5D & 6F). This pattern is particularly evident on young leaves (Fig. 6F). The sculpturing pattern of the abaxial external cuticle of *P. orarius* is also very prominent, especially after treatment with chloroform to remove wax (Fig. 5B, right); *P. spathoides* also has some sculpturing on this surface but it is different and less distinct (Fig. 4B). The internal cuticle also reveals differences between the Malaysian (*P. spathoides*) and Solomon Islands (*P. orarius*) specimens. In *P. spathoides* the guard cell 'wings' are fairly large and often cover a fairly deep and porous groove on the lateral subsidiary cells, whereas in *P. orarius* the guard cell 'wings' are usually absent or relatively small and the lateral subsidiary cells of the stomatal complex have only a slight groove or porous area. Small cavities (more distinct on the abaxial surface than the adaxial) are present alongside the epidermal cell walls on both leaf surfaces in *P. orarius* (Fig. 5E & 5G) but these were not observed in *P. spathoides* (Fig. 4E & 4G). The periclinal surfaces of the adaxial epidermal cells have a more coarsely granular texture in *Podocarpus spathoides* (Fig. 4E) than in *P. orarius* (Fig. 5E). Finally, the margins of the lateral subsidiary cells are noticeably more irregular and 'jagged' in appearance in *P. spathoides* and are clearly outspread (Fig. 4H) compared with *P. orarius* in which they are almost smooth and even tend to curl inwards (Fig. 5H).

Examination of the cuticle of an immature leaf of *Podocarpus orarius* shows that in this species the wax plug/layer appears to sit on the guard cells within the peristomatal chamber early in development (Fig. 6C & 6D). The lateral subsidiary cells at this point form a narrow ridge either side of the guard cells (Fig. 6C & 6D). These ridges continue beyond the stomata to link all the stomata in the row but the feature gradually becomes less evident as the leaf becomes fully developed (Fig. 5B, right). In other *Podocarpus* species Whiting (2009) found that the wax plug sits high in the peristomatal chamber with a relatively large gap between the wax plug and the guard cells. It was also found that the base of the wax plug often reflected the shape of the guard cells somewhat (Whiting 2009). The shape of the wax plug therefore indicates that it was once seated on the guard cells (as seen in Fig. 6C–E) although the latter have changed in shape or position. It is possible that as the subsidiary cells develop and expand, they push or rotate the guard cells downwards. The layer of wax occurring on the guard cells may be displaced, leaving a wax layer fixed between the subsidiary cells and with a gap between the wax plug and the guard cells. Another explanation would be that the wax plug has been lifted and compressed by the lateral subsidiary cells causing an overall change in shape of the wax plug. There may be an upward movement of the wax plug as the subsidiary cells expand upwards, particularly in *Podocarpus* subgenus *Podocarpus* in which there is a Florin ring. This topic will be discussed in more detail elsewhere (Whiting 2009, Whiting & Mill in prep.).

Discussion

There are three other *Podocarpus* species that have been definitely recorded from the Solomon Islands: *Podocarpus glaucus* Foxw., *P. insularis* de Laub. and *P. salomoniensis* Wasscher (Wasscher 1941, de Laubenfels 1988). *Podocarpus neriifolius* D. Don has also been recorded (Gray 1958, two specimens cited: Whitmore 1966, Farjon 2010a) but many specimens from the Solomons purporting to be that species have been misidentified and we have not so far seen correctly identified material from there. *Waterhouse 209* at K, cited by Gray (1958) under *P. neriifolius*, bears an annotation slip by Buchholz saying, "Under study – probably juv. form of *P. salomoniensis* Wasscher", and a much later *determinavit* slip by A. Farjon who identified it as *P. insularis*. It is none of those three species and in fact belongs to *P. orarius* of which it represents one of the few inland collections seen.

Podocarpus glaucus is a small-leaved (8–18 mm long; Farjon 2010a) species from relatively high altitudes (normally above 1000 m asl) that cannot be confused with *P. insularis*, *P. salomoniensis* or *P. orarius*. Previous records of *P. salomoniensis* have been from San Cristoval (the type locality and others on that island) and San Jorge (*Corner 2717*, K). It has also been recorded from Bougainville (Foreman 1971); this island is politically part of New Guinea although phytogeographically it forms, together with the Solomon Islands (other than the Santa Cruz group), a well-defined unit that has been called the Solomon Islands rain forests ecoregion (ecoregion AA0119; WWF 2001). Until the 2008 expedition, *P. salomoniensis* had not been recorded from Choiseul but on that expedition it was collected there and also re-collected on San Jorge (M.F. Gardner, pers. comm. 15 Nov 2010). During the 2008 expedition, specimens of *P. salomoniensis* were found at very low altitudes (as low as c. 10 m asl) whereas previously the known altitudinal range had been quoted as being 400–900 m asl (Silba 1986). *Podocarpus salomoniensis* has very narrow leaves (Fig. 1C) and is a very distinct, unmistakable species that cannot be confused with any other *Podocarpus* on the Solomons archipelago or indeed anywhere in Malesia.

Podocarpus insularis de Laub. was based on *Brass 27987* (Fig. 1D) from Mt. Riu on Sudest Island; this is the largest island of the Louisiades Archipelago (New Guinea, Milne Bay District) and is now known as Vanatinai. De Laubenfels (1988) gave its distribution as "New Hebrides [Vanuatu] and all Solomon Islands; in Malesia, New Guinea and adjacent islands: Rossel, Sudest, Misima, Woodlark, Fergusson, and New Britain." The leaves of the holotype (Fig. 1D) and isotype of *P. insularis* measure only 45–70 × 4–7 mm, much shorter and narrower than those of *P. orarius* (Fig. 1B) and smaller also than those of Malaysian *P. spathoides* (Fig. 1A). Farjon in 2007 determined *Whitmore BSIP 5247* at K as *Podocarpus insularis*. Since that specimen is the type of *Podocarpus spathoides* var. *solomonensis*, that name (and the later combination *P. spathoides* subsp. *solomonensis*) would become synonymous with *P. insularis* were Farjon's identification proved to be correct. However, neither the Leiden nor the Kew examples of *Whitmore BSIP 5247* match the type of *Podocarpus insularis*—they have much larger leaves and belong to *P. orarius* described above—and consequently we disagree with Farjon's determination. It is possible that the statement by de Laubenfels

(1988) that *P. insularis* occurs on “all Solomon Islands” is at least partly wrong and that some material of the new species here described as *P. orarius* was included in his original concept of *P. insularis* as well as his circumscription of *P. spathoides*. Until *P. insularis* is revised (a topic beyond the scope of this paper), its account in *Flora Malesiana*, like that of *P. spathoides*, needs to be treated with caution.

Podocarpus neriifolius has large leaves that could perhaps be confused with those of *P. orarius*. However, even in its widest senses as interpreted by Wasscher (1941) and Farjon (2010a), it can be distinguished from *P. orarius* by its shorter, spreading outer bud scales normally not exceeding 5 mm, its shorter receptacles of the female cones (8–10 mm, as opposed to 10–13.5 mm in *P. orarius*), and its purplish-tinged ripe seeds that are more oblong or ovoid than the subglobose seeds of *P. orarius*, being (8–)10–15 × 7–8 mm including the epimatium rather than 11–12 × 9–9.5 mm as in *P. orarius*.

Podocarpus spathoides has also been recorded from the island of Morotai in the north Moluccas, off the north tip of Halmahera (de Laubenfels 1988). The specimen upon which this record was based has been examined and again was found to differ from the Malayan type but although it bears immature male cones it is a rather poor specimen that is here regarded as insufficient as the basis for a formal description. No other material identified as *P. spathoides* has yet been seen from that island. Therefore, formal segregation of the Morotai plant from *P. spathoides* must await the examination of further material, either by discovery of more material in herbaria or by collecting. Similarly, another record of *P. spathoides* from the Moluccas, from the islet of Kepulauan Talaud (Silba 1986) also needs re-evaluation but the material upon which it was based is not known. It is possible that it might have been an error for the Morotai record although Kepulauan Talaud is in a different region of the Moluccas, NE of Sulawesi close to the Philippine Trench.

De Laubenfels (1988) also recorded *P. spathoides* from Rossel Island in the Louisiades Archipelago (New Guinea). These islands lie between New Guinea and the Solomons; Rossel (now known as Yela) is the easternmost of the archipelago. One specimen from Rossel Island has been seen; it was determined in 1979 by de Laubenfels as *Podocarpus spathoides* and is presumably the basis for his record of that species from Rossel Island in *Flora Malesiana* (de Laubenfels 1988). Earlier determinations on this sheet were as *Podocarpus rumphii* (on the sheet's label by an unknown person, possibly the collector) and *P. polystachyus* R.Br. ex Endl. (by de Laubenfels in 1968). De Laubenfels (1988) himself noted that the terminal buds of the Rossel I. specimen were half the size of those from the Solomons, being instead similar in size to those of the type of *P. spathoides* from Mt. Ophir. Also, the leaves are concave adaxially as in *Podocarpus polystachyus* rather than flat as in *P. orarius*. The habitat, “inner edge of mangroves”, is one favoured by *Podocarpus polystachyus* in other areas (Wasscher 1941, Farjon 2010b); it also likes rocky shores (Turner et al. 2000) and limestone karst where it can be very dwarfed (Donnelly et al. 2003). All these are different from the habitats favoured by both *Podocarpus spathoides* and *P. orarius*. De Laubenfels (1988) restricted *P. polystachyus* to a range extending only from the Malay Peninsula through islets off Sumatra to Borneo (especially Sabah, Brunei and Sarawak but also a

few localities in W Kalimantan), the Philippines and western New Guinea (especially the Vogelkop Peninsula): Wasscher (1941) gave a similar range except that he did not include any material from New Guinea. Further study of this Rossel Island plant is therefore needed but it does not belong to either *Podocarpus spathoides* as delimited here or to *P. orarius*.

Henderson 186 (K) from the Solomon Islands (Malaita, Maluu), seen only as an image, has much more tapering and narrower leaves than is typical for *Podocarpus orarius*. Its original label bears the identification *Podocarpus insularis* but the specimen more resembles *P. salomoniensis* than either *P. insularis* or *P. orarius*. However it is not typical of *P. salomoniensis* either and examination of the actual specimen is needed before a definite identification can be made.

The work reported here clearly demonstrates that *Podocarpus spathoides* as delimited by de Laubenfels (1985, 1988) was a mixture of at least three taxa and that *P. insularis* may well have been a mixture too. In the case of *P. spathoides*, de Laubenfels himself acknowledged the possibility that his concept of that species might encompass more than one taxon. Despite that, however, the apparently very disjunctly scattered distribution of *Podocarpus spathoides* sensu de Laubenfels (1988) has been regarded as following a biogeographic pattern by Heads (2001, 2003). In the second of those papers (Heads 2003, Fig. 87) this pattern was graphically illustrated by two lines, one connecting the Malay and Rossel I. populations and the other linking Morotai with the Solomons, based on the comments by de Laubenfels (1988) concerning bud size. The present paper has shown that the Malay, Morotai, Rossel I. and Solomons plants all belong to different taxa, not all of which can at present be given formal names due to the insufficiency in quality and or quantity of the Morotai and Rossel I. material for description or identification. Consequently, the 'pattern' identified by Heads (2003) is in this instance false although in his earlier paper (Heads 2001) he did give other examples of species that show a disjunction between the Malay Peninsula and the Solomons. The present paper emphasises how larger patterns and conclusions, such as in forming biogeographic patterns, might be better based on data generated in unambiguous situations. Particularly in a currently poorly known family such as Podocarpaceae, many of the apparently very wide disjunctions in distribution may turn out to be fictional, based on incompletely understood taxonomy, as in the case of *P. spathoides* that has in part been unravelled here. This also has implications when assessing the conservation status of species such as *Podocarpus spathoides* and *P. insularis*, and highlights that sound taxonomic research is also crucial in underpinning such conservation studies.

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***Distichochlamys benenica* (Zingiberaceae), a new species from Vietnam**

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ABSTRACT. *Distichochlamys benenica* (Zingiberaceae) from north Vietnam is described. Colour plates are provided and the key to *Distichochlamys* species is updated.

Keywords. *Distichochlamys*, Vietnam, Ben En National Park

Introduction

The small ginger genus *Distichochlamys* M.F.Newman is endemic to Vietnam. The type species of the genus, *D. citrea* M.F.Newman, was based on collections from central Vietnam, Bach Ma National Park (Newman 1995). Since then, another two species, *D. orlowii* K. Larsen & M.F.Newman (Larsen & Newman 2001) from central Vietnam, Gia Lai Province, and *D. rubrostriata* W.J.Kress & Rehse (Rehse & Kress 2003) from northern Vietnam, Cuc Phuong National Park, have been described. Morphologically, *Distichochlamys* resembles *Scaphochlamys* Baker but differs by the distichous arrangement of the bracts and tubular bracteoles (vs. spiral bracts and open bracteoles in *Scaphochlamys*). Larsen & Newman (2001) suggested that placing *Distichochlamys* in synonymy under *Scaphochlamys* could not be ruled out yet as early molecular analyses did not seem to be conclusive (Searle & Henderson 2000; Ngambriabsakul 2001). In the more recent studies of Kress et al. (2002) and Ngambriabsakul et al. (2004), the two genera appear to be distinct sister-clades. The geographic disjunction of over 1000 km between *Distichochlamys* and *Scaphochlamys*, which is confined to Malaysia and S. Thailand, provides additional support for retaining them as separate genera.

During recent exploration of northern Vietnam, we encountered a new *Distichochlamys* species, which is described and illustrated below. The key to the species of *Distichochlamys* given by earlier authors (Larsen & Newman 2001; Rehse & Kress 2003) is modified to include the latest addition.

***Distichochlamys benenica* Q.B.Nguyen & Škorničk., sp. nov.** (Fig. 1 & 2)
Distichochlamys rubrostriatae similis, robustior ad 60 cm alta (contra ad 30 cm), staminodiis lateralibus luteis (contra luteis maculis duabus linearibus atrorubris), labello in parte dimidia basali macula rubella (contra clare lutea) differt. TYPE:

Vietnam, Thanh Hoa Province, Nhu Thanh District, Ben En National Park, altitude c. 120–150 m, mixed evergreen forest, limestone, 5 April 2011, *Nguyen Q.B. VNM-B0001352* (holo VNMN; iso E, HN, P, SING).

Terrestrial rhizomatous herb to 60 cm tall. **Rhizome** sympodially branching, c. 7–13 mm in diam., light brown externally, cream white to ochraceous internally with prominent citrol smell, sheathing bracts not seen (decaying very soon and leaving only scars on mature rhizomes), **root tubers** fusiform, 3–8 cm long, 7–10 mm in diam., light brown externally, cream white to ochraceous internally. **Leafy shoots** with a single leaf, tightly arranged forming clumps. **Sheathing bracts** 1–3, inner one to 6 × c. 2 cm wide, outer ones gradually smaller, papery and decaying fast by the time of flowering, glabrous. **Leaf sheaths** 3–5 cm, deep purple, glabrous. **Ligule** bilobed, c. 3 mm long, papery, glabrous, soon decaying. **Petiole** 8–25 cm long, canaliculate, dark red-purple, glabrous. **Lamina** oval to obovate, unequal, 15–28 × 10–14.5 cm, plicate, green above, lighter green with purple shading at the apex beneath, apex subacute to nearly rounded, base rounded to slightly cordate. **Inflorescence** to 15 cm, partly hidden in leaf sheath. **Peduncle** 3–6 cm, c. 4 mm in diam., glabrous, with 2–3 sterile bracts, the outer ones papery, to 6 cm long, decaying fast, the inner ones red purple, c. 3–5 cm long, glabrous, 2 cm broad, apex acuminate. **Spike** 6–10 cm long, consisting of 8–13 bracts. **Bracts** ovate with acute apex; with more or less pink-red tinge, 1.8–3.2 × 1–2.2 cm, glabrous, enclosing cincinnus of 2–3 flowers. **Bracteoles** 13–23 mm long, 8–20 mm in circumference, tubular in basal 2–6 mm, with one keel, translucent white with pink tinge at apex, sparsely shortly hairy. **Calyx** 15–19 mm long, translucent white with slight pink tinge, glabrous but sparsely hairy at apex (margins of teeth), 3 teeth, unilateral slit 8–10 mm. **Floral tube** 18–21 mm, pinkish at base, light yellow towards apex, glabrous externally. **Dorsal corolla lobe** ovate, 16–23 × 6–7 mm, semi-translucent yellow with red tinge at apex, glabrous, apex mucronate, mucro 2.5 mm, shortly hairy. **Lateral corolla lobes** ovate, 16–20 × 6–8 mm, semi-translucent yellow with red tinge at apex, apex slightly concave, glabrous. **Labellum** broadly spathulate, bilobed at apex, 21–23 mm long, 18–21 mm broad at apex, c. 5 mm broad at base, lobes more or less rounded, split c. 7–8 mm, yellow with red-orange central patch, with short glandular hair. **Lateral staminodes** obovate, 20–24 × 7–10 mm, yellow, covered with glandular hairs. **Stamen** 7 mm long, **filament** 2.5–3 mm long, pinkish at base, light yellow towards apex, glabrous, **anther** 5 mm long, anther thecae dehiscing along their entire length, connective tissue deep yellow, covered with glandular hairs, anther crest c. 1 mm long. **Epigynous glands** two, 4–6 mm, cream white sometimes with slight pink tinge at base, ochraceous towards apex, sometimes connate. **Ovary** trilocular with axile placentation, 2–3 mm long, 2 mm in diam., cream white with slight pink tinge at apex, densely hairy. **Style** white, glabrous, **stigma** white, apex ciliate, quadrangular with transverse ciliate ostiole. **Fruits** unknown.

Habitat and phenology: This species occurs in evergreen broad-leaved mixed forest, on limestone, at elevations about 100–200 m. It flowers in March to April.



Fig. 1. *Distichochlamys benenica* Q.B.Nguyen & Škorničk.: A & B. Habit. C. Close-up of flowers. Photos: Q.B.Nguyen (A); Jana Leong-Škorničková (B, C).

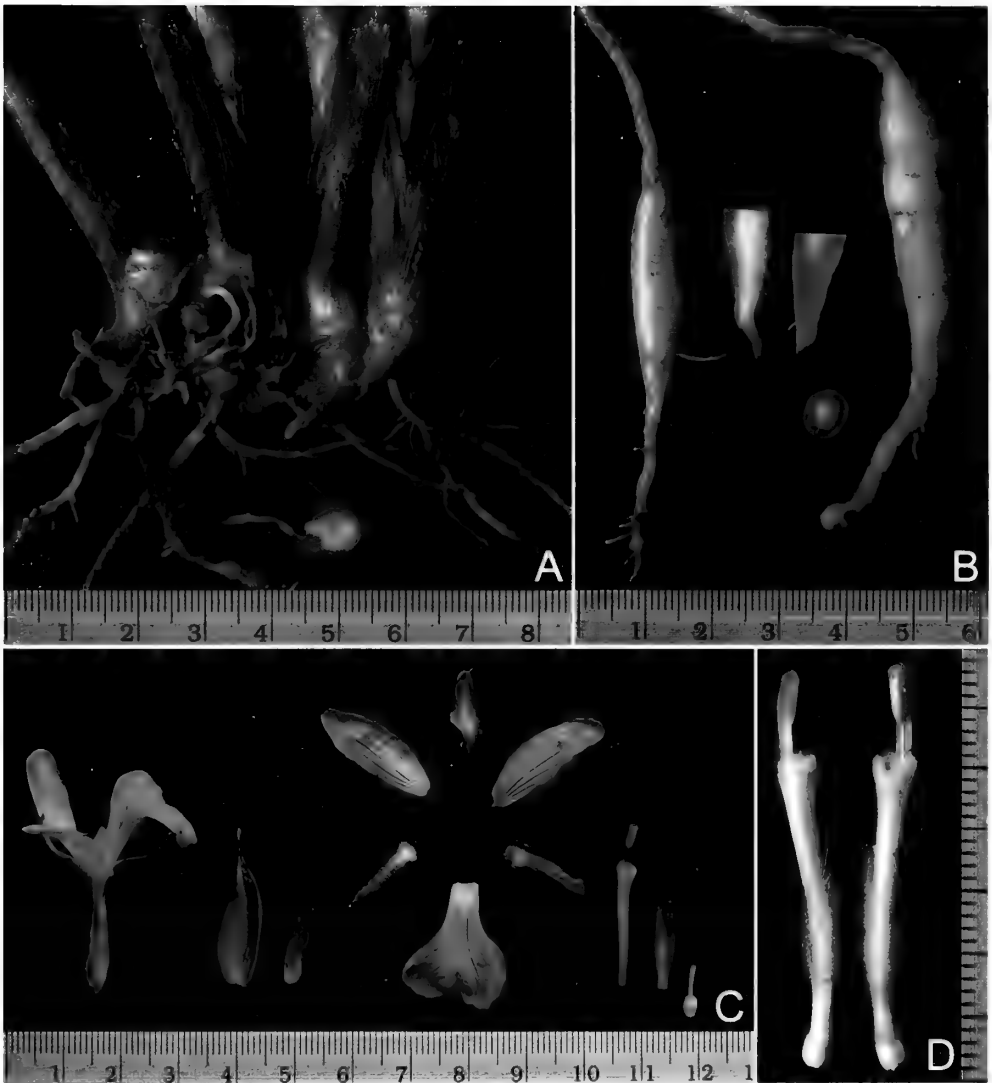


Fig. 2. *Distichoclamys benenica* Q.B. Nguyen & Škorničk.: **A.** Rhizome. **B.** Root tubers. **C.** Flower in bract (far left) and floral dissection (from left to right): bract, bracteole, corolla lobes, staminodes and labellum, floral tube with stamen, calyx, ovary with epigynous glands. **D.** Detail of ovary, calyx, floral tube and stamen. Photos: Jana Leong-Škorničková.

Distribution and IUCN assessment. We have examined all *Distichoclamys* specimens available at AAU, E, HN, SING and VNMN, but discrimination of *Distichoclamys* species from dried material, if not accompanied by spirit collection, is challenging. From all data available it appears that all *Distichoclamys* species, including the newly described *D. benenica*, are rather restricted in their distribution and therefore susceptible to any habitat changes.

Distichochlamys benenica is so far known only from the type locality in Ben En National Park, which has about 85 km² of primary vegetation in a total area of about 166 km². The primary habitat outside the park has been destroyed. We estimate that the area of occupancy of this species within Ben En National Park is less than 20 km² and therefore propose to treat this species provisionally under category Vulnerable (VU): D2.

Etymology: The specific epithet is derived from the type locality, Ben En National Park.

Key to *Distichochlamys* species

- 1a. Inflorescence bracts spreading, loosely imbricate: labellum deeply cleft to c. half its length *D. citrea*
- b. Inflorescence bracts appressed to floral axis, densely imbricate: labellum divided with cleft extending less than half its length 2
- 2a. Lateral staminodes yellow with two red linear patches at the base
..... *D. rubrostriata*
- b. Lateral staminodes yellow..... 3
- 3a. Labellum with red patch at base and two round lobes at apex *D. benenica*
- b. Labellum yellow with purple veins, dark yellow medium band and two emarginate lobes *D. orlowii*

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Four new species of *Aspidistra* Ker Gawl. (Asparagaceae) from China and Vietnam with a comment on *A. longifolia* Hook.f. and *A. hainanensis* W.Y.Chun & F.C.How

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ABSTRACT. Four new species of *Aspidistra* Ker Gawl. (Asparagaceae) are described and illustrated: *A. basalis* Tillich, *A. columellaris* Tillich, *A. gracilis* Tillich from China, and *A. coccigera* L.V.Averyanov & Tillich from Vietnam. The application of the name *A. longifolia* Hook.f. to plants from SE Asia and the intraspecific variability of *A. hainanensis* W.Y.Chun & F.C.How across its range from peninsular Malaysia to SE China is also discussed.

Keywords. Asparagaceae, *Aspidistra*, China, Malay Peninsula, Thailand, Vietnam

Introduction

The genus *Aspidistra* Ker Gawl. (Asparagaceae: Nolinoideae) is distributed from Assam (India) in the west to southern Japan in the east, and from Central China southwards to the Malay Peninsula but the centre of diversity is SE China (Guangxi Province) and adjacent northern Vietnam. During the past three decades the number of known species has increased considerably from 11 in 1980 to more than 100.

The recognition of new *Aspidistra* species is ongoing and stems largely from more widespread collecting, especially in remote areas of SE Asia combined with more detailed study of living plants. Since the publication of a comprehensive key to the genus (Tillich 2008), additional new species have been published (Hou et al. 2009; Lin et al. 2009, 2010; Lin & Liu 2011; Xu et al. 2010).

As a result of this ongoing work, a further four new species can now be added. One of them was collected by the second author in Vietnam, while three more species have been in cultivation for several years at the Juniper Level Botanical Gardens, Raleigh, North Carolina, USA. This Garden obtained the plants from several collectors, mostly with incomplete collection location details. Cuttings of these plants were sent to the Botanical Garden Munich and added to the rich *Aspidistra* collection where they grew vigorously and came to flower during the summer and autumn of 2009 and 2010. Once they flowered, it was apparent that these plants represented four clearly different and undescribed species (see Tillich 2008) and this paper accordingly names them formally.

***Aspidistra basalis* Tillich, sp. nov.** (Fig. 1D & 3H, I.)

Species Aspidistra lurida Ker-Gawl. similis, sed differt pedicello 0.5 cm longo, floribus ad solum prostratis, stigmatate convexo, laeve, 8 maculis albis periphericis proviso, lamina foliorum ca. 40 × 4–5 cm. TYPE: Cultivated plant in the Munich Botanical Garden, originally from the Nanjing Botanical Garden, Jiangsu Province (?), China, Tillich 5720 (M, including flowers in the liquid collection).

Rhizome epigeous, diameter 8–10 mm, richly branched, covered with deltoid scales. Cataphylls up to 6 cm long. **Leaves** solitary, 2–5 cm apart. Petiole 3–5 cm, stout, stiff, ventrally with a deep v-shaped furrow. Blade narrowly lanceolate, 35–45 × 4–5 cm, without clear limitation, tapering gradually to petiole, sharply folded at base, dark green, shiny, margin finely serrate and revolute, midrib sharply protruding abaxially. **Peduncle** up to 0.5 cm, or flower subsessile. **Perigone** bowl-shaped, blackish purple inside and out. Lobes 8, in two whorls of 4, outer lobes deltoid, 6–7 mm long and wide, inner lobes 6–7 × 5 mm, more or less romboid distally. All lobes with 4 low basal keels, the submarginal keels connected to those of the adjoining lobe, the two median keels disappearing in the middle of the tube. **Stamens** 8, inserted at tube base, subsessile, anthers broadly ovate, ca. 1.5 mm long. **Pistil** mushroom shaped, 5–6 mm high. Stigma circular, c. 10 mm in diameter, smooth, convex, light red, the margin with 8 soft strongly reflexed lobes and 8 submarginal, white-edged, radially elongated, weak indentations (Fig. 3H). Fruit unknown.

Etymology: The species name relates to the flower position adjacent to the soil or litter surface.

Notes. The species is similar to *A. lurida* Ker Gawl. but differs clearly by its shorter pedicels (0.5 cm), placing the flowers in horizontal position at ground level, the pink (not white) stigma with its marginal lobes bent downwards nearly to the base of the perigone tube, and the v-shaped leaf blades in cross-section, c. 40 × 4–5 cm (not flat, 15–20 × 3–5 cm).

The original plant from the Nanjing Botanical Garden was found in cultivation along with *A. minutiflora* Stapf and *A. retusa* K.Y.Lang & S.Z.Huang, so it was surprising that this remained undescribed.

***Aspidistra coccigera* L.V.Averyanov & Tillich, sp. nov.** (Fig. 2C–G)

Species Aspidistra marasmiioides H.-J.Tillich similis, sed rhizomate breve nec longe repente, petiolo 17–20 cm longo, lamina 15–18 × 6–7.5 cm, perigonio late cupiforme 20 mm diametro. TYPE: Vietnam, Quang Binh Province, Minh Hoa District, Dan Hoa Municipality, Chuong Lon Mountain, Vietnam-Laotian border, about 6 km N of Cha Lo border station, around point 17°44'04" N, 105°46'53" E; L.V.Averyanov, P.K.Loc, N.T. Vinh & N.S.Khang HAL 11693, , 19 April 2008 (holo HN; iso LE, M).

