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THE GARDENS' BULLETIN
SINGAPORE

Volume 38
(1985)

A periodical reflecting the interests and
activities of the Botanic Gardens
Singapore

**Published by the Botanic Gardens
Parks and Recreation Department
Ministry of National Development
Cluny Road, Singapore 1025.**

Printed by Eurasia Press

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THE GARDENS' BULLETIN

SINGAPORE

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Published by the Botanic Gardens
Parks and Recreation Department
Ministry of National Development
Cluny Road, Singapore 1025.

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The price of the Gardens' Bulletin varies according to the content of each issue. This issue, is priced at Singapore \$20.00 cts. excluding postage. Overseas subscribers are requested to make payment in the form of bank drafts or international money orders in Singapore currency payable to the *Commissioner of Parks and Recreation, Singapore*.

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**Published by the Botanic Gardens
Parks and Recreation Department
Ministry of National Development
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Printed by Eurasia Press

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The Botany of Some Islets East of Pahang and Johore

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Abstract

The appearance and vegetation of the islets Babi Tengah, Baru, Berhala, Chibeh, Duchong, Gup, Labas, Pyah, Rengis, Sepoi, Setindan, Tokong Burong, and Tulai are compared with Tanjong Ruit in Tiunan, as they were in 1932-1936. Their status as degenerate headlands in the Riouw Pocket is considered. The islets belong to three geological formations. Remains of the giant clam, *Tridacna*, were found on Pulau Tulai.

This is a historical account of the vegetation of the small islands to the west and south of Pulau Tiunan (Tioman) and off the Mersing coast, as I found them fifty years ago. In June 1932 and August 1935 I accompanied Mr William Birtwistle, Officer-in-charge of Fisheries F.M.S., on his inspection of fishing boats and fishing villages on the Pahang coast. We visited most of the islets on one or other day from early morning till 1 p.m. The ocean swell would then rise and squalls descend, and we would have to return in the rowing boat to the launch, either the Sri Gala in 1932 or the Sri Pekan in 1935; generally, the shore was too rocky for safe approach except in calm sea. The first trip was exploratory, for no one could tell me what the islands looked like or what vegetation they had; the second was more thorough. There was usually time to investigate fully in the one morning the vegetation of one islet. Collections were made of plants that I could not identify for certain and they have been deposited in the Singapore herbarium. Uncertainty of names has delayed publication but, now, with many revisions in the *Flora Malesiana*, edited by Professor C.G.G.J. van Steenis, most problems have been resolved. I have followed that botanical nomenclature and have, accordingly, omitted the burden of citation of authors.

On the second trip I realised that most of these islands corresponded with granite headlands of Tiunan in various degrees of disintegration. I have used, therefore, the headland of Tanjong (Tanjung) Ruit at the north end of Juara Bay, on the east side of Tiunan, as the standard for comparison.

At the end of this article I have given notes, mainly geographical, on some of the more characteristic plants. The whole region is the northern part of the Riouw (Riau) Pocket (Corner 1978); the plants are vestiges of its history. If their extraneous distribution is plotted, not as circular or elliptical areas but as outline tracks, more in the manner of Croizat's Panbiogeography, it will be seen that they enter the region from all points of the compass, as if they were comets orbiting about it.

Tanjong Ruit, Juara Bay, Pulau Tiunan

Figure 1, plates 1 & 2

Tanjong Ruit ends in a low rocky point, about 30 ft high, of granite boulders. It is connected with the main island by a neck or isthmus, about 50 yards long, com-

Editorial Note. Current spellings of place names, if different, are inserted in parentheses following the old spelling on first mention in the main text.

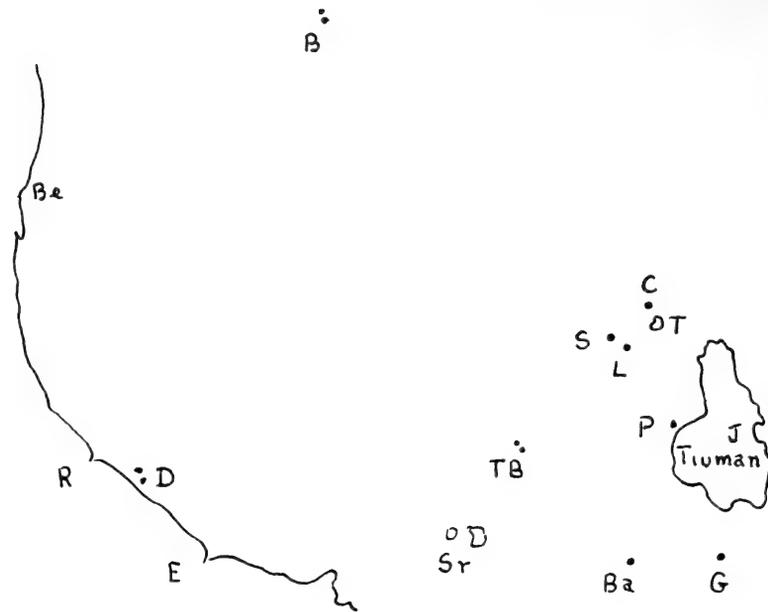


Fig. 1. Map of the islands about Pulau Tioman: scale, 1.5 in = 10 miles. B, P. Berhala; Ba, Baru Rock; Be, Bebar; C, P. Chibeh; D, P. Duchong; E, Endau; G, P. Gup; J, Juara Bay; L, P. Labas; P, P. Pyah; R, Rompin; S, P. Sepoi; Sr, P. Sribuat; T, P. Tulai; TB, P. Tokong Burong.

posed of small water-worn granite boulders just above high tide level, but probably awash at the highest tides and in storms. The island here descends into a steep granite face plunging into the sea. It leads westwards for about a third of a mile to meet the sandy bay where it turns, as it were, inland. I explored the forest that bordered on to this steep face, the isthmus, and the rocky point.

The bare granite face varied 12-35 ft high between the high tide level and the edge of the forest. It consisted of steeply sloping blocks of granite, broken up in places into irregular ledges and, where the face was breaking up, there were big boulders piled precariously on one another. At the foot of the face there was a talus of water-worn boulders exposed at low tide; a few big isolated boulders stood as rocks in the sea. Above the face the forest stretched inland on the steep hillside, with a moderately thick layer of earth and humus. The granite face, itself, swept by waves during the north-east monsoon, was bereft of vegetation except for some ledges and rock hollows in its upper part, and they supported small grasses, sedges, and other herbs. This bare granite face was a feature of most of the granite islets which plunged into the sea, its depth ranging from 17 fathoms off P. Sepoi to 20 fathoms off Tg Ruit. I limited my exploration to the *Terminalia*-zone which was the front of the forest at the top of the granite face, and to the zone of *Eugenia grandis* immediately behind. There was no time to explore further inland.

The *Terminalia*-zone was a broken and almost single file of trees and climbers with some shrubs and herbs, typical of the *Terminalia-Barringtonia* formation on the rocky east coast of Malaya. Here and there, in sheltered places, there were intrusions of the inland forest. The seeds and fruits of many of these plants are water-borne and, presumably, are splashed up the granite face by waves. The list of plants in this zone is given in Table 1. It will be seen that there were no *Cycas*,

Lumnitzera, *Peltophorum*, *Scaevola*, or *Casuarina*, which belong to the sandy or less boisterous coasts.

A striking feature of this *Terminalia*-zone, as on other rocky parts of the east coast, was the great abundance, often thick masses, of such epiphytes as orchids, aroids, and ferns growing on the rocks. Conditions of insolation, drainage, and intermittent rain seem comparable with those of the limbs of trees, and the epiphytes which can stand the sea-spray become truly saxicolous. Climbers, also, where they could root into a crevice between the exposed boulders, spread thickly over them in a mat or carpet that hid the boulders, curtained the sides, and could be lifted off. Similarly, several species of strangling fig, normally beginning as epiphytes, carpeted the exposed rocks without developing erect branches; such carpets were mostly sterile and it was not till many years later that I managed to identify the species more or less satisfactorily.

Another feature of the granite face was a special habitat for small herbs where some humus and rain-water could collect in crevices and small hollows, especially where shaded by trees. Some of the hollows were merely little basins in the rock from which the plants could be scooped, as if from a pot. Such plants were *Aneilema* (SFN 29794), *Cyperus cyperinus*, *C. dubius*, *C. javanicus*, *Fimbristylis dichotoma*, *Oldenlandia paniculata*, *Sporobolus virginicus*, and *Vandellia hirsuta*. This habitat was noticeably absent from the granite islets around Tioman; the granite face might have been too wave-swept or have been unable to accumulate enough soil or rain.

Immediately behind the *Terminalia*-zone there was that of *Eugenia grandis*, mostly 1-2 trees deep. The trees did not actually front the coastal forest but occurred where there was shade enough for their roots. The seeds of *E. grandis* germinate in the open or in shade but seem unable to establish themselves in high forest or in the shade of their own kind. Thus, the trees start in the open and come slowly to overshadow the *Terminalia*-zone. However, this coastal fringe of forest was retreating, as witnessed by the fallen boulders, and the interaction between *E. grandis* and the *Terminalia*-zone was by no means clear. The inland forest intruded with seedlings and saplings into the zone of *E. grandis*. The coastal forest at Tg Ruit was thinned to a strip and, on the islets around, it was variously disrupted as they were disintegrated. The headland had two special features.

The point itself carried the *Terminalia-Barringtonia* formation which stopped abruptly at the isthmus of water-worn boulders. These were mixed with coral debris and sandy detritus, heaped together by the waves as a low barrier. It carried an almost pure stand of *Pemphis acidula*, which did not occur elsewhere at the headland. It formed twiggy gnarled bushes, up to 12 ft high, the leaning and twisted trunks rooting in the debris. This sort of junction of a headland with a spit of talus seems to be a favourite habitat of *Pemphis*. On the rocky mainland coast of east Johore, with haematite quartzite shale, *Pemphis* forms prostrate sprawling mats, scarcely a foot high, and rooted in the crevices, but I did not see it in this manner on the granite boulders of the Tioman complex.

Then at the landward end of the isthmus, where the granite face rose steeply, there was a little wood of *Ochrosia oppositifolia*, about 50 yards long and 30 yards wide, between the *Terminalia*-zone and that of *E. grandis*. The trees, up to 50 ft

tall, were thickly placed, rather slender, and together with many of their seedlings and saplings formed an almost pure stand. The ground was a mixture of small boulders and sand at the foot of the cliff. It was difficult to see why such a stand should have developed. The species did not occur in the *Terminalia*-zone on the granite face; on the east coast of Johore it frequented sandy shores. It seemed to be the result of a freak current or storm which had washed up the fruits on this part of the beach at a time when it was bare of vegetation, and that the colony had persisted while the *Terminalia*-zone took over the frontage.

Pulau Tulai

Figure 1

This is the largest of the small islands off Tioman and lies about 3 miles WNW. of its north end. In 1935 it was largely covered with inland forest. I was able to explore in detail only the NW. coast and the bay on the west of the island. The whole coast, except for this bay, is rocky and composed of granite blocks c. 20 ft high *in situ* and others tumbled on top of them, and on the NW. side, at least, there was the talus of water-worn boulders plunging into the sea without foreshore. The coastal flora was essentially the same as at Tg Ruit but without *Ochrosia*; there was the fringing *Terminalia*-zone along the top of the granite face with an interrupted zone of *E. grandis* connecting with the inland forest. There were, however, the following additions:—

Adenanthera pavonina (strangely none seen at Tg Ruit),
Cissampelos sp.,
Clerodendron inerme,
Colubrina asiatica,
Derris scandens,
Elatostema sp. (on rocks in the shade),
Ficus variegata (in *E. grandis* zone),
Hemiscopia trimera (common on rocks in the *Terminalia*-zone),
Piper retrofractum (on shaded rocks with *Elatostema*, often in thick carpets sweeping up vertical sides of rocks),
Randia schoemannii (*R. exaltata*),
Streblus ilicifolius (not on exposed rocks),
Xylocarpus (*Carapa*) *moluccensis* (a frequent spreading tree).

Hydnocarpus ilicifolia was abundant as a small tree to 30 ft high both in the coastal fringe and in the inland forest. There were no *Cycas*, *Pandanus*, or *Podocarpus*.

The main bay, as a bight on the west side of P. Tulai, had a mangrove forest of considerable extent. Here the granite face receded inland and, at the SE. corner of the bay, a small sluggish stream flowed over a shallow flat of coral detritus, exposed at low water, before emptying into the bay. The shallow flat was roughly semicircular and about 200 yards in diameter. Here was the mangrove forest composed of *Rhizophora conjugata*, *R. mucronata*, and *Bruguiera gymnorrhiza*, on clean firm ground without the usual mud and slime. There were many coral fragments mixed with the sand and in places lumps of dead coral more or less buried *in situ*. *R. mucronata* was by far the commonest, occupying most of the flat and all the seaward front, but scarcer inland. *R. conjugata* occurred sparingly on the landward side. *B. gymnorrhiza* was scattered in the central part of the flat and abundant on its landward side, even in places to the exclusion of *Rhizophora*. Some trees of *B.*

gymnorhiza stood 60-70 ft high, those of *R. mucronata* being somewhat smaller. Pneumatophores were present in great abundance and, at low water, it could be seen that a tangle of *Rhizophora* roots flanked the stream; at high water a prahu could float down it. The mangrove was advancing into the bay which was sheltered from the NE. monsoon and from the SE. tenggara*. How old this mangrove was, I could not determine, but it was growing on a fringing reef that must have been raised in fairly recent times.

Immediately behind the mangrove flat, there was a sandbank 4-5 ft high, stretching inland, and evidently a former beach. It was largely planted with coconuts but had clearly been covered originally with the *Terminalia-Barringtonia* formation and that of *E. grandis*; there were many plants of *Tacca leontopetaloides*. The sandbank led to the granite slope with inland forest.

Just north of the mangrove flat, by some large rocks at high tide level, there were several large shells of the giant clam *Tridacna*, 2-3 ft across, *in situ* and upright but almost completely buried in sand; the wavy outline of the valves was more or less visible. Out in the bay we saw through its clear water smaller living clams about a foot wide at depths of 8-10 ft; we also met them in our early diving efforts with helmet and air-pump in this bay. They lived close to the rocks, neither in the sand of the bay nor in the living coral. Here was further evidence that P. Tulai had been raised or tilted, perhaps some 20-30 ft, to uplift and expose the giant clams. Previously there could have been no mangrove there, and where the stream flowed there might have been a narrow strait separating the SW. part of the island from the rest. As this part was raised, so the bay silted up to give the sandy padang with coconuts. In other words, the age of the mangrove must be connected with the raising or tilting of the island.

No one lived on P. Tulai but it was frequented by fishermen and, doubtless, the owner of the coconuts. There was a well, supplying fresh water, on the south side of the mangrove. From the general appearance of the forest, it seemed that the island had never been inhabited.

The broad-leafed and tree-like *Pandanus dubius* was abundant on the west side of P. Tulai. It grew on the sandy shore of the bay in the *Terminalia*-zone and in the hillside forest somewhat inland, but not on the rocky coast. The biggest plants had stems up to 25 ft high and were not so large as those on P. Chibeh (Cibeh). I saw it at the north end of Tiunan and on the south side of Juara Bay, but not at Tg Ruit, and I did not see it on the south and west of Tiunan. I found no flower or fruit anywhere in August 1935, but its seedlings were abundant.

Pulau Chibeh

Figures 1 & 2, plates 3-6

This small island, about 250 ft high, lies a mile or so north of P. Tulai. It consists of immense granite blocks more or less *in situ*, immense fallen boulders, a bare granite face above tide level, and more or less of a submerged talus of boulders and pebbles. It resembled a disintegrated headland of Tiunan and its vegetation was that of Tg Ruit on a diminished scale, but without regular formation (Table 1). I visited it on 19 August 1935 from 7 a.m. till 1 p.m. when the swell forced me to

*"Tenggara" means south-east but as used by the fishermen of the East Coast, the use is transferred from the direction to the afternoon wind itself on which they sailed home. Ed.

return to the launch. I explored most of the island but did not cover the whole of the exposed east side where the immense boulders made passage very difficult. However, they were largely bare of vegetation and I did not miss any plant of importance.

The north and south ends of the island were steep with the boulders exposed and hot, but on some of them there were mats of saxicolous strangling figs with tufts of *Cyperus javanicus* and *Nephrolepis* in crevices, as the only vegetation. The specimens which I collected resolved into *F. kurzii*, *F. stricta*, and *F. tinctoria* ssp. *gibbosa*, not *F. microcarpa* as I had supposed; all occur, together with *F. microcarpa*, on rocky parts of the east coast of Malaya and they show no obvious ecological preferences. Higher up on the north end of the island there were scrubby patches of *Diospyros ferrea*, *Memecylon coeruleum*, and *Premna obtusifolia*. Then, in sheltered nooks on the north and west sides, near to the sea-level, there were a few bushes of *Scaevola*.

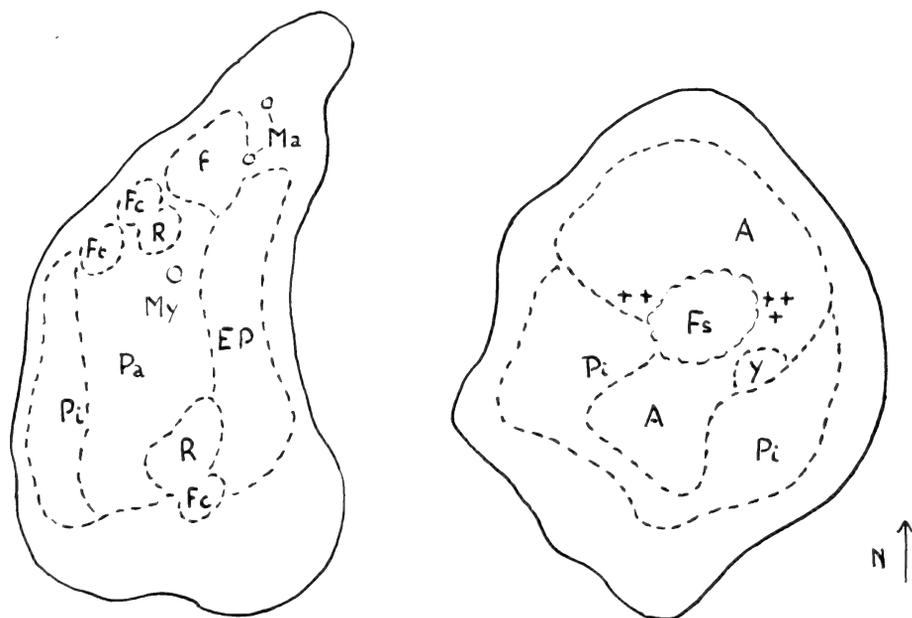


Fig. 2. Sketch map of the main vegetation on P. Chibeh (left) and P. Sepoi (right). A, *Atalantia* wood; EP, *Eugenia grandis* and *Pandanus dubius*; Fc, *Ficus caulocarpa*; Fs, *Ficus superba*; Ft, *Ficus tinctoria* ssp. *gibbosa*; f, *Diospyros-Premna* scrub; Ma, *Manilkara kauki*; My, *Myristica guatterifolia*; Pa, wood of *Parinari corymbosa*; Pi, *Pisonia grandis* wood; R, *Calamus chibehensis*; Y, *Phyllanthus* sp., SFN 29848; +, *Knema globularia*.

On the east side, above the bare granite face, there was a rather open wood of *Eugenia grandis* with other trees of the *Terminalia*-zone and abundant *Pandanus dubius*. On the west side, which was sheltered and not so steep, this kind of woodland with trees up to 50 ft high was better developed and had a frontage of *Pisonia grandis*, the white branches of which were conspicuous from out at sea. The woodland extended over the centre of the island and consisted mainly of tall trees of *E. grandis*, *Parinari corymbosa*, *Sterculia foetida*, *Vitex pubescens*, and *Ficus caulocarpa* with *F. stricta*; the smaller trees were *Atalantia monophylla*, *Caryota mitis*, *Eurycoma longifolia*, *Gnetum gnemon*, *Hydnocarpus ilicifolia*, *Knema globu-*

laria, and *Pandanus dubius* (up to 40 ft high with stilt-roots up to 12 ft high). Surprisingly, the herb *Pseuderanthemum* was very abundant in this woodland. There were three plants of special interest in the upper part of the island. At the north end there were two trees of *Manilkara kauki*, up to 30 ft high, standing apart from the woodland. In the woodland in the centre of the island there were one or two trees of *Myristica gatteriiifolia*. Then, in the north-west corner of the woodland and in the south part, there were two clumps of the rotan which C.X. Furtado called *Calamus chibehensis*. Beside the northern clump of rotan there stood two big trees of *Ficus tinctoria* ssp. *gibbosa* and one of *F. caulocarpa* which had a nest of the sea eagle. Another big tree of *F. caulocarpa* stood on the outside of the southern clump of rotan. I noted two trees of *Ficus variegata* in the woodland. It was an extraordinary association of forest relics.

The trunks of the strangling fig-trees stood directly on the boulders over which their roots spread and entered into crevices, possibly down to the water-table (? brackish) in the centre of the island. The roots were so numerous and strong that they undoubtedly helped to basket the loosening boulders and hold them up. How the fig-trees had started was not evident. If they had begun as epiphytes, which their trunks suggested, there was no trace of the host-tree. I did not meet *Manilkara* anywhere else on the islets off Tiunan; it was not likely to have been overlooked because of its appearance like a chiku tree with dark fissured bark and white undersides to the stiff shiny leaves. At the time of my visit in August, the trees of *F. caulocarpa* and *Pisonia* were getting new leaves.

The climbers and ferns mostly formed carpets on the boulders, both in the open and in the lighter shade of the woodland. Their variety added to the peculiar composition of the flora.

I concluded that P. Chibeh had a woodland made largely of plants of the *E. grandis* forest of rocky coasts, with a few relics of inland forest, as shown by *Manilkara*, *Myristica*, and *F. variegata*.

I noted that ants were very abundant, especially the red keringga with fiery bite. There were several large ant-hills or mounds up to 3 ft high.

Pulau Sepoi

Figures 1-4, plates 7-13

This is a single rounded hill-top, 230 ft high, three miles due west of P. Tulai, and the sea-depth around is given as 17 fathoms. It is a mass of granite blocks and boulders similar to P. Chibeh and rather smaller. Its vegetation was also similar but with still fewer species (Table 1). I visited it in June 1932 and on 20 August 1935. It was tenanted by many terns which nested on the higher rocks where the vegetation began; they laid their eggs, apparently one to a nest, on bare ground under a projection of the rock without any sticks or leaves. There were numerous rocky caves round the foot of the island, as on P. Pyah (Paya), but which I did not note on P. Chibeh. The upper part of the island was covered with a low wood, 30-40 ft high, from which some large fig-trees projected, notably *Ficus superba*. The top consisted of large and small boulders with very little, if any, soil. The trees were well spaced, mostly on the boulders, with little or no undergrowth so that it was easy to walk among them. The granite face between the sea and the vegetation had scattered tufts of *Cyperus javanicus* and some sprawling patches of *Lygodium* and *Stenochlaena*.

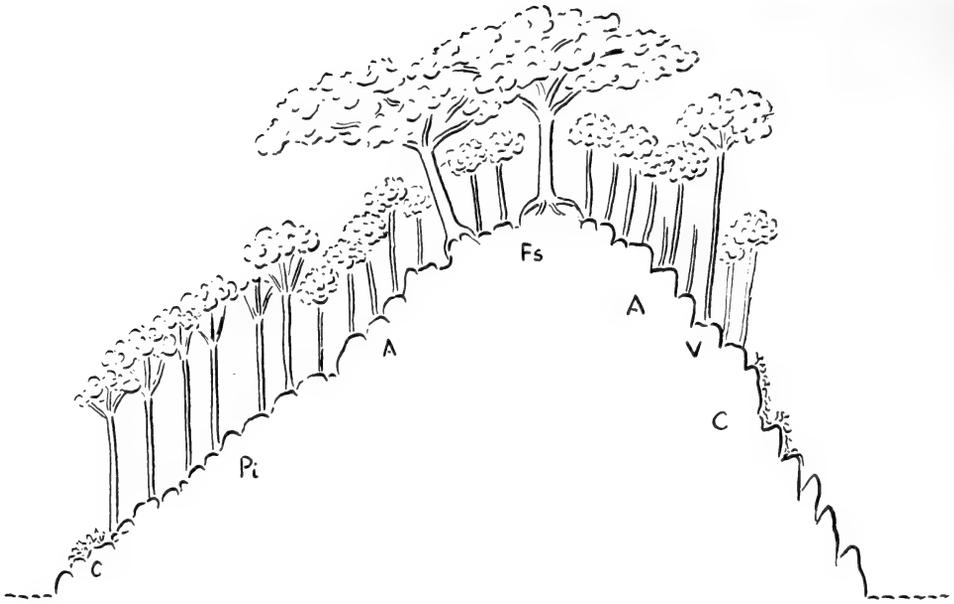


Fig. 3. Sketch of a transect from west (left) to east across P. Sepoi. A, *Atalantia* wood; C, mats of climbers on the rocks; Fs, *Ficus superba*; Pi, *Pisonia grandis* wood; V, *Vitex pubescens*.

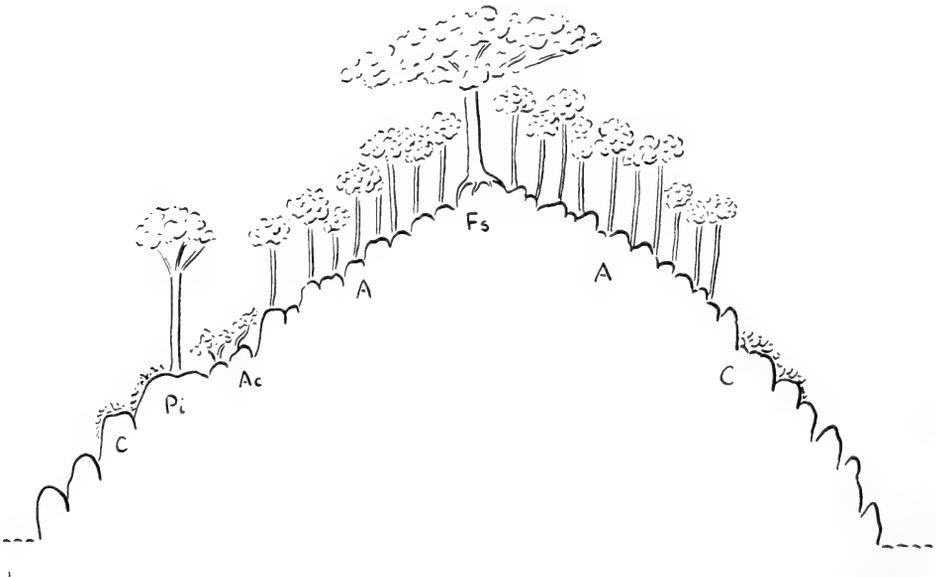


Fig. 4. Sketch of a transect from south (left) to north across P. Sepoi. Letters as in Fig. 3; Ac, *Allophylus cobbe*.

The woodland had two very different parts. That covering the upper part of the island I called the *Atalantia* wood because of the abundance of *A. monophylla*. The other was the *Pisonia* wood on the west and south-east parts of the island, on the lower slopes where there was some shelter from the NE. monsoon and the slopes were less steep. The *Atalantia* wood had also abundant *Hydnocarpus ilicifolia*, *Planchonella obovata*, and *Ficus superba*, the many roots of which clasped the rocks and descended into the depths of the granite. The fluted trunks of *A. monophylla*, set with thorny twigs, were easily recognisable. Near the top, in the *Atalantia* wood, there were numerous trees of *Knema globularia*. At its outskirts in the south-west, *Derris uliginosa* formed close mats on the rocks. Several large trees of *Vitex pubescens*, up to 50 ft high, occurred on the east side of the wood where there was the one patch of the small climber *Phyllanthus?* (SFN 29848). In contrast, the *Pisonia* woods were almost pure stands of *P. grandis* with an undergrowth of *Stenochlaena palustris* and a few trees of *Adenanthera pavonina*, *Ficus microcarpa* (with many aerial roots from the branches), and some stray *Atalantia*. The smooth grey trunks of *Pisonia* were seated on the rocks, with roots spreading over them in the manner of fig-roots. All the *Pisonia* trees were, in August, getting new leaves and beginning to flower, as on P. Chibeh; their white branches rendered them conspicuous. The trees of *F. superba* were also getting new leaves.

In many places there appeared to have been landslips or, at least, the fall of boulders which had destroyed parts of the *Atalantia* wood, and masses of creepers were covering the fallen rocks. Remarkably, there were no *Eugenia grandis*, palms of any kind, *Pandanus dubius*, *Terminalia catappa*, Apocynaceous climber *Aganostoma*, or epiphytes. In fact, there was no vestige of either the formation of *E. grandis* or of *Terminalia*.

In August 1935, many of the trees showed signs of wilting. What little soil there was between the boulders was dry; fallen leaves crackled under foot. Patches of *Lygodium* and *Stenochlaena* in the open were brittle. The leaves of many smaller trees and their saplings were drooping, wilting or dried out. At first, I thought that this might be due to a landslip upsetting and breaking roots, but there was no actual indication of a recent fall. Then, I thought that the wilting might have been caused by the abundance of guano round the nests of the terns, but I could discover no relation between the nests and the wilting trees. The only cause seemed to be, simply, the lack of rain. The roots of the fig-trees, of *Pisonia*, and of *Vitex pubescens* penetrated deeply into the mass of boulders and their leaves showed no signs of wilting.

There were many old and rotting trees, standing and fallen, in both the *Atalantia* and the *Pisonia* woods, where there were also plenty of seedlings and saplings. Hence I concluded that the vegetation of the island must have been of long standing. Landslips, boulder-falls, and periods of excessive drought evidently killed some of the trees and enabled a new generation to arise. Pigeons and fruit-bats, even the large hornbills, visiting the island from Tiuman or P. Tulai, might carry seeds to re-stock, but all the evidence that I could gather pointed to the conclusion that P. Sepoi was a degenerating headland of ancient coastal forest. Indeed, this cluster of islets about P. Tulai probably made long ago one hill or mountain which, in its turn, may have been part of Tiuman itself. I was thinking of subaerial denudation. Lowering of the sea-level during glaciations would have exposed the base of the hills without necessarily a connection.

Pulau Labas

Figure 1

This is the fourth and smallest island of the P. Tulai group. It lies about two miles SW. of P. Tulai and about one mile SE. of P. Sepoi. I visited it also on 20 August 1935. It is a collection of large and enormous granite boulders raised about 30 ft above the sea-level. There were scattered trees of *Ficus superba*, mats of *F. microcarpa* and *Aganosma marginata* on some rocks, and scattered clumps of *Cyperus javanicus* and the mangrove fern *Acrostichum aureum*. Otherwise, the only other 'higher plant' on the island was a tall fruiting coconut palm, evidently planted, with several seedlings around it. The island seemed to represent the stump of a headland to which, in time, P. Sepoi would be reduced. However, the presence of *Acrostichum* brought in another factor to suggest that P. Labas might be the remains of a small granite headland, such as at Tg Ruit, beside a mangrove forest such as on P. Tulai. Indeed, this mangrove at P. Tulai was probably the vestige of a much more extensive mangrove forest when all four islands were joined in periods of glaciation.

All four islands were, and should be allowed to remain, historical sanctuaries.

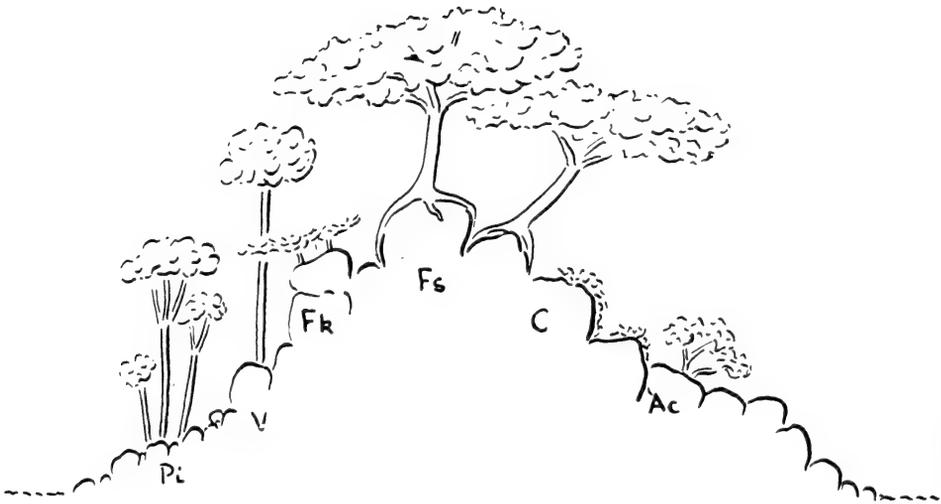


Fig. 5. Sketch of a transect of P. Rengis. *Ac*, *Allophylus cobbe*; *C*, climbers on the rocks; *Fk*, *Ficus kurzii*; *Fs*, *Ficus superba*; *Pi*, *Pisonia grandis*; *V*, *Vitex pubescens*.

Pulau Rengis and P. Pyah

Figure 1

The very small island P. Rengis (Renjis), about 80 yards, across lies about a third of a mile from the west coast of Tiunan in Telok (Teluk) Tasek. I visited it on 16 August 1935. It was a mass of granite boulders piled on top of one another as P. Labas, and with water-worn boulders strewn at the base. The island was tenanted by frigate birds, not nearly so numerous as the terns on other islets, and the guano was not so persistent; nevertheless, many trees were white with guano. The flora

was very limited to 11 species. There was no *Terminalia*-zone or *Eugenia grandis*, and I saw no herbs, grass, or sedge. It consisted of:—

Allophylus cobbe var. *marinus*, common by the shore,
Callicarpa longifolia, as a few scattered bushes,
Ficus kurzii, as a few small spreading trees at the south end, with copious aerial roots, starting as a bush on the rocks; (easily mistaken for *F. microcarpa*),
Ficus superba, as frequent big trees in the centre of the island, never as a prostrate mat,
Hoya diversifolia, very common on trees and rocks,
Nephrolepis biserrata, a single clump,
Pisonia grandis, as the commonest tree by the shore,
Premna obtusifolia, as a scraggy subscandent bush,
Schefflera venulosa, abundant on trees and rocks, all its leaves white with guano,
Trema amboinensis, as a few scraggy treelets,
Vitex pubescens, as a single tree 50 ft high.

On 11 June 1932, when we had anchored for the night in Ayer (Air) Batang bay, I visited the islet P. Pyah, just off the south headland of the bay, but I failed to make an inventory of its flora. It was, as P. Rengis, a cluster of granite boulders on which the chief tree was *Ficus superba*. There were many caves round the foot where I spent most time looking for algae, but with little success.

Pulau Tokong Burong, Baru Rock, and P. Gup

Figure 1, plates 14 & 15

A cluster of three steep islets of haematite shale or laterite-looking rock, about 10 miles SW. of P. Sepoi and some 17 miles from Tg Penyabong on the mainland, make the group of Tokong (Tukong) Burong. I visited them on 16 August 1935. The largest rises to 160 ft high and the base, strewn with large boulders, reminded me of Tg Sedili. There was no forest. The islands were tenanted by thousands of terns which nested under tussocks of the grass *Chrysopogon fulvus*, as the only vascular plant on the islands. It grew from high tide level on the south face on terraces or niches in the rock, and right over the summit. There was no sward because the runways of the terns kept the tussocks more or less apart. There were no seedlings of other plants, stumps, or traces of others, from which it seemed that the islands, as they now stand, might never have been forested. The top of the large island had the appearance of having been burnt but, if so, the effect had merely halted the grass temporarily.

Baru Rock, or P. Baru, and P. Gup are islets of roughly the same size, comparable with the largest of the Tokong Burong group. Baru Rock, 190 ft high, lies about 11 miles south of Tokong Burong. P. Gup, 140 ft high, lies to the east in the same latitude and about 4 miles south of Tiunan. I was never able to visit either of them but, on a voyage to Kemaman in October 1935 in S.S. *Mahidol* of the Danish East Asiatic Company, I persuaded the captain to pass as close as possible to the islands so that I could have a look at them. He enjoyed the manoeuvre and handed me his telescope. The difference between the islands was as astounding as that between Tokong Burong and Sepoi. Baru Rock was a firm consolidated mass of rock, probably the haematite shale, with precipitous sides, serving as a ternery, and rising straight from the sea with few or no boulders at the foot. The upper two-thirds were covered with a tussock grass, presumably the same as on Tokong Burong. At the

north end, half-way up the island, there were a few small stunted trees with rather large leaves, which could have been *Morinda citrifolia*. Thus Baru Rock may have been less degraded than Tokong Burong. Perhaps both were originally forest-clad like P. Duchong (Ducong).

In complete contrast, P. Gup was a mass of granite boulders with the upper part rather closely wooded, very similar to P. Sepoi. I could not distinguish any floristic details but looked unsuccessfully for the white branches of *Pisonia*.

Pulau Duchong

Figure 1, plate 16

Two small islands lie near the mainland just south of Pontian. The larger, P. Duchong Darat, 80 ft high, is about a mile off the coast. The smaller, P. Duchong Laut, is about half a mile SE. of the larger. I visited Duchong Darat on 22 August 1935, but had no time to visit the smaller, which did not appear to differ floristically. They are steep craggy masses of haematite shale, similar to P. Setindan off Mersing and to Tg Sedili. The flora was that of the *Terminalia-Barringtonia* zone and of *Eugenia grandis* forest with some additions as relics, perhaps, of inland forest. Thus, in a general way, it resembled the coastal flora of Tiunan but several conspicuous plants were missing, namely the trees *Atalantia*, the strangling figs, *Hydnocarpus ilicifolia*, *Manilkara*, *Pandanus dubius*, *Pisonia*, and *Sterculia foetida*, the climber *Aganosma*, and the sedge *Cyperus javanicus*. The floristic list is given in Table 1.

Round the foot of the island there was the *Terminalia*-zone. The rest was covered with rocky forest with trees up to 60 ft high, though those of the upper part were merely 15-20 ft. Exposed rocks were covered with masses of sprawling climbers and epiphytes among which *Asplenium nidus-avis* was conspicuous. There was no evidence that the forest had been cut over. Various herbs and grasses of the sandy shore of the mainland occurred in small sandy places among the lower rocks. The *Chrysopogon* of Tokong Burong did not occur.

Pulau Setindan

I visited this island off Mersing on 15 August 1935 and on 30 January 1937. Geologically and floristically it was similar to the headlands of the east coast of Johore and to P. Duchong. There were the formations of *Terminalia-Barringtonia* and of *Eugenia grandis*, but where there had been inland forest, I found mostly scrub; at some time the island had been extensively cut over. The plants which I found are given in Table 1, for comparison with P. Duchong. The islands were generally similar but Setindan is larger and more representative; yet, there were unaccountable differences. Certainly, Setindan relates more with the flora of the Riouw Pocket, as shown by the abundance of the southerly *Tristania obovata*. The lists in Table 1 largely repeat what I have written about the Sedili coast, but I decided to include it as a record what deforestation is likely to obliterate. It reminds one of what might be expected.

Pulau Berhala

Figures 1 & 6, plates 17-21

This islet lies north-west of Tiuman and about 20 miles north-east from Bebar on the Pahang coast. It is a flat granite platform, roughly circular, about 400 ft wide, raised a foot or more above sea-level and, probably, awash at highest tides or in storms. The platform is dissected radially by deep gullies plunging into the sea (12-13 fathoms deep). In the centre there was a sandstone mass, about 80 ft high, shaped like the crown of a hat to which the granite platform was the brim. It was neither the mass of granite boulders of the Tiuman islets nor the compact haematite of the coastal islets. The sandstone was fairly hard and distinctly, though not deeply, undercut round the granite platform. The islet clearly belonged with another geological formation and recalled Gunung Panti in east Johore.

The vegetation was confined to the upper half of the sandstone hillock where it was rather evenly dense, but the granite platform was destitute of any plants except, perhaps, some lichens and microscopic algae. The flora consisted of merely 5 species, thus:—

- Stenochlaena palustris* and *Polypodium scolopendria* in a low tangle, with tufts of *Cyperus javanicus*, forming the lowest fringe of vegetation;
- Morinda citrifolia* as bushes up to 10 ft high, mostly higher up the hillock from the fern tangle;
- Parinari corymbosa* as a cluster of several much branched trees up to 20 ft high, at the top beside the Survey Beacon.

I remember, but have failed to note, rather numerous large and metallic green 'rose-beetles' buzzing about on the summit as if they were bees. On the west side of the summit, which was actually a slight ridge running north and south, there was a large nest of the sea-eagle, surrounded by fish-bones and the skeletons of sea-snakes.

Half a mile north of P. Berhala, roughly in line with its slight ridge, there was a skerry of granite rocks just breaking the surface of the sea, about 40 yards across, and devoid both of sandstone and vegetation. It indicated another such islet worn down to the granite platform that was itself disintegrating.

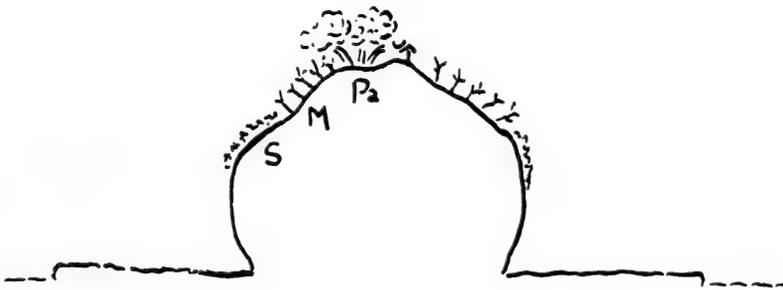


Fig. 6. Sketch of a transect across P. Berhala, with granite platform and sandstone hill. *M*, *Morinda citrifolia*; *Pa*, *Parinari corymbosa*; *S*, *Stenochlaena*.

Pulau Babi Tengah

I visited this island off the Johore coast on 10 June 1932, 27 September 1936 and 29 October 1936. It is a granite island with an accumulation of granite boulders on the points with sandy bays between them. It had been largely deforested but retained on the north and east shores a *Terminalia*-zone with its backing of *Eugenia grandis*, typical of the east coast of Johore. Coconut palms had been planted over most of the island. At the north-east end the small headlands or spits of granite boulders were connected with the main island by necks of small water-worn boulders and coral detritus on which *Pemphis acidula* formed elfin woods, almost pure stands, as at Tg Ruit. Between these spits, the sandy bays had small stands of mangrove as at P. Tulai. A sandy spit at the north-west end had a natural growth of *Casuarina equisetifolia* and some tufts of *Spinifex littoreus* on the growing front.

It will be seen from the list in Table 1 that none of the plants characteristic of the granite islets of Tiunan occurred, unless the rather ubiquitous *Atalantia* and *Diospyros*. I failed to record the ferns and coastal aroids and orchids. Hence there are many apparent absentees in Table 1, which account for its low total of species. It could have been that, before deforestation, the island had much of the flora of the granite islets off Tiunan.

I make the following observations on a few of the plants:- *Atalantia* was very abundant. *Barringtonia macrostachya* and *Garcinia nigrolineata* were common inland. *Pandanus odoratissimus* var. *laevis* (*P. spurius*, as the thornless variety) grew under the coconut palms and might have been planted. The record of *Schizachyrium sanguineum* is the only one for the Malay Peninsula according to Gilliland. The shrub *Timonius compressicaulis* was common on rocky headlands on the north-east side of the island. Concerning *Messerschmidia* (*Tournefortia*) one would like to know its distribution in the Peninsula.

Notes on special plants

Allophylus cobbe — I made several varieties for this species in the Malay Peninsula (Corner 1939a). They have been recognised by Leenhouts (1967) who equates them as follows:—

- var. *glaber* as *A. javanicus* and *A. longipes*,
- var. *limosus* as near to *A. ternatus*,
- var. *marinus* as *A. timorensis*,
- var. *velutinus* as *A. racemosus*,
- var. *villosus* as *A. villosus*

but he agrees with me that there is, practically, only one species. It would be interesting to pursue this problem experimentally, by raising seed of the varieties and by hybridisation.

Breynia coronata ?, SFN 29853. — This was a straggling climber on P. Duchong, 22 August 1935, common on rocks near the top of the island. The leaves were glaucous beneath. All the plants were sterile.

Cissampelos ?, Corner s.n., P. Tulai, 18 August 1935; common climber in the *Terminalia*-zone, with yellowish leaves.

Calamus chibehensis, SFN 29842. — Furtado (1956) attributed this collection to M.R. Henderson, which is an error. I saw what I took to be the same plant also at P. Tulai and Juara Bay. It is probably no other than a variety of *C. burkillianus* which occurs on Tiunan.

Celastrus ? SFN 29829, P. Chibeh, 19 August 1935. — This was a frequent small tree on rocks at the top of the island and on the west slope. It resembled the guava-tree (*Psidium*) in shape, leaf, and pale brown, slightly papery-flaky, bark. I collected it as *Aporosa* ?, but it was referred to *Celastrus* by M.R. Henderson. It is not listed by Ding Hou (1965).

Chrysopogon fulvus. — This tussock grass occurs in Africa, India, and Thailand, but in Malaya it is known only from Kedah (Bukit Wang) and P. Tokong Burong (Gilliland 1971). It would seem to be carried somehow by terns, but that would not explain its strange distribution.

Diospyros ferrea. — Concerning the variation in this very widespread species there is the article by Fosberg (1939). Recently, however, doubt has been thrown on the use of this name (Smith 1981).

Ehretia sp., SFN 29827, P. Chibeh, 19 August 1935; SFN 29845, P. Sepoi, 20 August 1935; straggling climber on more or less exposed rocks; berries small, dull orange.

Ficus. — When I visited the islets, the identification of the strangling figs was in a state of confusion. I believe, now, that I mistook several records which I made on the spot as *F. microcarpa*. Certainly some, for which I made specimens, have turned out to be *F. kurzii* and *F. stricta*. Careful study of the venation of the dried leaves is necessary to identify these sterile saxicolous fig-plants. I note that *F. hispida*, abundant in the northern half of the Peninsula, was absent from the southerly islands, just as from the south of the Peninsula.

Gnetum gnemon. — There are notes on the wild occurrence of this tree in Malaya (Corner 1939b).

Hemiscolopia trimera. — The strange distribution of this small tree, resembling the rukam (*Flacourtia*), is given by Sleumer (1954), to whose account must be added his later records from Malacca and Ulu Sedili. It suggests a north-south line from Indo-China to the Sunda Straits. On P. Tulai it must be a relic. It may have had the wider distribution of *Hydnocarpus ilicifolia* in the northern part of the Peninsula from Langkawi across Kedah to Pahang. The tragedy is that with such intensive deforestation the Peninsula has lost much of its botanical history.

Hydnocarpus ilicifolia, SFN 25762, P. Sepoi, 13 June 1932; SFN 29826, P. Chibeh, 19 August 1935. — Tree - 30 ft high; trunk cylindrical or slightly fluted downwards; bark light brown to greyish brown, slightly flaky with thin angular pieces but appearing smooth, becoming shortly and finely fissured, not pustulate or rugose; inner bark pallid white, greenish below the outer bark; fruits 3-5 cm wide, subglobose, velvety black; seeds with thin oily sweet pulp round them.

Manilkara kauki. — This tree, widely spread from Burma and Indo-China to north Australia, occurs in the Malay Peninsula only 'on rocky headlands and

islands off the east coast of Johore and Pahang' (Ng 1972). I found it only on P. Chibeh. Like *Hydnocarpus ilicifolia*, it seems to be a relic of the monsoon climate at the north of the Riouw Pocket (Corner 1978).

Myristica guatteriifolia. — The remarkable and almost coastal distribution of this 'very distinct species' is given by Sinclair (1958, 1968). It is surely connected with the northerly shore-line of the Riouw Pocket as it impinged on the China Sea and extended along the east coast of Malaya to Sumatra and Java; in fact, it circumscribes the Riouw Pocket. In Malaya it is known from P. Tenggol (Dungun), P. Tiunan, P. Chibeh, P. Setindan, and the coast of Johore from Mersing to the Sedili rivers (Corner 1978).

Pandanus dubius. — As I have noted (Corner 1978), this tree-like species with stout stilt-roots and broad leaves reaches its western limit of distribution on P. Tenggol (Dungun), P. Tiunan and some of its islets, and Tanjong Sedili Kechil (Kecil). It is another indication of the northern limit of the Riouw Pocket. It is common on the rocks at Bako National Park in Sarawak where it is accompanied by the saxicolous state of *Pandanus epiphyticus*. That species occurs in the south-east of Malaya and indicates the more central part of the Riouw Pocket. Strangely, it seems never to occur on coastal rocks in the Peninsula (Corner 1978).

Phyllanthus ?, SFN 29848, P. Sepoi, 20 August 1935; sprawling climber on rocks half-way up the island and at the south end; leaves subglaucous beneath; berries pinkish purple, small.

Pisonia grandis. — This seashore tree, which I used to call *P. excelsa*, is widely distributed on rocky coasts in the west Pacific but, in Malaya, only on the granite islets about Tiunan and at Kuala Trengganu. Its sticky fruits adhere to the feathers of birds which distribute it, and it is thought to succeed only in soil enriched with guano. It appears, like *Pandanus dubius*, to have come westwards; yet, unlike that pandan, it has not been recorded from the China Sea coast of Borneo. There is a photo of it, which I took on P. Sepoi, in the Flora Malesiana (Stemmerik 1964). Concerning the general occurrence of *Pisonia* forest and its competition with *Ochrosia oppositifolia*, there is the article by Fosberg (1976).

Planchonella firma. — This is said to be a tree of mossy mountain forest in Malaya, with P. Setindan as the only lowland record (Ng 1972). There are other plants, such as *Baeckia*, *Styphelium*, and *Vaccinium bracteatum*, which move from mountain to lowland, but none of these occurred in the islets around Tiunan. It may be a relic of the mountain flora of P. Aor and P. Tinggi, and it should be looked for on Gunong Pantii. See, also, the following note.

Planchonella linggensis. — This species is distributed throughout Malesia to Australia and the Pacific islands, but in the Malay Peninsula it appears to be restricted to the rocky sea-coast of Penang, Pahang, and east Johore, except for records from Penang Hill and Mt Ophir (Ng 1972). I found it on P. Chibeh, P. Tulai, and P. Duchong. It is a remarkable relict occurrence.

Polyalthia sclerophylla. — Concerning the identity of the collection from P. Duchong, I have already published a note (Corner 1978).

Premna obtusifolia. — This name supplants those of *P. corymbosa* and *P. integrifolia*, which have been widely used for this common plant (Fosberg 1953).

Tristania obovata — Tanjong Penyabong and P. Setindan appear to be the northern limits, on the east coast of Malaya, of this species of the Riouw Archipelago.

Table 1. List of flowering plants and ferns at Tanjong Ruit (R), Pulau Chibeh (C), P. Sepoi (S), P. Duchong (D), P. Setindan (St), and P. Babi Tengah (B).

(+ means present; – means absent or not found)

	R	C	S	D	St	B
TREES, SHRUBS, PALMS, PANDANS						
<i>Adenanthera pavonina</i>	–	+	+	+	+	–
<i>Allophylus cobbe</i> v. <i>limosus</i>	–	–	–	–	–	+
v. <i>marinus</i>	+	+	+	–	–	+
v. <i>velutinus</i>	–	–	–	+	–	–
<i>Antidesma cuspidatum</i>	–	+	+	–	–	–
<i>Ardisia crispa</i>	–	–	–	–	+	–
<i>Ardisia elliptica</i>	+	+	–	–	+	–
<i>Arthrophyllum ovalifolium</i>	–	–	–	–	+	–
<i>Atalantia monophylla</i>	+	+	+	–	–	+
<i>Barringtonia asiatica</i>	+	–	–	+	–	+
<i>Barringtonia macrostachya</i>	–	–	–	–	–	+
<i>Buchanania arborescens</i>	–	–	–	–	+	–
<i>Callicarpa longifolia</i>	+	+	–	–	–	–
<i>Caryota mitis</i>	–	+	–	–	–	–
<i>Casuarina equisetifolia</i>	–	–	–	+	–	+
<i>Cedrela</i> ?	–	+	+	–	–	–
<i>Celastrus</i> SFN 29829	–	+	+	–	–	–
<i>Cerbera manghas</i>	+	–	–	–	–	–
<i>Chionanthus ramiflorus</i>	+	–	–	–	–	–
<i>Cocculus ovalifolius</i>	–	–	–	–	+	–

<i>Trees, etc., cont.</i>	R	C	S	D	St	B
<i>Cordia subcordata</i>	-	-	-	-	-	+
<i>Croton heterocarpus</i>	-	-	-	-	+	-
<i>Cycas rumphii</i>	-	-	-	-	-	+
<i>Cynometra ramiflora</i>	-	-	-	-	+	-
<i>Decaspermum paniculatum</i>	+	-	-	-	-	-
<i>Desmodium umbellatum</i>	-	-	-	+	+	+
<i>Diospyros ferrea</i>	+	+	-	-	-	+
<i>Diplospora malaccensis</i>	+	+	-	+	+	-
<i>Dracaena maingayi</i>	-	-	-	+	-	-
<i>Elaeocarpus floribundus</i>	-	-	-	-	+	-
<i>Erioglossum rubiginosum</i>	-	-	-	+	-	-
<i>Erythrina indica</i>	+	-	-	+	-	+
<i>Erythroxyton cuneatum</i>	+	+	-	+	+	-
<i>Eugenia claviflora</i>	-	-	-	+	-	-
<i>Eugenia glauca</i>	-	-	-	-	+	-
<i>Eugenia grandis</i>	+	+	-	+	+	+
<i>Eugenia longiflora</i>	-	-	-	+	+	-
<i>Eugenia palembanica</i>	-	-	-	-	+	-
<i>Eugenia polita</i>	-	-	-	-	+	-
<i>Eugenia subdecussata</i>	-	-	-	-	+	-
<i>Eurycoma longifolia</i>	-	+	-	+	+	-
<i>Excoecaria agallocha</i>	-	-	-	+	+	-
<i>Ficus caulocarpa</i>	+	+	+	-	-	-
<i>Ficus crassiramea</i>	+	-	-	-	-	-
<i>Ficus deltoidea</i>	-	+	-	-	-	-
<i>Ficus drupacea</i>	+	-	-	-	-	-

<i>Trees, etc., cont.</i>	R	C	S	D	St	B
<i>Ficus fistulosa</i>	+	-	-	-	+	-
<i>Ficus grossularioides</i>	-	-	-	-	+	-
<i>Ficus hispida</i>	+	-	-	-	-	-
<i>Ficus kurzii</i>	-	+	-	-	-	-
<i>Ficus microcarpa</i>	+	+	+	-	+	-
<i>Ficus stricta</i>	-	+	-	+	-	-
<i>F. sundaica</i> v. <i>beccariana</i>	-	-	-	+	-	-
<i>Ficus superba</i>	-	-	+	-	+	-
<i>F. tinctoria</i> ssp. <i>gibbosa</i>	+	+	-	-	-	-
<i>Ficus variegata</i>	-	+	-	-	-	-
<i>Garcinia hombroniana</i>	-	-	-	-	+	-
<i>Garcinia nigrolineata</i>	-	-	-	-	-	+
<i>Gelonium glomerulatum</i>	-	-	+	+	-	+
<i>Glochidion littorale</i>	-	-	-	-	+	-
<i>Gnetum gnemon</i>	+	+	-	+	-	-
<i>Grewia paniculata</i>	+	-	-	-	-	-
<i>Guettarda speciosa</i>	+	-	-	+	+	+
<i>Guioa pleuropteris</i>	-	-	-	-	+	-
<i>Heritiera littoralis</i>	+	-	-	-	-	+
<i>Hernandia nymphaeifolia</i>	+	-	-	-	+	-
<i>Hibiscus tiliaceus</i>	-	-	-	+	+	+
<i>Hydnocarpus ilicifolia</i>	+	+	+	-	-	-
<i>Ixora congesta</i>	-	-	-	-	+	-
<i>Kleinhovia hospita</i>	+	-	-	+	-	-
<i>Knema globularia</i>	-	+	+	+	-	-

<i>Trees, etc., cont.</i>	R	C	S	D	St	B
<i>Knema malayana</i>	-	-	-	+	-	-
<i>Leea indica</i>	-	-	-	-	+	-
<i>Lepisanthes fruticosa</i>	-	-	-	-	+	-
<i>Litsea glutinosa</i>	-	+	-	-	-	-
<i>Macaranga javanica</i>	-	-	-	-	+	-
<i>Mallotus tiliaefolia</i>	-	-	-	+	-	-
<i>Manilkara kauki</i>	-	+	-	-	-	-
<i>Melastoma sanguineum</i>	-	-	-	-	+	-
<i>Memecylon coeruleum</i>	+	+	+	+	+	-
<i>Memecylon myrsinoides</i>	-	-	-	+	-	-
<i>Memecylon ovatum</i>	-	+	-	-	+	-
<i>Messerschmidia argentea</i>	-	-	-	-	-	+
<i>Morinda citrifolia</i>	-	-	-	+	+	+
<i>Myristica guatteriiifolia</i>	-	+	-	-	+	-
<i>Myrsine porteriana</i>	-	-	-	-	+	-
<i>Neolitsea zeylanica</i>	+	+	-	-	+	-
<i>Ochrosia oppositifolia</i>	+	-	-	-	-	-
<i>Oncosperma filamentosa</i>	-	-	-	+	+	-
<i>Pandanus dubius</i>	-	+	-	-	-	-
<i>Pandanus odoratissimus</i>	+	-	-	+	+	+
<i>Parinari corymbosa</i>	-	+	+	-	-	-
<i>Pemphis acidula</i>	+	-	-	-	-	+
<i>Phoebe declinata</i>	-	-	-	+	-	-
<i>Pisonia grandis</i>	-	+	+	-	-	-
<i>Pithecellobium contortum</i>	-	-	-	-	+	-
<i>Pithecellobium ellipticum</i>	-	-	-	+	-	-

Trees, etc., cont.	R	C	S	D	St	B
<i>Pittosporum ferrugineum</i>	-	-	-	+	+	-
<i>Planchonella firma</i>	-	-	-	-	+	-
<i>Planchonella linggensis</i>	-	+	-	+	-	-
<i>Planchonella obovata</i>	+	+	+	+	+	+
<i>Podocarpus polystachyus</i>	-	-	-	+	+	-
<i>Polyalthia sclerophylla</i>	-	-	-	+	-	-
<i>Pongamia pinnata</i>	+	-	-	+	+	-
<i>Premna obtusifolia</i>	-	+	-	-	+	+
<i>Scaevola taccada</i>	-	+	-	+	+	+
<i>Sterculia foetida</i>	+	+	-	-	-	-
<i>Stereospermum fimbriatum</i>	+	-	-	-	-	-
<i>Terminalia catappa</i>	+	+	-	+	+	+
<i>Thespesia populnea</i>	-	-	-	+	+	-
<i>Timonius compressicaulis</i>	-	-	-	-	-	+
<i>Trema amboinensis</i>	-	+	-	-	-	-
<i>Trigonopleura</i> ?	-	-	-	+	-	-
<i>Tristania obovata</i>	-	-	-	-	+	-
<i>Vitex pubescens</i>	+	+	+	+	+	+
<i>Wendlandia ternifolia</i>	-	-	-	-	+	-
CLIMBERS						
<i>Aganosma marginata</i>	+	+	-	-	-	-
<i>Caesalpinia bondhuc</i>	-	-	-	+	-	-
<i>Caesalpinia crista</i>	-	-	-	+	+	+
<i>Calamus chibehensis</i>	+	+	-	-	-	-
<i>Calamus perakensis</i>	-	-	-	-	+	-
<i>Canthium confertum</i>	-	-	-	-	+	-

<i>Climbers cont.</i>	R	C	S	D	St	B
<i>Cassytha filiformis</i>	-	-	-	-	-	+
<i>Cissus repens</i>	+	-	-	-	-	-
<i>Connarus monospermus</i> v. <i>malayanus</i>	-	-	-	-	+	-
<i>Derris scandens</i>	-	-	-	+	+	-
<i>Derris thyrsoiflora</i>	-	+	-	+	+	-
<i>Derris uliginosa</i>	-	-	+	+	+	-
<i>Ehretia</i> SFN 29827, 29845	+	+	+	-	-	-
<i>Ficus parietalis</i>	-	-	-	+	-	-
<i>Flagellaria indica</i>	+	+	+	-	-	-
<i>Gnetum latifolium</i> v. <i>funiculare</i>	+	+	-	+	-	-
<i>Gynochthodes coriacea</i>	-	-	-	-	+	-
<i>Hoya diversifolia</i>	+	+	-	+	+	+
<i>Ipomoea illustris</i>	-	-	-	+	-	-
<i>Loeseneriella pauciflora</i>	-	+	-	-	-	-
<i>Morinda umbellata</i>	-	+	-	+	+	-
<i>Paramignya andamanica</i>	-	-	-	+	+	-
<i>Parsonsia spiralis</i>	-	-	-	-	+	-
<i>Phyllanthus</i> ? SFN 29848	-	-	+	-	-	-
<i>Pisonia aculeata</i>	+	-	-	-	-	-
<i>Psychotria sarmentosa</i>	-	-	-	-	+	-
<i>Salacia chinensis</i>	+	-	-	+	-	-
<i>Sauropus albicans</i>	+	-	-	-	-	-
<i>Sauropus</i> sp. (s.n.)	-	+	-	-	-	-
<i>Schefflera venulosa</i>	+	+	+	+	+	-
<i>Tetracera assa</i>	-	-	-	-	+	-
<i>Tristellateia australasica</i>	-	-	-	+	+	+

<i>Climbers cont.</i>	R	C	S	D	St	B
<i>Vitis japonica</i>	+	-	-	-	-	-
Yellow, cordate-leaved climber	-	+	+	-	-	-
HERBS, SEDGES, GRASSES						
<i>Aneilema</i> sp. SFN 29794	+	-	-	-	-	-
<i>Bulbophyllum vaginatum</i>	-	-	-	+	-	-
<i>Canavalia turgida</i>	-	-	-	+	-	-
<i>Cansjera zizyphoides</i>	-	-	-	+	-	-
<i>Chasalia curviflora</i>	+	+	-	-	-	-
<i>Coelorrachis glandulosa</i>	+	-	-	-	-	-
<i>Commersonia platyphylla</i>	-	-	-	+	-	-
<i>Cyperus cyperinus</i>	+	-	-	-	-	-
<i>Cyperus diffusus</i>	+	-	-	-	-	-
<i>Cyperus dubius</i>	+	-	-	-	-	-
<i>Cyperus javanicus</i>	+	+	+	-	-	-
<i>Cyperus kyllingii</i>	+	-	-	-	-	-
<i>Cyperus radians</i>	-	-	-	+	-	-
<i>Dianella ensifolia</i>	-	-	-	-	+	+
<i>Digitaria ciliaris</i>	-	-	-	+	-	-
<i>Eulalia ridleyi</i>	-	-	-	-	-	+
<i>Fimbristylis dichotoma</i>	+	-	-	-	-	-
<i>Hedyotis verticillata</i>	+	-	-	-	-	-
<i>Ipomoea pes-caprae</i>	-	-	-	+	-	-
<i>Ischaemum muticum</i>	-	-	-	+	-	+
<i>Lasianthus cyanocarpus</i>	-	-	-	-	+	-
<i>Oldenlandia paniculata</i>	+	-	-	-	-	-
<i>Panicum repens</i>	-	-	-	+	-	-

<i>Herbs, etc., cont.</i>	R	C	S	D	St	B
<i>Paspalum conjugatum</i>	-	-	-	+	-	-
<i>Plocoglottis porphyrophylla</i>	-	-	-	-	+	-
<i>Pseuderanthemum crenulatum</i>	-	+	-	-	-	-
<i>Schizachyrium sanguineum</i>	-	-	-	-	-	+
<i>Scleria lithosperma</i>	+	-	-	-	-	-
<i>Spinifex littoreus</i>	-	-	-	-	-	+
<i>Sporobolus virginicus</i>	+	-	-	-	-	-
<i>Taeniophyllum serrula</i>	-	-	-	+	-	-
<i>Themeda villosa</i>	-	-	-	+	-	-
<i>Vandellia crustacea</i>	-	+	-	-	-	-
<i>Vandellia hirsuta</i>	+	-	-	-	-	-
<i>Vigna marina</i>	-	-	-	+	-	-
<i>Wedelia biflora</i>	-	-	-	+	+	+
<i>Zoysia matrella</i>	-	-	-	-	+	-
EPIPHYTES ON EXPOSED ROCKS						
<i>Asplenium nidus-avis</i>	+	-	-	+	+	-
<i>Cymbidium finlaysonianum</i>	+	+	-	+	+	+
<i>Davallia solida</i>	+	-	-	+	+	-
<i>Dendrobium crumenatum</i>	+	+	-	+	+	+
<i>Dendrobium serra</i>	-	-	-	-	+	-
<i>Dischidia rafflesiana</i>	-	-	-	-	+	+
<i>Drynaria quercifolia</i>	+	-	-	+	+	-
<i>Fagraea auriculata</i>	+	-	-	-	+	-
<i>Hydnophytum formicarium</i>	-	-	-	-	+	-
<i>Medinilla hasseltii</i>	-	-	-	+	-	-
<i>Polypodium scolopendria</i>	+	-	+	+	+	-

<i>Epiphytes cont.</i>	R	C	S	D	St	B
<i>Scindapsus</i> sp.	+	-	-	-	-	-
SFN 29816	+	-	-	-	-	-
FERNS (OTHER THAN EPIPHYTES)						
<i>Adiantum stenochlamys</i>	-	-	-	-	+	-
<i>Asplenium glaucophyllum</i>	-	-	-	+	-	-
<i>Asplenium macrophyllum</i>	+	-	-	-	-	-
<i>Blechnum orientale</i>	-	-	-	-	+	-
<i>Cyclophorus adnascens</i>	-	+	-	+	+	-
<i>Lygodium flexuosum</i>	-	+	+	-	-	-
<i>Nephrolepis biserrata</i>	+	+	-	+	+	-
<i>Pteridium aquilinum</i>	-	-	-	-	+	-
<i>Pteris ensiformis</i>	+	-	-	-	-	-
<i>Stenochlaena palustris</i>	-	+	+	+	+	-
<i>Vittaria elongata</i>	-	-	-	+	-	-
TOTALS	76	63	27	83	94	40

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Plate 1. Tanjung Ruit, Pulau Tioman, in 1932.
The *Terminalia* headland is on the right, the rocky isthmus with *Pemphis* in the centre, and the coastal forest of *Terminalia* and *Eugenia* on the left.



Plate 2. *Pemphis acidula* on the rocky isthmus of Tg Ruit, P. Tiunan; 1932.



Plate 3. Pulau Chibeh from the south-west, 1935.

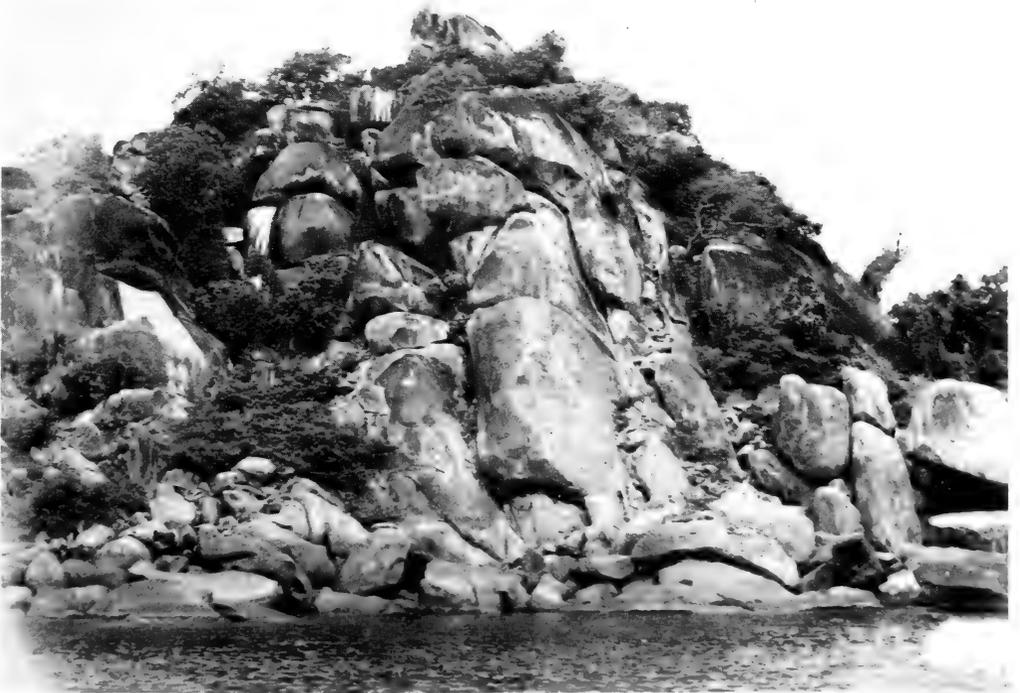


Plate 4. P. Chibeh, north end, 1935.

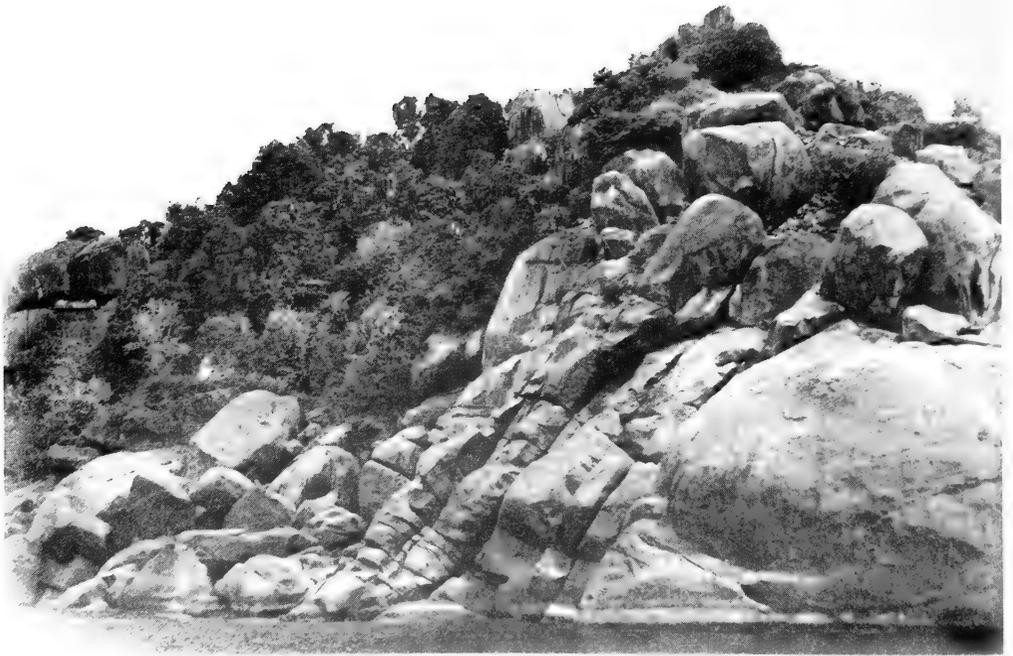


Plate 5. P. Chibeh from the north-east, 1935.



Plate 6. P. Chibeh, rocks at the south end, with the plant-collector Kiah bin Mohd. Salleh; 1935.

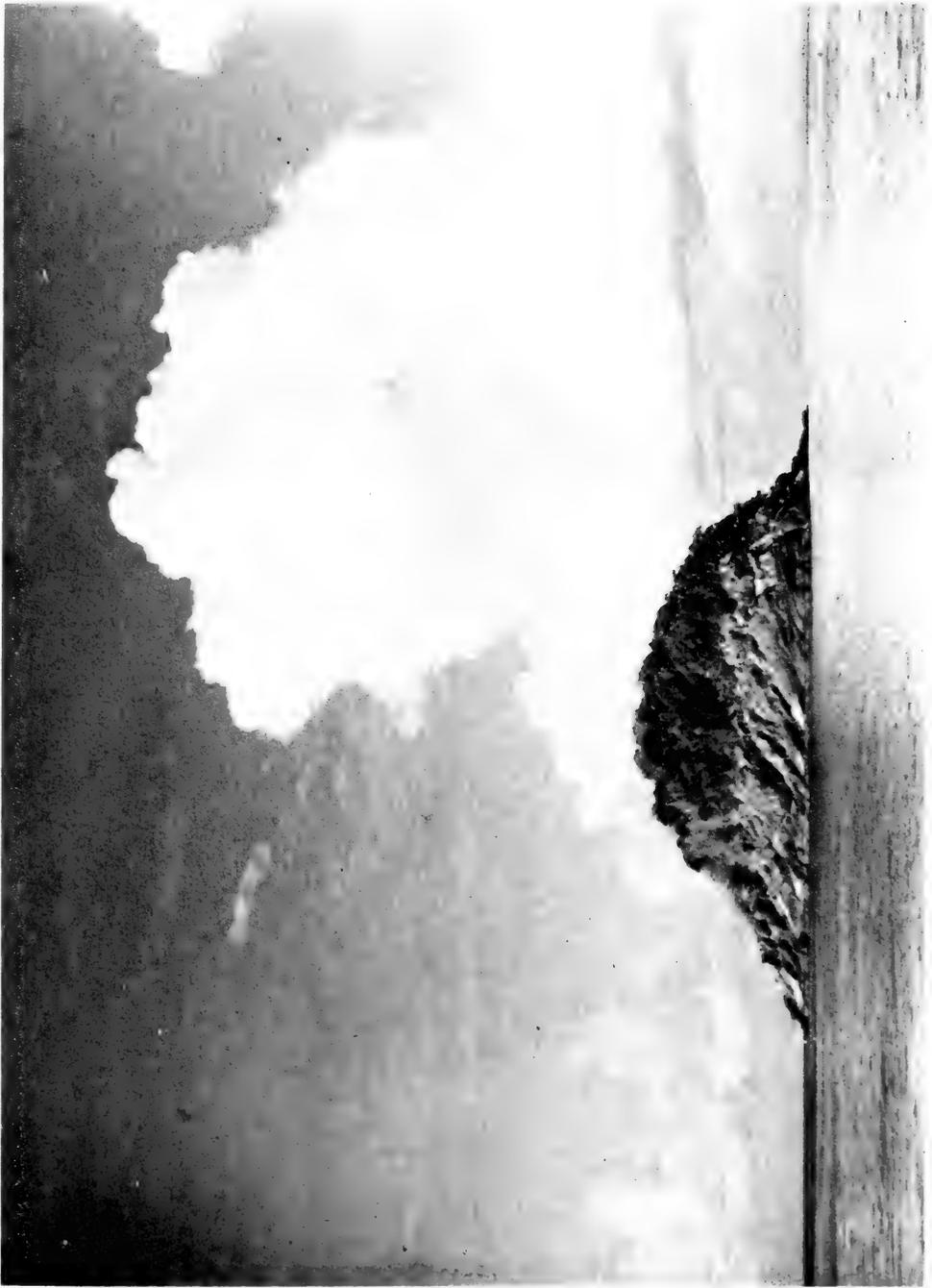


Plate 7. Pulau Sepoi from the north, 1932.



Plate 8. P. Sepoi from the east, 1932.



Plate 9. P. Sepoi at the north-west end, 1935.



Plate 10. P. Sepoi at the south-east end, 1935.
Trees of *Psomia grandis* with white, almost bare, branches.



Plate 11. P. Sepoi in the forest, 1935.
The tangle of fig-roots claspng the boulders and tree-trunks.



Plate 12. P. Sepoi inside the forest, 1935.
The fluted trunks of *Atalantia monophylla* among the fig-roots (mainly of *Ficus superba*).
The plant-collector Kiah bin Mohd Salleh in the middle distance to the right.



Plate 13. *P. Sepoi* in the forest of *Pisonia grandis* with undergrowth of *Stenochlaena palustris* and the *Atalantia-forest* behind; the plant-collector Kiah bin Mohd Salleh; 1935.



Plate 14. Pulau Tokong Burong.
The two small islands as seen from the summit of the main island: 1935.

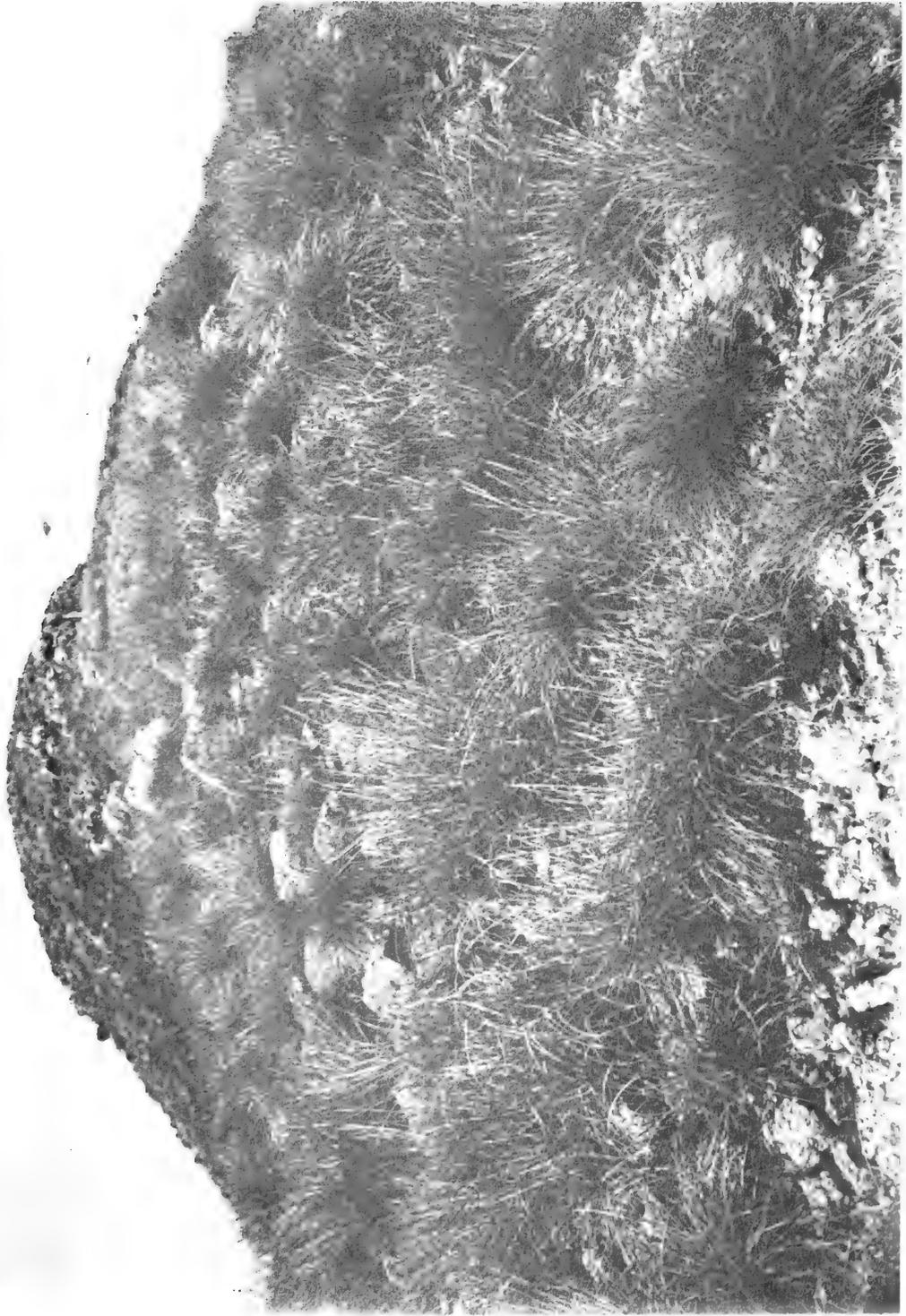


Plate 15. The tussocks of the grass *Chrysopogon fulvus* on the top of the main island of P. Tokong Burong; 1935.



Plate 16. Pulau Duchong Laut from the east, showing the frontage of *Terminalia* and, to the left, *Barringtonia*; 1935.



Plate 17. P. Berhala, showing the granite platform, with the launch Sri Gala in the distance; the seated figure on the right, W. Birtwistle; 1932.



Plate 18. Pulau Berhala from the north, with the crowns of *Parinari corymbosa* showing as a cockade on the hat; 1932.



Plate 19.
The rocks to the north
of P. Berhala; 1932.



Plate 20.
P. Berhala, the
granite platform
with the base of the
sandstone hill to the
right, and in the
distance the low
rocky island to the
north; 1932.

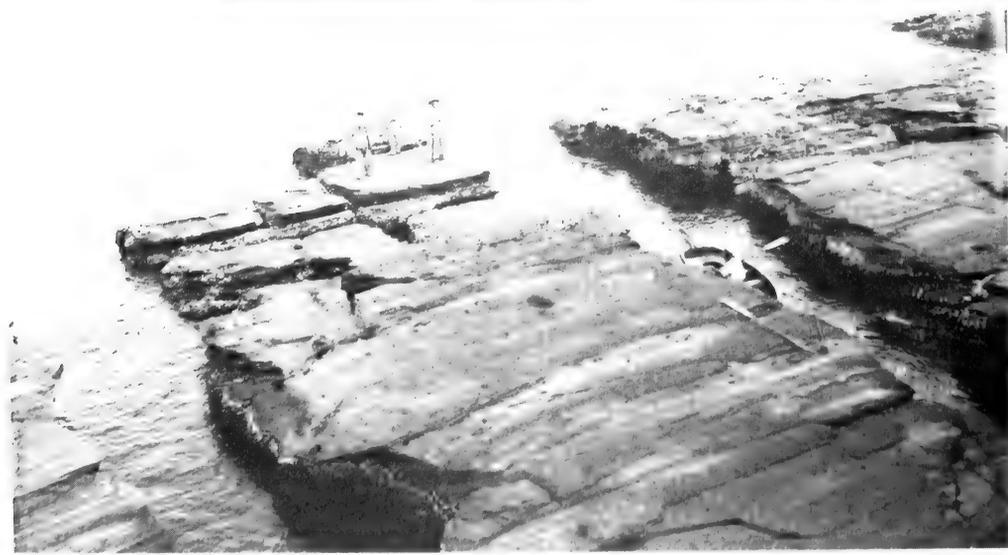


Plate 21.
P. Berhala, showing
the granite platform
from the summit of
the hill; 1932.

New Species of the Genus *Homalomena* (Araceae) from Sumatra with a Short Note on the Genus *Furtadoa*

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EFFECTIVE PUBLICATION DATE: 31 AUG. 1985

Abstract

Five new species of the genus *Homalomena* (Araceae) from Sumatra are described and their relationships and chromosome numbers briefly discussed. Among them, *Homalomena rusdii* sp. nov. stands out by its free ligule at the petiole base and by its (usual) basal placentation of ovules. *Homalomena mixta* is transferred to the genus *Furtadoa* on the basis of the floral characters.

From 1980 to 1984, I had several opportunities to visit West Sumatra as a member of the Sumatra Nature Study (SNS) Project, cooperating in field studies of Andalas University (Indonesia) and Kyoto University (Japan). Members of the Botany Group of the Project had been gathering many herbarium specimens including a rich and good aroid collection (Hotta, 1984), and during those travels I had opportunities to work on the taxonomy of Sumatran flora at the Herbarium Bogoriense and the Singapore Botanic Gardens' Herbarium.

The aroid flora of Sumatra is characterized by a slightly poorer diversity than that of Borneo, especially among those elements that have a limited distribution in the wet tropical region of Malesia. Borneo has 6 endemic genera of Araceae: *Aridarum*, *Bucephalandra*, *Heteroaridarum*, *Hottarum*, *Pedicellarum* and *Phymatarum* but Sumatra does not have endemics since *Furtadoa* once believed to be endemic to Sumatra, has now been found in Malaya (see end of article). On the other hand, in Sumatra, the genus *Homalomena* is rich in species and shows much variation. In this paper, new and interesting species from our Sumatran material of *Homalomena* are described.

Homalomena megalophylla M. Hotta, sp. nov. (sect. *Homalomena*) Fig. 1, 2 & 4A

Herba maxima caudiculo erecto 0.5-1.5 m longo, 8-15 cm crasso. Foliorum petiolus crassiuscule quam lamina 2-plo longior, 1-1.6 m longus, ad 1/3-1/4, longitudinis vaginatus, lamina subcoriacea, supra obscure viridis, subtus pallide viridis, ovato cordata, 50-80 cm longa, 35-50 cm lata, lobis posticis rotundato-oblongis usque 20 cm longis, lobo antico ovato, acuminato, nervis lateralibus 1. utrinque circ. 3 basalibus, 5-6 costalibus ascendentibus prope marginem sursum curvis. Pedunculi plures usque 25-30 cm longi. Spathae pars inferior oblongo-ovoidea (4)5-6.5 cm longa, 1.5-2.5 cm ampla, pars superior convoluta 7-10 cm longa. Spadicis stipite 3-5 mm suffulti inflorescentia feminea (2.5)3.5-4(4.8) cm longa, 1.5(-2) cm crassa, mascula 6.5-8 cm longa. Flores masculi 4-5(-6) andri. Pistilla oblongo-obovoidea virescentia, stigmatate discoideo intracta; ovaria inferne trilocularia, placentis 3 in quoque loculo a centro prominentibus, superne unilocularia, placentis parietalibus, ovulis numerosis affixa. Staminodia claviformia. Baccae obovoidea 7 mm longa; semina ellipsoidea 1.5 mm longa.

WEST SUMATRA: Airsirah pass, 850-900 m, July 28, 1984, M. Hotta, H. Okada & T. Kohyama 8 (KYO); between Sungai Dareh and Sijunjung, steep-rocky cliff off the road side, alt. 100-200 m, Aug. 20, 1981, M. Hotta, H. Okada & R. Tamin 104 (Holotypus in KYO, isotypus in BO); Harau, Pajakumbuh, rocky open place at the foot of the hill, alt. 600 m, Aug. 27, 1983, M. Hotta & R. Tamin 299 (KYO).



M. Umebayashi

Fig. 1. *Homalomena megalophylla* M. Hotta
Leaf, $\times \frac{2}{9}$; and habit, $\times \frac{1}{16}$.

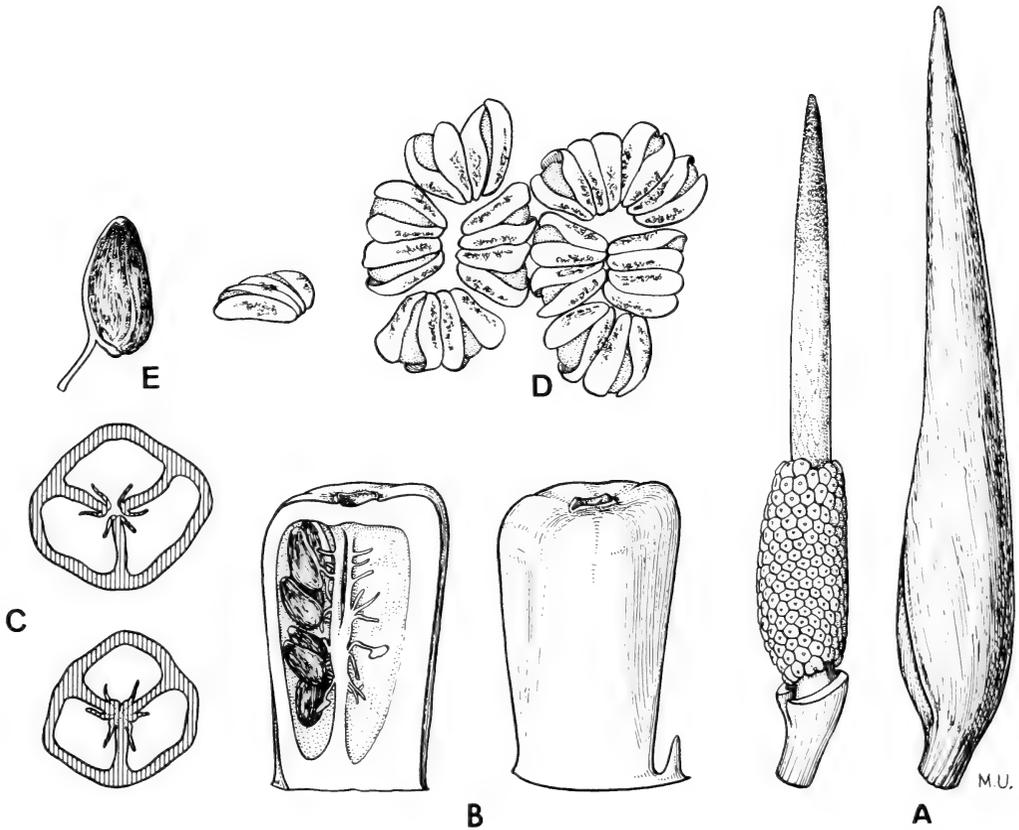


Fig. 2. *Homalomena megalophylla* M. Hotta

A: spathe (right) and fruiting spadix (left), $\times \frac{1}{2}$; B: fruit (right) and its longitudinal section (left), $\times 5$; C: cross-sections of upper (above) and lower (below) parts of ovary, $\times 5$; D: close-ups of two male flowers, front view (right) and a stamen, side view (left), $\times 10$; E: seed, $\times 10$.

This new species is one of the largest plants found among the species of the genus *Homalomena*. It seems to be related to *H. rubescens* (Roxb.) Kunth, the relationship being indicated by the male flower, which has large ovoid pollen sacs attached directly to the surface of the spadix axis (cf. Engler 1912: p. 64, fig. 39, D & E). However, my new species is distinctively different in that it has a constricted spathe and is an extremely large plant. In the latter respect it is like *H. gigantea* Engler but differs from that by the shape of the stamen and that of the spathe.

H. megalophylla is a common and conspicuous aroid on open, wet, rocky slopes in West Sumatra. It is therefore strange that specimens are not found in the Bogor or Singapore herbaria. The chromosome number of this species is $2n=40$ (based on counts in Airsirah clones made by H. Okada, unpublished).

***Homalomena gadutensis* M. Hotta, sp. nov. (sect. *Homalomena*).**

Fig. 3, 4D

Herba majuscula caudiculo erecto 10-40 cm longo, 1.5-2 cm crasso. Foliorum petiolus quam lamina 1.5-2-plo longior, 30-50 cm longus, ad $\frac{1}{3}$ - $\frac{1}{2}$ longitudinis vaginatus, lamina supra viridis, subtus pallide viridis, ovato cordata, 13-25 cm longa, 10-15 cm lata, lobis posticis ovato-triangularis usque 5 cm longis, lobo antico ovato, acuminato, nervis lateralibus 1. utrinque circ. 3 basalibus, 5-6 costalibus adscendenti-



Fig. 3. *Homalomena gadutensis* M. Hotta

A: habit, $\times \frac{1}{2}$; B: spathe (left) and spadix (right), $\times \frac{3}{4}$; C: close-up of female part of spadix, $\times 7$; D: close-up of male part of spadix, $\times 7$; E: female flower (left) and staminode (right), $\times 9$; F: longitudinal section of ovary, $\times 9$; G: cross-section of ovary, $\times 15$; H: ovule, $\times 40$; I: side view (above) and longitudinal section of male flower (below), $\times 10$.

bus prope marginem sursum curvis. Pedunculi plures usque 8-15 cm longi. Spathae pars inferior oblongo-ovoidea 2.5-3.8 cm longa, 1.2-1.5 cm ampla, pars superior naviculiformia, 5-7.5 cm longa. Spadicis stipite 10 mm suffulti inflorescentia feminea 2-2.5 cm longa, 0.5-0.6 cm crassa, mascula 4.5-6 cm longa. Flores masculi (3-)4(-5) andri. Pistilla oblongo-obovoidea virescentia, stigmatate discoideo intracta; ovaria inferne trilocularia, placentis 3 in quoque parietalibus, ovulis numerosis affixa. Staminodia superne obconica, inferne filiformia.

WEST SUMATRA: Ulu Gadut, in forest floor near hill ridge, alt. 500 m, Nov. 29, 1980, *M. Hotta* 25091 (KYO, BO), alt. 550 m, Nov. 29, 1980, *H. Hotta* 25105 (Holotypus in KYO, isotypus in BO); Pinang Pinang, Ulu Gadut, common on forest floor, alt. 400-800 m, Dec. 17, 1982, *M. Hotta*, *H. Okada* & *M. Ito* 88 (KYO); G. Kambot, alt. 400-650 m, Jan. 23, 1981, *M. Hotta* & *R. Tamin* 255 (KYO), 262-b (KYO), 270 (KYO); Gajabuih, common on forest floor, alt. 400-650 m, Jan. 5, 1981, *M. Hotta* 25830 (KYO, chromosome number $2n=38$, cited by Dr. H. Okada, 1984 as *Homalomena* sp. nov. 1), 450-700 m, July 31, 1984, *M. Hotta*, *H. Okada* & *T. Kohyama* 101 (KYO); Batu Bajolang, forest floor near ridge, alt. 400-600 m, *M. Hotta*, *H. Okada* & *M. Ito* 1132 (KYO, BO, AND*).

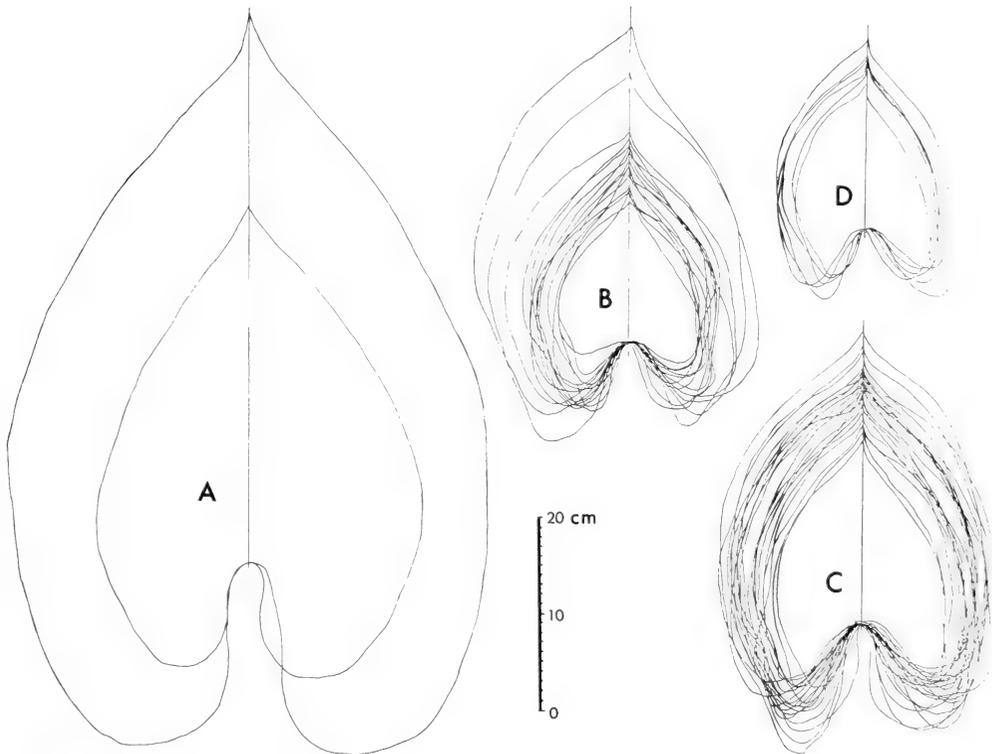


Fig. 4. Leaf shape variation of allied species of *Homalomena* in Mt. Gadut area
A: *H. megalophylla*; B: *H. sagittifolia*; C: *H. pendula*; D: *H. gadutensis*.

H. gadutensis is closely related to *H. sagittifolia*, one of the very variable species in Malaysia. Collections of the latter related species in the same group (*H. pendula* group, *H. megalophylla* and *H. gadutensis*) from Mt. Gadut area vary a great deal in shape and size of the leaves (Fig. 4), and in the spathe (Fig. 5). Precise identification of each species in the group could not have been achieved without examining the characters of the spathe and the male flower. The leaf size shows a tendency to decrease as the elevation increases. This tendency is illustrated by measurements of the largest leaf of each collection, after classification using spathe

*AND = Herbarium of Andalas University, Ulu Gadut, Padang, West Sumatra, Indonesia.

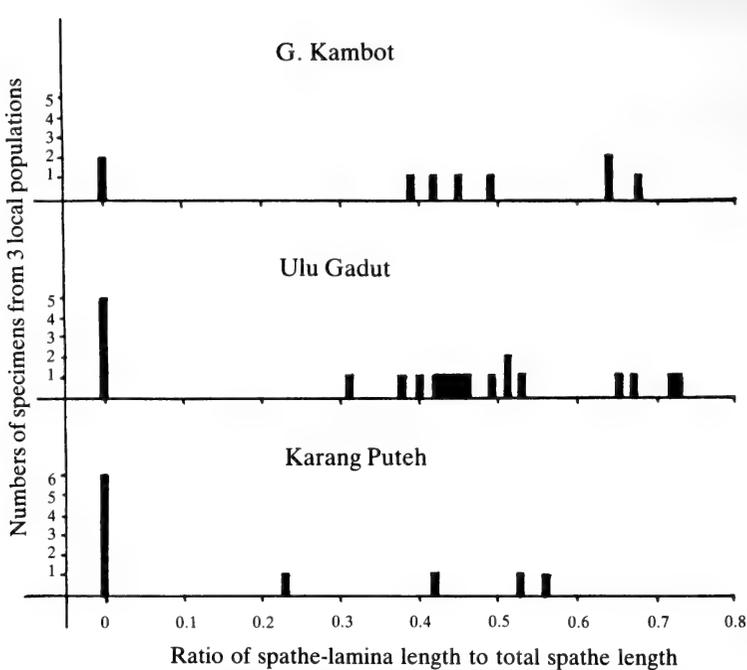


Fig. 5. Variation of spathe of four *Homalomena* taxa in Mt. Gadut area. Ratio of the length of spathe lamina to the total length of spathe (*horizontal axis*), and number of specimens from three local populations (*vertical axis*); ratio 0 = *H. pendula* group (spathe without constriction and undifferentiated into the basal (=tube) part and apical lamina), 0.2-0.6 = *H. sagittifolia*, and over 0.6 = *H. gadutensis*.

characters (see Fig. 5), i.e., (a) spathe unconstricted — *H. pendula* species group, (b) spathe constricted and separable into the spathe tube and the lamina. Group (b) is subdivided into (1) ratio of lamina/total length of spathe 0.2-0.6 — *H. sagittifolia*, and (2) ratio of lamina/total length of spathe 0.6 or more — *H. gadutensis*. From the analysis, it is seen that *H. gadutensis* also has smaller leaves and is a comparatively smaller plant. Besides, the lamina of its spathe is white and boat-shaped, spreading open widely at the time of flowering. The chromosome counts for *H. pendula* group, *H. megalophylla* and *H. sagittifolia* of Mt. Gadut area are in all cases $2n=40$ or 80 , but is $2n=38$ for *H. gadutensis*, a number peculiar for the genus (H. Okada 1984 & unpublished).

A variety, *H. sagittifolia* var. *sumatrana* v. Ard. v. Rosen., may at first seem to be *H. gadutensis* on account of the smaller size of the entire plant and its occurrence in a locality at a higher altitude (Talu, Ophir, 950 m, *Bünnemeijer 1299*, lectotype in BO), but this specimen, to my mind, represents a mountain ecotype of *H. sagittifolia* with a spathe-lamina which is rather short; and furthermore, *H. sagittifolia* occasionally does occur on mountains above 1000 m in West Sumatra. This mountain ecotype usually has a tetraploid chromosome complement, $2n=80$, cited by Dr. H. Okada (unpublished).

***Homalomena padangensis* M. Hotta, sp. nov. (sect. *Chamaecladon*)**

Fig. 6

Herba majuscula rhizomate obliquo 3-8 cm longo, 1-1.5 cm crasso, pauce (2-4) foliato. Foliorum petiolus quam lamina 1.5-2-plo longior, 30-40 cm longus, ad $\frac{1}{5}$ longitudinis vaginatus, lamina subcoriacea, supra vertinus nitida, viridis, subtus pallide viridis, cordata, paullum inaequilatera, 15-25 cm longa, 10-15 cm lata, apice breviter acuminata, nervis lateralibus I. utrinque 5-8 ascendentibus leviter arcuatis, nervis secundariis inter primarios numerosis interjectis. Pedunculi usque 3-4 cm longi. Spathae oblonga breviter apiculata, viridis, 2 cm longa, 6-8 mm ampla. Spadicis sessilis oblongi inflorescentia feminea 4 mm longa, quam mascula 4-plo brevior. Flores masculi (1-)3 andri. Pistilla ovoidea virescentia, stigmate discoideo coronata; ovaria bilocularia, ovulis medio affixis. Staminodia crassa claviformia quam ovaria duplo brevior.

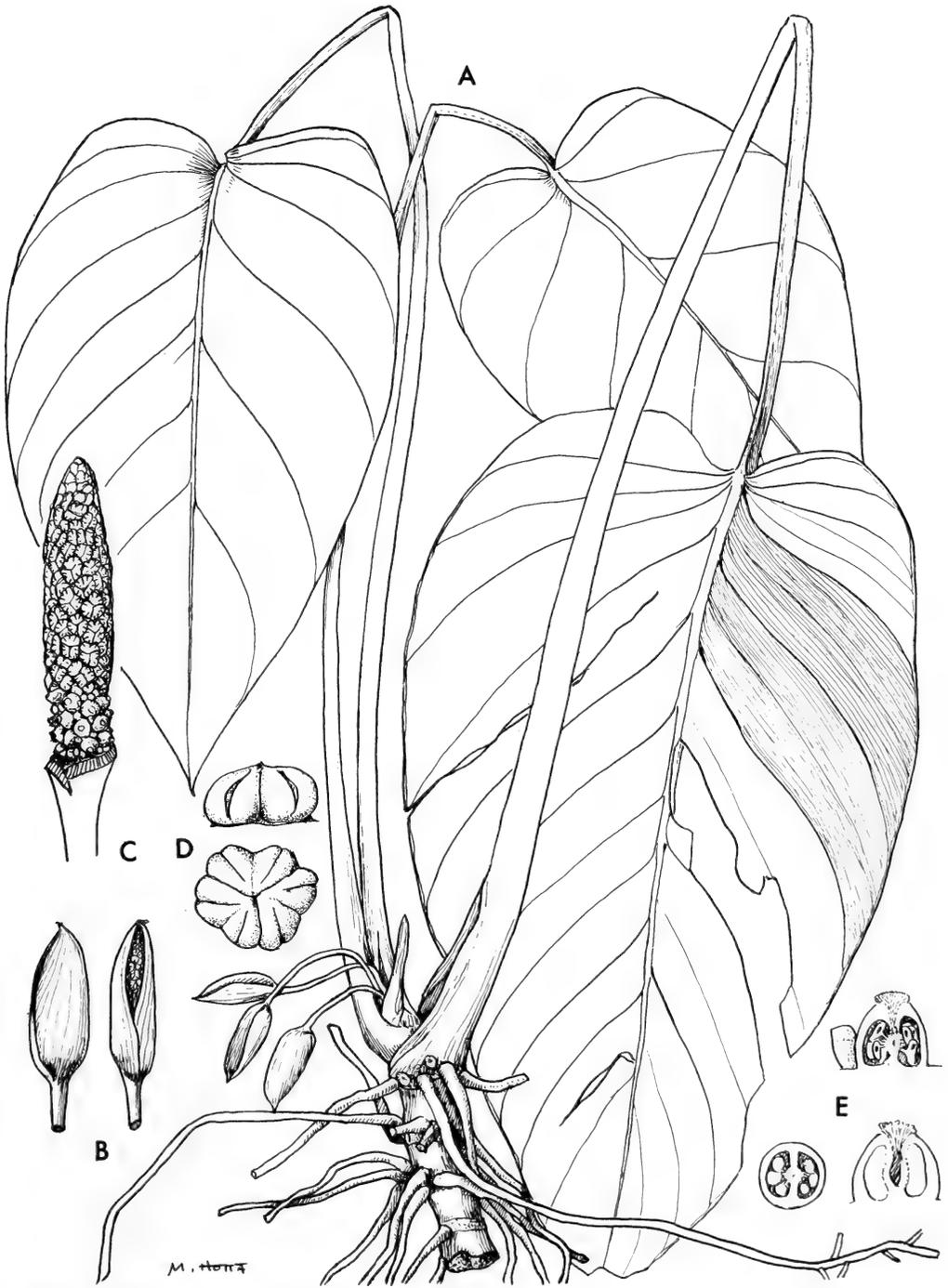


Fig. 6 *Homalomena padangensis* M. Hotta

A: habit, $\times \frac{1}{2}$; B: spathe $\times 1$; C: spadix, $\times 1$; D: male flower, front (below) and side views (above) $\times 12$; E: cross-section (lower left) and longitudinal (lower right) sections of female flower with staminode (above), $\times 8$.

WEST SUMATRA: Karang Puteh, on wet and open limestone cliff, alt. 150-300 m, Feb. 16, 1981, *M. Hotta & H. Okada 344* (KYO, chromosome number $2n=40$, cited by H. Okada 1984 as *Homalomena* sp. nov. 2), alt. 100-200 m, Aug. 14, 1981, *M. Hotta & H. Okada 476* (Holotypus in KYO, isotypus in BOD, AND, SING & L).

H. padangensis seems to be related to *H. griffithii*, a common and widely distributed species in western Malesia, but distinctly differs from the latter by its coriaceous leaf with a velvet-like gloss, cordate leaf base, and the decumbent stem with many strong roots growing out from the nodes.. *H. padangensis* is characterized by the very short filament of the stamen of the male flower (the pollen sac being attached directly to the spadix axis), and the relatively fewer female flowers in the lower part of the inflorescence. This species occurs in a limited area on the limestone hill of Karang Puteh and needs careful protection.

Homalomena hastata M. Hotta, *sp. nov.* (sect. *Chamaecladon*)

Fig. 7

Herba majuscula caudiculo obliquo 3-5 cm longo, 1 cm crasso, 1-2 foliato. Foliorum petiolus laminae subaequilongus vel ea 2-plo longior, 40-60 cm longus, vagina 4-5 cm longa instructus, lamina supra opaca viridis, subtus pallide viridis, triangulari-oblonga inaequilatera, leviter curvata, basi hastata, apice acuminata, 25-35 cm longa, 10-15 cm lata, lobis posticis triangularis usque 5-8 cm longis, nervis lateralibus I. utrinque circ. 2 basalibus, 4-5 costalibus adscendentibus. Pedunculi usque 5-6 cm longi. Spathae ovoidea 2 cm longa, 0.8 cm ampla, apice cuspidata. Spadicis sessilis inflorescentia feminea 0.7 cm longa, 0.4 cm crassa, mascula 0.8 cm longa. Flores masculi 3 andri. Pistilla oblongo-obovoidea virescentia, stilo cylindrici et stigmatate discoideo intracta; ovaria inferne trilocularia, placentis 3 in quoque locullo a centro prominentibus, superne unilocularia, placentis parietalibus, ovulis numerosis affixa. Staminodia elongata claviformia inferne filiformia, pistilla aequantia.

WEST SUMATRA: Along road between Lubuksikaping and Bondjor, Lurah Berangin Nature Reserve, 400-500 m, Sept. 21, 1984, *M. Hotta 30231* (KYO); Pinang Pinang plot, Ulu Gadut, in dense forest floor of limestone area, alt. 500 m, Aug. 25, 1981, *M. Hotta & H. Okada 624* (KYO), Aug. 27, 1981, *M. Hotta & H. Okada 689* (KYO), Sept. 2, 1981, *M. Hotta 26670* (Holotypus in KYO, isotypus in BO), Feb. 6, 1983, *M. Hotta, H. Okada & M. Ito 1082* (KYO, BO); upper part of Pinang Pinang ridge, 700 m, Aug. 1, 1984, *M. Hotta, H. Okada & T. Kohyama 221* (KYO); G. Kambot, alt. 400-600 m, Jan. 23, 1981, *M. Hotta & R. Tamin 269 & 291* (KYO).

In general *H. hastata* can be regarded as a plant well adapted to the habitat on the forest-floor. There are few leaves (usually 1 to 2) with thin and dark green lamina. The petiole is slender and very shortly sheathed at the base. The stem is somewhat decumbent and branches underground. The hastate leaf blade and the long filament of the male flower, both distinctive characters for the section *Chamaecladon*, are also found in this species. The chromosome number of this species is $2n=40$ based on a clone of Pinang Pinang ridge (H. Okada, unpublished).

This new species occurs commonly in and around the Pinang Pinang Plot (one of our study sites for forest ecology on the gentle ridge of Pinang Pinang Hill), and we also found it in a few other places of the Mt. Gadut area and once in northern W. Sumatra (Lurah Berangin). It seems to have a limited distribution in and around the limestone areas of West Sumatra.

Homalomena ruscii M. Hotta, *sp. nov.* (sect. *Chamaecladon*)

Fig. 8

Herba parvula, rhizomate repente, 3-10 cm longo, 1-1.5 cm crasso, dense foliato. Foliorum petiolus quam lamina 1.5-plo longior vel ei aequilongus, 8-13 cm longus, basi late vaginatus, vagina ovato-triangulare (2.5-3 cm) liguliformi-producta, lamina coriacea, supra nitida viridis, subtus pallidior, lanceolata vel oblongo-lanceolata, 8-11 cm longa, 2-3.5 cm lata, apiculo 2 mm longo cylindriciformi, nervis lateralibus I. utrinque 3-4 angulo acuto adscendentibus leviter arcuatis. Pedunculi tenui usque 4-5 cm longi. Spathae oblonga breviter apiculata, viridis, 1.5-2 cm longa, 6-8 mm ampla. Spadicis sessilis

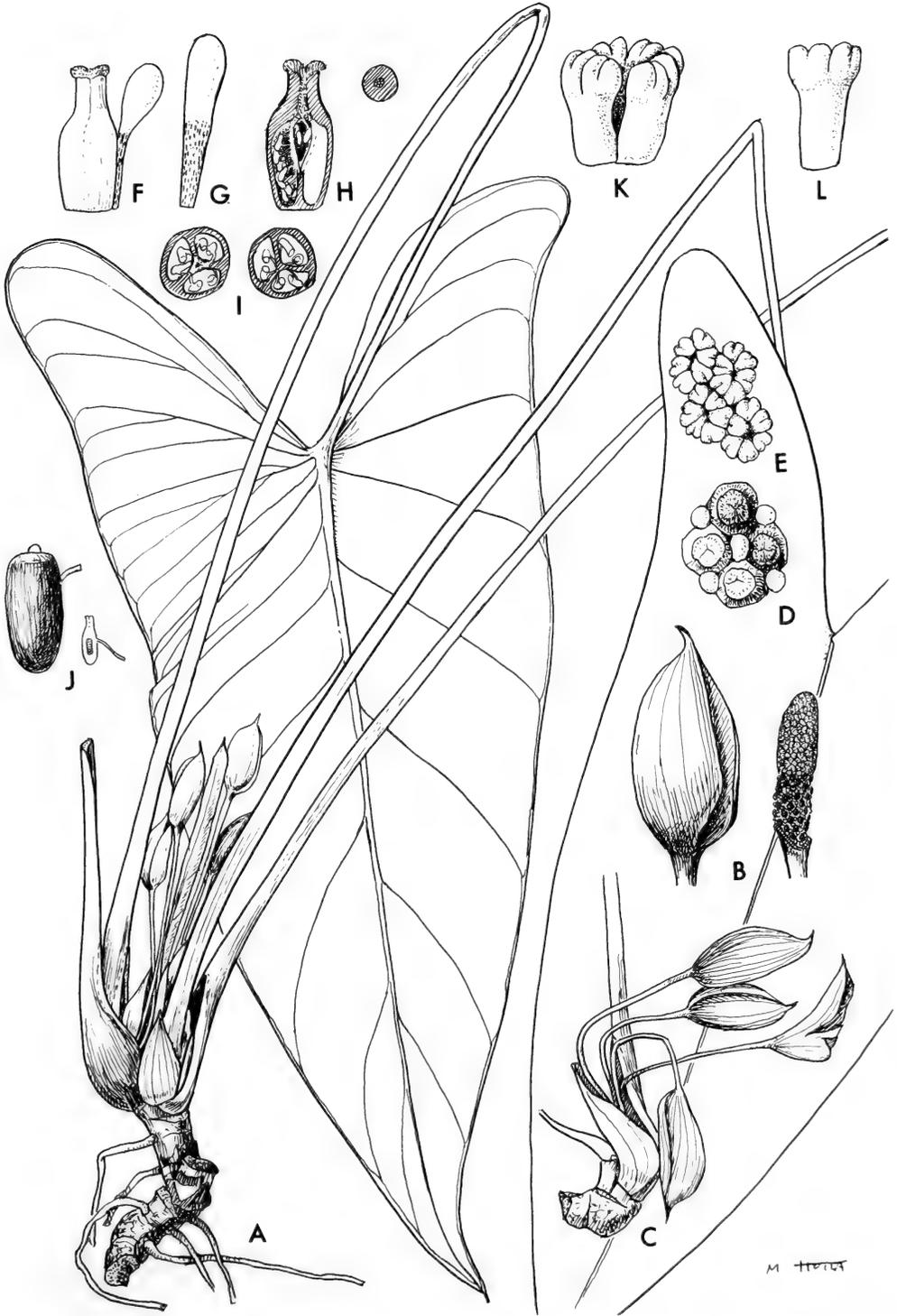


Fig. 7. *Homalomena hastata* M. Hotta

A: habit, $\times \frac{1}{2}$ (Hotta, Okada & Ito 1082); B: spathe (left) and spadix (right), $\times \frac{1}{2}$; C: fruiting inflorescences, $\times \frac{1}{2}$ (Hotta & Tamim 291); D: close-up of female part of spadix, $\times 10$; E: close-up of male part of spadix, $\times 10$; F: female flower with staminode, $\times 15$; G: staminode from base of spadix, $\times 15$; H: longitudinal section of ovary (left), cross section of style (right), $\times 15$; I: cross-sections of ovary at upper (left) and lower (right) parts, $\times 15$; J: ovule (right) and seed, $\times 40$ (left); K: male flower (side view), $\times 15$; L: stamen, $\times 15$.

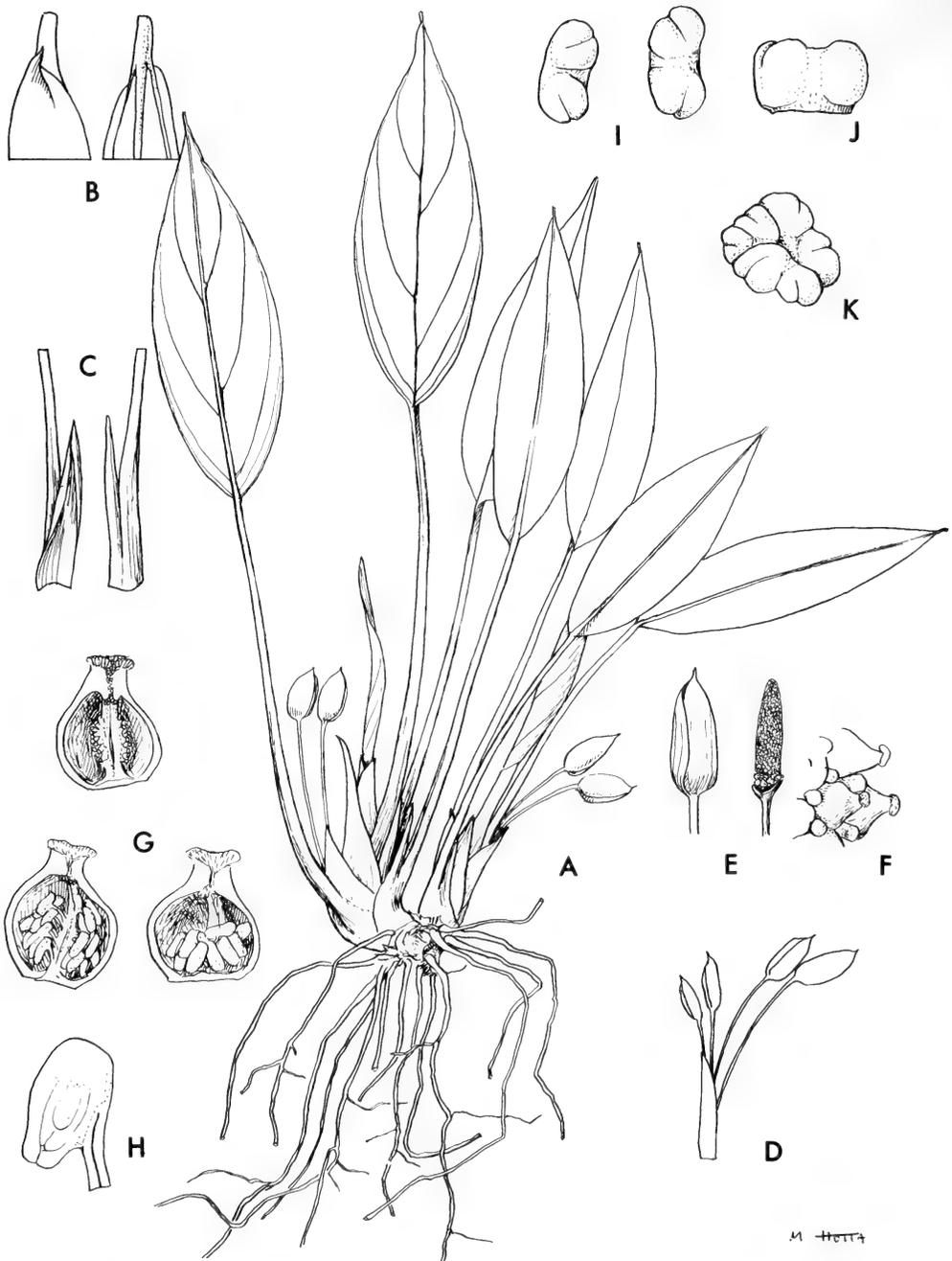


Fig. 8. *Homalomena ruscii* M. Hotta

A: habit, $\times \frac{1}{2}$; B: leaf apices, $\times 4$; C: petiole bases with free ligule, $\times 1\frac{1}{2}$; D: inflorescences, $\times \frac{1}{2}$; E: spathe (left) and spadix (right), $\times 1$; F: female part of spadix, $\times 8$; G: longitudinal sections of 3 ovaries, $\times 13$; H: ovule, $\times 40$; I: stamens (front view), J: stamen (side view), $\times 40$; and K: male flower (front view), $\times 40$.

oblongi inflorescentia feminea 2 mm longa, quam mascula 5-plo brevior. Flores masculi (1-)3 andri. Pistilla late ovoidea virescentia, in stilum brevissimum stigmatate discoideo instructa; ovarium uniloculare, placentis 1, ovulis hemianatropis medio vel basi-affixis. Staminodia claviformia quam ovaria duplo breviora.

WEST SUMATRA: Fort de Kock, Harau, Aug. 5, 1931, *Frey Wyssling 154* (BO); Arau (Harau) Nature Reserve, Pajakumbuh, on wet rock near waterfall, 600 m, Aug. 27, 1983, *M. Hotta & R. Tamin 300* (Holotypus in KYO, isotypus in BO & L).

H. rusdii has the distinct characters of the genus *Homalomena*, such as the free ligule of the petiole-sheath, and a uniloculate ovary with parietal-basal placentation. It is undoubtedly also closely related to *H. paucinervia* by the coriaceous, lanceolate leaf blade with a few primary lateral veins (usually 3-4 on each side). *H. paucinervia* is a typical rheophytic aroid which is widely distributed in West Malesia (Borneo, Malay Peninsula and Sumatra), and two Sarawak collections (*Hirano & Hotta 1284*, and *Hotta 15380*) and one from southern Thailand (collection of Dr. *T. Yahara* and cultivated in the green-house of Kyoto University) have uniloculate ovaries with basal placentation. This type of uniloculate ovary in *Homalomena* with parietal or basal placentation, has been reported on in *H. minutissima* (Hotta 1967), closely related to *H. humilis* that has no direct relationship with the present species. The peculiar character of the uniloculate ovary in *Homalomena* might have been evolved in a parallel way within two groups. On the other hand, the genus *Furtadoa* of the subtribe Homalomeninae has a uniloculate ovary with basal placentation, but this genus differs from the genus *Homalomena* by the sterile pistil in the male portion of spadix, i.e., a male flower formed by a stamen and a sterile pistil. This interesting floral character is found in *Homalomena mixta* collected from the Malay Peninsula, the second species now assigned to the genus *Furtadoa*.

***Furtadoa mixtum* (Ridley) M. Hotta, comb. nov.**

Homalomena mixta Ridley in Jour. Bot. 40: 36 (1902); Engler in Pflanzenr. IV. 23 Da: 80 (1912); Furtado in Gard. Bull. Str. Settl. 10: 209 (1939).

MALAYA. PAHANG: Tahan woods, 1891, *Ridley s.n.* (SING, holotype of *H. mixta* Ridley).

This species has elliptic and wider leaf lamina than *Furtadoa sumatrensis* and seems to be a forest-floor aroid.

Acknowledgments

It is a pleasure to record my thanks to the many persons who helped me in my work. I am grateful to Dr. Kuswata Kartawinata of Herbarium Bogoriense and Dr. Chang Kiaw Lan of the Singapore Herbarium for the use of facilities under their care and for kindly helping with my herbarium work; Dr. Amsir Bakar, Head of Indonesian counterparts of SNS, Andalas University, and Dr. S. Kawamura, Leader of the SNS project, Kyoto University for their encouragement. Mr. Rusjdi Tamin and students of Andalas University kindly co-operated during my recurrent field work in West Sumatra. Dr. H. Okada has carefully made chromosome counts of the new species of *Homalomena*.

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A New Account of the Genus *Horsfieldia* (Myristicaceae), Pt 2*

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EFFECTIVE PUBLICATION DATE: 31 AUG. 1985

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Myristica irya Gaertn., Fruct. 1 (1788) 195, tab. 41; Hook.f. & Thoms., Fl. Ind. (1855) 159; A. DC., Prod. 14 (1856) 202 (excl. *M. exaltata*, p.p., see under *Endocomia*, Blumea 30 (1984) 173; King, Ann. Roy. Bot. Gard. Calc. 3 (1891) 308, pl. 141, 141-bis. — *H. irya* (Gaertn.) Warb., Mon. Myrist. (1897) 317 (incl. vars. or forms *ceylanica*, *javanica*, *malayana*, *wallichii*, *moluccana*, *siamensis*), t. 22 fig. 1-4; Sinclair, Gard. Bull. Sing. 16 (1958) 382, fig. 33, Pl. IX-A; 28 (1975) 61; Back. & Bakh. van den Brink, Fl. Java 1 (1963) 138. — Type: *Gaertner's drawing*.

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M. spherocarpa Wall., Pl. As. Rar. (1830) 79, t. 89. — *M. irya* var. *wallichii* King, Ann. Roy. Bot. Gard. Calc. 3 (1891) 309, pl. 141-bis, 3-5. — Type: *Wallich Cat. 6796* (K-W).

M. micrantha Wall., Cat. 6807 (1832), *nom. nud.* — Type: *Wallich 6807* (K).

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M. subglobosa Miq., Fl. Ind. Bat. Suppl. 1 (1861) 383. — *M. globularia* Bl. var. *subglobosa* (Miq.) Miq., Ann. Mus. Lugd. Bat. 1 (1864) 206 — *H. subglobosa* (Miq.) Warb., Mon. Myrist. (1897) 328 (for the original syntype only) — Type: Sumatra, *Diepenhorst Hb. 2148* (U), *Teysmann Hb. 3189* (U).

M. vrieseana Miq., Ann. Mus. Bot. Lugd. — Bat. 2 (1865) 49. — *M. irya* var. *longifolia* King, Ann. Roy. Bot. Gard. Calc. 3 (1891) 309, pl. 141-bis, 1-2. — Type: *de Vriese s.n.* (L).

H. labillardieri Warb., Mon. Myrist. (1897) 283, t. 21 f. 1-2. — *M. labillardieri* (Warb.) Boerl., Handl. Fl. Ned. Ind. 3, 1 (1900) 85. — Type: Java, Hb. — *Labillardiere s.n.*, male flowers (B, †; iso; FI, see note by Sinclair p. 89).

H. acuminata Merr., Phil. J. Sc. 17, 1920 (1921) 253; En. Phil. Fl. Pl. 2 (1923) 181. — Type: *de Mesa FB 27507* (PNH, n.v., probably destroyed).

H. nunu Kanehira, Trop. Woods 29, 5 (1932) *nom. nud.*; Bot. Mag. Tokyo 46 (1932) 451; Fl. Micr. (1933) fig. 32; Enum. Micron. Plants, in J. Dept. Kyushu Imp. Univ. 4, 6 (1935) 319. — Type: *Kanehira 1303, 1304* (n.v.).

H. amklaal Kanehira, Bot. Mag. Tokyo 47 (1933) 670; Fl. Micr. (1933) 109, fig. 31, pl. 16. — Type: *Kanehira 1944* (FU, n.v.), *1978* (FU, n.v.), *2058* (FU, n.v., iso: K & P), *2059* (FU, n.v.).

H. congestiflora A.C. Smith, J. Arn. Arb. 22 (1941) 64. — Type: *Brass 8010* (A, n.v.; iso: BM & L).

Tree 10-25(-40). Twigs terete or often drying flattened towards apex, usually thinly ridged, (2-)3-10(-30) mm diam., glabrescent, tomentum minute to conspi-

*Continued from Gdns' Bull. Sing. 37(2): 179.

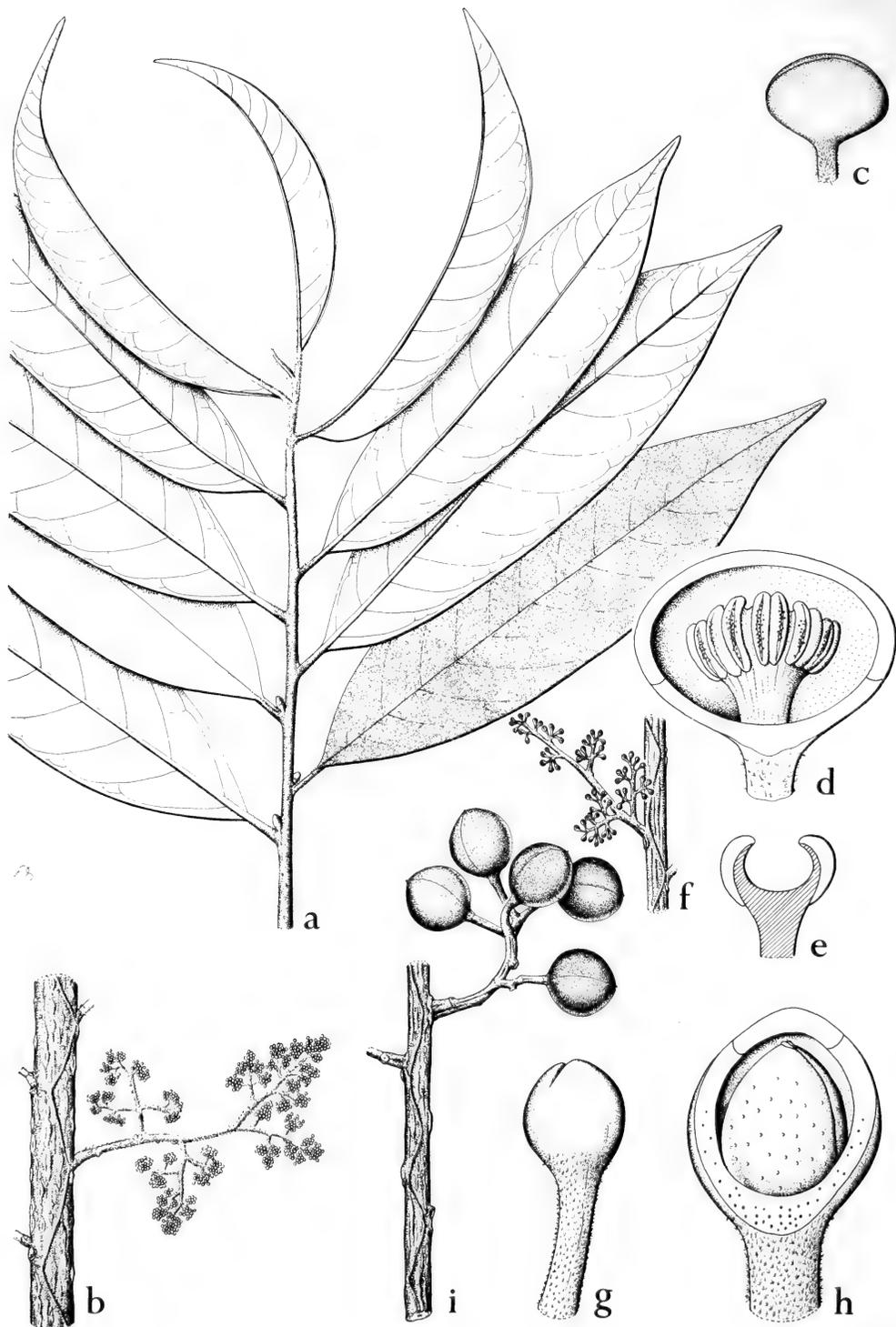


Fig. 6. *Horsfieldia irya* (Gaertn.) Warb.
a, leafy twig apex, note whitish blotched leaves, $\times \frac{1}{2}$; *b*, twig portion with male inflorescence, note ridged twig, $\times \frac{1}{2}$; *c*, mature male flower bud, lateral view, $\times 12$; *d*, male flower, longitudinal section, showing androecium, $\times 25$; *e*, androecium, longitudinal section, schematic, $\times 25$; *f*, twig portion with female inflorescence, $\times \frac{1}{2}$; *g*, mature female flower, $\times 6$; *h*, ditto, opened, showing glabrous ovary with minute 2-lipped stigma, $\times 12$; *i*, twig portion with infructescence, note spherical fruits. — *a* & *b* from NGF 22319; *c-e* from *Kostermans* 24385; *f-i* from *FRI* 3044.

cuous (New Guinea and Pacific Isls.), grey to rusty, of mixed dendroid hairs 0.1-0.5(-1.0) mm; bark often coarsely striate, often \pm blackish, when older not flaking; lenticels usually conspicuous. Leaves in 2 rows, abaxially often \pm curved especially towards the tip, membranous, elliptic-oblong to lanceolate, 10-30(-35) \times 3-7(-9) cm, base rounded to attenuate, tip acute-acuminate; upper surface drying dull greenish-brown to blackish-brown, usually finely pustulate with paler stipples and almost always with larger irregular whitish marks of unknown origin, lower surface early glabrescent to glabrous, without dark dots; midrib slender above, flattish; nerves 10-20 pairs, very thin and flattish above, inconspicuous, the marginal arches usually not distinct; tertiary venation forming a lax network, faint above, thin though distinct beneath; petiole 7-16 \times 1.5-3(-4) mm; leaf bud c. 10(-15) \times 2-3 mm, pubescent with hairs c. 0.1-0.5(-1.0) mm. Inflorescences densely tomentose with hairs 0.1-0.5(-1.0) mm long, persistent or glabrescent, in σ : 3-4 times ramified, many-flowered, c. 4-18 \times 3-7(-10) cm; in ρ : c. 2-6(-8) cm long, 2(-3) times ramified; common peduncle 0.5-4.5 cm long; bracts acutish, 1.5-4 mm long, caducous. Flowers in σ in clusters of 3-10, in ρ usually solitary or a few together, perianth glabrous or at base glabrescent, perianth 2-valved; pedicel pubescent or glabrescent, at base not articulated. Male perianth subglobose or \pm transversely ellipsoid, somewhat laterally compressed or not, c. 1.0-1.3(-1.5) \times (1.0-)1.2-1.5(-2.0, Indo-China) mm, apical part broadly rounded, at base rounded or short-tapering; pedicel slender, (0-)0.1-1(-1.5) mm, inarticulate at base; perianth at anthesis cleft to c. $\frac{1}{2}$ - $\frac{2}{3}$, valves c. 0.2 mm thick. Androecium broadly obovoid, \pm broadened transversely, c. 0.8-1.2 \times 1.0-1.5 mm; anthers 6-9(-10), Indo-China), not closely touching, c. 0.5-0.8(-1.0) mm long, towards apex incurved and free for c. 0.2-0.3 mm, dorsally attached to the broadly concave, often \pm saucer- or cup-shaped androphore c. 0.4-0.5 \times (0.5-)0.6-1.0 mm, tapered towards the base. Female perianth obovoid or ellipsoid, c. 1.5-2.3 \times 1.3-2.0 mm, at anthesis cleft to c. $\frac{1}{4}$ - $\frac{1}{3}$, valves c. 0.3 mm thick, pedicel 1-4 mm long; ovary broadly obovoid, glabrous c. 1.2-1.5 \times 1.0-1.3 mm, stigma minute, c. 0.05 \times 0.1 mm. Fruits 2-8 per infructescence, globose, 1.5-2.2 cm diam., glabrous, with the surface finely granular, without larger tubercles or lenticels, drying dark brown to blackish, dry pericarp c. 1-2 mm thick; stalk 5-10 mm long, perianth not persisting.

Distribution. From Ceylon through Malesia to the Solomon Isls.: Ceylon, Burma, Andaman Isls., Nicobar Isl., S. Indo-China (Cochin-China), Cambodia, Thailand, Malaya, Singapore, Sumatra, Java, Borneo, Celebes, Moluccas, C.(?) & S. Philippines, New Guinea, Caroline Isls., Solomon Isls.; no collections seen from the Lesser Sunda Isl. and N. Philippines.

CEYLON: *Davidse & Sumithraarachi* 8119; *Gardner* (Hb. Hooker) 748; *King's Coll.* (1884); *Kostermans* 24385, 27202; *Thwaites C.P.* 221, 2620; *Walker s.n.*; *Wall.*, *Cat.* 6804 (σ , part of the material of *M. exaltata*, not the lectotype); *Waes* 1272; *Worthington* 487, 517, 576, 686, 1848, 6351.

ANDAMAN Isls.: *Balakrishnan & Bhargava* 3622; *Kurz s.n.*; *Parkinson* 1050.

NICOBAR Isl.: *Nair* 3512.

BURMA: *Wallich* 6804 C (Moulmein, σ fls.; part of the original material of *M. exaltata*, not the lectotype).

THAILAND: *Kerr* 4108 (A, B, C), 11419, 13883, 14252, 18599, 18907, 19036; *Lakshnakara* 615; *Larsen c.s. FHB.* 31253; *Marcan* 232, 720, 971, 1978; *Maxwell* 75-61; 75-1026; *Put* 623, 1580; *Rabil* 218, 273; *Smith* 348; see further *Sinclair's* list (1975, p. 62).

CAMBODIA: *Poilane Ch.* 158.

VIETNAM (SOUTH): Müller 1020; Pierre 5745; Poilane 769, Thorel 1186 (p.p., other specimens of the same number are the type of *H. thorelii*).

MALAYA: Griffith 4357; Kep. FN 94710; Ridley 4957; Wallich 6807 — Kedah: Wyatt-Smith KFN 71179 — Perak: FRI 3044; King's coll. 7447; Ridley 3043; SFN. 33240 — Kelantan: Ridley 7206; Shah & Kadim MS 550 — Trengganu: SFN 40739. — Pahang: Evans s.n. — Selangor: SFN 34145. — Malacca: Kep. FN 94710; Maingay 1292, 2944, 3075. — Johore: Corner 25856, 25964, 28493; Maxwell 80-142; Ridley 897, 11328. — Penang (etc.): Curtis 936; Kep. FN 80999; Ridley s.n.

SINGAPORE: Ridley 4814, 8957; SFN 339448, 40202; Sinclair s.n. (1953).

SUMATRA: Ashton 15361; b.b. E. 868, 5208, 21463, 28460; Buwalda 6804; Forbes 3197; Grashoff 1088; Horsfield s.n.; Praetorius s.n.; Rahmat si Toroes 3961 — Simeulue Isl.: Achmad 60, 362, 830, 1732 — Mentawai Isls. (Sipora): Iboet 487, Ridley 14760 — Riau: b.b. 20382.

JAVA (W, C & E): Backer 27971; b.b. 1177, Boerlage s.n.; Buwalda 3001A, 3076 (= FRI. Ja. 4214); Coert 1489; Hoogerweg a 1954; Junghuhn s.n., 33, 49, 875; Koorders 5211 β , 5213 β , 5215 β , 5224 β , 5265 β , 12274 β , 13493 β , 15521 β , 24784 β , 25392 β , 27479 β , 28353 β , 38882 β ; Kostermans (Unesco) 52, 19281; Soepadmo 279; Van Steenis 5274; Nengah Wirawan 429.

BORNEO. Sarawak: Haviland & Hose 3305, 3305B; S. 16805, 18120, 18864, 34153, 36084 — Brunei: (Ashton) BRUN 5553 — Sabah: Amdjah 1, 94, 846; Elmer 20013, 21032; Rajuyap A 463; SAN. 31, 18726, 21768, 30297, 34497, 47151, 75131, 84575, 90864 — W. Kalimantan: Hallier 1021, 1043; Teysmann 8676, 8680, 8683 — C. Kalimantan: Veldkamp 8256 — S. Kalimantan: Korthals s.n. — E. & SE. Kalimantan: b.b. 2114, 19042, 25129, 29415, 34244; Kostermans 4006, 5047, 21226, 21456.

CELEBES: b.b. 22986; Forster (?) 329; Koorders 18157 β ; Meijer 10139; Noerkas 305; Prawiroatmodjo & Soewoko 1777; Teysmann (11897).

MOLUCCAS: Atjè 33, 50; de Vogel 3807; de Vriese s.n., s.n. (87).

PHILIPPINES. Palawan: Elmer 12682, 12684; Merrill 9208 — (Luzon, Mindanao): Cenabre FB 29146, 29176; Cruz FB 23887; Natividad FB 25751; (Ramos & Edano) BS 36770, 41198; Vidal 3567; Wenzel 3023.

NEW GUINEA. Irian Jaya (West New Guinea): Zippel s.n.; b.b. 22530, (Kostermans 127) 33354; BW 393, 873, 3288, 4436, 5165, 5348, 5838, 5840, (Schram BW) 6082 (in K), 6563, 6595, 7258, 10827, 11870; van Royen 4675, 5101 — Papua New Guinea: Brass 8010; Craven & Schodde 776; Hartley (TGH) 9738; Hollrung 657 (in P, not in K); Hoogland 4213, 4650; LAE 74298; NGF 16320, 22319, 25577, 35309, 37574, 47300.

CAROLINE Is.: Kanehira 1303, 2058; Masahiko Takamatsu 392; St. John 21446; Stone 1901.

SOLOMON Is.: BSIP 39, 909, 910, 1663, 1664, 2014, 3668, 4743, 5286, 5788, 5855, 6037, 6119, 6948, 10614, 13211, 15441, 15806, 17057, 17275; Comins 355; Kajewski s.n., 2444.

Ecology. A tall tree in primary and (old) secondary forest. Most frequent coastal or riverine, on alluvial (sandy, loamy, or clayey) soils, but also found more inland; 0-450 m. Mentioned mostly from wet or marshy localities at low altitudes, e.g., coastal swamp forest, sandy alluvium behind the beach, open, low marshy ground (with sago-palms), swamp forest, river banks below tidal limits, seasonal swamps, periodically inundated forest, coastal shrubberies (on limestone), river flood-plains with mud soil, etc., but also recorded from undulating country, and well-drained soils (e.g., in Ceylon and Solomon Is.). From Ceylon recorded from the "dry zone". In Thailand in riverine evergreen forest. Flowers and fruits apparently throughout the year, but this is likely correlated with regional and local climatic conditions.

Vernacular names. Amklaal, Nunu (Palau Is.); Aininiu, Ainynu (Kwara'ae lang., Solomon Is.); more vernacular names will be published in *Flora Malesiana*.

Uses. Rare in record that fruits are edible; fruits recorded as eaten by monkeys in Ceylon.

NOTES

1. *Fieldnotes.* A tall tree with straight bole; crown described as with several big limbs each monopodially branched, or narrow and with slender drooping branches near the top; bole often recorded as fluted, or with prop roots, or, usually, with buttresses up to 3 m high, 2 m out, and up to c. 10 cm thick, but also recorded as without buttresses. Bark sometimes noted as smooth, often as fissured or cracked, or mostly as flaking or peeling off in small pieces; inner bark cream or whitish, to c. 7 mm thick; sapwood cream or whitish, ochreish, straw-coloured, or pinkish; heartwood absent or only slightly darker, pale brown; wood rather soft. Flowers yellow, dark yellow, or orange-yellow, once recorded as reddish; strongly sweet-scented, once recorded as unscented. Fruit yellowish, greenish orange, to orange-red, or red; the aril usually orange or orange-red, rarely recorded as red. Fresh fruit recorded as large, up to c. 2³/₄ cm diam. The seed is reported to contain an air chamber, facilitating dispersal by floating.

2. *Variability.* *H. irya* is a homogeneous species, well characterized by its small subglobose male flowers of c. 1 mm diam. (in Indo-China up to 1.6 mm diam.), with typical broad and deeply concave androecium with tapered, distinct (i.e., relatively large) androphore. The fruits (and seeds) are perfectly spherical, glabrous (ovary glabrous). The twigs are usually thinly ridged from petiole to petiole. Very characteristic are irregular whitish marks of unknown origin, almost always present on the older leaves. The leaves have a lax reticulation. Variation abounds in the tomentum: short-haired; sometimes seemingly glabrous specimens are predominant in Ceylon, SE. Asia, and W. Malesia and the Moluccas; in New Guinea and the Solomon Isls. most specimens have a conspicuous, often wooly, tomentum of hairs to c. 1 mm long on the twig apex, leaf bud, and inflorescences.

7. *Horsfieldia spicata* (Roxb.) Sinclair

Fig. 1A(7); 7

Myristica spicata Roxb., Fl. Ind. 3 (1832) 847; (ed. 1874) 744; Warb., Mon. Myrist. (1897) 271 in obs. sub *H. smithii* Warb. — *H. spicata* (Roxb.) Sinclair var. *spicata*, Gard. Bull. Sing. 28 (1975) 112, 113, p.p. — Type: Roxburgh's description.

M. canariformis Bl., Rumphia 1 (1837) 190 — *H. canariformis* (Bl.) Merr., Interpret. Rumph. (1917) 230 — Based on: *Palala quarta*, *P. canariformis*, *P. dentaria* Rumph., Hb. Amb. 2, 10 (1741) 27 t. 8; see Sinclair, 1975, 162-165.

H. batjanica Warb., Mon. Myrist. (1897) 275, tab. 21, 1-4 — *M. batjanica* (Warb.) Boerl., Handl. Fl. Ned. Ind. 3, 1 (1900) 85 — Type: Introduced by Teysmann in hortus Bogor. (B, lost; iso: FI, n.v.; original tree still cultivated in Bogor, and collected sub *Kostermans 11186*, *Rastini (220)*, *Sinclair 10035*).

H. roxburghii Warb., Mon. Myrist. (1897) 277, tab. 21, 1-2. — *M. roxburghii* (Warb.) Boerl., Handl. Fl. Ned. Ind. 3, 1 (1900) 85 — Type: *Smith* in Hb. Roxburgh (BM; B, BR, n.v.; ♀ fl., orig. Ternate); Culta in hortus Bog. (♂ fl., orig. Ambon) (B, FI, n.v.; lecto: P, tree still in cultivation in Bogor sub no. IV. G. 90, collected under *Sinclair 10037*).

H. parviflora auct. non (Roxb.) Sinclair: Sinclair, Gard. Bull. Sing. 28 (1975) 82, p.p.

Tree 2.5-20 m. Twigs terete, not ridged, towards the apex 2-4 mm diam., tomentum greyish, with hairs c. 0.1 mm or less, early glabrescent; bark striate, pale brown to whitish brown, usually contrasting with the blackish colour of dried

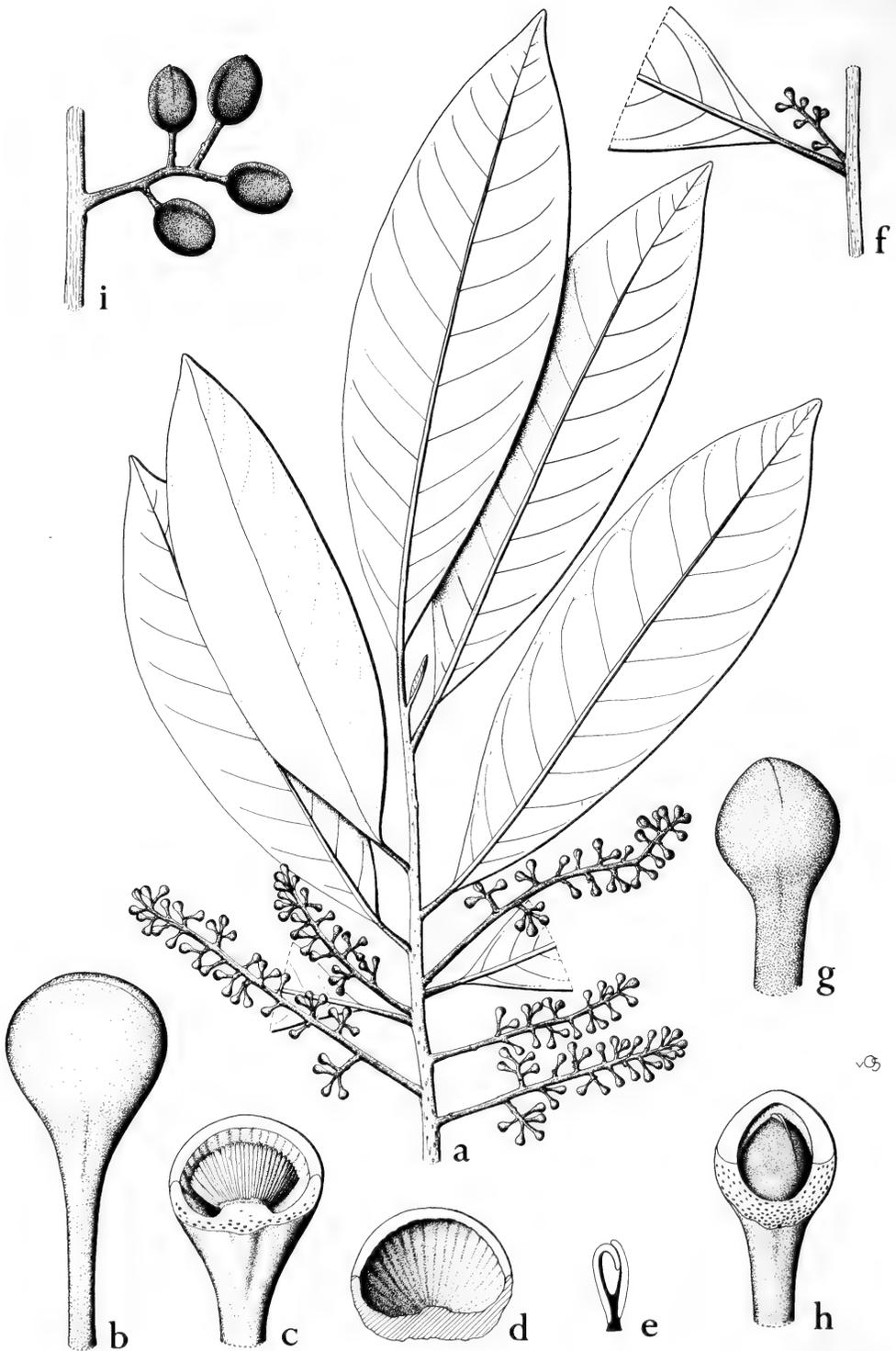


Fig. 7. *Horsfieldia spicata* (Roxb.) Sinclair

a, leafy twig with male inflorescences, $\times \frac{1}{2}$; *b*, mature male flower, lateral view, $\times 6$; *c*, male flower, opened, showing androecium, $\times 6$; *d*, male perianth, inner side, showing impression of androecium, $\times 6$; *e*, androecium, longitudinal section, schematic, $\times 6$; *f*, twig portion with female inflorescence, $\times \frac{1}{2}$; *g*, mature female flower, lateral view, $\times 6$; *h*, ditto, opened, showing glabrous ovary and 2-lipped stigma, $\times 6$; *i*, twig portion with infructescence, $\times \frac{1}{2}$. — *a-d* from *Beguin 1407*; *e* from *Teysmann s.n.* (Ambon); *f-h* from *Kostermans s.n.* (Hort. Bog. sub IV.H. 13); *i* from *de Vogel 3206*.

petioles and inflorescences, when older not flaking, usually with few coarse lenticels. Leaves in 2 rows, membranous, elliptic-oblong to oblong, 8-30 × 2.5-10 cm, base attenuate, top acute-acuminate, often densely speckled by paler irregular pustules of unknown origin, especially beneath; upper surface drying dull greenish brown to brown, lower surface with very minute scales as on the leaf bud, very early glabrescent, i.e., glabrous; without larger blackish dots, but often with dense, very minute, blackish dots; midrib flattish above; nerves 11-17 pairs, thin and flattish above, tertiary veins very thin, distinct or not on both surfaces; petiole 10-20 × 1.5-3 mm, drying blackish; leaf bud slender, c. 10 × 1.5-2 mm, densely pubescent with grey-brown hairs c. 0.1 mm long or less. Inflorescences drying blackish, usually slender, spike-like, early glabrescent, not ramified or the lateral branches only up to c. 2(-5) mm, common peduncle c. 1-3 cm, not many-flowered, in ♂: 4-10 × c. 1 cm, in ♀: c. 2-3 cm long; bracts bluntish, 0.5-1 mm, caducous. Flowers solitary or 2 together in ♀, up to 3 together in ♂, very early glabrescent; perianths 2-valved; pedicel glabrous (glabrescent), at base inarticulate. Male perianth ± obovoid or short-pear shaped, in lateral view the upper part subcircular to reniform, laterally rather compressed, about as long as broad or slightly broader than long, 2.3-3 × 3-3.5 mm, the upper part broadly rounded, base ± tapering into the much tapered pedicel 1.5-3 mm long; perianth at anthesis split to or nearly to the base, valves c. 0.2 mm thick. Androecium reniform, rather well compressed, upper part broadly rounded, at base broadly attached, 1.5-1.8 × 2.5 mm, androphore ± absent; anthers (12-)16-22, closely set, ± septate only in young state, free apices 0.1-0.4 mm, little to strongly incurved into the apical cavity which reaches to c. ¼-½(-¾, see notes). Female perianth subglobose, 2-2.5 × 2.2-2.8 mm, at base passing into the somewhat tapered pedicel 1.5-2.5 mm, at anthesis split to c. ½-¾, valves 0.4-0.5 mm thick; ovary broadly ovoid, glabrous, c. 1.5 × 1.5 mm, stigma minute, faintly 2-lobed, c. 0.1 mm high. Fruits 1-5 per infructescence, short-ellipsoid, apex and base rounded, 1.5-2.0 × 1.2-1.8 cm, glabrous, drying blackish, without pustules, pericarp c. 1.5 mm thick; stalk 4-10 mm long; perianth not persisting.

Distribution. Moluccas: Morotai, Halmahera, Ternate, Bacan Isl., Ambon.

Cultivated (origin Bacan Isl., Ambon): *Kostermans* 11186; *Rastini* (220); *Sinclair* 10035, 10037; Hb. Hasskarl s.n. (*Teysmann* s.n., 1868, orig. "E. Java").

MOROTAI: *Kostermans* 1014, 1157, 1218, 1256; *Lam* 3499.

HALMAHERA: *Pleyte* 409, p.p.; *de Vogel* 3206, 3289, 3334, 3367, 3434, 3490, 3496, 4391, 4467.

TERNATE: *Beguin* 1407.

BACAN: *b.b.* 32787; Hb. *Hance* s.n.; *de Vogel* 3529, 3531, 3748.

AMBON: *Buwalda* 6141; *Robinson* 240, 1885; *Teysmann* s.n. (1867).

Ecology. Alluvial soils, deep clay, soil rich in humus, and porous volcanic soil over schists; 0-1000 m. Flowers and fruits throughout the year.

Vernacular names. Anunu magilioro (Halmahera), Onguaka (Tobaro lang., Halmahera).

Uses. According to the label of *de Vogel* 3206, the outer bark, mixed with "Kuleman" (a different species of *Horsfieldia*), is used for curing hepatitis.

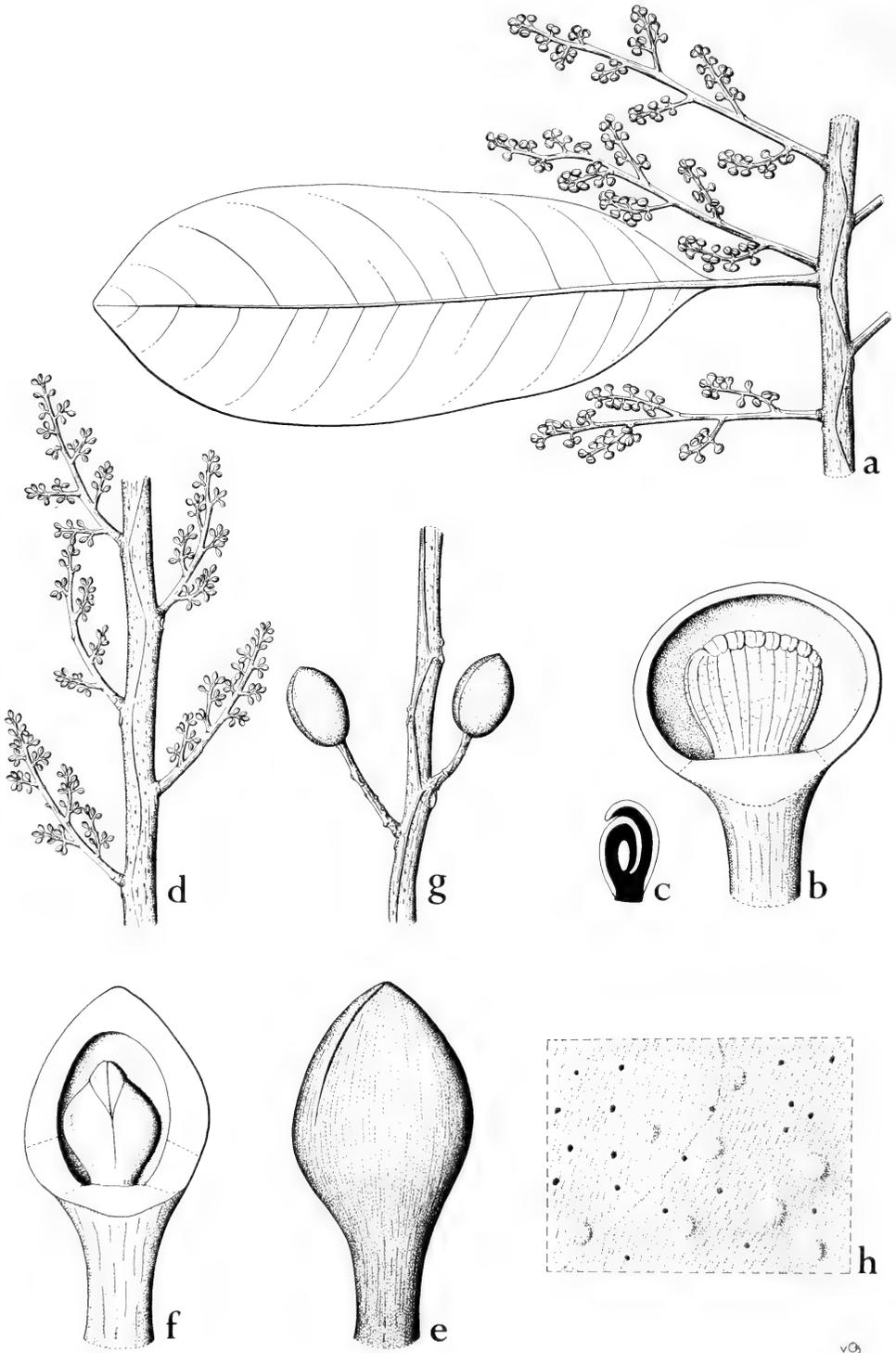


Fig. 8. *Horsfieldia inflexa* de Wilde

a, twig portion with male inflorescences, note lined twig, $\times \frac{1}{2}$; b, mature male flower, opened, showing androecium, $\times 12$; c, androecium, longitudinal section, schematic, $\times 12$; d, twig portion with female inflorescences axillary to fallen leaves, $\times \frac{1}{2}$; e, mature female flower, lateral view, $\times 12$; f, ditto, opened, showing glabrous ovary with broad-lipped stigma, $\times 12$; g, twig portion with infructescences, $\times \frac{1}{2}$; h, portion of lower leaf surface with scattered dark-coloured non-traumatic cork warts as blackish dots, $\times 12$. — a-c from LAE 52866, type; d-f from van Royen 3166; g & h from LAE 52862.

NOTES

1. *Fieldnotes*. Flowers greenish-yellow or ochreish yellow. Mature fruit orange; aril bright red. Bark often recorded as unfissured, peeling off. Exudate watery, not or only slightly reddish coloured. Sapwood usually creamish, gradually passing into the darker coloured heartwood. Buttresses recorded as present and up to 50 cm out and high, or as absent.

2. This species is clearly recognizable at first glance by its spike-like inflorescences drying blackish, and by the pale twigs rather contrasting with the blackish colour of the dried petioles and the inflorescences. As presently circumscribed by me this species is used in a much narrower sense than accepted by Sinclair, who included also specimens from Celebes, Philippines, Lesser Sunda Isls., and Banda and Aru Isls., now referred by me to various different species.

3. Possibly its most closely related species is *H. moluccana*. Apart from the characters as used in the key, and pointed out in note 2, *H. spicata* differs from *H. moluccana* by its more membranous leaves. See also note 4.

4. Intermediate specimen. *Teysmann s.n.* (in L), from Ambon, is intermediate between *H. spicata* and the related *H. moluccana*. It has the diagnostic conspicuously pale twigs, contrasting with the blackish petioles and inflorescences, but these latter structures are rather ramified, not spicate, with ramifications at the base c. 6 mm long. The androecium of the flowers of this specimen are hollow for c. $\frac{3}{4}$ and the anthers at one side of the androecium curve into this apical cavity. Possibly the specimen is a hybrid.

5. Sinclair (1975, p. 122) discussed elaborately the typification of Roxburgh's name which is accepted here.

8. *Horsfieldia inflexa* de Wilde, *sp. nov.*

Fig. 1A(8); 8

Horsfieldia species perianthis masculis usque ad basin 2-valvibus atque antheris inflexis, ex affinitate gregis *H. sepikensem* et *H. moluccanam* amplectens, sed differt virgis valde porcatis atque foliis subtus punctatis. — Typus: *Streimann & Martin LAE 52866* (L).

Tree 10-21 m. Twigs distinctly ridged from petiole to petiole and distinctly angular especially in the apical portion, 2-5(-7) mm diam., early glabrescent, tomentum grey-brown, of hairs up to 0.1 mm; bark indistinctly striate, when older not flaking, lenticels abundantly present but usually not very conspicuous. Leaves in 2 rows, thinly chartaceous, elliptic-oblong to oblong, broadest at about or \pm above the middle, 8-20 \times 2.5-7.5 cm, base attenuate, tip bluntish to acute-acuminate; upper surface drying olivaceous to blackish brown, not or indistinctly pale-pustulate, lower surface early glabrescent and with \pm regularly scattered dark brownish dots (lens \times 10!); midrib above slender, flattish or slightly raised; nerves 8-13 pairs, above thin and flat, indistinct, beneath with the marginal arches fairly regular but indistinct; tertiary venation forming a rather lax network indistinct on both surfaces; petiole 14-30 \times 1.5-2.5 mm; leaf bud 10-14 \times 1.5-2 mm, with tomentum, hairs c. 0.1 mm long or less. Inflorescences glabrescent or with scattered minute scale-like hairs less than 0.1 mm; in σ : 2(-3) times ramified, the primary branches rather spike-like, c. 3-10 \times 1.5-4.5 cm, in ρ : 3-5 cm long; common peduncle 1-12 mm long; bracts elliptic, 1-3 mm long, with fimbriate margin, caducous. Flowers solitary or up to 4 together, glabrous; perianth 2-valved; pedicel glabrous, at base inarticulated. Male perianth subglobose, generally slightly

broader than long, not or but little laterally compressed, sometimes (together with the pedicel) slightly pear-shaped, c. $2.2-2.5 \times 2.5-3$ mm, upper part broadly rounded, lower part rounded or slightly tapering; pedicel 1-2 mm long, glabrous; perianth at anthesis split to almost reaching the base (c. $\frac{9}{10}$), valves 0.2-0.5 mm thick, not collapsing on drying. Androecium bluntly quadrangular in outline, sometimes broader than long, broadly rounded above, laterally compressed, c. $1.5 \times 1.5-2.0$ mm; anthers 10-12(-14?), septate when young, c. 1.5-2 mm long, free apices c. 0.7-1.0 mm (i.e., anthers upper half free), at one side of the androecium strongly incurved into the hollow almost reaching the base; androphore 0-0.1 mm long. Female perianths ovoid-ellipsoid, c. $2.0-2.5 \times 2$ mm, cleft at anthesis to c. $\frac{2}{3}$, valves c. 0.5 mm thick; pedicel 1-1.5 mm long; ovary ovoid, c. 1.5×1.2 mm, glabrous, stigma sessile, minutely 2-lobed, c. 0.2 mm broad. Fruits solitary or up to 6 per infructescence, ellipsoid, top rounded to subacute, base \pm rounded, c. $2.0 \times 1.4-1.5$ cm, glabrous, drying dark brown, without or with small tubercles or lenticels only; dry valves c. 1.5 mm thick; stalk 2-6 mm long; perianth not persisting.

Distribution. Northern part of New Guinea. Irian Jaya: Vogelkop, Geelvink Bay, Jayapura; Northern Papua New Guinea: West Sepik.

NEW GUINEA. Irian Jaya (northern) (incl. Vogelkop, Japen Isl., Meos Noem): *Aet & Idjan* (exp. van Dijk) 389; *b.b.* 21812, 25724, 30376, 30617, 30945; *BW* (Schram) 6046, (Iwanggin) 10021, (Moll) 11672; *Pleyte* 736; *van Royen* 3166. — Papua New Guinea (northern), West Sepik: (*Streimann & Martin*) LAE 52862; 52866.

Ecology. Primary and old secondary forest on alluvial soils, e.g., sandy clay, also in hilly forest, swamp forest; 0-400 m alt. Flowers throughout the year, fruits from September to November.

Vernacular names. Kamopi (Roberbai, Japen Isl.), Madak (Mooi lang., Vogelkop), Teenjak (Tehid lang., Vogelkop).

NOTES

1. *Fieldnotes.* Slender tree, buttresses absent. Bark shallowly longitudinally fissured, not or slightly peeling off; slash reddish brown, sapwood whitish red or cream, heartwood not differentiated. Flowers green, turning yellow, fragrant. Fruits yellowish-orange.

2. Besides a few species like *H. glabra* and *H. punctatifolia* from Western Malesia this is the only other *Horsfieldia* but the only one in New Guinea with specifically typical largish blackish dots on the lower leaf surface. These dots are apparently of the same nature as those in series *Punctatae* of the genus *Knema*, and have been identified as cork warts of non-traumatic origin.

3. Specimens of the present new species were included by Sinclair in his *H. spicata* var. *sepikensis* (Mkgf.) Sinclair, a taxon which is presently regarded as representing several distinct species, among which *H. sepikensis*, *H. moluccana* (var. *petiolaris*) and *H. olens*.

4. *H. inflexa* is obviously closely allied with *H. moluccana*, and can also be confused with the closely related species *H. angularis* and *H. basifissa*.

H. moluccana has generally rather pear-shaped male flowers (incl. pedicel), which may also be the case in certain specimens of our present *H. inflexa*, e.g., *BW 6046* from Vogelkop; *H. moluccana* differs, however, by its terete or only faintly lined twigs, and its non-punctate leaves. *H. inflexa* may resemble *H. moluccana* very much in the general shape and texture of the leaves, including the relatively long petioles. *H. angularis* differs by its non-punctate leaves, hairy flowers, the androecium with a central narrow crevice and its straight anthers. *H. basifissa* has, in contrast, terete or only faintly ridged twigs, differing further by various characters of the male flower including the androecium.