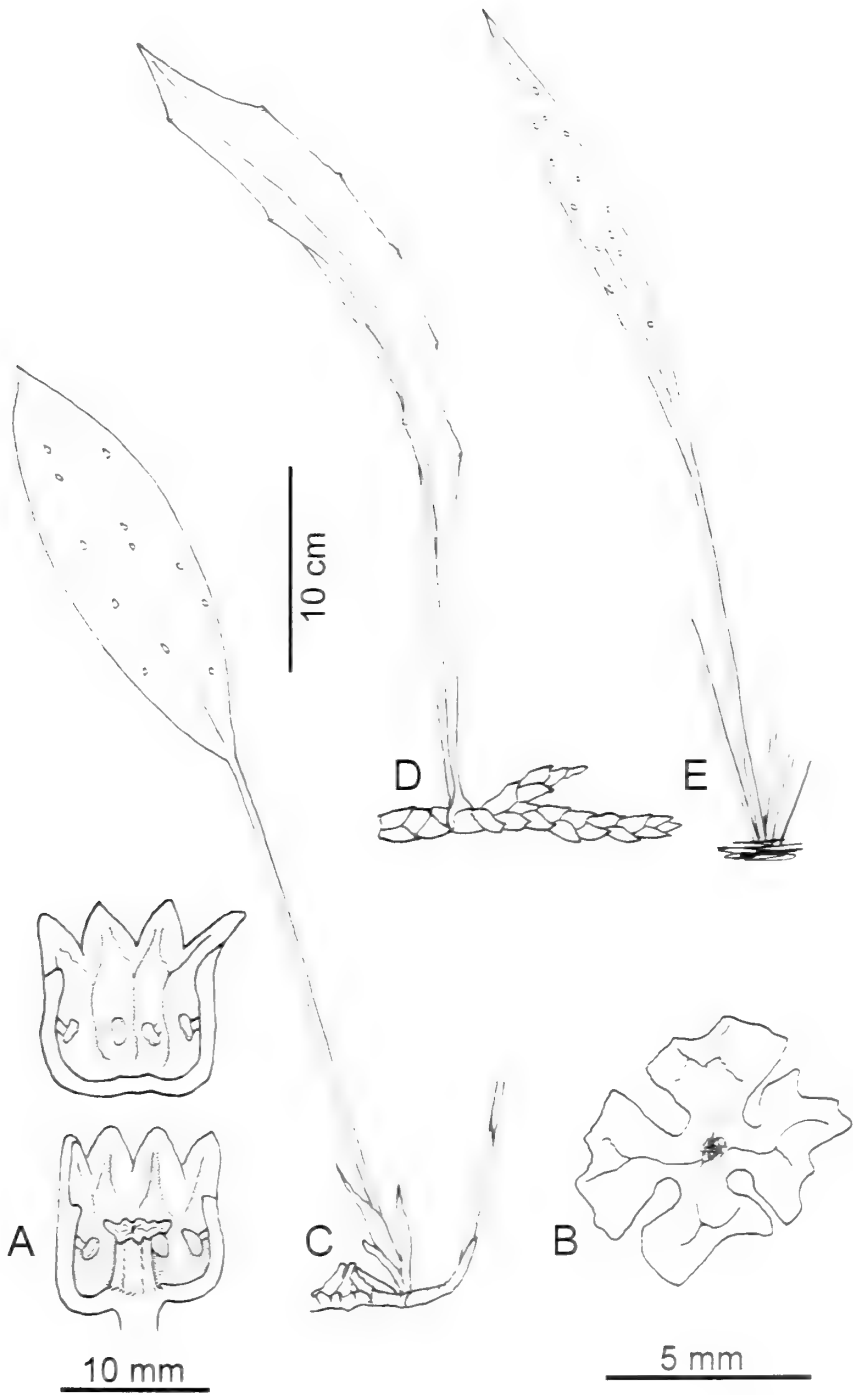


Fig. 1. A–B. *Aspidistra columellaris*. A. Flower longitudinally dissected. B. Stigma in upper view. C–E. Rhizomes and typical leaves. C. *A. columellaris*. D. *A. basalis*. E. *A. gracilis*.

Rhizome with very short internodes, **leaves** crowded, cataphylls up to 5 cm long. Petiole 17–25 cm long, stiff, blade ovate-acuminate, base rounded, 15–18 × 6.0–7.5 cm, light green, kept obliquely upright. **Peduncle** 2.5–6 cm long, erect or ascendant, purple, with 5 purple scales, 2 subtending the flower and 3 along the scape. **Perigone** widely cupuliform. Tube diameter 15–17 mm, white externally, internally blackish purple in upper third, white below. Lobes 6, (blackish-) purple, reflexed, smooth. **Stamens** inserted at mid-tube, filaments 1.5 mm long, protruding horizontally, anthers ovoid, 1.5 mm long. **Pistil** mushroom-like, c. 13 mm long, slightly exceeding the perigone, ovary depressed-conical, basal diameter c. 4 mm, style delicate, cylindrical, white, stigma circular, prominently convex, smooth, bright pink. **Fruit** depressed-globose, diameter c. 1.5 cm, deep purple, softly echinate.

Ecology. The species grows in primary broad-leaved forest on very steep slopes and rocky cliffs of remnant mountains of solid marble-like highly eroded limestone at elevations of 400–750 m a.s.l. The species is locally abundant.

Etymology. The species name relates to its purplish-red fruits.

Notes. The flowers of this species are similar to *A. marasmioides* Tillich from Haiphong Province, Vietnam. The latter species is distinguished by its richly branched, long creeping rhizomes, numerous leaves forming a dense carpet of horizontally oriented blades, and the flowers completely hidden below the leaves. In *A. coccigera*, there are clusters of fewer, much larger leaves, the blades are erect to semi-erect and the flowers and their bright pink stigmas are clearly displayed.

***Aspidistra columellaris* Tillich, sp. nov.** (Fig. 1A–C; 2A, B)

Species Aspidistra leyeensis Y.Wan & C.C.Huang *similis*, sed differt perigonio 12 mm diametro, lobis erectis 4–5 mm longis, lamina foliorum scortea, ovalis, 18–20 × 5–7 cm. TYPE: Cultivated plant in the Munich Botanical Garden, collected in China (Province and collector unknown), *Tillich 5719* (M, including flowers in the liquid collection).

Rhizome epigeous, diameter 5 mm, with soon decaying scales. Cataphylls up to 7 cm long. **Leaves** solitary, 1–1.5 cm apart. Petiole slender, 20–35 cm. Blade ovate-acuminate, coriaceous, 18–20 × 5–7 cm, with numerous white spots. **Peduncle** 0.5–2.5 cm, with 4–5 purple spotted scales. **Perigone** cupulate, thick-walled, changing from green to beige externally, lobes abaxially spotted brownish-red. Tube 7–8 mm high, 12–15 mm in diameter, finely verrucose, purple-black internally. Lobes 8, deltoid, c. 4 mm long and wide, fleshy, erect to somewhat recurved, adaxially purple with beige tips, finely verrucose, with two low verrucose keels, each keel approaching the neighboring keel of the adjacent lobe and extending to the base of the tube. **Stamens** 8, inserted in the lower third of the tube, filaments short, directed obliquely downwards, anthers 2.5–3.0 mm, hooked around filaments, oriented downwards. **Pistil** 5 mm high,



Fig. 2. A, B. *Aspidistra columellaris*. A. Flower. B. Flower longitudinally dissected, and stigma in upper view. C–G. *Aspidistra coccigera*. C. Plant at natural habitat. D. Plants with flowers and fruits prepared for herbarisation. E. Fruits. F. Flowers in upper view. G. Flower longitudinally dissected. Bar scale: A, B, E–G: 1 cm; C, D: 10 cm.

flat-topped. Style a stout column with 4 longitudinal grooves alternating with the stigma lobes, dark purple. Stigma 7–8 mm in diameter, delicate, thin, upper surface purple, finely verrucose, cruciform with 4 arms bifurcating to 8 flattened, pale lobes (Fig. 1B & 2B).

Etymology. The name relates to the column-like style.

Notes. The species is similar to *A. leyeensis* Y.Wan & C.C.Huang with the stigma divided into separate lobes, but is clearly distinguished mainly by the characters in Table 1.

Table 1. Characteristics distinguishing *A. columellaris* and *A. leyeensis*.

	<i>A. columellaris</i>	<i>A. leyeensis</i>
Leaf blade	ovate, c. 20 × 5–7 cm	lanceolate, c. 40 × 4–6 cm
Perigone diameter	12 mm	20–25 mm
Perigone lobes	erect	reflexed
Style	stout, with 4 longitudinal grooves	slender, smooth
Stigma	divided into 4 flat, slightly bifurcate lobes	divided into 8 narrowly-ovate lobes

Aspidistra gracilis Tillich, **sp. nov.** (Fig. 1E & 3F, G)

Species *A. oblancheifolia* F.T. Wang & K.Y. Lang *similis*, *sed differt foliis anguste lanceolatis, lamina 25–30 × 2–2.5 cm, pedunculo erecto, 3–4.5 cm longo, ovario albo, stigmatate convexo, laeve.* TYPE: Cultivated plant in the Munich Botanical Garden, collected in China, Hong Kong S.A.R., Lantau Island, Sunset Peak (collector unknown), *Tillich 5718* (M, including flowers in the liquid collection).

Rhizome thin, with very short internodes, numerous *leaves* and dry petioles of decayed leaves densely clustered together, petiole 15–20 cm, semi-circular in cross section, blade narrowly lanceolate, 25–30 × 2.0–2.5 cm, light green with scattered paler green spots. **Peduncle** erect, 3.0–4.5 cm, with 3 scales along the scape and 2 subtending the flower. Flower obliquely erect to horizontal. **Perigone** campanulate, 14–16 mm long, 12–14 mm in diameter, grey-green or reddish-purple mottled externally, smooth and purple internally. Lobes 8, deltoid, straight or slightly spreading, thick-fleshy, 3.0–4.0 mm long and wide, finely verruculose adaxially. **Stamens** 8, inserted near tube base. **Pistil** mushroom shaped, ca 10 mm long, white, stigma circular, conspicuously convex, smooth. Fruit depressed-globose, pale green, mottled with red, c. 15 mm in diameter.

Etymology. The name relates to the dainty flowers, borne on an erect peduncle in horizontal position.

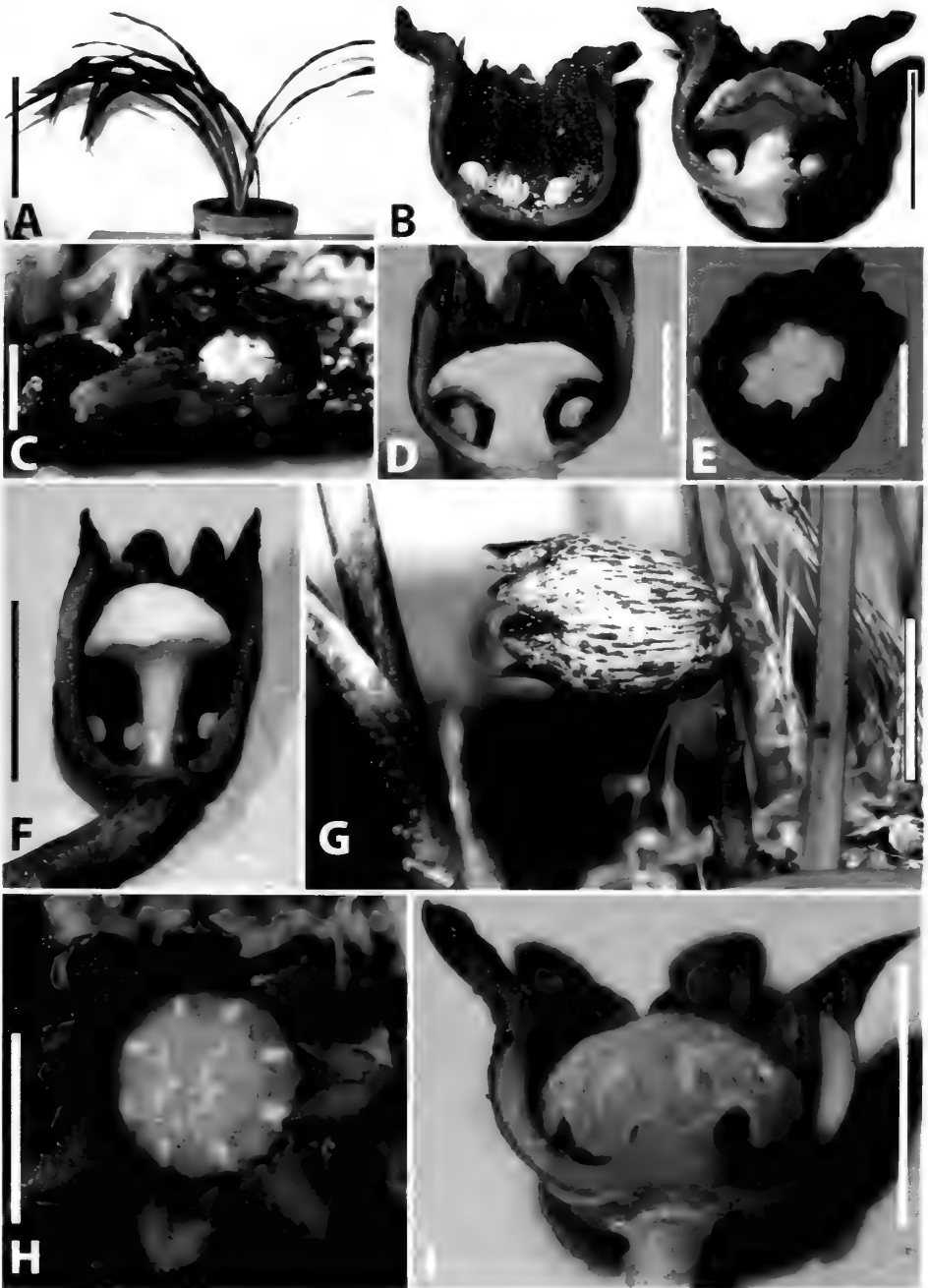


Fig. 3. A–E. *Aspidistra hainanensis* W.Y.Chun & F.C.How s.l. A–C. Plant from Thailand. A. Habit, note the many white spots on leaves. B. Flower longitudinally dissected. C. Flower in upper view, note the stigma composed of irregularly folded lobes. D, E. Plant from Laos. D. Flower in longisection. E. Flower in upper view, note the fine line pattern on the smooth stigma surface. F, G. *Aspidistra gracilis*. F. Flower longitudinally dissected. G. Flower in natural position. H, I. *Aspidistra basalis*. H. Flower in upper view. I. Flower longitudinally dissected. Bar scale: A: 20 cm; B–I: 1 cm.

Notes. The species is similar to *A. oblanceifolia* F.T.Wang & K.Y. Lang and *A. insularis* Tillich, but is clearly distinguished as shown in Table 2.

Table 2. Characteristics distinguishing *A. gracilis* from two related species.

	<i>A. gracilis</i>	<i>A. oblanceifolia</i>	<i>A. insularis</i>
Leaf blade	25–30 × 2–2.5 cm	35–50 × 2.5–4 cm	40–50 × 7–8 cm
Peduncle	3–4.5 cm	0.3–2 cm	0.2–0.5 cm
Flower position	horizontal	vertical	vertical
Perigone shape	narrow-campanulate	campanulate	cupuliform
Stigma colour	white	purple	purple
Stigma shape	convex, circular smooth	conical, 8-lobed, smooth	square, with 4 prominent radial ribs

Notes on *Aspidistra hainanensis* W.Y.Chun & F.C.How in SE Asia

In SE Asia there is a group of *Aspidistra* species that ranges from peninsular Malaysia through Thailand and Southwest-China (Yunnan) eastwards to Laos, Hainan, and Southeast-China (Guangxi) and is characterised by tufted, oblanceolate to linear leaves. The flowers of plants from different sites across that region are similar at first sight, bearing a campanulate to slightly urceolate perigone and mushroom-shaped pistils. However, they are distinguishable by several minor characters, such as the number and course of the adaxial perigone ribs, details of the stigma surface, and in colour patterns. The leaves also vary from variously spotted to homogeneously green.

As an example, two floral variants are shown in Fig. 3. The plant in Fig. 3A–C was purchased from a Thai flower market and is now in cultivation at the Botanical Garden Munich. The plant in Fig. 3D–E was collected by H. Billensteiner in Laos, Bokeo Province, and is now in cultivation at the Palmengarten Frankfurt/M. During the past several decades, some of these local variants have been described as new species: *A. hainanensis* W.Y.Chun & H.W.How, *A. yingjiangensis* Peng, *A. larutensis* deWilde & Vogel (Chun & How 1977, Peng 1989, de Wilde & Vogel 2005) and Phonsena & de Wilde (2010) recently discussed the taxonomy of this group. We agree with the conclusion of Phonsena & de Wilde (2010) that excessive splitting is unwarranted, and that presumably “local *Aspidistra* populations represent clones of uniform plants, each clone conserving its characteristics against those of remote populations”.

Experience with *Aspidistra* has shown that taxonomically meaningful solutions can be obtained only by studying plants from a great number of well-documented collection sites side by side in cultivation and this is one of the best ways to circumscribe taxa. However, there is a problem in that Phonsena & de Wilde (2010) placed all these SE Asian plants into *A. longifolia* Hook.f., a species described from Assam, India, and based on two specimens from the Griffiths Herbarium at Kew

(Hooker 1892). One of these specimens (*Griffith 5887*, barcode 000099915) was designated twice as Type, initially by Tillich (2008) and independently by Phonsena & de Wilde (2010). Unfortunately, neither of these herbarium specimens are suitably preserved for detailed flower analysis but Hooker's description leaves no doubt that *A. longifolia* is clearly different from the SE Asian plants as he states "perianth 1/2 in. diam., fleshy, subglobose contracted at the mouth; lobes very small". This character combination clearly differs from the campanulate to slightly urceolate flowers with lobes (nearly) as long as or longer than the tube, which is the condition seen in all the SE Asian plants so far examined.

We therefore propose to regard the SE Asian *Aspidistra* specimens with oblanceolate to lineate, tufted leaves as part of the *A. hainanensis* W.Y.Chun & H.W.How complex, until more comprehensive cultivation experiments can provide clarity regarding their variability and taxonomic status.

ACKNOWLEDGEMENTS. We are grateful to Prof. D. Podlech (Munich) for the Latin diagnoses, and Todd Rounsaville (Raleigh, NC, USA) and Clemens Bayer (Palmengarten Frankfurt) for providing plant material.

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Phylogenetic study of the *Schismatoglottis Nervosa* Complex (Araceae: Schismatoglottideae)

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ABSTRACT. The *Schismatoglottis Nervosa* Complex (Araceae: Schismatoglottideae) currently comprises 10 species: *Schismatoglottis adoceta* S.Y.Wong, *S. elegans* A.Hay, *S. liniae* S.Y.Wong, *S. tessellata* S.Y.Wong, *S. ulusarikeiensis* S.Y.Wong, *S. matangensis* S.Y.Wong, *S. simonii* S.Y.Wong, *S. turbata* S.Y.Wong, and *S. nervosa* Ridl., occurring in Borneo, with each endemic to a specific locality and most to a particular geology; and one species (*S. brevicuspis* Hook.f.) widespread in Peninsular Malaysia and Sumatera, where it is restricted to granites. Based on analysis of the *matK* region, a preliminary biogeographical hypothesis for the origins and subsequent taxogenesis of the *Nervosa* Complex is presented. This study also provides insight into possible evolution of localised mesophytic endemics in everwet, humid, and perhumid megathermal Sundaic forests. Two clades are resolved: one north of, and another south of, the Lupar Divide.

Keywords. Araceae, biogeography, Borneo, *matK*, *Schismatoglottis Nervosa* Complex, vicariance

Introduction

Geology and tectonics of Borneo

Borneo is the third largest island in the world and the second largest tropical island after New Guinea. Borneo is situated in a tectonically intricate region between three marginal basins: the South China, Sulu and Celebes Seas (Hall et al. 2008), the latter two on the eastern edge of the Sunda Shelf. Borneo has a complex geological history having been formed by Mesozoic accretion of oceanic crustal material (ophiolite), island arcs and microcontinental fragments accreted to the Palaeozoic continental core of the now Schwaner Mountains (Hutchison 1989; Moss & Wilson 1998; Hall et al. 2008). Despite this rather active formation, Borneo is now a stable area with little or no seismic activity, and has no active volcanoes (Hall 2002; Hall et al. 2008).

Plant endemism in Borneo

Borneo is frequently cited—rightly although nowadays somewhat repetitively—as one of the world's areas of 'mega'-biodiversity. With a flora comprising at least 3000

tree species alone (MacKinnon et al. 1996; Slik et al. 2003), Borneo's floristic patterns are significantly correlated with topography and geography (Slik et al. 2003). Present-day floristic patterns are probably influenced by Pleistocene glaciations and are suggested to be of recent emergence after the Pleistocene glacial period. The Southeast Asian mainland and Sumatera were formerly connected to Borneo by land bridges during the Pleistocene glacial (Morley 2000) and the emergence (more accurately, re-emergence) of lowland humid forest is almost certainly owing to rapid radiation of the relictual fragmentary floras from southeast Borneo (Meratus), and/or expansion of forest remnants from the Riau Pocket (see Corner 1960; Ashton 2005). It has also been suggested that Pleistocene refugia extended to north and northwest Borneo (Ashton 1972; Wong 1998), providing yet other points of taxon radiation.

It is estimated that c. 37% of Borneo's 15,000 vascular plant species are endemic (Roos et al. 2004; Welzen et al. 2005), although these figures are likely both underestimates given that studies are consistently revealing that a high percentage of the mesophytic flora appears to be endemic, and includes a great many novelties, e.g., the findings in Zingiberales alone: Theilade & Mood (1997, 1999), Nagamasu & Sakai (1999) and Takano & Nagamasu (2007).

Sabah and Sarawak together are frequently cited to have the most endemic plant species in Borneo, notably in mountainous areas (Moss & Wilson 1998). Frequently it is stated that much of the plant endemism of Borneo occurs in areas of the north, west Sarawak (notably), Sabah's Crocker Range (including Kinabalu) and Trusmadi Range, the central Bornean mountain chain (the Schwaner–Muller–Iran Range), and also in the southeastern Meratus range (Mackinnon et al. 1996). However, it is important to remember that the collecting density of much of highland Borneo is almost infinitesimally small, and thus the taxonomic wealth of the numerous smaller and isolated upland areas (e.g., the Kalimantan Kapuas Hilir, and flanking (Sarawak) Klingkang range, the Kapuas Hulu, Sambiliung, etc.) has yet to be sampled in any scientifically meaningful way. Furthermore, increasingly it is becoming apparent that the *lowland* areas have, despite their frequently degraded condition, still an extraordinary untapped reserve of novel taxa, many with highly restricted, often geologically obligate, ranges.

The *Schismatoglottis Nervosa* Complex

Since 2000, the genus *Schismatoglottis* has been the focus of attention aimed at resolving both its taxonomy and phylogeny (Hay & Yuzammi 2000). Wong (2010) delimited the Nervosa complex by the presence of aromatic vegetative tissues (terpenoids), longitudinally ribbed petioles, and leaf blades with tessellate tertiary venation. Seven novel species additional to the two (*Schismatoglottis nervosa* and *S. elegans*) recognised by Hay & Yuzammi (2000) were proposed. In addition, *S. brevicuspis* was recognised as belonging to the Nervosa complex.

Thus, as now defined the Nervosa Complex comprises 10 described species. A further four species await description. *Schismatoglottis nervosa* and *S. elegans* are

restricted to Karst limestones in the southwest and northeast of Sarawak, respectively: *Schismatoglottis matangensis* and *S. turbata* are species of sandstones, with *S. matangensis* occurring on soft sandstones under perhumid moist forest, while *S. turbata* occurs in humid forest where it is restricted to the tops of small Bornhardts comprised of very hard sandstone. *Schismatoglottis adoceta*, *S. tessellata* and *S. ulusarikeiensis* are restricted to shales, *S. simonii* is unusual in that it occurs on both limestones (the type) and sandstones, while *S. liniae* and *S. brevicuspis* are granite obligates. Of the four species awaiting formal description, one is endemic to basalt in East Sabah, and one each to limestone at Mulu, shale in west Kapit, and limestone in southern central Bintulu.

This study investigates taxonomic relatedness within the Nervosa Complex and possible correlation between phylogeographical patterns and phylogeny of the complex, and presents a hypothesis of taxogenesis of the localised endemics.

Materials and methods

Sample collection and outgroup selection

The ingroup for the analysis consisted of 13 species (each with one accession, except for *S. simonii*, from two localities) from Sabah and Sarawak and one species from West Malaysia. Of these, 13 accessions were collected from the living collection at Semenggoh Botanical Research Centre, Kuching, Sarawak, and one accession was collected from Perak, Peninsular Malaysia, supplied through Universiti Sains Malaysia, Pulau Pinang (see Table 1). The outgroup taxon selected was *Apoballis acuminatissima* S.Y.Wong & P.C.Boyce, established as the Asian sister species to *Schismatoglottis* (Wong et al. 2010).

DNA extraction, PCR and sequencing

DNA was extracted from fresh samples using the protocol of Wong et al. (2010). The primers used for the *matK* gene region, which partially includes the 5' flanking region of the *trnK* intron were: *matK* 19F (Gravendeel et al. 2001), and *matK* 2R (Steele & Vilgalys 1994).

Polymerase Chain Reaction (PCR) amplifications were performed in a Biometra Tgradient thermal cycler. PCR conditions included an initial 2-min denaturation at 95°C, 35–40 cycles of 1 min at 95°C (denaturation), 1 min at 50–60°C (annealing), and 2 min at 72°C (extension), followed by a final 10-min extension at 72°C. PCR products were purified using a PureLink™ PCR Purification Kit (Invitrogen Corp.). The purified products were then sent to a commercial company for sequencing by including two internal primers: 390F and 1326R (Cuénoud et al. 2002).

Data analyses

Sequences were assembled and manually aligned using BioEdit Sequence Alignment Editor v7.0.5 (Hall 1999). Parsimony analysis was performed with PAUP* 4.0b10 (Swofford 2000) using PaupUp graphical interface (Calendini & Martin 2005) with

Table 1. GenBank accessions, vouchers and locality information for species of the *Schismatoglottis Nervosa* Complex (Araceae: Schismatoglottideae) in the present study.

Species	GenBank accession	Voucher no.	Location	Geology
<i>Schismatoglottis simonii</i>	JN570740	AR174	Sarawak, Serian, Gunung Ampungan	limestone
<i>Schismatoglottis nervosa</i>	JN570742	AR944	Sarawak, Bau, Gunung Bidi	limestone
<i>Schismatoglottis tessellata</i>	JN570748	AR1087	Sarawak, Kapit, Taman Rekreasi Sebabai	shales
<i>Schismatoglottis adoceta</i>	JN570739	AR1408	Sarawak, Kapit, Belaga	shales
<i>Schismatoglottis ulusarikeiensis</i>	JN570746	AR1579	Sarawak, Sarikei, Ulu Sarikei	shales
<i>Schismatoglottis simonii</i>	JN570751	AR1686	Sarawak, Serian, Mongkos	shales
<i>Schismatoglottis matangensis</i>	JN570741	AR1864	Sarawak, Matang, Kubah National Park	sandstone
<i>Schismatoglottis elegans</i>	JN570747	AR1877	Sarawak, Miri, Niah National Park	limestone
<i>Schismatoglottis</i> sp. nov. aff. <i>nervosa</i>	JN570744	AR1930	Sarawak, Miri, Mulu	limestone
<i>Schismatoglottis liniae</i>	JN570743	AR2062	Sarawak, Lundu, Gunung Gading	granite
<i>Schismatoglottis</i> sp. nov. aff. <i>nervosa</i>	JN570749	AR2078	Sarawak, Bintulu, Bukit Sarang	limestone
<i>Schismatoglottis turbata</i>	JN570750	AR2143	Sarawak, Lundu, Sempadi	sandstone
<i>Schismatoglottis</i> sp. nov. aff. <i>nervosa</i>	JN570745	AR2482	Sabah, Tawau	basalt
<i>Schismatoglottis brevicuspis</i>	GQ220910	AR2677	Peninsular Malaysia, Perak	granite

all characters treated as “unord” and with equal weight. Gaps were treated as missing values. Random addition sequence was used as starting point and 10000 replicates retained. Branch-swapping was undertaken using the tree-bisection-reconnection (TBR) algorithm. No more than 3 trees of score (length) ≥ 1 were saved for each replicate. Steepest descent option was not in effect and branches were collapsed if maximum branch length was zero. The “MulTrees” option was in effect and topological constraints not enforced. 10000 bootstrap replicates were completed. The consistency index (CI), homoplasy index (HI), retention index (RI) and rescaled consistency index (RCI) were calculated with one of the most-parsimonious trees (MPTs).

Results

Unaligned sequences of the *matK* region of the ingroup taxa ranged from 1448 to 1740 bp. The final length for the aligned sequences comprised 1436 characters which

included two additions in *S. simonii* AR1686 (from 626 to 631bp) and *A. acuminatissima* (from 1505 to 1510bp). To align the sequences with the outgroup, 11 gaps were added. 3 variable sites were found from 200bp to 1400bp. From the 1436 bps, 1413 (98%) characters were constant, 14 (1%) of them were parsimony-uninformative and 9 (1%) of them were parsimony-informative characters.

One of 28 most parsimonious trees was selected (Fig. 1). There are two apparent clusters within the Nervosa Complex with weakly supported bootstrap values: *S. simonii* AR1686, *S. adoceta* AR1408, *S. tessellata* AR1087, *S. sp. nov. aff. nervosa* AR2078, *S. brevicuspis* AR2677, *S. ulusarikeiensis* AR1579 and *S. elegans* AR1877 (bootstrap 43%); and *S. nervosa* AR944, *S. simonii* AR174, *S. matangensis* AR1864, *S. liniae* AR2062, *S. turbata* AR2143, *S. sp. nov. aff. nervosa* AR1930 and AR2482 (bootstrap: 50%). Within these, however, *Schismatoglottis adoceta*, *S. brevicuspis*, *S. tessellata* and *S. sp. nov. aff. nervosa* AR2078 form a group with strong bootstrap support (100%), and this is weakly grouped (bootstrap: 36%) with *S. simonii* AR1686. *Schismatoglottis ulusarikeiensis* and *S. elegans* are sister to this clade (bootstrap: 64%). *Schismatoglottis nervosa*, *S. simonii* AR174, *S. matangensis*, *S. liniae* and *S. turbata* form a strongly supported clade (bootstrap: 100%). The *S. sp. nov. aff. nervosa* AR1930 and *S. sp. nov. aff. nervosa* AR2482 clade is also strongly supported (bootstrap: 100%).

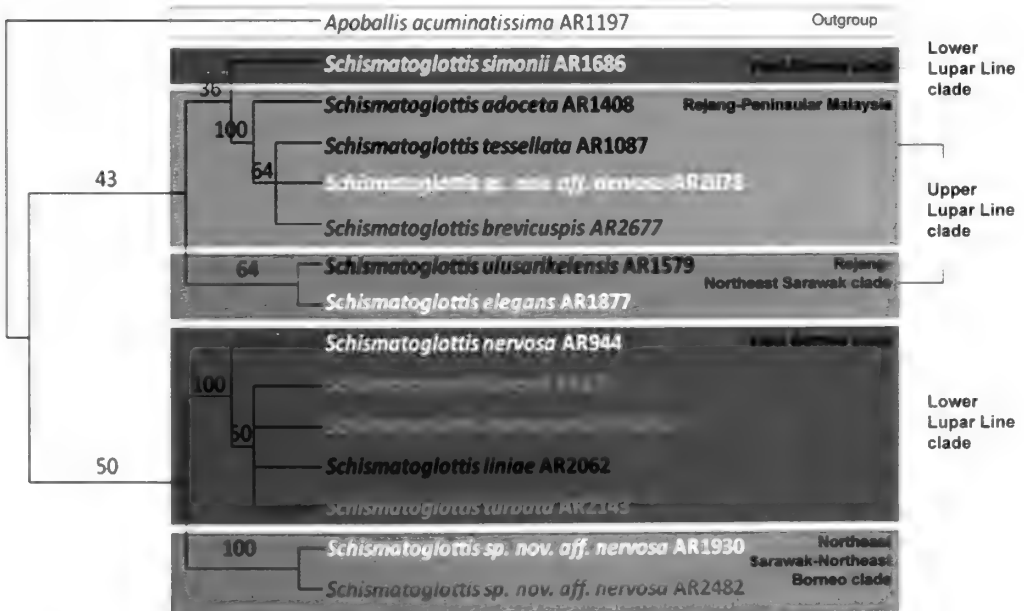


Fig. 1. One of 28 most parsimonious trees for the *Schismatoglottis* Nervosa complex based on the *matK* region. Tree length 26. Consistency index (CI) 0.885. Retention index (RI) 0.870. Rescaled consistency index (RC) 0.769. Homoplasy index (HI) 0.115. Although some clusters are weakly supported, potential clade relationships that may correspond to either side of the Lupar Line are indicated as hypotheses for continuing work.

Discussion

The Nervosa Complex comprises two general clusters: ((Rejang-Peninsular Malaysia), West Borneo) Rejang-NE Borneo and (W Borneo, NE Sarawak-NE Borneo). Apparently, the cluster radiations are separated to below and above the Lupar Divide. The upper Lupar Divide clade comprises *S. adoceta* and *S. tessellata* (both Kapit, on shales), *S. sp. nov. aff. nervosa* AR2078 (Bintulu), and *S. elegans* in Miri. The Lower Lupar Line clade comprises *Schismatoglottis simonii* AR1686, *S. nervosa*, *S. simonii* AR174, *S. matangensis*, *S. liniae*, and *S. turbata*. The Lupar Line was an active convergent plate margin between the Late Cretaceous (65–99mya) to Palaeocene (54.8–65mya), with the margins extending through Engkilili and Lubok Antu (Tan 1979), approximately in line with the saddle that currently separates the Kapuas Hilir and Kapuas Hulu mountains. Hutchison (1996) stated that the sediments of the Lupar Line are the result of fluvial system deposition from the interior of a proto-Sundaland. The Lupar Formation comprises turbidites (deposits comprising rhythmic alternations of fine-grained, graded sandstones and shale beds) and igneous rocks (Honza et al. 2000). Active subduction of the oceanic crust occurred during the Cretaceous (65–144 mya) or early Tertiary (33.7–65 mya). The Rejang-Peninsular Malaysia clade (*S. adoceta*, *S. tessellata* and *S. sp. nov. aff. nervosa* AR2078, *S. brevicuspis*), is estimated to have evolved from the last common ancestor during the Early Tertiary (33.7–65 mya). *Schismatoglottis adoceta*, *S. tessellata* and *S. sp. nov. aff. nervosa* AR2078 are in the Belaga and Lupar formations in Sarawak and Embaluh Group and Selangkai Formations in Kalimantan, circumscribed in the South by the Lupar Line ophiolite and in the North by the Bukit Mersing Line (Hutchison 1989). The Rajang Group comprises turbidite sedimentation dating from the Late Cretaceous (65–99 mya) to Late Eocene (33.7–41.3mya), formed by accretion at a subduction trench (Honza et al. 2000). Bedding dips are generally southward, but become younger northward. Our preliminary results also suggest that the Belaga might act as geographical barrier for the distribution of *S. simonii*, *S. tessellata*, *S. sp. nov. aff. nervosa* AR2078, and *S. adoceta*. *Schismatoglottis adoceta* and *S. tessellata* are found on shales, whereas *S. sp. nov. aff. nervosa* AR2078 is locally restricted to limestones. The inclusion of *S. brevicuspis* (granite, Perak, Peninsular Malaysia) may be explicable as a relict of the former Riau Pocket flora (Corner 1960), running from present-day Terengganu to north-east Borneo, and might in former times have provided a corridor of everwet “stepping stones”. Indeed, morphologically, *S. simonii* is morphologically proximate to *S. sp. nov. aff. nervosa* AR2078.

Schismatoglottis ulusarikeiensis is grouped with *S. elegans* to form the Rejang-NE Sarawak cluster/clade. *Schismatoglottis ulusarikeiensis* occurs on shales at Ulu Sarikei, while *S. elegans* is restricted to the Niah limestones at Gunung Subis, which are composed of limestone from the Tangap Formation (Hazebroek & Abang Kashim 2000). The southern part of the Niah system consists of sandstone from the Nyalau Formation. The Subis Limestone was formed by reefs, coralline algae and tiny shellfish of about 23 mya (Hazebroek & Abang Kashim 2000).

The West Borneo clade comprises *S. nervosa*, *S. simonii*, *S. matangensis*, *S. liniae* and *S. turbata*, and is considered to be perhaps Middle Eocene (33.7–54.8 mya) in origin. The sediments on which two of the species (*S. matangensis* and *S. turbata*) occur are of Eocene origin (Moss & Wilson 1998). However, *S. nervosa* is restricted to the Bau Limestone, which are Upper Jurassic (180–206mya) (Wolfenden 1965), although its origin is dependent on when the Bau limestones emerged. *Schismatoglottis matangensis*, *S. simonii* AR174 and *S. turbata* are restricted to sandstones but on separate localities and differing ecologies: *S. matangensis* is found on soft sandstones under perhumid moist forest in Matang, Kuching, *S. simonii* AR174 on sandstone in Gunung Ampungan, Serian, while *S. turbata* is restricted to micro-Bornhardts comprised of very hard sandstone in Lundu. *Schismatoglottis liniae* is restricted to granite beneath perhumid forest at Gunung Gading, Lundu.

Schismatoglottis sp. nov. aff. *nervosa* AR1930 is restricted to the Mulu limestones. The Mulu Formation comprises Palaeocene (54.8–65mya) to Eocene (33.7–54.8mya) miogeoclinal (non-volcanic) formations of limestone, sandstone, shale and slate (Hutchison 1989), suggesting the as-yet undescribed species might have evolved during the Eocene. *Schismatoglottis* sp. nov. aff. *nervosa* AR2482, is restricted to basalt outcrops at Bukit Quoin, Tawau (E Sabah), predominantly the result of young volcanism: the Tawau-Gunung Wullersdorf area is predominantly composed of basaltic-andesite which resembles the Pliocene (1.8–5.3mya) eruptions of the Mostyn Estate of Kunak (Hutchison 2005). Bukit Quoin is further considered a young volcanic edifice as the volcanic rocks have weathered only to a depth of 6m (Kirk 1962), suggesting that the volcanism of the Tawau area ceased during the Quaternary. Although *Schismatoglottis* sp. nov. aff. *nervosa* AR1930 and *S. sp. nov. aff. nervosa* AR2482 are sister taxa; *S. sp. nov. aff. nervosa* AR2482 occurs on the young basalts, suggesting an adaptation that may have occurred recently (probably during Pliocene or Pleistocene).

Conclusion

The *Schismatoglottis Nervosa* complex diversified in Borneo with one widespread species in West Malaysia to Sumatera. The Bornean local endemism of the complex is unique with each species being adapted to their geological localities. This seems to be correlated with speciation radiations and numerous vicariance events. Analyses of *matK* data resolves the *Schismatoglottis Nervosa* complex into two apparent clusters, one above and one below the Lupar Divide: a Rejang-Peninsular Malaysia clade and a W Borneo clade, with the exception of two species from NE Sarawak-NE Borneo that grouped with species from W Borneo. Recent and rapid radiation of the Nervosa Complex in Borneo is perhaps owing to vicariance events from spatial and temporal isolations, combined with geological and ecological factors. On-going analyses involving further gene regions and mapping of morphological and ecological data are being undertaken to better resolve incongruences.

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The plant taxa of H.N. Ridley, 4. The primitive angiosperms (Austrobaileyales, Canellales, Chloranthales, Laurales, Magnoliales, Nymphaeales and Piperales)

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ABSTRACT. The names of plant taxa authored by H.N. Ridley from the orders of primitive angiosperms are enumerated. A total of 157 taxa across 11 families (Annonaceae, Aristolochiaceae, Chloranthaceae, Illiciaceae, Lauraceae, Magnoliaceae, Monimiaceae, Nymphaeaceae, Piperaceae, Trimeniaceae and Winteraceae) and seven orders (Austrobaileyales, Canellales, Chloranthales, Laurales, Magnoliales, Nymphaeales and Piperales) are listed with synonyms and accepted names. The types are listed for those taxa that Ridley described. Lectotypes are designated for 37 taxa. *Melodorum breviflorum* Ridl. (Annonaceae) is transferred to *Fissistigma*, and two Ridley species in Piperaceae that are later homonyms are provided with new names: *Peperomia kerinciensis* I.M.Turner for *Peperomia villosa* Ridl. (1917, *nom. illegit. non P. villosa* C.DC. (1866)) and *Piper angsiense* I.M.Turner for *Piper venosum* Ridl. (1925, *nom. illegit. non P. venosum* (Miq.) C.DC. (1869)).

Keywords. Austrobaileyales, Canellales, Chloranthales, Laurales, Magnoliales, Nymphaeales, Piperales, primitive angiosperms, Ridley

Introduction

This paper continues an intermittent series on the plant taxa named by Henry Nicholas Ridley (1855–1956). The three parts published to date (Turner & Chin 1998a, b; Turner 2000), dealt with the pteridophytes, gymnosperms and Zingiberales, respectively. The focus shifts to the primitive angiosperms in the current paper.

Ridley described many plant species. Among the primitive angiosperm orders there are numerous examples which are enumerated in this paper. Most of these taxa were described in the course of Ridley's many papers documenting the diversity of South-East Asian plants often in relation to the research expeditions undertaken by Ridley and others.

The three families best represented from among the primitive angiosperms are Annonaceae, Lauraceae and Piperaceae. They are here ordered in terms of declining attention from taxonomists since Ridley's day. The Annonaceae are a diverse family in tropical Asia represented by many genera. There has been and remains a considerable activity in Annonaceae systematics. The Lauraceae are more poorly served despite

the efforts of the late A.J.G.H. Kostermans. The Piperaceae in Malesia have been particularly neglected. Ridley's account in his *Flora of the Malay Peninsula* is still the only treatment available for the area, though it relies very heavily on the work of C. de Candolle, particularly his paper describing many new species for the Malay Peninsula (Candolle 1912). In a reversal of the general position, the Piperaceae of eastern Malesia (New Guinea) have received more recent attention, largely thanks to Drs. W.L. Chew and R.O. Gardner, than the far west of the region. One surprise from the enumeration is that Ridley seems never to have named any members of the Myristicaceae, despite the nutmegs being both diverse and common in the lowland forests of South-East Asia. Warburg's monographic work on the family (Warburg 1897) may be one reason for this. Another possible explanation is that the Singapore Botanic Gardens did not have professional tree climbers, so canopy trees were probably little collected by Ridley—there was a vast number of novelties to be found in the lower layers of the forest.

An enumeration of Ridley's primitive angiosperm taxa

The taxa Ridley described as new are listed against Arabic numbers, and purely nomenclatural novelties are itemised with Roman numerals. Ridley's combination starts each entry and is given in bold. Synonyms, including basionym where relevant, are given. Where possible a currently accepted name is included in bold small capitals, either included in the list of synonyms if homotypic to Ridley's taxon or below, preceded by '=', if heterotypic. In some cases the identity of Ridley's taxon is uncertain (e.g., sheets are determined but the information seems not to have been published), in which instances a question mark is employed, or unknown in which case no accepted name is listed. The place of publication of all names is given and reference to important revisions and monographs are included.

For each of the taxa Ridley described, the types are listed including as many syntypes as have been located, and the herbaria in which they are found. The author has seen most of the specimens, but some records come from published sources, information from correspondents or on-line databases. There are doubtless duplicates in other herbaria and there remain a few instances where no type material has yet been found.

A note on typification

A high proportion of Ridley's taxa requires lectotypification because he rarely designated types from among the various specimens he cited when publishing new taxa. Specimen citation by Ridley can frequently be careless—he often omitted collection numbers, rarely noted collection dates, and generally failed to state in which herbaria material was deposited. He was also inconsistent in annotating the specimens he saw. Typification is therefore often problematic. Ridley's career can be divided into two main periods—the Singapore years (1888–1912) and the retirement to Kew (1913 onwards). This information is important in making decisions relating to typification of Ridley taxa as it helps identify what is likely to be original material, but experience

has shown that many types one might expect, from the date of publication, to be in Singapore are found at Kew. In order to reduce the number of repetitive explanatory notes in the list, if choice of lectotype was simply based on selecting the specimen of highest quality from among candidate syntypes, no note is included.

AUSTROBAILEYALES

Illiciaceae

1. **Illicium cambodianum** Hance var. **tenuifolium** Ridl., Fl. Malay Penins. 1 (1921) 19, as '*tenuifolia*'. **ILlicium TENUIFOLIUM** (Ridl.) A.C. Sm., Sargentia 7 (1947) 68; Saunders, Fl. Males. 13 (1997) 182; Phoon, Fl. Pen. Malaysia, ser. II, 1 (2010) 142. SYNTYPES: Peninsular Malaysia, Pahang, Telom Cascade, *H.N. Ridley 13534*, November 1908 (lectotype, designated by Smith (1947), K (barcode no. K000442171); isolectotype, BM); Gunong Tahan; Selangor, Menuang Gasing, *C.B. Kloss s.n.*, February 1912 (BM, K). Perak, Thaiping Hills, *H.H. Kunstler*. Kedah, Kedah Peak, *L.M. Bell & Md Haniff s.n.*, March 1911 (K[×2]).

2. **Illicium cambodianum** var. **crassifolium** Ridl., Fl. Malay Penins. 1 (1921) 19, as '*crassifolia*'. SYNTYPES: Peninsular Malaysia, Selangor, Gunong Menkuang, 5000 feet, *H.C. Robinson s.n.*, 18 January 1913 (lectotype, designated here, K (barcode no. K000442171); isolectotype, BM (barcode no. BM000017468)); Bukit Kutu (flowers fascicled on stems), *H.N. Ridley 7218*, May 1895 (K); Sempang Mines, *H.N. Ridley 15691*, April 1911 (K); Semangkok Pass. Perak, Gunong Kerbau, *Md Haniff 4017*, May 1909 (K); Gunong Batu Putih, *L. Wray 251*, s. dat. (K). Malacca, Mt Ophir, Pahang, K'luang Terbang, *W.D. Barnes 10876*, 1900 (K); Gunong Berembun near Telom, *H.N. Ridley 13563*, November 1908, (BM, K); Gunong Tahan, *H.N. Ridley 16268*, July 1911 (K); *H.N. Ridley 16009*, July 1911 (K).

≡ **ILlicium RIDLEYANUM** A.C. Sm., Sargentia 7 (1947) 66; Saunders, Fl. Males. 13 (1997) 181; Phoon, Fl. Pen. Malaysia, ser. II, 1 (2010) 140. The lectotype selected for Ridley's var. *crassifolium* is the holotype of *Illicium ridleyanum* A.C. Sm., which seems appropriate given Smith's choice of epithet for the species. Making these taxa homotypic synonyms may simplify future rearrangements in *Illicium*.

Trimeniaceae

3. **TRIMENIA PAPUANA** Ridl., Trans. Linn. Soc., Bot. 9 (1916) 144; Rodenburg, Blumea 19 (1971) 9; Philipson, Fl. Males. 10 (1986) 331. TYPE: New Guinea, Mt Carstensz, Camp VIb, 3900 ft, *C.B. Kloss s.n.*, 17 February 1913 (holotype, BM (barcode: BM000950880)).

CANELLALES

Winteraceae

4. **Drimys buxifolia** Ridl., Trans. Linn. Soc., Bot. 9 (1916) 12. *Tasmannia buxifolia* (Ridl.) A.C. Sm., Taxon 18 (1969) 288. TYPE: New Guinea, Mt Carstensz, Camp XIII to XVI (13–11 on sheet), 8300 to 10500 ft, *C.B. Kloss s.n.*, 1912–1913 (holotype, BM (Barcode: BM00574841); isotype, K).
= **TASMANNIA PIPERATA** (Hook.f.) Miers, Ann. Mag. Nat. Hist. ser. 3, 2 (1858) 110; Hopkins in Johns et al., Guide Alp. & Subalp. Fl. Mt. Jaya (2006) 496.
5. **Drimys densifolia** Ridl., Trans. Linn. Soc., Bot. 9 (1916) 12. *Tasmannia densifolia* (Ridl.) A.C. Sm., Taxon 18 (1969) 289. TYPE: New Guinea, Mt Carstensz, Camp XII to XIII, 10500 to 11000 ft, *C.B. Kloss s.n.*, 29 January 1913 (holotype, BM (barcode no. BM 000574843)).
= **TASMANNIA PIPERATA** (Hook.f.) Miers, Ann. Mag. Nat. Hist. ser. 3, 2 (1858) 110; Hopkins in Johns et al., Guide Alp. & Subalp. Fl. Mt. Jaya (2006) 496.
6. **Drimys elongata** Ridl., Hook. Icon. Pl. 31 (June 1916) t. 3051; Trans. Linn. Soc., Bot. 9 (August 1916) 12. *Tasmannia elongata* (Ridl.) A.C. Sm., Taxon 18 (1969) 288. SYNTYPES: New Guinea, Mt Carstensz, Camp III to VIII, 2500 to 4900 ft, *C.B. Kloss s.n.*, December 1912 (BM (barcode no. BM00574844)); Camps VIb and VIc, 3900 to 5500 ft, *C.B. Kloss s.n.*, 17 February 1912 (BM (barcode no. BM00574845)); Camp VIb, *s.dat.*, *C.B. Kloss s.n.* (lectotype, designated by Vink (1970), K (barcode no. K0006816245)).
= **TASMANNIA PIPERATA** (Hook.f.) Miers, Ann. Mag. Nat. Hist. ser. 3, 2 (1858) 110; Hopkins in Johns et al., Guide Alp. & Subalp. Fl. Mt. Jaya (2006) 496.

7. ***Drimys grandiflora*** Ridl., Trans. Linn. Soc., Bot. 9 (1916) 11. *Tasmannia grandiflora* (Ridl.) A.C. Sm., Taxon 18 (1969) 288. TYPE: New Guinea, Mt Carstensz, Camp XIII, 10500 ft, *C.B. Kloss s.n.*, 29 January 1913 (holotype, BM (barcode no. BM000574847); isotype, K).
= **TASMANNIA PIPERATA** (Hook.f.) Miers, Ann. Mag. Nat. Hist. ser. 3, 2 (1858) 110; Hopkins in Johns *et al.*, Guide Alp. & Subalp. Fl. Mt. Jaya (2006) 496.
8. ***Drimys parviflora*** Ridl., Trans. Linn. Soc., Bot. 9 (1916) 12. *Bubbia parviflora* (Ridl.) Burtt, Hook. Icon. Pl. 34 (1936) t. 3315, p. 3. *Tasmannia parviflora* (Ridl.) A.C. Sm., Taxon 18 (1969) 288. TYPE: New Guinea, Mt Carstensz, Camps XI to XII, 8300 to 11000 ft, *C.B. Kloss s.n.*, 28 January 1913 (holotype, BM (barcode no. BM000574842); isotype, K).
= **TASMANNIA PIPERATA** (Hook.f.) Miers, Ann. Mag. Nat. Hist. ser. 3, 2 (1858) 110; Hopkins in Johns *et al.*, Guide Alp. & Subalp. Fl. Mt. Jaya (2006) 496.
9. ***Drimys rosea*** Ridl., Trans. Linn. Soc., Bot. 9 (1916) 11. *Tasmannia rosea* (Ridl.) A.C. Sm., Taxon 18 (1969) 288. TYPE: New Guinea, Mt Carstensz, Camp XII to XIII, 10,000 ft, *C.B. Kloss s.n.*, 29 January 1913 (holotype BM (barcode no. BM 00057446); isotype, K).
= **TASMANNIA PIPERATA** (Hook.f.) Miers, Ann. Mag. Nat. Hist. ser. 3, 2 (1858) 110; Hopkins in Johns *et al.*, Guide Alp. & Subalp. Fl. Mt. Jaya (2006) 496.
10. ***Drimys umbellata*** Ridl., Trans. Linn. Soc., Bot. 9 (1916) 11. *Bubbia umbellata* (Ridl.) Dandy, J. Bot. 72 (1934) 41. **ZYGOGYNUM UMBELLATUM** (Ridl.) W. Vink, Blumea 31 (1985) 54. TYPE: New Guinea, Mt Carstensz, Camp VIb, 3900 ft, *C.B. Kloss s.n.*, January 1913 (holotype, BM (barcode no. BM000574861)).
11. ***Drimys vaccinioides*** Ridl., Trans. Linn. Soc., Bot. 9 (1916) 13. *Tasmannia vaccinioides* (Ridl.) A.C. Sm., Taxon 18 (1969) 288. TYPE: New Guinea, Mt Carstensz, Camp XIII, 10500 ft, *C.B. Kloss s.n.* (holotype, BM, ? lost).
= **TASMANNIA PIPERATA** (Hook.f.) Miers, Ann. Mag. Nat. Hist. ser. 3, 2 (1858) 110. Hopkins in Johns *et al.*, Guide Alp. & Subalp. Fl. Mt. Jaya (2006) 496.

I have not been able to find the type material of *Drimys vaccinioides*. Vink (1970) also reported it missing.

CHLORANTHALES

Chloranthaceae

12. **Chloranthus brachystachys** var. **melanocarpa** Ridl., J. Straits Branch Roy. Asiat. Soc. 87 (1923) 89. **SARCANDRA GLABRA** (Thunb.) Nakai var. **MELANOCARPA** (Ridl.) Verdc., Kew Bull. 40 (1985) 217; Verdcourt, Fl. Males. 10 (1986) 136. TYPE: Sumatra, Berastagi, *H.N. Ridley s.n.*, February 1921 (holotype, K (barcode no. K000802684); isotype, SING).

LAURALES

Lauraceae

13. **ACTINODAPHNE CONCIINNA** Ridl., J. Fed. Malay States Mus. 5 (1914) 44. TYPE: Peninsular Malaysia, Selangor, Gunong Menkuang, 5000 feet, *H.C. Robinson s.n.*, 18 January 1913 (holotype, K (barcode no. K000793048); isotypes, BM, SING (barcode no. SING 0051764)).
14. **Actinodaphne gelonioides** Ridl., Fl. Malay Penins. 3 (1924) 111. TYPE: Peninsular Malaysia, Perak, Gunong Kerbau, *H.C. Robinson s.n.*, June 1913 (holotype, K (barcode no. K000793057); isotype, BM).
= **ACTINODAPHNE OLEIFOLIA** Gamble, Bull. Misc. Inform. Kew 1910 (1910) 313; Kochummen, Tree Fl. Malaya 4 (1989) 106.
15. **Actinodaphne oleifolia** Gamble var. **glabra** Ridl., Fl. Malay Penins. 3 (1924) 111. SYNTYPES: Peninsular Malaysia, Pahang, Gunung Tahan, *H.N. Ridley 16169*, July 1911 (lectotype, designated here, K (barcode no. K000793056)); *H.N. Ridley 16109*, July 1911 (K).
= **ACTINODAPHNE OLEIFOLIA** Gamble, Bull. Misc. Inform. Kew 1910 (1910) 313; Kochummen, Tree Fl. Malaya 4 (1989) 106.
I do not believe the collection numbers of the syntypes are given in error. Both sheets have original SING labels which have different initial determinations.
16. **BEILSCHMIEDIA BREVIPES** Ridl., Fl. Malay Penins. 3 (1924) 86; Kochummen, Tree Fl. Malaya 4 (1989) 118. TYPE: Peninsular Malaysia, Pahang, Ulu Rompin, *F.W. Foxworthy Forest Department FMS 3181*, 21 April 1919 (holotype, K (barcode no. K000768680)).

17. **Beilschmiedia longipedicellata** Ridl., Bull. Misc. Inform. Kew 1926 (1926) 475; **DEHAASIA LONGIPEDICELLATA** (Ridl.) Kosterm., New & Crit. Mal. Pl. IV. (For. Serv. Indones., Div. Plann.) (1955) 37; Kostermans, Bot. Jahrb. Syst. 93 (1973) 462. TYPE: Peninsular Malaysia, Selangor, Semeniyih, *H.L. Hume 8432*, 13 August 1921 (holotype, SING (barcode no. SING 0055156); isotype, BO).