5. The specimens *BW 10021* and *b.b. 30617* from Japen Isl. resemble *H. parviflora* in their rather unbranched spike-like inflorescences; *H. parviflora* has more pronounced pear-shaped flowers and twigs which are paler and not angular. In most of the specimens of *H. inflexa*, the male inflorescences are distinctly ramified whereas the lateral branches are almost unbranched and are spike-like.

9. *Horsfieldia moluccana* de Wilde, *sp. nov.*

Fig. 1A(9)

Horsfieldia olivaeformis Warb., Mon. Myrist. (1897) 352, t. 23 fig. 1-2; Markgraf, Bot. Jahrb. 67. 2 (1935) 152, p.p. — *Myristica olivaeformis* (Warb.) Boerl., Handl. Fl. Ned. Ind. 3, 1 (1900) 87 — Type: Irian Jaya, Sorong (Vogelkop), *Beccari 171* (Fl. n.v., identity not sure, see notes).

Horsfieldia species perianthiis masculis 2-valvibus pyriformibus atque antheris inflexis, eis *H. spicatae* similibus, ab eo differt virgis in sicco dense brunnescentibus atque inflorescentiis valde ramosis non spicatis. — Typus: *Kostermans 673 a* (L).

Tree, 8-20(-30) m. Twigs terete, not ridged, or sometimes slightly angular, towards the apex 2-5 mm diam., early glabrescent; tomentum with hairs 0.1-0.3 mm; bark striate, when older not flaking, lenticels conspicuous to inconspicuous. Leaves in 2 rows, thinly chartaceous, elliptic-oblong to oblong, (6-)8-25 × 2.5-8.5 cm, base attenuate, tip acute-acuminate; upper surface drying olivaceous to brown, usually minutely pale-pustulate, lower surface early glabrescent, without dark brown dots; midrib slender above, flat; nerves 6-15 pairs, above thin, flat, indistinct, beneath with the marginal arches indistinct; tertiary venation ± fine, indistinct on both surfaces; petiole 10-26 × 1-2 mm; leaf bud 6-12 × 1-2 mm, with hairs 0.1-0.3 mm. Inflorescences sparsely pubescent, hairs stellate, c. 0.1 mm or less, in ♂: (1-)2-3 times ramified (sometimes not or hardly ramified, i.e., spike-like, see notes), 5-11 × 2-5 cm, in ♀ up to 5 cm long; common peduncle 5-20 mm; bracts ± oblong, 1.5-4 mm long, thinly pubescent, caducous. Flowers from solitary to 4 together, glabrous; perianths 2-valved; pedicels glabrous, inarticulate at base. Male perianth (incl. pedicel) pear-shaped, laterally much to little compressed, about as broad as long to slightly broader than long, 1.5-2.5(-3) × 2.2-3.8 mm, upper part broadly rounded, the lower $\frac{1}{3}$ tapering into the tapered pedicel 2-3(-3.5) mm; perianth at anthesis split to c. $\frac{2}{3}$ - $\frac{4}{5}$, valves 0.2-0.3 mm thick. Androecium laterally compressed, broadly transversely ellipsoid or kidney-shaped in outline, broadly rounded above, c. 1.1-1.5 × 1.4-2.8 mm; anthers (7-) 10-18, not septate, c. 1.5-2.0 mm long, free apices 0.1-0.5 mm, only at one side of the androecium strongly incurved; androecium hollow for at least $\frac{2}{3}$; androphore 0-0.1 mm long. Female perianths broadly ovoid-ellipsoid, 1.8-2.2 × 2.0-2.2 mm, cleft at anthesis to $\frac{1}{2}$ - $\frac{4}{5}$, valves c. 0.3 mm thick; pedicel 2-2.5 mm long; ovary ovoid, glabrous, c. 1-1.5 × 1 mm, stigma sessile, minutely 2-lobed, c. 0.1 mm high. Fruits solitary or 2-6 per infructescence, ellipsoid, top rounded to subacute, 1.3-2.8 × 1.1-1.7 cm, glabrous, drying brown or blackish, without or with sparse tubercles; dry valves 1-2 mm thick; stalk 2-5 mm long; perianth not persisting.

Distribution. Northern Moluccas, West New Guinea.

NOTES

1. A variable species with 4 varieties, closely related to *H. spicata* and *H. tuberculata*. With *H. spicata* there occur a few specimens intermediate to var. *moluccana* discussed in the notes. *H. spicata* has the generally deeply asymmetrical incurved anthers in common with *H. moluccana*, but the former differs in the pale twigs and the (almost) spike-like male inflorescences. *H. tuberculata* has largely a solid staminal column, hollowed at the apex only for the upper $\frac{1}{5}$ - $\frac{1}{3}$. See further notes under the varieties.

2. Unfortunately I have not seen the type of *H. olivaeformis*. If it turns out to be identical with the present new species, it would then have priority. Sinclair lumped this name in his large concept of *H. spicata*, from which the present new species is segregated.

The type of *H. olivaeformis*, *Beccari 171*, has been described as having a glabrous ovary, the fruits rather narrow, c. 2.3 cm long and its pericarp thin, the leaf blades 10-15 cm and petioles almost 10-15 cm long. In fruit size it agrees with var. *robusta*, known from the same area, but the petioles in that are distinctly longer than those described for *H. olivaeformis*.

KEY TO THE VARIETIES

- 1a. Hairs of leaf bud rather woolly-rust pubescent, hairs 0.2-0.3 mm long. *Vogelkop: Fak-Fak*
 **d. var. pubescens**
- b. Hairs of leaf bud up to c. 0.1 mm **2**
- 2a. Petioles 10-15 mm long. Male perianth 2.5-3 mm wide. *Morotai, Obi Isls.* **a. var. moluccana**
- b. Petioles (10-) 15-25 mm long, generally longer in proportion to the smaller blade. *New Guinea* **3**
- 3a. Leaf blades 7-15 cm long. Fruits 1.3-1.8 cm long. Male perianth 2-2.5 mm wide **b. var. petiolaris**
- b. Leaf blades 13-23 cm long. Fruits 2.2-3.0 cm long. Male perianth 3.5-3.8 mm wide ... **c. var. robusta**

a. var. moluccana

Fig. 1A(9)

Leaf blades 9-22 × 4-8 cm; petioles (8-)10-20 mm. Tomentum of leaf bud composed of hairs c. 0.1 mm long or less. Male perianths 2.0-3.0 × 2.7-3.3 mm, pedicel 2-3 mm long. Fruits c. 1.5 cm long.

Distribution. Northern Moluccas: Morotai, Obi Isls.

MOLUCCAS (Northern). Morotai: Tankilisan (exp. Kostermans) 250 (= *b.b.* 33920); *Kostermans* 673a, 899, 1513, 7888; *Lam* 3459, 3510. — Obi Isls.: *de Vogel* 4099, 4105, 4111, 4121, 4137, 4193, 4240, 4253, 4298, 4303.

Ecology. Well-drained forests on clayey soil, volcanic soil, alluvial soil rich in humus, also flat land just behind the mangrove; recorded from over limestone, or at base of serpentine-rock, or on very porous nickel-containing soil; 0-600 m alt. Flowers and fruits throughout the year.

Vernacular names. Gosora (Ternate lang.), Kulemàn (Morotai), Pala hutan (Malay lang.).

NOTES

1. *Fieldnotes.* Recorded as a straight tall tree, to 30 m. Bark peeling off or not. Once reported to have prop roots up to 1.5 m. Exudate from bark watery, turning pink, later turning brownish. Flowers yellow, once recorded as red.

2. Sinclair included a large part of the present taxon in his concept of *H. parviflora*. In the present revision *H. parviflora* is accepted in a narrower sense, and is mainly characterised by more roundish (not pear-shaped) male perianths, and by shorter petioles. *H. spicata* is closely related but differs in the paler colour of the dried twigs, the generally spike-like male inflorescences and the more membranous leaves. See also note 3.

3. *Specimens intermediate to H. spicata.* The male inflorescences of *de Vogel* 4253, from Obi Isls at sea level, are spike-like. In all other aspects, including chartaceous leaves, short and robust male perianths and brown twigs, it is identical with other material from there. *De Vogel* 4193, also from the same source, has the inflorescences almost spike-like and are thus reminiscent of those in *H. spicata*. Its leaves are membranous and it may be a hybrid; it was collected from a secondary regrowth at c. 200 m. alt. One should note that the lectotype of *H. roxburghii* Warb. (in this treatment, a synonym of *H. spicata*) is from a tree cultivated in Bogor Botanic Gardens, with Ambon as its provenance; it has inflorescences which are rather branched, not strictly spike-like and thus it looks intermediate between *H. moluccana* and *H. spicata*.

b. var. petiolaris de Wilde, *var. nov.*

Gemmae indumentum brevissimum, maxime c. 0.1 mm longum, petiolo proportione longo, 1-2 cm longo, foliorum pagina c. 7-15 cm longa, perianthiis masculis 2-2.5 mm latis, fructibus c. 1.5 cm longis. — Typus: *van Royen* 5388 (L).

Leaf blades 6-15(-19) × 2.5-6.5(-7) cm; petioles proportionally long, 10-20 mm. Tomentum of leaf bud composed of hairs up to 0.1 mm long. Male perianth 1.5-2.2 × 2.2-2.4 mm and pedicel 2-3.5 mm long. Fruits 1.5-1.8 cm long.

Distribution. Irian Jaya: Vogelkop; Islands in Geelvink Bay (Noemfoer, Meos Waar, Japen Isl.); Waigeo Isl.

IRIAN JAYA: b.b. 30587, 32987; (*Koster*) BW 1018, 1201, 1283; BW 1295; (*Kalkman*) BW 6255; (*Koster*) BW 13535; *van Royen* 5388, 5396.

Ecology. Locally common in forests on sandy or stony-clayey soils; *Calophyllum-Ficus* forest; 0-100 m. alt. Flowers and fruits throughout the year.

Vernacular names. Beterohooi (Manikiong lang.), Kamojer (Noemfoer lang.), Mbowak (Tehid lang.), Sebohongwa (Manikiong lang.).

Uses. Fruits once reported as edible and sour.

NOTES

1. *Fieldnotes*. Bark flaking. Flowers greenish. Fruits yellow or orange-yellow, seed aril red.

2. Sinclair included the specimens of var. *petiolaris* in his *H. spicata* var. *sepikensis* (Mkgf.) Sinclair; here I have, however, kept *H. sepikensis* as a separate species, characterized by a 3-valved perianth.

c. var. robusta de Wilde, *var. nov.*

Gemmae indumentum c. 0.1 mm longum, petiolis c. 1.5-2.5 cm longis, foliorum pagina 13-23 cm longa, perianthiis masculus c. 3.5 mm latis, fructibus c. 2.5 cm longis. — Typus: van Royen & Sleumer 6682 (L).

Leaf blades 12-22(-25) × 3.5-8(-9) cm; petioles 12-26 mm. Tomentum of leaf bud consisting of hairs c. 0.1 mm long. Male perianths 2.5-3 × 3.5-3.8 mm, pedicel c. 3 mm. Fruits 2.2-3.0 cm long.

Distribution. Irian Jaya: Vogelkop Penins.; Batanta Isl.

IRIAN JAYA: (Moll) BW 9775; van Royen 3548; van Royen & Sleumer 6682.

Ecology. Secondary and coastal forest, on limestone; 0-15 m. Flowers and fruits throughout the year.

Vernacular name. Kamore (Biak dial.).

NOTES

1. *Fieldnotes*. Bark flaking. Flowers yellow, fragrant. Fruits yellow.

2. Sinclair included the present variety in his *H. spicata* var. *spicata*. He has annotated on the type sheet (van Royen and Sleumer 6682) that it looked to him intermediate to *H. sepikensis* (in Sinclair's sense).

3. Var. *robusta* is a form similar to var. *petiolaris* but is coarser in all aspects: the leaves, flowers and fruits are all larger. It superficially resembles *H. tuberculata*, which differs in the generally shorter petioles, the androecium — the anthers not strongly inflexed into the cavity — as is the case in the present var. *robusta*.

d. var. pubescens de Wilde, *var. nov.*

Gemma lanata, e pilis c. 0.3 mm longis composita. — Typus: Vink BW 15370 (L; iso: K).

Leaf blades (6-)8-14 × (2.5-)3-5 cm; petioles (9-)11-18 mm long. Tomentum of leaf bud ± woolly, composed of hairs 0.2-0.3 mm long. Flowers not seen. Fruits c. 1.3 cm long.

Distribution. Irian Jaya: Vogelkop Penins.

IRIAN JAYA. Vogelkop Penins.: BW (Iwanggin) 5640, (Schram) 6153, (Iwanggin) 10153, (Vink) 15370.

Ecology. Common in primary and secondary forest on clayey soil or sandy clay over limestone; 50-300 m. alt. Fruits in March and May.

Vernacular names. Kamorei (Biak lang.), Medak (Mooi lang.), Sēmies, Simies (Maibrat lang.).

NOTES

1. *Fieldnotes.* Tree to 16 m; buttresses up to 1 m high, 0.5 m wide; bark strongly peeling. Inner bark reported as with much red and clear exudate. Wood white. Fruits light green. Most collections are from limestone.

2. This variety appears to be almost identical with the var. *petiolaris*, except for the more woolly tomentum. In *Horsfieldia*, usually the nature of the tomentum has appeared to be of taxonomic significance. Flowers are not known.

3. The bark of the older wood in the Kew duplicate of *BW 15370* is one that flakes strongly; that in the Leiden specimen and some other collections, of older twigs behind the leaves, is one that does not or flakes minimally.

4. Sinclair included the specimens of the present variety in his *H. spicata* var. *sepikensis* (Mkgf.) Sinclair, as those of the preceding variety.

10. *Horsfieldia parviflora* (Roxb.) Sinclair

Fig. 1A(10)

Myristica microcarpa Willd. in Roem. & Usteri, Bot. Mag. 3, 9 (1790) 27; Sp. Pl. 4, 4, 2 (1806) 871 (excl. var. B = *H. spicata*, incl. var. γ). — Based on *Palala* "kitjil", *P. minima* Rumph.; var. γ based on *P. globularia* Rumph.; identity doubtful, see Sinclair 1975, p. 168-170.

M. parviflora Roxb., Fl. Ind. 3 (1832) 847; (ed. 1874) 744; Icones 2574. — *H. parviflora* (Roxb.) Sinclair, Gard. Bull. Sing. 28 (1975) 82. — Type: *Roxburgh's description and figure*.

M. tingens Bl., Rumph. 1 (1837) 190 — *Horsfieldia* sp. Merr., Int. Rumph. (1917) 231 — Based on *Palala minima*, *P. tertia*, *P. tingens* Rumph., Herb. Amb. 2, 10 (1741) 27, t. 7 f. A-B; see Sinclair 1975, p. 161.

M. globularia Bl., Rumphia 1 (1837) 191, t. 64, fig. 2 (non Lamk.) — *Pyrrhosa globularia* (Bl.) Hassk., Cat. Pl. Hort. Bog. (1844) 174 — *H. globularia* (Bl.) Warb., Mon. Myrist. (1897) 288, t. 21 (1-4). — *Palala globularia* (= *P. quinta*) Rumph., Herb. Amb. 2, 10 (1741) 28, t. 9 f. a-b (see Sinclair 1975, p. 165-167). — Type: *Blume's figure*, and *Zippel s.n.* (Ambon, "mas"), a sterile specimen.

M. bivalvis Hook.f., Fl. Brit. Ind. 5 (1886) 107; King, Ann. Roy. Bot. Gard. Calc. 3 (1891) 307, pl. 139. — *H. bivalvis* (Hook.f.) Merr., Phil. J. Sc. Bot. 2 (1916) (issued Jan. 1917) 271; Sinclair, Gard. Bull. Sing. 16 (1958) 379, fig. 32, pl. VIII B. — Type: *Murton 149* (K).

H. globularia var. *minahassae* Warb., Mon. Myrist. (1897) 617. — *H. minahassae* (Warb.) Koord., Fl. N.O. Cel. (1898) 70 — Type: *Koorders 18123* β (BO), *18124* β (BO), *18146* β (BO, L), *18164* β (BO; L, lecto).

Tree 10-20 m. Twigs in apical portion somewhat flattened but not angular, lower down terete, not ridged, 2-5(-10) mm diam., glabrescent from a minute tomentum composed of hairs c. 0.1 mm; bark finely striate, brown when older not flaking, lenticels smallish, abundant, not very conspicuous. Leaves in two rows, membranous, oblong-lanceolate to lanceolate, broadest at or slightly above the middle, 8-23 \times 2.5-7.5 cm, base attenuate, top acute-acuminate; upper surface drying olivaceous to dark brown, dull, faintly finely paler punctate-pustulate or not (rarely with pale, irregularly shaped marks as in *H. irya*), lower surface early glabrescent.

without blackish dots; midrib flat above; nerves 10-15 pairs, flattish and inconspicuous above, marginal arches not distinct; tertiary venation indistinct, forming a rather fine network; petiole 6-16 × 1.5-2.5 mm; leaf bud slender, c. 6-13 × 1-2 mm, with hairs c. 0.1 mm long or less. Inflorescences with sparse to dense tomentum of hairs 0.1-0.3 mm; in both ♂ and ♀ 3-4 times ramified, many flowered, (4-)6-10 × 4-8 cm, common peduncle 1-2 cm long; bracts pubescent, elliptic to oblong, 2-5 mm long, caducous. Flowers in loose clusters of 2-4 each, perianths 2-valved, glabrous or in ♀ sometimes minutely pubescent at base, pedicels sparsely pubescent with the hairs c. 0.1 mm long or less, at base inarticulate. Male perianth ± obtriangular to transversely ellipsoid, somewhat laterally compressed, 2.2-3.0 × 2.5-4 mm, upper part broadly rounded, at base short-attenuate, rather firm, on drying not collapsing, often bright brown or with a grey-blue tinge; pedicel slender, 1-2 mm long. Perianth at anthesis cleft to c. ½-way, valves (0.1-)0.2-0.3 mm thick. Androecium transversely ellipsoid or ± obtriangular, only slightly or not laterally compressed, largely hollow, (1.0-)1.6-2.2 × 1.6-3.0 mm; anthers (18-)20-25, mutually completely connate, forming a thin-walled cup, the anthers (sometimes only of one side of the androecium) completely inflexed from their middle and reaching nearly to the bottom of the cup; free apices of anthers 0-0.1 mm; androphore rather narrow, (0-)0.1-0.3 mm long. Female perianth ellipsoid, c. (2.5-)3-3.5 × 2.5 mm, at anthesis cleft to c. ⅓, valves c. 0.3 mm thick, pedicel 1-2 mm, thinly pubescent with the hairs c. 0.1 mm; ovary ovoid-ellipsoid, c. 2-2.3 × 1.5 mm, glabrous, style and stigma minute, 2(-3)-lobed, 0.1-0.2 mm long. Fruits 2-10 per infructescence, ellipsoid to nearly globose, 1.1-1.6 × 1.0-1.3 cm, glabrous, finely granulate, not or hardly tuberculate, drying brown; dry valves 1-1.5 mm thick; stalk 2-4 mm; perianth not persisting.

Distribution. Celebes (incl. Kabaëna Isl.); Moluccas: Ceram, Ambon; running wild in the Gardens Jungle of the Botanic Garden, Singapore.

Cultivated. Java (Bot. Garden Bogor): *Forbes 1184a*; *Rastini 105*, (206), (223); *Woerjantoro 99*. — Singapore (Bot. Garden): *Ding Hou 134*; *Murton 149*; *Ridley s.n.*, 393; *Furtado SFN 34818*; *Sinclair 7493*.

CELEBES: *b.b. 5432, 8459, 13748, 20754*; *Elbert 3457*; *Koorders 18146 β, 18164 β*; *Meijer 11286*.

CERAM: *Kuswata & Soepadmo 86, 236*.

AMBON: *Kuswata & Soepadmo 292*; *de Vriese & Teysmann s.n.*; *de Vriese s.n.*; *Zippel s.n.* ("mas").

Ecology. Forests; once recorded from sandy loam; 0-600 m alt. Flowers and fruits throughout the year.

Vernacular names. Kolantie, Niniwo (Celebes).

NOTES

1. *Fieldnotes.* Tree without buttresses. Bark smooth or fissured. Wood whitish. Flowers yellow, fragrant; anthers yellowish-white. Fruits ramiflorous, yellow to light brown. Aril bright red, once recorded as yellow (unripe?).

2. *Variation.* The male flowers of *Koorders 18146 β* (syntype of *H. globularia* var. *minahasae*), and those of e.g., *Ding Hou 134* (Bot. Garden Singapore) are relatively large, the perianths being as wide as c. 4 mm.

The androecium of *b.b.* 13748 (N. Celebes) is relatively short, measuring c. 1×2.5 mm; its flower are small, c 3 mm in width.

Kuswata & Soepadmo 236, W. Ceram, has comparatively small fruits, c. 1.1×1.0 cm.

Elbert 3457 (Kabaëna Isl., limestone; S. Celebes) has rather large fruits, c. 1.6 cm long, with a distinct pseudo-stalk 1.5-2 mm long.

3. *H. parviflora* is easily distinguished by the smooth and rather inflated male perianths, which do not collapse on drying, are \pm obtriangular to transversely ellipsoid in lateral view, and usually dry to a bluish or reddish-brown tinge. The androecium is largely hollow, inflated, cupshaped, composed of anthers connate along the whole length; the distal end from approximately $\frac{1}{2}$ -way curved into the androecium, almost reaching the bottom.

4. In Sinclair's sense, *H. parviflora* has a much wider circumscription than is accepted here. The material he included is here referred to various different species such as *H. obscurinervia* and the variable *H. laevigata*.

5. *Typification.* *H. parviflora* was described on a female specimen cultivated in the Botanic Gardens at Calcutta, and apparently no authentic material is preserved. Sinclair (p. 88, 122) discussed elaborately the identity of Roxburgh's descriptions.

Although named 'parviflora' because of the female flowers, our present species has male perianths of 2.5-4 mm wide, which is among the largest in *Horsfieldia*.

11. *Horsfieldia obscurinervia* Merr.

Fig. 1A(11)

H. obscurinervia Merr., Phil. J. Sc. C. Bot. 12, 5 (1917) 265; En. Phil. Fl. Pl. 2 (1923) 182. — Type: *de Mesa & Magistrado* FB 26503 (iso: K).

H. ramosii Merr., Phil. J. Sc. 17, 3 (Sept. 1920) (1921) 254; En. Phil. Fl. Pl. 2 (1923) 182. — Type: *Ramos* BS 35047 (PNH, n.v. (iso: K)).

Tree c. 11 m. Twigs terete, not ridged, 1.5-4 mm diam., glabrescent from a minute tomentum of greyish hairs less than 0.1 mm long; bark finely striate, when older not flaking; lenticels present, rather distinct. Leaves in two rows, chartaceous, oblong-lanceolate to lanceolate, $5-14 \times 2-4$ cm, broadest at or slightly above the middle, base attenuate, tip acute-acuminate; upper surface drying olivaceous to brown, \pm glossy, lower surface early glabrescent, without larger dark dots; midrib flat above to slightly raised; nerves 7-15 pairs, slender, very inconspicuous on both surfaces, marginal arches very inconspicuous; tertiary venation hardly visible; petiole $6-15 \times 1-1.5$ mm; leafbud c. $6-10 \times 1.5-2$ mm, with hairs 0.1 mm long or less. Inflorescences sparingly pubescent or subglabrous with hairs c. 0.1-0.3 mm long; in σ : 2-3 times ramified, rather few-flowered, c. $3-4 \times 2-3$ cm, common peduncle 5-10 mm; bracts and bracteoles not seen, caducous; ρ inflorescences not seen. Flowers solitary or 2 or 3 together, perianths 2-valved, glabrous; pedicel glabrous, at base inarticulate. Male perianth subobtriangular, broadly rounded above, \pm cuneate at base, c. 2×2.2 mm, rather firm, on drying not collapsing, bright brown, pedicel slender, c. 1 mm long; perianth at anthesis cleft to c. $\frac{1}{2}$ -way, valves 0.2-0.3 mm thick. Androecium \pm obtriangular or obovoid,

narrowed to the base, only slightly laterally compressed, thickish, c. 1.5×1.2 mm, largely hollow; anthers 11 or 12 (i.e., 11 or 12 thecae on each side), almost completely connate, forming a firm thick-walled cup reaching to c. $\frac{2}{3}$ of the androecium, the anthers at one side deeply inflexed into and almost completely filling the cup; free apices of anthers 0-0.1 mm; androphore narrow, short, c. 0.1 mm long. Female perianths not seen. Fruits 2-5 on once or twice ramified stalk, infructescences 2-3 cm long; fruits short-ellipsoid, $1.1-1.3 \times 0.9-1.1$ cm, almost glabrescent but with minute dendroid hairs at base (hence ovary pubescent), finely granulate, not tuberculate, drying (reddish) brown; dry valves 1-1.5 mm thick; stalk 2-5 mm; perianth not persisting.

Distribution. Philippines: Luzon.

PHILIPPINES: *de Mesa & Magistrado* FB 26503; *Ramos & Edano* BS 33693; *Ramos* BS 35047.

Ecology. On low hills at c. 20 m. Flowers in July, fruits November and December.

Vernacular name. Duguan.

NOTES

1. *Fieldnotes.* Small tree; flowers yellow.

2. Related to *H. parviflora* from the Moluccas on account of the almost similar flower structure; *H. parviflora* differs by its larger membranous leaves, larger male perianths of 2.5-4 mm width, more (18-25) anthers, thinner-walled and deeper androecium-cup, with the anthers usually inflexed at both sides of the androecium, and the glabrous ovary and fruit.

3. Sinclair (p. 83, 90) treated *H. obscurinervia* as a synonym of *H. parviflora*.

12. *Horsfieldia ardisiifolia* (DC.) Warb.

Fig. 1A(12); 9

Myristica ardisiifolia A. DC., Ann. Sc. Nat. Bot. 4, 4 (1855) 31, t. 4; Prodr. 14, 1 (1856) 203 (*ardisiaefolia*). — *H. ardisiifolia* (DC.) Warb., Mon. Myrist. (1897) 274; Sinclair, Gard. Bull. Sing. 28 (1975) 3. — Type: *Cuming* 1702 (iso: L).

H. warburgiana Elmer, Leafl. Phil. Bot. 3 (1911) 1061; Merr., En. Phil. Fl. Pl. 2 (1923) 183. — Type: *Elmer* 12297 (iso: K & L, only the fruits, see the notes).

H. gigantifolia Elmer, Leafl. Phil. Bot. 9, 123 (1925) 3120, 3129; 10, 136 (1939) 3763, *nom. nud.* — Type: *Elmer* 17220 (iso: L).

Tree 5-10 m. Twigs flattened in the apical part, 2-angular, lower down terete with two distinct ridges from petiole to petiole, 3-6(-13) mm diam., early glabrescent from the bright rusty tomentum composed of hairs 0.3-0.5(-0.8) mm long; bark rather smooth to striate, distinctly lenticellate; not flaking when older. Leaves in 2 rows, membranous, elliptic-oblong to oblong, $20-40 \times 5.5-15$ cm, base nearly rounded to attenuate, tip acute-acuminate; upper surface drying olivaceous to blackish-brown, finely minutely paler pustulate or not, lower surface early glabrescent except for some tomentum remaining on the midrib, consisting of rather coarse hairs 0.3-0.5 mm; larger dark dots absent; midrib fairly broad, flattish above; nerves 18-28 pairs, slender above, flattish, the marginal arches rather

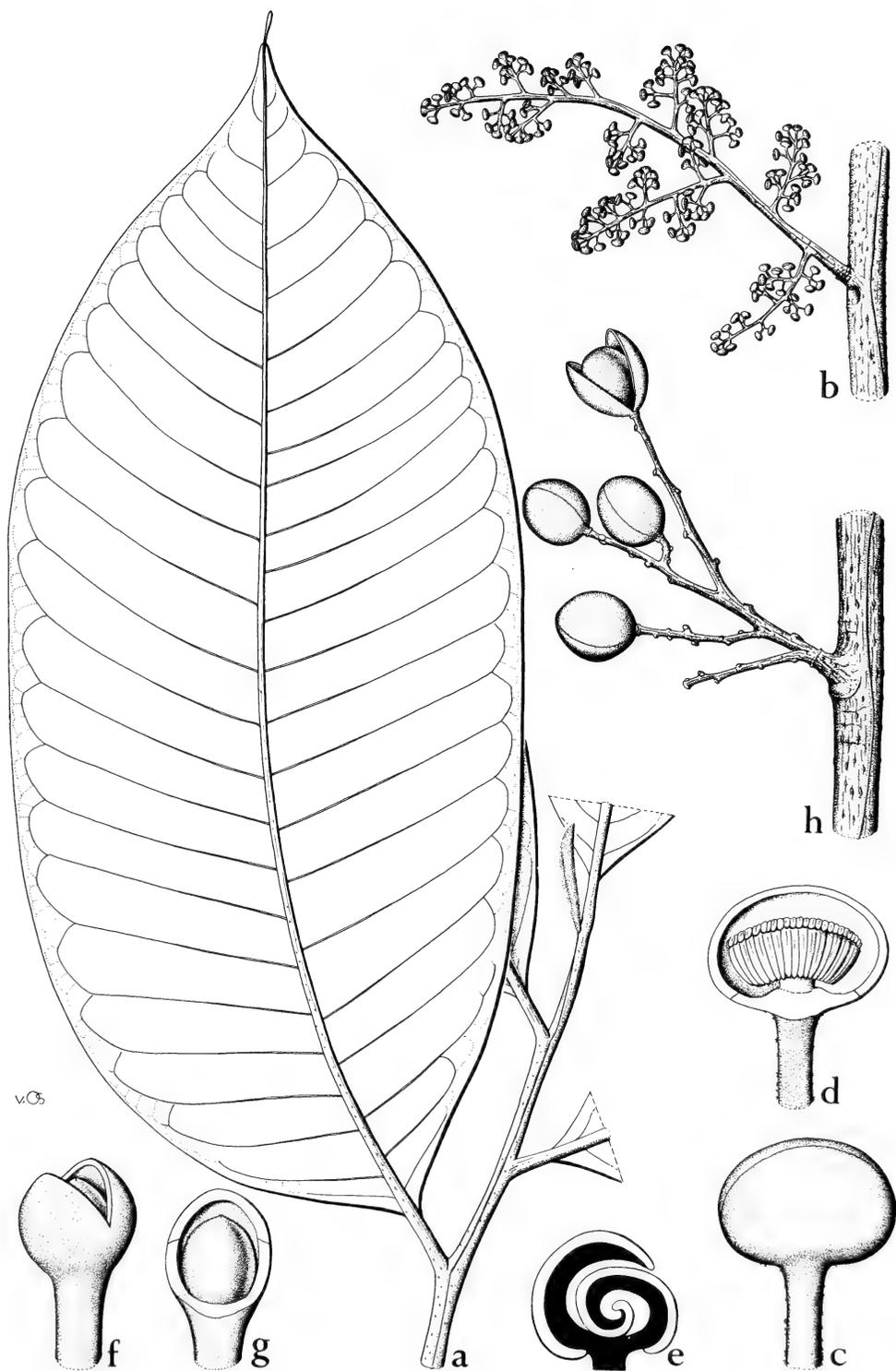


Fig. 9. *Horsfieldia ardisiifolia* (A. DC.) Warb.

a, leafy twig apex, note ridged twig, $\times \frac{1}{2}$; *b*, twig portion with male inflorescence in axil of fallen leaf, $\times \frac{1}{2}$; *c*, mature male flower, lateral view, $\times 6$; *d*, ditto, opened, showing androecium, $\times 6$; *e*, androecium, longitudinal section, schematic, $\times 12$; *f*, mature female flower, lateral view, $\times 6$; *g*, ditto, opened, showing glabrous ovary with minute stigmas, $\times 6$; *h*, twig portion with infructescence with ripe fruits. — *a*, Ramos BS 39770; *b*, Sulit PNH 6236; *c-e*, Elmer 12337; *f* & *g*, Elmer 17220; *h*, Conklin PNH 17461.

regular and distinct beneath; tertiary venation forming an inconspicuous lax network; petiole 13-16 × 3-4.5 mm. Leaf bud 10-20 × 3-4 mm, pubescent with hairs 0.3-0.8 mm long. Inflorescences thinly pubescent with stellate-dendroid hairs c. 0.3 mm; in ♂: 3-4 times ramified, rather many-flowered, broadly pyramidal, c. 7-16 × 6-14 cm, common peduncle 5-10(-20) mm; in ♀: 4-8 cm long. Bracts broadly ovate, pubescent, c. 3-4 mm long, caducous. Flowers solitary or 2-4 together, perianths 2-valved, glabrous, pedicels glabrous or glabrescent from sparse hairs, slender, at base inarticulate. Male perianth transversely ellipsoid or reniform, moderately laterally compressed, drying dull, ± collapsed on drying or not, 2.5-3 × 4-4.5 mm, above broadly rounded, below broadly rounded to sometimes with a basal sinus; pedicel 1-2(-4) mm, glabrous or with few scattered hairs 0.2-0.3 mm; perianth at anthesis cleft to c. $\frac{4}{5}$ - $\frac{5}{6}$, valves c. 0.2(-0.3) mm thick. Androecium broadly transversely ellipsoid, slightly laterally flattened, hollow, c. 1.5 × 3-3.5 mm, anthers (18-)20-24, for c. $\frac{1}{2}$ -way connate and forming a cup in which the anthers from one side are deeply inflexed, the anthers from the other side for a large part overarching the former; anthers sometimes slightly sagged at base, hiding the rather narrow androphore c. 0.2-0.3 mm long. Female perianth subglobose-ovoid, c. 2.5 mm diam., at anthesis cleft to c. $\frac{1}{2}$ -way, valves c. 0.3 mm thick, pedicel c. 2(-2.5) mm long, (sub)glabrous; ovary broadly ovoid-subglobose, 1.5-1.7 mm diam., glabrous, stigmas sessile, as 2 minute lobes c. 0.1-0.2 mm. Fruits 2-6 per infructescence, broadly ellipsoid to subglobose, 20-25 × 17-20 mm, glabrous (or possibly with few minute hairs at base), finely rugulose, without marked tubercles, drying (reddish-)brown; dry valves 1.5-2 mm thick; stalk 3-6 mm long; perianth not persisting.

Distribution. Philippines: Luzon, Mindoro, Sibuyan, Samar, Leyte.

PHILIPPINES: *Brass* 1220; BS (*Bermejos*) 1518, (*Ramos*) 39770, 40823, 46414; *Cuming* 1702; *Elmer* 7094, 12067, 12297, 12337, 17220; For. Bur. (*Parras & Aduiso*) 28297; *Gaudichaud s.n.*; *PNH* (*Celestino & Castro*) 1925, (*Sulit*) 6236; (*Conklin*) 17461.

Ecology. Lowland forest in moist valleys. Flowers and fruits throughout the year; 0- c. 400 m.

Vernacular names. Aragay (Mangalang, Mindoro), Dagoan (C. Biscuay), Tapol (Tagbilaran), Lagasi (Biscuay Isl.).

NOTES

1. *Fieldnotes.* Flowers reported as yellow or lemon yellow, fragrant. Fruits orange-red.

2. According to Sinclair (p. 5) this species is closely related to *H. spicata*. Sinclair's idea of *H. spicata* embodied several taxa, which are presently regarded as different species because of differences in the androecium. As can be seen from the present key to the species it is now considered as being close to species like *H. parviflora* and *H. smithii* from the Moluccas, i.e., of the group with anthers strongly incurved or inflexed into the androecium-cup. *H. ardisiifolia* is quite distinct by its stout habit, with thick twigs which are winged or ridged, large leaves, coarse tomentum on the leaf bud, large male perianths (4-4.5 mm wide), broad androecium with the anthers deeply incurved and clasping each other.

3. Of the type of *H. warburgiana*, *Elmer* 12297, I have seen only two isotypes, in K and L. They are conspecific and consist of a leafy twig, and fruits in an attached

envelope. The fruits belong to *H. ardisiifolia*, but the leafy twigs are most likely *H. macrocoma*, a species which is recently referred by me to a new genus *Endocomia* (1984).

In 1959 Sinclair identified *Elmer 12297* in L as *H. ardisiifolia* but later he regarded that name a synonym of *H. brachiata* var. *sumatrana*, a taxon of which the Philippine specimens are presently referred by me to various other species.

13. *Horsfieldia talaudensis* de Wilde, *sp. nov.*

Fig. 1A(13)

Horsfieldia species perianthiis masculis 2-valvatis atque antheris inflexis, ex affinitate *H. ardisiifoliae*, ab ea differt virgis teretibus non-angularibus, perianthio minore c. 2.5 mm diam. atque pedicellis pubescentibus. Typus: *Lam 2628* (L).

Tree 15-35 m. Twigs terete, not ridged, towards the apex 2-4(-7) mm diam., early glabrescent, tomentum scarce, composed of hairs 0.1 mm or less; bark striate, not flaking when older, lenticels rather inconspicuous. Leaves in 2 rows, membranous to chartaceous, oblong-lanceolate, 8-30 × 2.5-10 cm, base attenuate, tip acute-acuminate, finely paler pustulate on both surfaces; upper surface drying greenish to dark brown, lower surface bright brown, early-glabrescent, hairs minute, stellate-scaly, 0.1 mm long or less, dark dots absent; midrib flat above; nerves 12-20 pairs, above slender, flat, inconspicuous, marginal arches not distinct, tertiary veins thin, indistinct on both surfaces; petioles 10-18 × 1.5-3 mm, leaf bud c. 10 × 2 mm, with hairs c. 0.1 mm. Inflorescences densely pubescent with hairs 0.1-0.2 mm, c. 3 times ramified, in ♂ and ♀ c. 4-8 × 3-4 cm, rather many-flowered, common peduncle 1.5-2 cm; bracts broadly ovoid-ellipsoid, densely pubescent, 1.5-3 mm long, caducous. Flowers in ♂ in clusters of 2-3 each, perianths 2-valved, glabrous; pedicel pubescent, at base inarticulated. Male perianth transversely ellipsoid, only little laterally compressed, c. 2-2.2 × 2.5-3 mm, broadly rounded above and at the base, glabrous, drying brown, not collapsing; pedicel slender, 1-1.5 mm, rather densely pubescent with grey or pale brown hairs c. 0.1 mm; perianth at anthesis cleft to $\frac{2}{3}$ - $\frac{4}{5}$, valves rather firm, c. 0.2-0.3 mm thick. Androecium transversely ellipsoid to reniform, not much compressed, c. 1.5 × 2 mm; anthers c. 18, closely set, connate for about $\frac{1}{2}$ -way and forming a ± saucer-shaped cup or cavity into which the free apical halves of the anthers are inflexed; young anthers septate; androphore slender, 0.2-0.3 mm long. Female flowers not seen. Fruits 3-10 per infructescence, short-ellipsoid, top and base rounded, 1.5-1.6 × 1.3-1.4 cm, glabrescent, tomentum of stellate hairs c. 0.1 mm or less (hence ovary pubescent), drying brown, without conspicuous tubercles, dry valves c. 1.5 mm thick, stalk 3-4 mm long; perianth not persisting.

Distribution. Moluccas: Talaud Isls. (Karakelong); possibly Celebes: Minahassa (see notes).

CELEBES. Minahassa: *Koorders 18136* B (doubtful, see notes).

MOLUCCAS. Talaud Isls.: *Lam 2638, 2650, 2811, 2929.*

Ecology. Old forest on mountain slopes; 70-200 m alt. Flowers in April, fruits in April and May.

Vernacular name. Larán'a.

NOTES

1. *Fieldnotes*. Tree to 35 m. Ripe fruits orange or brownish yellow.

2. Possibly endemic on the Talaud Isls. A species of the group with the androecium having strongly inflexed anthers, characterised by the firm, transversely ellipsoid to subglobose male perianth, by the anthers connate to c. $\frac{1}{2}$ -way, by hairy, short but slender pedicels, and by the pubescent ovary (thinly pubescent young fruit).

3. The specimen from the Minahassa (Celebes; *Koorders 18136 B*) is sterile but agrees vegetatively, in the leaf colour and texture, and very well with the fruiting specimens from Talaud Isls.

4. The specimens belonging to the present new species were included by Sinclair in *H. parviflora*, a species presently accepted in a much narrower sense.

14. *Horsfieldia samarensis* de Wilde, *sp. nov.*

Fig. 1A(14)

Horsfieldia species perianthiis masculis 2-valvibus et antheris profunde inflexis, ex affinitate *H. ardisiifoliae* atque *H. talaudensis*, ab *H. ardisiifolia* differt virigis non-angularibus et floribus minoribus, ab *H. talaudensi* antheris inflexis solum ad unum androecii latus atque pedicellis perianthio longioribus. — Typus: *Gutierrez PNH 147374* (L).

Tree 5 m. Twigs terete, not ridged, towards the apex 1.5-3.5 mm diam., early glabrescent, tomentum minute, of greyish hairs less than 0.1 mm; bark finely striate, when older not flaking, lenticels rather inconspicuous. Leaves in 2 rows, membranous, oblong-lanceolate to lanceolate, c. 7-11 × 2-3 cm, base attenuate, tip acute-acuminate, not finely, paler pustulate: upper surface drying dull olivaceous, lower surface bright brown, early glabrescent, hairs sparse, less than 0.1 mm, without dark dots; midrib slightly raised above; nerves 10-13 pairs, above slender, flat, rather contrasting in colour; marginal arches on lower surface faint but rather regularly looping; tertiary venation inconspicuous on both surfaces; petioles c. 8-10 × 1-1.5 mm, leaf bud c. 10 × 1 mm, with hairs less than 0.1 mm. Inflorescences glabrescent or thinly pubescent by stellate scales c. 0.1 mm or less, rather slender, in ♂: 2-3 times ramified, 3-4 × 1.5-2.5 cm, rather few-flowered, common peduncle c. 1-1.5 cm; bracts not seen, caducous. Male flowers solitary or in loose clusters of 2 or 3 together; perianths 2-valved, glabrous, pedicels glabrous, at base inarticulate. Male perianth transversely ellipsoid, only slightly laterally compressed, 2-2.2 × 2.5-2.7 mm, above and below broadly rounded, drying brown, firm, not collapsing, glabrous; pedicel slender, (1.5-)2-3 mm long, glabrous; perianth at anthesis cleft to $\frac{2}{3}$ - $\frac{4}{5}$, the valves rather firm, 0.2(-0.3) mm thick. Androecium broadly obovoid to transversely short-ellipsoid, 1.2-1.3 × 1.4-1.5 mm, thickish, 0.8-0.9 mm thick; anthers 14 or 15, closely set, septate when immature, largely connate and forming a rather thick-walled saucer-shaped cup into which the anthers at one side inflect deeply nearly to the base, clasping and covering the other anthers, the inflexed parts of the anthers mutually free; androphore narrow, (0-)0.1 mm long. Female flowers and fruits not seen.

Distribution. Philippines: Samar Isl. (only known from the type).

Ecology. North slope, 600-800 ft. Flowers in May.

NOTES

1. *Fieldnotes*. Tree c. 5 m tall, dbh c. 6 cm. Inflorescence (flowers) green.
2. According to the flower structure related to *H. talaudensis*, but differing in several points. *H. talaudensis* is stouter, with male inflorescences stouter, more densely pubescent; its pedicels are shorter (shorter than the perianth) and densely pubescent, the perianth somewhat larger, the androecium with the anthers inflexed from both sides into the cavity.
3. The specimen on which the present new species is based was collected after Sinclair's revision.

15. *Horsfieldia smithii* Warb.

Fig. 1A(15)

H. smithii Warb., Mon. Myrist. (1897), 270, t. 21, 1-3. — *Myristica smithii* (Warb.) Boerl., Handl. Fl. Ned. Ind. 3, 1 (1900) 87 — Type: *Smith s.n.* (1797, in BM sheet numbered 296) (iso: BM, K, L; LINN, B†, BR & G, *n.v.*).

Tree 10-20 m. Twigs in apical portion flattish and 2-angled, often somewhat yellowish, lower down subterete, with two distinct or faint ridges or lines from petiole to petiole, 2.5-5(-8) mm diam., glabrescent, minute tomentum with hairs 0.1 mm long or less; bark finely striate, when older not flaking, lenticels rather small and inconspicuous. Leaves in 2 rows, membranous, oblong-lanceolate, (10-) 15-30 × (4-) 5-10 cm, base attenuate, tip acute-acuminate; upper surface drying olivaceous to brown, with fine minute paler pustules or not, almost always with larger irregular whitish marks, lower surface early glabrescent, hairs 0.1 mm long or less; without dark dots; midrib above slender, flat; nerves 10-18 pairs, above thin and flat or slightly raised, inconspicuous, marginal arches not distinct; tertiary venation forming a rather lax network, indistinct; petiole 10-16 × 1.5-2.5 mm; leaf bud c. 10 × 2 mm with hairs c. 0.1 mm or less. Inflorescences with sparse to dense tomentum of hairs c. 0.1 mm or less; in ♂: (2-) 3-4 times ramified, many-flowered, c. 5-8 × 4-8 cm; in ♀: c. 2-3 cm long; common peduncle 5-15 mm; bracts not seen, caducous. Flowers 2-4 together, perianths and pedicels glabrous, perianths 2-valved; pedicel glabrous, at base inarticulate. Male perianth subcircular to distinctly transversely ellipsoid or slightly reniform, laterally compressed, dull and usually ± collapsed on drying, 2.5-3.0 × 3-4 mm, above broadly rounded, at base rounded, or subtruncate, or shortly tapering; pedicel slender, 1.5-2 mm; perianth at anthesis cleft to c. $\frac{2}{3}$ - $\frac{3}{4}$, valves 0.1-0.2 mm thick. Androecium as viewed laterally from the broad side transversely ellipsoid, inflated, consisting of a bunch of anthers 1-1.5(-2.0) × 2.5-3.5 mm, and a sterile basal part or androphore, rather tapering, 0.5-0.8 mm long; anthers 12-15 (i.e., 12-15 thecae at both sides of the androecium), the thecae slender, mutually almost free, c. 1.5-2 mm long, their upper halves deeply curved into the cavity; which extends almost to the base of the androecium, the thecae subdorsally attached to the rim of the androphore only at the base. Female perianth ovoid-ellipsoid, 2-3 mm diam., at anthesis cleft to c. $\frac{1}{2}$ -way, valves c. 0.3 mm thick, pedicel c. 2 mm long, thinly pubescent; ovary globose-ovoid, c. 2 × 1.7 mm, glabrous, stigma c. 0.1 mm long or less. Fruits 1-3 per infructescence, ellipsoid, 1.5-2.0 (-3.0) × 1.4-1.6 cm, glabrous, drying brown, with scattered small tubercles or lenticels; dry valves 1.5-2 mm thick; stalk 3-5 mm long; perianth not persisting.

Distribution. Moluccas: Ceram, Banda, Damar Isls., possibly Ternate (see notes).

CERAM: Kornassi (exp. Rutten) 218; Rutten 1776.

BANDA: Cult. hort. Bogor: Anon. 270 (anno 1901); Forbes 1158 (anno 1880); Koerniasih 42; Banda, Chr. Smith s.n. & 296 (May 1797).

DAMAR Isls.: Riedel s.n. (syntype *H. novoguineensis*, not the lectotype).

TERNATE: ? Smith s.n. (see the notes).

Ecology. Nothing known.

Vernacular names. Pohon lobi-lobi (Banda, Ceram), Pala oetan (Ceram).

NOTES

1. *Fieldnotes.* Flowers yellow, in May and October; fruits yellow with whitish dots, in October; 0-100 m alt.

2. Closely related to *H. palauensis*, *H. parviflora* and *H. ardisiifolia*, with which it shares the character of largely free thecae which are curved into the hollowed \pm cup- or saucer-shaped androphore; the more or less incurved anthers of *H. irya* are reminiscent, but in this latter species the perianth is much smaller and the anthers are shorter and free at the apex for only c. 0.2 mm; in *H. moluccana* the male perianth is \pm pear-shaped and the anthers are largely inter-connate.

3. The present species as well as related species like *H. parviflora*, *H. ardisiifolia*, and also *H. irya* and *H. moluccana* may have somewhat ridged or angular twigs, and in sterile or fruiting stages may be confused with species with typically ridged or winged twigs, e.g., *H. angularis*, and a few species confined to West Malesia.

4. With Warburg's key, *H. smithii* is keyed out (p. 262) in a group (series *Smithii*) which is characterized by 2-valved perianths, ridged twigs and interconnate anthers. However, in reality the anthers appear to be almost entirely or largely mutually free, with the long free portions of the thecae deeply curved into the \pm bowl-shaped androecium.

5. Sinclair included the present species in his broad concept of *H. spicata*, the latter presently accepted by me in a much narrower sense, and regarded as distinct by the spicate male and female inflorescences, pear-shaped male perianths, erect uncurved anthers, etc.

6. The specimen from Damar Isls. (Riedel. s.n.) was determined by Sinclair as *H. parviflora* which in his notion is also a broad species and which I accept in a narrower sense. *H. parviflora* differs from *H. smithii* by the less distinctly ridged or lined twigs, the thicker male perianths which do not collapse on drying, the more rigid and broader (wider) androecium with the thecae only mutually free in the long incurved portions, and by the absence of irregularly shaped whitish marks on the leaves.

7. The specimens from Ternate (possible collected by Smith, Oct. 1801; in BM) bears immature female flowers with glabrous ovaries. The indumentum of the inflorescences is rather thick and woolly, and the specimen could well be *H. irya*, a species usually with similar whitish markings on the leaves.

16. *Horsfieldia palauensis* Kanehira

Fig. 1A(16)

H. palauensis Kanehira, New Trees Micronesia I, in Bot. Mag. Tokyo 46 (1932) 452 ('palauense'); Fl. Micronesica (1933) 111, Fig. 33; Bot. Mag. Tokyo 47 (1933) 670, in the notes to *H. amklaal*; An Enumeration of Micronesian Plants, in J. Dept. Agric. Kyushu Imp. Univ. 4, 6 (1935) 319. — Type: Kanehira 270 (♀), Palau Isls. (FU, *n.v.*; iso: BISH, FI; NTS, *n.v.*).

H. glabra auct. non (Bl.) Warb.: Kanehira, Bot. Mag. Tokyo 45 (1931) 280.

Tree 7-15 m. Twigs terete, lined from petiole to petiole, c. 3-4(-8) mm diam., early glabrescent, tomentum minute, with hairs c. 0.1 mm; bark striate, when older not flaking, lenticels minute and rather indistinct. Leaves in 2 rows, membranous to subchartaceous, oblong(-lanceolate) to lanceolate, 10-22 × 3.5-7 cm, base short-attenuate to rounded, tip obtuse to acute-acuminate; upper surface drying olivaceous brown to dark brown, not finely pustulate, sometimes with a few paler marks of irregular shape, lower surface early glabrescent from hairs 0.1 mm or less, without dark dots; midrib slender above, flat or slightly raised; nerves 10-20 pairs, thin and flat above, inconspicuous, marginal arches indistinct; tertiary venation forming a rather lax network, indistinct or invisible; petiole 10-16 × 1.5-2 mm; leaf bud c. 10 × 2 mm, with tomentum of hairs c. 0.1 mm or less. Inflorescences with sparse to dense woolly rusty tomentum with hairs 0.1-0.3 mm; in ♂ and ♀: 2-3 times ramified, rather few- to many-flowered, ± short, c. 3-6 × 2-4 cm; common peduncle 5-15 mm; bracts broadly ellipsoid, 2-3 mm long, caducous. Flowers 3-6 together, perianths glabrous, 2-valved, pedicels glabrescent or with sparse to ± dense tomentum of hairs 0.1-0.2 mm, inarticulate at base. Male perianth sub-obtriangular to transversely ellipsoid or kidney-shaped, rather distinctly laterally compressed, dull dark brown, c. 1.7-2.0(-2.3) × 2-2.5(-3.0) mm, above broadly rounded, at base subtruncate to short-cuneate; pedicel 0.5-1.0(-1.5) mm; perianth at anthesis cleft to c. 2/3-4/5, valves c. 0.2-0.3 mm thick. Androecium subellipsoid, c. 1.0-1.5 × 1.8-2.0(-2.5) mm, with a sterile basal part mainly consisting of the androphore, ± hollowed out and rather tapering, c. 0.5-0.6 mm long; anthers c. 8-13, i.e., c. 16-26 thecae and these mutually free for the upper 2/3 or more, c. 0.7-1.5 mm long, strongly incurved, the ones at one side of the androecium usually covering those of the other side. Female perianth broadly ellipsoid, c. 2.5-3.0(-3.5) × 2.2-3.0 mm, at anthesis cleft to c. 1/2-way, valves c. 0.3 mm thick, pedicel 1-2 mm long, ± sparsely pubescent with hairs c. 0.1 mm; ovary globose-ellipsoid or obovoid, c. 1.6-2.0 mm long, glabrous, stigma very minutely 2-lobed. Fruits 2-5 per infructescence, ellipsoid, 2.5-3.0 × 1.5-2.0 cm, glabrous, drying dark brown, without tubercles; dry valves c. 2-3 mm thick; stalk 2-5 mm; perianth not persisting.

Distribution. Caroline Isls.: Palau Isls.

PALAU ISLS.: Hosokawa Takahide 6756; Kanehira 270, 1847, 1958, 1960, 2371; Masahiko Takamatsu 1205, 1668, Shearard & Spence 94; Tuyama *s.n.*, 10 Sept. 1937, 9, 14, 15, 17, 19, *s.n.* Aug. 1939.

Ecology. Locally abundant in primary lowland forest, usually not in the wetter localities and usually at somewhat higher altitudes; apparently not or only rarely in mangrove forest. Flowers and fruits throughout the year.

Uses. Pericarps edible, eaten by the natives.

NOTES

1. *Fieldnotes.* Flowers recorded as yellow or orange.

2. Closely related to *H. smithii* from the Moluccas, which differs chiefly by the larger male perianth, c. 3-4 mm wide, by the anthers which are all (i.e., not only from one side of the androecium) incurved towards the centre of the androecium, and by the generally somewhat thinner leaves with the lateral nerves on the upper surface flat or slightly raised. In *H. palauensis* the older leaves are somewhat chartaceous, above with the lateral nerves flat or sunken, and the tertiary venation very indistinct or even invisible.

3. Sinclair (pp. 112, 119, 124) treated the present species as a synonym of *H. spicata*. However, as understood by Sinclair, *H. spicata* appears to be a heterogeneous species which is in my present treatment divided among various different species. *H. spicata*, in the restricted and original sense, is a species presently regarded as confined to Celebes and the Moluccas.

4. As far as I know, only two species occur on the Palau Isls., viz. the widespread *H. irya* (syn. *H. amklaal*, *H. nunu*), and *H. palauensis*, an endemic species closely related to *H. smithii* from the Moluccas.

5. *Doubtful specimens*. Two sheets of *Takamatsu 1205*, in BISH, one female flowering and the other a fruiting specimen, somewhat deviate by the membranous leaves with rather distinct, slightly raised lateral nerves and venation.

17. *Horsfieldia olens* de Wilde, *sp. nov.*

Fig. 1A(17)

Horsfieldia species perianthio masculino glabro fere ad basin 3-valvi, androecio elongato, ex affinitate *H. sepikensis*, ab ea differt virgis angularibus, perianthio minus elongatis, atque antheris haud profunde inflexis. — Typus: NGF 31966 (L).

Tree 10-35 m. Twigs in apical portion distinctly quadrangular through ridges from both sides of the bases of the petioles, lower down stem merely ridged or lined, 2-4(-8) mm diam., early glabrescent from greyish to brown tomentum of hairs c. 0.1 mm; bark striate, when older not flaking, lenticels usually distinct. Leaves in 2 rows, chartaceous, oblong (to oblong-lanceolate), broadest at or above the middle, 7-14 × 2.5-6 cm, base attenuate, tip either rounded, or obtuse, or bluntly short-acute-acuminate, upper surface drying brown to blackish, without or with few whitish minute dots or pustules, lower surface early glabrescent, hairs minute, c. 0.1 mm or less, without blackish dots but irregularly shaped pustules of a different nature present; midrib raised above; nerves 7-10 pairs, above and below thin, flattish, and inconspicuous, the submarginal arches rather regularly shaped; tertiary venation forming a lax network, very faint on both surfaces; petioles relatively long and slender, 12-20 × 1.5-2 mm; leaf bud 6-10 × c. 1.5 mm, with hairs c. 0.1 mm long. Inflorescences glabrescent or with sparse tomentum of stellate hairs c. 0.1-0.2 mm, rather short and stout, 2-3 times ramified, common peduncle 1-10 mm long, rather many-flowered, in ♂ and ♀ (according to the infructescences): 2-6 × 1.5-4 cm, bracts not seen, caducous. Flowers in loose clusters of 3-5(-7) together; perianths 3-(or 4-) valved, glabrous; pedicels slender, glabrous, at base ± articulated or not. Male perianth broadly ellipsoid to globose, not angular, c. 1.8-2.3 mm diam., top and base rounded, pedicel not tapering, 2.5-4 mm long, glabrous; perianth at anthesis cleft to c. 5/6 or nearly to the base, valves c. 0.2 mm thick. Androecium ± obovoid, blunt-triangular, c. 1.5 × 1.0 mm (hence not completely filling the perianth); anthers c. 10-12, free apices c. 0.3-0.8 mm, incurved, those of one side clasping the others; column rather broad and solid, hollowed for the upper 1/4 to 1/3; androphore rather broad, up to 0.1 mm long.

Female flowers not seen. Fruits 2-6 per infructescence, ellipsoid, 1.0-1.6 × 0.8-1.2 cm, top minutely pointed, base sub-attenuate, glabrous, without or with sparse small tubercles or lenticels, dry valves c. 1-1.5 mm thick; stalk 1-4 mm long; perianth not persistent.

Distribution. New Guinea: Irian Jaya, Digul (SE. New Guinea); Papua New Guinea, Western Prov.

NEW GUINEA. Irian Jaya: (Bouman) BW 3234, (Nautje) 6530, 6608; Soegeng 413. — Papua New Guinea, Western Prov.: Lae 51821; NGF 8297, 31770, 31966.

Ecology. Swamp edges, in fringes (with *Acacia*) of savanna and rain-forest; ridge forest, primary forest on level land inundated in the wet season, swampy forest on peaty soil; also in Myrtaceae-*Vatica-Campnosperma* forest on well-drained podsol-ground; 0-200 m alt. Flowers in June, fruits from February to August.

Vernacular names. Isasir, Jisasir, Jesaser (Asmat lang.), Selamae (Kunga dial.), Ma-tak (Kinuga Dist.).

NOTES

1. *Fieldnotes.* Once reported to have small stilt roots. Bark longitudinally fissured, brown or red-brown, or blackish brown, inside reddish, with some reddish exudate; reported to have a very offensive smell, or a strong disinfectant smell. Wood whitish to yellow. Leaves ± leathery, once recorded as bluish-green above. Flowers yellow. Fruits orange-yellow or orange, seeds orange or red.

2. Apparently closely related to *H. sepikensis*, one of the few other New Guinean species with 3-merous perianths. That species differs in its non-angular twig-apices, more elongate perianth, more slender inflorescences, membranous leaves, and apparently a different ecology. The present new species is mostly found in dry or wet habitats on poor peaty or podsolic soils.

3. Specimens of the present species were included by Sinclair (p. 125, 126) in *H. spicata* var. *sepikensis* (Mkgf.) Sinclair, a taxon which appears to be a heterogenous entity.

18. *Horsfieldia sepikensis* Markgraf

Fig. 1A(18); 10

Horsfieldia sepikensis Markgraf, Bot. Jahrb. 67, 2 (1935) 147. — *Horsfieldia spicata* var. *sepikensis* (Mkgf.) Sinclair, Gard. Bull. Sing. 28 (1975) 125, p.p. — Type: Ledermann 8016 (B†; iso: SING. n.v.).

Tree 10-25 m. Twigs terete, faintly ridged or not, towards apex 2-4(-6) mm diam., early glabrescent, tomentum of hairs greyish brown, c. 0.1 mm long or less; bark striate, when older not flaking, lenticels rather small but distinct. Leaves in 2 rows, membranous, oblong to oblong-lanceolate, broadest usually at or above the middle, 8-17 × 3.5-6 cm, base attenuate, tip acute-acuminate with the very tip usually bluntish; upper surface drying dark brown, without minute whitish pustules, lower surface early glabrescent, minute hairs less than 0.1 mm, without blackish-brown dots; midrib above flattish or slightly raised; nerves 8-12 pairs, above thin and flat; tertiary veins forming a lax network, very faint on both surfaces; petiole relatively long, 15-24 × 1-2 mm, leaf bud c. 10 × 1 mm, with hairs



Fig. 10. *Horsfieldia sepikensis* Markgraf
 a, twig portion with male inflorescence, $\times \frac{1}{2}$; b, mature male flower, lateral view, $\times 12$; c, ditto, opened, showing androecium, $\times 12$; d, androecium, longitudinal section, schematic, $\times 12$; e & f, portions of female flowering twig, inflorescences axillary to leaves and fallen leaves, $\times \frac{1}{2}$; g, mature female flower bud, $\times 12$; h, ditto, at full anthesis, showing glabrous ovary and large broadly 2-lipped stigmata, $\times 12$. — a-d, from Hoogland & Craven 10255; e-h, Hoogland & Craven 10237.

less than 0.1 mm. Inflorescences glabrescent or with sparse hairs c. 0.1 mm, 2-3 times ramified, many-flowered, in ♂: 7-12 × 4-6 cm, in ♀: 2-4 × 1.5-2 cm, common peduncle c. 0.5-1.5 cm long; bracts not seen, caducous. Flowers in loose clusters of 2-7 together; perianths 3-(or 4-) valved, finely punctate, in mature bud rather angular (though perianths never tightly clustered), glabrous; pedicels glabrous, at base not articulated. Male perianth broadly ellipsoid-obovoid, ± 3-angular, c. 1.5-2.0 × 1.4-1.6 mm, at apex acutish, base ± attenuate, pedicel slender, not tapering, 2-3 mm long; perianth at anthesis cleft to c. 5/6, valves c. 0.1 mm thick. Androecium ± obovoid, ± bluntish 3-angular, c. 1.5 × 1-1.2 mm; anthers 12-14, tightly set, septate before maturity, free apices c. 0.2-0.5 mm long and these ± curved into the hollowed upper 1/3 part of the rather broad anther column (anthers at one side of the androecium in *Hoogland & Craven* 10255 mutually touching each other in a fish-bone pattern, see fig. 10) androphore 0-0.1 mm, rather narrow. Female perianth ellipsoid, c. 2.0 × 1.6-1.8 mm, 3- or 4-valved, cleft at anthesis almost to the base, valves c. 0.1-0.2 mm thick, pedicel 1.5-2 mm long; ovary ovoid, c. 1.5-1.8 × 1.2-1.5 mm, glabrous, style absent, stigmas relatively very large, consisting of two broad fleshy lobes c. 1.0 × 0.2 mm, only c. 0.1 mm high. Fruits not seen.

Distribution. Papua New Guinea: East Sepik Prov.

PAPUA NEW GUINEA. East Sepik Prov.: *Hoogland & Craven* 10237, 10255; *Ledermann* 6738.

Ecology. Primary and secondary forest, riverine forest; ridge forest; 0-50 m. Flowers and fruits throughout the year.

Vernacular name. Bangera (Waskuk lang., Sepik).

NOTES

1. *Fieldnotes.* Flowers yellow.

2. A noteworthy species because of its predominantly 3-merous flowers, the only other species with 3- or 4-merous flowers in New Guinea being the ± related *H. olens*. Furthermore, the present species stands apart by its thick, conspicuous stigmas. It is in many cases reminiscent of a species of *Gymnacranthera*, but the New Guinean *G. paniculata* var. *zippeliana* differs in the nature of the hairs (on leaf bud, and flowers), by the hairy perianths, split at anthesis to only c. 1/2-way deep, by a hairy ovary, and a different texture and colour of the leaves (whitish below).

3. The fruits are reported by Markgraf in the original description as globose, c. 13-15 cm diam., the dry pericarp c. 2 mm thick; seed globose, c. 1 cm diam. I have not seen fruits of our present species, and the fruiting *Ledermann*-specimens formerly in the Berlin herbarium have probably all been destroyed.

4. I have not seen the isotype *Ledermann* 8016 (♂), in SING. The flowers are described by Markgraf in the original description as being cleft to c. 1/2-way deep at anthesis. However, in the male and female specimens I saw have the perianths split to almost the base. *Ledermann* 6738, in K, a duplicate of one of the authentic collections cited by Markgraf, has good male flowers. See further under note 5.

5. Sinclair, who examined a duplicate of the holotype *Ledermann* 8016 in SING,

accepts the present species as a variety under *H. spicata*, including specimens with 2-valved as well as with 3-valved perianths. In my opinion the 3-merous perianths are typical for the present species, which are endemic in the Sepik area, one which has no close relationship with *H. spicata* from the Moluccas.

6. *Hoogland & Craven 10255* contains one flower with a 'double' androecium; the perianth is somewhat larger and has 4 valves. Female flowers are either 3- or 4-valved.

19. *Horsfieldia sylvestris* (Houtt.) Warb.

Fig. 1A(19); 11

Myristica sylvestris Houtt., Nat. Hist. 2, 3 (1774) 340 — *Horsfieldia sylvestris* (Houtt.) Warb., Mon. Myrist. (1897) 337, t. 22 fig. 1-6; Sinclair Gard. Bull. Sing. 28 (1975) 142. — Type: not indicated.

M. salicifolia Willd. in Roem. & Usteri, Mag. Bot. 3, 9 (1790) 26; Sp. Pl. (4th ed.) 4, 2 (1806) 871; Roxb., Fl. Ind. ed. Carey (1832) 846 — Type: not known.

M. pinnaeformis Zipp. (msc.) ex Miq., Ann. Mus. Bot. Lugd.-Bat. 2, 1 (1865) 49 — Type: *Zippelius s.n.* (180) (L).

M. pendulina Hook.f., Fl. Brit. Ind. 5 (1890) 859; King, Ann. Roy. Bot. Gard. Calc. 3 (1891) 329, pl. 170 — Type: *Cantley s.n.* (A, CAL, n.v.; K).

M. edulis F.v.M., in sched. (Hb. v. Müller, d'Alberis 11, MEL, not seen).

H. sylvestris var. *villosa* Warb., Mon. Myrist. (1897) 341 — Type: *Beccari 696* (Fl, n.v.), *Warburg 20708* (A, B⁺, n.v.).

Tree 7-40(-60) m. Twigs stout, terete, hollow, in young innovations when dry \pm angular or flattish, usually thinly ridged, 4-14(-20) mm diam., glabrescent from rusty \pm woolly tomentum composed of hairs 0.3-1.0(-1.5) mm; bark faintly striate, when older not flaking, with coarse lenticels. Leaves in 2 rows, (thinly) chartaceous, lanceolate to lanceolate-linear, parallel-sided, (17-)20-45 \times 3-7(-9) cm, base rounded to short-attenuate, tip long acute-acuminate; upper surface drying usually dull, greenish brown to dark brown, minutely pustulate or not, lower surface late glabrescent or with (partially) persistent or sub-persistent tomentum of mixed hairs 0.1-1(-1.5) mm; without dark brown dots; midrib flattish above, late-glabrescent; nerves 30-42 pairs, thin, above flat or sunken, beneath with distinct marginal arches; tertiary venation forming a lax network, distinct (and then the leaves \pm bullate) or usually not distinct above; petiole short, 2-7 \times (2-)3-5 mm, usually shortly winged, the lamina being decurrent; leaf bud generally stout, up to 8 cm long, densely woolly-pubescent. Inflorescences pubescent or late-glabrescent, hairs woolly, 0.5-1 mm long, in σ : large, many-flowered, 3-5 times ramified, paniculate, 7-20(-30) \times 4-10(-14) cm, in f : 4-10(-15) cm long; common peduncle 2-7 cm \times 2-5 mm, at base with a few persistent bluntish cataphylls 2-4 mm long; bracts rather late-caducous, \pm concave, (2-) 4-8(-16) mm long. Flowers in σ in loose clusters of 4-10 each, in f up to 5 only; perianths 2-(or 3-) valved, often somewhat angular, glabrous or at base glabrescent, pedicels slender, glabrescent or with persistent tomentum of hairs c. 0.3 mm, at base inarticulate; flowers before anthesis, especially in σ , densely packed into subglobose or ellipsoid glomerules 4-7 mm diam. wrapped in bracts. Male perianths obovoid to narrow-obovoid, or clavate, irregularly shaped and angular by being closely packed in bud, c. 1.5-2.1 \times 0.5-1.3(-1.5) mm, at apex obliquely obtusish, towards base usually \pm tapering into pedicel c. 0.2-1.5(-2) \times c. 0.3 mm; perianth at anthesis split to c. $\frac{1}{3}$ - $\frac{1}{2}$ -way, valves 0.1-0.3 mm thick, sometimes with a few pale dots. Androecium ellipsoid-oblong, c.

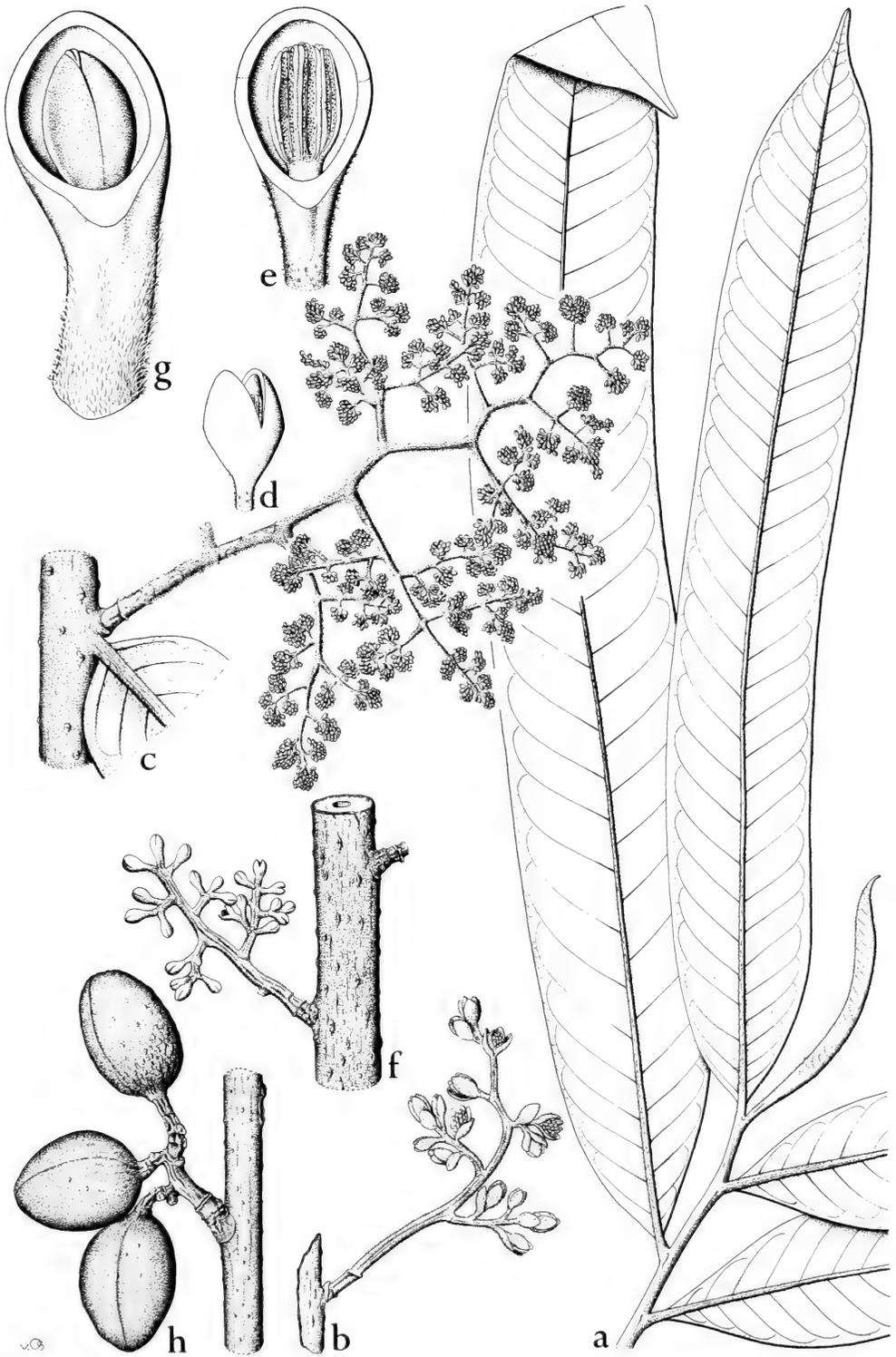


Fig. 11. *Horsfieldia sylvestris* (Houtt.) Warb.

a, leafy twig apex, $\times \frac{1}{2}$; b & c, twig portions with respectively immature and full-grown male inflorescences, note bracts in b, $\times \frac{1}{2}$; d, male flower, $\times 6$; e, ditto, opened, showing androecium, $\times 12$; f, twig portion with female inflorescence axillary to fallen leaf, $\times \frac{1}{2}$; g, female flower, lateral view, opened, showing glabrous ovary, note much larger size as compared with the male flowers, $\times 6$; h, twig portion with infructescence with mature fruits. — a, f, g, de Vogel 3069; b, de Vogel 3094; c-e, Craven 739; h, de Vogel 3370.

1-1.2 × 0.5-0.6 mm, broadly rounded at apex; anthers 4-8, septate (at least before full maturity), c. 0.8-1.5 mm long, connate (without free apices); androphore rather broad, c. 0.1-0.4 mm long. Female perianths ellipsoid to broadly ovoid, stout, ± coriaceous, c. 3.5-5 × 3-4.5 mm, split at anthesis to c. 1/3, valves 0.7-1 mm thick; pedicels stout, 1.5-5.5 mm long; ovary broadly ovoid-ellipsoid, c. 2.5-3 × 2.5 mm, glabrous, stigma sessile, not-lobed, c. 0.1 × 0.5 mm. Fruits 2-10 per infructescence, ellipsoid, at base and apex rounded or sometimes subacutish after drying, 3.4-5.5 × 2.5-3.5 cm, glabrous, drying dark brown, without or with few coarse tubercles, dry valves 2-4(-5) mm thick; stalk 5-13 mm; perianth not persistent.

Distribution. Moluccas (Morotai to Kai Isls.), Aru Isls., New Guinea (not in Morobe and Milne Bay Prov. of Papua New Guinea), not in Bismarck Arch. and Solomon Isls.

MOLUCCAS: *b.b. s.n.* (April 1920), 16468, 23187, 23749, 24864, 24879, 25176, 25825, (Buwalda 636) 25981; *Beguín* 1400; *Buwalda* 5628, 6112; *Idjen & Mochtar* 362; *Jaheri* 710; *Kostermans* (*b.b.* 33725) 13, (*b.b.* 33921) 251, 767 (p.p.), 1123, 1685; *Kuswata & Soepadmo* 3; *Lam* 3463, 3538; *Pleyte* 379; *Robinson* 235; *de Vogel* 3069, 3094, 3114, 3370, 3491, 3713, 3765, 3815, 3857, 3930, 4164, 4518; *Teysmann & de Vriese s.n.*; *de Vriese s.n.*

ARU Isls.: (*Buwalda* 249) *b.b.* 25282; *Buwalda* 4994.

IRIAN JAYA (incl. Vogelkop): *Aet & Idjan* 487; *b.b.* 15901, 22268, 22532, 32682; *BW* 24, 343, 498, 533, 536, 1151, 1280, 1366, 1433, 1733, 1754, 1766, 1812, 1838, 1839, 2131, 2207, 2208, 2209, 2210, 2211, 2227, 2428, 2535, 2687, 2699, 2948, 2950, 3985, 4089, 4369, 4446, 4460, 5191, 5413, 5844, 5923, 6002, 6539, 6964, 7404, 7689, 7836, 8174, 9194, 9868, 10160, 10835, 10870, 11844, 11869, 11900, 11905, 12409, 12990, 13032, 13795, 14929, 15628, 15648, 15653; *Gjellerup* 180, 180b, 407; *Kostermans* (*b.b.* 33355) 128, (*b.b.* 33414) 201; (*b.b.* 33664) 2652, 2669; *Kostermans & Soegeng* 103, 485; *Pleyte* 686; *van Royen* 4510; *van Royen & Sleumer* 6193, 7051; *Soehoed* 31; *Zippelius s.n.* (180) — *Biak & Japen Isl.*: *Aet & Idjan* 396, 749; *b.b.* 1009, 30272, 30393, 30570.

PAPUA NEW GUINEA: *Baldwin UPNG* 5752; *Brass* 7068; *Craven & Schodde* 739; *Darbyshire* 908; *Hart* 5007; *Hoogland* 5021; *Jacobs* 9052; *LAE* 73978; *NGF* 7153, 8214, 10353, 13267, 27471, 34366, 35623, 36015, 48157, 48467; *Pullen* 8181; *Saunders* 920, 1104; *Schodde & Craven* 4289, 4470; *Schodde* 4506; *Womersley* 3694, 3743.

Cultivated: (Singapore) *Cantley s.n.* (1886), *Ridley* 186, (*Furtado*) *SING* 34863 — (Sumatra) *Forbes* 1155 A; *Teysmann s.n.* — (Java) *Forbes* 1218 c, e; *Rastini* 90; *Sutrisno* 66.

Ecology. Primary and secondary forest, on alluvial soils (sandy and clayey soils), especially common in the coastal plains of Vogelkop; also in swampy forest (with *Pometia*), in forest inundated by heavy rains or in stagnant water; also on well-drained porous volcanic soils, or close to limestone outcrops, in ridge forest, or in *Castanopsis* forest (at 530 m., in Vogelkop); 0-700 m alt. Sometimes recorded as a solitary emergent tree. Flowers and fruits throughout the year. The trees may bear flowers and fruits simultaneously..

Vernacular names. See Sinclair, p. 147.

Uses. The wood is heavy, easily worked (easy to cut), not very durable. Fruits taste sour, and are edible (Sepik Dist.). The fruit wall is used in rojak, and in manisan (a sweet pickle) (Moluccas). Extract of bark is used as a drug against "penyakit keputihan" by expecting women, also against hepatitis (Moluccas). The fruits are gathered and eaten by the Gogodala tribe, Western Distr., Papua; once reported as found planted at a former village site. Fruits eaten by birds (e.g., pigeons, parrots), apparently swallowed whole.

The trees are several times recorded as beautiful, and recommended as an ornamental.

The many vernacular names indicate that the tree is widely known by local people.

NOTES

1. *Fieldnotes*. Recorded as a striking tree, with pendulous branches (twigs up to 2m), and leaves drooping and distichous (resembling compound pinnate leaves), glossy above. Bole often mentioned as very straight, in old specimens with rotten core. Recorded as with or without buttresses; these low or up to c. 1.5(-2.5) m high, up to 1.5 m out, up to 8(-20) cm thick, sometimes recorded as having small stilt roots. Bark brownish, smooth or usually recorded as shallowly fissured, or often as slightly to strongly peeling off in small scales; exudate pale red-brown, watery. Sapwood colour usually pale yellowish or straw, usually gradually passing into the slightly darker or reddish-cream heartwood. Fruits pinkish, pink-orange, pink-brown, orange, red-brown, or deep red; aril orange-red or bright red. Flowers bright yellow, dark yellow, or orange-yellow, slightly fragrant or not; pollen pale yellow or whitish.

2. *Variation and resembling species*. *Horsfieldia sylvestris* is a homogenous species; it only rather varies in the hairiness of twigs, leaf-bud, and (juvenile) leaves. Very hairy specimens were described as var. *villosa* by Warburg, but many forms intermediate to the typical occur. Wildenow's *H. salicifolia* has the leaves woolly beneath. A comparatively slightly hairy (i.e., short-haired) specimen is, e.g., *BW 10835*, from the vicinity of Manokwari (Vogelkop); very much hairy forms are, e.g., *BW 536, 2535, 7836, 11905, 13795, b.b. 32682, or Kostermans 128 (b.b. 33355)*, material which partly came from the same area.

Sterile specimens may be confused with certain forms of *H. hellwigii*, sometimes with similarly hairy twigs and almost similarly long leaf-buds. In that species the leaves are usually narrower, the perianth subglobose, not clavate, and the fruits smaller and hairy; in the present species the fruits are generally larger, and always glabrous.

In *H. sylvestris* the number of anthers constituting the elongate androecium is rather difficult to ascertain; I counted 4-8 (8-16 thecae), Sinclair had it as 8-10.

3. Warburg placed *H. sylvestris* and *H. ralunensis* in his sect. *Orthanthera*, which also included *H. iryagedhi* from Ceylon, because all three species have rather elongated and angular male perianths clustered into flower heads. The first two named species, however, have the flowers only clustered in immature inflorescences, and are here not considered closely related to *H. iryagedhi* on various grounds.

20. *Horsfieldia australiana* S.T. Blake

Fig. 1A(20); 12

Horsfieldia australiana S.T. Blake, Austr. J. Bot. 2 (1954) 124, Pl. 5; Sinclair, Gard. Bull. Sing. 28 (1975) 6, pp., for the Australian specimens only. — Type: S.T. Blake (BRI; iso: SING, n.v.).