Ridley did not cite the Hume collection number or state in which herbaria the type material was deposited. Given the data and place of the original publication, Kew would seem the likely institution, but I have failed to locate any relevant specimens. Hume worked for the FMS Museums and his collections were deposited in the Museum's herbarium from where they were indefinitely loaned to the Singapore Herbarium (van Steenis-Kruseman 1950). In SING there is a sheet of *Hume 8432* which is labelled *Beilschmiedia longipedicellata* in Ridley's hand. I assume this to be the holotype which Ridley must either have seen during a visit to Kuala Lumpur or was sent to Kew for him to name and later returned to Kuala Lumpur and then transferred to Singapore.

18. **Beilschmiedia sumatrensis** Ridl., J. Malayan Branch Roy. Asiat. Soc. 1 (1923) 89, as '*Beilschimedia*'. TYPE: Sumatra, Berastagi woods, *H.N. Ridley s.n.*, February 1921 (lectotype, designated here, K (barcode no. K000778438)).

There is another sheet at K (barcode no. K000778439) which may be a duplicate, or another gathering by Ridley from the same locality. The lectotype has a collection label in Ridley's hand; that of the 'duplicate' seems not to be written by him.

19. **BEILSCHMIEDIA TONKINENSIS** Ridl., J. Straits Branch Roy. Asiat. Soc. 82 (1920) 190, as '*Beilschimedia*'; Kochummen, Tree Fl. Malaya 3 (1989) 122. TYPE: Thailand, Satun, Setul. *H.N. Ridley 15465*.

Kostermans (1964) and Kochummen (1989) treat this as a new combination based on *B. glomerata* var. *tonkinensis* Lecomte. However, Ridley refers to *B. tonkinensis* as 'sp. nov.' in the publication. I have not managed to trace any type material.

20. **Cinnamomum iners** var. **angustifolium** Ridl., Fl. Malay Penins. 3 (1924) 93. TYPE: Peninsular Malaysia, Perak, Temengoh, Kelantan River, *H.N. Ridley 14516*, July 1909 (lectotype, designated by Soh (2011), SING (barcode no. SING 0055564); isolectotype, K).

= **CINNAMOMUM INERS** (Nees & T.Nees) Reinw. ex Blume, Bijdr. (1826) 570; Kochummen, Tree Fl. Malaya 4 (1989) 126.

21. **CINNAMOMUM KUNSTLERI** Ridl., J. Straits Branch Roy. Asiat. Soc. 82 (1920) 191; Kochummen, Tree Fl. Malaya 3 (1989) 127. TYPE: Peninsular Malaysia, Perak, Larut, *Dr King's Collector* [H.H. Kunstler] 5568, February 1884 (lectotype, designated here, K(barcode no. K000778640); isolectotypes, BM (barcode no. 000950947), K[×2], SING (barcode no. 0051701), L (barcode no. L0035840)).
Of the three sheets of *King's Collector 5568* at K, one came from the personal herbarium of J.S. Gamble and was only donated to Kew in 1925 so is unlikely to be original material of *Cinnamomum kunstleri* Ridl. The other two sheets are annotated by Ridley with the species name. All three sheets have red 'type' tickets with one sheet indicated as holotype. I designate this sheet as the lectotype.
22. **Cinnamomum parvifolium** Ridl., J. Fed. Malay States Mus. 6 (1915) 54, *non C. parvifolium* Lecomte (1913); **CINNAMOMUM MICROPHYLLUM** Ridl., Fl. Malay Penins. 3 (1924) 92, *nom. nov.*; Kochummen, Tree Fl. Malaya 4 (1989) 127. TYPE: Peninsular Malaysia, Perak, Gunong Kerbau, *H.C. Robinson s.n.*, 20 March 1913 (holotype, K (barcode no. K000778644)).
23. **CINNAMOMUM PUBERULUM** Ridl., Fl. Malay Penins. 3 (1924) 96; Kochummen, Tree Fl. Malaya 4 (1989) 128. SYNTYPES: Peninsular Malaysia, Pahang, Bentong, Ulu Raub, *Ahmad* [F.W. Foxworthy's collector] 5096, 5 January 1920 (lectotype, designated here, K (barcode no. K000778651)); *Ahmad 5063*, 29 December 1919 (K, SING (barcode no. SING 0055569)); *Ahmad 5095*, 5 January 1920 (SING (barcode no. SING 0055568)).
24. **CINNAMOMUM SCORTECHINII** Gamble var. **SELANGORENSE** Ridl., Fl. Malay Penins. 3 (1924) 95; Kochummen, Tree Fl. Malaya 4 (1989) 131. TYPE: Peninsular Malaysia, Selangor, Ulu Kali, *A.M. Burn-Murdoch 339* [A. Hashim leg.] (lectotype, designated by Kostermans (1970), SING (barcode no. SING 0051711); isolectotypes, K[×2]).
25. **Cinnamomum velutinum** Ridl., J. Straits Branch Roy. Asiat. Soc. 82 (1920) 190. TYPE: Peninsular Malaysia, Pahang, Gunong Tahan, Teku woods, *H.N. Ridley 16110*, 17 July 1911, (holotype, K (barcode no. K000778660); isotype, SING (barcode no. SING 0051702)).
= **C. SCORTECHINII** Gamble, Bull. Misc. Inform. Kew 1910 (1910) 219; Kochummen, Tree Fl. Malaya 4 (1989) 130.

26. **Cryptocarya tenuifolia** Ridl., J. Straits Branch Roy. Asiat. Soc. 82 (1920) 190. TYPE: Peninsular Malaysia, Selangor, Ulu Gombak, *H.N. Ridley s.n.*, 9 March 1915 (holotype, K).
= **CRYPTOCARYA ZOLLINGERIANA** Miq., Fl. Ind. Bat. 1(1) (1858) 924; Kochummen, Tree Fl. Malaya 4 (1989) 137.
27. **Dehaasia elliptica** Ridl., Fl. Malay Penins. 5 (1925) 329. SYNTYPES: Peninsular Malaysia, Selangor, Klang, Bukit Cheraka, [*F.W. Foxworthy*] 3462 (lectotype, designated here, K (barcode no. K000350888)); Kuala Lumpur, Public Gardens, *F.W. Foxworthy* 4706, 5 July 1919 (K (barcode no. K000350887));
= **DEHAASIA POLYNEURA** (Miq.) Kosterm., Bot. Jahrb. Syst. 93 (1973) 466. Kostermans cited *Foxworthy* 4760 as the type of *Dehaasia elliptica* but while this specimen was annotated by Ridley it was not cited in the protologue.
28. **DEHAASIA LANCIFOLIA** Ridl., J. Linn. Soc., Bot. 38 (1908) 320; Kostermans, Bot. Jahrb. Syst. 93 (1973) 461. SYNTYPES: Peninsular Malaysia, Gunung Tahan 5000–6000 ft, *L. Wray & H.C. Robinson* 5468, 5 July 1905 (lectotype, designated here, BM; isolectotypes, K, SING[×2]); *H.C. Robinson* 5525, 12 July 1905 (BM).
29. **Endiandra crassifolia** Ridl., Bull. Misc. Inform. Kew 1926 (1926) 79. **NOTHAPHOEBE CRASSIFOLIA** (Ridl.) Kosterm., Reinwardtia 7 (1968) 354. TYPE: Sumatra, Mentawai Islands, Siberut, *C.B. Kloss* 14593, 27 September 1924 (holotype, K (barcode no. K000778906)).
30. **Lindera caudifolia** Ridl., J. Straits Branch Roy. Asiat. Soc. 82 (1920) 192. SYNTYPES: Peninsular Malaysia, Penang, Penang Hill, Road to Penara Bukit, 2000 ft, *C. Curtis* 2447, June 1890 (lectotype, designated here, K (barcode no. K000815584); isolectotype, BM); 2000 ft. Tiger Hill, *H.N. Ridley s.n.*, March 1915 (K, BM);
= **LINDERA SUBUMBELLIFLORA** (Blume) Kosterm., J. Sci. Res., Indonesia 1 (1952) 127; Kochummen, Tree Fl. Malaya 4 (1989) 148, as '*subumbellifera*'.
The Curtis collection may be numbered 2442 - the last figure is not clear.

31. **Lindera cinnamomea** Ridl., J. Fed. Malay States Mus. 6 (1915) 173. NEOLITSEA CINNAMOMEA (Ridl.) Kosterm., Reinwardtia 6 (1962) 287. TYPE: Peninsular Malaysia, Pahang, Gunong Tahan, *H.N. Ridley 16124*, July 1911 (holotype, K (barcode nos. K000815497, K000815498)).

There are two sheets of *Ridley 16124* at K. One has the blue collection label typically used in the Singapore Herbarium the other has details written on a Herb. Hort. Bot. Reg. Kew slip. The two sheets were received at Kew on the same date – 9 November 1911. The sheet with the Singapore label is annotated ‘*Lindera cinnamomea* Ridl.’ in Ridley’s hand. The other sheet has ‘cinnamomea’ in Ridley’s hand on the Kew slip. Above the collection label on each sheet someone has written ‘bis’. My interpretation is that these two sheets represent a single specimen – there was too much material to mount on one sheet so the excess was mounted on a second sheet and the label details copied on to a Kew slip. A type must consist of a single specimen [ICBN (McNeill et al. 2006) Art. 8.1]. A specimen may be mounted as more than one preparation as long as the parts are clearly labelled as being part of the same specimen [ICBN Art. 8.3]. While ‘bis’ (Latin = twice), seems to have several meanings when put on herbarium sheets, in this case I infer that it means that the specimen was mounted on two sheets and the holotype consists therefore of two sheets.

32. **LINDERA CONCINNA** Ridl., J. Straits Branch Roy. Asiat. Soc. 82 (1920) 192; Kochummen, Tree Fl. Malaya 4 (1989) 146. SYNTYPES: Peninsular Malaysia, Pahang, Gunong Tahan, *L. Wray & H.C. Robinson 5455*, 2 July 1905 (lectotype, designated here, K (barcode no. K000815604); isolectotype, BM (barcode no. BM000951093)); *H.N. Ridley 16108*, July 1911 (K[×2]).

33. **LINDERA MONTANA** Ridl., J. Fed. Malay States Mus. 6 (1915) 172; Kochummen, Tree Fl. Malaya 4 (1989) 146. SYNTYPES: Peninsular Malaysia, Pahang, Gunong Tahan, Wray’s camp, 3300 ft, *H.N. Ridley 16161*, July 1911 (lectotype, designated here, K (barcode no. K000815596) (excluding fruiting material in capsule)); Gunung Tahan 5600 ft, *H.N. Ridley 16161*, July 1911 (K, fruiting material in capsule only (barcode no. K000815597)).

Ridley 16161 consists of a herbarium sheet with an attached capsule and two collection labels. The mounted specimen is a leafy twig with flowers that the label indicates was collected at 3300 ft on Gunung Tahan. The capsule contains fruits that were collected at 5600 ft. Though Ridley included these under the same collection number they clearly represent separate gatherings and so lectotypification is required.

34. **Lindera selangorensis** Ridl., J. Fed. Malay States Mus. 5 (1914) 44. SYNTYPES: Peninsular Malaysia, Selangor, Gunong Menkuang Lebah, *H.C. Robinson: s.n.*, 6 February 1913 (lectotype, designated here, K (barcode no. K000815585); isolectotypes, BM, SING (barcode no. SING 0046618)); Sempang Mines, *H.N. Ridley: 15589*, April 1894, (K[⁺2], SING (barcode no. SING 0046596)).
= **LINDERA LUCIDA** (Blume) Boerl., Handl. Fl. Ned. Ind. 3 (1900) 147.
The species was described in a paper on plants collected from Gunong Mengkuang Lebah, so the Robinson specimen is chosen as lectotype.
35. **Lindera stricta** Ridl., J. Fed. Malay States Mus. 6 (1915) 172. TYPE: Peninsular Malaysia, Pahang, Gunong Tahan, *H.N. Ridley: 16128*, July 1911 (holotype, K (barcode no. K000815595); isotype, BM).
= **LINDERA MONTANA** Ridl., J. Fed. Malay States Mus. 6 (1915) 172; Kochummen, Tree Fl. Malaya 4 (1989) 146.
36. **LITSEA ACRANTHA** Ridl., J. Fed. Malay States Mus. 10 (1920) 152; Kochummen, Tree Fl. Malaya 4 (1989) 151. TYPE: Peninsular Malaysia, Kedah-Perak boundary, Gunong Bintang, *nat. coll. F.M.S. Mus. s.n.*, June 1917 (holotype, K (barcode no. K000797079)).
37. **LITSEA CINERASCENS** Ridl., J. Linn. Soc., Bot. 41 (1913) 296; Kochummen, Tree Fl. Malaya 4 (1989) 153. SYNTYPES: Peninsular Malaysia, Selangor, Gunong Menuang Gasing, *C.B. Kloss*, Pahang, Telom, *H.N. Ridley: 13781*, November 1908 (K; SING (barcode no. SING 0055903)).
I have not been able to trace the Kloss specimen. As the species was described in a paper concerning plants collected on Gunong Menuang Gasing, it seems prudent to defer lectotypification in this case.
38. **Litsea glabrifolia** Ridl., J. Fed. Malay States Mus. 10 (1920) 152. TYPE: Peninsular Malaysia, Pahang, Gunong Senyum, *I.H.N. Evans s.n.*, June 1917 (holotype, K; isotype, BM).
= **LITSEA INSIGNIS** (Blume) Boerl., Handl. Fl. Ned. Ind. 3 (1900) 142; Kochummen, Tree Fl. Malaya 4 (1989) 159.

39. **Litsea machilifolia** Gamble var. **montana** Ridl., Fl. Malay Penins. 3 (1924) 127. TYPE: Peninsular Malaysia, Pahang, Bukit Fraser (Sempang), *I.H. Burkill & R.E. Holttum Forest Dept., F.M.S. 7784*, 16–30 September 1922 (holotype, K (barcode no. K000797064)).
= **LITSEA MACHILIFOLIA** Gamble, Bull. Misc. Inform. Kew 1910 (1910) 320; Kochummen, Tree Fl. Malaya 4 (1989) 160.
There are further Burkill & Holttum collections from Fraser's Hill in K made on the same visit but collected under SF numbers. None of these is annotated by Ridley as var. *montana* so I assume the annotated sheet to be the holotype.
40. **Litsea persella** Ridl., Agric. Bull. Straits Fed. Malay States 5 (1906) 6. *Cylicodaphne persella* (Ridl.) Nakai, Bull. Tokyo Sci. Mus. No. 22 (1948) 32. TYPE: Borneo, Sarawak, Kuching, *H.N. Ridley 12429*, September 1905 (lectotype, designated here, K (barcode no. K000815214)).
=?**Litsea garciae** S. Vidal, Revis. Pl. Vasc. Filip. (1886) 228.
In the protologue Ridley wrote 'I found it beautifully in flower in Sarawak in September 1905, in the town of Kuching, and later Mrs Ellis and Mr Hewitt sent me seeds and fruits of it.' I have not been able to locate any fruit or seed material, but there is a flowering specimen as Kew which I designate the lectotype of *Litsea persella*.
41. **Litsea tenuipes** Ridl., Bull. Misc. Inform. Kew 1926 (1926) 79. TYPE: Sumatra, Mentawai Islands, Sipora, *C.B. Kloss 14751*, 22 October 1924 (holotype, K (barcode no. K000815203)).
=?**Litsea insignis** (Blume) Boerl., Handl. Fl. Ned. Ind. 3 (1900) 142.
42. **Litsea terminalis** Ridl., Fl. Malay Penins. 5 (1925) 330. TYPE: Peninsular Malaysia, Perak, Gunung Inas, *R.H. Yapp 494*, 19 December 1899 (holotype, K (barcode no. K000797080)).
= **LITSEA ACRANTHA** Ridl., J. Fed. Malay States Mus. 10 (1920) 152; Kochummen, Tree Fl. Malaya 4 (1989) 151.
43. **Nothaphoebe angustifolia** Ridl., J. Fed. Malay States Mus. 7 (1916) 50, as '*Nothophoebe*'. TYPE: Peninsular Malaysia, Kedah, Kedah Peak, 3800 ft, *H.C. Robinson & C.B. Kloss 5996*, December 1915 (holotype, K (barcode no. K000778892); isotype, SING (barcode no. SING 0056072)).
= **PERSEA FRUTICOSA** (Kurz) Kosterm., Reinwardtia 7 (1968) 355; Kochummen, Tree Fl. Malaya 4 (1989) 173.

44. **NOTHAPHOEBE CONDENSEA** Ridl., J. Straits Branch Roy. Asiat. Soc. 82 (1920) 191; Kochummen, Tree Fl. Malaya 4 (1989) 170. TYPE: Peninsular Malaysia, Pulau Langkawi, Kerap [Kesap], *Md. Aniff 15473*, February 1911 (holotype, K (barcode no. K000575991); isotype, SING (barcode no. SING 0056073).
45. **Phoebe tavoyana** var. **villosa** Ridl., Fl. Malay Penins. 3 (1924) 105. SYNTYPES: Peninsular Malaysia, Pulau Langkawi, Gunong Raya, *Md Aniff 15469*, February 1911 (lectotype, designated here, K); Kedah, Bukit Jenun, *Md Haniff SFN 1210*, 19 November 1915 (K[×2]). Burma, Mergui.
= **PHOEBE TAVOYANA** (Meissn.) Hook.f., Fl. Brit. India 5 (1886) 143; Kochummen, Tree Fl. Malaya 4 (1989) 178.
- i. **CINNAMOMUM MICROPHYLLUM** Ridl., Fl. Malay Penins. 3 (1924) 92, *nom. nov. pro Cinnamomum parvifolium* Ridl.; Kochummen, Tree Fl. Malaya 4 (1989) 127.
- ii. **Cinnamomum rhynchophyllum** var. **lampongum** (Miq.) Ridl., Fl. Malay Penins. 3 (1924) 93. Basionym: *Cinnamomum lampongum* Miq., Fl. Ned. Ind., Eerste Bijv. 3 (1861) 358.
= **CINNAMOMUM RHYNCHOPHYLLUM** Miq., Fl. Ned. Ind. 1 (1858) 895. Soh, Blumea 56 (2011) 256.

Monimiaceae

46. **Palmeria paniculata** Ridl., Trans. Linn. Soc., Bot. 9 (1916) 144. TYPE: New Guinea, Mt Carstensz, Camp VIc, 5500 ft, *C.B. Kloss s.n.*, 1912–1913 (?BM).
= **PALMERIA GRACILIS** Perkins, Bot. Jahrb. 31 (1902) 745; Philipson, Fl. Males. 10 (1986) 269.
There is a specimen in BM, labelled Camp Dundok Padang, which may be the type.

MAGNOLIALES

Annonaceae

47. **Mezzettiopsis** Ridl., Bull. Misc. Inform. Kew 1912 (1912) 389. TYPE: *Mezzettiopsis creaghii* Ridl.
= **OROPHEA** Blume, Bijdr. (1825) 18.
48. **Uvariella** Ridl., Fl. Malay Penins. 1 (1922) 35. TYPE: *Uvariella leptopoda* (King) Ridl.
= **UVARIA** L., Sp. Pl. (1753) 536.
49. **Alphonsea keithii** Ridl., J. Straits Branch Roy. Asiat. Soc. 59 (1911) 66. TYPE: Thailand, Phangnga, Bangtaphan, *A. Keith 311*, 16 April 1890 (holotype, SING (barcode: SING0048653)).
50. **Artabotrys havilandii** Ridl., Bull. Misc. Inform. Kew 1912 (1912) 382. SYNTYPES: Borneo, Sarawak, Kuching, *G.D. Haviland 1629* (lectotype, designated by Turner (2009a), K; isolectotype, SAR); near Kuching, *G.D. Haviland & C. Hose 3340*, 24 November 1894 (BM, K, SAR); s. loc., *O. Beccari P.B. 381* (K); *O. Beccari P.B. 786*; *O. Beccari P.B. 713* (K), *O. Beccari P.B. 554* (FI-B, K),
= **ARTABOTRYS MAINGAYI** Hook.f. & Thomson, Fl. Brit. India 1 (1872) 55; Turner, Folia Malaysiana 10 (2009) 62.
Beccari's *P.B. 554* is the type of *Artabotrys pleianthus* Diels, a synonym of *Artabotrys roseus* Boerl.
51. **ARTABOTRYS HIRTIPES** Ridl., Bull. Misc. Inform. Kew 1912 (1912) 383; Turner, Folia Malaysiana 10 (2009) 86. SYNTYPES: Borneo, Sarawak, Rejang Kapit, *G.D. Haviland 2326*, March 1893 (lectotype, designated by Turner (2009a), K); Kuching, *G.D. Haviland 2106*, 19 January 1893 (K, SING); *G.D. Haviland & C. Hose 2106*, 29 November 1894 (K).
52. **Disepalum grandiflorum** Ridl., Bull. Misc. Inform. Kew 1912 (1912) 384. SYNTYPES: Borneo, Sarawak, Baram, *C. Hose 142* (lectotype, designated by Johnson (1989), K; isolectotypes, B, BM); Marudi, *C. Hose 214* (K).
= **DISEPALUM ANOMALUM** Hook.f., Trans. Linn. Soc. 23 (1860) 156; Johnson, Brittonia 41 (1989) 375.

53. **DREPANANTHUS CARINATUS** Ridl., Fl. Malay Penins. 1 (1922) 38. **Cyathocalyx carinatus** (Ridl.) J.Sinclair, Gard. Bull. Singapore 14 (1955) 241. TYPE: Peninsular Malaysia, Selangor, Sungei Buluh, *F.W. Foxworthy 2263*, December 1923 (holotype, K (barcode no. K000691221); isotype, SING).
54. **Goniothalamus caudifolius** Ridl., Bull. Misc. Inform. Kew 1914 (1914) 324. TYPE: Peninsular Malaysia, Perak, Pondok Tanjong, *A.M. Burn-Murdoch 180*, 1909 (holotype, K (barcode no. K000691878); isotype, K).
= **GONIOTHALAMUS TENUIFOLIUS** King, J. Asiat. Soc. Bengal. Pt. 2, Nat. Hist. 61 (1892) 71; Saunders, Bot. J. Linn. Soc. 142 (2003) 331.
55. **GONIOTHALAMUS PARALLELVENIUS** Ridl., Bull. Misc. Inform. Kew 1912 (1912) 385, as '*parallelovenius*'; Saunders, Bot. J. Linn. Soc. 139 (2002) 244. TYPE: Borneo, Sarawak, *O. Beccari P.B. 3772, s. dat.* (holotype, K (barcode no. K000691904); isotypes, FI-B, P).
56. **Goniothalamus pendulifolius** Ridl., Fl. Malay Penins. 5 (1925) 287. TYPE: Peninsular Malaysia, Pahang, 6 miles north of Bentong, *I.H. Burkill & Md. Haniff SFN 16501*, 5 November 1924 (lectotype, designated by Saunders (2003), K (barcode no. K000691852); isolectotypes, K (barcode no. K000691853), SING[×2]).
= **GONIOTHALAMUS UVARIOIDES** King, J. Asiat. Soc. Bengal. Pt. 2, Nat. Hist. 61 (1892) 78; Saunders, Bot. J. Linn. Soc. 142 (2003) 326.
57. **GONIOTHALAMUS UNDULATUS** Ridl., J. Fed. Malay States Mus. 10 (1920) 81. TYPE: Thailand, Tasan, *C.B. Kloss 6836, s. dat.* (holotype, K (barcode no. K000691832); isotype, SING).
58. **Melodorum breviflorum** Ridl., J. Malayan Branch Roy. Asiat. Soc. 1 (1923) 51. **FISSISTIGMA BREVIFLORUM** (Ridl.) I.M. Turner, *comb. nov.* TYPE: Sumatra, Berastagi, *H.V. Ridley s.n.*, 8 February 1921 (lectotype, designated here, K (barcode no. K000691997); isolectotypes, K[×2]).

The generic name *Melodorum* Lour. has a complex nomenclatural history that is not entirely resolved (Ueda 1986). For a long period it was wrongly applied to *Fissistigma* Griff. Merrill (1919) corrected this mistake and transferred many species from *Melodorum* to *Fissistigma*. However Ridley did not follow Merrill when publishing this new species from Sumatra (or in his Flora of the Malay

Peninsula). *Melodorum breviflorum* has the features typical of *Fissistigma* including its climbing habit, scalariform leaf venation, branched inflorescences, inner petals slightly smaller than outer petals and excavated at the base. I am not able to match the specimens to any other described *Fissistigma* species so I transfer *Melodorum breviflorum* to *Fissistigma*.

59. **Melodorum fagifolium** Ridl., Bull. Misc. Inform. Kew 1912 (1912) 386. *Fissistigma fagifolium* (Ridl.) Merr., Philipp. J. Sci., C. 15 (1919) 131. *Fissistigma kingii* (Boerl.) Burkill var. *fagifolium* (Ridl.) Airy Shaw, Bull. Misc. Inform. Kew 1939 (1939) 238. TYPE: Borneo, Sarawak, Entagut River, *C. Hose* 397, December 1894 (lectotype, designated here, K (barcode no. K000574676); isolectotypes, A, B, BM, K, L, P).
= **FISSISTIGMA KINGII** (Boerl.) Burkill, Bull. Misc. Inform. 1935 (1935) 317. Turner, Nordic J. Bot. 27 (2009) 368.
There are two herbarium sheets at K with the relevant Hose collection number. The better specimen is chosen as lectotype.
60. **Melodorum longipetalum** Ridl., Bull. Misc. Inform. Kew 1912 (1912) 387. **FISSISTIGMA LONGIPETALUM** (Ridl.) Merr., Philipp. J. Sci., C. 15 (1919) 133. TYPE: Borneo, Sarawak, Kuching, *G.D. Haviland* 2102 [Ngaing leg.], 11 January 1893 (holotype, K (barcode no. K000574672); isotypes, BM, SAR, SING).
61. **Melodorum ovalifolium** Ridl., Bull. Misc. Inform. Kew 1912 (1912) 387. *Fissistigma ovalifolium* (Ridl.) Merr., Philipp. J. Sci., C. 15 (1919) 134. *Oxymitra ovalifolia* (Ridl.) J. Sinclair, Sar. Mus. J. 5 (1951) 607. *Richella ovalifolia* (Ridl.) Steenis, Blumea 12 (1964) 357. **FRIESODIELSIA OVALIFOLIA** (Ridl.) I.M. Turner, Blumea 55 (2010) 118. SYNTYPES: Borneo, Sarawak, Kuching, *G.D. Haviland* & *C. Hose* 3151, 17 May 1894 (lectotype, designated by Turner (2010), K); *G.D. Haviland* & *C. Hose* 3141, 17 May 1894 (K, SAR[×2], SING).
62. **Melodorum paniculatum** Ridl., Bull. Misc. Inform. Kew 1912 (1912) 386. **FISSISTIGMA PANICULATUM** (Ridl.) Merr., Philipp. J. Sci., C. 15 (1919) 134. TYPE: Borneo, Sarawak, near Kuching, *G.D. Haviland* 1845, October 1892 (holotype, K (barcode no. K000574667); isotype, K).
One of the two sheets of *Haviland* 1845 at K has 'Type' written in Ridley's hand on it. I take this to be the holotype.