Tree 6-25 m. Twigs terete or lined or ridged towards the top 2-5(-12) mm diam., early glabrescent, tomentum pale brown to grey-brown, with minute hairs 0.1 mm



Fig. 12. *Horsfieldia australiana* S.T. Blake

a, twig portion with male inflorescences, twig not ridged, $\times \frac{1}{2}$; b, ditto, twig lined or ridged, $\times \frac{1}{2}$; c, opened male flower showing androecium and schematic longitudinal section of androecium, $\times 6$; d, ditto of different specimen, mature male flower closed, opened, and schematic longitudinal section of androecium, $\times 6$; e, portion of twig with female inflorescences axillary to fallen leaves, $\times \frac{1}{2}$; f, mature female flower and longitudinal section of the same, note pubescence at base of ovary, $\times 6$; g, portion of twig with infructescence, $\times \frac{1}{2}$. — a & c, from Dunlop 3585; b & d, from Hyland 2724; e & f, from Smith 11913; g, from Hyland 2551.

or less; bark faintly striate, when older not flaking, lenticels usually conspicuous. Leaves in 2 rows, membranous or chartaceous, elliptic oblong to lanceolate, broadest at about the middle, or more or less parallel-sided and broadest below or above the middle, 10-24 × 3-7 cm, base attenuate, tip obtusish or acutish to acute-acuminate, often with bluntish tip; upper surface drying dull olivaceous to bright brown, not finely pale-pustulate, lower surface early glabrescent, hairs minute 0.1 mm or less, the midrib often rather reddish-brown and usually remaining sparingly minutely scaly-stellate hairy, lower surface without brown-black dots; midrib flattish to slightly raised above; nerves 10-17 pairs, above thin, sunken or flat, or slightly raised, beneath with the submarginal arches rather regularly looping but inconspicuous; tertiary veins forming a lax network, inconspicuous; petiole 3-7 × 1.5-2 mm, leaf bud 8-15 × 1-2 mm, with hairs c. 0.1 mm. Inflorescences sparsely to densely pubescent with hairs 0.1-0.2 mm long hairs, in ♂ and ♀: 2 or 3 times ramified, (1.5-) 3-8 × 2-5 cm, common peduncle 0.5-1.0 cm long; bracts elliptic to broadly triangular, acutish, 2-6 mm long, short-pubescent, caducous. Flowers in loose clusters of 2-6 (in ♀: 1-3) each; perianths 2-valved, rather sparsely pubescent with hairs 0.1 mm or less long, pedicels slender, thinly pubescent, at base inarticulate. Male perianth ellipsoid or subglobose, slightly laterally compressed, (2-)2.5-3.3 × (1.5-) 2-3.0 mm, above and below rounded, pedicel not tapering, 1-2 mm long; perianth at anthesis cleft to c. ½-way, valves c. 0.2 mm thick. Androecium moderately laterally compressed, above subtruncate to broadly rounded, below somewhat attenuate, (1.8-) 2.0 × 1.5-2.0 mm; anthers (10?-) 12-14, almost straight, the free portions at apex c. 0.1-0.2 mm long and these slightly or much incurved; the column rather wide, spongy, the apical ¼-½ broadly hollowed out but the basal portion more or less protruding into the upper part of the hollow; androphore rather narrow, 0.1-0.2 mm long. Female perianth ellipsoid, c. 2.5(-3) × 2.0(-2.5) mm, cleft at anthesis to c. ½-way, valves c. 0.2 mm thick, pedicel 1-2 mm long; ovary ovoid, c. 2.0 × 1.5 mm, towards base with dense tomentum of minute hairs 0.1 mm or less, style minutely 2-lobed, c. 0.2 mm broad. Fruits 3-8 per infructescence, ellipsoid, top rounded or faintly pointed, 1.8-2.2 × 1.1-1.4 cm, with the surface granulate and with or without a few coarse tubercles, glabrous except at the very base; dry pericarp c. 2 mm thick; stalk 2-4 mm long; perianth not persisting.

Distribution. Australia: Northern Territory, northern Queensland.

AUSTRALIA. Northern Territory: *Byrnes* NB 1259 (NT. 14918); *Dunlop* 3585; *Must & McKean* B 687 — Queensland: *Hyland* 2551, 2557, 2724, 3123, 5516; *Smith* 11762, 11913; *Stocker* 1043.

Ecology. Riverine forest, gallery forest in gullies of sandstone areas, sheltered gorge forest, monsoon forest on sandy soils; 0-200 m alt. Flowers from August to October, fruits from September to January.

NOTES

1. *Fieldnotes.* Bark fissured or tessellated, usually flaky, stem often recorded as ± fluted, buttressed. Blaze exudate watery, red; blaze smells like ants. Wood whitish. Flowers yellow or orange, the female noted as strongly and sweetly scented (as the flowers of *Alocasia macrorhiza* or the fruits of *Passiflora edulis*); the males recorded as scentless.

2. Possibly two forms can be recognized, but the material at hand prevents a final decision. Specimens from Northern Territory, incl. the type and *Must & McKean B 687* (♂), *Dunlop 3585* (♂), *Byrnes NB 1259* (fr.), have the twigs not or only indistinctly ridged, the leaf blades rather elliptic-oblong (not oblong-lanceolate), possibly relatively longer petioles, the blades more of a membranous texture with \pm prominent lateral nerves, and possibly the male perianth broader, i.e., broadly ellipsoid or subglobose. Specimens from Queensland have usually rather leathery leaves, usually with flattened or sunken lateral nerves, the blades usually more oblong-lanceolate, with shorter and broader petioles, and the twigs apparently more distinctly ridged or even winged. However, specimens which distract from this image exist, e.g., the sterile specimen *Hyland 3123* from Northern Terr. has an 'eastern' habit, or the sterile specimen *Smith 11762*, from Queensland, which has the leaves rather membranous and nerves prominent.

3. Sinclair accepted the present species as including specimens from New Guinea which are presently regarded as representing a separate new species, *H. sinclairii*.

21. *Horsfieldia crux-melitensis* Markgraf

Fig. 1A(21); 13 a-c

Horsfieldia crux-melitensis Markgraf, Bot. Jahrb. 67, 2 (1935) 148; Sinclair, Gard. Bull. Sing. 28 (1975) 26 (*cruxmelitensis*) — Type: *Schlechter 19246* (B, n.v.; iso: K, L, E, G, NY, S, Z, n.v.).

Shrub or treelet 2-4 m. Twigs terete, not ridged, towards the apex 1.5-3(-4) mm diam., glabrescent, tomentum rusty, of hairs c. 0.1 mm; bark finely striate, when older not flaking, lenticels absent or inconspicuous. Leaves in 2 rows, membranous, elliptic to obovate-oblong, broadest usually above the middle, 12-27 \times 5.5-11.5 cm, base attenuate, tip acute-acuminate; upper surface drying dark brown, without or with very minute paler dots, lower surface with persistent tomentum of rather sparse hairs (c. 0.1 mm) especially on the midrib, or late glabrescent, without dark dots, the nerves not contrasting in colour; midrib above slightly raised; nerves 10-15 pairs, sometimes with additional intercalary nerves, thin and flat above, much raised beneath, the submarginal arches distinct but not very regularly shaped; tertiary veins forming a lax, rather indistinct network; petiole 10-16 \times 1.5-2.5 mm; leaf bud 7-12 \times 1-2 mm, with hairs 0.1-0.2 mm. Inflorescences situated in between the leaves, woolly-pubescent with stellate-dendroid hairs 0.1-0.2 mm, 2(-3) times ramified, in ♂ and ♀: rather few-flowered, c. 1.5-5 \times 1.5-4 cm, common peduncle 0.6-1.5 cm long; bracts c. 0.5 mm, pubescent, early caducous. Flowers solitary or up to 3 together; perianths 2-valved, with scattered stellate hairs c. 0.1(-0.2) mm, densest towards base, pedicels tapering, pubescent, at base inarticulate. Male perianth subglobose, gradually passing into the strongly thickened and tapered pedicel, together forming the long-clubshaped flower c. 9-11 \times 2-3.2 mm; perianth broadly rounded above, somewhat laterally compressed, c. 2-3 \times 2-3.2 mm, pedicel c. 7-8 \times 2-3 mm, \pm obconical, rather densely pubescent; perianth at anthesis split to c. $\frac{1}{8}$ - $\frac{1}{5}$, i.e., to 0.3-0.6 mm deep, valves c. 0.2-0.3 mm thick, the perianth-wall lower down c. 0.6-0.8 mm thick. Androecium a club-shaped body, the top \pm rounded, c. 1.5-2.5 \times 0.7-1.2 mm, with 3-5 stellately arranged, connate anthers at the apex, c. 0.2-0.3 mm long, androphore thick, subcylindrical, the surface \pm wrinkled-bullate and more striate towards the base, glabrous; central column up to the apex solid. Female perianth and pedicel together forming an obconical flower similar to ♂ flowers, c. 8 \times 3

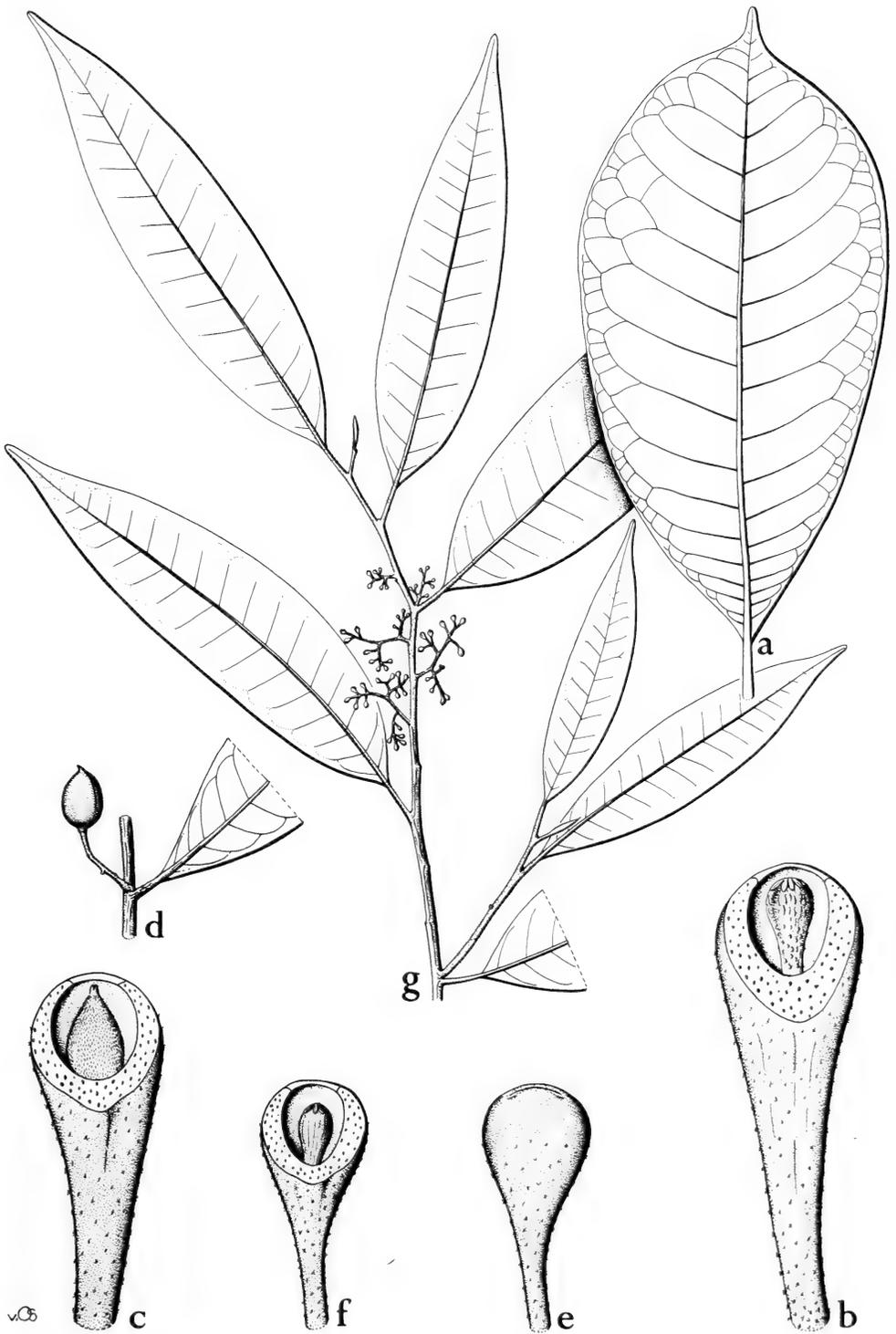


Fig. 13. *Horsfieldia crux-melitensis* Markgraf: a, leaf, $\times \frac{1}{2}$; b, opened male flower, showing club-shaped androecium, $\times 6$; c, female flower, opened, showing pubescent ovary with minute narrow bilobed style, $\times 6$. — *H. clavata* de Wilde: d, portion of twig with infructescence with mature fruit, $\times \frac{1}{2}$; e, mature male flower, lateral view, $\times 6$; f, ditto, opened, showing club-shaped androecium, $\times 6$. — *H. squamulosa* de Wilde: g, habit of leafy twig with male inflorescences. — a & c, from LAE 73830; b, from Schlechter 19246 (type); d, from Hoogland 3623; e & f, from Hoogland 3663 (type); g, from Brass 7221.

mm; perianth c. 2.2×3 mm, split at anthesis for c. 0.2-0.3 m deep; pedicel broadly obconical, c. 6×2.6 mm; ovary obvoid, c. 2×1.5 mm, densely pubescent through hairs c. 0.1 mm long or less, style together with the 2-lobed stigma c. 0.2-0.3 mm long. Fruits (according to young infructescences in LAE 73830) 1-4 each, possibly becoming more than 1.6 cm long, pubescent; stalk much elongated, and thickened towards the fruit, 10-14 mm long; perianth not persisting.

Distribution. Papua New Guinea: Morobe Prov.

PAPUA NEW GUINEA. Morobe Prov.: LAE 73822, 73830; NGF. 24092; Rau 550; Schlechter 19246.

Ecology. Mixed rain forest, lowland forest, common in wet areas; 0-50 m. Flowers from January to May; fruits in March.

NOTES

1. *Fieldnotes.* Shrub or treelet, 2-4 m; bark grey or dark green, wood cream or white. Flowers cream or orange. Fruits yellowish or red.

2. Fruits ripening red are said to have been mentioned on the label of LAE 73830; in L only female flowers and young fruits are present. Mature fruits have not been seen by me.

3. Specimens from the Northern Province, presently assigned to a new species *H. clavata*, were included by Sinclair in the present species.

4. I have not seen the duplicates of the para-type, Schlechter 17408 (G, NY). According to Sinclair's notes on p. 27, its leaves are rather narrowly elliptic or elliptic or elliptic, not broadly elliptic. This means the specimen could belong to different related species, e.g., *H. clavata*, or rather *H. squamulosa*, which is also known from the Morobe Province.

22. *Horsfieldia clavata* de Wilde, *sp. nov.*

Fig. 1A(22); 13 d-f

Horsfieldiae crux-meliensis atque eodem modo *Horsfieldiae squamulosae* affinis quoad androecium clavatum, sed differt a *H. squamulosa* floribus masculis multo minoribus, a *H. crux-meliensis* pedicellis attenuatis. — Type: Hoogland 3663 (L; iso: BM, K; CANB, n.v.).

Shrub or tree, 3-6 m. Twigs terete, not ridged, 1.5-3 mm diam., glabrescent, tomentum grey-rusty, of hairs c. 0.1 mm long; bark finely striate, when older not flaking, lenticels absent or inconspicuous. Leaves in 2 rows, membranous, elliptic to oblong, broadest at or somewhat above the middle, $7-18 \times 3-6$ cm, base short- to long-attenuate, tip acute-acuminate (in Hoogland 3523 c. 2 cm, caudate); upper surface drying olivaceous, without minute paler dots, lower surface with persistent tomentum of rather scattered stellate-dendroid, scale-like hairs c. 0.1-0.2 mm especially on midrib, without larger dark brown dots, the nerves not much contrasting; midrib slender above, raised; nerves 10-20 pairs (including some weaker intercalary nerves), above thin and flat or slightly raised, beneath much raised, with distinct, rather regularly looping submarginal arches; tertiary veins forming a lax, rather indistinct network; petiole $7-14 \times 1-1.5$ mm; leaf bud $7-10 \times 1-1.5$ mm, with hairs c. 0.1 mm. Inflorescences situated in between the leaves, delicate 1-2(-3) times ramified, lowest side branch from near the base, in ♂ rather many-flowered,

2-3 × 1.5-2 cm, in ♀: 2-3-flowered, 1-2 cm long; axes finely scaly-pubescent with hairs c. 0.1 mm or less; bracts densely pubescent, c. 1-1.5 mm long, caducous. Flowers solitary or 2-3 together; perianths 2-valved, rather densely pubescent with stellate-dendroid hairs c. 0.1 mm; pedicels at base inarticulate. Male perianth subglobose, gradually passing into the strongly tapering pedicel, together forming a club-shaped flower c. 4-5.5 × 1.5-2.2 mm; perianth rounded above, c. 1.5-2 × 1.5-2.2 mm, pedicel c. 2.5-3.5 × 1-1.5 mm, rather densely pubescent; perianth at anthesis split to c. $\frac{1}{10}$ (i.e., for c. 0.2 mm only), valves c. 0.2 mm thick, the perianth-wall lower down c. 0.5-0.7 mm thick. Androecium a club-shaped body c. 1.5 × 0.7 mm, at apex consisting of 3 anthers (or c. 6 thecae; c. 0.3 mm long, ± arranged into a star shape, without free apices; the androphore thickish sub-cylindrical, slightly bullate-striate, glabrous; central column not hollowed out at apex. Female perianth ellipsoid, c. 1.8(-2) × 1.2 mm, split at anthesis to c. $\frac{1}{4}$, valves c. 0.2 mm thick; pedicel ± slender, c. 2 mm long; ovary ovoid, c. 1.0 × 0.6 mm, densely pubescent with stellate-scaly hairs c. 0.1 mm or less, style c. 0.4 mm long, stigma 2-lobed, c. 0.2 mm long. Fruits 1 (or 2) per infructescence, broadly ellipsoid-ovoid, base broadly rounded, top ± acuminate, c. 2 mm beaked, excl. the 1.5-2 mm long pseudo-stalk c. 1.3 × 1.0 cm, pubescent with hairs c. 0.1 mm long, drying brownish, without lenticels; dry valves c. 1 mm thick; seed ellipsoid; stalk 6-10 mm long; perianth not persistent.

Distribution. Papua New Guinea: Northern Prov.

PAPUA NEW GUINEA. Northern Prov.: *Hoogland* 3523, 3623, 3663.

Ecology. Locally common in regrowth in tall lowland forest, on well-drained soil; 0-50 m. Flowers and fruits in August.

Vernacular name. Hamana (Orokaiva lang., Mumuni).

NOTES

1. *Fieldnotes.* Shrub or treelet; flowers yellow; fruits orange or red, aril red.

2. Related to *H. squamulosa* and *H. crux-melitensis* which have a similar club-shaped androecium. *H. squamulosa* differs by its slender, male pedicels. The pedicel, and hence the whole male flower of *H. crux-melitensis* is similarly club-shaped as in the present species, but about twice as large; its leaves are also larger, drying to a darker colour. In *H. crux-melitensis* both male and female flowers have much thickened pedicels.

3. Sinclair included the specimens of the present species in *H. crux-melitensis*.

23. *Horsfieldia squamulosa* de Wilde, *sp. nov.*

Fig. 1A(23); 13 g

Horsfieldia species androecio clavato, *H. crux-melitensis* atque eodem modo *H. clavatae* affinis, differt pedicellis gracilibus non-attenuatis — Type: *Henty & Barlow* NGF 42995 (L: iso: K: A. BRI, CANB, n.v.).

Shrub or tree, 1-10 m. Twigs terete, not ridged, towards the apex 1-3 mm diam., glabrescent, tomentum of minute rust-coloured hairs 0.1-0.2 mm long; bark finely striate, when older not flaking, lenticels fine and inconspicuous. Leaves in 2 rows,

membranous, elliptic to lanceolate, broadest at or above the middle or \pm parallel-sided, $4-20 \times 0.7-5$ cm, base attenuate, tip up to 3.5 cm long, acute-acuminate, upper surface drying dark brown, with or without very minute paler dots, lower surface with persistent tomentum (especially on the midrib) or glabrescent, hairs 0.1-0.2 mm long or less, without larger dark brown dots, the nerves not contrasting in colour; midrib slender above and slightly raised; nerves 10-25 pairs, including some weaker intercalary ones, thin and flat above, much raised beneath, with the submarginal arches regularly looping or not, distinct or not; tertiary veins forming a lax network, distinct or indistinct; petiole $6-13 \times 1-1.5$ mm; leaf bud c. 10×1 mm with dark rust-coloured hairs 0.1-0.2 mm long. Inflorescences in between the leaves, 2(-3) times ramified (lowest branch 0-5 mm from the base), few to rather many-flowered, in σ : c. $1.5-3 \times 1-2$ cm, in ρ few-flowered, c. 1-3 cm long; axes woolly pubescent through stellate scaly or dendroid hairs 0.1-0.2 mm long; bracts pubescent, 0.5-1.5 mm long, caducous. Flowers 1-3 together; perianths 2-valved, stellate-scaly hairs scattered, densest towards the base; pedicel \pm densely scaly-pubescent, at base inarticulate. Male perianth ellipsoid to broadly obovoid, $2.0-3.0 \times 1.5-2.2(-2.4)$ mm, upper part rounded, at base long- to short-attenuate; pedicel 2-3.5(-6) mm, slender; perianth at anthesis split to c. $\frac{1}{8}-\frac{1}{6}$ (c. 0.1-0.4 mm deep only), valves 0.1-0.2 mm thick, the perianth-wall lower down 0.5-0.8 mm thick. Androecium a cylindrical club-shaped body $1.5-2.5 \times 0.5-0.8$ mm, at apex consisting of 3-4 anthers (or 6-8 thecae) 0.3-0.5 mm (the anthers \pm stellately arranged, with free apices 0-0.2 mm), and lower down a thickish sub-cylindrical androphore, in the upper $\frac{1}{3}-\frac{2}{3}$ wrinkled-bullate or warted, in the lower $\frac{1}{2}-\frac{2}{3}$ either minutely scaly-hairy or surface striate but glabrous; central column not hollowed out at apex. Female perianth broadly ellipsoid, $2-2.5 \times 1.5-2.1$ mm, split at anthesis to c. $\frac{1}{4}-\frac{1}{3}$, valves c. 0.2(-0.3) mm thick; pedicel 2-3.5 mm long; ovary ovoid, c. $1.5 \times 1.2-1.4$ mm, densely pubescent through stellate-scaly hairs c. 0.1 mm or less, style c. 0.2 mm long, stigma distinctly 2-lobed, 0.2-0.3 mm long. Fruits 1-3 per infructescence, broadly ellipsoid-ovoid, base rounded, top rounded to acutish, rostrum if present 1-3 mm, excl. the 1.5-5 mm long pseudostalk c. $1.0-1.6 \times 0.7-1.1$ cm, sparsely to densely pubescent through hairs c. 0.1 mm long, drying blackish, without lenticels; dry valves c. 0.5(-1.0) mm thick; seed ellipsoid; stalk 10-12 mm; perianth not persisting.

Distribution. Papua New Guinea: Morobe Prov., Northern Prov., Milne Bay Prov. (incl. Normanby Isl.), Western Prov.

PAPUA NEW GUINEA: *Brass* 7221; *Carr* 16192; *LAE* 67148, 70239, 71160; *NGF* 23574, 28894, 31751, 31888, 34088, 38093, 42995, 46892; *Pullen* 8287; *Schlechter* 17408 (n.v.)

Ecology. Scattered or locally plentiful shrub or small understorey tree, 1-6(-10) m in rain forest; on slopes and ridges, creek banks, edges of (sago) swamp forest. In Normanby Isl. in *Eucalyptopsis*-dominated forest, in New Guinea found associated in forest with dominant *Castanopsis*, or with *Lithocarpus*, *Anisoptera* and *Hopea*-dominant; 0-500 m. alt. Flowers and fruits throughout the year.

NOTES

1. *Fieldnotes.* Shrubs or treelets, recorded with the branches \pm whorled, or horizontal. Bark smooth, grey-brown; red exudate; wood cream to straw. Flowers yellow. Ripe fruit orange to orange-red, aril bright red.

2. By the similar shape of the androecium closely related with *H. clavata* and *H. crux-melitensis*. Most collections were acquired after Sinclair's time. Only one specimen was included by Sinclair in *H. subtilis* var. *schlechteri*, which is presently again accepted as a separate species, *H. schlechteri*.

3. The androphore in *Pullen* 8287, from Milne Bay Prov., is glabrous, whereas those of the type specimen, and other specimens from Western Prov. are densely minutely scaly-hairy on the lower part of the androecium. It is possible that this difference has a taxonomical significance, but more material is needed to decide on it.

24. *Horsfieldia ampla* Markgraf

Horsfieldia ampla Markgraf, Bot. Jahrb. 67, 2 (1935) 148 — Type: (Sepik) *Ledermann* 9639 (B, †, n.v.).

Small tree, 4-5 m. Twigs terete. Leaves large, cuneate-obovate, up to 40 × 16 cm, base ± attenuate, tip short-acuminate; nerves 16-18 pairs, straight, sharply raised beneath and connected before the margin. Petiole, 1 cm long. Inflorescences on the older wood, large, to 25 cm long and 10 cm wide, glabrescent, loosely flowered. Male flowers yellow, clavate, 4 × 2 mm (excl. pedicel?), the perianth 2-valved, split at anthesis to hardly ¼. Staminal column thick; anthers to c. 10, the androphore about as long as the anthers or slightly shorter.

Distribution. NE. New Guinea, Sepik Prov., Aprilfluss. Mountain slope near camp 18. Known only from the type.

Ecology. Dense, very humid forest, on mountain slope at 200-400 m alt. Male flowers date 12 November, 1912.

NOTES

1. This species is known only from the type. It is keyed out by Markgraf against *H. crux-melitensis*, with which it has in common the clavate flowers. In the key is mentioned that the perianth, other than the androecium, is largely hollow. He mentions in a note that the species is peculiar amongst the New Guinean *Horsfieldias* because of its large male flowers, which in other species are smaller and almost always broader than long, and hence that it is without close relatives.

2.. *H. ampla* was not mentioned by Sinclair.

25. *Horsfieldia ampliformis* de Wilde, *sp. nov.*

Fig. 1B(25): 14

Horsfieldia species inflorescentiis masculis grandis, c. 30 cm longis, attamen pubescentibus, a *H. ampla* Markgraf differt perianthiis latioribus (c. 3 mm latis) atque antheris 7. — Type: (New Guinea, Sepik Dist.) *Hoogland & Craven* 11085 (♂ fl.). (L; iso: K; A, BRI, CANB, LAE, US, n.v.).

Tree 5-8 m. Twigs stoutish, terete, when young thinly ridged, towards apex 4-7(-10) mm diam., early or late glabrescent, pubescence ± woolly, of hairs c. 0.2-0.5 mm long; bark coarsely striate, lenticellate, when older not flaking. Leaves in 2 rows, thickly membranous, elliptic-oblong to oblong, (18-)25-38 × (6-)7-13 cm, base short to long-attenuate, tip attenuate-acuminate; upper surface drying dark brown, lower surface early or late glabrescent or with subpersistent tomentum of rather scattered stellate hairs 0.2-0.5 mm long; larger dark brown dots absent;

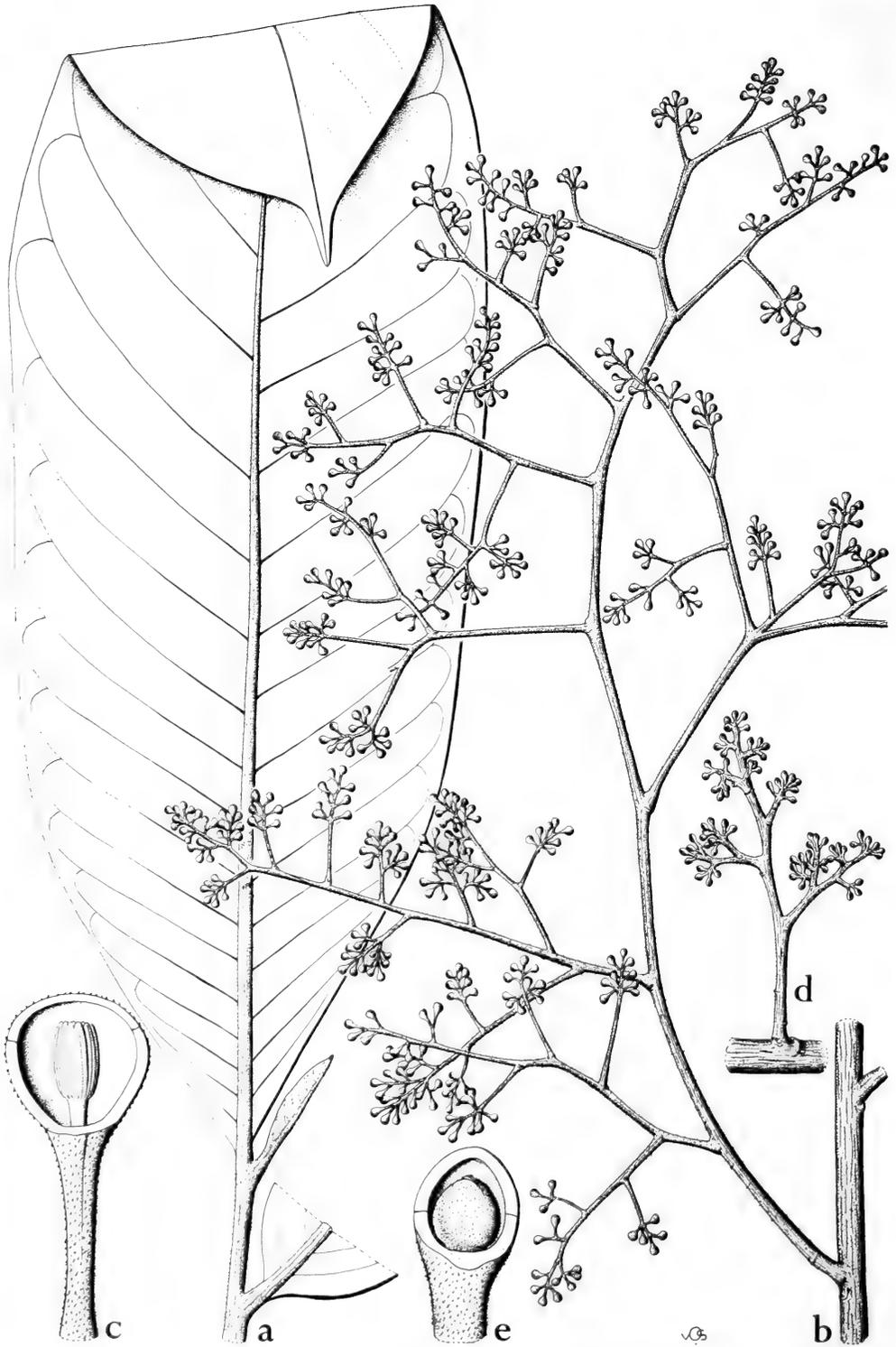


Fig. 14. *Horsfieldia ampliformis* de Wilde.

a, twig apex with leaves, $\times \frac{1}{2}$; b, portion of twig with male inflorescence axillary to fallen leaf, $\times \frac{1}{2}$; c, mature male flower, perianth opened, showing androecium, $\times 6$; d, portion of twig with female inflorescence, $\times \frac{1}{2}$; e, female flower, opened, showing finely pubescent ovary and minute 2-lipped stigma. — a-c, from Hoogland & Craven 11085; d & e, from Craven & Schodde 1463.

midrib above \pm slender, flattish; nerves 18-22 pairs, above thin, flat or sunken; the submarginal arches beneath not very prominent; tertiary venation forming a lax network, indistinct on both surfaces; petiole short, $4\text{-}6 \times 3\text{-}4$ mm; leaf bud 25-40 mm long, with hairs 0.2-0.5 mm. Inflorescences situated below the leaves, in σ : large, many-flowered, 4-5 times ramified, c. $25\text{-}35 \times 20\text{-}30$ cm, common peduncle 40-50 mm; in f : c. $9\text{-}10 \times 6\text{-}8$ cm; all branches rather loosely pubescent with hairs 0.2-0.5 mm long; bracts (only seen in f) c. 5 mm long, caducous. Flowers 2-5 together in σ and f , flowers and pedicels loosely pubescent, hairs (0.1-)0.2-0.3 mm long, in f the perianth glabrescent towards apex; perianths 2-valved; pedicel at base inarticulate. Male perianths broadly obovoid, laterally \pm flattened, c. $3\text{-}3.3 \times 3\text{-}3.2$ mm, at apex obtuse to broadly rounded, at base shortly tapering into pedicel 2-4 mm long; perianth largely hollow, at anthesis split to c. $\frac{1}{3}$, valves c. 0.3 mm thick. Androecium small, \pm flattened, incl. androphore c. $2.5 \times 1\text{-}1.2$ mm, broadly rounded at apex; anthers 7, when young indistinctly septate, synandrium $1.5\text{-}1.8 \times 1\text{-}1.2$ mm, free apices of anthers 0.1-0.2 mm; androphore $0.8\text{-}1.0 \times 0.5\text{-}0.6$ mm; the column at apex narrowly hollowed for c. $\frac{1}{4}\text{-}\frac{1}{3}$. Female perianths broadly ovoid, c. $3 \times 2.6\text{-}2.8$ mm, split at anthesis to c. $\frac{2}{3}$, valves c. 0.3 mm thick; pedicel 1-2 mm long; ovary broadly ovoid, c. $2\text{-}2.2 \times 1.8\text{-}2.0$ mm, densely pubescent with hairs 0.1 mm or less, stigma short, not or hardly lobed, c. 0.1×0.4 mm. Fruits not seen.

Distribution. Northern Papua New Guinea: Sepik Prov., Morobe Prov.

PAPUA NEW GUINEA. *Craven & Schodde 1463; Hoogiand & Craven 11085.*

Ecology. Lower montane rainforest, 1200-1300 m alt. Flowers in April and August.

Vernacular name. Guma (Sepik Prov., Waskuk lang.).

NOTES

1. *Fieldnotes.* Small tree, c. 8 m high. Flowers medium green, yellow at anthesis.

2. Close to *H. ampla* Mkgf., a species of which I have seen no material. According to the description it differs by the more elongate, possibly glabrous, perianths c. 4×2 mm, the androecium with 10 anthers, and the glabrescent inflorescences. The present new species has in common with *H. ampla* the peculiarly long-stalked androecium and the large male inflorescences. *H. ampla* was collected at 200-400 m alt.

3. Known from a male and a female flowering specimen. The perianths of the female specimen, *Craven & Schodde 1463*, from Morobe Prov., are glabrescent in the upper half. This could also be *H. ampla* as well. Moreover, as the hairs on the leaf bud are slightly shorter than those of the male specimen it is difficult to distinguish *H. ampliformis* from the variable and widespread *H. laevigata*.

26. *Horsfieldia angularis* de Wilde, *sp. nov.*

Fig. 1B(26)

Ramuli angulares vel biporcati, perianthio masculino subgloboso, 2-3 mm diam., basin versus pubescenti, 2-4-valvato fere usque ad basin, antheris 12-20, erectis, ovario pubescenti, fructibus breviter ellipsoideis, 1.7-2.0 cm longis, minute pubescentibus vel glabrescentibus. — Type: Vogelkop Penins., σ

fl., BW 5828 (L).

Tree 15-30 m. Twigs 2-angular from the two ridges from petiole to petiole, lower down subterete with two distinct ridges, 3-7(-10) mm diam., early glabrescent, tomentum grey-brown, with hairs 0.1 mm or less; bark striate, distinctly coarsely lenticellate, when older not flaking. Leaves in 2 rows, membranous to thinly chartaceous, oblong to oblong-lanceolate, broadest usually in the middle, 10-27 × 3-7.5 cm, base attenuate, tip acute-acuminate; upper surface drying pale to dark brown, often finely paler pustulate, lower surface glabrescent, hairs very minute grey stellate, less than 0.1 mm; without brown or blackish dots; midrib flattish or slightly raised above; nerves 12-15 pairs, above thin and flattish or slightly sunken; tertiary venation forming a lax network, faint; petiole 7-15 × 2-3 mm; leaf bud 10-15 × 2-2.5 mm, with hairs 0.1 mm. Inflorescences rather densely pubescent with hairs 0.2-0.3 mm; in ♂ and ♀: 2 or 3 times ramified, rather few-flowered, c. 3-4 × 2-2.5 cm, common peduncle 3-6 mm; bracts not seen, caducous. Flowers (in ♂) generally 2-4 together; perianths in ♂: 2-4-, in ♀: 2(-3)-valved, pubescent in the lower half with hairs 0.1(-0.2) mm long; pedicels pubescent, at base inarticulate. Male perianth in lateral view circular or slightly transversely ellipsoid, slightly or not laterally compressed, not collapsing on drying, 1.7-2.3 × 2.2-3.2 mm, above and at base (broadly) rounded, pedicel not tapering, 1-2 mm long; perianth at anthesis cleft to the base (c. $\frac{1}{10}$), valves (0.2-) 0.3 mm thick. Androecium slightly laterally flattened (and in 3- or 4-valved flowers ± 3- or 4-angular in transverse section), above broadly rounded, 1.2-1.5 × 1.5-2.2 mm, anthers 12 (2-valved) to c. 20 (in 4 valved flowers), ± erect, not septate, free portions at apex up to 0.1 mm, central column at apex narrowly hollowed for ($\frac{1}{3}$ -) $\frac{1}{2}$; androphore absent, the androecium ± broadly attached. Female perianth depressed globose, c. 2.5 × 3-3.2 mm, cleft at anthesis to c. $\frac{3}{4}$, valves 0.8-1.0 mm thick, pedicel 1-1.5 mm long; ovary ± depressed globose-ovoid, c. 1.2 × 1.5 mm, densely short-pubescent, style and stigma minute, minutely 2-lobed, c. 0.1 × 0.3 mm. Fruits 5-10 per infructescence, short-ellipsoid, 1.7-2.0 × 1.4-1.7 cm, pubescent at very base, with coarse paler-coloured lenticel-like tubercles; dry valves thick-woody, c. 3-5 mm thick; seed ellipsoid, stalk 3-5 mm long; perianth not persistent.

Distribution. New Guinea: Vogelkop Peninsula, subdist. Manokwari.

NEW GUINEA. Irian Jaya, Vogelkop: BW 2340, 5828, 10922, 15752; Kostermans 2635; van Royen & Steumer 6813 — Jayapura Dist. (doubtful): b.b. 31124; BW 5340.

Ecology. Primary forest; on clayey soils, locally common; 0-600 m alt. Flowers in February and August, fruits in February and October.

Vernacular names. Babijag (Karoon lang.), Bepoes (Hattam lang.), Betelohoi and Sebohongwa (Manikiong lang.).

NOTES

1. *Fieldnotes.* Locally common in primary forest on the coastal plain, up to 600 m. in Kebar valley. Sometimes buttresses to c. 1 × $\frac{1}{2}$ m. Bark sometimes fissured, or peeling off in small scales; with red exudate. Sapwood pale brown or white, heartwood not discernable or pinkish. Flowers greenish. Fruits yellow-brown or yellow, aril orange or red; fruit recorded as sour and edible.

2. The present new species is much related to *H. basifissa* of which the sterile specimens (presumed to belong to it) are difficult to identify since their twigs are rather ridged. *H. angularis* is distinguished from *H. basifissa* by (1) the more

strongly ridged and somewhat stouter twigs, (2) the more hairy and variably 2-4-valved flowers with thicker valves, (3) the hairy ovary, and the thinly pubescent ellipsoid fruits; the two species have in common thickish subglobose male (flower) perianths, which do not or hardly collapse on drying, and which at anthesis are cleft to the base.

3. Sinclair identified specimens as *H. polyantha*, a name presently considered a synonym of *H. laevigata*; specimens of the resembling *H. basifissa* were also identified by Sinclair as *H. polyantha*.

4. Two sterile specimens, with ridged twigs, *b.b.* 31124 and *Karstel BW 5340*, from Jayapura Dist., Irian Jaya, probably belong to the present species.

27. *Horsfieldia iriana* de Wilde, *sp. nov.*

Fig. 1B(27)

Horsfieldia novo-guineensis Warb., Mon. Myrist. (1897) 271, p.p., only the type of *H. iriana*, not the lectotype.

Myristica nesophila auct. non. Miq., Ann. Mus. Bot. I (1864) 206; Miq., Ann. Mus. Bot. II (1865) 49, p.p., as based on *Zipelium* (139 d), not the lectotype of *Myristica aruana* Bl. = *H. aruana*.

Ramuli angulati vel sulcati. Perianthium in fl. ♂ valvis 2 instructum. Androecium lateraliter compressum. Antherae erectae. Cum *H. aruana* comparibilis, sed differt pedicellis perianthio longioribus perianthoque sub anthesi usque ad basin fissum. — Type: *Zipelium* (139 d) (L; iso: K).

Tree c. 10(?) m. Twigs 2-angular from the two ridges between the petioles, lower down subterete but ridged, 3-5 mm diam., early glabrescent, tomentum grey-rusty, composed of hairs c. 0.2 mm long; bark rather smooth, when older not flaking; lenticels small, distinct. Leaves in two rows, thinly coriaceous, oblong-lanceolate, broadest at or above the middle, 17-28 × 4.5-8 cm, base long-attenuate, tip acute-acuminate; upper surface drying olivaceous, lower surface early glabrescent from stellate-scaly hairs 0.1-0.2 mm long, larger brown-blackish dots absent; midrib rather broad and flat above; nerves 13-16 pairs, thin and flat above; tertiary veins forming a lax network, slightly raised above but indistinct; petioles 6-11 × 2-3.5 mm; leaf bud slender, 10-15 × 1.5-2 mm, with hairs 0.1-0.2 mm long. Inflorescences in ♂: axillary to the lower leaves, sparsely pubescent with stellate hairs 0.2(-0.3) mm long, (2 or) 3(or 4) times ramified, rather many-flowered, 6-8 × 4-6 cm, common peduncle 5-10 mm long; bracts not seen, caducous. Flowers in loose clusters of 2-5, perianth 2-valved, largely glabrous but with some minute hairs towards the base; pedicels slender, sparsely pubescent, at base inarticulate. Male perianth in lateral view circular to slightly longitudinally ellipsoid, not or slightly laterally compressed, blackish brown, not collapsed on drying, 2.3-2.8 × 2.2-2.8 mm, subacute or narrowly rounded at the top, at base rounded, pedicel not tapered, slender, c. 2.5-3 mm long; perianth at anthesis cleft to $\frac{3}{4}$ - $\frac{5}{6}$ deep, valves c. 0.2 mm thick. Androecium laterally compressed (flattened), c. 1.5 × 1.5-2 mm, (broadly) rounded above; anthers c. 10-14, erect, finely septate when young, free portions at apex 0.1(-0.2) mm long, column at apex narrowly hollowed for c. $\frac{1}{4}$; androphore absent. Female flowers and fruits not seen.

Distribution. SW. New Guinea (Irian Jaya), known only from the type.

Ecology. Nothing known; likely from coastal lowland forest.

NOTES

1. Only known from the type specimen, *Zipelius* (139 d) in L (K, iso). This specimen is part of the heterogenous *Zipelius* material which served for the description of *Myristica aruana* Blume and *Horsfieldia novo-guineensis* Warb., of which the typification is explained under *Horsfieldia aruana*. The syntype-specimens *Zipelius* (139d) were erroneously included by Sinclair in *H. polyantha* Warb. as accepted by him. This name is here considered a synonym of *H. laevigata*.

28. *Horsfieldia aruana* (Bl.) de Wilde, *comb. nov.*

Fig. 1B(28)

Myristica aruana Bl., Rumphia 1 (1837) 191; Sinclair, Gard. Bull. Sing. 28 (1975), 112, 118, 119 122-124, in the synonymy of *Horsfieldia spicata* — *Palala aruana* Rumph., Herb. Amb. 7(Auct.)(1755), t. 24 — *H. novo-guineensis* Warburg, Mon. Myrist. (1897) 271, t. 23 fig. 1-3, p.p., for the lectotype only. — Lectotype: those specimens of *Zipelius s.n.* at L, annotated by Blume.

Tree c. 15m. Twigs 2-angular from the two ridges between the petioles, lower down subterete though also provided with 2 ridges, 3-5 mm diam., early glabrescent, tomentum minute, of hairs c. 0.1 mm long; bark striate, when older not flaking; lenticels small, inconspicuous. Leaves in two rows, membranous, elliptic-oblong, broadest at or above the middle, 15-29 × 5-9.5 cm, base attenuate, tip acute-acuminate, upper surface drying olivaceous to brown, lower (surface) early glabrescent, without larger brown-blackish dots; midrib flattish or slightly raised above; nerves 13-15 pairs, slender, flattish; tertiary veins forming a lax network, indistinct; petioles 10-15 × 1.5-2.5 mm, leaf bud c. 10 × 1.5 mm, with hairs c. 0.1 mm long. Inflorescences situated in between or below the leaves, sparsely pubescent by hairs c. 0.1 mm or less, in ♂: 3 or 4 times ramified, 5-8 × 4-5 cm, rather many-flowered, common peduncle 5-15 mm long; bracts not seen, caducous. Flowers in loose clusters of 2-5 each, perianth 2-valved, glabrous; pedicels slender, sparsely pubescent, inarticulated at base. Male perianth in lateral view circular to somewhat transversely ellipsoid, laterally compressed, blackish and collapsing on drying, 1.5-2 × 2-2.5 mm, top broadly rounded, base ± rounded, pedicel not tapering, slender, 1-1.5 mm long; perianth at anthesis cleft to c. $\frac{2}{3}$ - $\frac{3}{4}$, valves c. 0.2 mm thick. Androecium much laterally compressed, c. 1.5 × 2.0 mm, above broadly truncate-rounded; anthers (c.) 14-18, finely septate when young, distal free portions 0-0.1 mm, anther column completely solid or almost so (see notes); androphore absent or up to 0.1 (-0.2) mm. Female flowers and fruits not seen.

Distribution. SW. New Guinea (Irian Jaya); possibly also Aru and Tanimbar Isls. (see notes).

TANIMBAR ISLS.: *b.b.* 24414 (doubtful).

ARU ISLS.: *Buwalda* 4969 (doubtful).

NEW GUINEA: Irian Jaya, SW.: *Zipelius s.n.* (in L, as annotated by Blume).

Ecology. Not known.

NOTES

1. *Horsfieldia aruana* with mature male flowers is only known from the lectotype, i.e., three unnumbered Zipelius collections in Leiden, which have membranous leaves, and which bear annotations by both Blume and Zippel "Myristica Sp. arb. 40-50, N. Guinea". Also deposited in Leiden are three duplicates of which two are unannotated. They form part of the syntype material including the Zippel-collections mentioned by Warburg under his *H. novo-guineensis*; see further, notes 2 and 3.

2. Warburg (p. 273) had rejected the name *Myristica aruana* Bl. and replaced it with a new name, *H. novo-guineensis* Warb., as he considered the type of *M. aruana* a mixture and dubious. Later he in turn conceived *H. novo-guineensis* as a very variable species (it being based on a number of specimens), not indicating a holotype, citing *M. aruana* Bl. p.p. and *M. nesophila* Miq. in its synonymy, *Annales* II (i.e. not the one in *Annales* I). *H. novo-guineensis* is presently referred to *H. irana*, a new species.

The specimens cited by Warburg for *H. novo-guineensis* (now the syntype) are the following: New Guinea (West), *Zipelius s.n.* (♂, several sheets of two different species); *Beccari 684* (♂, fr.), *116* (♂) — (East), Sepik, *Hollrung 657* (fr.) — Aru Isls., *Moseley s.n.* (fr.) — Dammar Isl., *Riedel s.n.* (fr.).

The Zipelius specimens are all in Leiden and represent two different species. Warburg (p. 273) had alluded to the difference. Part of it is now chosen to typify the presently accepted name *H. aruana* and to lectotypify *H. novo-guineensis* as explained in note 3.

The remaining material, marked *Zipelius (139d)* in Leiden (K, iso) is now accommodated in *H. irana*, the newly described species.

I have not examined the Beccari specimens. Sinclair referred *116* to *H. spicata* and *684* to *H. polyantha*. Of these two species I have presently quite different ideas.

Hollrung 657 was referred by Sinclair to *H. spicata* as well but I consider it to be *H. pilifera* or *H. laevigata* although its fruits are intermediate in size, 16-18 mm long, and the twigs tend to be ridged.

Sinclair had not mentioned *Moseley s.n.*, from the Aru Isls., in K, and I have not seen it.

Riedel s.n. from the Dammar Isls is *H. smithii*.

3. The name *M. aruana* Bl. was considered as dubious and rejected by Warburg (p. 273), being based on Rumph's "Palala aruana" (Herb. Amboin., Auct. p. 56) whereas he regarded the Zipelius specimens too different from Rumphius's descriptions. I agree with Sinclair (l.c.) who accepts Blume's name typified by the Zipelius collections (see note 1) as annotated by Blume at the Leiden Herbarium. Sinclair regarded the name *aruana*, thus typified, as synonymous with *H. spicata* in the wider sense. It will become clear that Warburg's new name "novo-guineensis" remains with "aruana" as lecto-typified by Sinclair (pp. 122 & 123). Of the Zipelius collections, Sinclair had cited them under the number of "(139d)" as being *H. iriana*, newly proposed by him.

4. Doubtful specimens are *Buwalda 4969* (K,L) from the Aru Isls. and *b.b. 24414* (L) from the Tanimbar Isls. The male flowers of both are immature and they may well belong to the type collection. Even more dubious is *b.b. 24414* as the stamen column of its androecium appears to be open for nearly $\frac{1}{4}$ or $\frac{1}{5}$, and irregular whitish blotches on its leaves are similar to those usually found in *H. irya* and *H. smithii*. The anther columns of *Buwalda 4969* are cleft to a depth of only $\frac{1}{10}$. Sinclair identified this as *H. pilifera* (at Kew) and as *H. spicata* (at Leiden), and *b.b. 24414* as *H. irya*.

5. *Distribution*. Because of the doubts concerning *Buwalda 4969* discussed above and the reference by Blume to "Palala aruana", it cannot be ascertained that the present species occurs on the Aru Islands.

29. *Horsfieldia subtilis* (Miq.) Warb.

Fig. 1B(29); 15 g, h.

Myristica subtilis Miq., Ann. Mus. Bot. Lugd.-Bat. 2,1 (1865) 50 — *Horsfieldia subtilis* (Miq.) Warb., Mon. Myrist. (1897) 286, t. 23 fig. 1-4; Markgraf, Bot. Jahrb. 67, 2 (1935) 152 — Type: *Zipelius* (78) (U; iso: K, L; S, n.v.).

For further synonyms see under the varieties.

Tree 2-10(-15) m. Twigs terete, not ridged, 1-3(-8) mm diam., early glabrescent, tomentum grey-brown, of hairs c. 0.1 mm long or less; bark finely striate, when older not flaking, lenticels fine, usually present. Leaves in 2 rows, membranous or as in var. *calcarea* \pm chartaceous, elliptic to oblong-lanceolate, broadest usually at or above the middle, 6-25(-28) \times 2-9(-9.5) cm, base attenuate, tip acute-acuminate; upper surface drying dull olivaceous to brown, with or without fine paler dots, lower surface very early glabrescent, hairs 0.1 mm or less; without larger dark-coloured dots, the nerves darker and contrasting in colour or not; midrib above flattish or slightly raised; nerves 6-16 pairs, above thin and flat or raised, beneath with the submarginal arches faint or distinct; tertiary veins forming a lax network, usually indistinct on both surfaces; petiole 5-13 \times 1.2-5 mm; leaf bud 6-12 \times 1.5-2 mm, with hairs c. 0.1 mm. Inflorescences in σ^7 1-2(-3) times ramified, common peduncle up to 10 mm long, rather few- to many-flowered, 2-8(-9) \times 1.5-6 cm, in f : 2-5(-8) cm long; glabrescent or with sparse tomentum of scattered stellate-scaly hairs 0.1-0.2 mm long; bracts 0.5-2 mm long, glabrescent, with fimbriate margins, caducous. Flowers in loose clusters of 1-8(-10) each; perianths 2-valved, glabrous, pedicel slender, glabrous, at base not articulated. Male perianth in lateral view circular or more or less broadly transversely sub-ellipsoid, or broadly ob-triangular, usually distinctly flattened, and collapsing on drying, 1.3-2.4 \times 1.8-3 mm, upper part generally subtruncate or (broadly) rounded, at base subtruncate to short-cuneate, pedicel not tapering, slender, 1-3 mm long, perianth at anthesis split to c. $\frac{1}{4}$ - $\frac{1}{3}$ (- $\frac{1}{2}$), valves 0.1-0.2 (in var. *acuta* up to $\frac{1}{2}$) mm thick. Androecium laterally flattened towards the top, at base broadened and usually almost cylindrical, lateral view subquadrangular in outline, i.e., broadly rounded or subtruncate above, the androecium nearly filling the perianth, c. (0.7-)1-1.5(-1.7) \times 1.4-1.6 mm; anthers (9-) 10-12, faintly septate when young, \pm erect, free portions at apex up to 0.1 mm long, anther column at apex narrowly hollowed for c. $\frac{1}{4}$ - $\frac{1}{3}$; androphore \pm slender, distinct, 0.2-0.5 mm long, sometimes \pm hidden by the sagged anthers. Female perianth broadly ellipsoid to ovoid, or subglobose, 1.8-2.5 \times 2-2.5 mm, split at anthesis to c. $\frac{1}{3}$, valves c. 0.2 mm (at base of perianth 0.3-0.6 mm) thick, pedicel 1-5 mm long; ovary avoid, 1.1-1.5 \times 0.8-1.1 mm, glabrous, style with minutely bilobed stigma c. 0.2 mm long. Fruits (1-) 5-15 per infructescence, either globose or subglobose, 0.9-1.2(-1.3) \times 0.8-1.1(-1.3) cm (pseudostalk up to 1 mm), or in some

varieties with larger ones rather ellipsoid, 1.4-1.9 × 1.1-1.4 cm, with the top rounded to acutish, base rounded, without or with pseudostalk up to 3 mm; glabrous, drying blackish, without or with minute paler tubercles or lenticles; dry valves c. 1(-2) mm thick; seed subglobose to ellipsoid; stalk 1-7 mm; perianth not persisting.

Distribution. Aru. Isls., the whole of New Guinea.

In order to accommodate a number of specimens with the fruits distinctly larger than the majority, local varieties are recognized.

KEY TO THE VARIETIES

- 1a. Male perianth 2-3 mm wide. Fruits globose or short-ellipsoid, 9-12(-13) mm long incl. pseudostalk 0-1 mm **a. var. subtilis**
- b. Male perianth c. 2.5-3 mm wide (always?). Fruits short-ellipsoid, 14-19(-20) mm long incl. pseudo-stalk 3 mm 2
- 2a. Leaves chartaceous, elliptic, 6-9 cm long. Pseudostalk of fruit 2-3 mm long. Limestone area, SW. Vogelkop Penins.; 200-300 m alt **b. var. calcarea**
- b. Leaves coriaceous or membranous, elliptic-oblong, 10-22 cm long. Pseudostalk of fruit 0-3 mm long. Papua New Guinea; 600-1000 m alt 3
- 3a. Leaves membranous. Perianth (♀) glabrous inside **c. var. aucta**
- b. Leaves coriaceous. Perianth (♀) hairy inside **d. var. rostrata**

a. var. subtilis

Fig. 1B(29); 15 g, h

Horsfieldia subtilis var. *subtilis*: Sinclair, Gard. Bull. Sing. 28 (1975) 132.

H. aruensis Warb., Mon. Myrist. (1897) 284, t. 23 fig. 1-3; Markgraf, Bot. Jahrb. 67, 2 (1935) 154 — *Myristica aruensis* (Warb.) Boerl., Handl. Fl. Ned. Ind. 3, 1 (1900) 85 — Type: *Beccari s.n.* (FI Acc. Nos. 7622, 7622 A-C, 7623, n.v.).

H. lauterbachii Warb., Mon. Myrist. (1897) 285, t. 23 fig. 1-2; Schumann & Lauterbach, Fl. Deutsch. Schutzgeb. (1900) 324; Pulle, Nova Guinea 8 (1912) 635; Markgraf, J. Arn. Arb. 10, 2 (1929) 213; Bot. Jahrb. 67, 2 (1935) 153 — Type: *Lauterbach 805* (B, † *BRSL*, n.v.).

H. ramuensis Warb. in K. Sch. & Laut., Fl. Deutsch. Schutzgeb., Nachtr. (1905) 266 — Type: *Rodatz & Klink 20, 24* (both B †).

H. globularia auct. non (Bl.) Warb.: K.Sch. & Laut., Fl. Deutsch. Schutzgeb. (1900) 324.

H. nesophila auct. non (Miq.) Warb.: Pulle, Nova Guinea 8 (1912) 635.

Leaves membranous, elliptic to oblong. Male perianths 1.8-3 mm wide. Fruits (sub)globose, c. 9-12(-13) × 8-11 mm, incl. the pseudostalk 0-1 mm long.

Distribution. As for the species.

ARU ISLS. *Buwalda 4970*; *Jensen 255*.

NEW GUINEA. Irian Jaya: *Aet 2, 313, 382; Aet & Idjan 554; Astarip 63, 715; BW 2362, 2464, 3517, 3518, 4340, 4761, 4834, 4837, 4942, 6056, 6235, 6796, 8377, 10278, 10628, 11388, 12255, 13524, 13576; Docters van Leeuwen 9122, 9611, 9698, 9767, 10702, 11066, 11067, 11222; Gjellerup 11, 273; Ijiri & Niimura 53; Kostermans 2668, 2670, 2686, 2802, 2903, 4744; Lam 770; Pymans 7383; Pleyte 1006; Pulle*

52, 1239; von Römer 676; van Royen 3473, 3560, 4017, 4745, (& Sleumer) 6694; Soegeng 366; Teysmann 7566; Versteeg 1140, 1568, 1612, 1616, 1814; Zipelius 78 — Papua New Guinea: Brass 1414, 28938; Carr 11545, 11629, 12575, 12820, 16281; Craven & Schodde 840, 1012; Darbyshire 1024; Hartley T.G.H. 10710, 11328; Hoogland (& Womersley) 3245, 3503, 3617, 4208, 4583, (& Craven) 10475; Jacobs 9129, 9252; Kanis 1031; LAE 51573, 61106, 61231, 63002, 66272, 70255, 70256, 70455, 73949, 76136; NGF 3890, 4553, 8232, 10378, 13066, 13146, 16068, 16075, 17775, 18308, 18433, 18436, 23575, 24844, 31731, 32822, 33410, 35340, 35427, 35449, 35472, 41108, 41878, 43692, 43693; Pullen 1074, 7280, 7419, 8139; Schodde 2590, 2910, 2968, 3066; Womersley 3890, (& Simmonds) 5080.

Ecology. Understorey tree of primary and secondary forests; dry and marshy forest, but often tidal (fresh water) or riverine; on alluvia, clayey soil, sandy clay, also on limestone or coral soils; 0-800 m. Flowers and fruits throughout the year. Stems once reported as inhabited by ants.

Vernacular names. Aitobi (Aru Isls.), Airawikoezata (West N.G., Tisa), Bendoei (Vogelkop, Hattam lang.), Boskomok (East N.G., Western Prov., Oriomo R.), Iinapo (Uruaruh lang., Gulf Prov.), Mag (E. N.G. Gulf Prov., Daru lang.), Mangaifa (Papua, Centr. Prov.), Njet (W. N.G., Kebar lang.), Oara (Papua, South Vieya), Peh (begie) (Div. South N.G., Digoel R., Awjoe lang.), Rengkêferèk (W. N.G., Beriat, Tahid land.), Rewwoh (W. N.G., Fak-Fak, Argoeni lang.), Roman (E. N.G., Pt. Moeresby, Centr. Prov., Waria lang.), Suri (E. N.G., Sepik Prov., Waskuk lang.), Tabwi (E. N.G., Sepik Prov., Wagu lang.), Torua (E. N.G./Papua, North. Prov., Barua lang.).

Uses. Once recorded that the leaves and twigs were burnt as a mosquito repellent.

NOTES

1. *Fieldnotes.* Low understorey tree, usually 3-5 m tall. Bole straight; bark greyish black or grey-brown, finely longitudinally fissured, with broadened lenticels. Branches often horizontal or drooping. Exudate pinkish, or colourless and turning reddish. Wood straw-coloured, usually mottled with reddish streaks. Perianth yellow, rarely orange-yellow. Fruits greenish-yellow, yellow, or (yellow) orange, aril orange or red.

2. *Deviating specimens.* Van Royen & Sleumer 6694 from a coral cliff near Mankokwari (Vogelkop) somewhat deviates in the relatively narrow perianth, \pm longer than broad, c. 2.4×2.2 mm. Versteeg 1612 from SW. New Guinea has relatively large fruits, c. $1.3 \times 1.1-1.3$ cm.

3. The type-variety as presently accepted largely agrees with Sinclair's *H. subtilis* var. *subtilis*. Of the other two varieties accepted by him, are var. *rostrata* (Mgkf.) and var. *schlechteri* (Warb.), the latter presently treated as a different species, distinguished by characters different from those used in his key to the varieties.

b. var. *calcarea* de Wilde, var. nov.

Differt a *H. subtilis* var. *subtilis* perianthiis masculis latioribus atque fructibus maioribus, c. 1.5-2 cm longis, stipitibus 2-3 mm longis, foliis chartaceis, usque ad 10 cm longis. — Type: Vink BW 15270 (L; iso: K; A, BO, BRI, CANB, LAE & US, n.v.).

Leaves thinly chartaceous, elliptic, 6-9 \times 2.5-4 cm, at the apex proportionally long-acute-acuminate for 1-1.5 cm. Male flowers not seen. Fruits ellipsoid, 17-19 \times

12-14 mm, incl. pseudostalk 2-3 mm long.

Distribution. West New Guinea, SW. Vogelkop Penins.

IRIAN JAYA. Vogelkop Penins.: (*Versteegh*) BW. 7432; (*Vink*) BW. 15270.

Ecology. Secondary forest on limestone rock with thin clay cover; 220-300 m alt. Fruits in March and May. Female flowers in May.

Vernacular name. Baiwach, Hafringee (Maibrat lang.).

NOTES

1. Recorded as a shrub, 5 m tall; rather common. Ripe fruits orange.

2. Judging from the aspect after drying, the pericarps of the fruits in *Vink* BW 15270 suggested they were rather fleshy in the fresh state and drying left the pseudostalks distinct, c. 3 mm long.

c. var. **aucta** de Wilde, var. nov.

A *Horsfieldia subtilis* typica differt fructibus maioribus, a *H. subtilis* var. *calcareo* foliis maioribus membranaceis — Type: *Jacobs* 8972 (L; iso: K).

Leaves membranous, elliptic-oblong, 11-20 × 3-7.5 cm, apex for 1-1.5 cm acute-acuminate. Male perianth obtriangular, c. 2.5-3 mm wide (always?). Fruits short-ellipsoid, 15-19(-20) × 11-15 mm including the up to 2.5-mm long pseudostalk.

Distribution. Papua New Guinea; possibly also near Manokwari, Vogelkop Penins., W. New Guinea (see notes).

NEW GUINEA. Irian Jaya, Vogelkop: (*Koster*) BW 4340 (doubtful). Papua New Guinea: (Western Dist.) NGF. 42815; (S. Highlands) *Jacobs* 8711, 8972, 9053, 9071, 9071-A; (Central Distr.) *Kanis* 1328.

Ecology. Montane primary and secondary rain forest, on well-drained volcanic soil, or peaty soil; at 600-1000 m. Flowers in September and October, fruits from July to October.

NOTES

1. Shrub or low tree, 3-8 m. Male flowers fleshy, dark yellow. Fruits glossy orange, hard; aril dark orange, or red, at the base black.

2 The male flowers, known from *Jacobs* 9071, are stouter and have a thicker perianth as compared with those of var. *subtilis*. In *Jacobs* 9071 the perianth is obtriangular, c. 3 × 3 mm, and split into 2 (or some into 3) valves only for the apical 1/5-1/4; lower down, the perianth wall is thick-fleshy, c. 0.5 mm thick. On *Jacobs* 9071-A, a collection from a nearby tree with fruits measuring c. 16 × 14 mm when dry, *Jacobs* had remarked that in the fresh state the "seed (is) half the diameter of the fruit". The dry seed measures about 14 mm, and probably was not or only slightly larger in the fresh state; this means that fresh fruits were about 3 cm diam., i.e., the dry ones in the herbarium have shrunk to half.

The inflorescences in *Jacobs 8711*, with submature fruits, are 8-9 cm long; these are stouter than generally found in the type variety.

3. *Kanis 1328*, from Moresby area, deviates by a more slender habit. *Koster BW 4340*, from near Manokwari, Vogelkop (West New Guinea) at an altitude of c. 150 m. probably does not belong here. Moreover, its fruits are c. 14 × 12 mm, considerably larger than all the rest seen of var. *subtilis* from the same area.

d. var. *rostrata* (Mkgf.) Sinclair

Horsfieldia subtilis var. *rostrata* (Mkgf.) Sinclair, Gard. Bull. Sing. 28 (1975) 136 — *Horsfieldia rostrata* Mkgf, Bot. Jahrb. 67, 2 (1935) 152 — Type: *Ledermann 8916* (B, †; iso: SING, n.v.).

Leaves chartaceous to coriaceous, cuneate-obovate, c. 9-13 × 2-4.5 cm, tip shortly acute-acuminate. Male flowers not known. Female perianth pilose inside (see notes). Fruits ellipsoid, top rostrate, c. 20 × 12 mm, including the 2-4-mm long pseudostalk.

Distribution. NE. Papua New Guinea: Sepik Prov., Etappenberg; known only from the type.

Ecology. Mossy montane forest with much *Agathis*, c. 850 alt. Female flowers and fruits in October.

NOTES

The holotype of *H. rostrata*, containing ♀ flowers and mature fruit, was lost in B; an isotype is in SING and was examined by Sinclair. He maintained *H. rostrata* as a variety under *H. subtilis*. According to him, the SING specimen contains a single infructescence with two fruits, each measuring c. 1.4-1.5 × 1 cm; the fruits have a c. 2-mm beak, and pseudo-stalks 3-4 mm long. According to this description the foregoing new var. *aucta* appears almost entirely identical with var. *rostrata*. However, Markgraf, l.c. p. 153, describes the perianth of the female flowers as pilose inside; the ovary and fruit as glabrous. The hairiness of the inner side of the perianth would render the *Ledermann 8916* collection highly remarkable, and consequently I have provisionally kept it as a separate taxon. The inner hairy surface of the perianth seems reminiscent of *Endocomia macrocoma*, but this has three perianth lobes.

30. *Horsfieldia schlechteri* Warb.

Fig. 1B(30); 15 a-f.

Horsfieldia schlechteri Warb. in Schum. & Lauterbach, Nachtr. z. Fl. Deutsch. Schutzgeb. Südsee (1905) 267; Markgraf, Bot. Jahrb. 67, 2 (1935) 153 — *H. subtilis* var. *schlechteri* (Warb.) Sinclair, Gard. Bull. Sing. 28 (1975) 137 — Type: (Torricelli Mts.) *Schlechter 14500* (B, † iso: BM, K, P; BO, WRCL. G, n.v.).

Tree or shrub, 3-15 m. Twigs terete, not ridged, towards apex 1-4(-6) mm diam., early glabrescent, tomentum rusty-grey, with hairs c. 0.1 mm long; bark finely striate, when older not flaking; without or with few lenticels. Leaves in 2 rows, membranous or thinly chartaceous, elliptic-oblong to oblong-lanceolate, ± parallel-sided or not, 6-19 × 1.06-6.5 cm, base attenuate, tip acute-acuminate; upper surface drying olivaceous to dark brown, finely paler pustulate or not, lower surface early glabrescent, the hairs 0.1 mm or less, without larger brown dots, the

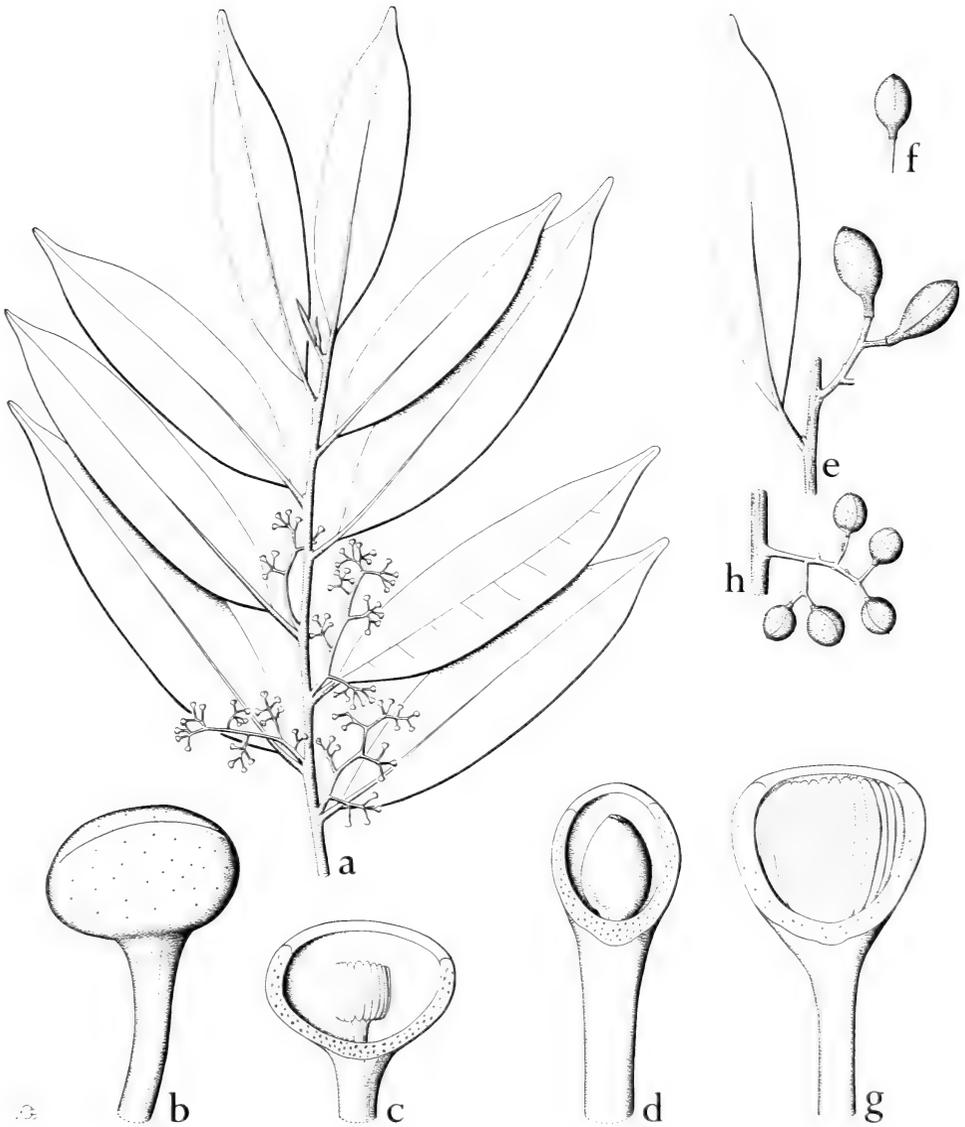


Fig. 15. *Horsfieldia schlechteri* Warb. a, leafy twig with male inflorescences, $\times \frac{1}{2}$; b, mature male flower, $\times 12$; c, ditto, opened, showing stiped androecium, $\times 12$; d, opened mature female flower, showing glabrous ovary, $\times 12$; e, portion of twig with infructescence with mature fruits, $\times \frac{1}{2}$; f, mature fruit of a different specimen, $\times \frac{1}{2}$. — *Horsfieldia subtilis* (Miq.) Warb. var *subtilis*: g, opened male flower, showing androecium, androphore hidden by the anthers, $\times 12$; h, twig portion with mature infructescence. — a-c, from Kostermans & Soegeng 359; d & e, from BW 4307; f, from BW 2900; g, from LAE 70256; h from Hoogland 3503.

nerves little contrasting; midrib slender, raised from both surfaces; nerves 6-14 pairs, raised or flattish above, indistinct; tertiary veins forming a lax network very indistinct on both surfaces; petiole 5-12 × 0.7-1.5 mm; leaf bud c. 8 × 1 mm, with hairs c. 0.1 mm long. Inflorescences glabrescent or with rather sparse to dense tomentum of stellate hairs 0.1 mm long or less, sometimes extending to the pedicels; in ♂: (1-)2(or 3) times ramified, 1.5-7 × 1-4 cm, common peduncle 3-15 mm, slender; in ♀: few-flowered, 1-4 cm long; bracts 0.5-1 mm long, densely woolly pubescent, caducous. Flowers solitary or 2 or 3 together, perianths 2-valved, glabrous; pedicels slender, at base inarticulate. Male perianth (broadly obovoid or) subglobose, (1-) 1.3-1.5 × (1-) 1.5-2 mm, not or only little laterally compressed, when dry wrinkled but not or slightly collapsed, rounded above, shortly tapered at base; pedicel slender, (1-)2-3.5 mm long, slightly broadened towards the perianth, glabrous or with some scattered minute hairs at base; perianth at anthesis split to c. $\frac{1}{3}$ (- $\frac{1}{2}$), valves 0.1-0.2 mm thick. Androecium ± flattened especially in the upper part, thickish at base, broadly ellipsoid in outline, above and at base broadly rounded, c. 0.6-0.8 × 0.9-1.0 mm; anthers 8, mutually appressed, free apices 0-0.1 mm; androphore 0.4-0.5 mm; anther column at apex narrowly excavated for c. $\frac{1}{5}$. Female perianth ellipsoid-obovoid, c. 1.5-2 × 1.5 mm, split at anthesis to c. $\frac{1}{4}$, valves 0.1(-0.2) mm thick, pedicel 1.5-2 mm long; ovary ellipsoid, c. 1-1.2 × 0.8 mm, glabrous or with a few minute hairs at apex (see notes), stigma minutely 2-lobulate, c. 0.1 mm long. Fruits 1(-2) per infructescence, ellipsoid, top rounded, not pointed or for only c. 1 mm, base rounded to short-attenuate into a pseudostalk (1.5-) 2-6 mm long, excl. pseudostalk 1.3-2.0(-2.5) × 0.9-1.2 cm, glabrous, drying blackish, with or without paler pustules (or lenticels), dry valves 1-2 mm thick; stalk 5-10 mm long; perianth not persisting.

Distribution. New Guinea: Irian Jaya, Jayapura Dist.; N. Papua New Guinea, W. Sepik Prov.

NEW GUINEA. Irian Jaya: *bb* 25083; *BW* 2900, 3681, 4064, 4307, 5522; *Kostermans & Soengeng* 235, 359; *van Royen & Sleumer* 6219, 6455 — Papua New Guinea: *Hoogland & Craven* 10703; *NGF* 13293, 18953, 39223, 48230, 48297; *Pullen* 1514; *Schlechter* 14500.

Ecology. Forest on stony slopes, foothills, ridges; mossy forest, lowland and lower montane forest; on stony clay, sandy soil; 20-500 m alt. Flowers and fruits throughout the year.

Vernacular names. Cheem (Sepik Prov.), Guma (Waskuk lang., Sepik Prov.), Medal (Wagu lang., Sepik Prov.).

NOTES

1. *Fieldnotes.* Bark dark brown or blackish, with longitudinal fissures. Perianths yellow or orange-yellow. Fruits green-yellow, yellow, or (yellow-)orange; aril red.

2. *BW4307* (Hollandia, 400 m) has markedly large fruits, c. 2.5 × 1.2 cm incl. the 5-6-mm long pseudostalk. The specimen *Kalkman 3681*, from the same area, at 50 m, has fruits c. 1.3 × 0.9 cm, with only a short pseudostalk (1-) 1.5 mm; its ovaries and very young fruits have a few minute hairs towards the apex; it approaches certain specimens of *H. subtilis*.

3. *H. schlechteri*, as accepted presently, largely agrees with Sinclair's *H. subtilis* var. *schlechteri*. However, specimens cited by him from outside the Jayapura/Sepik area are presently referred to *H. subtilis*.

31. *Horsfieldia basifissa* de Wilde, *sp. nov.*

Fig. 1B(31)

Horsfieldia polyantha auct. non Warb.: Sinclair, Gard. Bull. Sing. 28 (1975) 95, p.p.

A *Horsfieldia* speciebus quoad perianthia 2-valvata sese similibus, differt ramulis non-cristatis, perianthiis masculis sub anthesi usque ad basin divisa, androecio excavato per $\frac{1}{3}$ - $\frac{1}{2}$, atque fructibus glabris (sub)globosis. — Type: *White NGF 10242* (L).

Tree 10-25 m. Twigs terete, faintly ridged or not, towards the apex 2-4(-8) mm diam., early glabrescent, tomentum grey-brown, with hairs c. 0.1 mm; bark finely striate, when older not flaking; lenticels inconspicuous. Leaves in 2 rows, membranous to thinly chartaceous, elliptic-oblong to oblong-lanceolate, broadest usually above the middle, 10-22 × 3-8 cm, base attenuate, top acute-acuminate; upper surface drying olivaceous to brown (often with paler markings, possibly caused by calcium agglomerations), not or faintly, minutely, more palely pustulate, lower surface glabrescent, hairs c. 0.1 mm; without larger dark brown dots; midrib above flattish; nerves 10-15 pairs not particularly contrasting, above thin and flattish or sunken, beneath with the marginal arches not very regular nor prominent; tertiary veins forming a lax network, rather faint; petioles 5-10 × 1.5-2.5 mm; leaf bud c. 10 × 1.5 mm, with hairs c. 0.1 mm. Inflorescences in ♂:3(-4) times ramified, many-flowered, 4-10 × 2.5-6 cm, common peduncle 2-20 mm long; in ♀: c. 5 × 3.5 cm; densely to sparsely pubescent with stellate hairs 0.1-0.2 mm; bracts elliptic-oblong, acute, 1-2(-4) mm long, caducous. Flowers generally 1-3 together; perianth 2-valved, glabrescent except at the very base, pedicel thinly pubescent with hairs c. 0.1 mm long, at base not articulated. Male perianth as seen laterally subcircular, slightly broader than long, only little laterally compressed, not or but slightly collapsed on drying, 2.2-2.7 × 2.6-3 mm, upper and basal part broadly rounded, pedicel not tapering, 1.5-3 mm long; perianth at anthesis cleft to the base, valves 0.1-0.2 mm thick. Androecium laterally much flattened, above broadly rounded, c. 1.5-1.7 × 2.0 mm; anthers 12-14(-16), distinctly septate when immature, erect, free portions at apex c. 0.1 mm long, anther column at apex narrowly hollowed for $\frac{1}{3}$ - $\frac{2}{3}$; androphore 0-0.1 mm, broadly attached. Female perianth (immature flowers seen only) broadly ovoid, c. 1.5 × 1.4 mm, split at anthesis nearly to the base, valves c. 0.2-0.3 mm thick, pedicel 1.5-2 mm long; ovary ovoid, c. 1.1 × 0.6 mm, glabrous, style and stigma small, minutely 2-lobed. Fruits 1-20 per infructescence, globose or subglobose, 1.1-1.4 cm diam., glabrous, drying light to dark brown, with or without coarse, paler-coloured lenticels or warts; dry valves c. 1.5-3 mm thick, of woody-granular structure; seed ellipsoid; stalk 3-4 mm; perianth not persisting.

Distribution. New Guinea: NE. Irian Jaya; N. Papua New Guinea (Sepik, Madang Prov.).

NEW GUINEA. Irian Jaya: (*Schram*) BW 2665; (*Kalkman*) BW 3455 — Papua New Guinea: *Hoogland & Craven* 10215; *NGF* 10242, 26953, 32824, *Pullen* 1896; *Saunders* 198, 958; *Schlechter* 18302; *Womersley* 3798, 3821, 3899.

Ecology. Primary and secondary forest, marshy forest, locally common; also recorded from *Pometia-Intsia* forest on clays and marls; 0-200 m alt. Flowers in September, fruits in March, June, and October.

Vernacular names. Euoe (Sko lang., Hollandia); Ilis (Jal, Madang Prov.); Numba (Angorami, Sepik Prov.).

NOTES

1. *Fieldnotes.* Slender tree, branches horizontal. Flowers yellow; fruit green, turning orange.

2. Apart from *H. angulata* (see the notes under that species) it is possibly closely related to *H. parviflora*, because of the glabrous fruits. The fruits are globose, and often are very similar to those of *H. pilifera* or *H. sinclairii*; in these two species, however, the fruits are always hairy, at least towards the base. See also note 4.

3. Many of the specimens accepted in the present new species were identified by Sinclair (p. 97) as *H. polyantha*, with *H. novoguineensis* as a synonym. The specimens of the syntype of *H. polyantha*, Beccari 7619, 7619 A, not seen by me, however, most likely belong to *Knema laevigata*.

The syntypes of *H. novoguineensis* Warb. are very heterogeneous; the two lectosyntypes (Sinclair, p. 95), Beccari 684 (not seen), and Zepelius 139-d belong to *H. iriana*; a third syntype, Hollrung 657 (fruits) belongs to *H. pilifera* (a species close to *H. laevigata*) whereas other syntypes belong to yet other species.

4. The new species has much in common with *H. laevigata* var. *novobritannica*, which has the androecium also deeply hollowed inside; the latter has, however, a more hairy perianth. Of var. *novobritannica*, the female flowers are not known, but it has globose fruits larger than those of *H. basifissa*, and they are somewhat hairy at the base. The present new species is characterized by the subglabrous male flowers with a very deeply cleft perianth, glabrous ovary and glabrous globose fruits; it could be confused with *H. pilifera* and *H. sinclairii* which also may have globose fruits, but are never glabrous.

32. *Horsfieldia sinclairii* de Wilde, *sp. nov.*,

Fig. 1B(32)

Horsfieldia erubescens Sincl., in sched. (Gard. Bull. Sing. 28, 1975, 6-7) — *H. australiana* auct. non S.T. Blake: Sinclair, Gard. Bull. Sing. 28 (1975) 6, p.p. — Type in sched.: Womersley & Brass. NGF 8664 (SING, n.v.; iso: BM, K, L; A, BO, BRI, CANB, LAE & NSW, n.v.).

Perianthia mascula parva, subglobosa, c. 1.5-2 mm diam., glabra, sub anthesi usque ad ½ divisa, antheribus 6-10, androphoro usque ad c. ⅓ excavato, ovario pubescente, fructibus globosis vel breviter ellipsoideis, 1.5-2.5 cm longis, in siccitate nigrescentibus, pericarpio sicco 4-6 mm crasso. — Type: (Streimann & Katik NGF 28886 (L, iso: K).

Tree, 4-25 m. Twigs terete, not ridged, towards apex 1.5-3(-6) mm diam., early glabrescent, tomentum brown, of hairs c. 0.1 mm; bark finely striate, when older not flaking; lenticels mostly inconspicuous. Leaves in 2 rows, membranous, elliptic-oblong to oblong-lanceolate, broadest at or above the middle, 6-14 × 1.7-4.5 cm, base attenuate, tip acute-acuminate, upper surface drying light to dark brown, sometimes with paler markings, minutely, more palely pustulate or not; lower surface glabrescent, hairs c. 0.1 mm, without larger dark brown dots, the nerves usually not much contrasting; midrib slender, flat above, often reddish tinged and contrasting below; nerves 6-14 pairs, thin and flat above, beneath inconspicuous, marginal nerve faint; tertiary veins forming a lax network, inconspicuous; petiole 6-15 × 0.8-1.5 mm, leaf bud 8-15 × 1-2 mm with hairs c. 0.1 mm long. Inflor-

escences sparsely minutely hairy to subglabrous, hairs c. 0.1 mm; in ♂: many-flowered, 2-4 times ramified, 2.5-8 × 1.5-6 cm, common peduncle 2-10 mm long; in ♀: up to 5(-10) × 4 cm; bracts 0.5-2.5 mm long, caducous. Flowers in loose clusters 2-5 each; perianths 2-valved (in some specimens a rather high percentage of 3-valved perianths), glabrous; pedicels slender, glabrous, at base inarticulate. Male perianth subcircular (rarely slightly broader than long), slightly laterally compressed, not or somewhat collapsed on drying, 1.1-2.0 × 1.5-1.8 mm, broadly rounded above, rounded to broadly rounded below, pedicel not tapering, slender, 0.6-1.5 mm long; perianth at anthesis cleft to c. ½-way, valves 0.1-0.2 mm thick. Androecium ± flattened, in lateral view broadly circular to subobtriangular, above broadly rounded, c. 0.6-1.4 × 1-1.3 mm; anthers 6-10, septate when immature, free portions at apex rather conspicuous, 0.1-0.3 mm long, the anther-bearing column at apex not or only moderately hollowed up to c. ⅓; androphore narrow, 0-0.3 mm long. Female perianth much larger than in ♂, c. 2-2.4 × 1.8-2.2 mm, ellipsoid-ovoid, at anthesis split to c. ⅓, valves c. 0.2-0.3 mm thick, pedicel c. 1 mm long; ovary globose, c. 1.6 mm diam., densely minutely pubescent, style ± absent, stigma distinctly 2-lobed, c. 0.2 mm long. Fruits 1-5(-10?) per infructescence, globose to short-ellipsoid, or obovoid, top rounded, base rounded or contracted into a pseudostalk up to 2mm, rather distinctly ridged or not, drying dark brown to blackish, 1.5-2.5 × 1.5-2.0 cm, glabrescent but often with remnants of tomentum towards base (lens!), with or without only a few coarse lenticels or tubercles; dry valves 4-6 mm thick, woody; stalk 1-4 mm long; perianth not persisting.

Distribution. Papua New Guinea: Madang Prov., Morobe Prov., Northern Prov., Milne Bay Prov. (incl. Fergusson Isl. and Normanby Isl.), Central Prov., Gulf Prov.

PAPUA NEW GUINEA: *Brass* 21821, 21912, 21996, 21997, 25503; *Carr* 12398; *Clemens* 877; *Hartley T.G.H.* 9968, 10421; *Hoogland* 5139, 8957 (deviating); *Hoogland & Mc Donald* 3516; *Kanis* 1107; *LAE* 60239, 67162, 68817, 70202, 70272, 72475; *NGF* 8247, 8664, 28886; *Saunders* 528; *Schodde* 5638, (& *Craven*) 4366 (deviating).

Ecology. Primary and disturbed lowland and mountainous rain forest, flood-plain forest, on slopes, ridges, also along creeks on stony places. Understorey tree; found on *Castanopsis*-dominated ridge, and in *Anisoptera-Hopea*-dominated forest. Altitude 0-950 m. Flowers mainly in March, April & June, fruits mainly in July and October.

Vernacular names. Gaigihab (Dumpu; Madang Prov.), Hamana (Orokaiva lang., Mumini; Northern Prov.) Posiposi (Milne Bay Prov.), Saksak (Amele; Madang Prov.).

NOTES

1. *Fieldnotes.* Flowers creamy, yellow, or yellow-orange; twice recorded as fragrant. Fruits glossy green, turning yellow to orange. Once recorded as with buttresses 1 × 1 ft. Bark rough, fissured or peeling off in irregular flakes leaving concave depressions. Wood cream- or straw-coloured or brown. Bark with reddish exudate.

2. *Relationship.* Characterized by the slender twigs, smallish thin leaves with often reddish-tinged midrib beneath, small subglobose glabrous male perianths, the much larger female flowers with pubescent ovary, and the short-ellipsoid fruits drying dark brown or blackish, usually with 4-6-mm thick woody pericarp. The

fruits may be confused with those of *H. laevigata*, especially with those of certain specimens from SW. New Guinea, which have rather similar pericarps but much larger leaves. In the present species the fruits have often become quite glabrous, but younger fruits (and ovaries) are pubescent; often minute hairs can be seen close to the bases of old fruits.

3. The present new species was at first recognized by Sinclair, who named the sheets and in his manuscript as *H. erubescens*. A type (NGF 8664) was also designated. Shortly before his death Sinclair must have been of the opinion that his new species was conspecific with *H. australiana*, hence the use of *H. australiana* in the posthumous edition of his manuscript.

4. In general habit *H. australiana* resembles but differs in various ways, especially in the androecium.

5. The deviating specimens *Hoogland 8957* and *Schodde & Craven 4366*, both with male flowers, key out in the vicinity of *H. sinclairii*, but apparently are not conspecific. They rather agree with *H. sinclairii* in general appearance, but differ in their larger male flowers and in the pedicel being thinly minutely pubescent, also the basal part of the perianth in *Schodde & Craven 4366*. The latter collection is in these respects and in its rather elongate perianths reminiscent of *H. pilifera*, but for the larger flowers. *Hoogland 8957*, from Morobe Prov., c. 900 m, has male perianths subcircular in lateral view, c. 2.4 mm diam., cleft at anthesis to c. $\frac{1}{3}$; there are c. 10 anthers, the pedicel is minutely sparingly pubescent. *Schodde & Craven 4366*, from Gulf Prov. at c. 300 m, has the male perianths rather elongate, c. 2.5(-3.0) \times 1.8-2.0 mm, cleft at anthesis to c. $\frac{1}{2}$ - $\frac{2}{3}$, anthers c. 6 or 7, pedicel and basal part of perianth minutely pubescent. Probably these specimens represent separate taxa.

33. *Horsfieldia psilantha* de Wilde, *sp. nov.*

Fig. 1B(33)

Perianthium masculinum lateraliter compressum, aspectu laterali subcirculare, 2.5-3.5 mm diam., glabrum, pedicello gracili, haud attenuato. Infructescentiae usque ad 15 cm longae, laxae, fructibus ellipsoideis, 17-22 mm longis, minute pubescentibus — Type: Long Island, ♂ fl., *Womersley NGF 43642* (L, iso: K).

Tree 5-25 m. Twigs terete, not ridged, towards the apex 3-6(-15, in fruiting twigs) mm diam., rather early glabrescent, tomentum reddish or grey-brown, composed of hairs c. 0.1-0.3 mm; bark finely striate, lenticellate, when older not flaking. Leaves in 2 rows, membranous, oblong-lanceolate to lanceolate, sometimes almost parallel-sided, 20-40 \times 4.5-12.5 cm, base attenuate, tip acute-acuminate; upper surface drying olivaceous to green-brown, usually minutely pale-punctate; lower surface glabrescent or if leaves are younger, with scattered stellate hairs 0.1-0.3 mm on and near the midrib, without large dark dots, the nerves \pm greenish or reddish brown; midrib above flattish; nerves 14-24 pairs, above thin and flattish, beneath with the submarginal arches rather distinct, not very regularly shaped; tertiary veins forming a lax network, indistinct; petiole 5-20 \times 2-3.5 mm; leaf bud 20-25 \times 2.5-3.5 mm, pubescent with hairs 0.1-0.3 mm. Inflorescences with rather thin woolly tomentum or stellate-dendroid hairs 0.2-0.4 mm; in ♂ and ♀ (when fruiting): 3 or 4 times ramified, many-flowered, 10-16 \times 8-12 cm, common peduncle 10-40 mm; bracts not seen, caducous. Flowers in loose clusters of 2-5 each, perianths 2-valved, glabrous; pedicels slender, glabrous, at base inarticulate. Male perianth subcircular, somewhat laterally compressed, c.(2.0-) 2.5-3 \times (2/5-)

3-3.5(-4) mm, upper part broadly rounded, basal part rounded to short-attenuate, pedicel not tapering, (2-)3-4(-4.5) mm long; perianth at anthesis split to c. $\frac{1}{2}$ - $\frac{2}{3}$; valves c. 0.2-0.3 mm thick. Androecium much laterally flattened, rounded-truncate above. 1.4-1.8 × (1.5-)1.8-2.0(-2.2) mm; anthers c. 12-14, mutually appressed, not septate, erect, apices free for c. 0.1 mm; androphore up to 0.2 mm; anther column at apex narrowly hollowed for c. $\frac{1}{4}$ - $\frac{1}{2}$. Female flowers not seen. Fruits up to 10 per infructescence, ellipsoid, top and base obtuse to rounded, 1.7-2.2 × 1.2-1.7 cm, pubescent though sometimes hairs only remaining at the very base; hairs rusty, c. 0.2 mm long; pericarp drying brown, without or with scattered small or fine lenticels or wartlets, 1-2 mm thick; stalk 2-8 mm long; perianth not persisting.

Distribution. NE. New Guinea. Madang Prov.: Bagabag Isl., Long Isl; New Britain; New Ireland.

PAPUA NEW GUINEA. New Britain (W. & E.): LAE 52132; NGF 21797, 21902, 30448, 41421 — New Ireland: Sands *et al.* 2047 — Madang Prov., S. Bagabag Isl.: NGF 42229A — Long Isl: LAE 55033; NGF 42361, 42390, 42398, 43640, 43642.

Ecology. Forest (incl. beach), in shaded secondary forest; 0-200 m alt. Flowers in May and October, fruits throughout the year.

NOTES

1. *Fieldnotes.* Slender tree, branches often drooping, without or with a few buttress-roots. Bark blackish or dark grey-brown, longitudinally fissured; inner bark cream or pink, exudate pink or colourless; sap wood straw- or cream-coloured. Flowers orange-yellow. Fruit yellow to orange, aril orange.

2. Related species are *H. tuberculata*, *H. laevigata* and *H. whitmorei*. *H. tuberculata*, variable and wide-spread, has similarly glabrous flowers, but the shape of the perianth is more tapered at the base, while in the present species it is more circular in lateral view and at the base not or but slightly tapered: *H. tuberculata* furthermore has glabrous fruits and ovaries. *H. laevigata*, a variable and wide-spread species as well, always has pubescent perianths, though sometimes only scattered hairs are present; it usually has smaller leaves, and the fruits usually have many more and coarser lenticel-like tubercles. The leaves of *H. whitmorei*, from the Solomon Isls, sometimes have similarly, rather regularly looping, marginal nerves, and similar fruits, but the male perianth is smaller, only c. 2 mm diam. or less, the base pubescent, also the pedicels, and the perianth cleft at anthesis to c. $\frac{9}{10}$. NGF 41421, particularly, from West New Britain, resembles *H. whitmorei* in general habit, especially in the marginal nerve and in leaf colour.

3. Good representative specimens in fruit are LAE 55033 (from Long Isl) and NGF 42229A (Bagabag Isl).

4. Some of the specimens have similarly large, branched and spreading infructescences as are the male inflorescences (known only from the type). Female flowering specimens are not known.

34. *Horsfieldia whitmorei* Sinclair

Fig. 1B(34); 16

Horsfieldia whitmorei Sinclair, Gard. Bull. Sing. 27, 1 (1974) 135 — Type: Whitmore BSIP 1848 (SING; iso: K,L: LAE, n.v.).

Horsfieldia 'palewensis' (sphalm. *palauiensis*) auct. non Kanehira: Whitmore, Guide For. Brit. Solom. Isl. (1966) 131, 186 in checklist.

Tree 8-25 m. Twigs terete, faintly ridged or not, 2-5(-7) mm diam., \pm early glabrescent, tomentum often reddish-brown, composed of hairs 0.1-0.3(-0.4) mm; bark striate, when older not flaking; lenticels distinct or not. Leaves in 2 rows, membranous or rarely chartaceous, oblong to lanceolate, often almost parallel-sided, 9-30(-40) \times 2-7(-9) cm, base short- to long-attenuate, tip acute-acuminate; upper surface drying dull brown to green brown, often minutely paler pustulate; lower surface largely glabrescent but often a few hairs remaining, hairs 0.1-0.4 mm, without larger brown dots, the nerves generally reddish-brown; midrib above flattish; nerves 18-26 pairs, above thin and sunken, beneath with the marginal arches very regular and distinct; tertiary veins forming a lax or fine network, distinct or not on both surfaces; petiole 10-15 \times 1.5-3 mm; leaf bud 10-15 \times 2 mm, with hairs 0.1-0.4 mm long. Inflorescences with dense grey to rusty, \pm woolly tomentum with hairs 0.2-0.4 mm long, in σ : 2-3 times ramified, many-flowered, (1.5-) 3-11 \times 1-6 cm, common peduncle 2-20 mm; in ρ : 1.5-7 cm long; bracts 1-2.5 mm long, caducous. Flowers solitary or in loose clusters of 2-4, perianths 2- (rarely up to 4-) valved, glabrescent late and usually towards the base with some persistent tomentum of stellate hairs c. 0.2 mm long; pedicel slender, thinly pubescent, at base inarticulate. Male perianth subglobose, little to rather much laterally compressed (subcircular in outline), about as long as broad, 1.5-2 \times 1.5-2.1 mm, upper and basal parts rounded; pedicel 0.8-2(-2.5) mm long; perianth at anthesis cleft to c. $\frac{1}{10}$, valves 0.2(-0.4) mm thick. Androecium \pm flattened, in lateral view rounded above, c. 0.8-1.2 \times 1-1.3 mm; anthers (8-)10-12, suberect, mutually appressed, not septate, free apices up to 0.1(-0.2) mm long; androphore up to 0.2 mm long; anther column at apex narrowly hollowed for c. $\frac{1}{4}$ - $\frac{1}{3}$. Female perianth ellipsoid or ovoid to obovoid, 2-2.5 \times 1.5-2 mm, split at anthesis to c. $\frac{5}{6}$, valves c. 0.4 mm thick, pedicel 0.5-3 mm long; ovary ovoid-ellipsoid, densely pubescent with hairs c. 0.1 mm, 1.2-1.5 \times 0.8-1.2 mm, stigma sessile, 2-lobulate, c. 0.3 mm high. Fruits 1-8 per infructescence, ellipsoid, apex rounded, base rounded and usually short-contracted into the stalk, 1.7-2.5(-3.4) \times 1.5-1.8(-2.0) cm, glabrescent but always with minute hairs c. 0.1 mm at base (lens!), drying orange-brown or brown, without or with few scattered minute tubercles; dry valves 1-2 mm thick; stalk 5-8 mm long; perianth not persisting.

Distribution. Solomon Isls.

SOLOMON ISLS: *Arifanata* 2572; *BSIP* 427, 803, 970, 1124, 1332, 1405, 1537, 1848, 2273, 2582, 2811, 3035, 3052, 3218, 3318, 3406, 3481, 3679, 3745, 4045, 4046, 4096, 4230, 4834, 5539, 5569, 5617, 5905, 6230, 6724, 6787, 6900, 7565, 8166, 8362, 8455, 8659, 8916, 9090, 9224, 9427, 9558, 9697, 9955, 10205, 10256, 10574, 10802, 10978, 11179, 11237, 11408, 11586, 11618, 11714, 12264, 12383, 12523, 12637, 12782, 13038, 13063, 13235, 13442, 13520, 13360, 13777, 13982, 14088, 14126, 14368, 14475, 15611, 15860, 15864, 15924 (p.p.), 15967, 16033, 16294, 16364, 16604, 16907, 17370, 17494, 18497, 18694, 18842; *Chapman* 427; *Hunt* 2164; *Kajewski* 2022; *NGF*. 31097, 31370, 45611; *Waterhouse* 891-B: *Whitmore* 6112.

Ecology. Primary and secondary forest, on a variety of soils; alluvial (sandy, clayey) soil, marshy soil, limestone, red soil, ultrabasic and igneous rock; on well-drained as well as on (periodically) flooded and marshy ground; not in mangrove; 0-850 m. Flowers and fruits throughout the year.

Vernacular name. Aininiu (Kwara'ae).

NOTES

1. *Fieldnotes*. Tree usually recorded as without buttresses, but low buttresses were noted for *BSIP* 9090 (Guadalcanal). Flowers pale, i.e., pale greenish, pale yellow, whitish-yellow, or ivory, strongly sweet scented. Fruits greenish, when fully ripe possibly a deeper orange.

Chapman BSIP 427 (New Georgia) has exceptionally rather chartaceous leaves.

Fruits measure exceptionally as large as 3.0-3.4 cm, e.g., in *BSIP* 970, 9427 (Guadalcanal), *BSIP* 15967 (Tetepari Isl.).

2. *Related species*. Sinclair (l.c.) extensively comments on the relationship and postulates its possible hybrid origin from the other two Solomon Isls. species *H. irya* and *H. spicata* (only p.p., is in my present treatment as *H. tuberculata*). In my opinion, however, the present species is particularly related to *H. laevigata* (which Sinclair erroneously included in *H. parviflora*), a wide-spread variable species which is 'replaced' by *H. whitmorei* in the Solomon Isls.; for differences see the key to the species. Besides *H. laevigata*, the species seems also particularly closely related to *H. psilantha*, under which further notes are presented.

35. *Horsfieldia laevigata* (Bl.) Warb.

Fig 1B(35); 17 a-i.

Horsfieldia laevigata (Bl.) Warb., Mon. Myrist. (1897) 351, tab. 21, fig. 1-2 (excl. spec. Java) — *Myristica laevigata* Bl., Rumphia (1837) 191, t. 64, fig. 3, anal. 1-4; A. DC., Prod. 14, 1 (1856) 202; Miq., Fl. Ind. Bat. 1(2), 1 (1858) 65, p.p. — Type: (cult. Mauritius, ♀) *Commerson* 238 (L; iso: P).

For further synonyms see under the varieties.

Tree 4-25 m. Twigs terete, faintly ridged or not, towards the apex 1.5-5(-9) m diam., early glabrescent, tomentum grey to brown, with hairs c. 0.1-0.2 mm; bark striate, when older not flaking; lenticels conspicuous or not. Leaves in 2 rows, membranous or thin-chartaceous, elliptic to oblong-lanceolate, broadest usually at or above the middle, 10-30 × (3-)4-12 cm, base attenuate, top acute-acuminate); upper surface drying dull olivaceous to dark brown, usually minutely paler pustulate, lower surface (largely) glabrescent, the hairs 0.1-0.2 mm, without larger brown dots, the nerves not or little contrasting in colour; midrib above flattish; nerves (10-) 12-30 pairs, above thin and flattish or slightly raised, beneath with marginal arches usually not very regular and faint; tertiary veins forming a lax network, faint or distinct but thin on both surfaces; petioles 5-15 × 1.5-3 mm; leaf bud 10-15 × 1.5-2 mm, with hairs 0.1-0.2 mm. Inflorescences subglabrescent or with rather dense to sparse scale-like stellate hairs 0.1-0.2(-0.5) mm; in ♂: 2-4 times ramified, many-flowered, 5-20 × 3-10 cm, common peduncle 10-40 mm; in ♀: c. 2-10 cm long; bracts 2-3 mm long, caducous. Flowers generally in loose clusters of 2-5 each; perianths 2-valved, sparsely to densely pubescent (densest towards the base) with hairs c. 0.1-0.2 mm long; pedicel not tapering, pubescent, at base not articulated. Male perianth as seen laterally subcircular (or sometimes slightly longer than broad, or rarely broader than long, e.g., in certain specimens from the Papuan Isls.; see notes), usually distinctly flattened, 1.7-2.8 (-3.0) × 1.7-3.0(-3.3) mm, upper and basal part rounded; pedicel slender, 1.5-3(-4) mm long; perianth at anthesis cleft to $\frac{1}{2}$ - $\frac{3}{4}$ (- $\frac{4}{5}$, in certain specimens from the Papua Isls; see notes), valves (0.1-) 0.2-0.3 mm thick. Androecium laterally flattened, subquadrangular to ± reniform in outline, above broadly rounded to subtruncate, 1.1-1.5 × 1.1-1.8(-2.2) mm; anthers 9-16, usually distinctly septate, erect, free portions at apex up to

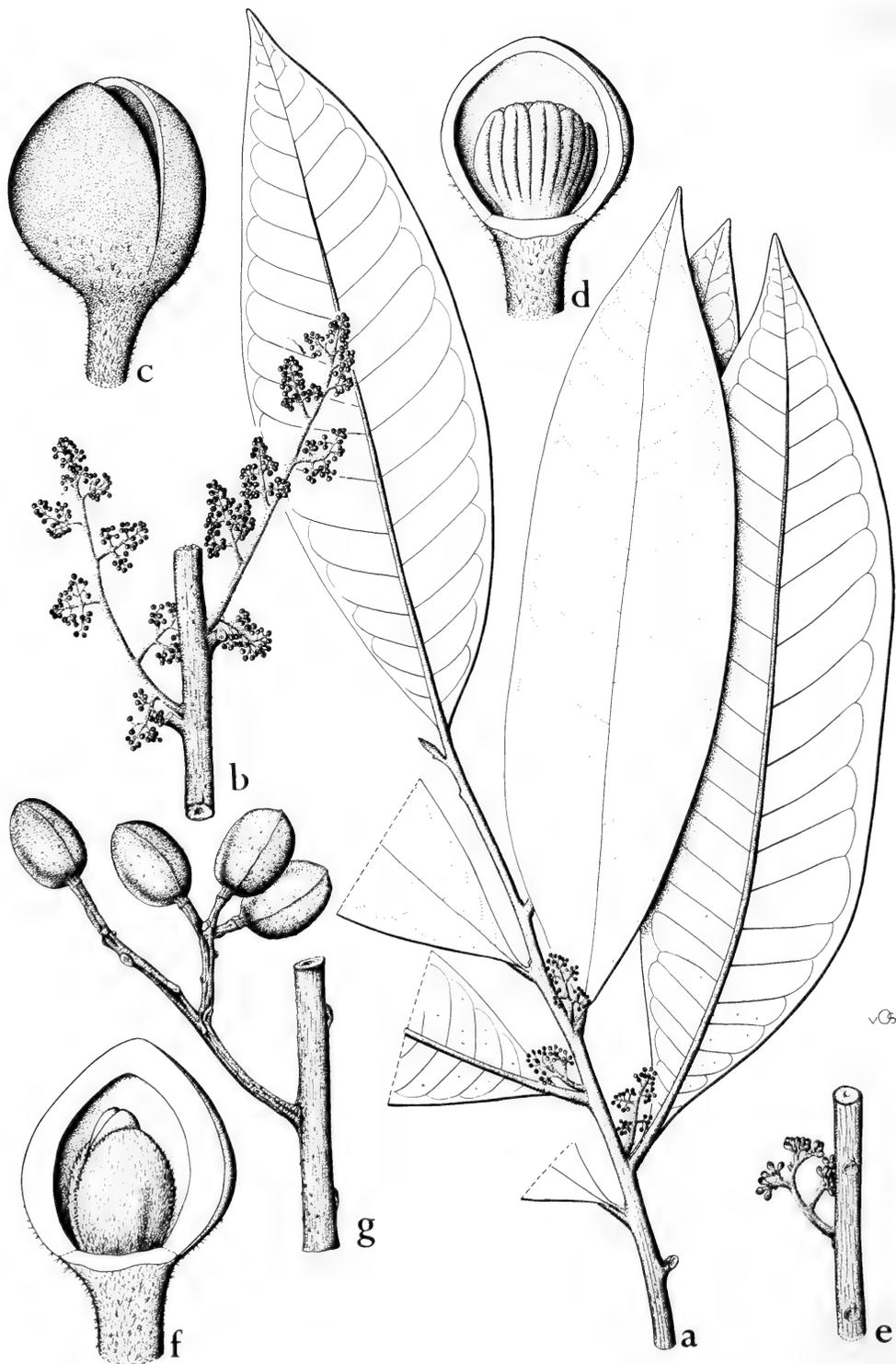


Fig. 16. *Horsfieldia whitmorei* Sinclair
 a, twig portion with male inflorescences, $\times \frac{1}{2}$; b, male inflorescences, lower down on the same twig, $\times \frac{1}{2}$; c, mature male flower, $\times 12$; d, ditto, opened, showing androecium, $\times 12$; e, portion of twig with female inflorescence, $\times \frac{1}{2}$; f, female flower longitudinally opened, showing pubescent ovary, $\times 12$; g, portion of twig with infructescence with mature fruits, $\times \frac{1}{2}$. — a-d, from BSIP 16033; e, from BSIP 3035; f, from BSIP 13442; g, from BSIP 15611.

0.2 or 0.4-0.6 (var. *novobritannica*) mm long, the anther column at apex narrowly hollowed for c. $\frac{1}{4}$ (- $\frac{1}{2}$) or in var. *novobritannica* for c. $\frac{9}{10}$; androphore up to 0.1(-0.2) mm, \pm broadly attached. Female perianth broadly ellipsoid to globose, 2.5-3.1 \times 2.8-3.1 mm, split at anthesis to c. $\frac{1}{3}$ - $\frac{2}{3}$, valves 0.3-0.5(-0.8) mm thick, pedicel 2-2.5 mm long; ovary ovoid or subglobose 2.0-2.3 \times 1.7-2.2 mm, pubescent with hairs c. 0.1 mm long or less, style up to 0.3 mm long, stigma sessile, minute, hardly bilobulate, c. 0.1-0.2 mm. Fruits (1-)-2-15 per infructescence, ellipsoid or rarely nearly globose, apex rounded to acutish, base rounded, (1.6-)-1.8-2.8(-3.0) \times 1.4-2.0(-2.2) cm, glabrescent but always with minute hairs c. 0.1 mm long at least at base (lens!), drying blackish or greyish-brown, usually with coarse, paler coloured tubercles or lenticels; dry valves 2-3 mm or 4-6 mm thick as in some forms from SW. New Guinea and New Britain; seed ellipsoid; stalk 3-6 mm long; perianth not persisting.

Distribution. Moluccas, New Guinea, Bismarck Arch. (see further under the varieties).

A variable, complex species, of which one prominent form is segregated here as a variety.

KEY TO THE VARIETIES

- 1a. Hairs on inflorescences 0.1-0.2(0.3) mm long, sometimes almost absent. Anthers at apex free for only c. 0.1-0.2 mm; stamen column hollowed for c. $\frac{1}{4}$ (- $\frac{1}{2}$, or slightly deeper). Fruit generally ellipsoid, pericarp 2-3 mm thick when dry, rarely (SW. New Guinea) 4-6 mm thick. Moluccas, New Guinea, Papua Isls., Bismarck Arch. **a. var. *laevigata***
- b. Hairs of inflorescences more woolly, c. 0.3-0.5 mm long. Anthers at apex free for c. 0.4-0.6 mm; the column hollowed for c. $\frac{9}{10}$. Fruit generally subglobose or short-ellipsoid, pericarp 2-5 mm thick. New Britain **b. var. *novobritannica***

a. var. *laevigata*

Fig. 1B(35); 17 a-e

Myristica nesophila Miq., Ann. Mus. Bot. Lugd. B t. 1(2) (1864) 206, p.p. (excl. sp. from Batjan) — *Horsfieldia nesophila* (Miq.) Warb., Mon. Myrist. (1897) 281, t. 21 fig. 1-2 — Type: Ceram, *de Vriese s.n.* (σ^7) (L, lecto).

Horsfieldia polyantha Warb., Mon. Myrist. (1897) 281, t. 23 fig. 1-2; Sinclair, Gard. Bull. Sing. 28 (1975) 95 (for the greater part, incl. type) — *M. polyantha* Warb.) Boerl., Handl. Fl. Ned. Ind. 3, 1 (1900) 85 — Type: (Aru Isls., Wokam) *Beccari s.n.* (Acc. Nos. 7619, 7619-A) (FI. n.v.).

Twigs in apical portion 2-5(-9) mm diam. Leaves 10-30 \times 4-12 cm. Inflorescences with rather dense to sparse tomentum of hairs 0.1-0.2(-0.3) mm, sometimes almost glabrous. Male perianth 1.7-3.3 mm diam., at anthesis split to c. $\frac{1}{2}$ - $\frac{3}{4}$ (- $\frac{5}{6}$). Anthers (9-)-10-16, free at apex for (0-)-0.1-0.2 mm; anther column at apex hollowed for c. $\frac{1}{4}$ (- $\frac{1}{2}$, or slightly deeper). Infructescence up to c. 10 cm long. Fruits ellipsoid, 18-28 mm long, drying blackish or brown, usually with coarse wart-like lenticels; pericarp 2-3(-6) mm thick.

Distribution. As the species (including New Britain).

MOLUCCAS. *Commerson s.n.* (Bourbon, 238 cult. Mauritius) — Halmahera: *Idjan & Mochtar 191; Pleyte 141, 377, 409* (p.p.); *de Vogel 3437, 3498* — Bacan (Batjan): *de Vogel 3694* — Ceram: *b.b. 25845; Kornassi (exp. Rutten) 996; de Vriese s.n.* — Aru Isls (Wokam): *Beccari s.n.* (FI Acc. Nrs. 7619, 7619A); *Buwalda 5015.*

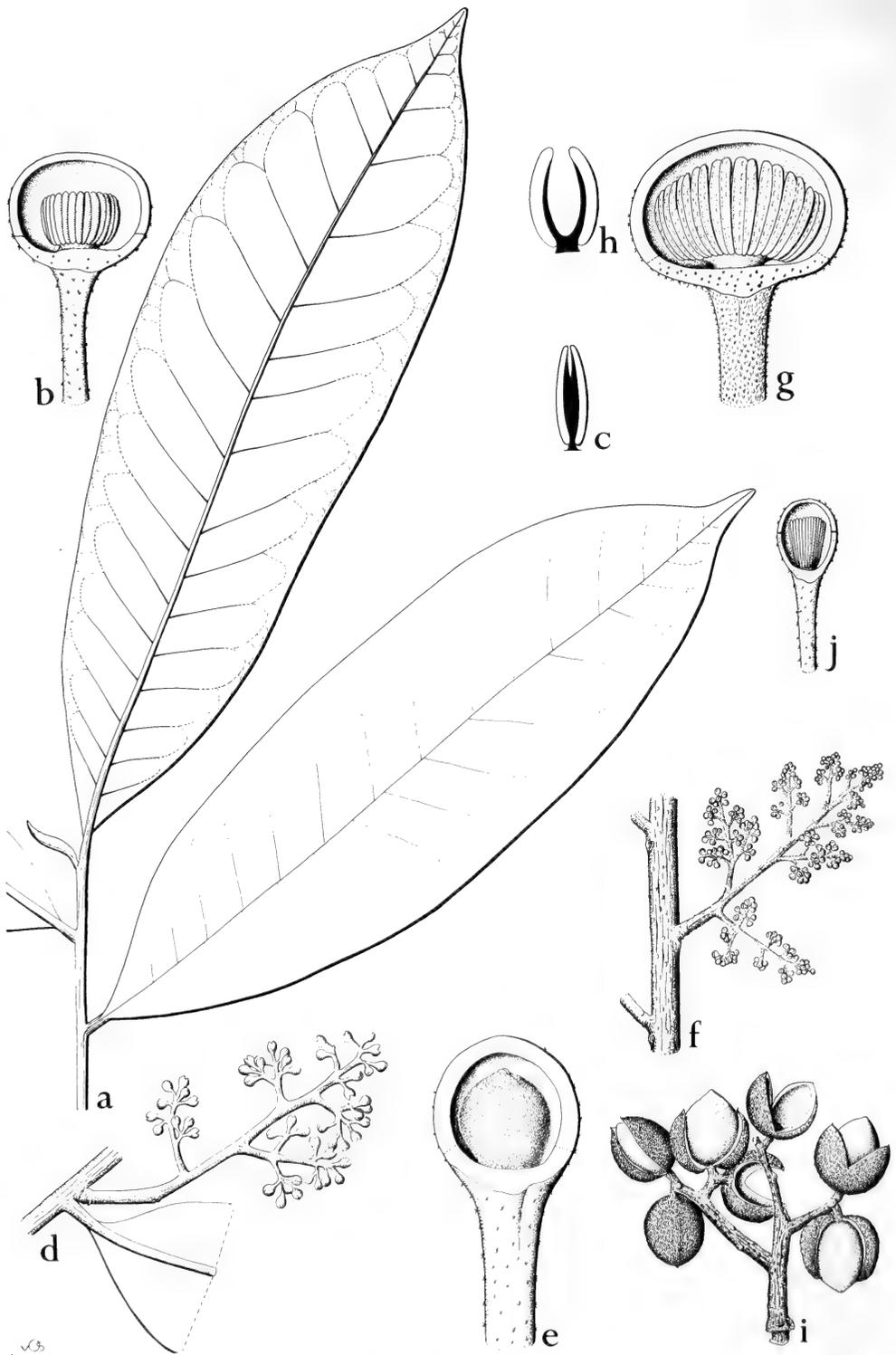


Fig. 17. *Horsfieldia laevigata* (BI.) Warb. var. *laevigata*: a, twig apex with leaves, $\times \frac{1}{2}$; b, opened mature male flower, showing androecium, $\times 6$; c, androecium, longitudinal section, schematic, $\times 12$; d, portion of twig with female inflorescence, $\times \frac{1}{2}$; e, female flower, opened, showing finely pubescent ovary and minute 2-lobed stigma, $\times 6$. — *Horsfieldia laevigata* var. *novobritannica* (Sinclair) de Wilde: f, portion of twig with male inflorescence, $\times \frac{1}{2}$; g, opened mature male flower, showing androecium, $\times 12$; h, androecium, longitudinal section, schematic $\times 12$; i, infructescence with mature fruits, $\times \frac{1}{2}$. — *Horsfieldia pilifera* Markgraf: j, opened male flower, showing androecium, $\times 6$. — a-c, from LAE 52086; d & e, from Commerson s.n. (Ile de France) (type); f-h, from Floyd 6430; i, from White NGF 10811; j, from Ledermann 6675.

NEW GUINEA. Irian Jaya: *Aet* (exp. Lundquist) 348; *b.b.* 30563, 30595; *Branderhorst* 165; *BW* (*Koster*) 1003, 1022, 7149, (*Schram*) 14943; *Doctors van Leeuwen* 10623; *Pleyte* 688; *von Römer* 329; *Soegeng* 284 — Papua New Guinea: *Brass* 1220, 24203; *Craven & Schodde* 874; *Hartley* 10147, 10707; *Jacobs* 9242; *Kanis* 1199; *LAE* 51683, 51841, 52030, 59069; *NGF* 2413, 2934, 7275, 14800, 17752, 19625, 20792, 24080, 28016, 42997, 46543, 48466, 48476; *Rau* 173; (*Vinas*) *UPNG* 3528 — Papuan Islands (*Fergusson*, *Normanby*, *Woodlark*): *Brass* 28660; *LAE* 52577, 68761, 68871 — Bismarck Arch. (incl. Admiralty Isls): *LAE* 51188, 52086, 52128, 53736, 63063, 66701; *NGF* 7039, 12980, 26659, 26785, 27303, 46030, 49511.

Ecology. Primary and secondary rain forest on ridges and plains, riverine forest, swampy scrub and forest, edges of sago-swamps; on a great variety of soils, incl. black volcanic soil (Moluccas); 0-1000 m alt. Flowers and fruits throughout the year.

Vernacular names. Kawok-kawoe (Noemfoer Isl.), Kamojer (Noemfoer Isl.), Luhakon (Halmaheira), Peita (Western Prov., Papua, Oriomo dial.), Samgoot (Kebar lang., Vogelkop).

Uses. Fruits reported as edible; wood used for house construction (wood reported several times as of medium weight and hardness).

NOTES

1. *Fieldnotes.* Bole straight, without buttresses; bark often shallowly vertically fissured, not peeling off; branches horizontal, or drooping. Wood whitish or straw. Flowers (greenish or brownish yellow. Fruits yellow to orange, aril bright orange.

2. *Variation.* After the separation of var. *novobritannica* the remaining type-variety is still a very variable entity. The most marked variations are in the following features:

- a. Leaf texture. The leaves are generally membranous, but certain specimens, especially some from New Britain, have rather leathery leaves so that the tertiary venation may be quite obscure.
- b. Length of hairs of the tomentum on the leaf bud. Hairs in specimens from NW. New Guinea (incl. Vogelkop Penins.) may be somewhat longer and coarser than usual, and may be up to 0.3 mm long.
- c. Twigs are usually terete, and not or hardly ridged in between the insertion of the petioles. A few specimens, e.g., *NGF* 2430 (in fruit) from N. Prov. Papua, or *LAE* 51683, from Morobe Dist., have rather distinctly lined twigs; such specimens may be confused with species with typically ridged twigs, e.g., *H. iriana* or *H. angularis*.
- d. The size and shape of the mature male perianth. Apparently all diameter sizes between 1.7-3(-3.3) mm can be found. Specimens of close affinity, with still smaller flowers, have been accommodated in the separate species *H. pilifera*. The shape of the perianth in lateral view is generally subcircular. Certain specimens, e.g., from the Papuan Isls and Gulf Dist. may have the perianth rather markedly broader than long, and these flowers may resemble those of, e.g., *H. spicata*. In specimens from the Moluccas the perianth is often slightly longer than broad.

- e. The degree to which the male perianth opens at anthesis. In most specimens the perianth opens to c. $\frac{1}{2}$ -way to $\frac{2}{3}$ deep; specimens from the Papuan Isls. (e.g., *Brass* 28660, LAE 52577, 68871), or the Bismarck Arch. (e.g., LAE 53736, 63063) may have male perianths split at anthesis to as deep as c. $\frac{4}{5}$ - $\frac{5}{6}$; this feature is reminiscent also of *H. spicata*. In these broad, deeply-splitting male flowers, the androecium is relatively broad, and rather reniform as seen laterally.
- f. Number of anthers. This varies normally from 12 to 16. Some specimens deviate in having a relatively small androecium with apparently only 10(-12) anthers; e.g., in *Pleyte* 141, and other material from the Moluccas.
- g. The thickness of the pericarp. A few specimens, especially from SW. New Guinea, e.g., *b.b.* 30563, 30595, *Aet* 348, have thick corky pericarps, 4-6 mm thick; these specimens perfectly agree in their leaves with var. *laevigata*.
3. In the drawing of the type specimen of *Myristica laevigata*, *Commerson* 238, a female specimen, the perianths are erroneously depicted as 3-valved by Blume in *Rumphia* 1; in the original specimen in L, from which the drawing was obviously made, all flowers have 2-valved perianths.
4. Some forms with larger and thick-walled fruits appear difficult to separate from *H. pachycarpa*; see the notes under that species.
5. Of *Jacobs* 9242, from E. New Guinea, mature fruits are in spirit. They are apparently similar in size to those in the fresh state, measuring c. 4×3.5 cm; the perianth at one side of the fruit (up to 15 mm) is much thicker than at the opposite side. On drying, these fruits had shrunk to c. 2.5×2 cm, with the pericarp only c. 5 mm thick, thus falling well within the sizes in dry material measured for var. *laevigata*.

b. var. novobritannica (Sinclair) de Wilde, *comb. nov.*

Fig. 17 f-i

Horsfieldia hellwigii var. *novobritannica* Sinclair, Gard. Bull. Sing. 28 (1975) 54 — Type: *Floyd* NGF 6430 (LAE, *n.v.*; iso: L, K, A, BRI, CANB, NSW, *n.v.*)

Horsfieldia novae-lauenburgiae Warb., Mon. Myrist. (1897) 278; K. Schum., Fl. Neu-Pomm. in Notizbl. Bot. Gart. Berlin 2 (1898) 117; K. Schum. & Lauterbach, Fl. Deutsch. Schutzgeb. Südsee (1900) 324; Markgraf, Bot. Jahrb. 67, 2 (1935) 151 — Type: Bismarck Arch., Neu Lauenburg Group, Ulu Isls., *Warburg* 20713 (B †; G, iso, *n.v.*; identity not sure, see notes).

Horstieldia ralunensis auct. non Warb., Kanehira & Hatusima, Bot. Mag. Tokyo 52 (1938) 355 (specimen Kanehira 3969 *n.v.*).

Twigs in apical portion 2-6(-8) mm diam. Leaves (12-)17-30 \times (3-) 5-8 cm. Inflorescences with rather dense woolly tomentum of hairs c. 0.3-0.5 mm long. Male perianth c. 1.8-2.0 \times 2.2 mm, at anthesis split to c. $\frac{4}{5}$. Anthers c. 14, almost completely filling the perianth, septate, at apex free for c. 0.4-0.6 mm; anther column from the apex hollow for c. $\frac{9}{10}$. Infructescences up to c. 8 cm long. Fruits broadly ellipsoid to almost globose, 18-22 \times 16-20 mm, drying grey-brown, with coarse wart-like lenticels; pericarp rather hard, 2-3(-5 mm, see notes) thick.

Distribution. Bismarck Arch.: New Britain.

NEW BRITAIN: *Floyd* (NGF) 6430, 6662; NGF 10040, 10811, 21731, 25504, 32622.

Ecology. Primary and disturbed rain forest; 0-1000 m. Flowers in August, fruits throughout the year.

Vernacular names. La gele kuku (W. Nakaina), Nungan (S. New Britain).

NOTES

1. *Fieldnotes.* Fruits globose, golden brown, yellow, or orange at maturity.

2. *Relationship.* The var. *novobritannica*, of which the male flowers are only known from the type, deviates within *H. laevigata* by its androecium. This completely fills the perianth; at the apex the anthers are mutually free to almost halfway, and the column is hollow from the apex to c. $\frac{1}{10}$ deep. The column is reminiscent of that in *H. irya*, and probably the variety originated by some hybridization with the latter. In this respect it can be mentioned that the inflorescences of *H. irya* from this region may be similarly woolly hairy, and also that the leaves of the type of the var. *novobritannica* show whitish markings, as found regularly in *H. irya*.

3. Vegetatively, the fruiting specimens resemble strongly the flowering type specimen, but one can not be quite sure whether all belong to the var. *novobritannica*. The fruits of *Floyd 6662* rather deviate as they are almost globose, c. 22 mm diam., and have a thick spongy pericarp c. 5 mm thick; this condition is possibly pathological.

4. On the label of *Floyd 6430*, the type, is commented that it is almost the same species as *Floyd 6410*. This is not so, as *Floyd 6410* is a good *H. hellwigii* var. *hellwigii*.

5. The identity of *H. novae-lauenburgiae* Warb. is not clear to me. The holotype *Warburg 20713* was burnt in B, but Sinclair (p. 116) has seen an isotype in G, enumerated under his broad conception of *H. spicata*. He has not commented on this specimen. I have not seen this isotype.

According to the original description the specimen is large-leaved, with rather persistent tomentum, the female inflorescences much-branched, the flowers 2-valved, \pm pubescent, the ovary tomentose, and this may well point to Sinclair's *H. hellwigii* var. *novobritannica*, the basionym of the present new combination. In Markgraf's opinion (p. 151) *H. novae-lauenburgiae* is close to *H. hellwigii*.

36. *Horsfieldia pilifera* Mkgf.

Fig. 1B(36); 17 j

Horsfieldia pilifera Markgraf, Bot. Jahrb. 67, 2 (1935) 154 — Type: Ledermann (B. \ddagger : iso: L)

Horsfieldia novoguineensis Warb., Mon. Myrist. (1897) 271, p.p., *Hollrung 657*, syntype; lectotype = *H. aruana*.

Tree (5-)10-20 m. Twigs terete, lined or faintly ridged or not, towards apex 1.5-4(-10) mm diam., early glabrescent, tomentum grey to brown, of hairs c. 0.1 mm; bark striate, when older not flaking; lenticels usually inconspicuous. Leaves in 2 rows, membranous, elliptic to oblong-lanceolate, broadest at about the middle, 7-27 \times 2.5-8.5 cm, base attenuate, tip acute-acuminate; upper surface drying brown, usually minutely whitish pustulate, lower surface early glabrescent.

hairs stellate, 0.1 mm long, without larger brown dots, the nerves not particularly contrasting in colour; midrib flat or slightly raised above; nerves 7-16 pairs, above thin and flat, beneath with the marginal arches faint and not very regular; tertiary veins forming a lax network, faint on both surfaces; petioles 6-12 × 1.5-2.5 mm; leaf bud c. 10 × 1-2 mm, with hairs c. 0.1 mm long. Inflorescences sparsely to densely pubescent with rather woolly hairs 0.1-0.3 mm; in ♂: 2-4 times ramified, many-flowered, 5-12 × 4-8 cm, common peduncle 10-25 mm, in ♀: 4-12 cm long; bracts 1-2(-3) mm long, caducous. Flowers generally 2-5 together; perianth 2-valved, sparsely to densely pubescent with stellate hairs c. 0.1 mm long; pedicel slender, not tapering, finely pubescent, at base inarticulate. Male perianth, as seen laterally, subcircular or sometimes slightly transversely or longitudinally elliptic, laterally little to much flattened, (1.0-)1.2-1.8 × 1.2-1.8(1.9) mm, upper part broadly rounded, at base rounded to short-attenuate, pedicel 1-2 mm long; perianth at anthesis split to $\frac{1}{3}$ - $\frac{1}{2}$, valves c. 0.1 mm thick. Androecium flattened, subquadrangular in outline, above broadly rounded, 0.7-1.2 × 0.6-1.1 mm; anthers 8-10, (sub)erect, septate, free portions at apex up to 0.1 mm long, the anther-bearing column at the top narrowly hollowed for c. $\frac{1}{5}$ - $\frac{1}{4}$; androphore up to 0.1 mm, broadly attached. Female perianth broadly ellipsoid c. 2.8 × 2.5 mm, cleft at anthesis to $\frac{1}{2}$ - $\frac{2}{3}$, valves 0.5-0.8 mm thick, pedicel c. 2 mm long; ovary globose to ovoid, c. 1.5 × 1.3 mm, pubescent with hairs c. 0.1 mm or less, style and stigmas minute, c. 0.1 mm long. Fruits (2-)5-20 per infructescence, globose to short-ellipsoid, top and base rounded, 1.1-1.6 × 1.1-1.6 cm, glabrescent but always with minute hairs persistent towards the base (lens!), drying bright to dark brown, without or with little larger paler tubercles; dry valves often somewhat woody, thickest at one side, 1-3 mm thick; seed ellipsoid; stalk 1-5 mm long; perianth not persisting.

Distribution. Northern half of New Guinea: Vogelkop, Japen Isl., Jayapura, Sepik, Madang, Morobe Prov.

NEW GUINEA. Irian Jaya: *bb.* 30429, 30547, 30558; *Brass* 14014; *BW* (Koster) 1097, (*Versteegh*) 4811, (*Schram*) 6082, (*Kalkman*) 6245, (*Versteegh & Vink*) 8298 — Papua New Guinea: *Clemens* 524, 635, 1710, 10825; *Hartley T.G.H* 11029; *Hollrung* 657; *Hoogland* 5139, (& *Craven*) 10275; *Jacobs* 9609, 9609A; *LAE* 52756, 73818; *Ledermann* 6675, 10450; *NGF* 28080; *Schlechter* 16933.

Ecology. Primary and secondary rain forest; reported from sandy loam soil, mixed forest with *Anisoptera* at c. 100 m; 0-1000 m alt. Flowers and fruits throughout the year. Fruiting once reported as very prolific.

Vernacular names. Gaben (Morobe Dist.), Gefrah (Tehid lang., W. Vogelkop), Guma (Waskuk lang., Sepik Prov.), Mamanganieproi (Biak lang.).

NOTES

1. *Fieldnotes.* Bark longitudinally fissured; sap watery, turning pink or red; wood straw to brown, of moderate weight and hardness. Flowers yellow. Fruits hard, glossy green, turning dark yellow, orange or red, aril orange-red.

2. *Relationship.* A species very close to *H. laevigata*, distinguished by the smaller male perianth, and smaller globose or subglobose fruits with or without but little coarser, paler-coloured lenticel-like tubercles. The male perianths rather vary in outline e.g., those of *Ledermann* 6675 being rather lengthwise ellipsoid and c. 1.5 × 1.3 mm whereas those of *Ledermann* 10450 (type) and *Clemens* 1710 are ± transversely ellipsoid, measuring c. 1.2 × 1.6 mm and 1.5-1.8 × 1.5-1.9 mm respectively.

The female flowers of *Schlechter 16933(K)* only have been seen and described by me: the perianth is generally somewhat smaller than in *H. laevigata*, but the female flowers probably do not differ significantly in the two species.

Because of the fruits, which are sometimes globose, the present species may be confused with *H. basifissa*, one which has quite different male flowers.

3. Sinclair (p. 112) included the present species in *H. spicata* var. *spicata*, a very large taxon as conceived by him.

37. *Horsfieldia lancifolia* de Wilde, *sp. nov.*

Fig. 1B(37): 18

Horsfieldia species foliis lanceolatis, 5-16 cm longis, perianthio masculino pyriformi, 2.5-3 mm longo, sparse pubescenti, antheris, 6-8, erectis, ovario pubescenti, fructibus ellipsoideis vel pyriformibus, 2.5-3.5 cm longis in siccitate, glabrescentibus. — Type: *b.b. Cel. II- 464* (L: iso: K: BO & SING, n.v.).

Tree, 10-30 m. Twigs terete, towards the apex 1-2.5(-5) mm diam., not or but faintly lined, glabrescent from tomentum composed of hairs 0.1 mm or less; bark finely striate, when older not flaking; lenticels smallish, not very conspicuous. Leaves in 2 rows, (thinly) chartaceous, oblong-lanceolate to lanceolate, broadest at or somewhat above the middle, 5-16 × 1.5-3.5 (-4.5) cm, base (long-)cuneate, tip acute-acuminate; upper surface drying olivaceous to brown, with or without small whitish marks (without larger irregularly-shaped whitish marks), lower surface early or late glabrescent, hairs c. 0.1 mm or less, provided or not with brownish dots and points of mixed sizes; midrib above flattish or slightly raised; nerves 9-17 pairs, thin, flat, and inconspicuous above, the submarginal arches ± regular in shape but indistinct; tertiary venation forming a rather lax network, inconspicuous; petiole slender, 10-20 × 1-1.5 mm; leaf bud 10-20 × 1.5-2 mm, with hairs c. 0.1 mm. Inflorescences with rather sparse tomentum of hairs 0.1-0.2 mm long, in ♂: 2 or 3 times ramified, not many-flowered, c. 5 × 3.5 cm, common peduncle c. 10 mm long, flowers solitary or 2 or 3 together; ♀ inflorescences short, 1-3 cm long, slightly ramified, 4-10-flowered; perianths 2-valved, rather sparsely pubescent with hairs 0.1 mm or less in length, pedicels pubescent through hairs 0.1-0.2 mm, at base inarticulate. Male perianth obovoid to pear-shaped, not much laterally compressed, drying blackish, not or little collapsed, 2.5-3 × 2.0-2.3 mm, above broadly rounded, at base tapering into the pedicel c. 1.5-2 mm long; perianth at anthesis cleft only for c. 1/6, valves (at base) thickish, c. 0.4-0.5 mm thick. Androecium (synandrium) long-obovoid, laterally flattened, 1.5-1.8 × 1.0-1.2 mm, above subtruncate; anthers 6-8, erect, free apices c. 0.3-0.4 mm; anther column solid, except for the apical portion in-between the free apices of the anthers; androphore rather slender, c. 0.6-0.8 mm long. Female perianth subglobose to obovoid, variable in size (see notes), 2-3 × (1.8-)2-3.5 mm, at anthesis cleft to c. 1/4-1/6, valves (perianth) c. 0.4-0.8 mm thick, pedicel 1-2 or 3-4 mm long, pubescent with hairs 0.1-0.2 mm; ovary ovoid, 1.4-2.2 × 1.0-2.0 mm, densely minutely pubescent; style and stigma(s) minute, c. 0.1 mm. Fruits 1-4 per infructescence, ellipsoid, (and ± contracted at base) or pear-shaped (see notes), 2.5-3.5 × 1.8-2.4 cm, completely glabrescent, granulate or with small lenticels or tubercles, drying brown; dry valves thick-woody, 4-8 mm thick; seed broadly ellipsoid, c. 17 × 14 mm; stalk 3-10 mm long; perianth not persisting.

Distribution. Central and South Celebes.

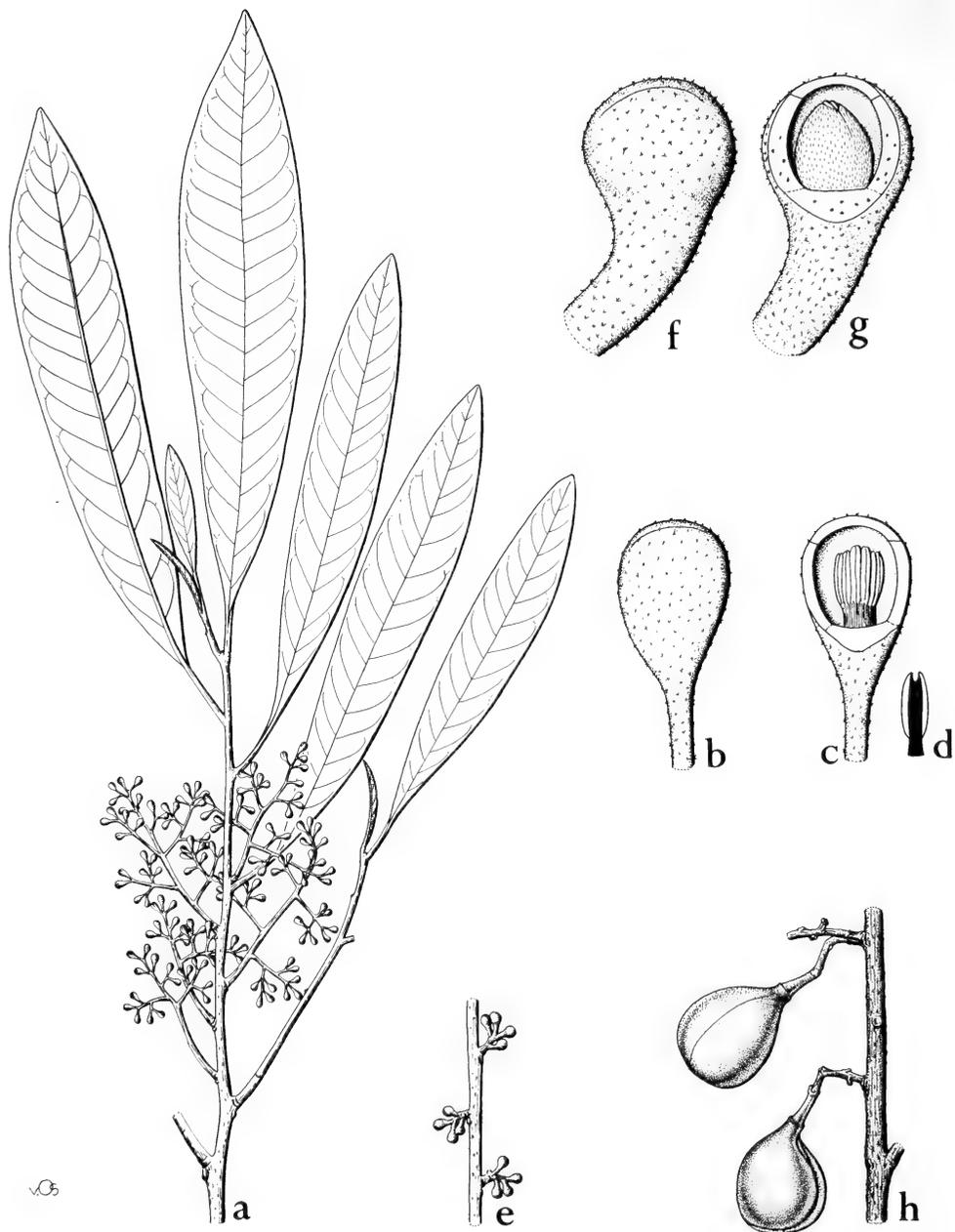


Fig. 18. *Horsfieldia lancifolia* de Wilde
 a, habit of leafy twig with male inflorescences, $\times \frac{1}{2}$; b, mature male flower, lateral view, $\times 6$;
 c, ditto, opened, showing androecium, $\times 6$; d, androecium, longitudinal section, schematic, $\times 6$;
 e, portion of twig with female axillary inflorescences, leaves fallen, $\times \frac{1}{2}$; f, mature female
 flower, lateral view, $\times 6$; g, ditto, opened, showing finely pubescent ovary, $\times 6$; h, portion of
 twig with infructescences with mature fruit, $\times \frac{1}{2}$. — a-d, from b.b. Cel./II-464 (type); e-g,
 from *de Vogel* 5267; h, from *van Balgooy* 3973.

CELEBES. Central: *van Balgooy* 3142; *de Vogel* 5267 — South (-Central): *b.b. Cel.* III-236, -404, -464; *van Balgooy* 3931, 3973, 4083; *de Vogel* 6243, 6287.

Ecology. Forest on ultrabasic rock (iron, nickel), laterite, also limestone ridges; 200-1200 m alt. Flowers throughout the year; fruits from May to July.

Vernacular name. Tabenoe benoe (Malili area).

NOTES

1. *Fieldnotes.* Flowers buds brown; fruits glossy green, turning yellow-green to orange.

2. The ♀-flowering specimens *de Vogel* 5267, *van Balgooy* 3142 (from Mt. Roroka Timbu, Central Celbes, 1100-1200 m alt.), and the one in fruit, *de Vogel* 6243 (S. Celebes, N. of Lake Matano, c. 400 m.), differ from the rest of the material from both Central and S. Celebes by, respectively, much stouter flowers with larger ♀ perianths (3-3.5 mm diam.) and larger fruits, subellipsoid in shape, c. 3.5 cm long. In the other specimens the ♀ perianths are only c. 2-2.5 mm, and the fruits generally more pear-shaped, c. 2.5-3.0 cm long.

3. Sinclair identified the then-known specimens, including the type of the present new species, as *H. parviflora* (Roxb.) Sinclair. The new species is easily recognized among Celebes-Moluccan material by its pear-shaped male flowers, its largish fruits with thick pericarp, and its small, rather narrow leaves. The androphore is proportionally long as compared to other species.

38. *Horsfieldia decalvata* de Wilde, *sp. nov.*

Fig. 1B(38)

Horsfieldia species floribus bivalvatis, *H. tuberculatae* atque *H. laevigatae* similis, ab eis differt floribus masculis breviter pyriformibus, perianthio tenuiter pubescenti, androcio compresso, antheris 6 apice non-incurvis, ovario pubescenti, fructibus subglobosis c. 1-1.2 cm diam., tenuiter pubescentibus. — Type: *Idjan & Mochtar* 181 (L; iso: BO, *n.v.*; K).

Tree 10-15 m. Twigs subterete, towards the apex ± flattened and faintly ridged or not, 1.5-4(-9) mm diam., early glabrescent, tomentum brown, composed of hairs c. 0.1 mm; bark dull brown, finely striate, when older not flaking, lenticels small, not very conspicuous. Leaves in 2 rows, membranous, elliptic-oblong to oblong-lanceolate, 11-25 × 3.5-7 cm, base attenuate to long-attenuate, tip acute-acuminate; upper surface drying dark brown, lower surface early glabrescent, hairs c. 0.1 mm; without brown dots; midrib above flat; nerves c. 12-16 pairs, above thin and flattish, on lower surface with the marginal arches not very distinct; tertiary venation on upper surface as a fine network, ± distinct or not; petioles c. 5-10 × 1.5-2.5 mm; leaf bud slender, c. 6-10 × 1-2 mm, densely dull brown pubescent by hairs c. 0.1 mm long or less. Inflorescences c. 2(or 3) times ramified, in ♂: c. 4-6 × (1-)2-4 cm, in ♀ up to c. 2.5 cm long; branches subglabrescent tomentum minute with hairs c. 0.1 mm; common peduncle in male 1-2 cm; bracts and bracteoles not seen, caducous. Flowers in ♂ solitary or 2 or 3 together, minutely pubescent through hairs c. 0.1 mm long or less; perianths 2-valved. Male perianth subglobose to short-pear shaped, moderately laterally compressed, as long as it is wide, c. 2.3 × 2.3 mm, upper part broadly rounded, the lower half tapering into the tapering pedicel c. 1.5-2 mm long, short-pubescent, inarticulate at base;

perianth at anthesis cleft to c. $\frac{2}{3}$, valves c. 0.2-0.3 mm thick. Androecium moderately flattened, in outline c. 1.6×1.4 mm, upper part rounded; anthers c.6 (i.e., c. 12 thecae with the connectives rather broad), not septate, c. 1.6 mm long, erect, not inflexed, free apical parts up to c. 0.1 mm; androphore up to c. 0.1 mm long; anther column cleft to c. $\frac{1}{5}$ - $\frac{1}{4}$. Female flowers not seen; immature fruits (ovaries) densely finely pubescent. Fruits c. 2-5 per infructescence, short-ellipsoid to subglobose, c. 1.1 - 1.2×1.0 - 1.1 cm, minutely pubescent with hairs c. 0.1 mm or less, drying brown, with scattered small tubercles; dry valves c. 1 mm thick; stalk slender, c 4 mm long; perianth not persisting.

Distribution. Moluccas.

MOLUCCAS. Morotai: *Kostermans 767*. — Halmaheira: *Idjan & Mochtar 181*. — Ceram: *Buwalda 5627*. — Ambon: *Robinson 1878*.

Ecology. Forest at low altitudes, 0-100 m. Flowers in September, fruits from May to November.

Vernacular name. Sekukumailor (Halmaheira).

NOTES

1. *Fieldnotes.* Flowers recorded as brown, fruits yellow.

2. *H. decalvata* superficially resembles very much a number of species including wide-spread species like *H. moluccana*, *H. tuberculata* and *H. laevigata*, but our present new species is distinct by its finely pubescent, pear-shaped male flowers, erect anthers, pubescent ovaries, and finely pubescent, small subglobose fruits. *H. tuberculata* also has pear-shaped flowers which are generally glabrous, and it has larger, glabrous fruits. *H. laevigata* has the male perianth more spherical in outline, and the fruits much larger and pubescent. *H. moluccana* has incurved anthers and glabrous fruits. See also note 3.

3. In 1975 Sinclair determined the specimens (now assigned to the present species by me) as *H. parviflora*, a species, which in my present treatment differs in general habitat (pale twigs), quite different spike-like inflorescences (glabrous male flowers with different androecium; glabrous ovaries) and in its glabrous, larger fruits, which blacken on drying. In his description of *H. parviflora*, he erroneously accepted both the glabrous and the tomentulose condition of the ovaries for that species.

39. *Horsfieldia tuberculata* (K. Sch.) Warb.

Fig. 1B(39); 19

Horsfieldia tuberculata (K. Sch.) Warb., Mon. Myrist. (1897) 279, t. 23 f. 1-3; K. Sch., Notizbl. Bot. Gart. Berl. 2 (1898) 117; Schum. & Lauterbach, Fl. Deutsch. Schutzgeb. Südsee (1900) 324; Markgraf, Bot. Jahrb. 67, 2 (1935) 151, p.p.; A.C. Smith, J. Arn. Arb. 22, 1 (1941) 62. — *Myristica tuberculata* K. Sch. in Schum. & Hollrung, Fl. Kais.-Wilh. Land (1899) 46; Warb., Bot. Jahrb. 13, 3-4 (1891) 308. — Type: (Bat Isl. Admiralty Isls.) *Hollrung 848* (♂, Kaiser Wilhelms-Land) (B †; iso: K, L & P); *Kärnbach s.n.* (fr., B †).

H. novoguineensis var. *moseleyana* Warb., Mon. Myrist. (1897) 273; K. Schum. & Lauterbach, Fl. Deutsch. Schutzgeb. Südsee (1900) 324. — Type: *Moseley s.n.* (B †; iso: BM, K).

H. solomonensis A.C. Smith, J. Arn. Arb. 22, 1 (1941) 64. — Type: *Kajewski 1549* (A, n.v.; iso: BM, P; BO, BRI & G, n.v.).

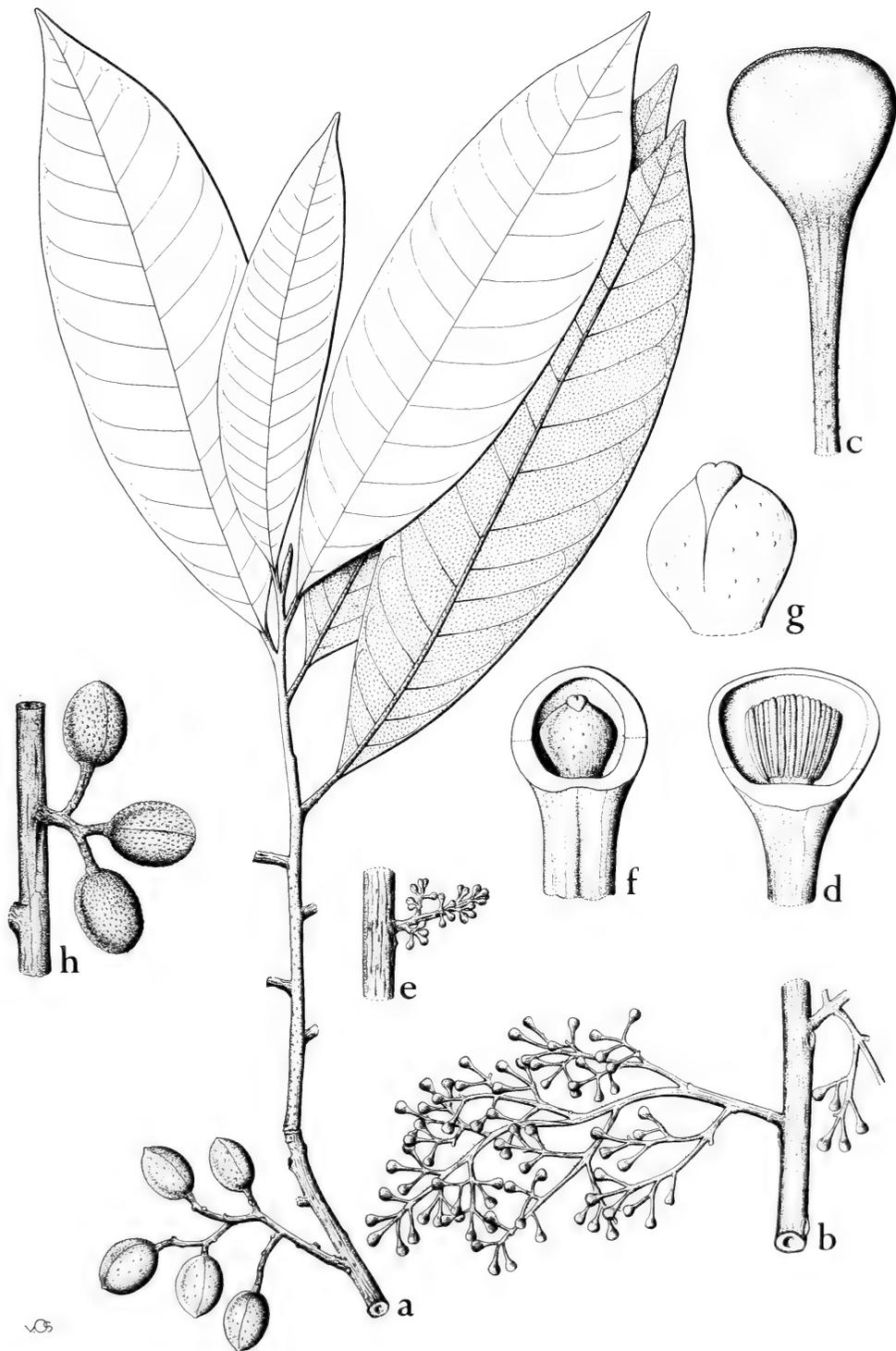


Fig. 19. *Horsfieldia tuberculata* (K.Sch.) Warb.
 a, habit of leafy twig with infructescence, $\times \frac{1}{2}$; b, portion of twig with male inflorescences, $\times \frac{1}{2}$; c, mature male flower, lateral view, $\times 6$; d, ditto, opened, showing androecium, $\times 6$; e, portion of twig with female inflorescence, $\times \frac{1}{2}$; f & g, opened female flower and glabrous ovary with shallowly 2-lobed stigma, $\times 6$ and $\times 12$ respectively; h, twig portion with infructescence with mature fruits, $\times \frac{1}{2}$. — a, from BSIP 14035; b-d, from Waterhouse 820-B; e-g, from BSIP 9628; h, from BSIP 10611.

Tree 5-20 m. Twigs terete, faintly ridged or not, towards apex 2-4(-6) mm diam., early glabrescent, tomentum (rarely \pm woolly), of hairs 0.1-0.3 mm, bark striate, when older not flaking, lenticels sparse and small, or sometimes almost absent. Leaves in 2 rows, membranous (or from higher altitudes sub-chartaceous), elliptic to oblong-lanceolate, 12-25(-40) \times 3-10(-16) cm, base short- to long-attenuate, or rarely rounded, tip acute-acuminate; upper surface drying dull greenish brown to brown, often minutely pustulate, lower surface early glabrescent, hairs 0.1(-0.3) mm, without dark brown dots; midrib above flat or \pm sunken; nerves 11-22 pairs, above thin and flattish or sunken, beneath with the marginal arches not very distinct; tertiary veins forming a rather fine network distinct or not on both surfaces; petiole 8-15(-18) \times 1.5-3(-5) mm; leaf bud 10-15 \times 2-3 mm, with hairs 0.1-0.3 mm long. Inflorescences with sparse tomentum of stellate-dendroid hairs 0.1-0.3 mm long, sometimes \pm glabrescent, in σ 1-3 times ramified, 3-15 (-22, see notes) \times 2-10 cm, common peduncle 5-25 mm long; in ρ : up to 7 cm long; bracts 0.5-3 mm long, caducous. Flowers solitary or in loose clusters of 2-4, glabrous (early glabrescent); perianths 2-(or 3-) valved; pedicels glabrous or rarely sparingly pubescent (*NGF 169*, New Britain), at base not articulated. Male perianth as seen laterally short-pear shaped, laterally compressed, generally about as long as broad to slightly broader than long, (1.5-)2-3.5 \times 2-4 mm, upper part broadly rounded, in the lower $\frac{1}{3}$ - $\frac{1}{2}$ usually narrowed into the somewhat tapering pedicel 2-5(-6) mm (pedicel sometimes only little tapered, e.g. *Brass 21765*); perianth at anthesis split to $\frac{1}{2}$ - $\frac{3}{4}$, valves c. 0.2 mm thick. Androecium \pm flattened, broadly rounded to subtruncate above, 1.5-2.5 \times 2-3 mm; anthers (12-)14-20, faintly septate, 1.5-2.5 mm long, erect, not inflexed, free apical parts 0-0.2 mm; anther column at apex narrowly hollowed for $\frac{1}{5}$ - $\frac{1}{3}$; androphore up to 0.2 mm long. Female perianths subglobose, 2-3 \times 2-3.5 mm, split at anthesis to $\frac{1}{2}$ - $\frac{2}{3}$, valves 0.4-0.8 mm thick; pedicel 1.5-2.5 mm long, ovary subglobose, glabrous, 1.5-2 \times 1.5-2 mm; stigma sessile, faintly 2-lobed, c. 0.2 \times 0.5-1 mm. Fruits 5-15 per infructescence, ellipsoid, apex rounded or slightly pointed, 1.5-3.7 \times 1.1-2.5(-3.0) cm, glabrous, drying blackish brown, with scattered or sparse, rather small to coarse, paler, lenticel-like tubercles; dry valves 1-8 mm thick; stalk c. 3-10 mm; perianth not persisting.

Large-fruited specimens from the Papuan Isls. Dist. are accommodated in a separate variety.

KEY TO THE VARIETIES

- 1a. Fruits 15-25 \times 11-16 mm. Dry pericarp 1-2(-3) mm thick **a. var. tuberculata.**
 b. Fruits 27-37 \times 17-25 mm. Dry pericarp 3-8 mm thick **b. var. crassivalva**

a. var. tuberculata

Distribution: Caroline Isls. (Palau Isls.), Admiralty Isls., Bismarck Arch., Solomon Isls., Papuan Isls., New Guinea: New Guinea: Cape Vogel Penins.

CAROLINE ISLS.: *Tuyama 9349; Masahiko Takamatsu 526.*

ADMIRALTY ISLS.: *LAE 53629, Hollrung 848; Moseley s.n.*

BISMARCK ARCH.: *Commerson s.n.; LAE 52150, 66532; NGF 169, 7944, 10981, 12329, 26574, 26621, 26737, 29680, 29683, 32227, 41370, 4140, 42280; Sands et al. 2975.*

PAPUA NEW GUINEA (mainland): *Brass 21765; Saunders 493; UPNG. 4035.*

PAPUAN ISLANDS: *Brass* 28464; *LAE* 52607, 74575, *NGF* 25280.

SOLOMON ISLS.: *BSIP* 426, 737, 766, 1125, 1273, 1967, 2248, 2615, 2855, 3145, 3358, 3437, 3510, 3703, 3739, 3843, 3986, 4154, 4183, 4719, 4842, 4873, 4960, 4998, 5180, 5396, 5519, 5743, 5806, 5922, 5689, 5997, 6172, 6391, 6414, 6849, 6858, 7110, 7186, 7419, 7717, 7736, 7826, 8164, 8395, 8721, 8880, 8912, 9046, 9165, 9323, 9628, 9783, 9951, 10057, 10179, 10223, 10295, 10393, 10522, 10576, 10611, 10697, 10721, 10824, 10887, 10913, 10952, 11374, 11284, 11766, 12212, 12565, 12651, 12836, 12864, 12917, 12958, 12992, 13066, 13131, 13281, 13347, 13402, 13558, 13682, 13798, 13871, 13948, 14025, 14035, 14078, 14099, 14127, 14202, 14205, 14342, 14488, 14553, 14625, 14826, 14868, 14900, 14929, 14981, 15074, 15161, 15260, 15281, 15556, 15568, 15871, 16000, 16141, 16422, 16507, 16595, 16769, 16784, 16895, 16915, 16982, 17436, 17538, 17802, 17880, 17987, 18045, 18221, 18313, 18478, 18683, 18722, 18758, 18835, 18912, 19421; *Brass* 2605, 2983, 3460; *Craven & Schodde* 90; *Hunt* 2387; *Kärnbach* 1892, sterile (L); *Kajewski* 74(75), 1549, 2554, 2710; *McKinnon* 7; *NGF* 16356, 16391, 16431, 19709, 25280, 31120, 45632, 45693, 45753; *Schodde (& Craven)* 3687, 4068; *Waterhouse* 35 (21275), 167, 178, 820-B: *Whitmore* 6022, 6188, 6290.

Ecology. Primary and secondary forest; on coral rock, seashores, limestone, swamp forest; 0-700 m. alt. Flowers and fruits throughout the year.

Vernacular names. Abuino'o, Ambuino'o, Ambuynor (Kwara'ae lang, Solomon Isls.); Aininiu, Ainynu (Kwara'ae lang., Solomon Isls.); Kokotetepina (Kwara'ae lang., Solomon Isls.); Bale bale (New Britain); Pive'ar (Mbuke lang., Manus Prov.).

On the label of a Whitmore specimen from Choiseul Isl. is written that 'Ambuynor' differs from 'Aininiu' (= *H. whitmorei*) in the shorter, broader leaves.

NOTES

1. *Fieldnotes.* Flowers several times recorded as yellow, sweet scented or with strong smell. Fruits yellow, orange or orange-brown. Exudate of bark red, watery. Slash wood white or brownish white, soft; slash bark soft, pale brown or reddish brown.

2. *Variability.* The sizes of flowers and fruits are available; for instance, the perianths of *NGF* 45632 (♂), *Waterhouse* 820-B (♂), both from Bougainville Isl., *BSIP* 9628 (♀, Rennell Isl.), and *Brass* 2983 (♀ Ulawa Isl.) measure 3-3.5(-4) mm diam., whereas *Whitmore* *BSIP* 3843 (♂) and 737 (♀), from Guadalcanal measure only c. 2 mm diam.

3. The leaves of specimens from Bat Isl. (Admiralty Isls.), incl. the type of *H. tuberculata*, can reach up to c. 40 by 14 cm.

The inflorescences of the type of *H. tuberculata* are as large as 12-18 cm long, those of *Commerson* (port Prastin) *s.n.* (P.) reach 22 cm.

The pedicels of the male flowers in *Brass* 21765 (Cape Vogel Penins.) are slender, and only slightly tapering; such specimens may easily key out wrongly. They probably represent a separate taxon as yet insufficiently defined.

Also, tab. 23, fig. 1, drawn by Warburg, was obviously made from the type in B; it does not show the perianths and pedicel as being much tapered but the latter is rather terete and slender.

On the other hand, I have examined the istotypes in K, L, and P and found them agreeing well with the description of the species as presently given.

b. var. *crassivalva* de Wilde, var. nov.

A varietate typica in fructibus maioribus 27-37 mm longis pericarpio sicco 3-8 mm crasso differt — Type: *Brass* 28352 (L: K. iso).

Twigs rather stout, at apex (3-)4-5 mm diam. Leaf blades 25-35 × 10-12.5 cm. Male perianths c. 3 × 3.3 mm; androecium much flattened, c. 1.8 × 1.8 mm, anthers c. 12, free apices c. 0.1 mm long; androphore c. 0.1 mm long. Pedicels 3-6 mm. Fruits 27-37 × 17-25(-30) mm. Dry pericarp c. 3-8 mm thick.

Distribution. New Guinea, Louisiade Arch.: Misima Isl., Tagula Isl., Rossel Isl.: doubtful on San Cristobal (Solomon Isls.).

LOUISIADE ARCH.: *Brass* 27648, 28143, 28352; *Whitmore* 6268 (San Cristobal, doubtful).

Ecology. Riverine rain forest at low altitudes, creek alluvium soil; 0-20 m.

NOTES

1 *Fieldnotes.* Subcanopy tree. Flowers yellow, very fragrant. Fruits to 5 cm diam., orange, ovoid or subglobose, keeled; aril pink.

2. Specimens belonging to the present variety generally have a stout habit with coarse twigs and large leaves, and have relatively large perianths; these sizes fall, however, within those accepted for the type variety.

3. The fruits of the type, *Brass* 28352, from Rossel Isl., at sea-level, are in the fresh state reported as subglobose and as large as 5 cm diam. Those of *Brass* 27648 (Misima Isl.) measure c. 4.5 × 3.5 cm. A specimen from Rossel Isl. included in var. *tuberculata*, *Brass* 28464, has mature fruits, which when dried are only c. 18-22 mm. This was collected at c. 700 m alt.

4. The specimen *Whitmore* 6268, from San Cristobal is doubtful; it has stout leaves, the dry fruits measure c. 27 mm long, but the pericarp is only c. 2 mm thick. It probably belongs to var. *tuberculata*.

5. Specimens in fruit may be confused with *H. pachycarpa*, but this has minutely pubescent fruits (and pubescent ovaries), at least at the base towards the insertion of the stipe.

40. *Horsfieldia corrugata* Foreman

Fig. 1B(40); 20 a-c

Horsfieldia corrugata Foreman, Contr. Herb. Austr. 10 (1974) 45, fig. 1. — Type: *Foreman & Lelean* LAE 52461 (LAE, n.v.; iso: K, L; BRI, CANB, A, E & SING, n.v.).