63. **Melodorum rigidum** Ridl., Bull. Misc. Inform. Kew 1912 (1912) 386.
Fissistigma rigidum (Ridl.) Merr., Philipp. J. Sci., C. 15 (1919) 135. SYNTYPES: Borneo, Sarawak, Kuching, *G.D. Haviland 421* [Garai leg.] [d.k.m.a.] (lectotype, designated here, K (barcode no. K000574656)); *s. loc.*, *O. Beccari P.B. 393* (FI-B, K, NY (fragment));
 = **PYRAMIDANTHE PRISMATICA** (Hook.f. & Thomson) Merr., J. Straits Branch Roy. Asiat. Soc., Spec. No. (1921) 262.
 Of the syntypes at K, the Haviland specimen is annotated as 'Type' in Ridley's hand and therefore chosen as lectotype. When Haviland began collecting in Sarawak he used a complex four-letter code for specimens that combined elements of the date and specimen number (Stapf 1907). He was advised to desist from this confusing practice and use a simple running number sequence. Many of the earlier coded collections were renumbered, but unfortunately he tended to give different gatherings of the same species the same number. Therefore it is important to use other information, such as date of collection, when dealing with typification of species based on Haviland collections. In this case, other herbaria (BO, SAR, SING) have *G.D. Haviland 421* specimens but these are of different collecting dates compared to the K specimen, so are not isolectotypes.
64. **Mezzettia pauciflora** Ridl., Bull. Misc. Inform. Kew 1912 (1912) 389.
 TYPE: Borneo, Sarawak, Kuching, *G.D. Haviland 1952*, 1 December 1892 (lectotype, designated here, K (barcode no. K000574873; isolectotypes, K, SAR, SING).
 = **MEZZETTIA UMBELLATA** Becc., Nuovo Giorn. Bot. Ital. 3 (1871) 187; van der Heijden & Keßler, *Blumea* 35 (1990) 220.
65. **Mezzettiopsis creaghii** Ridl., Bull. Misc. Inform. Kew 1912 (1912) 389.
OROPHEA CREAGHII (Ridl.) Leonardia & P.J.A. Kessler, *Blumea* 46 (2001) 149. TYPE: Borneo, British North Borneo [Sabah], Tinkango, *C. V. Creagh s.n.*, April 1895 (holotype, K (barcode no. K000574862); isotype, BM).
66. **MILIUSA AMPLEXICAULIS** Ridl., J. Straits Branch Roy. Asiat. Soc. 54 (1910) 13; Mols & Keßler, *Blumea* 48 (2003) 436. TYPE: Peninsular Malaysia, Pulau Langkawi, Coah [Kwah], *C. Curtis 3205*, April 1896 (lectotype, designated here, SING (barcode nos. SING 0045995); isolectotypes, K, SING (barcode no. SING 0045994), UC).

67. **Milium concinna** Ridl., J. Fed. Malay States Mus. 10 (1920) 127. SYNTYPES: Thailand, Phangnga, Hat Sunuk [Hat Sanuk], Koh Lak, *Hamid FMS Field No. 3802*, 3 April 1919 (lectotype, designated here, K (barcode no. K000691547); isolectotype, KEP); near Koh Lak, *Hamid FMS Field No. 3820*, 13 April 1919 (K, KEP).
= **POLYALTHIA EVECTA** (Pierre) Finet & Gagnep., Bull. Soc. Bot. Fr. 53, Mémoire 4 (1906) 91.
68. **Milium filipes** Ridl., J. Fed. Malay States Mus. 10 (1920) 81. TYPE: Thailand, Tasan, *C.B. Kloss 6968* (holotype, K).
69. **MILIUSA PARVIFLORA** Ridl., J. Straits Branch Roy. Asiat. Soc. 59 (1911) 65; Mols & Keßler, *Blumea* 48 (2003) 450. SYNTYPES: Peninsular Malaysia, Perlis, Tebing Tinggi, *H.N. Ridley 15340*, March 1910 (lectotype, designated here, SING; isolectotypes, BM, K); limestone rocks, Bukit Lagi, *H.N. Ridley 15239*, March 1910 (SING);
Mols & Keßler (2003) cited *Ridley 15340* as the holotype of *M. parviflora* but the original protologue cites both 15239 and 15340. Though misused terms relating to typification can be corrected [ICBN (McNeill et al. 2006) Art. 9.8], Mols and Keßler's statement is not a valid lectotypification for a publication after 1 January 2001 because 'designated here' or its equivalent was not employed [ICBN Art. 7.11].
70. **MITREPHORA ALBA** Ridl., J. Fed. Malay States Mus. 5 (1915) 158, Weerasooriya & Saunders, *Syst. Bot. Monogr.* 90 (2010) 39. TYPE: Thailand, Koh Samui western side, *H.C. Robinson 5717*, 13 May 1913 (lectotype, designated here, K (barcode no. K000691973); isolectotypes, K[×2] (barcode no. K000691974)).
Of the three sheets of *Robinson 5717* at K, two have original field tickets labelled with the date and Koh Samui. The chosen lectotype also has Robinson's collection label giving more details of the plant and collecting location. Both sheets are labelled '*Mitrephora alba* Ridl.' in Ridley's hand. The third sheet does not have any of Robinson's labels.
71. **Mitrephora crassipetala** Ridl., J. Straits Branch Roy. Asiat. Soc. 54 (1912) 13. TYPE: Peninsular Malaysia, Pahang, Tahan River, *Mat s.n.*, 23 September 1893 (holotype: SING (barcode no. SING 0119273)).
= **ANAXAGOREA JAVANICA** [Blume, *Fl. Javae Anon.* (1830) 66, t. 32] var. **JAVANICA**, Sinclair, *Gard. Bull. Singapore* 14 (1955) 347, 466.

72. **MITREPHORA KEITHII** Ridl., J. Straits Branch Roy. Asiat. Soc. 59 (1911) 66; Weerasooriya & Saunders, Syst. Bot. Monogr. 90 (2010) 70. TYPE: Thailand, Phangnga, Bangtaphan, *A. Keith* 373, 13 May 1890 (holotype, SING (barcode no. SING 0045997); isotype, K).
73. **Mitrephora obtusa** Blume var. **glabra** Ridl., Sarawak Mus. J. 1 (1913) 86. TYPE: Borneo, Sarawak, Mt Koum limestone, *G.D. Haviland* 1714 [Kalong leg.], 22 September 1892 (lectotype, designated here, K (barcode no. K000574547); isolectotypes, BM, L[×2], SAR[×2], SING[×2]).
= **MITREPHORA UNIFLORA** Weeras. & R.M.K. Saunders, Syst. Bot. Monogr. 90 (2010) 122.
74. **MITREPHORA RUFESCENS** Ridl., Bull. Misc. Inform. Kew 1912 (1912) 385. SYNTYPES: Sumatra, Sungei Buluk, Padang, *O. Beccari P.S.* 968 (lectotype, designated by Weerasooriya & Saunders (2010), BM; isolectotypes, FI-B, K), September 1878; *O. Beccari P.S.* 916, September 1878 (BM, FI-B, K[×2], L). Borneo, Sarawak, *O. Beccari P.B.* 1616 (FI-B, K); Matang, *G.D. Haviland* 1035 [leg. Garai] [e.c.q.b.] (K, SAR, SING); near Bau limestone *G.D. Haviland* 2249, 6 December 1893 (K, SAR).
The Sarawak syntypes are *Mitrephora longipetala* Miq. (Weerasooriya & Saunders 2010).
75. **Orophea setigera** Ridl., Trans. Linn. Soc., Bot. 9 (1916) 16. TYPE: New Guinea, Mt Carstensz, Camp III to VIII, 2500–4900 ft, *C.B. Kloss s.n.* (holotype, BM).
76. **Oxymitra linderifolia** Ridl., Bull. Misc. Inform. Kew 1912 (1912) 385. *Friesodielsia linderifolia* (Ridl.) Steen., Blumea 12 (1964) 360. SYNTYPES: Borneo, Sarawak, Kuching, *G.D. Haviland* 2333, 19 April 1893 (lectotype, designated here, K (barcode no. K000691760); isolectotypes, BM, K, SAR, SING); near Kuching, *G.D. Haviland & C. Hose* 3335, 11 October 1894 (K, BM, GH, SAR).
= **FRIESODIELSIA GLAUCA** (Hook.f. & Thomson) Steenis, Blumea 12 (1964) 359.
The Haviland collection was erroneously referred to as 3333 rather than 2333 in the original publication.

77. **POLYALTHIA ANGUSTISSIMA** Ridl., J. Straits Branch Roy. Asiat. Soc. 54 (1910) 11; Sinclair, Gard. Bull. Singapore 14 (1955) 286. SYNTYPES: Singapore: Bukit Timah, *H.N. Ridley 8050* (lectotype, designated by Bunchalee & Chantaranothai (2006), SING; isolectotype, K); sandy woods, Changi, *H.N. Ridley 5917* (SING, CAL); Gardens' Jungle, *H.N. Ridley 4813* (K, SING). Peninsular Malaysia, Johore: Kwala Sembong, *H.J. Kelsall 4047* (CAL, SING).
78. **POLYALTHIA ASTERIELLA** Ridl., J. Straits Branch Roy. Asiat. Soc. 82 (1920) 169; Sinclair, Gard. Bull. Singapore 14 (1955) 309. TYPE: Perak, Taiping Hills, Maxwell's Hill, *H.N. Ridley 2986*, February 1891 (holotype, K (barcode no. K000691443); isotypes, CAL, SING).
79. **Polyalthia castanea** Ridl., J. Fed. Malay States Mus. 8 (1917) 14. TYPE: Sumatra, Korinchi (Kerinci), Sandaran Agong at 2,450 feet. Small tree, flowers orange-brown.
I have failed to locate any (type) material of *Polyalthia castanea*.
80. **POLYALTHIA CHRYSOTRICHA** Ridl., Fl. Malay Penins. 1 (1922) 57; Sinclair, Gard. Bull. Singapore 14 (1955) 302. TYPE: Peninsular Malaysia, Selangor, Menuang Gasing, *C.B. Kloss s.n.*, February 1912 (holotype, K (barcode no. K000691577)).
81. **Polyalthia coriacea** Ridl., Bull. Misc. Inform. Kew 1912 (1912) 383. **ENICOSANTHUM CORIACEUM** (Ridl.) Airy Shaw, Bull. Misc. Inform. Kew 1939 (1939) 277. SYNTYPES: Borneo, Sarawak, Mt Buan Limestone, *G.D. Haviland 2002* [Garai leg.], 15 December 1892 (lectotype, designated here, K (barcode no. K000691411); isolectotype, SING); Bidi, *C.J. Brooks 1057*, April 1909 (BM).
82. **Polyalthia curtisii** Ridl., J. Straits Branch Roy. Asiat. Soc. 54 (1910) 11. TYPE: Peninsular Malaysia, Penang, Telok Bahang, *C. Curtis 3644* (holotype, SING; isotype, K).
= **POLYALTHIA GLABRA** (Hook.f. & Thomson) J. Sinclair, Gard. Bull. Singapore 14 (1955) 315.

83. **Polyalthia eriantha** Ridl., Bull. Misc. Inform. Kew 1912 (1912) 384, as '*eriantha*'. *Enicosanthum erianthum* (Ridl.) Airy Shaw, Bull. Misc. Inform. Kew 1939 (1939) 276. *Meiogyne eriantha* (Ridl.) J. Sinclair, Sarawak Mus. J. 5 (1951) 604. TYPE: Borneo, Sarawak, Kuching, *G.D. Haviland 410* [d.e.q.b.] (holotype K (barcode no. K000691133); isotypes, K[×2] (barcode nos. K000691134, K000691135), SAR).
= **MEIOGYNE VIRGATA** (Blume) Miq., Ann. Mus. Bot. Lugd.-Bat. 2 (1865) 12; van Heusden, Blumea 38 (1994) 495.
The holotype sheet is annotated 'Type' in Ridley's hand.
84. **Polyalthia hirta** Ridl., J. Straits Branch Roy. Asiat. Soc. 82 (1920) 168, *non* (Miq.) F. Muell. (1877); **POLYALTHIA HIRTIFOLIA** J. Sinclair, Gard. Bull. Singapore 14 (1955) 300, *nom. nov.* TYPE: Peninsular Malaysia, Penang, Pulau Butong Reserve, *C. Curtis 2745*, March 1892 (lectotype, designated here, K (barcode no. K000691452); isotypes, BM, K (barcode no. K000691453), SING).
85. **Polyalthia montana** Ridl., Journ. Linn. Soc., Bot. 41 (1913) 288. TYPE: Peninsular Malaysia, Selangor, Ulu Langat, Menuang Gasing, *C.B. Kloss s.n.*, February 1912 (lectotype, designated by Turner (2009b), K; isolectotype, BM).
= **TRIVALVARIA COSTATA** (Hook.f. & Thomson) I.M. Turner, Kew Bull. 64 (2009) 577.
86. **POLYALTHIA PARVIFLORA** Ridl., J. Straits Branch Roy. Asiat. Soc. 61 (1912) 49; Gard. Bull. Singapore 14 (1955) 299. SYNTYPES: Peninsular Malaysia, Pulau Langkawi, Kuala Malacca, *C. Curtis 2533*, September 1890 (lectotype, designated here, SING (barcode no. SING 0059296); isolectotype, CAL); Pulau Tengah, *H.N. Ridley 15893*, April 1911 (K, BM, SING (barcode no. SING 0059295)).
87. **POLYALTHIA PUMILA** Ridl., J. Straits Branch Roy. Asiat. Soc. 54 (1910) 12; Gard. Bull. Singapore 14 (1955) 289. SYNTYPES: Peninsular Malaysia, Perak, Dindings, Sera Woods, *H.N. Ridley 7996*, March 1896 (lectotype, designated here, SING (barcode: SING 0059298); isolectotype, K); Johore, Gunong Janing, *H.W. Lake & H.J. Kelsall s.n.*, 20 October 1892 (SING (barcode: SING 0059299)).

88. **Polyalthia purpurea** Ridl., J. Straits Branch Roy. Asiat. Soc. 82 (1920) 168. TYPE: Singapore, cultivated in Singapore Botanic Gardens, *H.N. Ridley 12014*, June 1904 (lectotype, designated here, K (barcode no. K000691573); isolectotype, SING).
= **POLYALTHIA SCLEROPHYLLA** Hook.f. & Thomson, Fl. Brit. Ind. 1 (1872) 65; Sinclair, Gard. Bull. Singapore 14 (1955) 311.
89. **Polyalthia velutinosa** Ridl., J. Straits Branch Roy. Asiat. Soc. 59 (1911) 64. TYPE: Peninsular Malaysia, Pulau Lankawi, Gunong Raya at 1500 feet, [Aniff] *Haniff 15552*, February 1911 (holotype, SING (barcode no. SING 0058808); isotypes, BM, K).
= **POLYALTHIA CINNAMOMEA** Hook.f. & Thomson, Fl. Ind. 1 (1855) 138; Sinclair, Gard. Bull. Singapore 14 (1955) 286.
90. **Popowia rufescens** Ridl., Bull. Misc. Inform. Kew 1926 (1926) 59. TYPE: Sumatra, Mentawai Islands, Siberut, *C.B. Kloss 14607* (holotype, K (barcode no. K000691711); isotype, BO).
= **POPOWIA PISOCARPA** (Blume) Endl. ex Walp., Repert. Bot. Syst. 1 (1842) 74; Sinclair, Gard. Bull. Singapore 14 (1955) 468.
91. **Unona conchylia** Ridl., Bull. Misc. Inform. Kew 1912 (1912) 384. *Desmos conchylia* (Ridl.) Merr., J. Straits Branch Roy. Asiat. Soc., Spec. No., (1921) 255. TYPE: Borneo, Sarawak, Kuching, *G.D. Haviland 771 [1779]*, 13 October 1892 (holotype, K (barcode no. K000691930)).
= **MEIOGYNE MONOSPERMA** (Hook.f. & Thomson) Heusden, Blumea 38 (1994) 502.
Ridley referred to *Haviland 1779* in describing the species. There are three sheets at Kew bearing this number, but all differ in collection date. One, which has the original collection number 771, has been annotated by Ridley as type. Other herbaria (B, BO, L, SAR, SING) have Haviland specimens with the number 1779 but none appears to be a duplicate of the holotype.
92. **Unona filipes** Ridl., J. Linn. Soc. Bot. 41 (1913) 287. *Desmos filipes* (Ridl.) Ridl., J. Straits Branch Roy. Asiat. Soc. 75 (1917) 6. **DASYMASCHALON FILIPES** (Ridl.) Bân, Bot. Zhurn. 60(2): 229; Wang et al., Syst. Bot. 34 (2009) 259. SYNTYPES: Peninsular Malaysia, Selangor, Menuang Gasing, *C.B. Kloss s.n.*, February 1912 (lectotype, designated here, K (barcode no., K000198741); isolectotypes, K[×2] (barcode nos. K000198739, K00019840); Perak, *Fr B. Scortechini 342*, September

1892 (BO, CAL, K, SING); Larut, *L. Wray 609*, May 1886 (K), Larut, *Dr King's Collector* [H.H. Kunstler] 5291 (K).

Nurmawati (2003) referred to the Herbarium Bogoriense duplicate of the Scortechini collection as the lectotype of *Unona filipes* but this is invalid as a lectotypification as the term 'designated here' or equivalent was not used [ICBN Art. 7.11]. I choose one of the Kloss specimens as the lectotype because, not only are they good specimens, but the protologue was published in the account of Kloss's expedition to Gunung Menuang Gasing. The chosen sheet has the species name in Ridley's hand.

93. **Unona jambosifolia** Ridl., Bull. Misc. Inform. Kew 1912 (1912) 384. *Desmos jambosifolius* Merr., J. Straits Branch Roy. Asiat. Soc. Spec. No. (1921) 255. *Polyalthia jambosifolia* (Ridl.) D.M. Johnson, Contrib. Univ. Mich. Herb. 22 (1999) 99. SYNTYPES: Borneo, Sabah, Kudat, *M. Fraser 174*, July 1885, (lectotype, designated here, K (barcode no. K000691580); Batu Putik, *C.V. Creagh s.n.* (BM, K (barcode no. K000691581);
= **POLYALTHIA MICROTUS** Miq., Ann. Mus. Bot. Lugd. Bat. 2 (1865) 13.
The Creagh specimen is *Polyalthia igniflora* D.M. Johnson.
94. **Unona purpurata** Ridl., Sar. Mus. J. 1(3) (1913) 79, *nom. illegit.* *Desmos purpuratus* (Ridl.) Merr., J. Straits Branch Roy. Asiat. Soc., Spec. No., (1921) 256, *nom. illegit.* TYPE: Same as *Unona conchyliata* Ridl.
= **MEIOGYNE MONOSPERMA** (Hook.f. & Thoms.) Heusden, Blumea 38 (1994) 502.
95. **UVARIA CAULIFLORA** Ridl., Bull. Misc. Inform. Kew 1912 (1912) 382. SYNTYPES: Borneo, Sarawak, *O. Beccari P.B. 1120* (FI-B, K); Tegora, *G.D. Haviland 417* [c.k.q.a.] [Garai leg.] (lectotype, designated here, K (barcode no. K000380300); isolectotype, K (barcode no. K000380298)); near Kuching, *G.D. Haviland 417* [Ulak leg.], 6 October 1892 (K); foot of Bembang, *G.D. Haviland 409* (K, SAR).
The lectotype sheet selected is annotated 'Type' in Ridley's hand.

96. **UVARIA LANUGINOSA** Ridl., Bull. Misc. Inform. Kew 1912 (1912) 382.
TYPE: Borneo, Sarawak, near Kuching, *G.D. Haviland & C. Hose* 3334, 13 November 1894 (holotype, K (barcode no. K000380301); isotypes, BM, SAR).
In the protologue, Ridley cited the type as 334, but the correct number is 3334.
97. **Xylopia congesta** Ridl., Bull. Misc. Inform. Kew 1912 (1912) 387.
POLYALTHIA CONGESTA (Ridl.) J. Sinclair, Sarawak Mus. Journ. 5 (1951) 607. TYPE: Borneo, Sarawak, *O. Beccari P.B. 2654* (holotype, K (barcode no. K000691591); isotypes, BM, FI-B).
98. **XYLOPIA CORIIFOLIA** Ridl., Bull. Misc. Inform. Kew 1912 (1912) 388.
SYNTYPES: Borneo, Sarawak, near Kuching, *G.D. Haviland & C. Hose* 3337, 6 November 1894 (lectotype, designated here, K (barcode no. K000574692); isolectotype, SAR); near Kuching, *G.D. Haviland 1906* [leg. Garai], 26 October 1892 (K); *s. loc.*, *O. Beccari P.B. 2652* (FI-B, K), *O. Beccari P.B. 3335* (FI-B, K);
99. **Xylopia havilandii** Ridl., Bull. Misc. Inform. Kew 1912 (1912) 388.
SYNTYPES: Borneo, Sarawak, near Kuching, *G.D. Haviland* 2334, 17 May 1893 (lectotype, designated here, K (barcode no. K000574708); isolectotypes, SAR, SING); *G.D. Haviland & C. Hose* 3352, 29 December 1894 (K).
= **XYLOPIA FUSCA** Maingay ex Hook.f. & Thomson, Fl. Brit. India 1 (1872) 83.
100. **Xylopia lanceola** Ridl., Bull. Misc. Inform. Kew 1912 (1912) 389.
SYNTYPES: Borneo, Sarawak, *O. Beccari P.B. 3368* (K); *O. Beccari P.B. 1968* (lectotype, designated by Sinclair (1951), K (barcode no. K000574695); isolectotypes, A, B, FI-B).
= **XYLOPIA CAUDATA** Hook.f. & Thomson var. **RETICULATA** J. Sinclair, Sarawak Mus. J. 5 (1951) 608.
Ridley misreported *P.B. 1968* as *1908* in the protologue – an excusable error as the labels are hand-written and the down stroke on the 6 is very feint. In K the specimen *G.D. Haviland 2066* is annotated in Ridley's hand as type of *Xylopia lanceola* although the specimen was not cited in the original publication.

101. **Xylopia pulchella** Ridl., Bull. Misc. Inform. Kew 1912 (1912) 388.
TYPE: Borneo, Sarawak, near Kuching, *G.D. Haviland 2101*, 16 January 1893 (holotype, K (barcode no. K000574761); isotype, SAR[×2]).
102. **Xylopia rotundata** Ridl., Bull. Misc. Inform. Kew 1926 (1926) 469.
TYPE: Borneo, Sarawak, Kuching, Siol, 7 January 1924, *Jantan bin Omar* [Foxworthy's collector] 00357 (holotype, SING; isotype, NY).
= **DREPANANTHUS BIOVULATUS** (Boerl.) Surves. & R.M.K. Saunders, Taxon 59 (2010) 1730.
- iii. **Sphaerocoryne** (Scheff. ex Boerl.) Scheff. ex Ridl., J. Straits Branch Roy. Asiat. Soc. 75 (1917) 8. Basionym: *Polyalthia* section *Sphaerocoryne* Scheff. ex Boerl., [Cat. Pl. Phan. 1 (1899) 26, *nomen*] Icon. Bogor. 1 (1899) 196. TYPE: *Sphaerocoryne aberrans* (Maingay ex Hook.f. & Thomson) Ridl. (designated by Fries (1959)).
Although Ridley made no direct reference to Boerlage's sectional name, ICBN rules apply such that the genus must be considered to be based on section *Sphaerocoryne* [ICBN Art. 33.3, viz. Ex. 9].
- iv. **Canangium latifolium** [Hook.f. & Thomson] Pierre ex Ridl., Fl. Malay Pen. 1 (1922) 44, *nom. superfl.* *Unona latifolia* Hook.f. & Thomson, Fl. Brit. India 1 (1872) 60, *non U. latifolia* Dunal.
Ridley's intention was to transfer *Unona latifolia* Hook.f. & Thomson to *Canangium*, but as this is a later homonym the transfer is invalid (hence square brackets in citation) and as a new name the combination is superfluous as Pierre had provided the replacement *Unona brandisiana* for Hooker and Thomson's name, which Safford had already transferred to *Canangium* (Turner & Veldkamp 2009).
- v. **Canangium monospermum** (Hook.f. & Thomson) Ridl., J. Straits Branch Roy. Asiat. Soc. 75 (1917) 7. **MEIOGYNE MONOSPERMA** (Hook.f. & Thomson) Heusden, Blumea 38 (1994) 502. Basionym: *Cananga monosperma* Hook.f. & Thomson, Fl. Brit. Ind. 1 (1872) 57.

- vi. **Desmos dasymaschalus** (Blume) Safford var. **wallichii** (Hook.f. & Thomson) Ridl., Fl. Malay Penins. 1 (1922) 47. *Dasymaschalon blumei* Finet & Gagnep. var. *wallichii* (Hook.f. & Thomson) Bân, Bot. Zhurn. 60 (1975) 228. *Dasymaschalon dasymaschalum* (Blume) I.M. Turner var. *wallichii* (Hook.f. & Thomson) I.M. Turner, Gard. Bull. Singapore 58 (2007) 277. **DASYMASCHALON WALLICHII** (Hook.f. & Thomson) Jing Wang & R.M.K. Saunders, Syst. Bot. 34 (2009) 263. Basionym: *Unona dasymaschala* var. *wallichii* Hook.f. & Thomson, Fl. Ind. 1 (1855) 135.
- vii. **Desmos filipes** (Ridl.) Ridl., J. Straits Branch Roy. Asiat. Soc. 75 (1917) 6. **DASYMASCHALON FILIPES** (Ridl.) Bân, Bot. Zhurn. 60(2): 229; Wang et al., Syst. Bot. 34 (2009) 259. Basionym: **Unona filipes** Ridl., J. Linn. Soc., Bot. 41 (1913) 287.
- viii. **MEZZETTIA HAVILANDII** (Boerl.) Ridl., Sarawak Mus. Journ. 1(3) (1913) 96; van der Heijden & Kessler, Blumea 35 (1990) 221. Basionym: *Mezzettia parviflora* Becc. var. *havilandii* Boerl., Icon. Bogor. 1 (1899) 111.
- ix. **Mitrephora chrysoarpa** (Miq.) Boerl. var. **sakumbangensis** (Miq.) Ridl., Sar. Mus. J. 1 (1913) 87. Basionym: *Orophea chrysoarpa* Miq. var. *sakumbangensis* Miq., Ann. Mus. Bot. Lugd.-Bat. 2 (1865) 24.
= **PSEUDUVARIA RETICULATA** (Blume) Miq., Fl. Ned. Ind. 1(2) (1858) 33; Su & Saunders, Syst. Bot. Monogr. 79 (2006) 150.
- x. **Polyalthia crinita** (Hook.f. & Thomson) Ridl., J. Straits Branch Roy. Asiat. Soc. 75 (1917) 6. Basionym: *Unona crinita* Hook.f. & Thomson, Fl. Brit. Ind. 1 (1872) 61.
= **POLYALTHIA STENOPETALA** (Hook.f. & Thomson) Finet & Gagnep., Bull. Soc. Bot. France Mem. 4 (1906) 96; Sinclair, Gard. Bull. Singapore 14 (1955) 285. (Note that this combination is often attributed to Ridley (J. Straits Branch Roy. Asiat. Soc. 75 (1917) 6) but Finet and Gagnepain have priority on the name by more than a decade).

- xi. **Polyalthia desmantha** (Hook.f. & Thomson) Ridl., J. Straits Branch Roy. Asiat. Soc. 75 (1917) 6. *Desmos desmanthus* (Hook.f. & Thomson) Saff., Bull. Torrey Bot. Club 39 (1912) 508. **POLYALTHIA CAULIFLORA** Hook.f. & Thomson var. **DESMANTHA** (Hook.f. & Thomson) J. Sinclair, Gard. Bull. Singapore 14 (1955) 295. Basionym: *Unona desmantha* Hook.f. & Thomson, Fl. Brit. Ind. 1 (1872) 61.
- xii. **Polyalthia submitrata** (Miq.) Ridl., Sar. Mus. J. 1 (1913) 82. Basionym: *Monoon submitratum* Miq., Ann. Mus. Bot. Lugd.-Bat. 2 (1865) 16. = **SPHAEROCORYNE AFFINIS** (Teijsm. & Binn.) Ridl., J. Straits Branch Roy. Asiat. Soc. 75 (1917) 8.
- xiii. **Polyalthia wrayi** (Hemsl.) Ridl., J. Straits Branch Roy. Asiat. Soc. 75 (1917) 6. *Desmos wrayi* (Hemsl.) Saff., Bull. Torrey Bot. Club 39 (1912) 507. **POLYALTHIA CAULIFLORA** Hook.f. & Thomson var. **WRAYI** (Hemsl.) J. Sinclair, Gard. Bull. Singapore 14 (1955) 296. Basionym: *Unona wrayi* Hemsl., Hook. Icon. Pl. 16 (1887) t. 1553.
- xiv. **Popowia nervosa** (Hook.f.) Ridl., Fl. Malay Penins. 1 (1922) 78. **TRIVALVARIA NERVOSA** (Hook.f. & Thomson) J. Sinclair, Gard. Bull. Singapore 14 (1955) 197. Basionym: *Ellipeia nervosa* Hook.f. & Thomson, Fl. Brit. Ind. 1 (1872) 52.
- xv. **Popowia pumila** (King) Ridl., Fl. Malay Penins. 1 (1922) 78. *Trivalvaria pumila* (King) J. Sinclair, Gard. Bull. Singapore 14 (1955) 198. Basionym: *Ellipeia pumila* King, J. Asiat. Soc. Bengal, Pt. 2, Nat. Hist. 61 (1892) 27. = **TRIVALVARIA COSTATA** (Hook.f. & Thomson) I.M. Turner, Kew Bull. 64 (2009) 577.
- xvi. **Sphaerocoryne aberrans** (Maingay ex Hook.f. & Thomson) Ridl., J. Straits Branch Roy. Asiat. Soc. 75 (1917) 8. *Popowia aberrans* (Maingay ex Hook.f. & Thomson) Pierre ex Finet & Gagnep., Bull. Soc. Bot. Fr. Mem. 4(2) (1906) 109. *Melodorum aberrans* (Maingay ex Hook.f. & Thomson) J. Sinclair, Gard. Bull. Singapore 14 (1953) 41. *Mitrella aberrans* (Maing. ex Hook.f. & Thomson) Bân, Bot. Zhurn. 59(2) (1974) 244. Basionym: *Polyalthia aberrans* Maingay ex Hook.f. & Thomson, Fl. Brit. Ind. 1 (1872) 67. = **SPHAEROCORYNE AFFINIS** (Teijsm. & Binn.) Ridl., J. Straits Branch Roy. Asiat. Soc. 75 (1917) 8.

- xvii. **SPHAEROCORYNE AFFINIS** (Teijsm. & Binn. ex Boerl.) Ridl., J. Straits Branch Roy. Asiat. Soc. 75 (1917) 8. Basionym: *Polyalthia affinis* Teijsm. & Binn. ex Boerl., Ic. Bogor 1 (1899) t. 63.
- xviii. **Sphaerocoryne siamensis** (Boerl.) Scheff. ex Ridl., J. Straits Branch Roy. Asiat. Soc. 75 (1917) 8. Basionym: *Polyalthia siamensis* Boerl., Ic. Bogor 1 (1899) 195.
 =**SPHAEROCORYNE AFFINIS** (Teijsm. & Binn.) Ridl., J. Straits Branch Roy. Asiat. Soc. 75 (1917) 8.
 Ridley cited three synonyms when making this combination: *Unona mesnyi* Pierre (Fl. Forest. Cochinch. (1881) t. 17), *Popowia mesnyi* Craib (Bull. Misc. Inform. Kew 1914 (1914) 5) and the apparently unpublished *Popowia edulis* Pierre. The first two, predating Boerlage's *Polyalthia siamensis*, at first sight makes Ridley's new combination superfluous (though this does not invalidate the combination [ICBN Art. 52.3]); but Pierre cited *Polyalthia aberrans* Maingay ex Hook.f. & Thomson (Fl. Brit. Ind. 1 (1872) 67) and *Melodorum clavipes* Hance (J. Bot. 15 (1877) 328) as synonyms when describing *Unona mesnyi*, rendering the name illegitimate. Craib, while explicitly excluding *Polyalthia aberrans* from *Unona mesnyi*, did not refer to *Melodorum clavipes*, so failed to validate Pierre's taxon as *Popowia mesnyi*. Therefore *Sphaerocoryne siamensis* was not superfluous when Ridley published it.
- xix. **Uvariella leptopoda** (King) Ridl., Fl. Malay Penins. 1 (1922) 35. **UVARIA LEPTOPODA** (King) R.E. Fr., Ark. Bot. 3 (1953) 40. Basionym: *Ellipeia leptopoda* King, J. Asiat. Soc. Bengal, Pt. 2, Nat. Hist. 61 (1892) 25.

Magnoliaceae

103. **Talauma beccarii** Ridl., Bull. Misc. Inform. Kew 1912 (1912) 381. *Magnolia candollei* (Blume) Noot. var. *beccarii* (Ridl.) Noot., Blumea 32 (1987) 375. **MAGNOLIA LILIFERA** Baill. var. **BECCARII** (Ridl.) Govaerts, World Checklist & Bibliogr. Magnoliac. (1996) 71. TYPE: Borneo, Sarawak, Mt Sadong, *O. Beccari* P.B. 3959, November 1867 (holotype, K (barcode no. K000681543); isotype, FI-B).

104. **Talauma oblanceolata** Ridl., Fl. Malay Penins. 5 (1925) 286. TYPE: Peninsular Malaysia, Pahang/Selangor, Sempang, *H.N. Ridley 15590*, April 1911 (holotype, K (barcode no. K000395248); isotype, SING).
= **MAGNOLIA LILIFERA** var. **OBOVATA** (Korth.) Govaerts, World Checklist & Bibliogr. Magnoliac. (1996) 71.
105. **Talauma singapurensis** Ridl., Bull. Misc. Inform. Kew 1914 (1914) 323. *Magnolia candollei* (Blume) Noot. var. *singapurensis* (Ridl.) Noot., Blumea 32 (1987) 375. **MAGNOLIA LILIFERA** Baill. var. **SINGAPURENSIS** (Ridl.) Govaerts, World Checklist & Bibliogr. Magnoliac. (1996) 71. SYNTYPES: Singapore, Chan Chu Kang, *H.N. Ridley 5091* (lectotype, designated by Dandy (1928), BM; isolectotypes, B (?destroyed), K, SING); Bukit Mandai Road, *H.N. Ridley 3656* (BM (carpological coll.), K).
K has a sheet of *H.N. Ridley 2110*, Bukit Mandai, January 1891, on which are mounted capsules containing material from the two syntypes. Presumably Ridley used all these collections in describing the species, but failed to cite 2110 in the protologue. Dandy (1928) effectively lectotypified the species name to a BM collection nearly half a century before Nootboom (1987) proposed the duplicate in SING as lectotype.
- xx. **Talauma longifolia** (Blume) Ridl., J. Fed. Malay States Mus. 7 (1916) 38. Basionym: *Talauma mutabilis* Blume var. *longifolia* Blume, Fl. Jav. Magnol. (1829) 37.
= **MAGNOLIA LILIFERA** Baill. var. **LILIFERA**, Govaerts, World Checklist & Bibliogr. Magnoliac. (1996) 33.

NYMPHAEALES

Nymphaeaceae

- xxi. **Barclaya kunstleri** (King) Ridl., Fl. Malay Penins. 1 (1922) 117. **HYDROSTEMMA KUNSTLERI** (King) B.C. Stone, Gard. Bull. Singapore 35 (1982) 71. Basionym. *Barclaya motleyi* var. *kunstleri* King, J. Asiat. Soc. Bengal, Pt. 2, Nat. Hist. 58 (1887) 390.

PIPERALES

Aristolochiaceae

106. **ARISTOLOCHIA GLAUCIFOLIA** Ridl., Bull. Misc. Inform. Kew 1925 (1925) 88; Ding Hou, Fl. Males. 10 (1984) 93. TYPE: Sumatra, Bencoolen, *C.J. Brooks s.n.* (holotype, K (barcode no. K000820375)).
107. **ARISTOLOCHIA KLOSSII** Ridl., Bull. Misc. Inform. Kew 1926 (1926) 78, Ding Hou, Fl. Males. 10 (1984) 93. TYPE: Sumatra, Mentawai Islands, Sipora, *C.B. Kloss SFN 14767*, 24 October 1924 (holotype, K (barcode no. K000820374); isotypes, BO, SING).
108. **ARISTOLOCHIA MINUTIFLORA** Ridl. ex Gamble, Bull. Misc. Inform. Kew 1910 (1910) 79; Ding Hou, Fl. Males. 10 (1984) 93. SYNTYPES: Peninsular Malaysia, Perak, *H.N. Ridley 8022*, March 1896 (lectotype, designated here, SING; isolectotype, BM); *H.N. Ridley 10259* (SING), *Kunstler* [King's Collector] 1964.
109. **Aristolochia pithecurus** Ridl., J. Bot. 52 (1914) 296. **PARARISTOLOCHIA PITHECURUS** (Ridl.) Mich. J. Parsons, Bot. J. Linn. Soc. 120 (1996) 207. TYPE: New Guinea, Central Province, Sogeri Region, Mt Korkoko 2500 ft, *H.O. Forbes 621* (holotype, BM; isotypes, L, WRS�).
110. **Thottea hirsuta** Ridl., Journ. As. Soc. Mal. 1 (1923) 87. TYPE: Sumatra, Sibolangit, Bukit Pasang, *Mohamed Nur SFN 7223*, 11 August 1921 (holotype, K; isotypes, BM, BO, SING (barcode no. SING 0097461)).
= **THOTTEA MACRANTHA** (Boerl.) Ding Hou, Fl. Males. 10 (1984) 81.
111. **THOTTEA PARVIFLORA** Ridl., J. Straits Branch Roy. Asiat. Soc. 57 (1911) 89; Ding Hou, Fl. Males. 10 (1984) 67. TYPE: Peninsular Malaysia, Perak, Upper Perak, Temengoh hill woods, *H.N. Ridley 14580*, August 1904 (holotype, SING (barcode no. SING 0097415)).

Piperaceae

112. **Peperomia hedyotidea** Ridl., Trans. Linn. Soc., Bot. 9 (1916) 142. SYNTYPES: New Guinea, Mt Carstensz, Camp VIc, *C.B. Kloss s.n.*, 22 February 1913 (lectotype, designated here, BM (barcode BM000950712); isolectotype, K); Camp III, 2500 ft, *C.B. Kloss s.n.*, Febuary 1913 (BM (barcode no. BM000950711)); Camp VIb, *C.B. Kloss s.n.*, 2 February 1913, (BM (barcode no. BM000950710), K). At both BM and K all the syntypes are mounted on one herbarium sheet.
113. **Peperomia malaccensis** Ridl., Bull. Misc. Inform. Kew 1895 (1895) 185. TYPE: Peninsular Malaysia, Malacca, *R. Derry s.n.* (holotype, K (barcode no. K000820265)).
? = **Peperomia gemella** Miq.
114. **Peperomia muscicola** Ridl., Trans. Linn. Soc., Bot. 9 (1916) 141. TYPE: New Guinea, Mt Carstensz. Camp I, 500 ft, *C.B. Kloss s.n.*, November–December 1913 (holotype, BM (barcode no. BM00950714); isotype, K).
115. **Peperomia obliqua** Ridl., Trans. Linn. Soc., Bot. 9 (1916) 142, *non P. obliqua* Ruiz & Pav. (1798). **PEPEROMIA RIDLEYI** C. DC., Candollea 1 (1923) 407. TYPE: New Guinea, Camp IX to XI, 5500 to 8300 ft, *C.B. Kloss s.n.*, February 1912 (holotype, BM (barcode no. BM000950715)).
116. **Peperomia purpurea** Ridl., Trans. Linn. Soc., Bot. 9 (1916) 141; *non P. purpurea* Ruiz & Pavon. (1798). **PEPEROMIA COLOSSINA** C.DC., Candollea 1 (1923) 383. TYPE: New Guinea, Camps I to III, 500 to 2500 ft, *C.B. Kloss s.n.*, 22 November 1912 (holotype, BM (barcode no. BM000950716); isotype, K).
117. **Peperomia villosa** Ridl., J. Fed. Malay States Mus. 8 (1917) 80, *non P. villosa* C. DC. (1866). **PEPEROMIA KERINCIENSIS** I.M. Turner, *nom. nov.* TYPE: Sumatra, Korinchi (Kerinci) Peak, Siolak. Daras 3000 ft, *H.C. Robinson & C.B. Kloss s.n.*, 19 March 1914, annot. 'Peperomia hispidula Ridl.' (lectotype, designated here, K (barcode no. K000820274)).

I have not traced any material labelled *Peperomia villosa* Ridl. In the Kew herbarium there is a Robinson & Kloss specimen that agrees with the details given in the protologue and which is labelled '*Peperomia hispidula* Ridl.', a name apparently never published by Ridley. One

supposes Ridley, realizing his proposed name was already used for a Caribbean species (*Peperomia hispidula* (Sw.) Dietr.), changed to *P. villosa* without correcting the specimen. Unfortunately *P. villosa* is also a later homonym, so I here provide an avowed substitute for it.

118. **PIPER ARGYRITES** Ridl. ex C.DC., Rec. Bot. Surv. India 6 (1912) 25; Suwanphakdee & Chantaranonthai, Blumea 56 (2011) 239. SYNTYPES: Peninsular Malaysia, Selangor, Gua Batu, *H.N. Ridley 8176* (lectotype, designated by Suwanphakdee & Chantaranonthai (2011), SING; isolectotype, G); Ginding Bidai, *H.N. Ridley 7611*.
119. **Piper burkillii** Ridl., J. Straits Branch Roy. Asiat. Soc. 82 (1920) 189. TYPE: Peninsular Malaysia, Negeri Sembilan, Tampin Hill, *I.H. Burkill SFN 1177*, 10 July 1916 (holotype, K (barcode no. K000794927); isotype, SING (barcode no. SING 0068757)).
 ?= **Piper curtisii** C. DC.
120. **Piper coactile** Ridl., Journ. As. Soc. Mal. 1 (1923) 88. TYPE: Sumatra, Berastagi, Karoo Plateau, 5000 ft, *H.N. Ridley s.n.*, 15 February 1921 (holotype, K (barcode no. K000820249)).
121. **Piper cyrtostachys** Ridl., J. Straits Branch Roy. Asiat. Soc. 82 (1920) 189. TYPE: Peninsular Malaysia, Pahang, Gunong Berumbun near Telom, *H.N. Ridley 14013*, November 1908 (holotype, K (barcode no. K000794912)).
 The Ridley collection number is the same as that for the type of *Piper subgrande* Ridl., but the location and date are different.
122. **Piper grande** Ridl., Trans. Linn. Soc., Bot. 9 (1916) 112; *non P. grande* Vahl (1798). *Piper pergrande* C. DC., Candollea 1 (1923) 268, *nom. nov.* SYNTYPES: New Guinea, Mt Carstensz, Camp 1, *C.B. Kloss s.n.*, October–November 1912 (lectotype, designated by Chew (1992), BM; isolectotype, K); Canoe Camp, 150 ft, *C.B. Kloss s.n.*, October–November 1912 (BM, K).
 = **PIPER SUBBULLATUM** K. Schum. & Lauterb., Fl. Schutzgeb. Südsee (1900) 262; Chew, Blumea 37 (1992) 161.
123. **Piper klossii** Ridl., J. Straits Branch Roy. Asiat. Soc. 82 (1920) 189. TYPE: Peninsular Malaysia, Selangor, Gunong Menuang Gasing, Ulu Langat *C.B. Kloss s.n.*, February 1912 (holotype, K (barcode no. K000794928)).

124. **Piper kraense** Ridl., J. Fed. Malay States Mus. 10 (1920) 112, as '*kraensis*'. TYPE: Thailand, Tasan, *C.B. Kloss 7045*, February–March 1919 (holotype, K (barcode no. K000794895); isotype, SING (barcode no. SING 0068765)).
 ?= **Piper majusculum** Blume
125. **Piper kurzii** Ridl., J. Straits Branch Roy. Asiat. Soc. 82 (1920) 188. SYNTYPES: Burma, Pegu, *W.S. Kurz 2220*, 21 February 1871 (lectotype, designated here, K (barcode no. K000794423) (excluding fruiting material in attached capsule (barcode no. K000794424)); isotype, CAL). Perak, Temengoh, *H.N. Ridley 14575*, August 1909 (K); Selangor, Batu Caves, *H.N. Ridley s.n.*, 4 March 1915 (K).
 Given Ridley's choice of epithet it seems appropriate to select the Kurz specimen as lectotype. In the protologue, Ridley confused his Ks and mistakenly referred to Kunstler as the collector of the lectotype sheet. The Kew duplicate of this sheet has an attached capsule containing one infructescence. This is labelled as *Kurz 491* and is therefore specifically excluded from the lectotype as it represents a different gathering. *Piper kurzii* C.DC. (*Candollea* 1 (1923) 198) is a later homonym of Ridley's species and probably represents the same taxon as *Kurz 2220* was cited (though *pro parte* – possibly explained by inclusion of material of *Kurz 491*) in the expanded description of the species (*Candollea* 2 (1925) 205).
126. **Piper melanocarpum** Ridl., Journ. As. Soc. Mal. 1 (1923) 88. TYPE: Sumatra, Berastagi, *H.N. Ridley s.n.*, 11 February 1921 (holotype, K (barcode no. K000820051)).
 ?= **Piper nigrescens** Blume
127. **Piper montivagum** Ridl., Trans. Linn. Soc., Bot. 9 (1916) 143. TYPE: New Guinea, Mt Carstensz, Camps IX to XIII, 5500 to 10500 ft. *C.B. Kloss s.n.* (holotype, BM (barcode no. BM000624276)).
 = **PIPER GIBBILIMBUM** C. DC., Nova Guinea 8 (1910) 416: Johns in Johns et al., Guide Alp. & Subalp. Fl. Mt. Jaya (2006) 401
128. **Piper oreophilum** Ridl., J. Straits Branch Roy. Asiat. Soc. 82 (1920) 188. TYPE: Peninsular Malaysia, Pahang, Gunong Tahan in the gully on the way to the plateau about 4000 ft. *H. N. Ridley 16106*, August 1911 (holotype, K (barcode no. K000794911)).

129. **Piper philodendron** Ridl., J. Malayan Branch Roy. Asiat. Soc. 1 (1923) 87. TYPE: Sumatra, Berastagi woods, *H.N. Ridley s.n.*, 14 February 1921 (holotype, K (barcode no. K000820057)).
130. **Piper polycarpum** Ridl., J. Fed. Malay States Mus. 10 (1920) 112, as '*polycarpa*'. TYPE: Thailand, Tasan, *C.B. Kloss 6888* (holotype, K (barcode no. K000794894)).
131. **Piper puncticulatum** Ridl., Trans. Linn. Soc., Bot. 9 (1916) 143. TYPE: New Guinea, Mt Carstensz, Camp VIa, 3100 ft, *C.B. Kloss s.n.*, 14 January 1913 (holotype, BM (barcode no. BM00062487); isotype, K).
= **PIPER GIBBILIMBUM** C. DC., Nova Guinea 8 (1910) 416. Johns in Johns et al., Guide Alp. & Subalp. Fl. Mt. Jaya (2006) 401.
132. **Piper salticola** Ridl., J. Malayan Branch Roy. Asiat. Soc. 1 (1923) 88. SYNTYPES: Sumatra, Berastagi, *H.N. Ridley s.n.*, 11 February 1921 (lectotype, designated here, K (barcode no. K00057307); Berastagi forests, *H.N. Ridley s.n.*, 13 February 1921 (K); Berastagi woods, *H.N. Ridley s.n.*, February 1921 (K).
? = **Piper korthalsii** Miq.
133. **Piper subgrande** Ridl., Fl. Malay Penins. 5 (1925) 329. TYPE: Peninsular Malaysia, Perak, Ulu Batang Padang, *H.N. Ridley 14013*, November 1908 (holotype, K (barcode no. K000794913)).
?= **Piper majusculum** Blume
Note that the Ridley collection number is the same as that for the type of *Piper cyrtostachys* Ridl., but the location and date are different.
134. **Piper uncinulatum** Ridl., J. Bot. 62 (1924) 300. TYPE: Peninsular Malaysia, Pahang, Fraser's Hill, 3000 ft, *R.E. Holttum SFN 11343*, 13 September 1923 (holotype, K (barcode no. K000794906)).
135. **Piper venosum** Ridl., Fl. Malay Penins. 5 (1925) 327, *non P. venosum* (Miq.) C.DC. (1869). **PIPER ANGIENSE** I.M. Turner, *nom. nov.* TYPE: Peninsular Malaysia, Negeri Sembilan, Gunong Angsi west side, *I.H. Burkill 11510* [Md Nur leg.], 20 November 1923 (holotype, K). Ridley's name is a later homonym. In order to supply a legitimate name for the species I propose an avowed substitute for *Piper venosum* Ridl.

- xxii. **Piper subpenninerve** (C. DC.) Ridl., Fl. Malay Penins. 3 (1924) 47.
 Basionym: *Piper nigrum* var. *subpenninerve* C. DC., J. Asiat. Soc. Bengal, Pt. 2, Nat. Hist. 75: 314.

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**Studies on Schismatoglottideae (Araceae) of Borneo XVII:
The *Schismatoglottis* Hottae Complex,
a new informal taxon, and three new species
from Sarawak, Malaysian Borneo**

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ABSTRACT. On the basis of a suite of shared morphological characters, the *Schismatoglottis* Hottae Complex is defined as a Borneo-endemic informal taxon in the *Schismatoglottis* Asperata Group. Four species, three novel, are assigned to the Hottae Complex: *S. hottae* Bogner & Nicolson, *S. dilecta* S.Y.Wong, P.C.Boyce & S.L.Low, sp. nov., *S. mira* S.Y.Wong, P.C.Boyce & S.L.Low, sp. nov., and *S. thelephora* S.Y.Wong, P.C.Boyce & S.L.Low, sp. nov. A key to species of the Hottae Complex is proffered. *Schismatoglottis hottae* is illustrated from the Holotype herbarium material, the three novelties from living plants.

Keywords. Araceae, Borneo, Sarawak, *Schismatoglottis*, *Schismatoglottis* Hottae Complex

Introduction

Earlier papers of this series (Boyce & Wong 2006; Wong 2010), and Hay & Yuzammi (2000), highlight that the Asperata Group (*sensu* Hay & Yuzammi 2000) is certainly heterogeneous. Notwithstanding the phylogenetic veracity or otherwise of the Asperata Group, during extensive fieldwork over the past 6 years in Sarawak we have come to recognise that within the Asperata Group there exists a number of 'species complexes'—subsets of morphotaxa—the application of an informal nomenclature to which provides a convenient tool for discussing potential phylogenetically significant units (PSUs). One such is the Hottae Complex, defined here by long-persistent somewhat bicarinate ligular sheaths, petioles and sometimes leaf blades with deciduous indumentum, leaf blades abaxially with conspicuous pellucid secretory canals, solitary inflorescences with a very short peduncle completely concealed within the subtending cataphylls, staminate flowers with a blunt, narrowly pyramidal connective extended well beyond the thecae, and a spathe limb darkening rapidly after opening and thence deliquescing without crumbling. All species show an ecological preference for vertical or very steep slopes with surface running water in lowland moist or perhumid gallery forest, with one (*S. thelephora* sp. nov.) at least a facultative rheophyte.

So far four species are known that display the above set of morphological characters: *S. hottae* Bogner & Nicolson, and three novelties, here described.

Key to the *Schismatoglottis* Hottae Complex

- 1a. Leaf blade lanceolate, abaxially with conspicuous pellucid secretory canals. Staminate flower zone much narrower than the pistillate zone. Interstice staminodes nipple-like, greatly exceeding the pistils and staminate flowers, upper-most staminodes furnished with a terminal yellow-brown rostrum (vestigial anther?). Anthers deep red 4. *S. thelephora*
- b. Leaf blade ovate to broadly ovate or ovato-cordate, abaxially with or without conspicuous pellucid secretory canals. Staminate flower zone width equalling or much exceeding the pistillate zone. Interstice staminodes not nipple-like, equalling pistils. Anthers pale salmon-orange, or bright pink 2
- 2a. Leaf blade adaxially minutely and softly densely tuberculate, abaxially often with adventitious plantlets. Emerging leaves green. Pistillate zone much narrower than the staminate zone, pale green. Staminate flowers pale brownish pink. Spathe limb opening green. Sarawak (Bintulu, Bukit Satiam), shales 3. *S. mira*
- b. Leaf blade adaxially minutely pubescent or smooth, abaxially without adventitious plantlets. Emerging leaves pink. Pistillate zone spadix sub-equalling or slightly exceeding the staminate zone. Spathe limb opening medium to bright pink. Sarawak and Brunei 3
- 3a. Plant to 35 cm tall. Leaf blade up to 30 cm × 20 cm, adaxially smooth, semi-glossy when wet, abaxially pale green with conspicuous pellucid secretory canals. Petioles, and midrib and primary lateral veins of abaxial surface sub-microscopically pale greyish pubescent. Spadix c. 9 cm long. Sarawak (Mulu), shales 2. *S. dilecta*
- b. Plant to 20 cm tall, often less. Leaf blade up to 12 cm × 9 cm, adaxially densely minutely hairy, matte even when wet, abaxially pale green without conspicuous pellucid secretory canals. Petioles, and mid-rib and primary lateral veins of abaxial surface densely pale brown pubescent. Spadix c. 2.5 cm long. Brunei (Teraja and Batu Patam), sandstones 1. *S. hottae*

1. *Schismatoglottis hottae* Bogner & Nicolson, Aroideana 2: 120 (1979); Mayo, Bogner & Boyce, The Genera of Araceae, 184, pl. 49(ii), D (1997); Hay & Yuzammi, Telopea 9(1): 70–71 (2000) — *Schismatoglottis cordifolia* M. Hotta, Mem. Coll. Sci. Univ. Kyoto, ser. B, 32: 229 (1966) (*non S. cordifolia* Ridl. (1911)). TYPE: Brunei, 'Seria Distr.' [Belait], Bukit Teraja, Teraja Forest Reserve, 21 Dec 1963, M. Hotta 12886 (holo KYO, K! photo). (Fig. 1)

Small lithophytic herb to 20 cm tall. **Stem** very condensed and shortly erect, c. 3 cm long \times 1 cm diam., older portions clothed in old leaf remains, with oldest portions naked and somewhat decumbent; modules pleioanthic. **Leaves** several together (4–7) with roots emerging from among their bases; petiole 5–9 cm long, slender, about equalling the blade, very densely clothed in minute straight pale brown hairs, sheathing only at the extreme base with the sheath extended into a narrowly triangular, abaxially pubescent, bicarinate ligular portion 2–4 cm long; blade ovate to broadly ovate, matte dark green, slightly metallic and densely minutely hairy throughout adaxially, matte pale green, densely minutely hairy on all the venation and minutely tuberculate between the veins abaxially, drying dark brown, 9–12 cm long \times 7–9 cm wide, the base retuse to cordate with rounded posterior lobes to 2 cm long, the apex broadly acute to obtuse and shortly apiculate; midrib not or hardly prominent abaxially and adaxially; primary lateral veins crowded, c. 13 on each side of the midrib, diverging at 45–60°, alternating with lesser interprimaries and very occasionally branching near the midrib, impressed adaxially, prominent abaxially; secondary veins abaxially prominent (due to hairs), arising from the midrib and the bases of the primary veins; tertiary venation obscure. **Inflorescence** solitary; peduncle very short, completely concealed within subtending leaf bases. **Spathe** c. 3.5 cm long, green to salmon pink and then veined with deeper pink; lower spathe ovoid, c. 1.1 cm long, differentiated from the limb by a slight constriction; limb 2.2–2.8 cm long, broadly lanceolate, apiculate for 2–3 mm, ?deciduous. **Spadix** 2.5 cm long, sessile; pistillate zone obliquely inserted, c. 3 mm long; pistils densely packed; ovary sub-globose, c. 1 mm diam.; stigma sessile, thickly discoid, almost as wide as the ovary; sterile interstice slightly wider than male and female zones, 2 mm long, c. 3 whorls of flat-topped irregularly polygonal staminodes c. 0.6 mm diam.; staminate flower zone cylindrical, slightly attenuate corresponding to spathe constriction, c. 3 mm long; stamens somewhat laxly arranged, mostly in adnate pairs with the blunt and narrowly pyramidal connective extended beyond the thecae; appendix cylindrical-ellipsoid, more than half the length of the spadix, about twice the width of the male zone, c. 2 cm long \times 6 mm thick, composed of flat-topped irregularly polygonal staminodes c. 1 mm diam. **Infructescence** unknown.

Other specimens examined: BRUNEI: Belait District: Melilas Subdistr., Ulu Ingei, Bukit Batu Patam, 04°05'N 114°42'E, 9 June 1989, P.C.Boyce *et al.* 279 (BRUN, K, L); Labi Subdistr., Bukit Teraja, south of summit, 04°20'N 114°27'E, 20 March 1991, R.J.Johns 6872 (BRUN, K).

Distribution. Brunei, to date recorded only from Bukit Teraja and Bukit Batu Patam.

Ecology. Lithophytic on sandstone boulders and low damp cliffs in lowland kerangas and humid hill dipterocarp forest, 180–400 m alt.