Tree 5-12 m. Twigs terete, not ridged, towards the apex (3-)4-5(-12) mm diam., early glabrescent, tomentum minute greyish to rusty, of hairs c. 0.1 mm; bark striate, when older not flaking, lenticels present, coarse but usually not much contrasting in colour. Leaves in 2 rows, thinly coriaceous, elliptic-oblong, broadest at or above the middle, 12-29(-32) × 4.5-8.5(-10) cm, base attenuate, top acute-acuminate; upper surface drying dark brown, minutely pustulate or not, lower surface early glabrescent, without larger dark-brown dots; midrib slender to rather broad, flattish above; nerves 12-18 pairs, thin and flat above, beneath with the

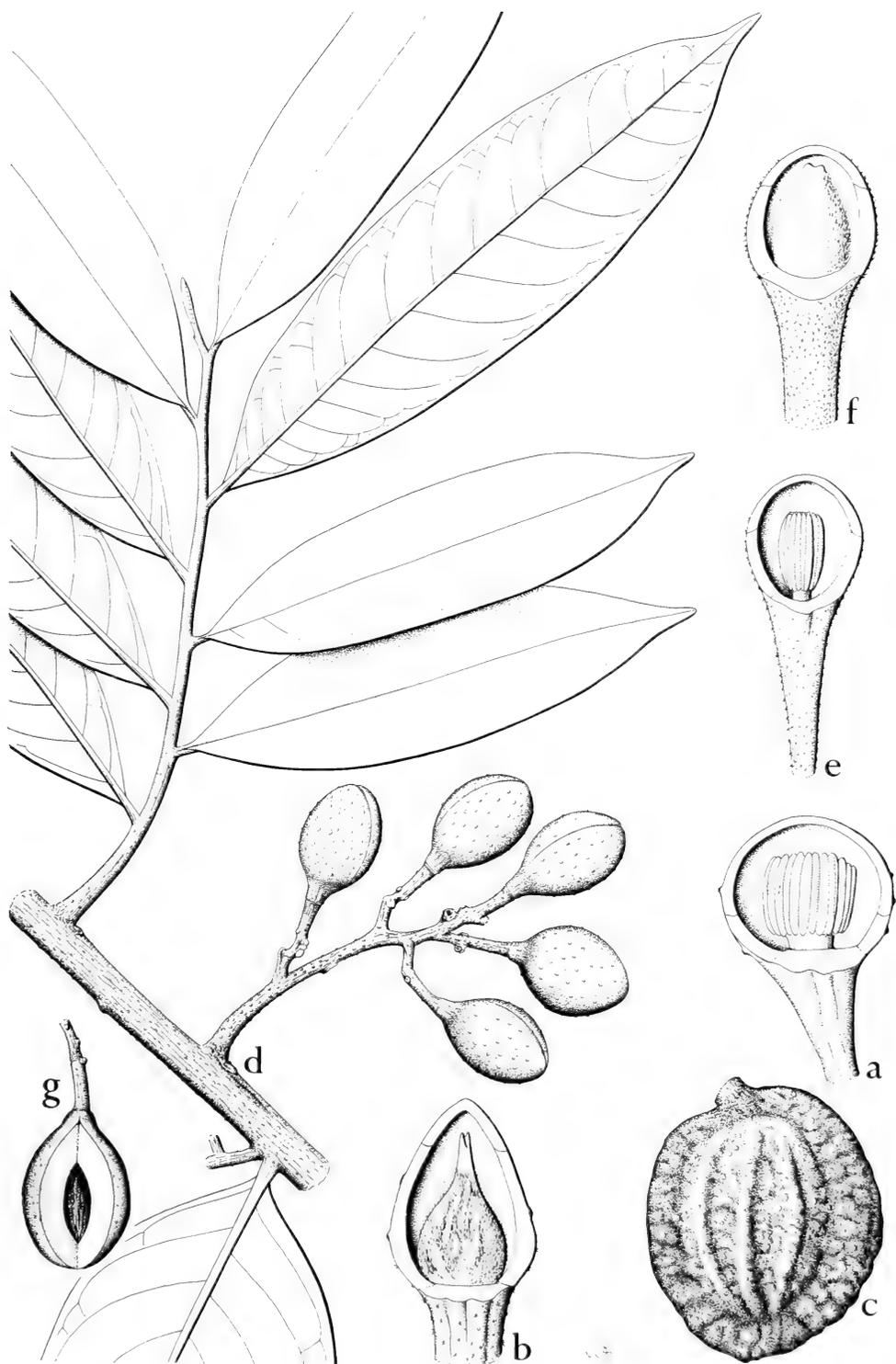


Fig. 20. *Horsfieldia corrugata* Foreman: a, longitudinally opened male flower showing androecium, $\times 6$; b, ditto, female flower, showing pubescent ovary and narrow 2-lobed style, $\times 6$; c, fruit, $\times \frac{1}{2}$. — *Horsfieldia pachycarpa* A.C. Smith: d, leafy twig with infructescence, $\times \frac{1}{2}$; e, longitudinally opened male flower, showing androecium, $\times 6$; f, ditto, female flower with pubescent ovary with shortly 2-lobed stigma, $\times 6$; g, almost mature fruit, $\times \frac{1}{2}$. — a, from Carr 14123; b, from LAE 60020; c, from Carr 14334; d, from LAE 62196; e, from LAE 51940; f, from Clemens 5378; g, from NGF 38895.

marginal arches distinct or not, not very regularly looping; tertiary veins forming a lax network, indistinct; petiole 6-18 × 2-3.5 mm; leaf bud 10-20 × 1.5-3 mm, with hairs c. 0.1 mm. Inflorescences thinly pubescent with rusty stellate hairs c. 0.1 mm long or less; in ♂: 2 or 3 times ramified, rather slender, (4-)6-14 × 2-9 cm, in ♀ up to c. 5 cm long, common peduncle c. 10 mm; bracts pubescent, 1.5-4 mm long, caducous. Flowers (in ♂) solitary or in loose clusters of 2-5, glabrous or glabrescent from scattered hairs less than 0.1 mm; perianth 2-valved; pedicel ± tapering, thinly pubescent or glabrescent, at base inarticulate. Male perianths in lateral view subcircular, including the short-pear shaped pedicel, which is somewhat laterally compressed, about as broad as long, 3.0-3.5 × 3.0(-4.0) mm, the top broadly rounded, the lower half ± tapering into the thickish tapering pedicel (2-)3-4 mm long; perianth at anthesis splitting from ½ to nearly ⅔, valves c. 0.2 mm thick at apex, the perianth towards base only slightly thicker, often provided with a few coarse blackish-brown wart-like dots. Androecium thickish, not much laterally compressed, above broadly rounded, (1.5-)2.0-2.2 × 2.0-2.2(-3.0) mm, anthers 8-12, erect, not septate, c. 2 mm long, free apical parts 0.1-0.2 mm, androphore 0.2-0.3 mm long; anther column narrowly hollowed for c. ⅕-¼ at apex. Female perianth rather narrowly ovoid, almost glabrous, with a few coarse, dark-brown wart-like dots, c. 4.5 × 3 mm, cleft at anthesis to c. ¼-⅓, valves c. 0.3-0.4 mm thick, coriaceous; pedicel 4-5 mm long, very minutely scattered-pubescent; ovary ovoid, somewhat dented or corrugated, c. 2.5-3 × 2.5 mm, densely minutely pubescent with hairs less than 0.1 mm long, style and 2-lobed stigma glabrous, 0.8-1.0 mm long. Fruits 1(-4) per infructescence, ramiflorous, broadly ellipsoid to subglobose, somewhat flattened, 6-7.5 × 4.5-6.5 cm, at base contracted or not into a short pseudostalk, top acutish, coarsely flanged and corrugated, drying blackish brown, with scattered coarse paler-coloured tubercles, glabrescent, valves ± woody-corky, 10-20 mm thick; stalk 5-10 mm long; perianth not persisting.

Distribution. Papua New Guinea: Central Prov., Northern Prov., Milne Bay Prov.

NEW GUINEA. Papua New Guinea: Carr 14123, 14334, Foreman & Lelean LAE 52461, 60020; NGF 41016, 46430; Pullen 5496.

Ecology. Primary and secondary rainforest on slopes and ridges, fagaceous forest; at 1200-1900 m. Flowers and fruits from July to December.

Vernacular name. Sodowa (Port Moresby Dist.)

NOTES

1. *Fieldnotes.* Mountainous terrain; small tree; wood very light brown. Flowers yellow or orange. Fruits green, strongly wrinkled or corrugated, and strongly ridged. Aril orange.

2. I have not seen the male flowering material described by Foreman, but the male flowers of Carr 14123, not cited by him, agree with his description.

3. Those specimens of this species, not seen by Foreman, were identified by Sinclair as *H. spicata* var. *spicata* (Carr 14334) or *H. praetermissa* Sinclair, *in sched.* (Carr 14123).

4. When in flower, the specimens may be difficult to distinguish from, e.g., *H. pachycarpa* or *H. tuberculata*. Possibly the few coarse and conspicuous blackish-brown wart-like dots on the perianth, found in both ♂ and ♀ flowers, are characteristic for the species. Furthermore, the very large corrugated and ridged thick-valved fruits are very distinctive. Large, thick-valved fruits also occur in *H. pachycarpa*, *H. tuberculata* var. *crassivalva* or in certain forms of *H. laevigata*, but in our present species the fruits exceed those in size.

41. *Horsfieldia pachycarpa* A.C. Smith

Fig. 1B(41); 20 d-g

Horsfieldia pachycarpa A.C. Smith, J. Arn. Arb. 22 1 (1941) 64 — Type: *Brass* 610 (A, n.v.).

Horsfieldia praetermissa Sinclair, *in sched.* (Carr 13262, etc.).

Tree; 5-25 m. Twigs terete, faintly ridged or not, towards the apex 3-5(-12) mm diam., early glabrescent, tomentum minute, with hairs c. 0.1 mm; bark coarsely striate, when older not flaking, lenticels usually coarse and distinct. Leaves in 2 rows, membranous or thinly coriaceous, elliptic-oblong to lanceolate, broadest below to above the middle, 17-30 × 4-11 cm, base attenuate, tip acute-acuminate; upper surface drying dark brown, usually minutely pustulate, lower surface early glabrescent, without larger dark-brown dots; midrib above slender to rather broad, flattish; nerves 14-18 pairs, above thin, flat, inconspicuous, beneath with the marginal arches distinct or not, not very regularly looping; tertiary veins forming a lax network, indistinct; petiole 6-12 × 2-5 mm, leaf bud 10-15 × 2-3 mm, with hairs c. 0.1 mm. Inflorescences subglabrous or with sparse stellate hairs 0.1-0.2(-0.3) mm, 2-4 times ramified, in ♂: 7-15 × 6-10 cm, in ♀ up to c. 10 × 4 cm, common peduncle 5-25 mm; bracts caducous, not seen. Flowers in loose clusters up to 5 each, thinly pubescent with hairs c. 0.1 mm, or glabrescent towards the apex; perianth 2-valved; pedicels thinly pubescent, at base not articulated. Male perianths short-pear shaped, laterally somewhat compressed, about as broad as long or slightly longer than broad, 2.5-3.2 × 2.8-3.2 mm, upper part bluntish to broadly rounded, the lower $\frac{2}{3}$ more or less tapering into the thickish and much tapering pedicel 2-5 mm long; perianth at anthesis cleft to nearly $\frac{1}{2}$, valves towards apex c. 0.2 mm thick, the perianth towards base usually thicker, \pm firm-fleshy or coriaceous, 0.3-0.8 mm thick. Androecium \pm laterally flattened, c. 1.8-2.1 × 1.1-1.8 mm, above broadly rounded, anthers 5 or 6, or 9 or 10, erect, not or hardly septate, c. 1.5-2 mm long, free apical parts c. 0.1-0.2 mm; androphore rather slender, 0.2-0.5 mm.; anther column at apex narrowly hollowed for c. $\frac{1}{6}$ - $\frac{1}{3}$. Female perianths ovoid-ellipsoid, 2.5-4 × 2.5-3.2 mm, split at anthesis to c. $\frac{1}{3}$, valves 0.4-0.6 mm thick; pedicel 2-4 mm long; ovary ovoid, densely minutely pubescent, 2.5-3 × 1.8-2.5 mm, stigma sessile, minutely 2-lobed, c. 0.1 mm. Fruits 1-6 per infructescence, ellipsoid to broadly ellipsoid, often \pm ridged towards the base, rounded or tapering into a short pseudostalk, apex rounded, (3.0-)3.5-4.5 × (1.8-) 2.0-3.0 cm, minutely pubescent towards the base, or glabrescent, drying blackish(-brown), usually with conspicuous coarse, paler-coloured lenticel-like tubercles; dry valves \pm woody, (4-)5-10 mm thick; stalk 5-10 mm; perianth not persisting.

Distribution. New Guinea. West (Irian Jaya): Snow Mountains (Idenburg R., 1300 m); East: West Sepik Prov., Western Highlands, Eastern Highlands, Southern Highlands, Madang, Morobe, Central Provinces.

NEW GUINEA. West (Irian Jaya): *Brass* 610, 12752. — Papua New Guinea: *Carr* 13262 (13362), 14146; *Clemens* 5378; *H. O. Forbes* (7) 192; *LAE* 51940, 60363, 60365, 62196, 65747; *Manner & Street* 307; *NGF* 21297, 29213, 29357, 32652, 38895, 47888.

For deviating specimens see the notes.

Ecology. Primary and secondary montane forest, forest clearings, etc.; often on ridges; recorded from fagaceous and *Castanopsis-Lithocarpus* forest; (450-)1000-2000 m alt. Flowers and fruits throughout the year.

Vernacular names. Cheeweng (Maring), Kupgne (West Sepik), Mong-mong (Weng lang., West Sepik).

NOTES

1. *Fieldnotes.* A montane species; branches often horizontal. Bark shallowly vertically fissured; exudate watery, clear or \pm reddish. Wood pink, cream, or whitish. Flowers yellow, fragrant. Fruits ramiflorous, glossy green turning yellow to orange, eaten by cus-cus.

2. *Related and resembling species.* Differs from *H. tuberculata* by the more thick-fleshy or woody-fleshy, largely pubescent perianth, and by the pubescent ovary and fruit.

Fruiting specimens may resemble *H. laevigata* much, which is obviously closely related. The male flowering specimens of the present species (*Carr* 13262, 13362, 14146, *LAE* 51940, *Manner & Street* 307) have, however, essentially differently shaped (\pm pear-shaped) flowers, and are of a more fleshy-woody consistency; those of *H. laevigata* being much more globose, with the pedicel more slender, not pear-shaped, and of a more membranous-herbaceous consistency.

Through the somewhat resembling male flowers *H. pachycarpa* appears related to *H. corrugata*, a species with much larger 'corrugated' fruits, from similar montane habitats. The flowers of *H. corrugata* are probably always provided with some large, thickened blackish dots, a character not seen in *H. pachycarpa*.

It should be remarked here that *H. tuberculata* var. *crassivalva* (from the Louisiade Arch.), a taxon only known from fruits which also have a thick pericarp, is very similar as well.

3. *Deviating specimens.* Rather many specimens in fruit deviate in the smaller sizes of female flowers and fruits, viz. *Carr* 13901, *Jacobs* 8834, 9079, *LAE* 66790, *NGF* 37317, 41594, *Robbins* 624. They are from Central Prov., W., E, and S. Highlands Prov., and West Sepik Prov.; all from well above 1000 m., except *Jacobs* 9079 (600-700 m alt.). The female perianths measure about 2-2.8 \times 1.8-2.3 mm; the fruits c. 2.5-3.5 \times 1.7-2.0 cm, and have a thick woody pericarp. In size and general appearance these fruiting specimens seem intermediate to and often can hardly be distinguished from the common *H. laevigata*. However, the fruits of the mentioned specimens also completely link up with the generally larger fruits of *H. pachycarpa*, of which the male flowers are presumably essentially of a different shape and texture as those of *H. laevigata*. Future collectors should search in the field for male specimens which belong with certainty to the above-mentioned female collections.

4. Sinclair included most specimens of the present *H. pachycarpa* in his *H. spicata* var. *spicata*; Car 14146 was identified provisionally as *H. praetermissa* Sinclair, *in sched.*, with the remark that better material is still required.

5. I have not seen the type specimen, Brass 610 (A) from Biriatabu at 450 m (Snow Mts. Dist.) but its description agrees well with the species as described presently. In P there is an isotype, without fruit.

42. *Horsfieldia pulverulenta* Warb.

Fig. 1B(42)

Horsfieldia pulverulenta Warb., Mon. Myrist. (1897) 342, t. 23 fig. 1-2; Markgraf, Bot. Jahrb. 67, 2 (1935) 150 (sub *H. ralumensis*) — *Myristica pulverulenta* (Warb.) Boerl., Handl. Fl. Ned. Ind. 3, 1 (1900) 87 — *Horsfieldia hellwigii* var. *pulverulenta* (Warb.) Sinclair, Gard. Bull. Sing. 28 (1975) 56 p.p., excl. Vink BW. 12194 = *H. leptantha* — Type: NW. New Guinea, Vogelkop Penins. (Andai, Mt. Arfak), Beccari 759 (FI, n.v.), 925 (FI, n.v.).

Horsfieldia hellwigi var. *hellwigii* x var. *pulverulenta* (Warb.) Sinclair, Gard. Bull. Sing. 28 (1975) 58 — Syntype: Saunders 202 (L, lecto), 358, 398, 483 (L: CANB, n.v.).

Tree 15-25 m. Twigs terete, towards the top 4-10 mm diam., early to rather late glabrescent, tomentum dark rusty with hairs c. 0.5-1.2 mm, bark finely striate or not, when older not flaking, lenticels usually present. Leaves in 2 rows, coriaceous, elliptic to oblong-lanceolate, broadest usually at or below the middle, or \pm parallel-sided, 14-35(-40) \times 4-10.5(-13) cm, base rounded or short-attenuate, tip acute acuminate, often to 2(-3 in sapling shoots) cm, caudate; upper surface drying usually dull brown to olivaceous, minutely rugose-pustulate, lower surface late glabrescent or with persistent tomentum composed of \pm evenly sized and spaced, rather harsh, dark brown hairs c. 1.0-1.5 mm long, when shed usually leaving thickened and rough hair bases, without brown dots; midrib above flattish, later glabrescent and usually with persistent tomentum towards base; nerves 11-30 pairs, generally rather straight, 50-70° with the midrib, c. 5-15 mm apart, thin and sunk above; beneath the marginal nerve with the arches usually very regular and prominent; tertiary venation rather lax, above well-visible and sunken, giving the blade often a \pm bullate appearance; petiole 2-12 \times 2.5-4.5 mm, not or hardly winged; leaf but stout, 3-6 cm long, with harsh hairs 1-1.5 mm long. Inflorescences woolly-pubescent with hairs 1-1.5 mm long, 2-3 times ramified, rather many-flowered, in ♀ and ♂: 4-10 \times 2-9 cm, common peduncle up to 15 long; bracts (broadly) ovate, acutish, 3-5 mm long, caducous. Flowers \pm solitary (in ♀) or in loose clusters of 2-6; perianths 2-valved, largely set with stellate(-dendroid) hairs 0.1-0.3 mm; pedicels slender, pubescent with coarse hairs 0.4-0.7 mm, at base inarticulate. Male perianths in lateral view subcircular, 1.5-3 \times 3-4 mm, the basal part thick and coriaceous, the remainder collapsed when dry and perianth then often saucer-shaped or wrinkled, at the apex just above the anthers, opening by a minute pore-like slit less than 1 mm wide; valves or apical part of perianth c. 0.2(-0.4) mm thick. Pedicels 2-3.5 mm long. Androecium consisting of a coriaceous \pm ellipsoid column c. 0.8-1.1 mm long, with 2 small anthers, each 0.2(-0.3) mm at the apex. Female perianth broadly ellipsoid-ovoid, 3.8-4 \times 3.5-4 mm, split at anthesis to c. $\frac{1}{5}$ - $\frac{1}{10}$, with a minute pore-like slit above the stigmas, valves c. 0.3-0.5 mm thick; pedicels (1.5-)3-5 mm long; ovary ovoid-subglobose, c. 2.5-3 \times 2.5 mm, densely pubescent with hairs 0.1-0.3 mm; style erect, glabrous, 0.2-0.8 mm long; stigma 2-lobed, c. 0.2-0.3 mm long. Fruits c. 3-10 per infructescence, ellipsoid, top acute and sometimes acuminate, 3.0-5.0 \times 2.0-3.0 cm, minutely pubescent at least at the base, valves woody-coriaceous, 4-7 mm thick, usually with paler, small or coarse lenticels or tubercles; stalk 2-7 mm long; perianth not persisting.

Distribution. New Guinea: Irian Jaya (Vogelkop, Jayapura, Geelvink Bay; Mimika, in the South), Papua New Guinea (West Sepik, East Sepik, Madang, Western; the Gulf Prov. specimen deviates).

NEW GUINEA. Irian Jaya: *b.b.* 30514, 31098, (Lundquist 103) 32822; BW 2727, 2733, 6666, 9173, 9420, 11111; *Doctors van Leeuwen* 10479 — Papua New Guinea: *Darbyshire & Hoogland* 8094; *Katik W* 2877; *LAE* 52930, 53567; *NGF* 27471, 34154, 34339, 45861, 45913, 48290; *Saunders* 202, 358, 398 — Deviating: Gulf Dist., *Schodde & Craven* 4662 (see notes).

Ecology. Lowland primary and (old) secondary rain forest, ridge-side forest, swamp forest; on clay, stony-sandy soil; 0-500 m alt.; flowers and fruits throughout the year.

Vernacular names. Baa (Hollandia), Gumaga (E. Sepik), Ibuumkwaraf (Kemtoek lang., Hollandia), Patepa (Siere-Octa, SW. New Guinea), Poi (Pogatumo lang., Sepik Prov.), Sabobo (Orne lang., Mafoka, Sepik Prov.), Vionge (Nemo lang., Hollandia).

NOTES

1. *Fieldnotes.* Bole unbuttressed or with slight buttresses. Bark often strongly peeling in small, oblong, thin scales, black-brown or dark brown. Wood whitish or straw, moderately hard and heavy. Flowers yellow, greenish-yellow or pale orange-yellow. Fruit greenish, greenish-yellow, or yellow-brown; aril red.

2. The present species obviously belongs to the group with *H. hellwigii* which has stout twigs, the pubescence on the leaf bud and apex of twigs conspicuous, composed of coarse hairs (0.5-)1-1.5 mm long. It is very distinct by its woody perianths, usually collapsed in ♂ around the much 'reduced' androecium. This latter consists of an ellipsoid woody body, its apex with only 2 apparently much reduced anthers or thecae just below the apical pore-like slit of the perianth.

The female flowers are larger than those of *H. hellwigii*.

3. The late Dr. Muller of the Rijksherbarium investigated the pollen of *LAE* 52930 and remarked: little pollen produced, 25-30 μ , boat-shaped with proximal side convex, exine 0.5 μ thick, very finely echinate, echinae 0.5 μ long. In comparison, the related *Horsfieldia hellwigii* (*Brass* 25949) produces abundant pollen, 30-40 μ , boat-shaped with convex proximal side, exine 1.5 μ thick, finely echinate, echinae 1 μ long.

4. *Deviating specimen.* The specimen *Schodde & Craven* 4662, from the Gulf Province, Papua, with ♂ flowers, deviates in its non-coriaceous leaves, the more woolly tomentum (not harsh) and the densely tomentose perianths. The perianths do not dry blackish brown as is usual in *H. pulverulenta*, but are instead, rather light brown and only slightly collapsed. The perianths contain a much reduced androecium, comparable to that found in *H. pulverulenta*. The marginal nerve of the leaves is looping very regularly, as in *H. pulverulenta*. The specimen may represent a separate taxon.

5. *Sterile, dubious specimens.* The sterile material cited below with rather membranous leaves, probably belong to the present species. For the greater part they might have been taken from sapling shoots. The tomentum is generally softer than

in a true *H. pulverulenta*. Often the leaves are long-caudate. They might belong to one of the other related species of the *H. hellwigii*-complex as well. Sinclair referred these specimens to a group of hybrids between *H. hellwigii* var. *hellwigii* and var. *pulverulenta*. The specimens are from the Madang district, NE. New Guinea: *Saunders* 202, 358, 398, and from Jayapura, Irian Jaya: *BW* 6666, 9173.

6. Sinclair accepted the present species as a variety under *H. hellwigii*.

He, however, did not cite the curious woody flowers with the apparently reduced androecium nor the differing female flowers.

7. I have not seen the syntypes; Sinclair enumerates them among several collections also seen by me, some of which, however, e.g., *Vink BW 12194* is presently referred to a new species, *H. leptantha*.

43. *Horsfieldia leptantha* de Wilde, *sp. nov.*

Fig. 1B(43)

Ramuli validi, eoram apicibus atque gemmis praeditis pilis 0.5-1.0 mm longis. Perianthium masculinum 2-valve, subglobosum, pubescens, in anthesi usque ad $\frac{3}{4}$ - $\frac{5}{6}$ divisum, valvis c. 0.2 mm crassis, androecii lateraliter compresso, antheris 10-14, erectis. Fructus breviter ellipsoidei, 2.0-2.4 cm longo, grosse tuberculati — Type: Irian Jaya, Fak-Fak, *Vink BW 12194* (L).

Tree 8-30 m. Twigs terete, towards the apex 4-8 mm diam., early to late glabrescent, tomentum rusty, of hairs 0.5-1.0 mm long, bark finely or coarsely striate, when older not flaking; lenticels usually present. Leaves in 2 rows, membranous to chartaceous, elliptic to oblong-lanceolate, broadest usually in the middle, generally not parallel-sided, 13-35 × 5-13.5 cm, base (short-) attenuate, tip acute-acuminate, not caudate; upper surface drying dull brown to olivaceous, smooth or finely pustulate, lower surface rather early to late glabrescent or with persistent tomentum of stellate-dendroid rather woolly or 'mealy' hairs of mixed sizes, 0.5-1.0 mm long, when shed not leaving rough hair bases; without brown dots; midrib above flattish, glabrescent except towards base; nerves 10-20(-30?, see notes) pairs, usually at c. 45°-50° with the midrib, 5-20 mm apart, above thin and sunken or flattish, below, the arches of the marginal nerve not very regular, prominent or not; tertiary venation lax, distinct or not; petiole 5-12 × 2.5-4 mm, not winged; leaf bud stoutish, 2.5-5 cm long, with dense tomentum of hairs 0.5-1.0 mm long. Inflorescences woolly-pubescent with hairs 0.5-1.0 mm long, in ♂: rather many-flowered, 2 or 3 times ramified, c. 11 × 7 cm, common peduncle 5-20 mm long; flowers in loose clusters of 2-6 each, perianth 2-valved, completely pubescent with hairs 0.2-0.3 (-0.5) mm; pedicels slender, pubescent, at base inarticulate; bracts broadly elliptic, obtuse, 2-3 mm long. Male perianth in lateral view subcircular, c. 2.5 × 2.7-3 mm, somewhat laterally compressed, sub-membranous, not collapsing on drying; pedicel 1-1.5 mm long; perianth at anthesis split to $\frac{3}{4}$ - $\frac{5}{6}$; valves c. 0.2 mm thick. Androecium laterally compressed, c. 1-1.3 × 1.3-1.6 mm, above broadly rounded-truncate, the column inside narrowly hollowed for c. $\frac{1}{4}$ (c. 0.3 mm), anthers 10-14, erect touching each other, somewhat septate when young, 1-1.1 mm long, free apices c. 0.2-0.3 mm, not or but faintly incurved; androphore ± 0. Female flowers not seen. Infructescences 6-12 cm long, branched. Fruits 2-8 per infructescence, broadly ellipsoid to subglobose (seed ellipsoid), apex obtuse or broadly rounded, 2.0-2.4 × 1.6-2.0 cm, largely glabrescent but with minute vestigial hairs towards the base, tubercles coarse, pale, lenticel-like, valves woody-coriaceous, 4-7 mm thick; stalk 5-10 mm long; perianth not persisting.

Distribution. New Guinea: Irian Jaya (Vogelkop, doubtful; Fak-Fak), Papua New Guinea (West Sepik).

Ecology. Secondary and primary forest, ridge forest, on clay soil over limestone; 0-600 m. Flowering and fruiting apparently not seasonal.

NEW GUINEA. Irian Jaya: *BW (Koster) 10763* (doubtful, see notes), *Vink 12194*, (*Moll*) *12952*; *Pleyte 553*; *Pulle 343*. — Papua New Guinea: West Sepik, *LAE 52962*; *NGF 25241*.

NOTES

1. *Fieldnotes.* Bark recorded as greenish black; blaze with pinkish red serous sap.

2. The male perianths are deeply cleft, to c. $\frac{3}{4}$ - $\frac{5}{6}$, much deeper than in the other species of the *H. hellwigii* complex. The fruits with their coarse lenticels and tubercles are strongly reminiscent of those in *H. laevigata*; there is likely to be a true close relationship with this species.

3. A doubtful sterile specimen from Vogelkop, *BW 10763*, is tentatively included in the present species, mainly because of its locality. It deviates by its numerous side-nerves, c. 30-33, which are almost parallel and depart from the midrib at an angle of c. 70°; the marginal nerve is distinct and loops very regularly, both characters predominant in the related *H. pulverulenta*. However, the tomentum on the lower leaf surface is rather mealy and is composed of hairs of rather mixed sizes, and the leaves are membranous in texture, not rough. The specimen might likewise belong to one of the other related species of the *H. hellwigii* complex.

44. *Horsfieldia hellwigii* (Warb.) Warb.

Fig. 1B(44); 21

Myristica hellwigii Warb., Bot. Jahrb. 18 (1893) 192 — *Horsfieldia hellwigii* (Warb.) Warb., Mon. Myrist. (1897) 343; Markgraf, Bot. Jahrb. 67, 2 (1935) 150; A.C. Smith, J. Arn. Arb. 22, 1 (1941) 61; Sinclair, Gard. Bull. Sing. 28 (1975) 49 (for the type variety only) — Type: Finschhafen (Papua New Guinea), *Hellwig 416* (B, †, n.v.).

H. glabrescens Warb. in K. Schum. & Lauterbach, Fl. Deutsch. Schutzgeb. Südsee (1900) 325 — Type: Papua New Guinea (Madang), *Tappendeck 74* (B, †; WRCL, seen by Sinclair).

Tree 5-30 m. Twigs stout, terete or rarely \pm ridged, often hollow, towards apex (4-)5-15 mm diam.; early to late glabrescent from rusty woolly or felty tomentum of hairs 0.5-1.0(-1.5) mm long; bark finely or coarsely striate, when older not flaking; lenticels present, usually distinct. Leaves in 2 rows, membranous or rarely chartaceous, elliptic-oblong to oblong-lanceolate, broadest at or above the middle, or sometimes \pm parallel-sided, 17-40(-50) \times 5-14 cm, base \pm rounded to (short-)attenuate, tip acute-acuminate (in New Britain specimens rarely short-caudate); upper surface drying usually dull olivaceous, minutely pustulate, lower surface late glabrescent or with persistent tomentum of hairs of mixed to subequal sizes 0.3-1.0 mm long, when shed not leaving thickened hair-bases; without brown dots; midrib above flat or slightly sunken, late glabrescent or usually with persistent tomentum towards base; nerves 12-33 pairs, thin, \pm flat above, generally at an angle of c. 45° with the midrib, the marginal nerve with arches usually rather thin and \pm irregular beneath; tertiary venation lax and thin, faint above; petiole (2-) 5-8

× 2.5-5 mm, not or hardly winged; leaf bud generally stout, 3-7 cm long, densely pubescent, hairs 0.5-1.5 mm long. Inflorescences woolly-pubescent, hairs 0.5-1.0 mm; in ♂: 3.5-15 × 2-10 cm, 2-3 times ramified, flowers in clusters of 3-6 each; in ♀ up to c. 8 × 5 cm, flowers in clusters of up to 4; common peduncle up to 30 mm; bracts elliptic to broadly ovate, acutish, 3-7 mm long, caducous; perianths 2-valved (flowers not known in var. *lignosa*), glabrous or early glabrescent except at base, pedicels pubescent by stellate-dendroid hairs 0.2-0.5 mm, at base inarticulate. Male perianths, as seen laterally, subcircular, 1.8-3.2 × 2.3-3.5 mm, somewhat laterally compressed, top and base broadly rounded, pedicel slender, 1-3(-4) mm; perianth at anthesis split to ($\frac{1}{3}$ -) $\frac{1}{2}$ - $\frac{2}{3}$, valves c. 0.2 mm thick. Androecium (1.2-) 1.5-2 × (1.3-) 1.7-2 mm, laterally compressed to c. 0.8-1 mm thick, above ± broadly rounded-truncate, column c. 0.3-0.5 mm, narrowly hollowed for the upper c. $\frac{1}{4}$ (-5), anthers (10-) 12-18 (i.e., 12-18 thecae at each side), erect, not septate, c. 1.2-2 mm long, completely sessile, mutually touching, free apices 0-0.1 mm, not incurved; androphore ± broad, up to 0.1 mm long. Female perianth subglobose or broadly ovoid, c. 2.8-3.5 × 3 mm, split at anthesis to $\frac{1}{3}$ - $\frac{1}{2}$, valves 0.2-0.3 mm thick; pedicel 1-2 mm long; ovary subglobose, c. 2 mm diam., densely pubescent with hairs 0.2-0.4 mm long, stigma largely sessile, faintly 2-lobed, c. 0.1 mm high. Fruits 3-15 per infructescence, subglobose or broadly ellipsoid to fusiform, top rounded or generally acutish (when dry), 1.2-2.8 × 1.0-1.8 cm, densely pubescent or partly glabrescent with hairs c. 0.5 mm, usually rather finely lenticellate-tuberculate, dry valves 1-3 mm, or in var. *lignosa* 4-8 mm thick; stalk 1-4 mm long; perianth not persisting.

Distribution. Papua New Guinea, New Britain and New Ireland; not yet found in Irian Jaya.

Ecology. Primary and secondary forest, regrowth; in primary forest an understorey or second storey tree, in secondary forest often common; lowland rain forest, ridge forest, also monsoon forest, gallery forest; on alluvial soils, also limestone; 0-1200 m. Flowers throughout the year, fruits predominantly from July to December.

Vernacular names. Apaap (Wanigela lang.), Camarngur (Lae subdist., Morobe), Fohja (Okema lang. Aku), Guma (Waskuk lang., Sepik Dist.), Hota (Garaina lang., Bulolo), Lagele Kuku (W. Nakanai, New Britain), Naufora (Talasea, New Britain), Mamasoh (Onjob lang., Koreaf), O'hènga (Orakaiva lang., Mumumi).

Uses. Fruits sometimes recorded as edible.

NOTES

1. *Fieldnotes:* Bole straight, unbuttressed, bark finely longitudinally fissured; crown narrow, dense; branches often tending to be whorled, horizontal, later on drooping; leaves drooping; wood rather soft and light, whitish or straw, heartwood pinkish. Flowers yellow. Fruits green turning yellow or orange, aril orange.

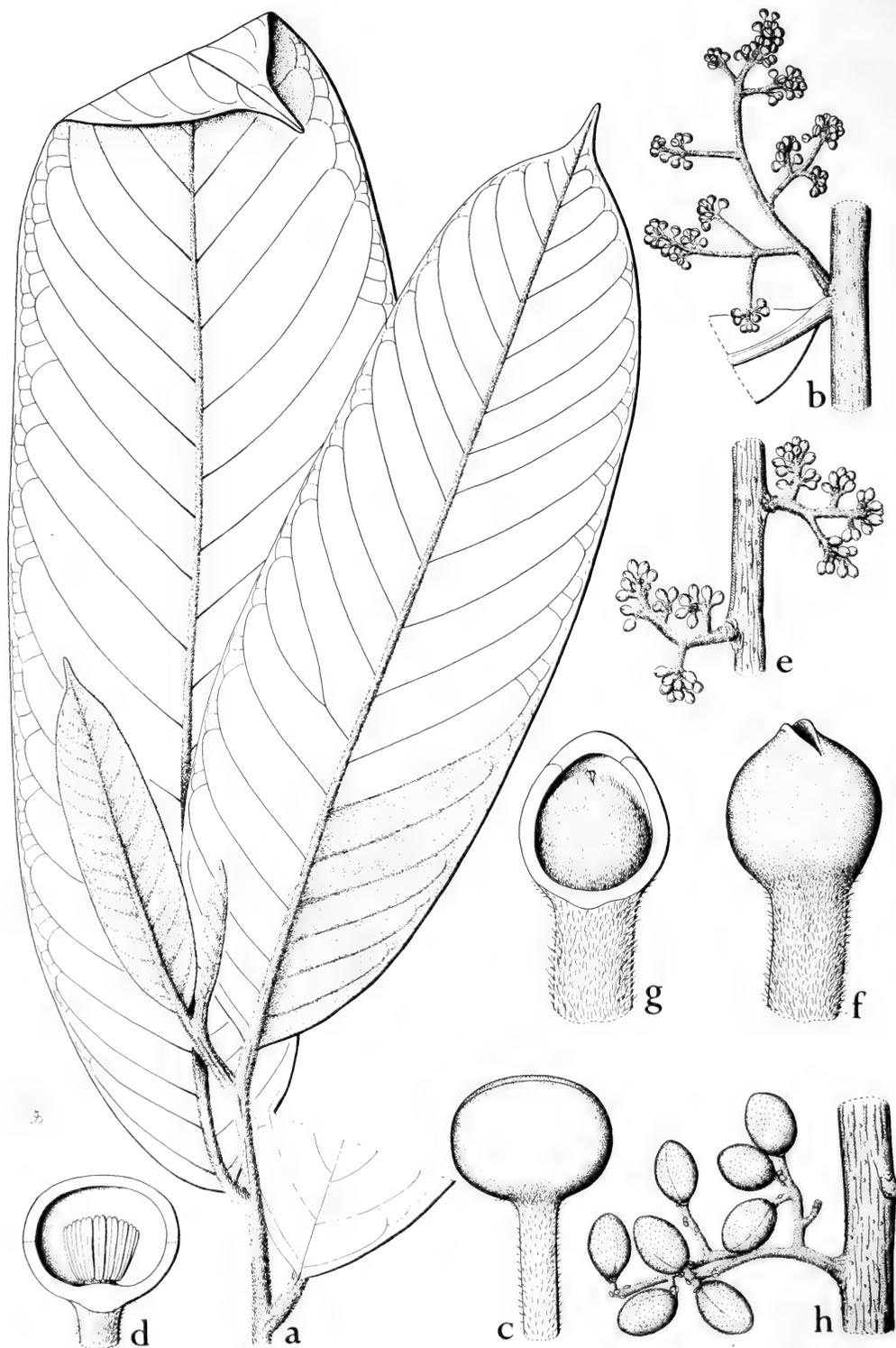


Fig. 21. *Horsfieldia hellwigii* (Warb.) Warb. var. *hellwigii*
a, apical portion of leafy twig, $\times \frac{1}{2}$; *b*, portion of twig with male inflorescence, $\times \frac{1}{2}$; *c*, mature male flower, lateral view, $\times 6$; *d*, ditto, longitudinally opened, showing androecium, $\times 6$; *e*, portion of twig with female inflorescences axillary to leaf-scars, $\times \frac{1}{2}$; *f*, female flower at anthesis, $\times 6$; *g*, ditto, longitudinally opened, showing pubescent ovary and small bi-lipped stigma, $\times 6$; *h*, infructescence with mature fruits. — *a*, from NGF 26412; *b-d*, from NGF 4019; *e-g*, from Hoogland 3431; *h*, from LAE 67101.

2. *Taxonomy*. The present species, here comprising three varieties, is largely identical with Sinclair's *H. hellwigii* var. *hellwigii*. Sinclair's var. *pulverulenta* (Warb.) and his var. *pulverulenta*, Vink BW 12104, are here referred to different species. Also, *H. ralunensis*, which Sinclair cited in the synonymy of *H. hellwigii* var. *hellwigii*, is presently accepted as a separate species. His var. *novobritannica* is presently partly, almost exclusively the type, referred to a variety of *H. laevigata*.

Horsfieldia hellwigii, as presently accepted, is still rather variable, especially in fruit size and shape; for some very small-fruited specimens and for specimens with conspicuously woody fruits, separate varieties are accepted.

KEY TO THE VARIETIES

- 1a. Fruit slightly asymmetrically subglobose; pericarp woody, 4-8 mm thick, the surface not wrinkled on drying c. var. **lignosa**
- b. Fruit subglobose, or ellipsoid, or fusiform; dry pericarp c. 2 mm thick, the surface usually somewhat wrinkled on drying 2
- 2a. Fruit broadly ellipsoid to nearly globose, 12-15 mm long b. var. **brachycarpa**
- b. Fruit broadly ellipsoid to fusiform, 16-28 mm long. a. var. **hellwigii**

a. var. **hellwigii**

Fig. 1B(44); 21

Lower leaf surface usually rather densely pubescent with hairs c. 0.3-1.0 mm. Male perianth (in bud) 2.2-3.2 × 2.4-3.5 mm, split at anthesis to $\frac{1}{2}$ - $\frac{2}{3}$. Anthers (12-)-14-18. Fruit broadly ellipsoid to fusiform, 1.6-2.8 × 1.0-1.8 cm, pericarp 2-3 mm thick.

Distribution. As for the species.

NEW GUINEA. Papua New Guinea — Bismarck Arch. (New Britain, New Ireland): *Floyd* 6410; *Hoogland* 3431; *LAE* 75366; *NGF* 10018, 10832, 24233, 26253, 26310, 27248; *Sands et al.* 2013; *Waterhouse* 877 — Main Island (Madang, Morobe, Northern, Milne Bay, Western, Central): *Brass* 24386; *Carr* 11962, 13901; *Clemens s.n.* (8.II. 1936), 78, 10908; *Fallen et al.* 282; *Floyd & Hoogland* 3813; *Frodin UPNG* 2139; *Fryar* 4019; *Hartley TGH* 9970, 10013; *Hoogland* 3256; 4386, 5210; *LAE* 67101; *NGF* 204, 857, 4019, 1617, 7331, 9677, 9681, 9770, 10540, 10981, 17129, 24003, 24329, 26412, 28553, 28776, 31697, 33857, 34154, 34339, 36304, 36773, 37656, 41170, 41421, 41823, 44388, 45861, 45921, 47431, 48290; *Saunders* 483; *Womersley & Hoogland* 5156 — Fergusson Isl. (Milne Bay Prov.): *Brass* 25949; *LAE* 52558 — Deviating specimens: *LAE* 66008 (Morobe Prov.); *NGF* 40599 (W. New Britain); see notes.

NOTES

1. *NGF* 24233, from limestone at c. 1200 m, has rather chartaceous leaves.
2. The twigs are normally terete, and not or faintly ridged, in *NGF* 37656 the twigs are very distinctly ridged in between the bases of the petioles.
3. Further deviating specimens: *NGF* 40599 from W. New Britain, and *LAE* 66008 from nearby Umboi Isl. rather differ one from the other, the former being much more pubescent. Both deviate from normal *H. hellwigii* var. *hellwigii* by the rather more pear-shaped, i.e., at base more tapering male perianths. Possibly the specimens are a hybrid, e.g., with *H. tuberculata*, and they may appear to represent a separate taxon.

b. var. brachycarpa de Wilde, *var. nov.*

Differt a var. *hellwigii* fructibus siccis fere globosis, 12-15 mm longis, pericarpio 2 mm crasso — Type: *Lauterbach 1191* (L; iso: BRSL & S, n.v.).

Lower leaf surface rather sparsely hairy, the hairs c. 0.3 mm long. Male perianth c. 2 mm diam. (1.9 × 2.3 mm), split at anthesis to c. 1/3. Anthers 10-12. Fruits subglobose to broadly ellipsoid, 1.2-1.5(-1.7) × 1.0-1.3 cm; pericarp 1-2 mm thick.

Distribution. Papua New Guinea (Sepik, Madang, Morobe Prov.).

NEW GUINEA. Papua New Guinea (Northern): *Hoogland & Craven 10312*; *Lauterbach 1191*; *NGF 9146*, *10258*.

Ecology. Twice collected in levee-forest; 0-100 m. alt.

NOTES

1. The original description of *H. hellwigii* was based on *Hellwig 416*, now lost. In his monograph of 1897, p. 344, Warburg mentions *Lauterbach 1191*, with fruits, as a specimen assigned to *H. hellwigii*. It was accepted later by Markgraf (p. 150) and Sinclair (p. 52) under *H. hellwigii*. Now it serves as type of my present new variety *brachycarpa*.

2. I have accepted *NGF 9146*, with male flowers, as belonging to var. *brachycarpa*. It has slightly smaller perianths and fewer anthers as compared with the type-variety.

c. var lignosa de Wilde, *var. nov.*

Differt a var. *hellwigii* fructibus siccis pericarpio lignoso 4-8 mm crasso — Type: Milne Bay Prov., *Leach LAE 56060* (L; iso: K; A, BISH, BO, BRI, CANB, SING, SYD, PHN & US, n.v.).

Lower leaf surface rather sparsely hairy, the hairs c. 0.2-0.3 mm long (on leaf buds c. 0.5 mm long). Flowers unknown. Fruits somewhat asymmetrically subglobose, slightly flattened or not, c. 1.6-1.9 cm diam (immature); pericarp very woody, 4-8 mm thick, the surface not wrinkled on drying, densely rusty tomentose with hairs c. 0.3(0.5) mm long.

Distribution. SE. Papua New Guinea: Central and Milne Bay Provinces.

Ecology. Lowland and mountainous forest, 300-1150 m alt. Fruits in June and September.

NOTES

1. One suspects the immature fruits in both cited collections as being diseased, e.g., infected by a gall, but on closer inspection all fruits seem healthy. The fruits of both collections are recorded as green.

2. The specimen *NGF 32401* has the lower leaf surfaces finely, irregularly, more darkly mottled; mottles are absent in the type. In the *NGF 32401* the older twigs are rather markedly ridged in-between the petiole scars.

3. The specimens cited were collected after Sinclair's revision *Horsfieldia*. Flowers are unknown; when these get collected, it may turn out that the present taxon can better be regarded as a separate species. Vegetatively it is very like the typical *H. hellwigii*.

45. *Horsfieldia ralunensis* Warb.

Fig. 1B(45)

Horsfieldia ralunensis Warb., Mon. Myrist. (1897) 336; K. Schum., Notizbl. Bot. Gart. Berl.-Dahl. 2 (1898) 117; Sch. & Laut., Fl. Deutsch. Schutzgeb. Südsee (1900) 324; Markgraf, Bot. Jahrb. 67, 2 (1935) 150 — Type: New Britain (Neu Pommern), Gazelle Penins., Ralum, Warburg 20709 (B. †, n.v.).

Tree 5-18 m. Twigs terete, towards apex 5-10 mm diam., early to late glabrescent from light rusty or yellow-brown tomentum with hairs 0.5-1.0 mm long, bark rather finely striate, when older not flaking; lenticels present but not distinct. Leaves in 2 rows, membranous, oblong-lanceolate to lanceolate, broadest towards the base or usually \pm parallel-sided, 30-60 \times 7-11 cm, base nearly rounded to (short-)attenuate, tip long acute-acuminate, usually 1-2 cm caudate; upper surface drying dull olivaceous, minutely, palely punctate-pustulate, lower surface with persistent tomentum of pale brown softish dendroid hairs of mixed sizes 0.5-1 mm, when shed, not leaving thickened rough hair bases; without brown dots; midrib flat above, glabrescent except at the very base; nerves 30-40 pairs, generally \pm straight, at an angle of 50-70° to the midrib, 8-15(-20) mm apart, thin and flat above; beneath, the marginal nerve rather distinct, not very regularly looping; tertiary venation lax, indistinct above; petiole 5-16 \times 3-4 mm, not or hardly winged; leaf bud stout, 4-6 cm long, with dense velvety tomentum with hairs (0.5-) 1 mm. Inflorescences woolly pubescent, hairs 1-1.5 mm long, in σ and ρ : 2 or 3 times ramified, rather many-flowered, 4-15 \times 3-10(-12) cm, common peduncle 5-50 mm long; bracts broadly ellipsoid, subacute, 5-10 mm long. Flowers in loose clusters of 3-6 each, perianth 2-valved, glabrous except at the very base, pedicels pubescent with hairs 0.3-0.8 mm long, at base inarticulate. Male perianths obovoid-ellipsoid, at apex acutish, c. 2-2.3 \times 1.5-1.7 mm, pedicel 1(-2) mm long, perianth at anthesis split to c. $\frac{1}{4}$, valves c. 0.2 mm thick. Androeium c. 1-1.1 \times 1.2-1.3 mm, \pm laterally flattened, broadly rounded above, column at apex narrowly hollowed for c. $\frac{1}{4}$ (0.2-0.3 mm), anthers c. 10(-12), \pm completely sessile, erect, mutually touching, c. 1-1.2 mm long, free apices c. 0.2 mm; androphore slender, 0.3-0.4 mm long. Female perianth obovoid, c. 4 \times 2.5-3 mm, split at anthesis to c. $\frac{1}{4}$, valves c. 0.3 mm thick; pedicels 1-1.5 mm; ovary ovoid, c. 2 \times 1.5 mm, densely pubescent with hairs c. 0.5 mm, style and stigmas minute, \pm elongate, minutely 2-lobed, c. 0.2 mm long. Fruits 2-10 per infructescence, ellipsoid, top obtusish, base broadly rounded, 2.5-3.0 \times 1.5-1.9 cm, pubescent, hairs c. 0.5 mm long, coarse, paler-coloured lenticel-like tubercles present, dry valves 3-5 mm thick; stalk 1-3 mm long; perianth not persisting.

Distribution. West and E. New Britain (Gazelle Penins.)

BISMARCK ARCH. New Britain: LAE 52084; NGF 7060, 7092, 36304 A, 36773, 38152, 44388, Warburg 20709 (B, † n.v.).

Ecology. Lowland rain forest, recorded from well-drained pumice terrain, sandy soil, ridge forest, at edge of swamp; 0-100 m. Flowering and fruiting apparently not seasonal.

NOTES

1. *Fieldnotes*. A small or medium sized tapered understorey or subcanopy tree; bole straight, branches horizontal but drooping terminally; once recorded as slightly buttressed. Bark dark coloured, mottled, or with short vertical fissures. Wood straw, moderately soft. Flowers yellow. Inflorescences (with flowers) recorded as erect. Mature fruit green or brown-green.

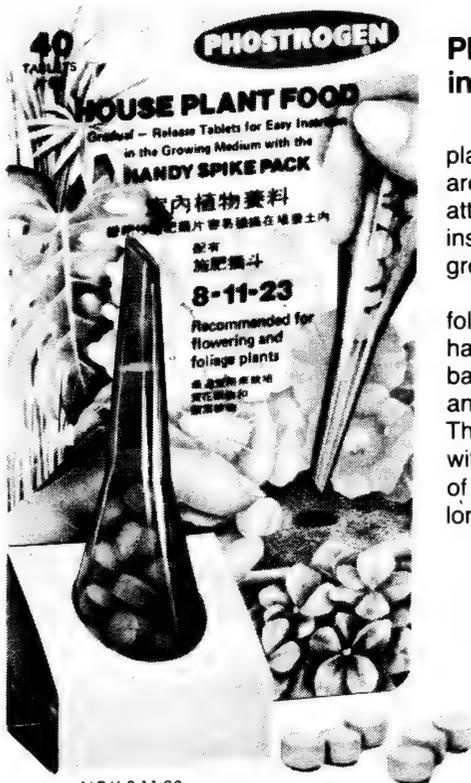
2. Related to *H. leptantha*, *H. pulverulenta*, and *H. hellwigii*, the last also occurring on New Britain. Distinguished from *H. hellwigii* by the larger fruits, smaller and narrower male flowers (with a somewhat different androecium), and the generally more elongated leaves.

3. Sinclair included the present species in *H. hellwigii* var. *hellwigii*.

4. I have not seen the type, which was apparently lost in B, but Warburg notes that the anthers do not reach the top of the androecium and leave a sterile narrow appendix. This latter is at variance with the material seen by me.

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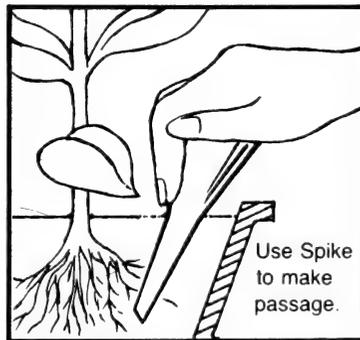
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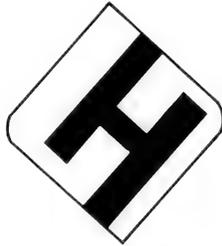
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THE GARDENS' BULLETIN

SINGAPORE

VOL. 38 (Part 2)

1st December 1985

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 Parks and Recreation Department
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The price of the Gardens' Bulletin varies according to the content of each issue. This issue, is priced at Singapore \$13.00 cts. excluding postage. Overseas subscribers are requested to make payment in the form of bank drafts or international money orders in Singapore currency payable to the *Commissioner of Parks and Recreation, Singapore*.

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Botanic Gardens
Parks and Recreation Department
Cluny Road,
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THE GARDENS' BULLETIN

SINGAPORE

VOL. 38 (Part 2)

1st December 1985

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**Published by the Botanic Gardens
Parks and Recreation Department
Ministry of National Development
Cluny Road, Singapore 1025.**

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Two copies of the manuscript should be submitted, typed on one side only with double-line spacings and a margin of at least 4 cm. Do not type all the letters of any word in capitals. Underline only in pencil: with a straight line for italic type face and wavy line for bold type face. Authors should see the layout of other papers recently published in this journal to ensure that papers submitted conform as closely as possible to the accepted pattern. Numerical data should only be included if it is essential to the argument and this can be presented either in the form of tables or diagrams.

Title and authors: The title should give a concise description of the contents of the papers. The name(s) and affiliation(s) of author(s) must be given below the title. Lengthy papers and those of a complex nature must have the contents listed at the beginning of the paper.

Scientific names: The complete scientific name — genus, species, authority, and cultivar where appropriate — must be cited for every organism at time of first mention. The generic name may be abbreviated to the initial thereafter except where intervening references to other genera with the same initial could cause confusion.

Tables: All tables should be numbered and carry headings describing their content. These should be comprehensive without reference to the text.

Abbreviations: Standard chemical symbols may be used in the text (e.g. IAA, IBA, ATP), but the full term should be given on the first mention. Dates should be cited as: 3 May 1976. Units of measurement should be spelled out except when preceded by a numeral where they should be abbreviated in standard form: g, mg, ml, etc. and not followed by stops.

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References to books and monographs should be cited according to the following form:

Ridley, H. N. (1930). *The Dispersal of Plants Throughout the World*, L. Reeve; Ashford, Kent; 242-255.

For literature citations in taxonomic papers the following style is required:

Medinilla alternifolia Bl., *Mus. Bot. Lugd.-Bat.* 1:2 (1849) 19.

Sterculia acuminatissima Merr., *Philip. J. Sci.* 21 (1922) 524.

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Two New Species of *Tectaria* from Limestone in Peninsular Malaysia, with Comments on Some Other Species

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EFFECTIVE PUBLICATION DATE: 15 FEB. 1986

SUMMARY

Tectaria curtisii and *T. translucens* are described as new species, with comments on *T. coadunata* (J. Sm.) C. Chr., *T. brachiata* (Zoll. & Mor.) Morton and *T. variolosa* (Hook.) C. Chr. Evidence is presented that the type specimen of *Pteridrys acutissima* Ching was probably collected on limestone and that the single collection of *Hypodematum* on limestone in Kelantan represents the species *Hypodematum glabrius* (Copel.) Holttum. **comb. nov.**

THE NEW SPECIES

Tectaria curtisii Holttum *sp. nov.*

Stipes usque 70 cm longus, basin versus castaneus, paleis angustis fuscis vestitus, sursum pallidior, minute pilosus; lamina usque 60 cm longa, tenuis, pinnis stipulatis 3-paribus etiam sessilibus vel adnatis 3-paribus constituta; pinnae infimae ultra 30 cm longae, longe stipulatae, pinnulas liberas unijugatas ferens, pinnula infima basiscopica 20 × 7 cm, profunde lobata, lobis acuminatis lobulatis, lobo infimo libero; pinnae suprabasales 30 cm longae, pinnulis liberis unijugatis subaequalibus praeditae; venae in areolis angustis costalibus et costularibus ordinatae, venulis retrorsis inclusis, areolis alliis ut in *T. coadunata* sed paucioribus et nonnullis venulis brevibus liberis instructis; costae, costulae venaque subtus pilis patentibus tenuibus 0.2-0.3 mm longis vestitae, pagina inter venas pilis erectis multis brevioribus praedita; costae supra pilis brevibus dense vestitae, pili ad et inter venas rares, margines (sinubus inclusis) pilis destitutae; sori plerique ad venas breves in areolis terminales; indusia tenuia, glabra.

Typus: near Ipoh, on limestone, *C. Curtis* 3376, December 1895 (holotypus K; isotypus SING). No other specimen is known.

This species differs from the small Peninsular plants of *Tectaria coadunata* (J. Sm.) C. Chr. in having much larger and more amply branched fronds with abundant hairs between veins on the lower surface and practically glabrous on the upper surface (hairs are lacking even at the sinuses). The new species differs also in the presence of small free veinlets arising from the outer veins of the costal areoles and directed towards the costae; such veinlets are absent in *T. coadunata*. Short free unbranched veinlets are also present in other areoles, often directed towards the costa; branched included veinlets have not been noticed.

Tectaria translucens Holttum *sp. nov.*

Caudex brevis, erectus; stipes usque 35 cm longus, modice castaneus, sparsim brevipilosus, basi paleis usque 15 × 1 mm, apice capillaceis, vestitus; lamina usque 40 cm longa, tenuis, translucens, pinnis stipulatis 2-jugatis etiam sessilibus vel adnatis 2-jugatis constituta; pinnae infimae usque 19 cm longae, pinnulis unijugatis praeditae, pinnula infima basiscopica 12 cm longa, basin versus profunde lobata; venae in areolis angustis costalibus et costularibus venulis liberis retroversis inclusis ordinatae, venulae liberae etiam in areolis alliis pleraeque costam versus currentes, raro furcatae, adsunt; axes frondis subtus sparsim brevipilosi, pagina inter venas utrinque glabra; sori plerique ad venas exteriores costularum, in lobis pinnarum distaliter ad venas liberas terminales siti; indusia tenuia, pilis brevibus interdum praedita.

Typus: Pahang, Taman Negara, on limestone, *B.S. Parris* and *P.J. Edwards* 10450 (K).

Young plants may have some hairs between veins on both surfaces.

A distinctive feature of these two new species is the presence of free veinlets in the costal areoles. Such veinlets occur also in *T. cherasica* (Holtum 1981, p. 141) and in *T. brachiata* (discussed below). This character distinguishes all four species from *T. coadunata*, which has the basic vein-pattern on which Presl (1836) based his genus *Sagenia*. Another difference is that in *T. coadunata* free veinlets in non-costal areoles are few, unbranched and outwardly directed, whereas in the other species many free veinlets are directed towards the costa and in some cases are branched. Branched veinlets are frequent in the sterile fronds of *T. brachiata* but rare in *T. cherasica* and *T. translucens* and they have not been noted in *T. curtisii*. Apart from these species there is, within *Tectaria*, a rather clear distinction between the species which show the *Sagenia* pattern and those which have abundant branched free veinlets in areoles (see Holtum 1983, p. 108 and fig. 1). It is notable that in SE Asia there is a species (*T. fuscipes* (Bedd.) C. Chr.) which has *Sagenia*-type venation in sterile fronds but free veins in fertile ones. This bridges the gap between species with anastomosing veins and those with free veins which Ching and others have included in a genus *Ctenitopsis*. A majority of such free-veined species occur in mainland SE Asia and the Philippines. Combining this information with the fact that there are far more species of *Tectaria* in the Palaeotropics than in the Americas, I suggest that the genus *Tectaria* originated in SE Asia. Taxonomically, it is unfortunate that the type species of the genus is a West Indian one.

TECTARIA VARIOLOSA AND *T. BRACHIATA*

In Holtum 1981, p. 137, the name *T. variolosa* is placed as a synonym of *T. brachiata*, but in fact the type specimens of the two differ in venation, and the characters specified for *T. brachiata* in the key on pp. 133-134 are those of *T. variolosa*.

In both species the pinnae of fertile fronds are contracted as compared with sterile ones (intermediate fronds may sometimes occur), and in both the only hairs between veins on the upper surface are small ones near the sinuses between pinnalobes. The pinnae of sterile fronds of *T. brachiata* are much less deeply lobed than those of *T. variolosa* and there are many free and branched veinlets both in costal and some other areoles (Fig. 1).

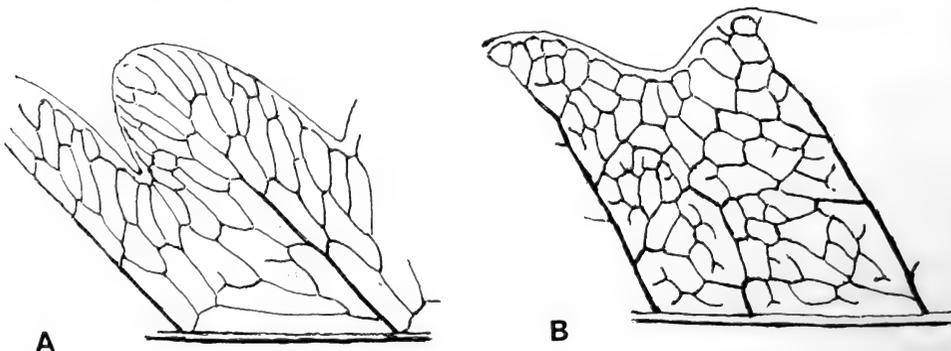


Fig. 1. Venation in a lobe of a middle pinna of a sterile frond of A: *Tectaria variolosa* (Toppin 4183, Upper Burma) and B: *Tectaria brachiata* (Curtis 1608, Penang), both $\times 2$.

The name *T. variolosa* (originally in the genus *Aspidium*) was copied from Wallich's catalogue and based on Wallich 379. Under this number Wallich included specimens from NE India (of which Ching selected one as lectotype) and also from Penang. The Penang specimens (of which two sheets are at Kew) are *T. brachiata*. Accepting Ching's choice of a type, *T. variolosa* occurs from NE India southwards into Burma, Thailand and Vietnam. Specimens so named from Hainan and Taiwan seen by me have broader fertile pinnae with a more ample venation and a greater number of smaller sori; they are more like *T. subtriphylla* (Hook. & Arn.) Copel. and need further study. It is possible that the type of *Phlebigonium impressum* Fée (Griffith, Pl. Indic. 34, now at Rio de Janeiro; see Windisch 1982, p. 59) is conspecific with the type of *T. variolosa*; if this should be established, Fée's name (1852) is the older and his specific epithet should be substituted for *variolosa*.

T. brachiata is widely distributed, but specimens are known from few localities. There are several collections from Peninsular Thailand and the northern part of Peninsular Malaysia; those for which a habitat is recorded indicate granite rocks, not limestone. The other specimens known to me are from Java (including the type), the Tenimbar Islands (*Buwalda* 4262) and the Cape York Peninsula in Queensland (*Brass* 19445, *Coveney* 7146). The species is evidently adapted to a continuously warm climate with a regular dry season.

Key to the species of *Tectaria* mentioned in this paper

1. Free included veinlets lacking in costal areoles
 2. Upper surface bearing many hairs between veins *T. coadunata*
 2. Upper surface lacking hairs between veins except a few near sinuses between pinna-lobes
..... *T. variolosa*
1. Free included veinlets present in costal areoles
 3. Fronds dimorphous; free veins present in costal and other areoles in sterile fronds, forked ones frequent; not on limestone *T. brachiata*
 3. Fronds not or little dimorphous; fewer free veins in areoles, forked ones infrequent; limestone plants
 4. Scales at base of stipes thin, light brown, becoming crumpled *T. cherasica*
 4. Scales at base of stipes firm, dark, much narrowed towards their tips
 5. Fronds to 60 cm long; a free tertiary leaflet present on basal pinnae; lower surface copiously short-hairy between veins *T. curtisii*
 5. Fronds smaller, no free tertiary leaflet; lower surface between veins glabrous in fronds of mature plants *T. translucens*

PTERIDRYS ACUTISSIMA CHING

This species is described in Holttum 1955, p. 531. The type was collected by Mohamed Haniff on a journey to Gunung Korbu with B.H.F. Barnard (Forestry Dept.) in 1909. The route was by way of the Korbu River, G. Yong Blar and G. Bal; thus he passed near limestone hills. The labels on the specimens at Singapore and Kew were written by H.N. Ridley, who named them *Lastrea syrmaticea* and wrote on them the altitude 6000 ft, giving them a number (14142) in his own series. Haniff's labels are lost. No other collection of this species has since been reported. Recently, however, Dr. B.S. Parris collected an almost identical specimen in Gunung Mulu National Park, Sarawak, at an altitude of 100 m, "on slopes of bat guano in cave mouth".

No specimen of this genus has been collected at a high altitude in Malesia, and the related species *P. syrmaticea* (Willd.) C. Chr. & Ching, widely distributed, is nearly always recorded as growing on limestone.

THE GENUS *HYPODEMATIUM*

There is only one record of the existence of this genus in Peninsular Malaysia; the specimen is *M.R. Henderson 29682*, from Gua Teja, Kelantan. In Holttum 1955, p. 501, this is named *H. crenatum* (Forsk.) Kuhn, with a note that it differs from the typical form of that species which was first described from Arabia and is widely distributed in Mainland Asia. On comparison with other specimens in the herbarium at Kew, I find that the Kelantan specimen agrees closely with the type of *Dryopteris glabrior* Copel., collected by C.J. Brooks at Bidi, Sarawak in 1908. Copeland's species was not transferred to *Hypodematium* by Ching in his paper of 1935 (probably he did not know of it). The fronds are much more open in branching than those of *T. crenatum* and the leaflets are thin and quite flat when dried. Acicular hairs are rather few, and capitate hairs are also present. The new combination *Hypodematium glabrius* (Copel.) Holttum is therefore proposed (basonym: *Dryopteris glabrior* Copel., Philip. Journ. Sci. 5C (1910) 283).

In Malesia all recorded plants of the genus have been found on limestone, and though they may be locally abundant few specimens have been collected. In the herbarium at Kew are three other specimens from Sarawak, all *H. glabrius*; from Sumatra are two collections which appear to represent two different species; one specimen from New Guinea which has very abundant very long hairs; and a specimen from the Philippines which appears to be true *H. crenatum*, said by Copeland to be known from several localities. A new study of the genus in Malesia is desirable, but more field work would first be needed.

The genus is isolated taxonomically and its affinity is uncertain. Chromosome counts show the base numbers 40 and 41. Ching at first suggested an affinity with *Cystopteris*, but later thought *Lastreopsis* more likely. The frond-form resembles that of *Lastreopsis* but hairs and scales are very different. Recently Iwatsuki (1964) suggested an alliance to Athyroid ferns, perhaps nearest (but not near) *Woodsia*.

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Annotated List of Seed Plants of Singapore (IX)*

HSUAN KENG

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II. Angiospermae-Dicotyledons (cont'd)

125. RUBIACEAE

Synoptic key to the genera†

1. Ovary containing numerous (rarely few) ovules in each locule
 2. Fruit dry, capsular
 3. Flower-clusters in globular heads *Adina*, *Nauclea*, *Neonauclea*, *Uncaria*
 3. Flowers in cyme, corymbose or paniculate
 4. Shrubs or trees or woody climbers *Coptosapelta*, *Mussaendopsis*
 4. Herbs or herbaceous twiners *Argostemma*, *Dentella*, *Hedyotis*, *Ophiorrhiza*
 2. Fruit drupaceous or baccate
 5. Corolla-lobes valvate in bud
 6. Flowers in compact heads *Lecananthus*, *Lucinaea*
 6. Flowers in cymose clusters, corymbose or paniculate *Mussaenda*, *Mycetia*, *Urophyllum*
 5. Corolla-lobes twisted in bud *Diplospora*, *Gardenia*, *Hypobathrum*, *Jackia*, *Randia*
Scyphiphora
1. Ovary containing a single (rarely 2 or few) ovule in each locule
 7. Epiphyte with tuberous stems tenanted by ants *Hydnophytum*, *Myrmecodia*
 7. Not as above
 8. Corolla-lobes imbricate or twisted in bud *Ixora*, *Coffea* (introduced), *Gardeniopsis*,
Guettarda, *Pavetta*, *Tarrena*
 8. Corolla-lobes valvate in bud
 9. Flowers unisexual *Prismatomeris*, *Timonius*
 9. Flowers bisexual
 10. Flowers 1-3 together on a terminal, slender stalk; creeping herbs *Geophila*
 10. Flowers many in compact umbels or heads, terminal and axillary; trees, shrubs or woody climbers *Cephaelis*, *Coelospermum*, *Gynochthodes*, *Morinda*
 10. Not as above
 11. Flower cymes in axillary fascicles
 12. Woody plants *Canthium*, *Lasianthus*, *Saprosma*
 12. Herbaceous *Borreria*, *Diodia*
 11. Flower-cymes in corymbs or panicles *Chassalia*, *Paederia*, *Psychotria*

* Continued from *Gdns' Bull. Sing.* 36: 124, 1983.

The author is indebted to Dr. Richard T. Corlett and Mr. Hugh T.W. Tan for going through the entire manuscript and the Rubiaceae respectively, and for their many suggestions.

† Based on Ridley, *Fl. Mal. Pen.* 2 (1923) 3, modified and simplified; some cultivated genera are not included.

Adina rubescens Hemsl. (alt. name: *Pertusadina eurhyncha* (Miq.) Ridsdale)

Tall tree, the trunk full of elliptic holes so the bark appears reticulate; leaves elliptic, 6-10 cm long; flowers in small heads, 6-8 mm across, usually 3 heads together on a slender peduncle. Scattered in forests; Bukit Timah (*Keng & Jumali 3483*). Vern. *Berambong*.

Borreria alata (Aubl.) DC. (= *B. latifolia* K. Sch.)

Fleshy herb, to 60 cm tall; stems winged; leaves obovate or elliptic, 2-7 cm long, hairy on both sides; flowers in axillary clusters; corolla 3-6 mm long, white; fruit subglobose, of two 1-seeded cocci, hairy. A weed of West Indian and S. American origin.

Bor. articularis (L.f.) F.N. Will. (= *B. hispida* K. Sch.)

Diffused herb, about 30 cm high; hairy; leaves obovate or oblong, 1.5-4 cm long; flowers in axillary clusters; corolla 4.5-7 mm long, pale purple. In waste ground and sandy spots; Changi (*Md Nur 29739*).

Bor. laevicaulis (Miq.) Ridl.

Slender herb, to 45 cm long, glabrous, often tinted purple; leaves sessile; oblong-lanceolate, 1.5-3 cm long; flowers in dense axillary clusters; corolla 2-3 mm long, white. In roadsides and sandy waste places; Pulau Ubin (*Furtado 18343*).

Bor. setidens (Miq.) Bold.

Diffused herb, sometimes creeping, 5-20 cm tall; branches winged; leaves lanceolate or ovate, 0.8-1.5 cm long; flowers in small axillary clusters; corolla very short, 2-3 mm long, white. In waste ground, Pasir Panjang (*Ridley 8109*).

Canthium confertum Korth.

Small tree, to 10 m tall, glabrous; leaves leathery, elliptic, 5-15 cm long, nerves 3-4 pairs; flowers in small clusters, 1.5-2 cm across; corolla 2-3 mm long, short-tubed, 5-lobed. Along tidal rivers near the sea, P. Tekong (*Ridley 4893*).

Canth. dicoccum (Gaertn.) T. & B. (= *C. didymum* Gaertn.)

Small tree, 7-8 m tall; leaves thin-leathery, ovate-lanceolate or elliptic, 6-10 cm long, nerves 4-5 pairs; flowers in clusters, 3-5 cm across. In forests or in mangroves, Pulau Serimbun (*Sinclair 39530*), Chua Chu Kang.

Canth. glabrum Bl.

Small tree to 13 m tall, glabrous; leaves ovate, 12-18 cm long; flowers in small cymose clusters; corolla 3-4 mm long, 5-lobed; berry ellipsoid, 2-3 cm long, greenish, with 2 flattened stones inside. In forests; Bukit Mandai (*Ridley 4434*), Tuas.

Canth. horridum Bl.

Spiny shrub, pubescent; spines straight or curved, 3-5 cm long; leaves ovate or elliptic, 2-3 cm long; nerves 3-4 pairs; flowers in cymose clusters; corolla 2-3 mm long, pale green. In forest edges or open places; Gardens' Jungle; Bukit Timah (*Ridley s.n.* in 1893).

Canth. molle K. & G.

Spiny climber, velvety; spines decurved, 1.5-2 cm long; leaves lanceolate to ovate, 5-7 cm long, brown-hairy; nerves 4-5 pairs; cymes small, axillary. In forests, Gardens' Jungle, MacRitchie Reservoir (*Sinclair SF 39147*).

Cephaelis singaporensis Ridley

Low shrub; leaves oblong, 2-6 cm long, narrowed at base; nerves 14-16 pairs; cymose heads 2-2.5 cm across; corolla trumpet-shaped, 2-3 cm long, yellow; drupe light blue, flattened. In forests; Bajau (*Ridley 4966*).

Chassalia curviflora (Wall.) Thw. (= *C. chartacea* Wall.)

Small shrub, 1-1.5 m tall, glabrous; leaves membranous, variable elliptic to oblanceolate, 6-20 cm long, nerves 5-6 pairs; cymes terminal, 3-5 cm long, peduncles and its branches purple or white tinted purple; flowers subsessile; corolla 1.5-2 cm long, 5-lobed. Berry ellipsoid or globose, 5-6 mm across, 2-seeded, seated on the swollen white branches of the inflorescence. In forests; Bukit Mandai (*Ridley s.n.* in 1889). (The generic name often spelled as *Chasalia*; some authors have reduced it to *Psychotria*).

Chas. pubescens Ridl.

Small shrub, much branched, hairy; leaves lanceolate, 12-15 cm long; pubescent beneath; nerves 7-8 pairs; compound cymose dense, 2-3 cm long, hairy; flowers in small clusters, rosy white; corolla 6-8 mm long. In forests; once collected at Bukit Timah (*Ridley s.n.* in 1884).

Coelospermum scandens Bl.

Slender climber; leaves elliptic or obovate, 6-12 cm long; nerves 4-7 pairs; flower-cymes umbellate, fragrant, arranged in a small terminal panicle, 3-4 cm long; corolla 2-3 mm long, 5-lobed, white. Berry depressed globose, 1-1.5 cm across, 2-4 seeded. Climbing on trees in forests; Changi (*Ridley 5926*), Bukit Timah. (The generic name sometimes spelled as *Caelospermum*).

Coffea liberica Bull. ex. Hiern.

Stout herb or small tree; leaves obovate, thick-leathery, 16-35 cm long, nerves 6-12 pairs; cymes axillary, subsessile; corolla white, 2.5-3 cm long, 6-8 lobed; berry subglobose, 1.5-2.5 cm long, red, with 2 flattened stones inside. Native to W. Africa, formerly planted.

Cof. robusta Linden ex De Wild.

Stout shrub; leaves broadly oblong, 15-30 cm long; nerves 10-12 pairs; cymes 3-5 flowered, axillary; corolla 1.5-2 cm long, 5-7 lobed; berry ovoid-globose, 1-1.5 cm long, red. Native to tropical Africa, formerly planted. Some authors have reduced this species to a variety of *Cof. canephora* Pierre ex Froehner.

Coptosapelta griffithii Hook.f.

Climbing shrub; leaves ovate-orbiculate, 4-6 cm long; nerves 3-4 pairs, hairy beneath; panicles terminal and axillary; corolla salver-shaped, 1.5-2 cm long, white, throat woolly, 5-lobed; capsule obovoid, pubescent, 0.8-1 cm long, seeds numerous. In forests; Gardens' Jungle, Chua Chu Kang (*Che Mat 6891*).

Copt. parviflora Ridl.

Lofty climber; leaves elliptic, narrowed on both ends, 6-8 cm long; nerves 4-5 pairs; panicle terminal, spreading, 6-8 cm long; corolla 6-8 mm long, green; capsule obovoid, glabrous, 2-4 mm long. Climbing to tops of trees in forests; Bukit Timah (no specimens available).

Copt. tomentosa (Bl.) Val. ex K. Heyne (= *C. flavescens* Korth.)

Lofty climber; leaves ovate or elliptic, 5-10 cm long, nerves 4-5 pairs, soft hairy beneath; corolla 2-2.5 cm long, white, fragrant; capsule obovoid, 4-6 mm long, glabrous. In forests, climbing on trees; Bukit Timah (*Ridley 14117*).

Dentella repens (L.) J.R. & G. Forst.

Creeping branched herb; leaves oblong to elliptic, 4-10 mm long; flowers solitary, in one axil of the paired leaves, 5-merous; corolla 0.5-1.5 cm long, yellowish; fruit ovoid, 2-3 mm long, dry, indehiscent; seeds numerous. In waste ground and damp places; Tanglin, Kallang, Sembawang (*Keng et al 4070*).

Diplospora malaccensis Hook.f.

Small tree, to 10 m tall, glabrous; leaves elliptic, 5-15 cm long; flowers 4-5 in small axillary clusters; corolla tubular, 2-3 mm long, 4-lobed, greenish white; berry globose, orange, few-seeded. In forests; Water Catchment Area, Bukit Timah (*Maxwell 8146*).

Diodia ocymifolia (Willd. ex R. & S.) Bremek.

Rough herb, to 1 m tall; leaves oblong-lanceolate, 3-7 cm long; nerves 5-8 pairs, hairy on nerves and near margin; flowers 6-many, in axillary clusters; corolla 2-4 mm long, 4-lobed; fruit of two 1-seeded cocci. A native of S. America; in damp places, forest edges and grassland.

Diodia sarmentosa Swartz

Herb; leaves oblong-ovate, 3-6 cm long, nerves 3-5 pairs, scabrous above, nerves hairy beneath; flowers 1-8, in axillary clusters. In forest edges and grassland. Native to S. America.

Gaertnera grisea Hook.f. ex Clarke

Shrub, to 1.2 m tall; leaves thin leathery, oblong or oblanceolate, apex acuminate, 20-35 cm long, densely hairy beneath, nerves 7-8 pairs; petiole 6-8 mm long, thick; stipule-sheath tubular, 2-2.5 cm long; cymes terminal and axillary, 6-8 cm long, hairy; corolla white, cylindrical, 6-8 mm long; lobes valvate. In forests; Bukit Timah, Bukit Panjang, Ponggol (*Burkill 7613*), Changi. This genus differs from almost all the rubiaceae genera in having a superior ovary, therefore it was classified under Loganiaceae in Ridley's Flora.

Gaert. obesa Hook.f. ex Clarke

Stout, fleshy shrub, 1.2 m tall; leaves fleshy leathery, oblong or lanceolate, apex short-acuminate, 25-35 cm long; nerves 9-12 pairs; stipule-sheath 3-4 cm long; cymes dense, umbellate, 4-5 cm across; corolla white, 6-8 mm long, sessile or subsessile, densely hairy in the mouth. In forests; Gardens' Jungle, Tuas, Chua Chu Kang (*Ridley 2680*).

Gaert. vaginans (DC.) Merr. (= *G. acuminata* Benth.)

Shrub; leaves membranous, elliptic, apex acute, 7-9 cm long; stipule-sheath 1-1.5 cm long; panicles terminal, 8-12 cm long; corolla 5-6 mm long, white, lobes acute, as long as the tube, mouth hairy. (In forests, collected in Singapore only once (*Wallich 8342*, not seen).

Gaert. viminea Hook.f. ex Clarke

Slender shrub, 1 m tall; leaves membranous, narrowly lanceolate, apex caudate, 6-9 cm long, nerves 6-7 pairs; cymes 4-6 cm long, 3-chotomously branched; corolla short-cylindric, 5-6 mm long, white, lobes 4, broadly ovate, as long as the tube. In forests; Gardens' Jungle, Bukit Mandai, Changi.

Gardenia carinata Wall. ex Roxb.

Small tree to 7 m tall; leaves thin-leathery, obovate or oblanceolate, 10-40 cm long; flowers solitary, in upper axils; calyx tube 1.5 cm long, 5-6 ribbed; corolla golden yellow, the tube 2.5 cm long, the limb 6-7 cm across, 6-9 lobed; fruit ellipsoid, 3-4 cm long, ribbed, crowned with the calyx lobes. Introduced from N. Malaya, planted as a roadside tree.

Gard. griffithii Hook.f.

Shrub or small tree, to 7 m tall; leaves obovate, thick-leathery, narrowed at base, 12-20 cm long; nerves 12-13 pairs; flowers solitary, terminal; calyx tubular, 6-8 cm long, the mouth expanded; corolla cylindric, 8-10 cm long, orange; fruit globose, woody, 4-5 cm across, crowned by the calyx-lobes. In edge of forests; Bukit Timah, Bukit Mandai (*Ridley 6673*).

Gard. jasminoides Ellis (= *G. angusta* Merr.; *G. florida* L.)

Shrub, 1-2 m tall; leaves obovate, thick and shining, 8-10 cm long; flowers solitary, axillary; calyx tubular, angled or winged; corolla waxy white, turning yellowish, 3-5 cm long, 5-10-lobed, fragrant. Native of S. China, in several horticultural forms, some double-flowered, sometimes planted in gardens. Vern. *Bunga Susu*, *Bunga China*, 梔子花

Gard. tubifera Wall.

Shrub, to 2 m tall; leaves oblanceolate, much narrowed at the base, 8-24 cm long, nerves 15-18 pairs; flowers terminal; calyx tubular, 1.5-2 cm long; corolla 12-14 cm long, creamy white turning orange-yellow, fragrant; fruit globose, 3-5 cm across. Along river banks in mud; Chua Chu Kang (*Ridley s.n.* in 1895).

Gardeniopsis longifolia Miq.

Shrub, with few stout branches, 2-3 m tall; leaves oblanceolate, 20-30 cm long; flowers sessile, in axillary clusters; corolla cylindric, 2-2.5 cm long, 5-lobed, rosy white; fruit ovoid or ellipsoid, with 10 ridges, 2-2.5 cm long, crowned with the enlarged, incurved calyx-lobes. In dense forests, Bukit Timah (no specimens available).

Geophila pilosa Pears

Small creeping herb, hairy; leaves ovate-cordate, 1-2.5 cm long; flowers terminal, solitary or 3 together on a slender stalk; corolla small, white, funnel-shaped, 4-6 lobed; drupe globose, black, with 2 stones inside. Rare in forests; Bukit Timah, (*Ridley 9516*), Reservoir woods.

Guettarda speciosa L.

Small tree, 5-10 m tall; leaves obovate, 10-25 cm long, the base heart-shaped; cymes axillary, 4-11 cm long; corolla trumpet-shaped, 6-11 cm long, limb 6-8-lobed, white, fragrant; fruit depressed globose, 2-2.5 cm across, greenish, faintly and closely ribbed, with a circular calyx-scar on the top. On sandy and rocky shores; Pulau Seletar (*Samsuri SA 1214*).

Gynochthodes coriacea Bl.

Woody climber, glabrous; leaves leathery, ovate-lanceolate, 6-10 cm long, tip blunt; nerves 4-6 pairs; flowers small, few in an axillary cluster; corolla 2-4 mm long, woolly inside; drupe globose, 1 cm across, white, with 2-4 stones inside. In forests, climbing on trees; Changi, Gardens' Jungle, Mandai (*Samsuri 1388*).

Gynoch. sublanceolata Miq.

Slender woody climber; leaves thin-leathery, elliptic-lanceolate, 5-8 cm long, tip acuminate, nerves 5-6 pairs; flowers sessile, few on very short axillary branches; corolla white; drupe globose, 4-5 mm across. In open country, often near the sea; Changi, Pulau Tekong (*Goodenough 2836*).

Hedyotis auricularia L.

Perennial, to 50 cm high; stems 4-angled, covered with white hairs; leaves lanceolate-oblong, 4-8 cm long; flowers in axillary, sessile, dense cymes; corolla salver-shaped, 2-3 mm long, white; capsule globose, hairy, indehiscent, few-seeded. In open places and road sides; Tuas, Chua Chu Kang (*Ridley 4125*).

Hedy. biflora (L.) Lamk. (= *Oldenlandia paniculata* L., *O. biflora* L.)

Ascending herb, to 20 cm high; leaves oblong or ovate, slightly fleshy, 5-10 mm long; flowers 3-10 in peduncled and often branched (terminal and axillary) cymes; corolla 2-2.5 mm long, white or purplish; capsule ribbed. In waste places; Tanglin (*Kassim 518*).

Hedy. capitellata Wall. ex G. Don

Climbing shrub, glabrous; leaves from branches lanceolate to oblong, 3.5-11 cm long; terminal panicles consisting of umbellate heads (1-1.5 across); corolla creamy coloured, 4-merous, fragrant, hairy inside. Climbing over bushes and hedges; Tanglin (*Ridley 15429*).

Hedy. congesta Wall. ex G. Don

Shrubby herb, to 2 m high; leaves leathery, lanceolate or elliptic, 10-15 cm long; flowers in axillary dense cymes, sessile; corolla campanulate, 3-4 mm long; fruit fleshy, oblong, white. In forests; Gardens' Jungle, Bukit Timah (*Burkill HMB 1894*).

Hedy. corymbosa (L.) Lamk. (= *Oldenlandia corymbosa* L.)

Erect or ascending herb, to 30 cm high; leaves oblong, acute, 1-3 cm long; flowers axillary, solitary or 2-8 in peduncled cymes; corolla white or pale purple, 2 mm long. In sunny places or rocky areas. Singapore (*Furtado s.n.* in 1924).

Hedy. dichotoma Koen. ex Roth (= *Oldenlandia dichotoma* Hook.f.)

Slender, diffused herb, 30-40 cm tall; leaves lanceolate or oblong, 1.5-3 cm long; cymes axillary, and terminal, in several dichotomous branches; corolla bell-shaped, 1.5-2 mm long, the lobes spreading. In dry sandy places near the sea; Geylang (*Ridley 11512*).

Hedy. diffusa Willd. (= *Oldenlandia diffusa* (Willd.) Roxb.)

Prostrate herb, to 40 cm high; leaves sessile, linear lanceolate, 1-2 cm long; flowers solitary or in pairs, axillary sessile or nearly so; corolla white or purple; capsule depressed globose, 2-3 mm long, usually nodding. In open sandy places; Chua Chu Kang (*Hullett 333*), Water Catchment Areas. 白花蛇舌草

Hedy. herbacea L.

Annual, to 20 cm high; leaves sessile, linear or narrowly elliptic, 1-2.5 cm long; flowers axillary, solitary or 2-4 in peduncled cymes; corolla white, 2 mm long. In open places, Singapore (*Ridley s.n.* in 1892).

Hedy. pinifolia Wall. ex G. Don.

Prostrate annual, to 30 cm high; leaves thick, sessile, linear to lanceolate, 1-1.5 cm long; flowers solitary, or 2-4 in peduncled cymes, axillary; corolla 3 mm long, white or purple; capsule with long bristles. In sandy places by the sea; Jurong (*Ridley 8924*).

Hedy. trinervia (Retz.) R. & S. (= *Old. trinervia* Retz.)

Prostrate annual, to 20 cm long; leaves thin, obovate, 0.2-0.5 cm long; flowers solitary, sessile or nearly so, axillary; corolla 1.5 mm long, white. In open spaces with sandy soil; Geylang, Pulau Sudong (*Maxwell 82295*).

Hydnophytum formicarium Jack

Epiphytic small shrub; fleshy tuber irregularly lobed, 16-20 cm across, glabrous, tunnelled and perforated forming an ant's nest; leaves leathery, elliptic, 4-10 cm long, subsessile, nerves 7-11 pairs; flowers 3-5, in axillary sessile cymes; corolla salver-shaped, 3-4 mm long, white; drupe narrowly ellipsoid, 4-5 mm long, with 2 stones inside. In secondary forests, often near the sea; Jurong, Changi (*Ridley 303*).

Hypobathrum coniferum (Ridl.) Bakh. f. (= *Petunga conifera* Ridl.)

Slender tree, 10 m tall; branches 4-angled, glabrous; leaves leathery, 15-22 cm long, nerves 7-9 pairs; flowers small, in pairs on cone-like dense axillary spikes, 4-angled, 1-1.5 cm long; corolla funnel-shaped, 2-3 mm long, 4-lobed, white. Only one tree formerly found in the Gardens' Jungle (*Ridley 10722*, type).

Ixora chinensis Lamk.

Shrub, branched, to 2 m tall; leaves short-stalked, obovate-oblong, leathery, 6-10 cm long; flowers in dense cymose corymbs, 5-10 cm across; corolla 3-3.5 cm long, 4-lobed, the lobes rounded, yellow turning red. Native to S. China and Thailand, cultivated. 仙丹花

Ixora coccinea L.

Branched shrub; leaves sessile, ovate to obovate, 3.5-10 cm long, the base heart-shaped, clasping the stem; corolla 3-4.5 cm long, red or sometimes yellow or pink, often fragrant; the lobes pointed. Native of India, cultivated.

Ixora congesta Roxb.

Shrub or small tree, to 7 m tall; leaves elliptic-oblong, 12-30 cm long; corymbiform inflorescence 15-20 cm across; corolla yellow turning orange or pink. In forests, Bukit Timah, Chua Chu Kang.

Ixora finlaysonianana Wall. ex G. Don

Shrub or small tree; leaves oblong or oblanceolate, leathery, 10-18 cm long; flowers white, fragrant. Native to India and Andaman Islands, sometimes cultivated.

***Ixora grandifolia* Z. & M.**

Bushy tree, to 2 m tall; leaves variable, lanceolate or obovate, 12-20 cm long, narrowed at base; corymbiform inflorescence 10-20 cm across; corolla 1-1.5 cm long, white tinged with pink; fruit ellipsoid, red, 6-8 mm long. In forests, formerly collected from Chua Chu Kang (*Ridley 4120*).

***Ixora javanica* (Bl.) DC.**

Shrub, variable; leaves elliptic oblong, 10-25 cm long, shortly stalked; corolla 2.5-3.5 cm long, yellow turning red; the lobes bluntly pointed. Native to Java, cultivated.

***Ixora lobbii* K. & G.**

Shrub, 2-3 m tall; leaves lanceolate or oblong, 10-25 cm long, many (15-25)-nerved; corymbiform inflorescence 12-15 cm across; corolla 3-4 cm long, yellow-orange turning red, the lobes acute. In forests; Sungei Morai, Gardens' Jungle, Changi (*Hullett s.n.* in 1893).

***Ixora pendula* Jack**

Shrub, to 8 m tall, glabrous; leaves variable, oblong or elliptic, 10-25 cm long; corymbiform inflorescence 10-20 cm across; corolla 2-3.5 cm long, rose-red. In forests; Changi (*Ridley 2868*), Gardens' Jungle.

***Jackia ornata* Wall.**

Slender tree, to 10 m tall; leaves leathery, oblanceolate, 15-40 cm long, pubescent, nerves 10-12 pairs; withering red; stipule-sheath with many long bristles or teeth round the edge; flowers small in axillary hanging panicles, 15-35 cm long; corolla funnel-shaped, less than 1 cm long, yellowish white; fruit obconic, nut-like, 1.5 cm long, crowned by 3 enlarged calyx-lobes. In swampy forests, Kranji, Dalvey Road (*Ridley 4114*).

***Lasianthus appressus* Hook.f.**

Small shrub, densely covered with soft yellow hairs; leaves leathery, lanceolate or oblong, 5-8 cm long; nerves 6 to 7 pairs; stipules prominent; flowers axillary, few together, sessile, surrounded by linear hairy bracts; corolla trumpet-shaped, 4-5 lobed, 5-6 mm long; drupe globose, 2-3 mm across, blue, hairy, with 2-6 stones inside. In forests; Chua Chu Kang (*Ridley 4122*).

***Las. attenuatus* Jack (Syn. *L. densifolius* Miq.)**

Shrub, covered with yellow hairs; leaves membranous, lanceolate-oblong, 5-8 cm long nerves, nerves 7-8 pairs; flowers 1-3 in axillary cymes. In forests; Bukit Timah, Chua Chu Kang (*Ridley 16704*).

***Las. chryseus* Ridl.**

Small shrub, 1 m tall, covered with appressed yellow hairs; leaves thin leathery, lanceolate, 10-12 cm long, nerves 8-9 pairs; cymes 5-6 flowered, sessile. In forests: Gardens' Jungle, Chua Chu Kang, Bukit Timah (*Ridley 8126*).

***Las. constricta* Wight**

Shrub; leaves thin-leathery, elliptic-oblong, 8-11 cm long, nerves 3-5 pairs; axillary cymes 4-6 flowered, sessile. In forests; Changi (*Ridley s.n.* 1892), Kranji, Sungei Buloh.

Las. cyanocarpus Jack

Shrub, hairy; leaves, leathery, oblanceolate to oblong, 10-16 cm long, the base narrowed, unequal, nerves 7-10 pairs; axillary cymes 3-4-flowered, sessile. In dry sandy places near the sea; Changi, Pulau Ubin (Ridley 9499).

Las. ellipticus Wight

Shrub, hairy; leaves thin-leathery, ovate or elliptic, 10-16 cm long, nerves 6-8 pairs; cymes few-flowered. In forests, Chua Chu Kang (Ridley 6146), Pasir Panjang.

Las. griffithii Wight

Small shrub, sparsely pubescent; leaves leathery, oblanceolate or elliptic, 20-30 cm long, nerves 13-15 pairs; flower-clusters 2-2.5 cm across; corolla white. In forests; Chua Chu Kang (Ridley 4121).

Las. maingayi Hook.f.

Small shrub, young parts covered with yellow hairs; leaves membranous, narrowly elliptic, 12-17 cm long, nerves 4-5 pairs; cymes few-flowered. In forests; Bukit Timah (Ridley 12550), Gardens' Jungle.

Las. ridleyi K. & G.

Shrub, soft-pubescent; leaves thin-leathery, oblong or elliptic, 12-20 cm long; flower-clusters 1-1.5 cm across. In forests, Gardens' Jungle (Ridley 4894), Bukit Timah.

Las. scabridus K. & G.

Shrub, densely hairy; leaves leathery, elliptic-oblong, 10-20 cm long, nerves 10-12 pairs; flower-clusters dense globose, 2-1.5 cm across. In forests; Jurong (Burkill 713).

Las. singaporensis K. & G.

Shrub, soft-hairy; leaves thin-leathery, elliptic, narrowed to both ends, 12-15 cm long; cymes 4-6 flowered. In forests; Bukit Timah (Ridley s.n. in 1891), Seletar.

Las. stipularis Bl.

Slender shrub, glabrous; leaves thin-membranous, lanceolate or oblong, base narrowed, decurrent to the petiole, 12-16 cm long; stipules broad-deltoid, completely covering the flowering heads. In forests; Bukit Timah, Bukit Panjang (Ridley 12547).

Las. tomentosus Bl.

Shrub, densely hairy; leaves leathery, oblong-lanceolate, 5-8 cm long, nerves 7-10 pairs; flowers in dense axillary cymes, sessile. In forests; Woodlands, Kranji (Ridley s.n. in 1891).

Lecananthus erubescens Jack

Woody climber; branches 4-angled, glabrous; leaves fleshy membranous, narrowly oblong or elliptic, 7-20 cm long; flowers in axillary involucre, round or oblong, clusters, 2-2.5 cm across; corolla funnel-shaped, white, tinted purple, 5-lobed. In wet forests, creeping on trees; Jurong, Kranji, Chua Chu Kang (Ridley 3814).

Lucinaea membranacea King

Epiphytic climber, pubescent; leaves membranous, oblong or elliptic, 8-12 cm long, nerves 8-9 pairs, midrib red beneath; flowers sessile, 8-10 in terminal and axillary heads, 1.5-2 cm across; heads 1-3 together, peduncled; corolla funnel-shaped, 2-3 mm long, 5-6 lobed; berry subglobose, fused at base forming a small head 6-8 cm across, red. In forests; Bukit Mandai (*Ridley s.n.* in 1891), Chua Chu Kang.

Luc. morinda DC.

Scandent shrub sometimes epiphytic, glabrous; leaves leathery, elliptic-lanceolate to ovate, 3-6 cm long, nerves 8-11 pairs; flower-heads 2 cm across, peduncled, 1-6 heads together terminal; corolla 5-6 mm long, white, fragrant; fruiting heads 1.5-2 cm across. In open sandy spots near the sea; formerly collected by W. Jack at Thomson Road, no specimens available.

Morinda citrifolia L.

Shrub or small tree, 3-4 m tall; leaves membranous, elliptic, 15-20 cm long; flowers sessile, in globose heads, 1.5-2 cm across, terminal and axillary; corolla cylindrical 1.5 cm long, white; fruit-cluster oblong-ovoid, 5-7 cm long, whitish, formed by the fusion of small fruits with their succulent calyces and the axis. Leaves are edible and fruits are used in local medicine; according to Ridley, it was probably introduced from Moluccas. Vern. *Mengkudu*.

Mor. ridleyi (K. & G.) Ridl.

Large climber; leaves obovate or oblong, base round, 6-8 cm long, densely red-hairy beneath, nerves 4 pairs; small heads 5-6 mm across, umbellate; berry black. In forests; Gardens' Jungle (Ridley 6470).

Mor. rigida Miq.

Stout climber, soft-hairy; leaves thick-leathery, elliptic, 6-10 cm long, nerves 18-20 pairs; fruiting heads 2-2.5 cm long, green. Usually near the sea; Changi, Kranji (*Ridley 4126*).

Mor. umbellata L.

Climbing shrub; leaves thin-leathery, lanceolate or elliptic, 7-12 cm long, glabrous, nerves 5-7 pairs; flower-heads subglobose, 5-6 mm across, umbellate; fruiting heads orange. In open sandy places; Kranji (*Ridley s.n.* in 1892), Changi, Pulau Ubin.

Mussaenda erythrophylla Schum. & Thonn.

Shrub, drooping or climbing, 2-4 m high; the calyx-lobes directed to the outside of inflorescence, enlarged, petaloid, obliquely ovate, 5-10 cm long, bright red above, pale red beneath. Native to tropical Africa, cultivated in gardens.

Mus. glabra Vahl

Climbing shrub, glabrous; leaves leathery, variable, lanceolate or elliptic, 6-9 cm long, nerves 5-6 pairs; cymes dense, terminal; calyx bell-shaped, the enlarged, petaloid lobe broadly ovate, 8-10 cm long and wide, white; corolla trumpet-shaped, dark red or orange-red. In secondary forests; Chua Chu Kang (*Hullett 846*). 玉葉金花

Mus. flava (Verdcourt) Bakh. f. (= *M. luteola* Delile)

The enlarged, petaloid lobe lemon yellow, 2.5-3.5 cm long. Native to tropical Africa.

Mus. mutabilis Hook.f.

Glabrous shrub; leaves membranous, elliptic to ovate, 12-18 cm long, nerves 8-9 pairs; compound cymes terminal; calyx cylindrical, the 5 lobes all narrow lanceolate, similar, not enlarged; corolla tubular, 5-lobed, orange or bright red, fading orange-yellow. In forests; Seletar (*Goodenough 1643*).

Mus. philippica L. C. Rich.

Shrub or rarely small tree, to 5 m tall; branches drooping; flowers prolifically most of the year. Several hybrid forms: only one of the calyx-lobes enlarged, pale pinkish ("Alicia"), or all five of the calyx-lobes enlarged, creamy white ("Dona Aurora") or pink ("Dona Luz"). Introduced from the Philippines, widely planted.

Mussaendopsis beccariana Baill.

Large tree, glabrous; leaves leathery, nearly orbicular, 8-15 cm long, nerves 5-6 pairs; cymes in panicles, 15-20 cm across; calyx bell-shaped, usually with 5 small lobes and 1 large, the large lobes obovate, white, 2-3 cm long; capsule oblong, 1-1.5 cm long. In forests, Jurong, Sembawang, Chua Chu Kang (*Goodenough 1850*).

Mycetia malayana (Wall.) Craib (= *Adenosacme malayana* Wall.)

Shrublets, 50-70 cm high; bark white, shiny; leaves membranous, elliptic-lanceolate, 15-25 cm long, densely hairy; flowers in terminal cymose panicles, 5-15 cm across; corolla yellow, very short (2-3 mm long), 5-lobed; berry subglobose, 2-3 mm across, white, pulpy. In dense forests; Bukit Timah (*Holtum 19794*).

Myrmecodia armata DC. (= *M. tuberosa* Bl.)

Epiphytic shrub, tuber 10-20 cm across, strongly spiny, tunnelled and perforated forming an ant's nest; leaves leathery, elliptic, base narrow, 7-12 cm long, nerves 7-10 pairs; flowers solitary or few together at base of cup-shaped cavities in stem; sessile; corolla cylindrical, 3-4 mm long, 4-lobed; drupe oblong, orange, 2 cm long, 4-8 seeded. On trees near the sea, not common; Jurong (*Ridley 3854*), Bukit Timah.

Nauclea officinalis (Pitard) Merr. & Chun (= *Sarcocephalus junghuhnii* Miq.)

Bushy tree, to 10 m tall; leaves leathery, elliptic to obovate, shortly acuminate, 10-15 cm long, nerves 5-7 pairs; flowers sessile, joined by the fused calyx-tubes into axillary globular heads, 1-1.5 cm across; peduncles stout, 3-7 cm long; corolla funnel-shaped, 2-3 mm long, creamy yellow, fruiting heads globose, 1.5-2 cm across. In forests; Upper Thomson Road (*Sinclair SF 40379*).

Nauc. subdita (Korth.) Steud.

Small trees, 4-10 m tall; branches glabrous; leaves thin-leathery, elliptic to broadly oblong, 8-14 cm long, nerves 5-7 pairs; flowers in peduncled heads, 1.5-2 cm across; corolla 5-6 mm long, pale yellow. In forests; Bukit Timah (No specimens available).

Ophiorrhiza singaporensis Ridl.

Herb, 10-30 cm long; stems succulent, hairy; leaves lanceolate-oblong, 10-15 cm long; flowers on the upper side of the branched terminal inflorescence; corolla cylindrical, white, 4-5 mm long, 5-lobed; capsule strongly flattened, broadly heart-shaped, 4-5 mm long, hairy. In forests; Bukit Timah, Chua Chu Kang (*Ridley s.n.* in 1890).

Paederia scandens (Lour.) Merr. (= *P. foetida* L.)

Twining slender shrub, foetid; leaves opposite, lanceolate or ovate, 5-8 cm long, nerves 4-5 pairs; flowers in terminal or axillary cymose panicles, 10-15 cm long; corolla funnel-shaped, pubescent, 1-1.5 cm long, violet; fruit orbicular, thin-walled, 4-6 mm wide, orange. In open places.

Paed. verticillata Bl.

Like the above species, but stems stouter and the leaves thicker and larger (6-10 cm long), opposite or in whorls of three; fruit white, flattened. In forest edges; Chua Chu Kang (*Ridley 3647*).

Pavetta indica L.

Shrub or small tree, Ixora-like; leaves oblanceolate or elliptic, 7-15 cm long, velvety; flowers in corymbose cymes, 5-10 cm across; corolla 1.5-2 cm long, 4-lobed, white, style projecting 1.5-2.5 cm beyond the corolla-tube. In forests; Chua Chu Kang, Kranji (*Cantley 2699*). A highly variable species, this plant sometimes considered to be a variety of *P. indica*, namely *P. indica* L. var *canescens* (Wall.) Ridl.

Pentas lanceolata (Forsk.) Defflers. (= *P. carnea* Beth.)

Herb or subshrub, hairy; leaves opposite, ovate, pointed, 3-8 cm long; cymes congested in terminal corymbose or head-like, 6-8 cm across; corolla tubular, 2 cm long, 5-lobed, purple, pink or white. Native to tropical Africa, sometimes cultivated in pots.

Prismatomeris tetrandra K. Schum. (= *P. malayana* Ridl.)

Shrub, 2-3 m tall, glabrous; leaves thin-leathery, variable, lanceolate to elliptic, 6-12 cm long, nerves 5-7 pairs; flowers with slender pedicels (1-1.5 cm long), in terminal sessile fascicle; corolla slender, white, fragrant, 1.5 cm long, 5-lobed; drupe globose, 1- or 2-seeded. In open places: Changi (*Ridley s.n.* in 1891), Chua Chu Kang.

Psychotria angulata Korth.

Erect shrub, glabrous; leaves leathery, oblanceolate, 9-15 cm long, nerves 8-10 pairs; cymes paniculate, terminal, 2-3 cm across; corolla 2-3 mm long, tubular, 5-lobed, the lobes silky inside; drupe red or black, ellipsoid, 4-5 mm long, 2-seeded, the seed grooved. In forests; Changi (No specimens available).

Psych. cantleyi Ridl.

Slender climber; leaves lanceolate or ovate, 5-8 cm long, nerves 5-6 pairs; flowers in compact cymes. In forests; Chua Chu Kang (*Ridley s.n.* in 1892).

Psych. griffithii Hook.f.

Low shrub, glabrous; leaves leathery, oblong, 14-24 cm long, nerves 11-15 pairs; cymes paniculate, 3-4 cm across; corolla fleshy. In forests; Bukit Timah (*Md. Shah & Ali 4144*), Bukit Mandai.

Psych. helferiana Hook.f.

Tiny shrub, densely hairy; leaves membranous, lanceolate or elliptic, 15-22 cm long; cymose heads globose; corolla white. In forests; Gardens' Jungle, Chua Chu Kang, Bukit Timah (*Md. Shah 749*).

Psych. maingayi Hook.f.

Slender climber, pubescent; leaves thick membranous, elliptic, narrowed at base, 5-9 cm long, nerves 5-6 pairs; cymes terminal and axillary; corolla yellowish green or white, 3-4 mm long. In woods near the sea; Kranji (*Ridley 6924*), Pasir Panjang.

Psych. malayana Jack

Shrub, to 2 m tall; leaves leathery, elliptic or elliptic-lanceolate, narrowed at base, 12-24 cm long, nerves 12-18 pairs; cymes corymbiform, 6-8 cm across. In edge of forests; Bukit Timah, Bukit Panjang (No specimens available).

Psych. obovata Wall.

Climbing shrub, glabrous; leaves ovate to obovate, leathery, 5-8 cm long, nerves 5-6 pairs; corymbiform inflorescence large, many-flowered; corolla greenish white, 2-3 mm long, the tube very short, 5-lobed. In forest edges; Gardens' Jungle, Kranji (*Ridley 2874*).

Psych. ovoidea Wall.

Slender climber, hairy; leaves leathery, ovate or cordate, 4-6 cm long, nerves 5-7 pairs; cymes dense, 2 cm across; corolla white, 4-lobed. In forests, Seletar, Gardens' Jungle, Bajau (*Ridley s.n.* in 1894).

Psych. penangensis Hook.f.

Woody climber, glabrous; leaves fleshy, leathery, obovate-elliptic, 7-11 cm long, nerves 5-9 pairs; cymes 4-5 in corymbiform inflorescence, 8-10 cm across; corolla white. In forests; Gardens' Jungle (*Ridley s.n.* in 1900); Water Catchment Areas.

Psych. ridleyi K. & G.

Low climber, 2 m tall, glabrous; leaves membranous, lanceolate to oblong-elliptic 10-14 cm long, nerves 8-10 pairs; branched cymes 4-5 cm across; corolla white. In forests; Gardens' Jungle, Bukit Timah (*Ridley 10818*).

Psych. rostrata Bl.

Erect shrub; leaves thin membranous, elliptic-oblong, narrowed at base, 7-14 cm long, nerves 5-6 pairs; cymes in small panicles; corolla white. In forests; Seletar, Pulau Ubin (No specimens available).

Psych. sarmentosa Bl.

Climber, often creeping with aerial roots on tree trunks; leaves thin leathery, elliptic, 6-10 cm long, nerves 7-10 pairs; cymose corymbs 4-5 cm across; corolla greenish. In forests; Kranji, Serangoon, Changi (*Ridley 2875*).

Psych. stipulacea Wall. ex Roxb.

Stout low shrub, glabrous; leaves membranous, oblanceolate or elliptic, 12-22 cm long, nerves 10-12 pairs; cymes densely flowered, 1-1.5 cm across; corolla greenish white. In forests; Bukit Timah (No specimens available).

Randia anisophyllea (Jack ex Roxb.) Hook.f. (Alt. name: *Porterandia anisophylla* Ridl.)

Small tree, to 10 m tall, often much branched, hairy; leaves obovate or elliptic, the base subequal, 10-30 cm long, nerves 10-14 pairs; cymes terminal, in dense clusters, 3-6 cm across; corolla tubular, 1.5-1.8 cm long, 5-lobed, white; berry

ovoid, 3-4 cm across, green, many-seeded, crowned by the 5-lobed calyx. In forests; common in Bukit Timah (*Burkill HMB 318*). (*Randia* as noted by Backer and Bakhuizen f. is an "extremely heterogenous" genus. The Malayan species were formerly dispersed in seven sections. Recently it was revised by Mr K. M. Wong (in *Mal. Nat. J.* Vol. 38). The names which appear in Mr Wong's paper are cited here as alternative names).

Randia auriculata (Wall.) Steud. (Alt. name: *Aidia corymbosa* (Bl.) Wong)

Stout climber; leaves leathery, elliptic or oblong, 10-15 cm long, nerves 6-8 pairs; cymes in terminal and axillary corymbs, 6-8 cm across, hairy; berry globose, 5-6 mm across, 2-loculate, many-seeded. In forests; Singapore (*Wallich*).

Randia cochinchinensis (Lour.) Merr. (Alt. name, *Aidia cochinchinensis* Lour.)

Shrub or small tree, to 12 m tall; leaves lanceolate to oblong-elliptic, 10-15 cm long; leathery; cymes in small dense clusters, axillary, 4-6 cm across, many-flowered; corolla 2-3 mm long. In forests; Chua Chu Kang (*Ridley 5662*).

Randia fragrantissima Ridl. (Alt. name: *Oxyceros fragrantissima* (Ridl.) Wong)

A stout climber, with paired recurved wood thorns, glabrous; leaves elliptic or ovate, leathery, 11-16 cm long; corymbiform inflorescences terminal and axillary, 4-5 cm across, of many fragrant flowers; corolla tubular, 2.5-3.5 cm long, creamy white. In forests, climbing on trees; Bukit Timah (*Ridley 13022*), Pulau Tekong, Changi.

Randia longiflora Lam. (Alt.: name, *Oxyceros longiflora* (Lam.) Yamazaki)

Climber with paired hooked thorns; leaves leathery, obovate or oblong, 4-8 cm long; umbellate cymes terminal or axillary; corolla 3-4 cm long, white. In tidal rivers and mangrove swamps; Changi, Pasir Ris (*Furtado SFN 18640*).

Randia macrophylla R. Br. ex Hook.f. (Alt. name: *Rothmannia macrophylla* Bremek).

Slender shrub, to about 1 m high, pubescent; leaves membranous, oblanceolate, 18-30 cm long, subsessile, nerves 11-14 pairs; flowers 1 or 2, in upper axils, pendulous; corolla trumpet-shaped, 15-20 cm long, 8-10 cm across at the mouth, white with purple spots inside ("purple trumpet"). In forests; Singapore (*Hullett 339*).

Randia macrantha DC. (Alt. name: *Euclinia longiflora* Salisb.)

A garden shrub, 3-4 m tall, with a cluster of long (20-23 cm long) white flowers at the end of a branch. Native to tropical Africa, sometimes cultivated.

Randia penangiana K. & G. (Alt. name: *Oxyceros penangianus* Tirvang.)

Woody climber with stout paired axillary thorns (to 1 cm long); leaves elliptic, thin-leathery, 8-10 cm long, nerves 5-7 pairs; cymes 3-4-flowered, terminal and axillary; corolla 3-4 cm long, white. In forests; Gardens' Jungle (*Ridley s.n.* in 1902), Bukit Timah.

Randia scandens (Bl.) DC. (Alt. name: *Oxyceros scandens* (Bl.) Tirvang.)

Climber, with paired recurved hooks, glabrous; leaves elliptic-oblong, thick leathery, 10-15 cm long; flowers 3 in a cyme; corolla tubular, 4-5 cm long, white. In forests, climbing on trees; Bukit Timah (*Ridley s.n.* in 1894).

Saprosma glomerulatum K. & G.

Low shrub, glabrous, twigs and leaves foetid when bruised; leaves thin-leathery, elliptic or ovate, 10-16 cm long, nerves 7-9 pairs; flowers 4-5 in a sessile axillary cluster; corolla salver-shaped, 3-4 mm long, 4-lobed; fruit depressed globose, blue. In forests; Bukit Timah (*Md. Shah & Samsuri 3896*), Bukit Mandai.

Scyphiphora hydrophyllacea Gaertn.f.

Shrub, rarely a small tree, glabrous; twigs and petioles reddish when young; leaves ovate, leathery, upright, 3-5 cm long; flowers in dense cymes, 3-4 cm across; corolla about 1 cm long, cylindrical, 4-lobed, pinkish; drupe green then whitish, 1 cm long, 6-8 grooved with two ribbed pyrenes inside. Common in mangroves and along muddy seashores; Jurong (*Ridley s.n.* in 1894). Vern. *Cengan*.

Tarenna adpressa (King) Corner (= *Stylocaryna adpressa* King, *Tarenna lancifolia* Ridl.)

Shrub, to 2 m tall; branches 4-angled, pubescent; leaves lanceolate or narrowly elliptic, thin-leathery, 15-20 cm long, nerves 6-10 pairs; many-flowered cymes forming dense corymbs, terminal; corolla cylindrical, 1 cm long, 5-lobed; berry globose 5 mm across, whitish, with 2 pyrenes inside. In damp forests; Bukit Timah (*Ridley s.n.* in 1896).

Taren. fragrans (Bl.) K. & V.

Shrub, to 2 m tall; leaves oblong or elliptic, 6-15 cm long; corymbs 5-7 cm across; berry globose, black. In forests; Geylang (*Ridley 10933*), Katong.

Taren. grandifolia (Hook.f.) Ridl.

Shrub, 1 m tall; leaves oblong-elliptic, thin-leathery, 10-20 cm long, nerves 8-12 pairs; cymes 2-3 cm across, in corymbs, pubescent; corolla 1.2 cm long, white. In forests; Bukit Timah, Seletar (No specimens available).

Taren. ridlei (Pears.) Ridl.

Shrub, 60 cm high, glabrous; leaves broad-elliptic, thin-leathery, 12-15 cm long, nerves 10-14 pairs; corymbs 5-6 cm across; berry fusiform. In open damp forests; Chua Chu Kang (*Ridley s.n.* in 1892).

Taren. mollis (Wall.) Ridl.

Small tree, hairy; leaves lanceolate to ovate, leathery, 10-15 cm long, nerves 10-12 pairs; corymbs 4-5 cm across; corolla white; berry black. In forests, Tanglin (*Ridley s.n.* in 1905).

Taren. stellulata Ridl.

Shrub, to 1 m tall; leaves elliptic, cuspidate, 10-20 cm long, nerves 7-10 pairs; corymbs 3-5 cm across; corolla 1 cm long; berry ovoid, 1 cm long. In forests; Woodlands (*Ridley 11645*); Bukit Mandai.

Timonius compressicaulis (Miq.) Boerl. (= *T. finlaysonianus* Hook.f.)

Shrub; leaves fleshy-leathery, oblanceolate or elliptic, 8-15 cm long, nerves 4-5 pairs; flowers unisexual, on separate trees; male in short cymes about 2 cm long; corolla silky white, 2-3 mm long; female solitary; berry globose, bluntly 4-angled, many-seeded. In tidal mud along seashores; Serangoon (*Ridley 2762*).

Timon. flavescens (Jack) Baker (= *T. peduncularis* Ridl.)

Small tree; leaves thin-leathery, elliptic, narrowed at both ends, 6-10 cm long, nerves 4-7 pairs; male cymes 3-7 flowered; corolla yellow, 1-1.2 cm long; berry oblong, 5-6 mm long, 4-angled, red. In open places; Bukit Mandai, Kranji, Seletar (*Kadim Tassim 512*).

Timon. wallichianus (Korth.) Valetton

Small tree; leaves lanceolate, 6-9 cm long, glabrous above, silvery hairy beneath, nerves 7-11 pairs; male cymes in dense clusters, 1.5-2.5 cm across; female cymes 3-flowered, stalked; berry oblong, 1.2-1.5 cm long, bluntly 4-shouldered. In forest edges; Bukit Timah, Changi, Chua Chu Kang (*Ridley s.n.* in 1889).

Timon. wrayi K. & G

Tree, 15 m tall; leaves leathery, obovate-elliptic, base narrow, 12-20 cm long, nerves 6-7 pairs; male flowers 6-8 in a cyme, pubescent; berry solitary, ellipsoid or globose, crowned by calyx-lobes. Changi (No specimens available).

Uncaria attenuata Korth.

Slender climber; leaves elliptic, 6-12 cm long, nerves 6-8 pairs; flowers in a globose head, 3-4 cm across; peduncles 2-5 cm long, hairy; corolla slender, 8-10 mm long; capsules fusiform, 2-valved, many-seeded. In forests; Bukit Mandai, Bukit Timah (*Ridley s.n.* in 1889). (Species of *Uncaria* are climbers, climbing by the aid of short, hook-shaped modified lateral branches. They can supply clear drinking water).

Uncar. cordata (Lour.) Merr. (= *U. pedicellata* Roxb.)

Climber; leaves coriaceous, ovate-elliptic, 8-12 cm long, nerves 7-8 pairs; heads 4-5 cm across; peduncles 4-5 cm long; corolla slender, 1.5-2 cm long. In open forests; Bukit Timah, Tuas (*Goodenough 2852*).

Uncar. gambir Roxb.

Slender climber or bush (in cultivation); leaves ovate-oblong, 8-14 cm long, nerves 4-5 pairs; flower-heads 3-4.5 cm across; peduncles 2.5 cm long, slender, glabrous; corolla 1-1.2 cm long, tubular, slender, red, the lobes oblong, white. Native to Sumatra and Borneo, formerly cultivated in large plantations. An astringent extract, the gambier or pale catechu, prepared by boiling down the leaves and stems, is used by tanners and dyers.

Uncar. glabrata (Bl.) DC.

Slender climber, glabrous; leaves oblong, 6-8 cm long; flower-heads 2-2.5 cm across; peduncle thick, 2.5 cm long; corolla tubular, 6-8 mm long. In forests; Jurong, Bukit Mandai (*Ridley 2846*), Pulau Ubin.

Uncar. jasminiflora Hook.f.

Slender climber; leaves thin-leathery, elliptic, acuminate, 6-12 cm long, nerves 5-6 pairs; flower-heads about 3 cm across; corolla slender, 1-1.2 cm long. In forests and mangrove swamps; Jurong, Bukit Mandai (*Ridley 10415*).

Uncar. longiflora (Poir.) Merr. (= *U. pteropoda* Miq.)

Large climber; leaves leathery, glabrous, elliptic, 12-16 cm long, nerves 7-8 pairs; petioles winged; flower-heads 2.5-3 cm across; peduncle as long. In forests; Bukit Timah (*Ridley 2854*), Gardens' Jungle.

Uncar. ovalifolia Roxb.

Slender climber; leaves membranous, elliptic, shortly acuminate, 4-7 cm long, nerves 3-4 pairs; flower-heads 2-2.5 cm across; peduncle 1.5-2.5 cm long, slender; corolla tubular, 1.5 cm long. In damp forests; Chua Chu Kang, Ang Mo Kio (*Ridley s.n.* in 1889), Gardens' Jungle.

Uncar. roxburgiana Korth.

Slender climber, soft hairy; leaves thin-leathery, ovate 5-8 cm long, nerves 5-6 pairs; flower-heads 1.5-2 cm across; peduncles 1 cm long; corolla 1-1.2 cm long, slender, pinkish. In forest margins; Bukit Timah, Bukit Panjang, Chua Chu Kang (*Ridley 6716*).

Uncar. sclerophylla Roxb.

Large climber, covered with red soft hairs; leaves leathery, ovate or oblong, 10-15 cm long, nerves 9-10 pairs; flower-heads 7-10 cm across; peduncle 6-8 cm long; corolla 2-3 cm long; silvery hairy. In thickets; Jurong, Gardens' Jungle, Water Catchment Areas (*Ridley 10635*).

Urophyllum glabrum Wall. ex Roxb.

Slender shrub, to 2 m tall, glabrous; leaves thin-leathery, elliptic, acuminate, 10-14 cm long, nerves 5-8 pairs; axillary clusters few-flowered, shortly peduncled; corolla greenish-yellow; berry globose, top flattened, orange, many-seeded. In forests; Ang Mo Kio (*Ridley 61160*).

Uroph. griffithianum Hook.f.

Shrub or small tree; leaves leathery, elliptic or oblong, 12-18 cm long, nerves 7-8 pairs; axillary cymes many-flowered. In forests; Gardens' Jungle, Changi, MacRitchie Reservoir (*Md. Shah & Md. Ali 3873*).

Uroph. hirsutum Hook.f.

Shrub, or small tree, soft hairy; leaves oblong-lanceolate, 7-12 cm long, nerves 8-10 pairs; flowers in small cymes; corolla 2-3 mm long, hairy. Common in forests; Gardens' Jungle, Chua Chu Kang (*Ridley 3906*, ♂).

Uroph. macrophyllum (Bl.) Korth.

Shrub or small tree; leaves elliptical oblong, acuminate, 3-8 cm long, nerves 9-11 pairs; flowers in dense short-peduncled umbels, pubescent; corolla cylindrical, 2-3 mm long. In forests; Kranji.

Uroph. streptopodium Wall.

Slender shrub, to 2 m tall; young branches 4-angled, yellow, soft-hairy; leaves thin-leathery, elliptic-oblong, 5-15 cm long; flowers in short, dense cymes about 1 cm long. In forests; Bukit Timah, Jurong, Pulau Ubin, Chua Chu Kang (*Ridley 4906*).

Uroph. trifurcum Pears.

Shrub or small tree, glabrous; leaves leathery, oblong-elliptic, 12-18 cm long, nerves 10-12 pairs; flowers in small umbels, usually 3 umbels in a common peduncle. In forests; Changi, Kranji.

Warszewiczia coccinea (Vahl.) Klotzsch.

Shrub, 3-6 m tall; leaves oblong or obovate, 15-60 cm long; cymes in terminal panicles; one of the calyx-lobes of the outermost flowers enlarged, petaloid, elliptic, bright red, 3-11 cm long; corolla-tube yellow or orange, 1 cm long, 5-lobed. Native to tropical America, sometimes cultivated in gardens.

126. CAPRIFOLIACEAE

Key to the Genera

- A. Leaves pinnately or bipinnately compound; flowers regular, in terminal corymbose inflorescence *Sambucus*
 A. Leaves simple
 B. Flowers regular, in terminal panicles *Viburnum*
 B. Flowers irregular, in axillary pairs *Lonicera*

Lonicera japonica Thunb.

Twining shrub; leaves simple, opposite, ovate, 3-7 cm long; flowers axillary, in pairs; corolla tubular, 2-lipped, 4-5 cm long, at first yellow, then becoming white, very fragrant; the bract below each flower-pair leaf-like, 1-1.8 cm long. Native to S. China and Japan. Another introduced species with smaller bracts is probably referable to *L. confusa* DC. of S. China.

Sambucus javanica Reinw. ex Bl.

Erect shrub, 2-3 m tall; leaves simple pinnate; flowers small, white, fragrant, in a large terminal corymbose inflorescence. Native to Java, sometimes cultivated. Another species, *S. canadensis* L. from N. America, with bi-pinnate leaves, occasionally also cultivated.

Viburnum sambucinum Bl.

Large shrub; leaves lanceolate-elliptic, 12-20 cm long; flowers small, white; drupe red. Formerly found in Chua Chu Kang (*Ridley* 6829), Kranji, Bukit Panjang and Bukit Mandai, now probably extinct.

127. CAMPANULACEAE

Key to the Genera

- A. Flowers regular; anthers free; inflorescences axillary, in scorpioid cymes *Pentaphragma*
 A. Flowers irregular; anthers mostly joined to form a tube
 B. Corolla-tube long and narrow, the limb not 2-lipped *Laurentia*
 B. Corolla-tube short, the limb 2-lipped *Lobelia*

Laurentia longiflora (L.) Peterm. (= *Isotoma longiflora* (L.) Presl)

Herb, 30-50 cm high, thick-stemmed, with milky sap; leaves simple, narrowly oblanceolate, 8-11 cm long, dentate or pinnatifid; flowers axillary, solitary; corolla white, tubulate, 7-11 cm long, 5-lobed near the top. Native to the West Indies, under hedges or along roadside. Vern. *Star of Bethlehem*.

Lobelia zeylanica L. (= *L. affinis* Wall.)

Ascending herb, to 15 cm long, usually pubescent; leaves ovate, acute, 1.5-4 cm long; flowers solitary, axillary; corolla white or pale blue, 2-lipped, upper lip 2-lobed, lower 3-lobed, 6-8 mm long; capsule ribbed. In damp spots; Bukit Timah, Kranji (*Ridley s.n.* in 1890).

Pentaphragma horsfieldii (Miq.) Airy-Shaw (= *P. scortechinii* K. & G.)

Succulent, woolly herb; leaves alternate, ovate-elliptic, slightly unequal-sided; flowers small, densely arranged in thick, curved scorpioid cymes, 5-6 cm long; corolla campanulate, yellowish; berry many-seeded. In damp forests, often on banks; formerly found in Bukit Timah, Sungei Morai, Pulau Damar (*Ridley s.n.* in 1894), Chua Chu Kang, now confined to Bukit Timah.

Pent. ridleyi King

Easily distinguished from the above species by its glabrous, often narrowly elliptic leaves with a narrowed base. In damp forests; Bukit Timah, Bajau (*Burkill* 723). According to Airy-Shaw, this is a natural hybrid, namely \times *elliptica* Poulsen, a cross between *P. acuminata* Airy-Shaw and *P. horsfieldii*.

128. GOODENIACEAE**Scaevola taccada** (Gaertn.) Roxb. (= *S. frutescens* Krause, *S. sericea* Vahl)

Succulent shrub; leaves fleshy, oblong-obovate, round-tipped, 15-25 cm long, spirally arranged; flowers in leaf-axillary branched clusters; corolla white or tinged lilac, about 2 cm long, the tube split open along the upper side, limb 5-lobed; drupe white, the endocarp corky, 1-2 seeded. A seashore plant, all round the coasts; Changi, Seletar, Labrador, Pulau Ubin, P. Tekong (*Ridley s.n.* in 1890).

129. STYLIDIACEAE**Stylidium tenellum** Swartz (?)

Slender shrub, 5-20 cm high, rarely branched; leaves obovate, alternate, 1-1.2 cm long; flowers very small, zygomorphic, purple, usually 2-3 together. In damp places in India and in the central and northern Malaya, recorded in Singapore by a specimen (*Furtado s.n.* in 1924) bought from a local Chinese drug shop. The identification of this specimen is highly questionable.

130. COMPOSITAE*Synoptic key to the genera**

1. Flower-heads several in a cluster, surrounded by bracts
 2. Clusters of flower-heads globose *Sphaeranthus*
 2. Clusters of flower-heads \pm flattened *Elephantopus*, *Sparganophorus*
1. Flower-heads solitary or in branched inflorescences, not in clusters
 3. Leaves (at least the lower ones) opposite or crowded at the base of the stems
 4. Creeping or climbing herbs
 5. Creeping and sprawling *Acanthospermum*, *Tridax*, *Wedelia*
 5. Climbing or twining *Eupatoria*, *Mikania*
 4. Erect herbs
 6. Flower-heads in leaf-axils or at shoot-apex, sessile or nearly so, not in branched inflorescences *Eleutheranthera*, *Enydra*, *Synedrella*
 6. Flower-heads in branched inflorescences *Adenostemma*, *Ageratum*, *Bidens*, *Eclipta*, *Siegesbeckia*, *Spilanthes*
 3. Leaves alternate; flower-heads usually in branched inflorescences
 7. Flower-heads globose *Dicrocephala*
 7. Flower-heads mostly cylindric, not globose
 8. Shrubs or shrubby, rarely trees *Blumea* (p.p.), *Pluchea*, *Vernonia* (p.p.)
 8. Herbs
 9. Scrambling or climbing *Centipeda*, *Gynura*, *Microglossa*
 9. Erect *Blumea* (p.p.), *Emilia*, *Erechites*, *Erigeron*, *Vernonia* (p.p.), *Youngia*

Acanthospermum australe O. Ktze. (= *A. brasilium* Schrank)

Greening herb, branched; leaves opposite, ovate, toothed, 1-2.5 cm long; flower-heads small, axillary; flowers white, the outer ones rayed. Native to tropical America, reported in Singapore in the last century.

* Many cultivated genera are not included.

Adenostemma lavenia (L.) O. Ktze. (= *A. viscosum* Forst.)

Erect shrub, to 1 m tall; leaves opposite, ovate, varying from 5 to 18 cm long, stalked and toothed; flower-heads in terminal branched and spreading inflorescences; flowers white, all tubular; achenes warty. In waste ground, often in damp places; Chua Chu Kang, Pulau Ubin (Hullett 78), Bukit Panjang.

Ageratum conyzoides L.

Herb, erect and hairy, to 1 m tall; leaves opposite below and alternate above, ovate, 2-9 cm long, toothed; flower-heads usually 3-4 (each stalked) together on a common stalk in leaf-axils and terminal; flowers white or pale blue, all tubular; fruit black. Common in waste places throughout the Island, a garden weed.

Artemisia lactiflora Wall. ex DC.

Like the species below, also strongly aromatic, but leaves usually smaller (0.5-2.5 cm long) and not white hairy beneath. Native of China, sometimes cultivated as a garden plant.

Art. vulgaris L.

Branched perennial, very aromatic; leaves ovate or lanceolate, 2-10 cm long, pinnately-lobed, densely white hairy beneath; flower-heads very small, in much branched panicles; light green, with one series of ray flowers enveloping the tubular ones. Native of north temperate countries, formerly commonly cultivated for medicine in Chinese villages.

Bidens pilosa L.

A branched herb, 30-50 cm high; leaves opposite, simple or compound (with 3-5 leaflets), 1-12 cm long, toothed; flower-heads on the top of branched stalks, each about 2 cm across, with marginal white or yellow ray-flowers; achenes long and narrow, black, bristled. Native of America, in waste places, common in hill stations in Malaya, occasionally recorded in Singapore.

Blumea balsamifera (L.) DC.

Shrubby herb, up to 3 meters or more high, hairy, aromatic; leaves alternate, elliptic, toothed, 8-40 cm long, the stalk often with 2-3 pairs of narrow-lobed appendages; flower-heads numerous, forming a very large terminal and axillary branched inflorescence; flowers all tubular, yellow. In open places, Bajau (Goodenough 2742). Leaves and stems with a strong smell of camphor when crushed; used in local medicine. Vern. *Sumbong*, Ngai camphor.

Blumea lacera (Burm. f.) DC.

Erect herb, 30-50 cm tall, strongly smelling; leaves oblong, 2-5 cm long, the lower leaves often lobed; flowers yellow. A weed on roadsides and grassland.

Centipeda minima (L.) A. Br. & Asch.

Tiny prostrate herb, much branched; leaves oblong, alternate, pinnately lobed, 0.4-2 cm long; flower-heads solitary, axillary, very small (0.2-0.4 cm across); marginal flowers white or purplish, central disc-flowers yellow. In waste ground; Botanic Gardens, Woodlands (*Sinclair SF 39237*).

Chrysanthemum morifolium Ramat. (= *C. indicum* Hort.)

The chrysanthemum is imported as a pot plant or a cut flower, very various in form and colour in the flower-heads. Native of E. Asia of ancient cultivation.

菊, 菊花

Coreopsis lanceolata L.

Perennial, 30-60 cm tall, branched; leaves tufted at base, opposite above, narrow spoon-shaped entire or 2-3 lobed; flower-heads 5-6 cm across, long stalked, ray and central flowers yellow. Native to N. America, sometimes cultivated.

Coreopsis tinctoria Nut.

Like the above, but leaves twice-pinnately divided; flower-heads 3-6 cm across; ray flowers reddish brown and central flowers reddish purple. Native to N. America.

Cosmos sulphureus Cav.

Tall herb, to 1 m high; leaves opposite, finely divided; flower-heads 4-6 cm across, solitary or few together, on long stalks; ray flowers light to deep yellow or orange, central ones yellow. Native to Mexico, sometimes cultivated.

Crassocephalum crepidioides (Benth.) S. Moore

Erect herb, fragrant, hairy, to 1 m high; leaves oblong or elliptic, 8-15 cm long, pinnately lobed or pinnatifid; flower-heads cylindric, 1.5 cm long, yellow with a reddish top, forming small branched corymbs. A weed of tropical African origin, a fairly recent introduction.

Dahlia pinnata Cav.

Perennial herb with tuberous roots; leaves opposite, simple or pinnately divided; flower-heads flat to globose; marginal ray flowers white, pink to purple, flat, tubular or rolled; central tubular flowers yellow. Native to Mexico, sometimes cultivated.

Eclipta prostrata L. (= *E. alba* Hassk.)

Branched creeping herb; leaves opposite, lanceolate, 2-10 cm long, almost sessile; flower-heads stalked (the stalk 2-5 cm long), solitary or 2-3 in a leaf axil, less than 1 cm across; ray flowers white. Common weed in waste ground.

Elephantopus scaber L.

Herb, varying from 2-3 cm to over 30 cm high, hairy; leaves often crowded at the base of stem, lanceolate or oblong, 4-15 (or more) cm long; flower-heads few-flowered, several heads together in a bracteate cluster at the end of branched terminal inflorescence; flowers all tubular, pinkish white. A common weed often found in waste places throughout the Island. Vern. *Tutup Bumi*.

Eleutheranthera ruderalis (Sw.) Sch.-Bip.

Annual aromatic herb, 10-60 cm high; leaves ovate, 1.5-7 cm long; flower-heads terminal and axillary, single or in pairs, few-flowered; flowers yellow. In sandy places; Changi, Pulau Ubin (*Furtado 18629*).

Emilia sonchifolia (L.) DC.

Erect shrub, 20-30 cm tall; leaves alternate, from rounded (lower ones) to heart-shaped (upper ones), toothed or variously lobed; the upper leaves sessile, the lower ones stalked; flower heads narrow-tubular, 1.5-2 cm long, solitary or few in long-stalked terminal inflorescence; flowers all tubular, upper part bright pink. A common weed in waste ground and in gardens. Vern. *Katumbi Jantan*.

***Enydra fluctuans* Lour.**

Creeping herb; leaves opposite, narrowly oblong, 2-10 cm long, entire or toothed, fleshy; flower-heads white or greenish, axillary, less than 1.5 cm across, sessile. In wet places; Geylang (*Ridley 10829*). Leaves and stem are edible (called 'Buffalo spinach'). (The generic name is often incorrectly spelled as *Enhydra*).

***Erechtites hieracifolia* (L.) Rafin. ex DC.**

Erect shrub, to 1 m tall; leaves alternate, narrowly oblong, 10-12 cm long, toothed; flower-heads cylindrical, 1-1.5 cm long, 2-5 together in branched terminal (or upper axillary) inflorescence; flowers tubular, yellow, with silky-white pappus hairs. In waste grounds; native to tropical America.

***Erecht. valerianifolia* (Wolf) DC.**

Differs from the above species in the broader and often deeply lobed leaves and in the pinkish-orange flowers with reddish violet pappus hairs. In waste grounds; also native to tropical America.

***Erigeron sumatrense* Retz.**

Annual, to 2 m high, branched; leaves alternate, long-spoon-shaped, 3-14 cm long, the upper ones smaller and narrower than the lower ones; flower-heads bell-shaped, about 0.5 cm long, greenish-white, numerous in large and much branched inflorescence. A common weed in waste and cultivated ground. Vern. *Sumbong Jantan*.

***Eupatorium odoratum* L. f.**

Tall herb sometimes shrubby; leaves opposite, ovate, pointed, 5-10 cm long; flower-heads pale blue to white, about 1.5 cm long, in paniculate inflorescences; flowers all tubular. A weed originally from N. America, arrived from Thailand to Malaya during the first World War, hence the Malay name "Pokok German"; occasionally found in Singapore since late 1970s.

***Gaillardia pulchella* Fong.**

Annual, 15-30 cm tall; leaves alternate, narrowly spatula-shaped, 5-12 cm long, entire or wavy-lobed; flower-heads 5-10 cm across, long-stalked; ray flowers 10-18, wedge-shaped, yellow or red; central flowers purplish. Native to N. America, sometimes cultivated.

***Gerbera jamesonii* Bolus. ex Hook.**

Perennial, hairy; leaves pinnately lobed, 20-30 cm long, in a basal rosette; flower-heads solitary, arising from a long stalk; ray flowers narrow, red or orange, in one or two rows surrounding the central white flowers. Native of Transvaal, S. Africa, often planted.

***Gynura procumbens* (Lour.) Merr. (= *G. sarmentosa* DC.)**

Creeping or climbing herb; leaves alternate, fleshy, ovate, pointed, 5-8 cm long, toothed; flower-heads tubulate, 1.5-2 cm long, 3-7 together in terminal branched inflorescence; flowers all tubular, orange yellow in a purple involucre. Common in open places or in secondary growth; Bukit Mandai, Bukit Timah (*Ridley s.n.* in 1891), Tanglin. Vern. *Akar Subiak*.

***Helianthus angustifolius* L.**

Herb, branched, 1 m or so high; leaves linear or linear-lanceolate, 4-30 cm long; flower-heads 5-7 cm across, several to many (in short and long stalks) in a leafy panicle; ray flowers golden yellow, surrounding a dark purple centre. Native to N. America, sometimes growing in borders or for cut flowers.

Helianthus annuus L.

Stout annual, 1-2 m tall; leaves alternate, ovate, 7-45 cm long, serrate; flower-heads 15-35 cm across, often nodding and turning towards the sun (thus 'Sun Flower'); ray flowers yellow, surrounding a brown-purple centre; achenes (known as 'Sunflower seeds') large, edible. Native of N. America, sometimes cultivated. 向日葵

Helianthus tuberosus L.

Erect shrub, 2-4 m high; tuberous root ellipsoid, up to 15 cm long ('Jerusalem artichoke'); leaves ovate oblong, 10-20 cm long; flower-heads 5-8 cm across, in leaf panicles; ray flowers golden yellow, surrounding a bright yellow centre. Native of N. America, sometimes cultivated for its edible tubers.

Lactuca indica L.

Herb, 1-2 m high; leaves lanceolate, 8-25 cm long, entire or dentate; flower-heads in large panicles; branches of the panicle with a few linear bracts only at the base. Native to E. Asia, cultivated as vegetables. 莴苣, 生菜

Lact. sativa L.

Herb, 0.3-1 m high; leaves broadly oblong, 6-14 cm long, finely dissected; flower-heads in large flat-topped inflorescence with many cordate bracts. Native to Europe, sometimes cultivated.

Melapodium divaricatum (Pers.) DC.

Herb with angular stems; leaves opposite, ovate, 2-9 cm long; flower-heads solitary, axillary, 1-1.5 cm across; ray flowers yellow. Native to Central America, sometimes cultivated as a pot plant.

Mikania cordata (Burm. f.) B. L. Robins.

Fast-growing climbing herb; leaves cordate or ovate, tip acuminate, base heart-shaped, 3-12 cm long; petiole 1-8 cm long; flower-heads cylindric, 6-9 mm long, in dense corymbs; corolla white or pale yellowish, all tubular; bracts enveloping the individual florets 5-6 mm long. Formerly very common in waste lands; Tanglin (*Burkill 407*); now almost completely replaced by the following slightly smaller-flowered exotic species, *M. micrantha*. This species sometimes was erroneously called *M. scandens* (L.) Willd., a species restricted to N. America.

Mikania micrantha HBK.

A very fast-growing climbing herb, commonly called 'Mile-a-minute'; leaves narrowly or broadly ovate, tip pointed, base heart-shaped, 4-8 cm long, 2-4 cm wide; flower-heads small, white, usually hanging at the ends of a much branched inflorescence; bracts enveloping the individual floret 3-4 mm long. In forest edges, secondary growth and open places, common.*

Pluchea indica (L.) Less.

Shrubby herb, to 1.5 m tall; leaves spirally alternate, thick, oblong, 2-6 cm long, toothed short-stalked; flower-heads cylindric, in much branched terminal inflorescences; flowers all tubular, purplish or white. Common in tidal swamps and on sea coast, rarely in inland grounds; Changi, Geylang, Jurong (*Ridley s.n.* in 1888). Vern. *Pokok Beluntas*.

* Information on this species was kindly supplied by Dr Richard Corlett.

***Rudbeckia serotina* Nutt.**

Hairy herb, to 1 m high; leaves alternate, lanceolate or oblong, 5-12 cm long; flower-heads solitary, terminal, 10-12 cm across; ray flowers golden yellow, surrounding a dull brown or black centre (thus called 'black-eyed Susan'). Native to N. America, sometimes growing in gardens.

***Sigesbeckia orientalis* L.**

Hispid herb, 0.3-1 m tall, branched; lower leaves petiolate, ovate or oblong 5-20 cm long; upper leaves narrower, smaller and sessile; flower-heads greenish, 1.5-2 cm across, in loose panicles; the ray flowers surrounded by linear glandulate spreading bracts. In moist waste places, not common.

***Solidago altissima* L.**

Herb, to 1 m tall; lower leaves forming a rosette at the base; the upper ones alternate, spatulate, 3-14 cm long; flower-heads golden yellow, rather small, usually borne on one side of the branches (hence called 'Golden rod') of a large panicle. Native to N. America; this and some other related species sometimes sold as cut flowers.

***Sparganophorus vaillantii* Crantz.**

Fleshy herb, 30-40 cm high; leaves alternate, elliptic, 2-12 cm long; flower-heads sessile in leaf-axils, flattend, 0.5-1.5 cm across; flowers white, all tubular. In damp places; a tropical American weed.

***Sphaeranthus africanus* L.**

Branched herb; stems and branches winged; leaves alternate, oblong, 2-3 cm long; flower-heads globose, less than 1 cm across, consisting of many small tubular florets, greenish white, solitary, terminal or in upper axillary, shortly stalked. In muddy waste places or in ditches; Geylang (*Ridley 5069*).

***Spilanthes acmella* (L.) Murr.**

Herb to 50 cm tall; leaves opposite, broadly ovate, 3-6 cm long, toothed; flower-heads terminal, solitary, ovoid, about 1 cm across, long-stalked (12 to 15 cm long); marginal ray-flowers yellow; achenes black. In waste ground; Seletar (*Hullett 630*); formerly sold in local herb shops for curing toothache (thus "the toothache plant"). Vern. *Krabo*.

***Syndrella nodiflora* (L.) Gaertn.**

Annual, with branched slender stems; leaves opposite, elliptic, 1-5 cm long; flower-heads axillary, yellow, small and few-flowered, sessile or subsessile, fruit black. Native of tropical America. (Similar to *Eleutheranthera ruderalis* but differing from the latter in having narrower stalked flower-heads with smaller bracts and 2-3 stiff spines on the achenes).

***Tagetes erecta* L.**

Herb, 30-50 cm tall; leaves opposite (lower ones) or alternate (upper ones), 5-12 cm long, deeply lobed or compound; flower-heads solitary, terminal, yellow or orange, 5-10 cm across; ray flowers many, flat or rolled. Native to Mexico, but horticulturally known as African Marigold. Another species also from Mexico but erroneously called French marigold, *Tagetes patula* L. having smaller flower-heads (3-4 cm across), the ray flowers are marked with red colour.

***Tithonia diversifolia* Gray**

Shrubby; leaves alternate, ovate, entire or 3-5 lobed, 10-25 cm long; flower-heads 8-10 cm across; ray flowers (about 12) orange yellow, surrounding the small yellow central tubular flowers. Native to Mexico and C. America, sometimes cultivated.

***Tridax procumbens* L.**

Creeping herb; leaves opposite, narrowly ovate, coarsely serrate, 1-5 cm long; flower-heads 2 cm across, on upright long-stalk (10-30 cm long); ray flowers pale yellow to white. A weed in open dry, sandy places; native to Central America.

***Vernonia arborea* Buch. Ham. (incl. *V. javanica* DC.)**

Tree, 10-20 m tall, much branched above; leaves alternate, ovate to oblong, 8-20 cm long; flower-heads 0.5 cm long, white or pink, 5-6 flowered, all tubular; paniculate inflorescences terminal, widely branched. In mature secondary forests; Changi, Chua Chu Kang, Jurong and Water Catchment Areas (*Corner s.n.* in 1936). Vern. *Merambong*. (This is the only tree species of the Compositae in this region. Two forms can be recognized: one a tall straight tree with glabrous leaves, and the other often stunted and gnarled, with pubescent leaves. The latter is either treated as a variety, i.e., var. *javanica* Clarke, or a separate species, *V. javanica* DC.).

***Vernonia cinerea* (L.) Less.**

Herb, to 1 m tall; leaves alternate, generally ovate, 1-8 cm long, but very variable; flower-heads narrowly cylindrical, 6-7 mm long, violet or pink, all tubular, many in a terminal, much branched inflorescence. Common weed, in waste places or in gardens.

***Vernonia patula* (Dryand.) Merr. (= *V. chinensis* Less.)**

Similar to *V. cinerea*, but stouter and with larger flower-heads and bracts. Technically, the two aspects can be distinguished by the following characters: in *V. patula*, achenes 5-angular, pappus hairs in 1 series; in *V. cinerea*, achenes cylindrical, pappus hairs in 2 series. Common in waste grounds and clearings; Geylang (*Teruya* 2523).

***Wedelia biflora* (L.) DC.**

Hairy scrambling herb, sometimes shrubby; leaves ovate, pointed, 3-nerved, 3-15 cm long; flower-heads usually solitary, bright yellow, about 1.5 cm across, with ray-flowers surrounding the tubular ones. On sandy beaches; Pulau Ubin (*Hullett* 387). Vern. *Serenai Laut*.

***Wed. trilobata* (L.) Hitch.**

Creeping herb; leaves fleshy, oval-shaped, toothed or 3-lobed; flower-heads of prominent yellow ray-flowers. A species of tropical American origin, often planted in gardens as a ground cover.

***Xanthium inequilaterum* DC. (= *X. strumarium* Auct. non L.)**

Herb, 30-60 cm tall; leaves alternate, ovate, toothed and lobed, 5-10 cm long; flower-heads unisexual, in spikes on upper leaf-axils; achenes oblong, enclosed in the enlarged involucre covered with hooked bristles known as 'burs'. Formerly recorded once at Rochore (*Ridley s.n.* in 1904) as a casual weed, now apparently disappeared.

***Youngia japonica* (L.) DC. (= *Crepis japonica* (L.) Benth.)**

Herb, 10-30 cm high; leaves nearly all basal, 5-10 cm long, round-topped, toothed or lobed below; flower-heads oblong, 5 mm long, yellow tipped, in loosely branched inflorescences. A weed commonly found in hill stations in Malaya, occasionally reported from Singapore.

***Zinnia linearis* Benth.**

Herb, 20-60 cm tall; leaves linear or lanceolate, 1-6 cm long; flower-heads 2-3.5 cm across; ray-flowers orange. Native of Mexico, sometimes cultivated.

***Zinnia elegans* Jacq.**

Herb, 0.3-1 m tall, branched; leaves elliptic, ovate, 3-15 cm long; flower-heads terminal, 3-7 cm across; ray-flowers red, pink, white or yellow. Native to Mexico, sometimes cultivated.

Micropropagation of *Lagerstroemia speciosa* (L.) Pers. (Lythraceae)

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Abstract

Lagerstroemia speciosa (L.) Pers., a common road-side tree of Singapore, was successfully mass-produced using the tissue culture technique. Nodal segments were the best explants as they could produce more multiple shoots than do shoot tips with BAP and 2ip treatments. The excised shoots were rooted in agar medium or sterilised sand, supplemented with IBA. The former was found superior. About 90% of the plantlets survived when transplanted to soil.

Introduction

Lagerstroemia speciosa is commonly planted along roadsides and in open spaces throughout Singapore for its shade. These trees also produce colourful flowers in abundance. There is some variation in the flowering characteristics of some of the trees in the population established. Some of them consistently flower more profusely than other trees located in close proximity. As it is the intention of the Parks and Recreation Department to introduce colours to our landscape effectively, it would be beneficial to plant avenues and groves of those trees recognised for their superior flowering qualities. A row of trees with uniform flowering habits is most desirable. To achieve this objective, there is a need to clone trees having the above characteristics. Although this could be achieved through rooted stem cuttings, the number that can be propagated is limited. Thus, the use of the tissue culture technique to mass propagate these trees is investigated and this paper reports the results of *in vitro* propagation of *Lagerstroemia speciosa*.

Materials and Methods

Young shoots from the crowns of mature trees as well as from the basal sprouts of tree stumps were collected. The leaves were removed and the axils were brushed lightly to remove dirt. This was carefully done so as not to break or damage the axillary buds at the nodes. The axillary buds were prominent and had an average length of 2-3 mm. Shoot tips and nodal segments with buds were separated, washed in tap water and used as explants. The length of the explants, i.e., shoot tips and nodal segments used were 5 mm and 10 mm respectively. They were then surface-sterilised by dipping in 98% ethanol for 5-10 seconds, and then in 30% clorox solution with Tween 80, for 45 minutes to 1 hour. The sterilised materials were rinsed five times in sterile water.

The basal medium consisted of Murashige and Skoog (1962) salt solution at the following concentrations: — a) macronutrient at half and, b) micronutrient at full strength, c) 3% sucrose. To test the response of explants, the media were further supplemented with IAA (Indole 3-acetic acid) and Kinetin (6 furfurylaminopurine). The concentrations used for both IAA and Kinetin ranged from 0-10.0 ppm, used either individually or in combination with one another. These concentrations were tested in 7×7 factorial combinations. There were 49 treatments altogether and each treatment was replicated 10 times.

For multiple shoot induction, media containing BAP (6-benzylaminopurine at 0, 1, 2, 3, 4 mg/l) or a combination of BAP at 1 mg/l and 2ip (N6 — [Δ^2 isopentyl] adenine at 1, 2, 3 mg/l) were used. Ten replicates of each treatment were prepared. After eight weeks of growth, shoot proliferation was evaluated in terms of increase in fresh weight, number of shoots formed and average length of shoots. The pH of the media was adjusted to 5.5 before autoclaving. The culture tubes were autoclaved at 120°C at 1.5 kg/cm⁻² pressure for 20 minutes. The cultures were kept under 1 klx lighting provided by true-lite tube on a 12 hour photoperiod. The environment temperature was kept at 21-25°C.

Results and observations

The various explants responded differently when cultured on the various media. The pattern of response to the various treatments by each of the explants tested, are described below.

Growth of Nodal Segments and Shoot Tips

Table 1. Growth response of *Lagerstroemia speciosa* on MS salt with 49 combinations of IAA and Kinetin.

Kinetin mg/l IAA mg/l	0	0.5	1	2	2.5	5	10
0	C	—	—	—	—	CC	—
0.5	CC S	C S	C S	C S	S	CC S	CC
1	CC S	C S	C S	C S	S	CC S	CC
2	CC S	C S	C S	C S	C S	CC S	CC
2.5	—	—	—	—	—	—	—
5	—	CCC RR	CC RR	—	—	—	—
10	—	CCC RR	CC RR	—	—	—	—

Callus, shoot, root development were observed in 20-day old cultures.

- C : slight callus
- CC : vigorous growth of callus
- CCC : abundant callus
- S : shoot
- : no growth
- RR : root

Of the 2 types of explants, nodal segments responded better and Kinetin had little effect on the growth (Table 1). Satisfactory callus and shoot formation were obtained with IAA at 0.5-2 mg/l. There was no significant difference in the response among the various combinations of Kinetin & IAA used. An average of 2 shoots developed from the axils of the nodal segment (Plate 1). Growth was first observed 7 days after inoculation, and about 20 days thereafter, shoots of 3-5 cm length were obtained. In most of the media, an initial swelling at the basal portion of the explant was observed. The swelling was due to cell divisions in the cortical layers leading to an increase of the tissue volume. After about 2 weeks, masses of friable and white callus were formed at the base of the culture shoots. Shoot tips on the other hand, usually browned off or showed less growth and they normally grew into single shoots (Plate 2).

Since nodal segments gave best growth, they were used as explants for all subsequent experiments.

Shoot multiplication

Multiple shoots developed within 15 days after inoculation. An average of about 3 buds were seen at each node and these developed into shoots in about 2 to 5 weeks. The best results were obtained in BAP medium at 1 mg/l (Table 2) and shoots reached a length of 1.8 cm. Increasing the BAP concentration promoted the growth of callus but caused a reduction in the shoot length (Table 2). The leaf blades were very much reduced, thus resulting in cane-like structures. There was no significant difference in the number of shoots formed.

Table 2. Effect of BAP on the induction of multiple shoots.

Concentration of BAP (mg/l)	Average no. of shoots *	Average shoot length
0	1	0.8 cm
1	3	1.8 cm
2	3	1.0 cm
3	1	0.7 cm
4	2	0.9 cm

* The shoots were counted in 30-day old cultures.

With the addition of 2ip into the medium, the multiplication of shoots improved markedly (Table 3). The average number of shoots increased three-fold to 9 shoots per explant. The average shoot length also increased from 1.8 to 3.2 cm and there was no significant difference at different concentrations of 2ip (1-3 mg/l). All the cultures showed healthy growth with a high frequency of normal leaves and shoots with long internodes (Plate 3). It was possible to mass-produce the shoots at this stage. Shoots which had elongated to about 5-10 nodes could be excised and cut

into several nodal segments for further multiplication on the same medium. In these segments, the axillary buds enlarged and additional young shoots appeared in about 2 weeks (Plate 4). In about 6 weeks, they multiplied again (Plate 5) and could be excised for rooting. This process could be repeated to produce the required number of plantlets.

Table 3. Effect of combination of 1 mg/l BAP and 2ip (1-3 mg/l) on the induction of multiple shoots.

Concentration of 2ip (mg/l)	Average no. of shoots [*]	Average fresh weight of shoots	Average shoot length
1	9	4.2854 gm	3.05 cm
2	8.8	4.5852 gm	3.16 cm
3	9.2	4.5103 gm	2.99 cm

* The shoots were counted in 30-day old cultures.

Rooting of excised shoots

Tests were conducted on excised shoots of 3 to 4 cm length planted onto basal medium supplemented with IBA (Indole-3-butyric-acid at 0, 2, 3, 6 mg/l) or in sterile sand supplemented with MS salt solution and IBA (at 5, 10, 20, 40 and 60 mg/l). In each of the treatments, there were 10 replicates.

No root was formed in the control medium but with IBA added into the medium, healthy roots were formed (Plate 6). The average number of roots and the average root length did not vary with different IBA concentrations (Table 4). The most important effect of IBA was to induce roots and rooting percentage increased proportionally with the concentration until it reached 100% at 6 mg/l. At low IBA concentration, soft callus formed at the base of the tissues.

Table 4. Effect of different concentrations of IBA on rooting of shoots on MS agar medium.

Concentration of BAP (mg/l)	Average no. of roots [*]	Average length of root	Rooting Percentage
0	0	0	0
2	9.7	5.07	25
3	10.2	5.35	50
6	11.4	5.90	100

* The roots were counted in 30-day old cultures.

Table 5. Effect of different concentrations of IBA on rooting of shoots in sand medium, supplemented with MS salt.

Concentration of 2ip (mg/l)	Average no. of roots [*]	Average length of root	Rooting Percentage
0	9.8	1.04	20
5	15	1.2	21
10	25	1.15	50
20	20	2.1	42
40	20	1.9	32
60	19	1.5	35

* The roots were counted in 30-day old cultures.

For rooting in sand supplemented with different concentrations of IBA, the best results were obtained at the concentrations of 10-20 mg/l (Table 5). Although more roots were formed, they were short (Plate 7). Only about 50% of the cultures produced roots at the optimal IBA concentrations of 10-20 mg/l.

After rooting, the small plantlets were removed from the media and potted with either a mixture of coco-peat and sand (1:1) or a mixture of sand, coco-peat and soil (1:1:3). The potted plantlets were covered with a plastic sheet for about 2 weeks to maintain high humidity. Water stress is thus reduced and the development of epicuticular wax allowed (Grant & Aston, 1977). After 2 weeks to 1 month, the plants had hardened and the plastic sheets were removed. Ninety percent of the plantlets which rooted from agar media survived whereas only 50% of the plantlets rooted directly from sand survived. They all resembled plants produced by cuttings (Plate 8) and were similar in growth habit and form. However, whether rooted in agar media or sand, the potting-out survival rate was observed to decrease sharply for plantlets kept in the rooting culture for longer than two months.

Discussion

Tissue culture techniques provide viable alternative methods of mass-production of healthy plants with uniform characteristics. These techniques have been successfully applied to many ornamental plants such as orchids (Lim-Ho, 1982), herbs and shrubs (George & Sherrington, 1984). Although it is known that the explants of woody and tree species of Gymnosperms and Angiosperms are difficult to grow *in vitro* and to induce regeneration, methods for micropropagation of temperate and tropical trees have been developed from a variety of explant sources during the last few years (Bonga & Durzan, 1982; Dodds, 1983).

In this study we have demonstrated the feasibility of mass-production of *L. speciosa* using nodal segment and shoot tip cultures from stump sprouts. The ability of explants from stump sprouts to regenerate shoots *in vitro* is an advantage as plantlets produced would resemble the mother plants in terms of growth characteristics and habits. This would be especially useful when the main objective is to clone trees identified for their profuse flowering characteristics. The results of the present study also support the view that tissues at the basal region of a tree trunk still remain juvenile irrespective of the age of the tree (Bonga & Durzan, 1982; Vietiez et. al., 1983; 1985).

The most commonly used cytokinin for shoot multiplication in trees is BAP and its effectiveness used singly has been well demonstrated in the seedling tissues of *Calophyllum*, *Eugenia*, *Fagraea* (Lee & Rao 1980, 1982), *Swietenia* (Rao & Lee, 1982), and mature tissues of *Quercus robur* (Vietiz, 1985) and *Eucalyptus* (Gupta et. al., 1981) from *in vitro*. BAP alone was not effective in promoting shoot multiplication of *L. speciosa*. The addition of 2ip induced a higher multiplication rate, showing an interaction effect of BAP and 2ip on shoot multiplication. Such results are very rare in literature (Bonga & Durzan, 1982). Further studies could be initiated on the interaction effects of other cytokinins with BAP to gauge the response of shoot multiplication.

Rooting experiments in agar media were more successful than those tested on sand. Furthermore, when the plantlets were potted out, there was 90% survival rate. Further work would help to ascertain the best rooting media that would encourage better survival of plantlets when potted out. The present methods also show that it is possible to rapidly produce large numbers of plantlets of *Lagerstroemia in vitro* and it is suggested that this method is available for the propagation of other useful trees.

Acknowledgements

The authors wish to thank Mrs Quek-Phua Lek Kheng and Mrs Teo-Lee Guek Choon for their competent assistance in the experiments.

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Plate 1. Two shoots developed from lateral bud (20-day old culture).

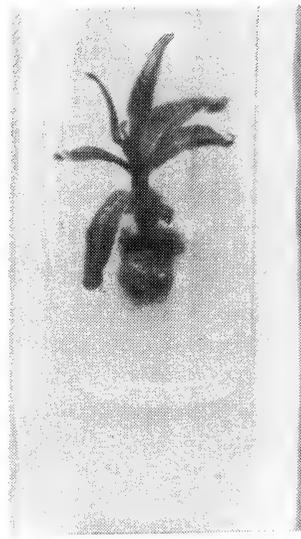


Plate 2. Single shoot developed from shoot-tip (20-day old culture).



Plate 3. Multiple shoots on MS supplement with BAP (1 mg/l) + Zip (1-3 mg/l) (18-day old culture).

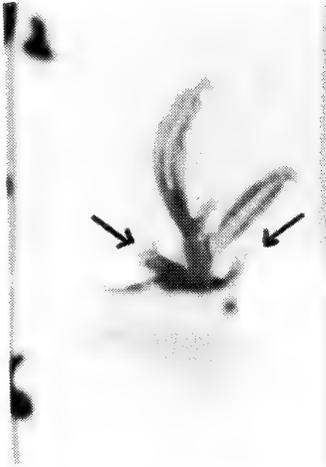


Plate 4. Young shoots arising from nodal segment (14-day old culture).

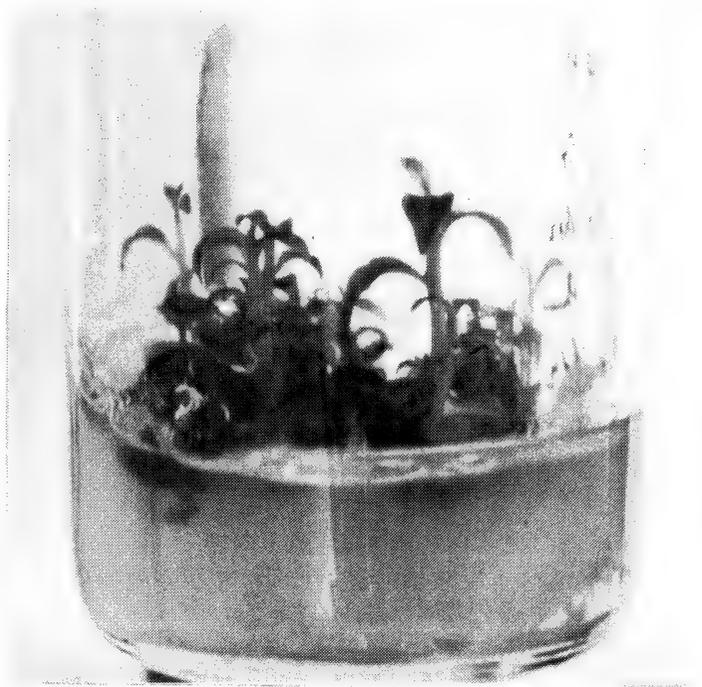


Plate 5. Multiple shoots from nodal segments (40-day old culture).



Plate 6. *Lagerstroemia* rooted in agar medium showed less but longer roots (30-day old culture).



Plate 7. *Lagerstroemia* rooted in sand showed more but shorter roots (30-day old culture).



Plate 8. Well-established *Lagerstroemia* plantlets produced by tissue culture (60 days in planting media).

A New Account of the Genus *Horsfieldia* (Myristicaceae), Pt 3*

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EFFECTIVE PUBLICATION DATE: 15 FEB. 1986

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46. *Horsfieldia sabulosa* Sinclair

Fig. 1B(46); 22

Horsfieldia sabulosa Sinclair, Gard. Bull. Sing. 27 (1974) 133 — Type: Sinclair & Kadim 10491 (K: iso: L; A, B, E, NY, SAR, *n.v.*).

Tree 10-37 m. Twigs stout, terete, neither ridged nor lined but with wart-like thickenings marking the leaf-scars, (3-)5-10(-20) mm diam., grey-brown, non-striate, rather late glabrescent from grey-brown to rusty tomentum with hairs 0.5-1.0(-1.5) mm long; bark lower down grey-blackish, usually longitudinally cracking and often \pm flaking; lenticels inconspicuous. Leaves in 3-5 rows, generally bunched towards the apex of the twigs, coriaceous, elliptic-oblong to (sub) lanceolate, nearly parallel-sided or broadest \pm at the middle, 9-21 \times 2-6 cm, base attenuate, tip acute (to short-acuminate); upper surface glabrous, \pm shining or not, olivaceous to brown, lower surface rather pale brown, early glabrescent, with scattered dark brown to blackish dots, these roundish or sometimes elliptic or line-shaped; midrib flat above, glabrous; nerves 12-20 pairs, flat above and below, the lateral arches and the tertiary venation invisible; petioles long in proportion to the blades, 25-50 \times 2-4 mm, rather late glabrescent, tomentum with hairs 0.5-1.5 mm; leaf bud rather short and stout, 10-15 \times (3-)4-5 mm, with dense grey-brown to rusty tomentum with hairs 0.5-1.5 mm long. Inflorescences behind the leaves on older twigs of 15-20 mm thick, emerging from the axils of the rough and woody wart-like petiole-scars on the older bark, densely pubescent with hairs 1.0-1.5 mm long; in σ (submature seen on *San 15146*): 4-5 \times 2-3 cm, c. 2-3 times ramified, many-flowered, flowers in loose clusters of 5-10 each; common peduncle c. 15 mm long; ρ inflorescences \pm few-flowered, 3-5 cm long; bracts elliptic to lanceolate, \pm boat-shaped, 4-15 mm long, densely pubescent with hairs 0.5-1.5 mm but glabrous inside, late caducous; flowers 3-(or 4-) valved, perianth glabrous, pedicels glabrous, at base articulate. Male perianth (immature) globose or depressed-globose, c. 0.7 \times 1.0 mm; pedicel c. 0.8-1.0 mm long; perianth (in bud) with valve-sutures to c. $\frac{1}{2}$ -way, buds not collapsing on drying; valves c. 0.2 mm thick. Androecium (immature) \pm globose c. 0.4 \times 0.5-0.6 mm, \pm circular in transverse section; anthers c. 12-15, \pm completely sessile, apical cavity small; androphore narrow, \pm 0.2 mm long. Female flowers (according to Sinclair, l.c., p. 134): ovary immature, glabrous. Fruits 1-6 per infructescence, ovoid, top and base broadly rounded, 3.0-5.0 \times 2.5-4.0 cm, glabrous, drying dark brown to somewhat bluish black, not warted; pericarp hard, 5-8(-10) mm thick; stalk 2-8 mm long; perianth not persisting.

Distribution. Borneo: Sarawak (Serian Dist., Bintulu Dist., Mulu Nat. Park), Brunei, Sabah (Sipitang).

*Continued from *Gdns' Bull. Sing.* 38 (1): 144.