Notes. Hay & Yuzammi (2000) remarked that *S. hottae* appeared allied to *S. puberulipes* Alderw. by sharing velvety hairs on the leaf, a solitary short-pedunculate inflorescence, and an 'inflated' appendix. However, there is confusion with regard application of



Fig. 1. *Schimatoglottis hottae* Bogner & Nicolson. Holotype: M.Hotta 12886 (KYO). Image courtesy of Dr. Hidetoshi Nagamasu (KYO). Used with permission.

the name *S. puberulipes*. The plant illustrated in Hay & Yuzammi (2000:79, Fig. 9), and the substantial part of the description given is *Schismatoglottis hayi* S.Y.Wong & P.C.Boyce endemic to Gua Niah (NE Sarawak) and allied to Mulu-endemic *S. multinervia*, sharing with that species aromatic (terpenoids) vegetative tissues, fully adnate petiolar sheaths, and a spathe limb rapidly darkening on opening but then breaking into strips. Together with several other novelties, these are regarded by us as belonging to the Multinervia Complex, and are most probably not closely allied to the Hottae Complex. The lectotype of *S. puberulipes* (BOKR! – BO spirit!) matches exactly *S. gamoandra* M.Hotta, a very distinctive species of doubtful affinity (Wong & Boyce 2011).

2. *Schismatoglottis dilecta* S.Y.Wong, P.C.Boyce & S.L.Low, **sp. nov.**, *Schismatoglottis mirae accedens, innovationibus clare roseis, laminis adaxialiter seminitidis, abaxialiter canalis secretoriis pellucidis conspicuis venis similibus, sine proliferis adventiis, zona pistillata spadiceis aliis zonis in latitudine aequali spatha rosea differt.* TYPE: Malaysia, Sarawak, Limbang, Nanga Medamit, Mulu N.P., Melinau Gorge, 3 Oct. 2007, P.C.Boyce et al. AR- 2312 (holo SAR!). (Fig. 2)

Moderately robust usually lithophytic herb to 35 cm tall. **Stem** stout, condensed, up c. 15 cm long × 2 cm diam., active portion erect, completely obscured by leaf bases, oldest parts tending to become decumbent, naked and ringed with conspicuous cataphyll/prophyll and petiole scars; shoot modules pleionanthic. **Leaves** several to rather few together (4–8) with roots emerging from among their bases, innovations pink; petiole 10–25 cm long, stout, about equalling the blade, sub-microscopically pale greyish pubescent, appearing matte greyish-green when dry and minutely asperate when wet, sheathing only at the extreme base, the majority of the sheath forming a narrowly triangular, bicarinate, somewhat fleshy ligular portion 3–5 cm long; blade ovate to ovate-elliptic, semi-glossy slightly metallic dark green adaxially, much paler dull lime green abaxially, blades drying medium brown, 10–20 cm long × 6–15 cm wide, the base cordate with rounded posterior lobes to 3 cm long, the apex broadly acute shortly apiculate; midrib prominent abaxially, deeply impressed adaxially, silvery when living; primary lateral veins crowded, c. 15 on each side of the midrib, diverging at 45–60°, irregularly alternating with only slightly lesser interprimaries and very occasionally branching near the midrib, deeply impressed adaxially, prominent abaxially, sub-microscopically pale greyish pubescent; primary lateral veins sub-microscopically pale greyish pubescent and raised abaxially; interprimary veins interspersed with vein-like pellucid glands abaxially; secondary and tertiary almost invisible. **Inflorescence** solitary; peduncle very short, together with the lowermost part of spathe completely concealed within subtending cataphyll bases. **Spathe** c. 8.5 cm long, peduncle and lower part of bright pink, spathe limb much paler pink, veined with deeper pink; lower spathe cylindrical, c. 3 cm long, differentiated from the spathe limb by colour but with no obvious constriction separating them; limb 2.2–2.8 cm long, very broadly lanceolate, apiculate for c. 4 mm, opening clear pale pink but

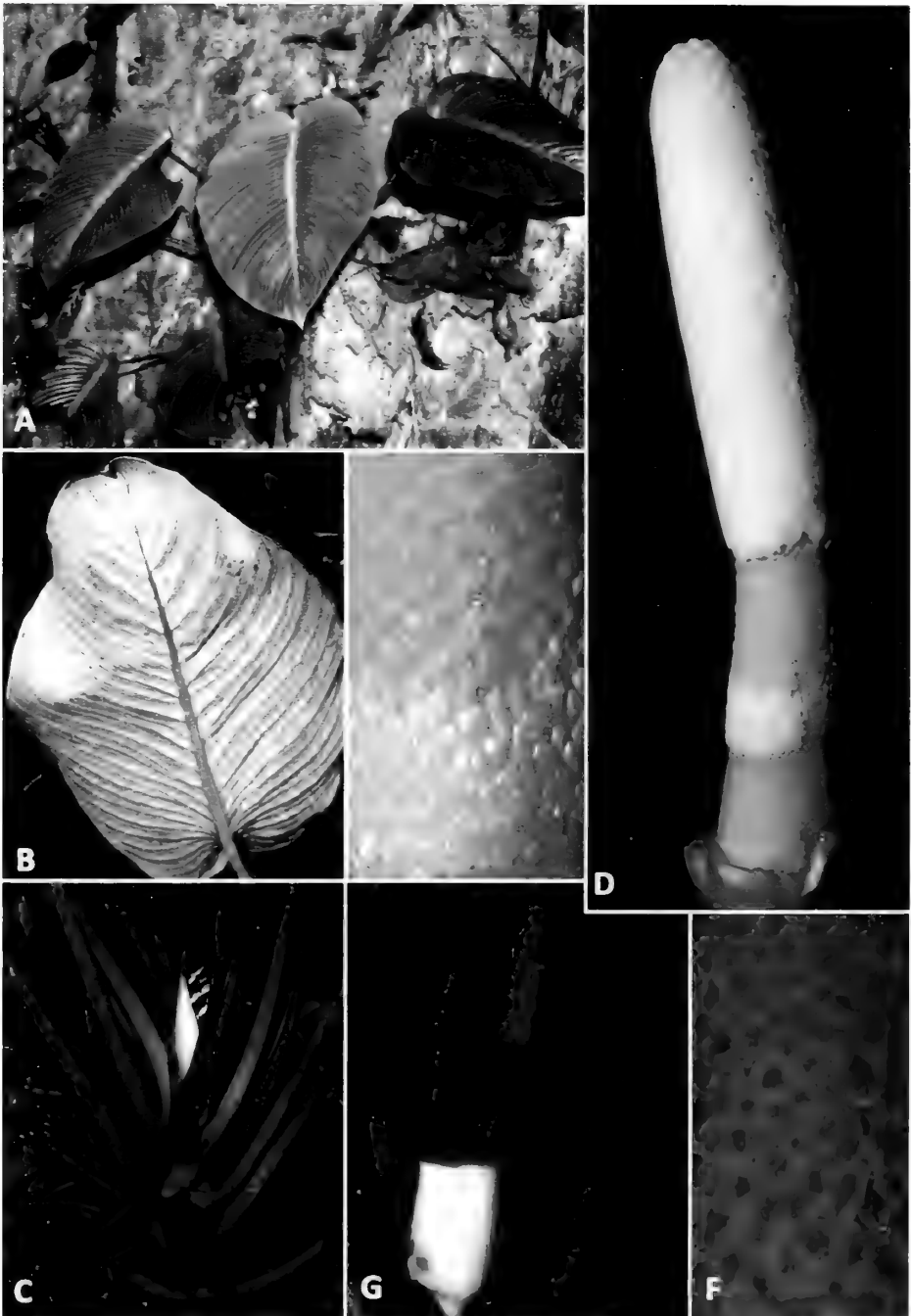


Fig. 2. *Schismatoglottis dilecta* S.Y.Wong, P.C.Boyce & S.L.Low. **A.** Plants in habitat; note the semi-glossy leaf blades. **B.** Leaf blade, abaxial view. **C.** Plant with emerging inflorescence. Note the long, persistent, fleshy ligules. **D.** Spadix at pistillate anthesis, spathe artificially removed. **E.** Detail of interstice staminodes (below) and staminate flowers (above). **F.** Detail of appendix staminodes. **G.** Post anthesis inflorescence. Note that the spathe limb has deliquesced and that the lower spathe persists. All from P.C. Boyce *et al.* AR- 2312. Photo credits: Peter C. Boyce.

swiftly darkening during staminate anthesis and then soon deliquescent. *Spadix* stout, 8 cm long, sessile; pistillate zone very slightly cone-cylindrical, weakly obliquely inserted, c. 1.5 cm long; pistils densely packed, medium pink; ovary sub-globose, c. 1.5 mm diam.; stigma sessile, thickly discoid, as wide as the ovary; sterile interstice very slightly wider than pistillate and staminate zones, 0.5 cm long, c. 7 whorls of flat-topped irregularly polygonal glossy pale pink staminodes c. 1 mm diam.; staminate flower zone cylindrical, c. 1.5 cm long, often with a few scattered groups staminodes of similar form to those in the interstice; stamens very densely arranged, mostly in adnate pairs with the blunt and narrowly oblong connective extended beyond the thecae, anthers medium pink; appendix stoutly clavate-cylindric, c. 2/3 the length of the spadix, exceeding the width of the staminate zone, dull pale pink, c. 4.5 cm long × 10 mm thick, composed of very densely arranged flat-topped irregularly polygonal staminodes c. 1 mm diam. *Infructescence* unknown.

Other specimens examined: Malaysia, Sarawak, Miri, Marudi, Long Lama, Mulu N.P., trail to Long Lansat, Sungai Licat, 04°00'03.5"N 114°48'49.8"E, 9 Aug, 2006, P.C.Boyce et al., AR-1974 (SAR).

Distribution. Mulu N.P., found so far in the extreme SW and NE parts of the park.

Ecology. Lowland moist gallery forest, restricted to vertical walls of low shale cliffs above forest streams, mostly on red clays with leaf litter accumulated around the bases, more rarely on almost bare shale with surface seepage moisture; c. 30 m asl.

Notes. *Schismatoglottis dilecta* is superficially very similar to *S. mira* (see below); from a distance plants of both are virtually indistinguishable. Aside from the floral characteristics noted above *S. dilecta* differs from *S. mira* by several vegetative features, including the leaf blade adaxial surface texture (smooth vs papillose), the presence abaxially of vein-like pellucid secretory veins, and an absence of adventitious plantlets (*S. dilecta*). The form and texture of the petiolar sheath ligules also differs (compare Fig. 2C & 3C).

Etymology. From *dilectos* (Latin) "lovely, esteemed", in allusion to the highly attractive foliage, and striking colour of the inflorescences.

3. *Schismatoglottis mira* S.Y.Wong, P.C.Boyce & S.L.Low, **sp. nov.**, *Schismatoglottis dilectae similis, innovationibus viridibus (non roseis) lamina adaxialiter minute et molliter dense tuberculata, abaxialiter proliferis adventitiis multis, zona pistillata spadiceis aliis zonis multo angustiore, et spatha viridis facile distinguenda*. TYPE: Malaysia, Sarawak, Bintulu, Bukit Satiam, 02°59'07.4"N 112°55'47.0"E, 15 July 2006, P.C.Boyce et al. AR-1906 (holo SAR!). (Fig. 3)

Moderately robust lithophytic herb to 45 cm tall. **Stem** stout, condensed, up c. 10 cm long \times 2.5 cm diam., active portion erect, completely obscured by leaf bases, oldest portions usually naked and tending to be decumbent; shoot modules pleionanthic. **Leaves** several to rather few together (3–7) with roots emerging from among their bases, innovations very pale green; petiole 10–25 cm long, stout, very weakly D-shaped in cross-section, sub-equalling the blade, minutely asperate, matte pale-green, sheathing only at the extreme base, the greater part of the sheath forming a narrowly triangular very weakly bicarinate, membranous ligular portion 2–7 cm long; blade broadly ovate, carried sub-perpendicular to petiole, adaxially minutely and softly densely tuberculate, abaxially often with adventitious plantlets, adaxially deep green with the midrib marked by a somewhat irregular broad pale yellow band, abaxially pale grey-green with the epidermal cells somewhat refractive, blades drying pale brown, 15–25 cm long \times 10–21 cm wide, the base cordate with rounded posterior lobes to 4 cm long, the apex blunt, shortly apiculate; midrib prominent abaxially, somewhat impressed adaxially, pale yellow when living; primary lateral veins crowded, c. 15 on each side of the midrib, diverging at 45–60°, irregularly alternating with only slightly lesser interprimaries and very occasionally branching near the midrib, slightly impressed adaxially, prominent abaxially; interprimary veins interspersed; secondary and tertiary almost invisible. **Inflorescence** solitary; peduncle very short, completely concealed within subtending cataphyll bases. **Spathe** c. 9 cm long, spathe exterior medium somewhat glaucous green, longitudinally veined deeper green; lower spathe cylindrical, c. 3.5 cm long, not clearly differentiated from the spathe limb; limb 6–6.5 cm long, broadly funnel-form lanceolate at pistillate anthesis, the terminal portion tending to remain weakly furled, and apiculate for c. 2 mm, opening pale green internally but swiftly darkening to glossy tan during staminate anthesis, and then rapidly deliquescent starting from the spathe limb margins. **Spadix** stout, sub-equalling the spathe, c. 8.5 cm long, sessile; pistillate zone cylindrical, much narrower than rest of spadix, somewhat obliquely inserted, c. 1.5 cm long; pistils rather densely packed, pale green; ovary sub-globose, c. 1.5 mm diam., interspersed with a few prominent, stoutly clavate white staminodes; stigma sessile, thickly discoid, almost as wide as the ovary; sterile interstice very slightly wider than pistillate and staminate zones, c. 5 mm long, with c. 6 whorls of somewhat rounded-topped irregularly polygonal staminodes c. 1 mm diam., lowermost whorls glossy very pale yellow, upper whorls pale salmon-orange; staminate flower zone cylindrical, c. 1 cm long; stamens moderately densely arranged, mostly in adnate pairs with the bluntly and narrowly oblong connective barely extended beyond the thecae, anthers pale salmon-orange; appendix stoutly cylindrical, c. 2/3 the length of the spadix, equalling the width of the staminate zone, dull pale salmon-orange, c. 6 cm long \times 10 mm thick, composed of very densely arranged flat-topped irregularly polygonal staminodes c. 1 mm diam. **Infructescence** unknown.

Other specimens examined: Malaysia, Sarawak, Bintulu, Bukit Satiam, 02°59'26.1"N 112°55'54.4", 11 Aug. 2004, P.C.Boyce & Jeland ak Kisai AR- 597 (SAR), AR-603 (SAR), AR-618 (SAR); Bukit Satiam, 02°59'13.3"N 112°55'57.5"E, 14 July 2006, P.C.Boyce et al. AR-1888 (SAR); 02°59'07.4"N 112°55'47.0"E; 15 July 2006 P.C.Boyce et al. AR-1906 (SAR).

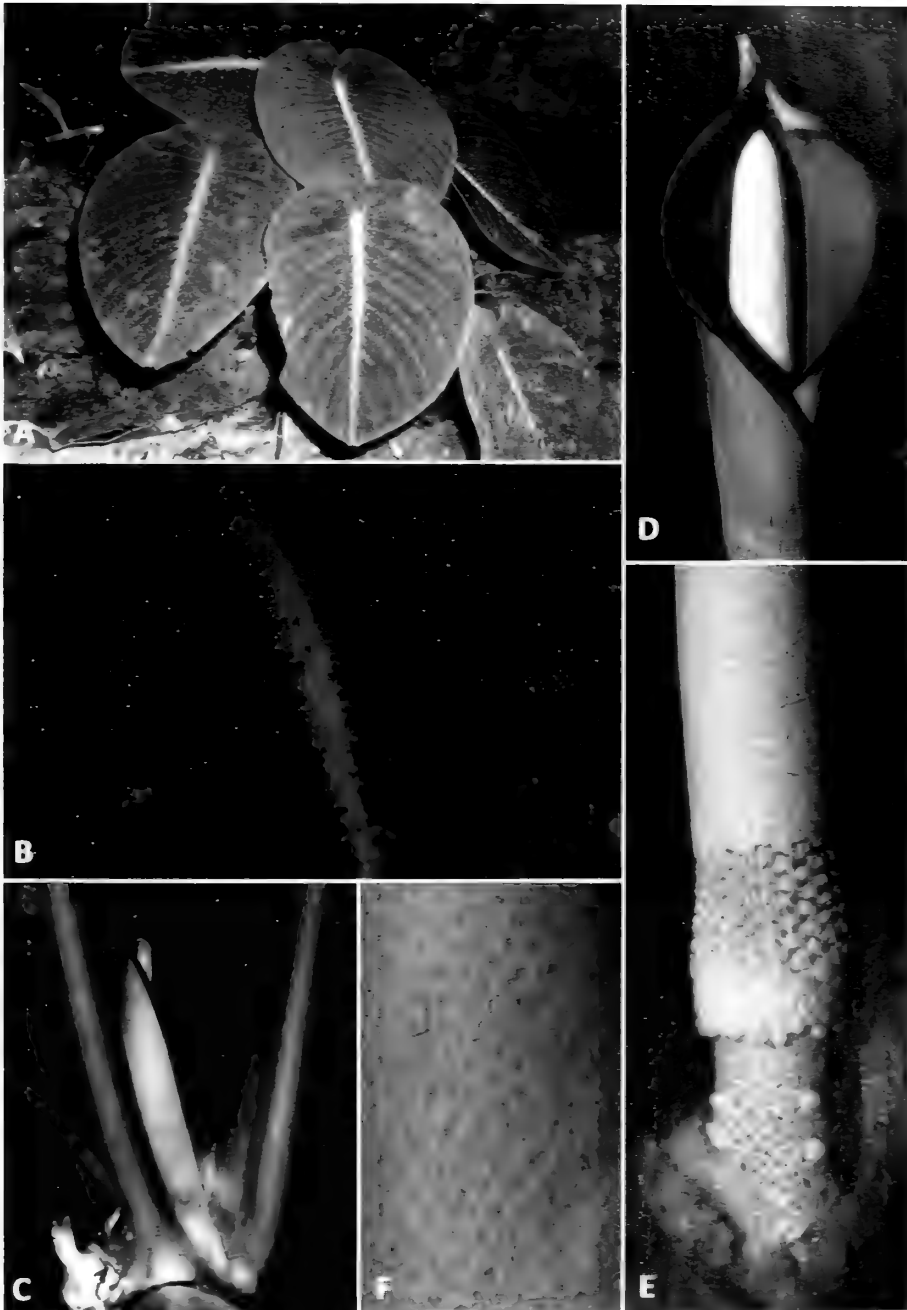


Fig. 3. *Schismatoglottis mira* S.Y.Wong, P.C.Boyce & S.L.Low. **A.** Plants in habitat: note the matte, tuberculate leaf blades. **B.** Leaf blade, adaxial view to show the tuberculate surface. **C.** Details of long, persistent, membranous ligules. **D.** Inflorescence at pistillate anthesis. Note that the spathe limb has already darkened and is starting to deliquesce along the margins. **E.** Detail of fertile portions of spadix and lower half of appendix: spathe artificially removed. **F.** Detail of appendix staminodes. All from P.C. Boyce *et al.* AR-1906. Photo credits: Peter C Boyce.

Distribution. Known only from Bukit Satiam, Bintulu.

Ecology. Vertical shale cliffs and margins of waterfalls in lowland moist evergreen forest; 100–120 m asl.

Notes. A strikingly beautiful species with an extraordinary leaf blade texture that is so far unique in the genus, although somewhat approached by *S. hottae*. The superficially similar appearance to *S. dilecta* is remarkable, although the species differ in numerous critical morphologies.

Etymology. Latin, *mirus* (wonderful) in reference to the appearance of the plant, and the unique texture of the adaxial surface of the leaf blade.

4. *Schismatoglottis thelephora* S.Y.Wong, P.C.Boyce & S.L.Low, **sp. nov.**, *Ab omnibus speciebus complexi Hottae foliorum laminis lanceolatis, zona staminata pistillata multo angustiore, staminodiis papilliformibus pistillis multo excedentibus, floribus staminatis rubrissimis differt.* TYPE: Malaysia, Sarawak, Bintulu, Tatau, GT Plantations, Sungai Pandan Kecil, trail behind Camp C to intake point for water supply-pipe, 02°42'40.1"N 113° 20' 37.9"E, 5 Sept. 2010, P.C.Boyce, S.Y.Wong & S.L.Low AR-3082 (holo SAR!). (Fig. 4)

Small facultative rheophytic herb to 25 cm tall, but usually somewhat less. **Stem** rather stout, condensed, creeping and rooting strongly, up c. 25 cm long × 2.5 cm diam., active portion completely obscured by leaf bases; shoot modules pleioanthic. **Leaves** several together (5–11), with roots emerging from among their bases, innovations very pale green; petiole 7–17 cm long, relatively stout, very weakly D-shaped in cross-section, sub-equalling to rarely exceeding the blade, minutely asperate, matte medium-green, sheathing only at the extreme base, the majority of the sheath forming a narrowly triangular, bicarinate, fleshy ligular portion 1.5–3 cm long; blade oblanceolate to lanceolate or very narrowly ovate, thick to sub-succulent, 7–20 cm long × 2–8 cm wide, the base acute to cuneate or weakly obtuse, tip acuminate for 1–3 cm and then conspicuously tubular-mucronate; adaxially semi-glossy medium green, abaxially paler with the epidermal cells somewhat refractive and scattered vein-line pellucid secretory canals, blades drying straw yellow; midrib and primary veins tough and abaxially prominent, adaxially very weakly impressed; primary lateral veins 3–9 on each side of the midrib, irregularly alternating with interprimaries ill-differentiated from the secondary venation, diverging at c. 30°; secondary venation mostly arising from the midrib, some from near the bases of the primary veins in the lower part of the leaf; tertiary venation obscure. **Inflorescence** solitary; peduncle very short, completely concealed within subtending cataphyll bases. **Spathe** c. 3.5 cm long, spathe exterior medium green, longitudinally veined deeper green; lower spathe ovoid, c. 1.5 cm long, very pale greenish-white, with a shallow, broad constriction differentiating it from the spathe limb; limb c. 2 cm long, broadly lanceolate, apiculate for c. 2 mm, opening pale

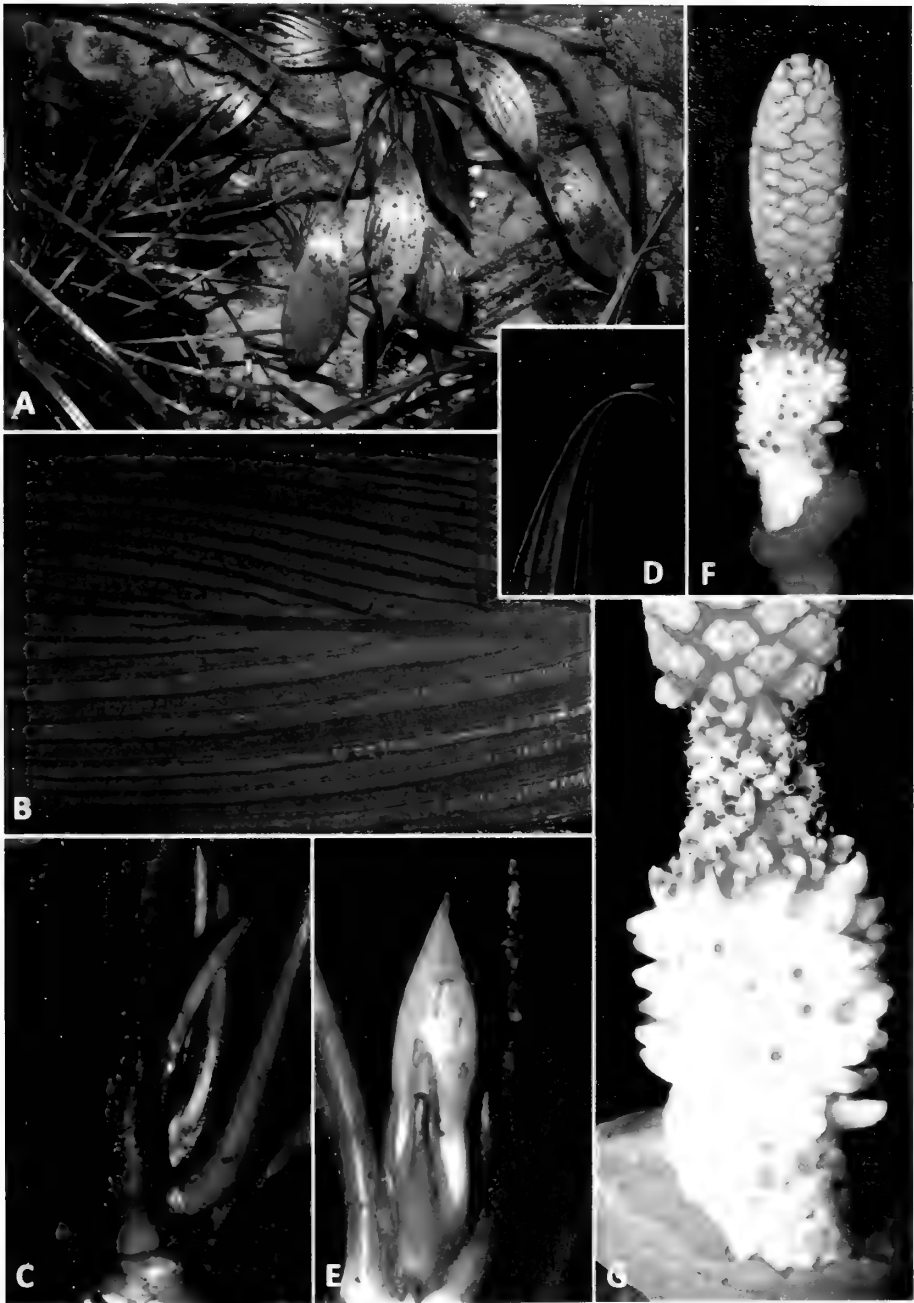


Fig. 4. *Schismatoglottis thelephora* S.Y.Wong, P.C.Boyce & S.L.Low. **A.** Plants in habitat. **B.** Leaf blade, adaxial view to show vein-like pellucid secretory canals. **C.** Details of long, persistent, membranous ligules. **D.** Leaf-tip tubule. **E.** Emerging inflorescence. **F.** Spadix at staminate anthesis, spathe artificially removed. **G.** Detail of fertile portions of spadix and lower half of appendix; spathe artificially removed. The nipple-like staminodes are prominent. Note, too, the slender strings of pollen. All from P.C. Boyce, S.Y. Wong & S.L. Low AR-3082. Photo credits: Peter C. Boyce.

green but swiftly darkening to dark glossy brown during staminate anthesis, and then rapidly deliquescent starting from the spathe limb margins. *Spadix* somewhat stout, sub-equalling spathe, c. 3 cm long, sessile; pistillate zone weakly conic-cylindrical, somewhat obliquely inserted, c. 5 mm long; pistils rather densely packed, white; ovary rhombic-subglobose, c. 0.5 mm diam.; stigma sessile, discoid, smaller than the ovary diam.; sterile interstice very slightly narrower than pistillate zone, c. 5 mm long, c. 6 whorls of elongated nipple-like staminodes, these up to twice as long as pistils, and with at least a few of these interspersed with the upper pistillate flowers, waxy white with a yellow-brown tip perhaps associated with a vestigial connective, each c. 2 mm long and 0.3 mm diam.; staminate flower zone cylindrical, c. 4 mm long; stamens rather loosely arranged, mostly in adnate pairs with the blunt and narrowly triangular connective extended beyond the thecae, deep yellow with the anthers (thecae) deep red, lowermost staminate flowers transitioning to staminodes, these dull yellow barely tinged red, these then transitioning to the elongated white staminodes present on the interstice; appendix bullet-shaped, c. $\frac{1}{2}$ the length of the spadix, much wider than the staminate zone, dark yellow, c. 2 cm long \times 6 mm thick, composed of rather loosely arranged flat-topped irregularly polygonal staminodes c. 0.7 mm diam. *Infructescence* subtended by the fleshy persistent lower spathe, rather loosely urceolate.

Other specimens examined: Malaysia, Sarawak, Bintulu, Tatau, GT Plantations, Sungai Likau, 02°44'37.6"N 113°26'10.5"E, 6 Sept. 2010, P.C.Boyce, S.Y.Wong & S.L.Low AR- 3092 (SAR).

Distribution. Known only from the neighbourhood of the type locality.

Ecology. Rheophytic along the lower fringes of lowland perhumid gallery forest on sandstones and sandstone-derived clays; 50–70 m asl.

Notes. *Schismatoglottis thelephora* is remarkable, indeed unique, in the genus by the greatly elongated nipple-like staminodes that clothe the interstice between the pistillate and staminate flower zones, and also occur scattered among the uppermost pistillate flowers. The deep red anthers are distinct from all other species in the Hottae Complex, and furthermore this colour has not been previously recorded for the genus. Pollen is released in very slender white strings.

Etymology. From Greek *thele-*, a nipple, and Latin *-phora*, to bear, in allusion to the staminodes separating the pistillate and staminate flower zones.

ACKNOWLEDGEMENTS. Research and fieldwork in Borneo was conducted, most recently, under Sarawak Forestry Department Research Permit Nos. NPW.907.4.4(V)-77 & NCCD.907.4.4(Jld.VI)-56 & Park Permit Nos. 34/20010 & 27/2011. The continuing collaboration and support of the Forest Department Sarawak, and Sarawak Forestry Corporation, are gratefully acknowledged. We would like to thank Mr. Wong Kee Heng, Mr. Wilfred Rogers and Mr. Serum Ungau of GT Plantation Sdn. Bhd. for facilitating our field trip at Sg. Kakus, Bintulu.

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BOOK REVIEW. Heritage Trees of Penang. Simon Gardner, Pindar Sidisunthorn & Lai Ee May. 2011.

Penang, Malaysia: Areca Books. 27.3 cm × 21.7 cm, hard cover. 397 pp. ISBN 978 967 5719 06–6. Price RM 100.

This is a superb piece of work. The book weaves strands of history, botany, culture and the visual arts into a rich tapestry on the subject of the heritage trees of Penang. The book will appeal to the informed layperson as well to professionals working with plants. The well-thought through layouts of the pages successfully combine stunning photographs and vivid botanical illustrations with just the right amount of text so that almost every page that one flips through is a delight to the eyes. Perhaps an unintended consequence of this is the relatively small font size for the text.

The professional will find that the book is well researched with up-to-date botanical names. The work takes into cognizance relatively recent changes in the family-level taxonomy of the trees treated. A prelude to the scholarship that the reader will find in this book is found in the “Note to Reader” at the opening of the book; here under the heading of “Orthography and Spelling” the authors set out how the Malay names of trees and places are treated in this work in English.

As an entrée before embarking on a sylvan odyssey, the introductory chapter presents convincing arguments on why Penang’s urban and natural forests are an integral part of Penang’s heritage and need to be protected for the future. Particularly noteworthy is a statement on page 4, “Any town or city without trees is simply a collection of buildings and scarcely fit for human habitation”.

Information on the history of tree planting, the Esplanade and the Botanic Gardens in Penang is presented. Trees are then introduced under the broad headings of Sacred trees, Village trees, and Forest trees. These are both informative and interesting. Under “Forest Trees” there is a simplification. In the first paragraph of page 24, the authors write that “... most of the species in Penang belong to the genus *Shorea* which normally has three-winged fruits”; in fact, *Shorea* usually has a 5-winged fruit where 3 of the lobes are larger than the other 2.

An interesting brief introduction to the inland forests of Penang is provided. Secondary growth, the vegetation of mangroves, sandy beaches and rocky seashores of the island are similarly treated. The Introductory chapter closes with a useful section on visiting forests in Penang.

About 200 species of trees are treated in the book. These are divided into six sections: Street Trees, Garden Trees, Sacred Trees, Village Trees, Forest Trees, and Coastal and Riverside Trees. The species in each section are arranged in alphabetical order. The format for each species begins with the botanical name followed by vernacular names, general comments, a section on uses, and a section on botany. For the botanical names, the describing authorities have been omitted. The general comments are very useful in highlighting exemplary specimens of the species treated and provide well-researched and interesting information on these individual trees. One of the key features of this book is that the authors have painstakingly provided stunning photographs illustrating the habits, trunks, fruits and flowers of the trees treated. These

are augmented by exquisite botanical illustrations usually of the flowers and leaves.

The magnificent trees of the forest dominate with 49 species treated under their section. The photographs and illustrations in the section are among the best in the book. On page 275, together with the flowers of *Callerya atropurpurea*, a photograph is presented of a pair of perfectly camouflaged caterpillars which are dark purple in colour with a cream stripe, just like the flowers of this tree!

In conclusion, I think that that the book has succeeded through words, photographs and botanical illustrations in drawing attention to these most important assets that Penang has in its heritage trees, urban forests and natural forests.

S.K. Ganesan

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BOOK REVIEW. *The Wild Orchids of Hong Kong*. G. Barretto, P.J. Cribb & S. Gale. 2011.

Kota Kinabalu: Natural History Publications (Borneo), in association with Kadoorie Farm & Botanic Garden. 26.3 × 19 cm, hard cover. 697 pp. ISBN 978-983-812-136-1. Price RM 240.

Hong Kong, situated on the coast of south-east China just south of the Tropic of Cancer, is best known as a modern city of high-rise buildings and as an economic and financial hub in the region. Much less known are its comparatively rich natural resources, of which the orchids form an interesting part.

A large part of Hong Kong is mountainous with rugged peaks and gorges, and although there has been a very long history of deforestation, the forest cover is still a surprising 13 % (although now mainly found at higher elevations). In addition, much of the countryside is regenerated secondary forest. Grassland is a human-induced environment (in many cases through accidental hill fire) and is also a widespread vegetation type in Hong Kong, accounting for 14% of the total land area. The small territory of some 1100 km² is home to 126 species and varieties of orchids which are placed in 58 genera, and this is a remarkably high number for a small area situated near the northern limit of tropical South-east Asia. In fact, 9% of all orchids of China are found in Hong Kong, although this small territory only amounts to 0.01% of its land area. About two thirds of native Hong Kong orchids (83 taxa) are terrestrial, while the remainder (43) are primarily epiphytic or lithophytic. The native orchids are most abundant on the north-facing slopes and in ravines above 300 m. Affinities to the orchid floras of southern China and northern Indochina are obviously the greatest, while a few species are more widespread. Five species from temperate Asia are also found in Hong Kong. In addition, eight taxa are currently considered endemic to Hong Kong. Several of Hong Kong's orchids have been decimated in nature to such an extent that they can now be considered as being at the risk of extinction in the wild. In view of this, conservation aspects are of particular importance in the present book.

The book is a complete and richly illustrated enumeration of all orchid species recorded in Hong Kong so far. It brings to fruition the work of Hong Kong resident Gloria Barretto (1916–2007) who, in over 40 years of painstaking and dedicated work, produced draft descriptions of all orchids of Hong Kong she had intended to use for a comprehensive treatment of the native orchids. Sadly, Gloria never saw the finished result of her studies, and co-authors Drs. Phillip Cribb (former curator of the Orchid Herbarium, Royal Botanic Gardens Kew, London, UK) and Stephan Gale (Kadoorie Farm and Botanic Garden, Hong Kong) concluded her work to publish this book.

An introductory part on more general aspects of the territory of Hong Kong and its orchid flora forms the first 74 pages of the book. A detailed and informative coloured map is provided in Fig. 1 (unfortunately rather difficult to read, and a black-and-white map labelled in larger font would probably be clearer: but in any case this is the only shortcoming of the book noted here). Chapters deal with the geology, topography, climate and vegetation of Hong Kong. A brief account of the history of exploration of the orchid flora is given, ranging from the early collections made in the 1830s and 1840s to the recent work by Gloria Barretto. As is commonly found in

publications of this kind, a description of the structure of vegetative and reproductive parts of the orchids is given, and their life cycle is briefly explained. A chapter is devoted to the cultivation of the orchids of Hong Kong which will be of special interest to many readers, given the fact that the cultivation of orchids in China dates back 2500 years to pre-Confucian times. Careful plant selection, mounting, potting, watering, fertilising as well as pests and diseases are explained and illustrated by photographs. The affinities of the orchid flora of Hong Kong are discussed, and a list of the species found in Guangdong Province (the Chinese province directly adjacent to Hong Kong) but not yet recorded in Hong Kong is given—it is estimated that some of these may be found inside the territory as well one day. In view of the decline of the orchids as a consequence of human activities, the discussion of various aspects of conservation is receiving particular attention. Threats to the continued survival of the orchids are various, and include man-made habitat destruction as a consequence of urban development and accidental hill fire, and illegal collecting by plant thieves. Effects of climate change are expected to have an additional adverse effect on the orchids as well. Natural phenomena like extreme weather conditions play a role too, and add to the man-made threats. The Hong Kong government has recognised the need for conservation of the natural environment, and has set aside about 40% of the total land area of the territory as 'Country Parks'. The comprehensive legal framework with its several ordinances is here well explained to the reader. On the basis of previously made herbarium collections, reputable field notes, contemporary orchid surveys and an estimation of threat levels, conservation assessments are made for all of the native orchids of Hong Kong. Currently, nearly three quarters of all orchid species native in Hong Kong are at risk of extinction in the wild and fall into the Vulnerable, Endangered or Critically Endangered categories (IUCN 2001). Seven species have not been seen for several decades and are therefore presumed extinct. In addition to conservation assessments using the IUCN criteria, an easy-to-use Hong Kong-centric system was applied where relative rarity (based on recent sightings) and distribution were used. It is estimated that this system would be more meaningful to land managers than a more scientific approach based on the IUCN criteria. One of the basic requirements of plant conservation in general is a good knowledge of the plant group concerned, and the authors of the present book have certainly succeeded in making comprehensive information available on the native orchids of Hong Kong.

The main part of the book consists of the genus and species accounts, with a short introduction on orchid classification and identification keys to subfamilies and genera. Genera are arranged in phylogenetic order, i.e., after groups of related ones, which is much more meaningful and easy-to-use than an alphabetic arrangement. For all accepted genera and generic synonyms, the name and place of description are cited, together with their typification. Following the generic description, the distribution of the genus and the number of its species (worldwide and in Hong Kong) are given. The derivation of the genus name is explained. This is followed by the treatment of the one to several species. An identification key is provided in all cases where more than one species is found in Hong Kong. Each species account starts with historical notes on the discovery, and gives other relevant information on identity and nomenclatural history.

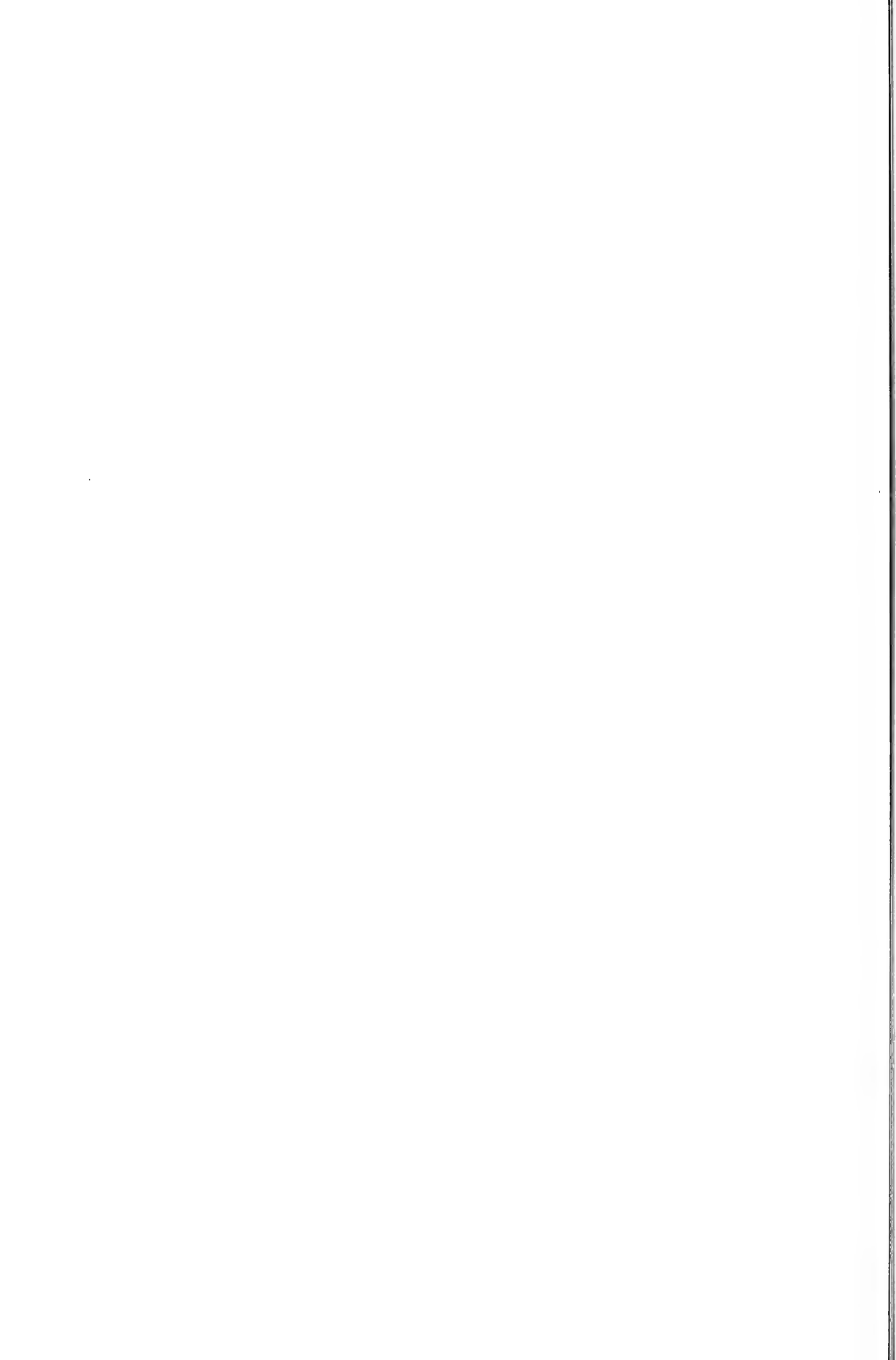
The currently accepted name and the relevant synonyms are cited, together with references, type specimens and the acronym of the herbarium where these are kept. Species descriptions are very detailed and are mostly based on Hong Kong material (rarely on material from adjacent Chinese provinces). For all species the worldwide distribution, habitat and occurrence in Hong Kong, phenology, vernacular names and the derivation of the species epithet are given. Detailed notes on conservation issues, area of occupancy and abundance are provided, and the category of relative rarity is displayed (colour-coded for easy reference). It is emphasised that the authors have on purpose omitted distribution maps to discourage theft of orchids which is still a significant threat. The species accounts are generously illustrated. One to three black-and-white line drawings are provided for each species, showing the habit of the plant as well as a dissection of the flower. Excellent high-quality photographs are reproduced in nearly all taxa (one to few per taxon) and show the plant, leaf characters (particularly in the 'Jewel Orchids') as well as floral details. Most of these photographs were taken in Hong Kong. In addition, fine colour paintings by General John Eyre are also reproduced to illustrate 25 species.

A comprehensive bibliography list and a detailed glossary follow the main text. Three appendices are provided. Many readers will find Appendix I very useful, containing brief biographies of plant collectors and botanists who are associated with Hong Kong since the 18th century. Appendices II and III are assessments of the conservation status of all native orchids (based on IUCN criteria and relative rarity in a Hong Kong-centric approach, respectively). Two indices are given in the end of the book, a General Index and an Index to Scientific Names.

This book is certainly an invaluable addition to the orchid flora treatments of continental Asian orchids, and as such will be used for decades to come. The text is very detailed, clearly written and well laid-out, and the numerous black-and-white drawings, as well as the magnificent colour photographs and fine paintings, make it a clearly outstanding achievement. The authors and the publisher can be congratulated to the production of this comprehensive handbook on the native orchids of Hong Kong. The book is well suited both to the botanist who studies Hong Kong orchids and to the amateur who is growing native orchids and is trying to name orchids in the wild. It will also prove an indispensable resource for researchers studying orchid floras elsewhere in continental Asia.

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BOOK REVIEW. **Flora of Peninsular Malaysia. Series II: Seed Plants, Volume 2.** (Malayan Forest Records No. 49) **R. Kiew, R.C.K. Chung, L.G. Saw, E. Soepadmo & P.C. Boyce** (eds). 2011.

Kepong: Forest Research Institute Malaysia. 25.7 cm · 18 cm, hard cover. 235 pp. ISBN 978-967-5221-53-8. Price RM 100 / US\$ 75.

Barely a year after the much anticipated first volume of the Seed Plants series, *Flora of Peninsular Malaysia*, the second volume was published. The contents of this volume are well structured and typically conform to the format preset for the first volume (see Review in *Gardens' Bulletin, Singapore* 62(2): 331–332).

This second volume is entirely devoted to the family Apocynaceae, with special emphasis on two of the five subfamilies, namely, Apocynoideae and Rauvolfoideae. The author of this momentous volume, Dr. David Middleton (Royal Botanic Garden, Edinburgh), is an accomplished apocynologist who specialises in the two subfamilies of Southeast Asian Apocynaceae. His past significant achievements in the region include revisions for the Flora of Thailand (1999), Tree Flora of Sabah and Sarawak (2004), and Flora Malesiana (2007). The other three subfamilies not treated in this volume are the Asclepiadoideae, Periplocoideae and Secamonoideae. These three subfamilies were formerly included in their own family, Asclepiadaceae, and rejoined Apocynaceae only recently based on phylogenetic findings. In this account, a total of 35 genera and 112 species, namely, 21 genera and 55 species for subfamily Apocynoideae, and 14 genera and 57 species for subfamily Rauvolfoideae, are enumerated.

The taxonomic account begins with a brief family description, followed by general distribution, ecology, general uses with some highlights of native species used as ornamental plants, and a brief taxonomic explanation of the family, in a broad sense, that includes Asclepiadaceae. Adding a phylogenetic tree to illustrate the evolutionary relationships of the five subfamilies in the more broadly defined Apocynaceae would have made it more informative. Conservation assessment was briefly provided by L.S.L. Chua with an accompanying table listing Critically Endangered (CR), Endangered (EN) and Vulnerable (VU) species in the two subfamilies. Arrangement of the taxonomic account in this volume is based on the position of the two subfamilies reflected in the key to subfamilies of Apocynaceae, beginning with subfamily Rauvolfoideae, and later Apocynoideae. However, genera enumerated were arranged alphabetically under each respective subfamily. The general enumeration format is as follows: accepted name, etymology, key references and type citation, description, vernacular name, distribution, species distribution map, conservation status, ecology, and uses.

In general, this volume is easy and friendly to use, not just for botanists but also horticulturists. There are two identification keys provided at the beginning of the account, namely, key to subfamilies of Apocynaceae (p. 8), and key to genera for the two subfamilies revised in this volume (pp. 9–13), before the enumeration of genera begins. Then, there are also identification keys to species provided in the account for the following genera: subfamily Apocynoideae: *Anodendron*, *Chonemorpha*, *Epigynum*, *Holarrhena*, *Kibatalia*, *Micrechites*, *Parameria*, *Parsonsia*, *Strophanthus*, *Urceola*, and *Wrightia*; and subfamily Rauvolfoideae: *Alstonia*, *Alyxia*, *Cerbera*,

Chilocarpus, *Kopsia* (also key to varieties of *Kopsia griffithii*), *Leuconotis*, *Melodinus*, *Rauwolfia*, *Tabernaemontana*, and *Willughbeia*. In addition to that, this volume is also well illustrated with 15 colour plates provided at the end of the account and also 36 line drawings distributed throughout the book for the various genera.

As the Flora of Peninsular Malaysia team is picking up its pace to document and disseminate information of Peninsular Malaysian plants to the scientific community, we eagerly look forward to the next volume.

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BOOK REVIEW. Wild Orchids of Peninsular Malaysia. P.T. Ong, P. O'Byrne, W.S.Y. Yong & L.G. Saw. 2011.

Kepong: Forest Research Institute Malaysia. 28.9 cm × 22.8 cm, hard cover. 196 pp. ISBN 978-967-5221-66-8. Price RM 150.

It is estimated some 10 per cent of all flowering plants are orchids, with perhaps 22,500 species worldwide. The Malay Peninsula has an impressive diversity, with around 900 species and 143 genera enumerated for the political part that is Peninsular Malaysia, a tally now expected to reach c. 1000 species as exploration proceeds through to many areas previously much less accessible. This orchid flora has 400-plus species in common with that of the wetter territories around—each of Borneo, Sumatra, Thailand—and less so with regions more seasonal or farther away, thus some 300 species with Java, c. 160 species with the Philippines, and just 60 species shared with Papua New Guinea. A fifth of Peninsular Malaysian orchids are endemic, not found elsewhere.

There are seven chapters: Introduction, Diversity, Habitats, Pollination, Classification, Scientific Research & Conservation, and The Path Ahead (the last essentially concluding statements centring on propagating the orchid message and contributing to orchid protection and conservation). Conservation discussion provides a variety of snippets, dealing even with orchid thievery that all too often feeds an obsession in the bid for unique possessions. Good summary accounts of the orchids of various vegetation types found in Peninsular Malaysia, from the lowlands to mountaintops, and on specialised substrates such as limestone, are given.

The key emphasis is on the impressive diversity in size, habit and floral structure and display. Some key facts are referenced by numbers referring to sources listed at the end of the book. There is, throughout, an attempt to explain would-be technical terms, from “species” and “genus” across a wide range to, for example, “heterotrophic mycotrophs”, the annointed term for non-chlorophyll-producing (so typically leafless) orchids that rely on the absorption of materials broken down by their fungal associates for their nutrition. Interesting snippets of information are carefully infused, covering such aspects as the adaptations of epiphytes, CAM photosynthesis and, of course, pollination. The information on pollination definitely provides many highlights and perhaps is the single most original aspect of this book, even though practically all areas covered have been wonderfully, albeit briefly, managed. Original information on pollination is included, revealing a newly emphasised area of investigation that not many, except the patiently observant, methodically curious and well-equipped, can partake. This fascination emerges early, as the very first photo with the opening main text already mentions the “rather nasty, fishy scent” of *Bulbophyllum virescens* flowers.

Text style is creative (a few section titles may appear to be an effort) and imaginatively crafted ‘stories’ teach a great deal about orchid specialisations and biology. One could certainly say that no part of this book tends to the verbose. After just some 60 pages of the most interesting primary information, the survey of representatives from the different orchid subfamilies takes the form of a *slab* of richly illustrated pages—evoking a curiously rebellious *deja vu* as it piles up an impressive

compilation of richly coloured illustrations somewhat reminiscent of all big illustrated accounts, yet with the biological and ecological sense they are organised, and by the time the reader reaches this portion of the book, it is all too clear that a great deal of knowledge and experience have been behind this.

A *lot* of effort has been put into photographing orchids and assembling illustrative images for the many topics covered, so essentially a variety of useful illustrated glossaries aid the beginner's initiation into a systematically woven (and may I add, eagerly pursued) introduction to orchid diversity. The authors are also the main photographers (you can tell that *they* enjoy orchids). There is a case for wondering if glossy art paper was the best choice for this book but colour printing is well served. Heavy use is made of black page backgrounds, to provide maximum contrast. Some extreme bursts of colour are cleverly choreographed into the account. And—the bizarre view of pollinating blowflies crawling all over a *Bulbophyllum lasianthum* inflorescence on the back cover simply closes this account with a thump.

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Instructions for contributing authors (continued)

Title and authorship. The title should concisely describe the contents. If a scientific name is used, its authority is normally excluded, but the family name would be provided. Authors' names, affiliations and postal/ e-mail addresses are stated below the title. If more than one author, indicate "corresponding author". Avoid footnotes. A short **running title** (up to six words) should also be provided.

Abstract. The abstract is at most 100–300 words. It should concisely indicate the article's contents without summarising it; mentioning novelties and name changes. **Keywords:** Suggest at most eight keywords, in alphabetical order.

Scientific names and author abbreviations. Genus and species names of organisms must be italicised and followed by the authority (with family name in parentheses) when first mentioned in the text or diagnoses. Standards for author abbreviations include:

Brummitt, R.K. & Powell, C.E. (1992) *Authors of Plant Names*. Kew: Royal Botanic Gardens, Kew.

Kirk, P.M. & Ansell, A.E. (1992) *Authors of Fungal Names* [Index to Fungi Supplement]. Wallingford: CAB International.

Herbarium abbreviations (<http://sciweb.nybg.org/science2/IndexHerbariorum.asp>) follow

Holmgren, P.K., Holmgren, N.H. & Barnett, L.C. (eds) (1990) *Index Herbariorum. Part 1: The Herbaria of the World* [Regnum Veg. vol. 120]. New York: New York Botanical Garden.

Journal and book title abbreviations. For journals:

Bridson, G.D.R., Townsend, S.T., Polen, E.A. & Smith, E.R. (eds) (2004) *BPH-2: periodicals with botanical content: comprising a second edition of Botanico-Periodicum-Hunlianium*. Pittsburg: Hunt Institute for Botanical Documentation.

For books:

Stafleu, F.A. & Cowan, R. S. (eds) (1976–88) *Taxonomic Literature*. 2nd edition. 7 vols [Regnum Veg. vols 94, 98, 105, 110, 112, 115, 116].

Stafleu, F.A. & Menega, E.A. (eds) (1992–) *Taxonomic Literature*. Supplements [Regnum Veg. vols 125, 130, 132].

(A useful source of verify ing names of publications is

<http://asaweb.huh.harvard.edu:8080/databases/publication_index.html>. If in doubt, list full titles.

Other abbreviations and units of measurement. If using standard abbreviations and acronyms, give the full term on first mention. Dates are cited as: 1 Jan 2000. SI (metric) units of measurement are used and spelled out except when preceded by a numeral; they are abbreviated in standard form: g, ml, km, etc.

Tables. Tables are numbered in arabic numerals in the order they are first mentioned in the text and carry an indicative legend at the head. Tables are given at the end of the manuscript.

Illustrations. All drawings, maps, graphs and photographic images (individually or collected in a plate) are to be numbered in arabic numerals in the order they are first mentioned in the text, as Fig. 1, Fig. 2, etc. (plate components would be referred to in the text as Fig. 1A, 1B, Fig. 1A–D, etc.). If relevant, scale bars should be used to indicate magnification.

When grouping photographs, the maximum page area 19.5 x 13 cm must be heeded. High resolution digital images may be submitted as *separate* files (line drawings in black and white at 600 dpi, photographs at 300 dpi) sent electronically or in a CD. Do not embed images into the main text file.

References in the text. Citation in the text should take the form: King & Gamble (1886) or (King & Gamble 1886), or King et al. (1886) if more than three authors to a work. Use 2000a, 2000b, etc. if several papers by the same author(s) in one year are cited.

References listed at the end. There, works mentioned in the text are listed alphabetically as follows:

Dallwitz, M.J., Paine, T.A. & Zurcher, E.J. (1999) User 's Guide to the DELTA Editor. <http://biodiversity.uno.edu/delta/> (accessed on 2 Aug. 2010).

Persson, C. (2000) Phylogeny of Gardenieae (Rubiaceae) based on chloroplast DNA sequences from the *rps* 16 intron and *trnL*(UAA)-F(GAA) intergenic spacer. *Nordic J Bot.* 20: 257–269.

Ridley, H.N. (1930) *The Dispersal of Plants Throughout the World*. Ashford, U.K.: L. Reeve.

Smith, A.C. & Darwin, S.P. (1988) Rubiaceae. In: Smith, A.C. (ed) *Flora Viliensis Nova. A New Flora of Fiji* 4: 143–193.

References to web-based resources should include either a doi (digital object identifier) specification or full URL mentioning also the date it was accessed. Use of DNA sequences from GenBank should be acknowledged and the studies for which the sequences were generated should be cited.

Style of nomenclatural summaries. The following style is required:

Gardenia anisophylla Jack ex Roxb., Fl. Ind. ed. Carey & Wall. 2: 561 (1824).

Medinilla alternifolia Blume, Mus. Bot. 1: 19 (1849).

If authors include full bibliographic data for these works in the list of references at the end of the paper, they should also be mentioned in the text briefly, e.g., "Nomenclatural references researched include Blume (1849) and Roxburgh (1824)."

Homotypic synonyms should be provided in a block, stating the type at the end.