BORNEO. Sarawak: *Brunig 956; (Chai) S. 39647; Sinclair & Kadim 10248* — Brunei: *BRUN 579, 0828; Sinclair & Kadim 10437, 10491* — Sabah: *San. 15146, 17560*.

Ecology. A moderate to large tree of mixed forest on sandy or peaty soil, deep yellow sands, sandy loam, or heavy yellow clay soil; in *Agathis* forest, ridge forest; 0-100 m alt. Flowers May & June, fruits May to December.

Vernacular name. Kumpang-perawan (Iban).

NOTES

1. *Fieldnotes.* Tall tree, buttresses absent. Bark dark grey, bark of trunk longitudinally fissured. Sap red, copious. Inner bark reddish brown, laminated, fibrous; sapwood soft, pinkish, with a hollow centre c. 2.5 cm wide. Leaves glossy above, very glaucous beneath, midrib greenish yellow. Fruits yellow, inside apricot; ramiflorous with many fruits on each branch.

2. A very characteristic species because of its thick branches with bunched leaves, the leaves with long petioles in (3-) 5 rows, ramiflorous. Sinclair discussed its relationship with *H. wallichii*, which has resembling fruits. This has also almost similar dark brown dots on the lower leaf surface.

3. According to Koster and Baas (1981, p. 152) the leaves have the unique feature of having an iso-bilateral mesophyll.

47. *Horsfieldia atjehensis* de Wilde, *sp. nov.*

Fig. 1B(47)

Horsfieldia amygdalina auct. non (Wall.) Warb.: Merrill, Contr. Arn. Arb. 8 (1934) 61.

Folia ramulorum fertiliu sparsa, subtus punctis sparsis fusco-brunneis non-traumaticis induta (ut in *H. glabra*), cortice ramulorum delapso. — Type: *W. & C.M. Bangham 882* (K; iso: A, NY, n.v.).

Tree c. 10 m. Twigs terete, not ridged, towards the top 3.5-5(-8) mm diam., rather pale grey-brown to yellowish brown, early glabrescent, tomentum grey-brown with hairs less than 0.1 mm, lower down with the bark coarsely striate and tending to flake; lenticels rather conspicuous towards the top of the twig. Leaves in 3-5 rows, thinly chartaceous, obovate-oblong or elliptic-oblong to oblong-lanceolate, broadest slightly above the middle, 13-25 × 4.5-9 cm, base long-attenuate, tip acute-acuminate; upper surface drying dark brown; lower surface early glabrescent, provided with regularly scattered brown to blackish non-traumatic larger dots (lens!); midrib flat above; nerves 10-12 pairs, flat above, marginal arches indistinct; tertiary venation forming a lax network indistinct or invisible on both surfaces; petioles 12-15 × 2.5-3.5 mm; leaf bud densely grey-brown pubescent with hairs less than 0.1 mm, moderately slender, c. 15 × 3.5-4 mm. Inflorescences situated behind the leaves, very thinly pubescent to glabrescent, hairs less than 0.1 mm; in ♂: c. 3 times ramified, rather many-flowered, 7-14 × 4-10 cm, common peduncle 10-20 mm long; ♀ inflorescences not seen; bracts elliptic-oblong, finely pubescent, 2-4 mm, caducous. Flowers 3-valved, in the male in loose clusters of 4-8 each, glabrous; pedicels glabrous, at base inarticulated. Male perianth (slightly immature) globose, c. 1.5 mm diam., at anthesis cleft to c. ½-way; valves c. 0.2(-0.3) mm thick; pedicel slender, 1-1.5 mm long. Androecium subglobose to short-ellipsoid, c. 1.2 × 1.0 mm, top broadly rounded, in transverse section subcircular; anthers 11, almost completely sessile, free apices c. 0.1(-0.2) mm, curved over and ± into the rather narrow apical cavity c. 0.3 mm deep;

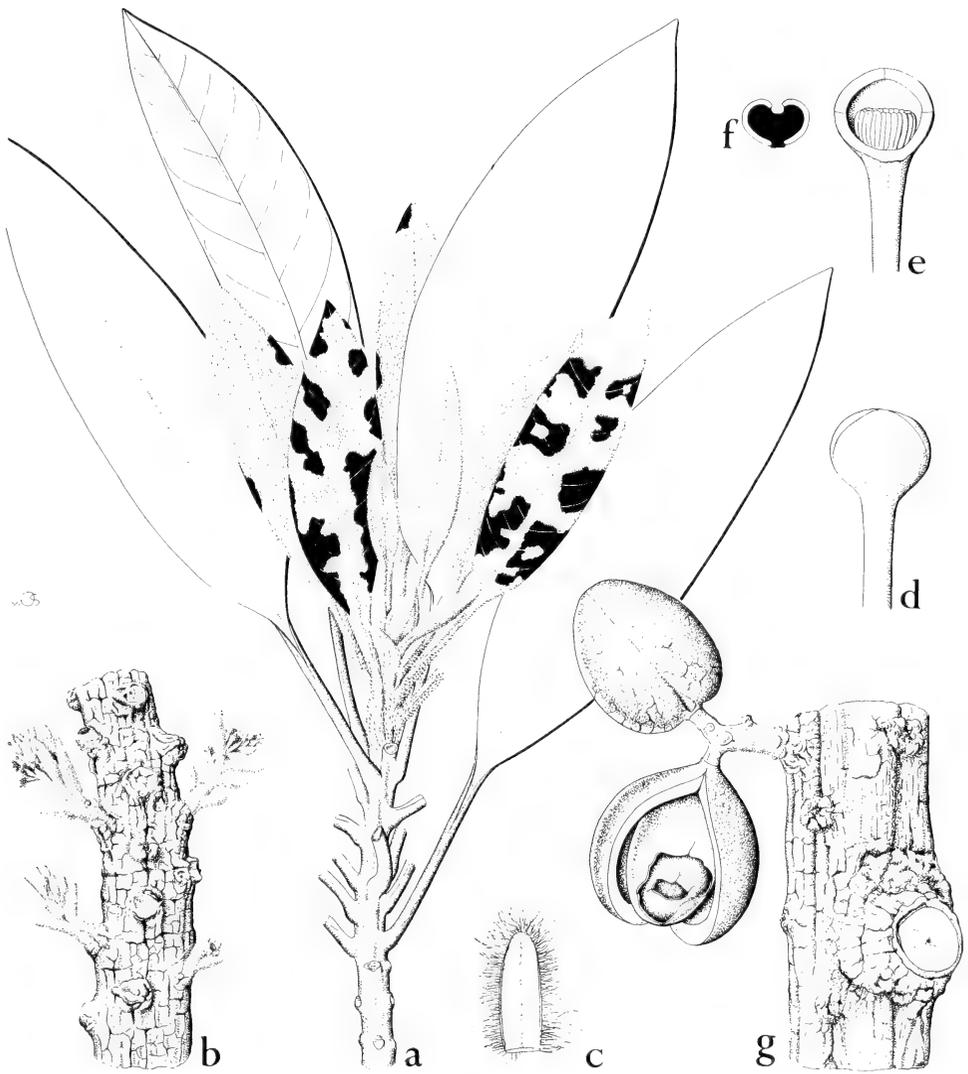


Fig. 22. *Horsfieldia sabulosa* Sinclair.

a. shoot apex with densely bunched leaves with dispersed phyllotaxis, tomentum of young leaves partially fallen, $\times \frac{1}{2}$; b. older wood with leaf scars in dispersed phyllotaxis and immature male inflorescences, note bracts, $\times \frac{1}{2}$; c. smaller bract, $\times 12$; d. immature male flower, lateral view, $\times 12$; e. ditto, longitudinally opened, showing androecium, $\times 12$; f. longitudinal section of androecium, schematic, $\times 12$; g. old wood with infructescence, fruits mature, seeds completely covered by aril, $\times \frac{1}{2}$. — a-f. from *San. 15146*; g. from *BRUN 0828*.

column broad, spongy-solid; androphore narrow, c. 0.2(-0.3) mm long. Female flowers and fruits not seen.

Distribution. Known from only one collection in N. Aceh, Sumatra.

Ecology. Mountainous forest at c. 1300 m (3500-5000 ft.); male flowers, still immature in January.

NOTES

1. *Fieldnotes*. Leaves leathery, glabrous, flower buds green.

2. This is in many respects much related to and \pm intermediate between *H. amygdalina*, *H. glauca*, *H. macrothyrsa*, and *H. sparsa*, but still markedly distinct from all these species.

H. amygdalina, a species from continental SE. Asia and the Andaman Isls. (not known from the Nicobar Isl. and Malaya), differs in general habit and further by the absence of blackish dots on the lower leaf surface and by the darker colour of the dried twigs.

H. sparsa from lowland Peninsular Thailand, Malaya, and Sumatra, has a rather similar general habit, with a similarly pale bark on the twigs, but differs by the absence of blackish dots on the lower leaf surface, and by the flowers which have a rather different androecium with less anthers (7-9), and a generally longer androphore.

H. macrothyrsa, occurring in N. and C. Sumatra, also in mountainous forest, has punctate leaves, but differs in the distichous phyllotaxis, and the much larger male flowers with a different androecium.

Hitherto *H. glabra* (var. *glabra*) is found on Sumatra only in the lowland in the southern part, and all specimens from that area strongly differ in general habit and have the leaves distichous. The present new species has in common with *H. glabra* the punctate leaves but differs in various characters *viz.* a stouter habit, the leaves in 3-5 rows along the twigs, the bark rather pale and coarsely striate, tending to flake, and probably in the slightly smaller male perianths. Furthermore, it was found rather distant from the area of *H. glabra* at a much higher altitude.

3. The Kew-specimen was identified by Sinclair as *H. sucosa* in 1959; in his treatment of 1975 it is enumerated under *H. bracteosa*. In the publication on the Bangham collections by Merrill (1934) the collection was treated under *H. amygdalina*.

48. *Horsfieldia sucosa* (King) Warb.

Fig. 1B(48)

Myristica sucosa King, Ann. Roy. Bot. Gard. Calc. 3 (1891) 301, pl. 172 — *Horsfieldia sucosa* (King) Warb., Mon. Myrist. (1897) 322; Sinclair, Gard. Bull. Sing. 16 (1958) 416 (p.p., incl. lectotype, excl. fig. 45 = *H. sparsa*), pl. XII A; 28 (1975), 139 p.p. — Syntype: *King's Coll.* 4078, 4647 (fr., lecto: K, L; CAL, G, *n.v.*; see notes), 10475; *Wray* 467; *Maingay* (Kew Dist.) 1300.
H. bracteosa Henderson, Gard. Bull. Str. Settl. 7, 2 (1933) 120, pl. 30; Sinclair, Gard. Bull. Sing. 16 (1958) 419, fig. 46 — *H. bracteosa* var. *bracteosa*: Sinclair, Gard. Bull. Sing. 28 (1975) 18. — Type: *Henderson* SFN 24521 (SING, *n.v.*; iso: K; DD, *n.v.*).

Tree 6-20 m. Twigs terete, neither lined nor ridged, towards the apex 2-10 mm diam., pale grey-brown or straw-coloured, contrasting with the blackish colour of the dried petioles, (very) early glabrescent, tomentum rusty to greyish, hairs 0.1-0.3 mm long; lower down the bark rather coarsely striate or not, with a tendency to flake, lenticels rather conspicuous only on the very young parts. Leaves in 2 or 3 rows, membranous to thin-chartaceous, elliptic-oblong to oblong-(ob) lanceolate, broadest at or above the middle, 14-28 \times 4.5-8.5 cm, base attenuate or long-attenuate, tip acute-acuminate; upper surface glabrous, drying greenish-brown to blackish-brown, often with a greenish tinge, lower surface early glabres-

cent, drying light brown, without larger blackish dots; midrib flat above or only slightly raised, glabrous; nerves 13-17 pairs, slender above, flat or slightly raised, lateral arches indistinct; tertiary venation forming a lax network indistinct or invisible above; petioles 10-20 × 2-3 mm, early glabrescent; leaf bud c. 10-15 × 2-3 mm, with rusty to greyish brown tomentum of hairs 0.1-0.3 mm long. Inflorescences situated behind the leaves, thinly pubescent or late glabrescent from hairs 0.1-0.2 mm long; in ♂: 3 or 4 times ramified, many-flowered, rather lax or condensed, 7-19 × 5-16 cm, common peduncle 10-20 mm long, flowers in clusters of 3-7 each; ♀ inflorescences rather few-flowered, 1-2 cm long; bracts ± ovate-elliptic to lanceolate, acutish, pubescent, 1.5-4 mm long, rather late caducous; flowers either mostly 2-valved (Borneo, see further under the subspecies) or mostly 3-valved (Malaya, Sumatra), perianth glabrous, pedicels usually glabrous (see under subsp. *sucosa*), at base distinctly articulate and contrasting with the pubescent branches of the inflorescence. Male perianth globose to depressed globose, top flattish to broadly rounded, base rounded or broadly rounded, 1.2-1.5 × 1.5-2.0 mm; pedicel 1.0-2.0 mm long, slender; perianth at anthesis cleft from c. $\frac{1}{3}$ to (nearly) $\frac{1}{2}$ -way, on drying not or only slightly collapsed at the top, valves 0.2-0.3 mm thick. Androecium depressed globose, 0.3-0.6 × 0.8-1.2 mm, top flattish or broadly rounded, circular or (in Borneo) broadly ellipsoid in transverse section; anthers 7-11, almost completely sessile towards the incurved apex, column broad, ± saucer-shaped, with a broad and flattish, rather shallow apical cavity reaching up to nearly $\frac{1}{2}$ -way deep; androphore rather narrow, 0.1-0.3 mm long. Female perianth (only seen in var. *bifissa*): broadly ellipsoid, 2.8-3.5 × 2.2-3.0 mm, 2-valved, cleft to c. $\frac{1}{4}$, valves 0.3-0.4 mm thick, pedicels 1-1.5 mm long, when young with minute hairs 0.1 mm long or less towards the base, ovary c. 1.5 mm diam., glabrous, stigma shallowly 2-lobed, c. 0.1 mm high. Fruits 1-4 per infructescence, broadly ovoid-ellipsoid, top ± narrowly rounded, 2.3-3.5 × 2.0-2.5 cm, glabrous, drying blackish with finely granulate surface, sometimes ± tuberculate; pericarp c. 4 mm thick; stalk 1-2 mm long; perianth in Malayan specimens persistent (see further under the subspecies).

Distribution. Malaya, Sumatra, Borneo.

NOTE. Divided into two geographically separated taxa, mainly based on the differing number of valves of the perianth, a character regarded as important in the genus and on which, *grosso modo*, the genus can roughly be divided into two divisions. It is noteworthy that this character, here on a subspecific level, occurs within the division of species with mainly 3-valved perianths.

KEY TO THE SUBSPECIES

- 1a. Perianths predominantly 3 (or 4)-valved. Malaya, Sumatra a. subsp. *sucosa*
 b. Perianths predominantly 2-valved. Borneo b. subsp. *bifissa*

a. subsp. *sucosa*

Fig. 1B(48)

Perianths predominantly 3-valved, rarely a few 2- or 4-valved; mature male perianths in bud 1.2-1.5 × 1.5-2.0 mm; androecium 0.4-0.6 × 0.8-1.2 mm; anthers 7-9 (Malaya) or 9-11 (Sumatra). Fruits 2.5-3.5 × 2.0-2.5 cm with persistent 3-lobed perianth.

Distribution. Malaya, Sumatra.

MALAYA (Perak, Kelantan, Trengganu, Pahang, Selangor, Malacca, Johore): *FRI* 1252, 4212, 5228, 14088, 14331, 15219, 15603; *Kep. FN*. 97901; *King's Coll.* 4647, 10475; *Phyt. survey Kuala Lumpur (Millard)* 1825; *Maingay* 2422; *SFN (Sinclair & Kiah)* 39937, 40621, 40629.

SUMATRA (*Jambi, Palembang, Bengkulu*): *b.b.* 1799, 31936; *Kostermans* 12020; *Lambach* 1311; *Marsden* (*Hb. Hooker*) *s.n.*; *Roos & Franken* 1704.

Ecology. Dry land and seasonal swamp forest; recorded from sandy soils or sandstone; also disturbed forest; 0-500 m alt. Flowers and fruits throughout the year.

Vernacular names. Merampat (Tamuan, Malaya); Pěředah bęsar (Palembang, Sumatra).

NOTES.

1. *Fieldnotes.* Bark smooth or shallowly fissured or thin-scaly. Slash bark laminated, reddish, with sticky reddish exudate. Wood yellowish or pink. Flowers yellow-green or yellow, scentless. Fruits shiny green, turning yellow or yellow-pink or pink-red. Aril orange-red.

2. Dry fruits, over 3.5 cm long, have never been measured, but fresh fruits are recorded as 5-7.5 cm long, with a thick pericarp.

3. As pointed out by Sinclair (1958, p. 418; 1975, p. 140) King's syntype is heterogeneous. Only *King's Coll.* 4647 and *Maingay* 1300 (also numbered 2422) belong to the present species. *King's Coll.* 4647 (in fruit) is herewith designated as lectotype.

4. King describes the flowers as externally pubescent; however, as explained by Sinclair (1958, p. 418) that material was very heterogeneous, and most likely this record is erroneous. The flowers of *H. sucosa*, as circumscribed presently, are generally glabrous, but the female flowers of *Kostermans* 12012 (Palembang) have pedicels somewhat pubescent towards the base.

5. In the herbarium, most specimens of our present *H. sucosa* subsp. *sucosa* were initially identified by Sinclair as *H. sucosa*, a species accepted besides the related *H. bracteosa*. Later on, most of these specimens were re-identified by Sinclair as *H. bracteosa*; he indicated he was aware of the heterogeneity of his *H. sucosa*, from which I have presently segregated the new species *H. sparsa*. Sinclair's lectotype-specimens of King's material, *King's Coll.* 4647 and 10475, however, are clearly identical with the type of *H. bracteosa*.

b. subsp. bifissa de Wilde, *subsp. nov.*

Perianthia mascula depresso-globosa. 1.2-1.4 × 1.5-1.7 mm, praecipue 2-valvata; androecium depresso-globosum, 0.3-0.4 × 0.8-0.9 mm, antheris 7. Fructus 2-2.5 cm longi, eius perianthium non-persistens. — Type: Kutei, *Soegeng* 58 (L; iso: BO, *n.v.*).

Perianths predominantly 2-valved, the odd 3-valved perianth present; mature male perianths in bud 1.2-1.4 × 1.5-1.7 mm; androecium 0.3-0.4 × 0.8-0.9 mm; anthers 7. Fruits c. 20-25 × 20 mm, the perianth ± caducous, 2-lobed.

Distribution. Borneo: E. Sabah, E. and S. Kalimantan.

BORNEO, E. Sabah: *Elmer* 21607; *San.* 68452, 73922 (NT 169). — E. & S. Kalimantan: *Afriastini* 195; *Endert* 3213; *Kostermans* 8081, 9973; *Soegeng Reksodihardjo* 59; *Hubert Winkler* 2373, 2695.

Ecology. Lowland forest: on sandy loam soil, sandy ridge in *Shorea laevifolia* forest; 0-800 m. Flowers and fruits throughout the year.

NOTES

1. *Fieldnotes.* Bark smooth, undulately fissured; inner bark c. 10 mm thick, laminated, reddish-brown or yellow-brown; wood whitish or pale brown, or reddish. Flowers yellow, the males very fragrant.

2. Specimens of the present new subspecies were formerly determined by Sinclair as *H. sucosa* var. *microcarpa*, a name later on (1975, p. 20) published as *H. bracteosa* var. *microcarya* Sinclair. Other specimens belonging to Sinclair's var. *microcarya*, incl. the type, are presently referred to a new species *H. pallidicaula*.

3. *H. sucosa* is vegetatively very similar to *H. pallidicaula* and *H. sterilis*, the two being markedly different in the male flowers; these have a differently built androecium, and the pedicels are inarticulate at the base.

4. It seems as if the distributional area excludes that of the related and resembling species *H. pallidicaula*.

49. *Horsfieldia pallidicaula* de Wilde, sp. nov.

Fig. 1B(49)

Cortex ramulorum pallidus, cinereus, non fusco-brunneus. Folia disticho vel sparsa, subtus non-punctata. Perianthia mascula subglobosa, 1.5-2 mm diam., 3-vel 4-valvatis; pedicelli graciles, 1-2 mm longi, basi non-articulati. Fructus late ellipsoidei, in sicco nigrescentes, perianthio persistente. — Type: *Jacobs 5413* (L: iso: K: SAR, G. US, CANB, B. S. SING, n.v.).

Tree 7-20 m. Twigs terete, neither lined nor ridged, towards the apex 2-10 mm diam., pale, whitish or greyish brown, contrasting with the blackish colour of the dry petioles (or petioles often greyish in the lower half), early glabrescent, tomentum with rusty or greybrown hairs 0.1-0.3 mm long; the bark lower down finely striate or not, slightly flaking or not, lenticels generally inconspicuous or absent. Leaves either in 2, 3 or 5 rows, membranous, oblong to oblong-lanceolate, broadest at or above the middle, 10-30 × 4-9.5 cm, base long-attenuate, tip acute-acuminate; upper surface drying brown to blackish-brown, lower surface drying brown to grey-brown, without larger blackish dots, early glabrescent; midrib flat or slightly raised above, glabrous; nerves 10-18 pairs, slender above, flat or slightly raised, lateral arches not distinct; tertiary venation forming a lax network, indistinct above; petioles 10-25 × 1.5-3 mm, early glabrescent; leaf bud rather stout to slender, 7-10 × 2-4 mm, covered by brown-grey rusty tomentum of hairs (0.1-) 0.2(-0.3) mm long. Inflorescences situated generally behind the leaves, glabrescent, tomentum weak, with hairs 0.1-0.2 mm; in ♂: (2 or) 3 times ramified, many-flowered, 3-9 × 2.5-7 cm, common peduncle up to 7 mm long (hence inflorescences often also ramified from near the base), the flowers more or less in clusters of 2-4; ♀ inflorescences rather few-flowered, 1-3 cm long; bracts lanceolate, acute, finely pubescent, 1-3 mm long, caducous; perianths 3- or 4-valved, in ♀ sometimes 2-valved, glabrous, pedicel glabrous, at base inarticulate. Male perianth globose or broadly obovoid, 1.5-2.0 (-2.2) mm diam., top (broadly) rounded, base rounded to short-attenuate; pedicel 1-2 mm, slender; perianth at anthesis cleft to c. $\frac{1}{3}$ to nearly $\frac{1}{2}$ -way deep, not or but slightly collapsing on drying, valves 0.2-0.3 mm thick. Androecium short-ellipsoid to somewhat depressed-globose, 0.8-1.2 × 0.8-1.2 mm, top rounded, circular in cross-section; anthers 8-10, completely sessile (i.e., free apices 0-0.1 mm long only), incurved towards the apex of the androecium; column

broad and solid with a small and narrow apical cavity, 0.1-0.2 mm deep only; androphore narrow, short, 0-0.2 mm long. Female perianth broadly ellipsoid or subglobose, c. 2.5-3.0 × 2.5 mm, cleft at anthesis to ¼-½, valves (0.2-) 0.3 mm thick, pedicels 1-1.5 mm long, ovary subglobose to broadly ovoid, 1.7-2.0 × 1.5-2.0 mm, glabrous, stigma shallowly 2-lobed, lobes 0.1-0.2 mm long. Fruits 1-5 per infructescence, broadly ellipsoid, top and base rounded, 1.5-4.0 × 1.0-3.0 cm, glabrous, drying blackish, finely granulate and sometimes tubercled, pericarp various; stalk 1-3 mm long; perianth persisting under the fruit (always?) (see further under the varieties).

Distribution. Three varieties in Borneo (Sabah, Sarawak).

KEY TO THE VARIETIES

- 1a. Fruits 15-17 × 10-12 mm; pericarp 1-1.5 mm thick. Leaves up to 23 cm long **b. var. microcarya**
 b. Fruits larger 2
 2a. Fruits c. 20-22 × 18 mm; pericarp 2-3 mm thick. Leaves up to 25 cm long **a. var. pallidicaula**
 b. Fruits 37-40 × 27-30 mm; pericarp 6-8(-10) mm thick. Leaves 25-30 cm long **c. var. macrocarya**

a. var. pallidicaula

Fig. 1B(49)

Leaves 10-25 cm long, up to 7.5 cm wide. Fruits c. 20-22 × 18 mm; pericarp 2-3 mm thick; stalk and perianth not seen.

Distribution. Borneo: Sarawak, West Sabah, West Kalimantan (doubtful, see notes).

BORNEO. Sarawak (1st, 3rd Div., Baram Dist.): *Jacobs* 5413; *Hose* 29, 86; *S.* 14971, 37692, — Sabah (West): *SAN.* 15254, 76783, 80505. — West Kalimantan: *Hans Winkler* 1435 (doubtful).

Ecology. Primary lowland and lower mountainous forest, recorded from sandstone; 0-700 m alt. Flowers throughout the year, fruits in June.

Vernacular name. Kumpang balau (Iban).

NOTES

1. *Fieldnotes.* Bark smooth, dark grey; sapwood white-red. Perianth yellow or yellow-green, androecium pale pink-yellow, pollen white.

2. The three varieties presently recognized are sympatric and are very similar in the vegetative characters. They are mainly distinguished by the remarkable differences in fruit-size, and hence I am not quite sure to which variety the male flowering material belongs.

The only known fruiting specimen regarded as belonging to the type-variety is *San.* 15254, with fruits of c. 21 × 18 mm and of which the calyx is lost.

Also, of the only two known female flowering specimens one cannot be sure to what variety they belong for the same reasons.

3. All three varieties of the presently proposed new species are vegetatively also very similar to the related species *H. sucosa* and *H. sterilis*, but both these differ essentially in the male flowers.

4. Most specimens of our present vars. *pallidicaula* and *microcarya* were at first identified by Sinclair on the sheets as *H. sucosa* var. *microcarpa*, and in 1975 published as *Horsfieldia bracteosa* var. *microcarya*.

5. A noteworthy deviating specimen. The collection *Hans Winkler 1435*, from West Kalimantan, Sungei Bika, 5.1.1925, with mature male flowers, keys out together with *H. pallidicaula*. It deviates in general habit by its very thin membranous leaves which dry greenish. The inflorescences are rather weak, the flowers small, slightly longer than broad c. 1.5×1.4 mm, pedicel c. 1-1.5 mm, perianth-valves 3, thin, splitting the bud to nearly $\frac{1}{2}$ -way, the androecium is subglobose, c. $0.8-0.9 \times 0.7-0.8$ mm, \pm sessile, anthers c. 9, sessile, the central-apical cavity being narrow and c. 0.2 mm deep. The specimen was collected in a marshy forest at c. 50 m alt. Possibly it represents a separate taxon. The specimen was determined by Sinclair as *H. carnosa*, which it certainly is not.

b. var. *microcarya* (Sinclair) de Wilde, *comb. nov.*

Horsfieldia bracteosa Henderson var. *microcarya* Sinclair, Gard. Bull. Sing. 28 (1975) 20—Type: *Wood & Kapis San. 16971* (K; iso: L; KEP, SAN SING, n.v.).

Leaves to 20 cm long, up to 7.5 cm wide. Fruits c. $15-17 \times 10-12$ mm; pericarp 1-1.5 mm thick; stalk c. 2 mm long, persistent perianth 3-lobed.

Distribution. Borneo: West Sabah, possibly E. Kalimantan.

BORNEO. West Sabah: *Wood & Kapis San. 16971*.

Ecology. Lowland forest at c. 100 m. Fruits in July.

NOTE. Known only from the type, a collection which vegetatively completely fits the species generally, but distinct in its particularly small fruits with persistent 3-lobed perianths. Possibly here belongs *Leighton 943* (E. Kutei; fruits not seen).

c. var. *macrocarya* de Wilde, *var. nov.*

Differt a var. *pallidicaula* fructibus siccis c. 4 cm longis, pericarpio sicco 6-8(-10) mm crasso. — Type: *Ding Hou 474* (L).

Leaves $23-30 \times 6-9.5$ cm. Fruits $35-40 \times 25-30$ mm; pericarp 6-8(-10) mm thick; stalk 1-2 mm long, persistent perianth 2- or 3-lobed.

Distribution. Borneo: Sarawak (4th and 5th. Division)

BORNEO. Sarawak: *Ding Hou 474; S 32299*.

Ecology. Lowland mixed Dipterocarp forest; yellow sandy clay soil; 30-200 m alt. Fruits in July and October.

NOTES

1. *Fieldnotes.* Bark recorded as smooth to slightly flaky, or as longitudinally fissured. Fruit pink, aril pink.

2. Known only from the type, with mature fruits, and one collection (*S 32299*) with immature fruit. Both have persistent perianths. These in the type are apparently 2-lobed, the ones of *S 32299* are 3-lobed.

50. *Horsfieldia sparsa* de Wilde, *sp. nov.*

Fig. 1B(50)

Horsfieldia sucosa auct. non (King) Warb.: Sinclair, Gard. Bull. Sing. 16 (1958) 416, fig. 45, plate XII A; 28 (1975) 139.

Cortex ramulorum pallidus, cinereus, non fusco-brunneus. Folia sparsa, subtus sine punctis brunneis non-traumaticis. Perianthium masculinum subglobosum, c. 2 mm diam, 3-5 valvatum, pedicello basi non-articulato. Androecium depresso-globosum, 0.8-1.2 mm diam., antheris 7-9. Fructus ellipsoidei 3-5.5 cm longi, in sicco nigrescenti, perianthio non-persistenti. — Type: Malaya, *Ogata Kep. 110406* (L: iso: K).

Tree 15-40 m. Twigs terete, neither lined nor ridged, towards apex 4-11(-15) mm diam., pale whitish brown or grey-brown, contrasting with the brown-black colour of the dried petioles, early glabrescent, tomentum brown or grey-brown, hairs 0.1-0.2 mm; bark lower down rather smooth or coarsely striate, sometimes with a tendency to flake, lenticels present but conspicuous only towards the apex. Leaves crowded or not towards the apex, arranged in 3-5 rows, thickly membranous to chartaceous, oblong to oblong-lanceolate, broadest at or above the middle, (10-) 18-24 × 3.5-7 cm, base long-attenuate, top acute-acuminate; upper surface drying bright brown to dark brown, lower surface drying bright brown, glabrous (early glabrescent), without larger blackish dots; midrib above flat or slightly raised, glabrous; nerves 12-16 pairs, above slender, flat or slightly raised, lateral arches not distinct; tertiary venation forming a lax network, not or hardly visible above; petioles (12-)14-34 × (1.5-)2-3 mm; leaf bud rather stout, relatively short and broad, c. 8-12 × 3-5 mm, with dense tomentum of hairs c. 0.1-0.2 mm long. Inflorescence behind the leaves, subglabrous or early glabrescent, tomentum very weak, of hairs c. 0.1-0.2 mm; in ♂: 2 or 3 times ramified, many-flowered, 6-12 × 4-6 cm, common peduncle (2-)5-15 mm long, the flowers ± fasciculate in clusters of 4-10 each; ♀-inflorescences (only known in fruit) rather few-flowered, c. 1.5-3 cm long; bracts minute, very early caducous; flowers 3 or 4(or 5)-valved, perianth glabrous, pedicel glabrous, at base not or only in a few cases indistinctly articulate. Male perianth globose or slightly depressed-globose, 1.5-2.0 × 2-2.5 mm, top and base (broadly) rounded, glabrous; pedicels 2-4 mm long, slender, glabrous; perianth at anthesis cleft to 1/3-1/2, not or but slightly collapsing on drying; valves 0.1-0.2 mm thick. Androecium subglobose or depressed-globose, 0.8-1.0 × 1.0-1.2 mm, top broadly rounded, circular in transverse section; anthers 7-9, almost completely sessile, incurved at the apex; central column broad and solid without an apical cavity or minute, or rarely (see note) rather broad and shallow, 0-0.4 mm deep, sometimes with a short protuberance; androphore rather slender and distinct, c. 0.3-0.4 mm long. Female perianth (only known from very young fruit) c. 3 mm long, 3-or 4 valved, glabrous; ovary glabrous. Fruits 2-4 per infructescence, ellipsoid, top (narrowly) rounded, base rounded, 3.0-5.5 × 2.5-4.5 cm, glabrous, drying blackish, finely granulate and sometimes ± tuberculate, pericarp (4-)5-15(-20) mm thick; perianth not persisting under the fruit; stalk 5-7 mm long.

Distribution. Peninsular Thailand, Malaya, Singapore, Sumatra.

THAILAND. Peninsular: (*Phusomsaeng 411*) *Fl. Thailand 40961*.

MALAYA (Perak, Kelantan, Selangor, Trengganu, Pahang, Negri Sembilan, Johore): *FRI 0609, 3530, 7819, 7982, 8346, 8909, 14412, 14463, 14500, 14750, 25024; KEP 76635, 80805, 94284, 94991, 108878, 110378, 110406; Shah & Noor MS. 1760; SFN (Sinclair) 40155*.

SINGAPORE. *Ridley s.n.; Sinclair s.n.* (L)

SUMATRA. Riau: *Soepadmo 186; Jambi: Roos & Franken 1936*.

Ecology. Primary and secondary dryland forest, also in periodically inundated forest; mainly on sandy soil, sandy loam soil, sandstone; 0-350 m alt. Flowers in March, August; fruits mainly May to July.

NOTES

1. *Fieldnotes.* Erect tree with clear bole, bole once recorded as \pm tapering, once recorded to have buttresses to 1 ft. Bark brown to blackish-brown, shallowly fissured or usually thinly flaking. Inner bark fibrous, pale reddish; copious watery or sticky pink-red juice; slash wood pale, cream to pale pink-brown, red-flecked. Fruits recorded as large, up to 11 cm with thick fleshy pericarp; seeds relatively small, up to 5 cm long; fresh pericarp yellow to orange red, often flushed pink, smooth, waxy, shining.

2. Sinclair recognized the present species as a distinct species under the name *H. sucosa*. Unfortunately, the lectotype-specimens, chosen by Sinclair, belong to the species treated by Sinclair under the name *H. bracteosa*, the latter thus being a later synonym of *H. sucosa*. The other specimens of King's syntype of *H. sucosa* belong to yet other species, as pointed out by Sinclair (1958, p. 418). Our present species, hence, has to be given a new name, with a new type-specimen.

3. Dry fruits reach c. 5.5 cm; according to the field labels the fruits may reach up to 11 cm, with thick fleshy-juicy pericarps, which obviously shrink a lot on drying.

4. *H. sparsa* is well characterized from resembling species like *H. sucosa* and *H. pallidicaula* by its stout whitish twigs, dispersed leaves with a rather chartaceous consistency, the leaves sometimes being crowded towards the thickish and short terminal leaf bud, the relatively long petioles; the inflorescences are nearly glabrous, the flowers 3- or 4-merous, the pedicels at base not or only indistinctly articulate, the androecium is rather distinctly stalked (androphore) and generally without an apical cavity. Only in *Phusomsaeng 411*, from Peninsular Thailand, is the apical cavity in the androecium rather large, reminiscent of *H. sucosa*. The fruits are large, with a particularly thick and fleshy pericarp; the perianth is not persistent. *H. sucosa* has articulate pedicels; *H. pallidicaula* differs with its sessile androecium.

5. The epithet 'sparsa' alludes to the dispersed leaves, an uncommon feature in *Horsfieldia*.

51. *Horsfieldia triandra* de Wilde, *sp. nov.*

Fig. 1B(51); 23

Folia elliptica ad oblonga, 5-9 cm longa. Flores masculi pubescentes, perianthio crasse-carnoso, 3-valvato, in anthesi usque ad c. $\frac{1}{5}$ divisio, androecio \pm turbinato, c. 1.5 mm longo, antheris 3, pro majore parte sessilibus, c. 0.6 mm longis. — Type: Sumatra, *Forbes 2465* (L).

Tree-height unknown. Twigs terete or subterete, not or only faintly ridged, towards the top 1.5-3(-4) mm diam., dark brown, early glabrescent, tomentum rusty, with hairs c. 0.3-0.7 mm long, bark finely and lower down coarsely striate, not flaking, lenticels small but conspicuous. Leaves in 2 rows, membranous to thinly chartaceous, elliptic-oblong to oblong, broadest at or slightly below the middle, 5-9 \times 2-3.5 cm, base (short-) attenuate, top acute-acuminate with conspicuous acumen 8-12 mm long; upper surface glabrous, drying dark olivaceous to dark brown, lower surface brown, glabrous (early glabrescent), without blackish

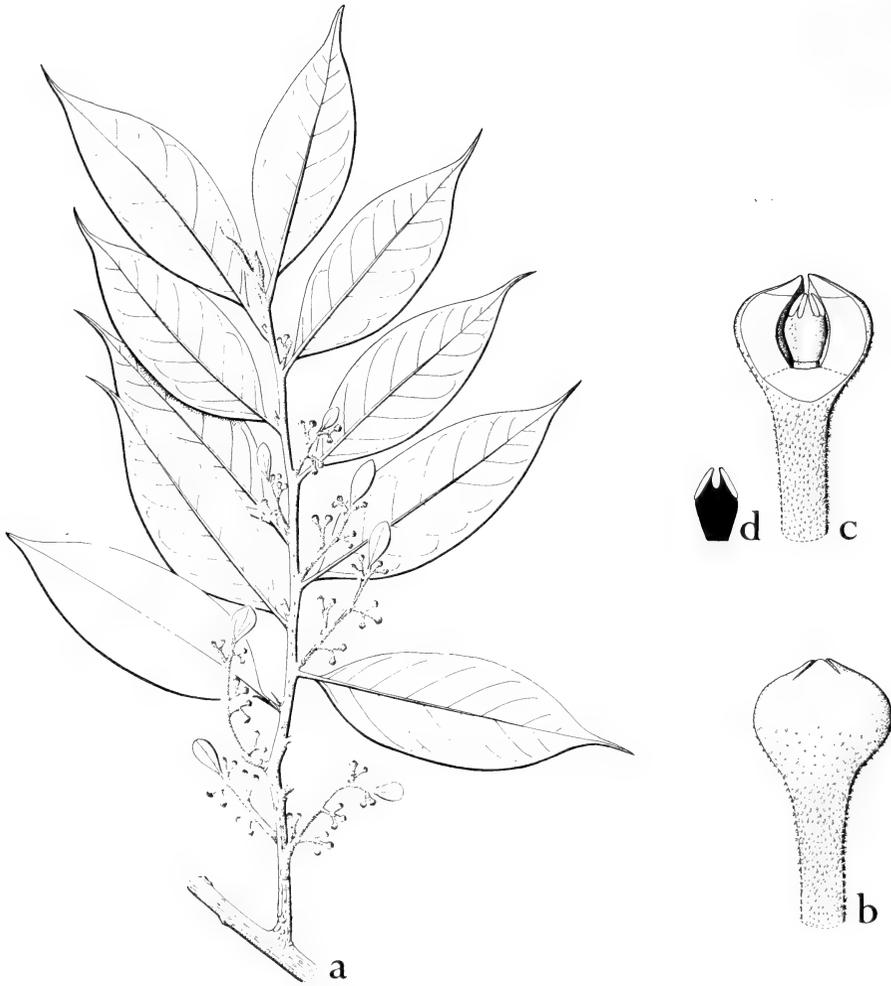


Fig. 23. *Horsfieldia triandra* de Wilde.

a. habit of leafy twig with male inflorescences, note leaf-like bracts, $\times \frac{1}{2}$; *b.* mature male flower, $\times 6$; *c.* ditto, longitudinally opened, showing thick-walled perianth, and androecium, $\times 6$; *d.* androecium, longitudinal section, schematic, $\times 6$. — *a-d* from Forbes 2465.

dots; midrib raised above, glabrous; nerves 6-10 pairs, above flat or \pm sunken; tertiary venation forming a lax network not or scarcely visible on both surfaces; petioles 7-13 \times 1.0-1.5 mm, early glabrescent; leaf bud c. 6-8 \times 2 mm, densely rusty pubescent with hairs 0.3-0.7 mm long. Inflorescences densely rusty pubescent with hairs c. 0.3-0.4 mm, in σ : 1 or 2 times ramified; flowers not many (10-20 flowers per inflorescence and in different stages of development) 3-5 \times 1-2 cm, common peduncle 3-10 mm long, flowers solitary or in loose clusters of 2-4 each; bracts ellipsoid-oblong, pubescent, 2-3 mm long, caducous, and usually with one (rarely 2) persistent subterminal bract, enlarged and resembling a small foliage leaf, 5-12 mm long (see notes). Flowers 3-valved, perianth towards the apex glabrous, lower down finely pubescent, pedicel pubescent with hairs 0.2-0.4 mm, inarticulate at base. Male perianth \pm obconical-obovoid, the top broadly rounded or with a blunt tip, base tapering, c. 2.5 \times 2.5 mm, glabrous in the upper half, pubescent with hairs 0.2-0.4 mm long towards the base; pedicel 3-4 mm long, slender; perianth at anthesis cleft for only c. $\frac{1}{5}$ - $\frac{1}{6}$, not collapsing on drying, valves at apex c. 0.2, towards the base c. 0.4 mm thick, \pm clasping the anthers, at anthesis hardly

opening, the basal part of perianth thick-walled, 0.8-1.0 mm thick. Androecium incl. androphore \pm turbinate, 1.5-1.7 \times 0.6-0.8 mm, subcircular in transverse section; anthers 3 (6 thecae), acutish, suberect, subsessile, 0.6-0.7 mm long, the apical c. 0.3 mm mutually free; androphore \pm obconical, tapering, c. 1.0 \times 0.6-0.7(-0.8) mm, above continuing into the column. Female flowers and fruits not seen.

Distribution. C. and S. Sumatra.

SUMATRA. Central (West Coast): *b.b.* 6479 — South (exact locality not known): *Forbes* 2465.

Ecology. Not known; the sterile collection *b.b.* 6479 collected at c. 1000 m alt.

NOTES

1. *Forbes* 2465, from Sumatra and without field data, is the only one which is fertile. Sinclair identified it at first as *Pygeum* (now *Prunus*), others as possibly *Platea* and finally as a *Horsfieldia* species.

The mature male perianths deviate from most *Horsfieldias* by the obconical shape and the thick-leathery texture, the perianth opening only slightly at the very top, and the turbinate androecium with only 3 anthers at the top, which are clasped by the perianth-valves before anthesis.

These flowers look as if they might be diseased, but on opening I found flowers and androecia normal. The rather few-flowered inflorescences, which bear one or two leaf-like enlarged bracts in the apical portion also look aberrant, but no trace of disease can be found. Enlarged leaf-like bracts in the inflorescences are occasionally found in the inflorescences of other species, e.g., in *H. irya*.

2. *H. sterilis* from Borneo, *H. pulverulenta* from new Guina, *H. crux-melitensis* (to a lesser extent) and related species from new Guinea have a 2-valved perianth and the following combination of characters, i.e., flowers with a perianth equally thick-leathery, similarly the opening limited to the top of the perianth, and the androecium having a "reduced number" of stamens.

3. A second specimen, *b.b.* 6279, from W. Central Sumatra, at c. 1000 m, is sterile. Sinclair determined it as *H. ridleyana*.

52. *Horsfieldia tristis* de Wilde, *sp. nov.*

Fig. 1B(52)

Folia membranacea ad chartacea, in sicco tristia, gemmis tomento minus quam 0.1 mm longis. Cortex ramulorum pallide brunneus, striati, \pm delapsus. Perianthium masculinum late ellipsoideum, c. 3 mm longum, 3-valvatum, in anthesi usque ad $\frac{1}{5}$ - $\frac{1}{3}$ diviso; androecio longiore quam latiore, antheris 12-20. — Type: Sarawak, *Lai Shak Teck* S. 37470 (L; iso: K; KEP, MO, SAN, S, *n.v.*).

Tree 10-15 m. Twigs terete, not ridged, towards the top 3-5(-7) mm diam., early glabrescent, tomentum greyish to rusty, with hairs c. 0.1 mm long or less, bark lower down rather bright brown to yellowish, coarsely striate with a tendency of cracking longitudinally or flaking; lenticels smallish, conspicuous or not. Leaves in 2 rows, membranous to thinly chartaceous, elliptic-oblong to lanceolate, broadest at or slightly above the middle, or \pm parallel-sided, 14-32 \times 4-8.5 cm, base

attenuate, tip acute-acuminate; above drying dull and to a finely wrinkled or granulate structure, dark olivaceous or olivaceous-brown, lower surface glabrous, olivaceous-brown, without blackish-brown dots; midrib flat or slightly raised above, glabrous; nerves 11-17 pairs, above flat or slightly raised or sunken, the marginal arches indistinct or invisible; tertiary venation forming a \pm lax network, inconspicuous or invisible; petioles 6-12 \times 2.0-5 mm, glabrous; leaf bud slender, 10-15 \times 1.5-2.5 mm, densely greyish to dull-brown pubescent with hairs up to c. 0.1 mm long. Inflorescences glabrous or with a few scattered minute hairs up to c. 0.1 mm, in σ^7 : c. 3 times ramified, rather many-flowered, 5-12 \times 3.5-7 cm, common peduncle 7-25 mm long; ρ inflorescences (in fruit): c. 2-3 cm long, once or twice ramified. Flowers (σ^7) in loose clusters 2-5 each, 3- (or 4)-valved, perianth glabrous; pedicel glabrous, at base not articulate; bracts not seen, caducous. Male perianth obovoid-ellipsoid to broadly ellipsoid, 2.8-3.7 \times 2.0-3.0 mm, top broadly rounded, based rounded to short-tapering; pedicel 1.5-5 mm long, slender and well marked off from the perianth; perianth at anthesis cleft to $\frac{1}{5}$ - $\frac{1}{4}$ (to nearly $\frac{1}{3}$); valves 0.2-0.4 mm thick. Androecium obovoid-ellipsoid, top broadly rounded or \pm depressed, in transverse section subcircular or bluntly 3- or 4-angular, 2.0-2.7 \times 1.5-2.0 mm; anthers 12-20, mutually appressed, almost completely sessile with free apices 0-0.1(-0.2) mm long, column broad and solid with a rather broad apical cavity, 0.5-0.8 mm deep, sometimes with a broad and flat base, almost completely concealed by the overcurved anthers; androphore narrow, 0.2-0.3 mm long, largely hidden by the anther-bases. Female flowers not seen. Fruits 4-8 per infructescence, ellipsoid, top subacute, base rounded, c. 1.5 \times 1.2 cm, glabrous, drying blackish, without lenticels or tubercles, pericarp c. 1.5 mm thick; stalk 1-2 mm long; perianth not persisting.

Distribution. Sumatra (E. Coast of Tapanuli), Lingga Arch. (Singkep Isl.), Borneo (Sarawak, S. Kalimantan).

SUMATRA: *Rahmat si Toroes 5486* — Lingga (Sinkep Isl.): *Bünnemeyer 7100*.

BORNEO. Sarawak (1st. Div.): (*Haviland*) *Kalong 1949*; (*Lai Shak Teck*) *S 37470* — S. Kalimantan (Sampit): *Kostermans 8043*.

Ecology. Forest on flat land; 0-100 m alt. Flowers in August and November, fruits in September.

Vernacular names. Kajoe penara (Singkep Isl.); Kajoe darodong lomba (Tapanuli).

NOTES

1. *Fieldnotes.* Flowers yellowish, fragrant.

2. It seems closely related to *H. fulva* and allies of that on account of the similar, elongate, male flowers, but in *H. fulva* the leaves dry brown instead of olivaceous, the twigs brown, neither pale nor bright brown, the bark of the twigs does not tend to crack longitudinally, the inflorescences are pubescent, and the pedicels articulate.

3. The plants have rather yellowish twigs and pale, olivaceous leaves, and give a rather pale overall impression; twigs, leaves and inflorescences are almost completely glabrous. Specimens from Borneo were identified by Sinclair as *H. carnosae*, the specimen from Singkep Isl. as *H. glabra* (see note 4), that from Sumatra as *H. irya*.

4. The one from Singkep Isl., *Bünnemeyer 7100*, somewhat deviates by the relatively thin leaves, their upper surface not very distinctly dull and wrinkled and by the rather broadly ellipsoid, almost subglobose, male perianths; its androecium has a very broad apical cavity with a broad, almost flat base.

53. *Horsfieldia fulva* (King) Warb.

Fig. 1B(53)

Myristica fulva King, Ann. Roy. Bot. Gard. Calc. 3 (1891) 297, pl. 124 — *Horsfieldia fulva* (King) Warb., Mon. Myrist. (1897) 297; Sinclair, Gard. Bull. Sing. 16 (1958) 396, fig. 37; 28 (1975) 33. — Syntype: *Maingay 1304* (2426) (CAL. n.v.: iso: K), *Scortechini 184 a* (CAL. n.v.: iso: BM, K, L, G, n.v.).

Tree 10-20 m. Twigs terete, towards the apex 3-5(-10) mm diam., rather late-glabrescent, tomentum dense, of short-dendroid hairs 0.2-0.3 mm long, lower down with the bark grey or grey-brown, finely to hardly striate; lenticels usually many, not very conspicuous; bark on older twigs not flaking. Leaves in 2 rows, chartaceous to coriaceous, dull, elliptic-oblong to (obovate-) oblong, broadest at or somewhat above the middle, 13-21 × 4-9.5 cm, base attenuate, top acute-acuminate to bluntish; upper surface drying dull pale olivaceous to bright brown, glabrous, lower surface pale brown, glabrous or with some persistent tomentum of hairs 0.2-0.3 mm on and near the midrib and lateral nerves; without larger brown-blackish dots; midrib above flattish or somewhat raised, early glabrescent; nerves 11-14(-18) pairs, above flat to ± sunken, the lateral arches regularly shaped, not distinct; tertiary venation not or hardly visible on both surfaces; petioles 8-13 × 2.5-3.5 mm, glabrous; leaf bud 10-15 × 2.5-3 mm, densely pubescent with hairs c. 0.2-0.3 mm. Inflorescences situated generally behind the leaves, not very densely pubescent, the hairs stellate-dendroid, 0.2-0.3 mm, in ♂: c. 3 times ramified, rather many-flowered, 3-10 × 2-6 cm, common peduncle 2-7 mm long; in ♀: few-flowered, 1-2 cm long; bracts not seen, caducous. Flowers solitary or in loose clusters of up to 5 each, 3-valved, perianth and pedicel glabrous, the pedicels ± articulated at base. Male perianth ellipsoid or ellipsoid-obovoid, 3.0-4.0 × 2.0-2.5 mm, top rounded, base ± attenuate to rounded; pedicel 1-3 mm long, slender; perianth at anthesis cleft to c. 1/5-1/4; valves 0.2-0.3 mm thick. Androecium elongate-ellipsoid, above truncate to rounded, sub-cylindrical to ± 3-angular, 2.0-3.0 × 1.1-3 mm; anthers 10-12, almost entirely sessile, appressed, apices free up to 0.1 mm, the apex of the column narrowly hollowed or cleft to c. 0.3 mm, androphore rather narrow, up to 0.1 mm long. Female perianth (according to Sinclair, 1959, p. 396): long-ellipsoid, 5-6 mm long, 3-valved; pedicel stout, c. 3 mm long; ovary 2.5-3 mm long, glabrous, stigma sessile, bi-lobed. Fruits up to 3 per infructescence, ovoid-ellipsoid, top obtuse to acutish, base broadly rounded, 2.2-2.4(-3.0) × 1.6-2.0(-2.5) cm, glabrous, drying bright brown, without lenticels or warts, dry valves c. 3 mm thick; stalk c. 3-5 mm long; perianth persisting under fruit (always?).

Distribution. Malaya (Perak, incl. Pulau Rumbia, Selangor, Negri Sembilan, Malacca), Sumatra (Jambi Prov.).

MALAYA: *FRI 16028, 16116, 25623, Kep. FN: 76031, 80627, 98837, 99334; Mangay (1304), 2426; Scortechini 184a; (Sinclair) SING 40170.*

SUMATRA: Jambi Prov. *Roos & Franken T.F.B. 1510, 1526*

Ecology. Lowland rain forest; undulating country, on ridges: 0-200 m. Flowers and fruits throughout the year.

NOTES

1. *Fieldnotes*. Bark yellowish-brown, thin, shallowly fissured longitudinally but not flaking; inner bark orange; wood white; sap watery, pale pink, not copious. Flowers orange, fruits yellow.

2. Easily recognized by the dull parchment-like leaves when dry; the nerves above are flat or somewhat sunken, and the tertiary venation is not or hardly visible; it is one of the few species with a 3-valved perianth which is elongate and rather large, 3 mm long or more. I agree with Sinclair that it must be closely related to *H. superba*, which is larger in size in almost all aspects, and which has a generally persistent pubescence on the lower leaf surface.

54. *Horsfieldia superba* (Hook. f. & Th.) Warb Fig. 1B(54)

Myristica superba Hook. f. & Th., Fl. Ind. (1855) 162; A. DC., Prod. 14, 1 (1856) 194; Miq., Fl. Ind. Bat. 1 (2), 1 (1858) 62; Hook. f., Fl. Brit. Ind. 5 (1886) 105; King, Ann. Roy. Bot. Gard. Calc. 3 (1891) 298, pl. 124 *bis*, 125 *bis*. — *Horsfieldia superba* (Hook. f. & Th.) Warb., Mon Myrist. (1897) 295; Corner, Wayside Trees Mal. 1 (ed. 1940 & 1952) 476; Sinclair, Gard. Bull. Sing. 16 (1958) 393, fig. 36, pl. X B; 28 (1975) 141. — Type: *Phillips s.n.* (K; iso: LE. *n.v.*).

Tree 10-30 m. Twigs terete or sometimes faintly angular, stout, towards the apex 5-8(-13) mm diam., rather late-glabrescent, tomentum dense rusty, composed of dendroid hairs 0.5-1.0 mm long, lower down with the bark dark grey, finely striate, lenticels usually many and conspicuous; bark on older twigs sometimes slightly cracking and flaking. Leaves usually in 2, sometimes in 3 rows (see notes), coriaceous, dull, elliptic-oblong to oblong, broadest usually at about the middle (17-)25-40(-70) × (7.5-)10-18(-22) cm, base narrowly subcordate to short-attenuate, top bluntish to acute-acuminate; upper surface drying dull with finely wrinkled structures, olivaceous to grey-brown, glabrous or glabrescent (except sometimes the midrib), lower surface with brown or bright brown rather sparse to dense "mealy" tomentum of dendroid hairs of mixed sizes, c. (0.3-)0.5-1.0 mm long, usually with many or few emerged hairs to c. 1.5 mm long; no larger brown-blackish dots present; midrib rather broad, flat above, pubescent or glabrescent; nerves 15-25(-30) pairs, above flat or sunken, the lateral arches fairly regularly shaped, not very distinct above; tertiary venation not or hardly visible on both surfaces, petiole 6-15 × 5-7 mm, rather late glabrescent; leaf bud 20-30 × 5-10 mm, densely pubescent by hairs 0.5-1.5 mm long. Inflorescences behind the leaves, moderately densely ± woolly pubescent with rather long-branched yellowish-brown dendroid hairs c. 0.5-1.0 mm long; in ♂: rather many-flowered, 2 or 3 times ramified, 7-15 × 2.5-10 cm, common peduncle 10-15 mm; in ♀: ± few-flowered, little branched, 2-5 cm long; bracts broadly ellipsoid, subacute-acuminate, up to 12 × 10 mm, densely pale brownish pubescent, caducous. Flowers (♂) up to c. 5 in a cluster, perianth 3- or 4-valved, glabrous, drying often with a grey-bluish tinge, the pedicels slender, glabrous, at base inarticulate. Male perianth ellipsoid to obovoid-ellipsoid, 6-7(-8) × 4-5 mm, top rounded, base rounded to short-attenuate, glabrous; pedicel 1.5-3.5(-5) mm; perianth at anthesis cleft to c. 1/5-1/4; valves c 0.4 mm thick. Androecium elongate-ellipsoid, subtruncate above, the apex sterile (i.e., not bearing anthers) for c. 0.5 mm (always?), with a shallow tri-radiate crack, base subtruncate, subcylindrical to 3-angular in transverse section, c. (4.0-) 4.5-5 × 2.2-2.5 mm; anthers 16-20, completely sessile, mutually appressed; androphore rather narrow, 0.1-0.4 mm long. Female perianth ellipsoid, c. 7.0-8.0 × 4.5 mm, glabrous, cleft at anthesis to c. 1/5, valves rather coriaceous, c. 0.5 mm thick; pedicel stout, 2-3.5 mm long, glabrous; ovary ovoid, slightly laterally compressed, c. 4-4.5

× 3.0 mm, glabrous, stigma shallowly 2-lobed, broad, c. 0.5 × 1.5 mm. Fruits 1-3 per infructescence, broadly ovoid-ellipsoid, top and base rounded, c. 3.8-5.5 × 2.8-4.5 cm, glabrous, drying dark brown, often ± coarsely warty and wrinkled, valves ± fleshy, when dry 8-12 mm thick; stalk stout, c. 3-6 mm long; perianth-parts persistent under the fruit.

Distribution. Malaya (all states except three), Singapore, Sumatra (Central-West).

MALAYA. *Ahmat F.M.S.* 4867; *Curtis* 2966; *FRI* 0739, 4511, 5416, 10512, 16040, 17076, 25695; *Hervey s.n.*; *Holmberg* 2100; *Kadim & Noor* 364; *Kep FN* 70473, 80618, 93151, 94998, 98192, 109000; *King's Coll.* 8024; *Phillips s.n.*; *Ridley* 10526; *Scortechini s.n.*; *Shah & Noor MS* 1894; *SFN.* 28703, 40496, 40570; *Soepadmo* 758; *Zainudin & Kasim* 01687.

SINGAPORE. *SFN (SING)* 36141, 40047, 40174, 40688.

SUMATRA. *b.b.* 23701; *Koorders* 10383.

Ecology. Forest on alluvial soils, undulating country, also in swampy forest; 0-400 m alt. Flowers visited by bees (*Whitmore FRI* 4511). Flowers August to October, most fruits collected May to August.

NOTES

1. *Fieldnotes.* Bole straight. Bark longitudinally fissured or distantly dipped or cracked. Bark slash brittle, gritty; slash wood soft, white to yellowish. Leaves glossy above, becoming dull with drying. Flowers bright yellow, smell unpleasant or of ripe pears, visited by bees. Fruits globose, greenish-yellow, yellow, or orange.

2. Sinclair suggested (l.c., p. 141) to place the present species together with the much related *H. fulva* in a separate series of their own, mainly on account of the oblong staminal column and the oblong or obovoid male perianth.

3. I have not seen the collection *Koorders* 10383, in BO, from Central Sumatra. The specimen *b.b.* 23701, from Sumatra, West Coast, at 400 m, is sterile, and has the leaves in 3 rows. Apparently this is the top of a robust erect-growing orthotropic sterile shoot. However, in *Whitmore FRI* 4511 (Malaya), fertile male-flowering, the leaves are — possibly by way of exception — arranged in 3 rows, and evidently not distichous as in the remainder of the material.

4. Sterile specimens of *Gymnacranthera bancana*, also with a stout habit and tomentum remaining on the twig apex and the lower leaf surface, may be confused with the present species. However, in the former the hairs of the tomentum are much more interwoven forming a thin felty mat, whereas in *H. superba* the leaf undersurface is covered with harsh, stellate-dendroid hairs.

5. The fruits are recorded by Sinclair (1958, p. 395) as being as large as 7-9 × 5.5-6.8 cm, and at first covered with harsh rusty scurf, becoming glabrous. In the material at my disposal the fruits are all smaller and glabrous, consistent with the glabrous ovary, and I assume that Sinclair's description was probably based on a mixture of species.

55. *Horsfieldia sessilifolia* de Wilde, *sp. nov*

Horsfieldia species *H. sylvestris* similis, ab ea differt folius maioribus, c. 50 × 14 cm, dense breviter

tomentosis ad folia paginam inferiorem, petiolo brevissimo ac lato, usque ad c. 3 mm longo, perianthio 3-valvato, usque ad $\frac{1}{2}$ diviso, ovario subglabro. — Type: *Turkey bin Tran S 27808* (L; iso: K, SING, Silv. Sib., *n.v.*).

Tree c. 30 m. Twigs terete, stout, towards the apex c. 8-10(-20) mm diam.; twig apex (and leaf bud) not seen; bark lower down glabrous, finely striate and rather densely set with conspicuous lenticels. Leaves arranged in 2 rows, chartaceous, oblong-lanceolate, \pm parallel-sided, c. 50×14 cm, base broadly rounded to subcordate, top acute-acuminate; upper surface drying dark brown, glabrous, lower surface finely bright-brown pubescent with densely interwoven hairs c. 0.1(-0.3) mm; without dark brown dots; midrib above flattish; nerves c. 30(-35) pairs, above flat or slightly sunken, beneath with distinct submarginal arches; tertiary venation forming a coarse network, indistinct, on the lower leaf surface and largely hidden by the tomentum; petiole short, c. $2-3 \times 8$ mm, or leaves sessile; leaf bud not seen. Inflorescences only known in ♀: c. 3 times ramified, c. $4-5 \times 3.5$ cm, rather many-flowered; branches rather densely rusty woolly-pubescent with hairs c. 0.3-0.5 mm; common peduncle c. 1×0.8 cm; bracts oblong-lanceolate, c. 1 cm long, inside subglabrous, outside pubescent as the inflorescence, caducous. Flowers in ♀ in clusters of 2-5 each; perianths 3-valved, minutely pubescent in the lower half. Male perianth not seen. Female perianth obovoid-ellipsoid, stout, c. $4.5-5.0 \times 4.0-4.5$ mm, coriaceous, pubescent with hairs c. 0.1 mm in the lower half, cleft at anthesis to c. $\frac{1}{8}-\frac{1}{10}$ only, valves c. 0.5 mm thick; pedicel stout, c. 1 mm long, minutely pubescent; ovary ovoid, c. 2.5×2.5 mm, subglabrous, with a few minute hairs, only on and near the base of the suture, whitish, less than 0.1 mm long; stigma broadly 2-lipped, c. $0.2-0.3 \times 1.5$ mm, not or only faintly lobed. Fruits not seen.

Distribution. Borneo. Sarawak: Sibu district (3rd Div.), known only from the type from Sg. Tutus, Loba Kabang (S) P.F., Batang Igan.

Ecology. Lowland mixed swamp forest, apparently under 100 m alt. Flowers in June.

Vernacular name. Kumpang tembaga.

NOTES

1. *Fieldnotes.* Recorded as a tree 100 ft. tall, 42 ins. girth, with stilt roots.

2. The specimen on which the new species is based is reminiscent of some other stout-leaved *Horsfieldias*, viz. *H. sylvestris* from SE. Malesia, and to a lesser extent of *H. splendida* (Borneo), *H. superba* (Malaya, Sumatra), or *H. pulcherrima* (Sumatra), but the present new species is distinct in its almost sessile leaves and the densely short-pubescent lower leaf surface. *H. sylvestris* is generally less stout; it has similarly subsessile (but narrower) leaves and 2-valved perianths. The other mentioned stout-leaved species all have the leaves distinctly petioled.

3. The specimen was collected in June, 1971, i.e., after Sinclair's work was published. In the absence of male flowers, Mr. J. Koster (Koster & Baas, 1981) investigated the leaf anatomy and confirmed the identity of the specimen as being a *Horsfieldia*.

56. *Horsfieldia grandis* (Hook. f.) Warb.

Fig. 1C(56)

Myristica grandis Hook. f., Trans. Linn. Soc. 23 (1860) 157 — *Horsfieldia grandis* (Hook. f.) Warb., Mon. Myrist. (1897) 301; Sinclair, Gard. Bull. Sing. 16 (1958) 400, f. 39; 28 (1975) 48. — Type: Sabah, *Low s.n.* (K).

Myristica rubiginosa King, Ann. Roy. Bot. Gard. Calc. 3 (1891) 302, pl. 130 — Type: Singapore, *King's Coll. 1233* (CAL, n.v.; iso: K, L).

Tree 6-25 m. Twigs stoutish, terete, towards the top (3-)4-10 mm diam., late-glabrescent, tomentum dense, harsh, with hairs c. 1.0-1.5 mm long; bark of twigs lower down rather coarsely striate, when older longitudinally and sometimes slightly transversely cracking, hence slightly flaking; lenticels often present, somewhat elongate, not conspicuous. Leaves in 2 rows, membranous or chartaceous, somewhat bullate, elliptic-oblong to oblong-ob lanceolate, broadest usually somewhat above the middle, 12-40 × 5.20 cm, base ± attenuate to subcordate, top acute or acute-acuminate; upper surface drying olivaceous to dark brown, minutely paler pustulate, largely with harsh, persistent tomentum of rather distant hairs, sometimes glabrescent, but always scabrous from harsh, persistent hair-bases, lower surface with persistent tomentum of dense to rather distant hairs c. 1.0-2.0 mm long, harsh-woolly to the touch; without brown dots; midrib above usually densely pubescent, somewhat raised; nerves (8-)10-16(-19) pairs, above flattish or usually sunk, the marginal arches distinct; tertiary venation forming a lax network, well visible on both surfaces especially the lower; petiole 6-15 × 2.5-6 mm, densely pubescent; leaf bud short-conical, densely pubescent, 7-15 mm long. Inflorescences densely pubescent, hairs yellow-rusty, 1.5-3.0 mm long, in ♂: many-flowered, 3 or 4 times ramified, usually rather lax, c. 6-25 × 2.5-10(-15) cm, common peduncle up to 12 mm long; ♀ inflorescences 1.5-5 cm long, the flowers often of different age and size; bracts generally oblong to lanceolate-linear, (1.0) 3-12 mm long, caduous. Flowers 3- or 4-valved, glabrous, solitary or usually in loose clusters, often aggregated into compound clusters corresponding to the main ramifications of the inflorescences; pedicels slender, glabrous, at base inarticulate. Male perianth globose or depressed-globose, 1.2-1.8(-2.0) mm diam, at apex rounded or broadly rounded, base rounded; pedicel (0.5-)1-2 mm long; perianth at anthesis cleft to c. 1/3 to nearly 1/2-way, valves c. 0.2 mm thick. Androecium depressed globose, not laterally compressed, apex broadly rounded to depressed, c. 0.5-1.0 × 0.8-1.5 mm; anthers 8-10, almost completely sessile, incurved towards the top, column broad, solid, hollow c. 0.2 mm deep; androphore rather narrow, 0.2-0.4 mm long. Female perianth subglobose to broadly ellipsoid, 2.0-3.2 × 2.0-2.8 mm, cleft at anthesis to c. 1/4-1/3, valves 0.2-0.3 mm thick; pedicel 0.3-0.5 mm long, glabrous except sometimes with a few hairs at the base; ovary globose to broadly ellipsoid, c. 1.5-2.0 × 1.5-1.8 mm, glabrous, stigma sessile, faintly 2-lobed, c. 0.2 mm high. Fruits 2-10 per infructescence, ± clustered, obovoid-ellipsoid, top rounded 1.0-1.4 × 0.8-1.1 cm, glabrous, valves c. 1.5 mm thick, drying dark brown or reddish brown, without distinct lenticels, not warted; seed almost globose, 8-10 mm diam.; stalk c. 1 mm long; perianth persistent.

Distribution. Sumatra (Palembang; Riouw, *n.v.*), Malaya (Pahang, Johore), Singapore, Borneo (Sarawak, Brunei, Sabah, E. Kalimantan).

MALAYA. Pahang: *Chew Wee-lek & Noor, CWL 261* — Johore: *FRI 8699, 17135; Holtum 9304; Ridley 4827; SFN 36831; Shah, Noor & Shukor MS 2060; Sinclair 10602.*

SINGAPORE. *King's Coll. 1233; Ridley 4133; Sinclair 9363.*

SUMATRA. Palembang: *Endert 44* — Riouw Arch.: *Teysmann s.n.* (not seen).

BORNEO. Sarawak: *Hose* 655; *S* 15006, 18940, 23057, 25486, 26257, 28966, 29189, 37731, 37952 — Brunei: *Ashton BRUN* 64, 752, 3011; *Fuchs & Muller* 21160; *Wyatt-Smith KFN*. 80106; *Sinclair & Kadim* 10455 — Sabah: *Castro A* 83; *SAN A* 1741, 3691, 17497, 36338, 36914, 44361, 44713, 48857, 69297, 72199, 77512, 80921, 84636, 93684; *Sinclair, Kadim, & Kapis* 9249; *Wood* 9; *Wood* 1226 — E. Kalimantan: *Enderi* 5081; *Jaheri* 727; *Korthals* 92; *Kostermans* 7035, 7044.

Ecology. Primary and secondary forest, ridge forest; on sand and clay soil, sandstone; 0-600 m alt. Flowers and fruits throughout the year.

Vernacular names. Kumpung (Malay, Iban name; Sarawak); Penarahan (Brunei); Tjemanding (Sumatra, Palembang).

NOTES

1. *Fieldnotes.* Slender tree, without buttresses; monopodial branches, branchlets few, horizontal. Bark sometimes recorded as smooth, non-flaking, usually as longitudinally fissured, or scaly, or flaky, or cracked; strips c. 1 mm thick, c. 1 cm wide, hard and thin; inner bark c. 2-3 mm thick, slash rich red-brown, with reddish watery exudate. Sapwood soft, whitish to yellowish pink, wood pale brown. Flowers yellow, with faint odour. Fruits yellow-green, yellow or \pm orange, pericarp inside pink; aril orange; seed pale grey.

2. Perianths are usually 4-, less frequently 3-valved. I think there are 8-10 anthers, but Sinclair says 13-15, the discrepancy is probably caused by the thecae being tightly appressed and difficult to count.

3. The fruits are small, rather contrasting with the stout habit of twigs and leaves. The perianth remains persistent under the maturing fruit.

4. The circumscription of the present species is the same as that by Sinclair. It belongs apparently to the group of West-Malesian species with pubescent lower leaf-surface, and is probably most closely related to *H. flocculosa*. *H. grandis* is well-marked in many details and readily recognizable by the scabrous upper leaf surface which is caused by the harsh hair-bases.

57. *Horsfieldia wallichii* (Hook. f. & Th.) Warb.

Fig. 1C(57)

Myristica wallichii Hook. f. & Th., Fl. Inc. (1855) 161 (p.p., Wall. Cat. 6806 being a mixture, see note by Sinclair, loc. cit., p. 158); A. DC., Prod. 14, 1 (1856) 230; Miq., Fl. Ind Bat. 1 (2), 1 (1858) 67; Hook. f., Fl. Br. Ind. 5 (1886) 105; King, Ann. Roy. Bot. Gard. Calc. 3 (1891) 303, pl. 132 & 133, excl. syn. *M. crassifolia* Hook. f. & Th. — *M. horsfieldia* auct. non Bl.: Wall. Cat. (1832) 6806, p.p. — *Horsfieldia wallichii* (Hook. f. & Th.) Warb., Mon. Myrist. (1897) 305; Sinclair, Gard. Bull. Sing. 16 (1958) 405, fig. 41, pl. XI A; 28 (1975) 156 (p.p. excl., part of the Bornean material = *H. borneensis*) — Syntype: Malacca, *Griffith s.n.* (K); Singapore. *Wallich Cat*, 6806, p.p. (CAL n.v.; K); *Lobb s.n.* (K, n.v.).

Tree, 10-30 m. Twigs terete or drying somewhat flattened, usually conspicuously hollow, towards apex 3-6(-9) mm diam., early to late-glabrescent from tomentum of hairs c. 0.3-0.6 mm, bark lower down usually dark brown or blackish, coarsely striate, with or without inconspicuous lenticels; bark on older twigs often longitudinally fissured, sometimes flaking. Leaves in 2 rows, membranous to coriaceous, ovate-oblong to oblong-lanceolate, broadest usually at about the middle or somewhat parallel-sided, (14-)19-40 \times (4-)4.5-12 cm, base rounded to short-attenuate,

top subobtusate to acute-acuminate; upper surface drying olivaceous to blackish-brown, glabrous (with minute tomentum remaining on the midrib or not); lower surface late-glabrescent or tomentum locally persisting, of rather spaced to dense dendroid hairs (0.3-)0.5-0.8 mm long, always provided with typical scattered brown-black dots and stripes of irregular sizes; midrib above flat or slightly raised, late glabrescent: nerves (12-1) 15-28 pairs, above very slender, flat or sunken; tertiary venation forming a lax network, usually indistinct or invisible, petioles relatively long, 15-35 × 2.5-4.5 mm, glabrescent; leaf bud c. 20-30 × 4-6 mm, densely pubescent, hairs c. 0.3-0.6 mm. Inflorescences usually behind the leaves, moderately to densely pubescent with stellate-dendroid hairs 0.5-1.0 mm long, in ♂: large, many-flowered, 3 or 4 times ramified, 10-33 × 6-22 cm, common peduncle 30-70 mm, in ♀: stoutish, fewer-flowered, c. 3-7 cm long; bracts broadly ovate, 3-10 mm long, densely woolly-pubescent, caducous. Flowers in ♂ in clusters of 5-12, perianth 3-(or 4)-valved, glabrous, or in ♀ glabrescent, pedicel short, pubescent, at base inarticulate. Male perianth broadly obovoid, 2-2.5(-3.0) × 2.4-2.5 (-3.0) mm, top broadly rounded, base ± attenuate, glabrous; pedicel short, 0.3-0.6 (-1.0) mm, pubescent with hairs 0.2-0.3 mm long; perianth at anthesis cleft to c. 1/3-2/3; valves c. 0.2-0.3 mm thick. Androecium broadly obovoid to subglobose, above ± depressed with a tri-radiate crack, based rounded to attenuate, faintly 3-angular in cross-section, 1.3-2.0 × 1.5-2.0 mm; anthers (12?-)15-23, completely connate, sessile and closely appressed, at apex rather deeply incurved into the broad hollow c. 1/2-way deep in the column; androphore short and narrow, up to 0.3 mm long. Female perianth ovoid-ellipsoid, 2.5-4.0 × 2.0-3.5 mm, glabrescent from hairs 0.1 mm, cleft at anthesis to c. 1/3, valves c. 0.5 mm thick; ovary ovoid to subglobose, 2.0 × 2.0-2.5 mm, glabrous, stigma rather broad, faintly 2-lobed, c. 0.3 × 0.8 mm; pedicel stout, 0.5-1.5 mm long, densely pubescent by hairs 0.2-0.3 mm. Fruits 2-9 per infructescence, ovoid-ellipsoid, top and base rounded, 4.0-6.0 × 3.0-4.5 cm, glabrous, drying dark brown, smooth or wrinkled, not or only faintly warted, valves 10-15 mm thick; stalk stout, 4-6 mm long; perianth generally persistent under the fruit.

Distribution. Malaya (all provinces except Perlis and Negri Sembilan), Singapore, Sumatra (Aceh, Tapanuli, W. & E. Coast, Indragiri, Djambi, Palembang; Simalur (Simeuluë), Morsala, Mentawai Isl., Bangka), Borneo.

MALAYA. *FRI*0514, 2135, 4565, 6703, 13252, 14675, 14771, 17076; *Kep. FN.* 94671, 99010; *Kunstler (King's Coll.)* 4827; *Maingay* 2665; *Scortechini* 246a; *SFN* 40484; *Sinclair* 9984.

SINGAPORE. *Maingay* 1001, 1001A, 1283, 1284; *SFN.* 33556, 34439, 39486, 39487, 40216; *Wallich Cat.* 6806.

SUMATRA. *Achmad* 251, 514, 675, 1219; *b.b. T* 944, 16382, 17452, 19346, 24049, 30033, 31758, 32146; *Forbes* 3048, 3078; *Kostermans* 205 (*b.b.* 34139), *b.b.* 34063, *b.b.* 34194; *Kostermans & Anta* 795, 845, 1068, 1194; *Krukoff* 4114; *Mochtar* 62A, 82A, 91A 97A; *de Wilde & de Wilde-Duyfjes* 18931.

BORNEO. Sarawak: *Haviland* 2182 — Sabah: *BNB For. Dept.* 1682 — Kalimantan, West: *b.b.* 25505; E. and SE.: *b.b.* 16139, 21179; *Forman* 484; *Kostermans* 5651; *Leighton* 844; *Hubert Winkler* 2419.

Ecology. Lowland forest, on 'red' soil, granitic sand soil, loam soil with coral limestone; ridge-top forest; 0-470m. Flowers and fruits throughout the year.

Vernacular names. Asem-asem (Bangka, Malay), Piangu, Pijangu (Bangka, Malay); Satim, Soemarallah-falah, Soemarallah-oeding, Toetoen soemarallah dè-lok (all Simeuluë Isls.).

NOTES

1. *Fieldnotes*. Bole straight; crown dense, monopodial. Bark shallowly or deeply longitudinally fissured, dark grey, not flaking. Bark c 1 cm. thick, slash under bark bright red, pink, reddish brown, or deep red; slash wood whitish, pale or dirty yellowish, light brown, brown or red-brown. Flower buds blue-green or yellow at anthesis. Fruits glaucous, turning green-yellow, yellow, orange, orange-yellow, or red; aril orange.

2. This species is identical with Sinclair's circumscription of the species for the Malay Peninsula (Sinclair, 1958), but if compared to Sinclair's, 1975, the majority of the specimens from Borneo should be excluded. These specimens are presently described as a new species *H. borneensis*.

3. *H. wallichii* is, in the sterile state, always recognizable by the blackish dots and stripes scattered on the lower leaf surface. Similar dots are only found in a few other species, incl. *H. borneensis*, but the latter differs in general habit and the male flowers; it has almost similar fruits.

H. wallichii in the sterile and fruiting state can also be confused with *H. superba*, a large-leaved species, but this lacks the blackish markings on the lower leaf surface. *H. motleyi* has also somewhat similar leaves, i.e., drying dull above, and with flat or sunken lateral nerves; apart from the difference in the flowers and fruits, its lower leaf surface is not dotted.

58. *Horsfieldia pulcherrima* de Wilde, *sp. nov.*

Fig. 1C(58)

Ramuli robusti, tarde glabrescentes, pilis 1-1.5mm longis. Folia 24-36 cm longa, subtus pubescentia atque munita punctis sordide brunneis non-traumaticis. Perianthium masculinum depresso-globosum, 1-1.3 mm diam., 3-valvatum, glabrum, pedicello basi non-articulato. Androecium depresso-globosum, 0.8-1.0 mm diam., anthers 12. — Type: Malaya, *Cockburn FRI 8008* (L; iso: K).

Tree 7-27 m. Twigs stout, terete, towards apex 5-8(-14) mm diam., densely felty to woolly pubescent with rusty or reddish brown hairs c. 1.0-1.5 mm, late glabrescent, bark coarsely striate, when older somewhat cracking and flaking; lenticels only in the older wood, large, not contrasting in colour. Leaves in 2 rows, chartaceous, elliptic-oblong to oblong, broadest usually at about the middle, (18-)24-36 × 8-14 cm, base rounded to attenuate, top acute-acuminate; upper surface drying dull olivaceous brown to blackish brown, glabrous (glabrescent, and not scabrous), lower surface with dense rusty or red-brown tomentum of mostly dendroid hairs 1.0-1.5 mm long and with scattered dark brown to blackish ± wart-like marks (cork warts); midrib above rather slender, late-glabrescent, flat; nerves 18-23 pairs, above slender, flat to sunken, marginal arches not very distinct; tertiary venation forming a rather lax network, usually faint or scarcely visible; petiole 15-25 × 5-7 mm, pubescent; leaf bud c. 25-30 × 7-9 mm, with hairs 1-1.5 mm long. Inflorescences behind the leaves, densely woolly-pubescent with ± shaggy hairs 0.5-1.5 mm long, in ♂: 5-8 × 5 cm, many-flowered, 3 or 4 times ramified, common peduncle 2-10 mm long; in ♀ a short, irregularly shaped, woody knob (as in some *Knemas*), c. 1 cm long. Flowers subsolitary or in loose clusters of up to 15 each, 3-(or 4-)valved, glabrous; pedicels glabrous, at base inarticulate; bracts ovate-oblong, acute, densely pubescent outside, 3-7 mm long, caduous. Male perianth somewhat depressed-globose, c. 1.0 × 1.2-1.3(-1.4) mm, top ± depressed or broadly rounded, base rounded, pedicel 1-1.5 mm long, slender, not tapered; perianth at anthesis

cleft to c. $\frac{1}{3}$ to nearly $\frac{1}{2}$ -way, valves c. 0.2 mm thick. Androecium depressed-globose, above \pm depressed and with a 3-(or 4-)radiate crack, $0.5-0.6 \times 0.8-1.0$ mm; anthers 12 or 13 (c. 24 thecae), mutually closely pressed, completely sessile, the apical parts overarching the apical hollow to c. $\frac{1}{2}$ -way deep; column broadly saucer-shaped, androphore narrow, 0.1-0.2(-0.3) mm long, largely hidden by the anthers. Female perianth (as known from caducous remnants under fruit): c. 3 mm long, sparingly pubescent with hairs c. 0.3 mm long, at anthesis cleft to nearly $\frac{1}{2}$ -way, valves c. 0.3 mm thick. Ovary pubescent. Fruits in clusters of 1-3 per infructescence, broadly ellipsoid to globose, c. $1.6-1.8 \times 1.5-1.7$ cm, densely shaggy rusty pubescent with hairs c. 2 mm long, valves \pm woody, c. 1.5 mm thick, seed broadly ellipsoid, c. 10 mm long, aril entire, completely enveloping the seed; stalk 0-1 mm; perianth not persistent.

Distribution. Malaya (Pahang, Johore), Sumatra (Jambi).

MALAYA: FRI 8008, 19881, 31807; Kep. 104997, 110369.

SUMATRA: Roos & Franken TFB 1983 (sterile).

Ecology. Lowland primary forest, swamp forest; 50-600 m alt.; apparently a rare species. Flowers in March, fruits in June and September.

NOTES

1. *Fieldnotes.* Slender tree, crown monopodial. Bole straight; bark grey-brown to blackish, shallowly fissured, occasionally flaking. Inner bark red, laminated, with some red exudate. Slash wood whitish to pale yellow, wood brown. Immature flowers green. Fruits yellowish-brown hairy.

2. All the specimens of this remarkable and beautiful new species known to me were collected after Sinclair's revision of *Horsfieldia*. In sterile state the species may be confused with *H. superba*, *H. flocculosa*, or *H. wallichii*, but its σ flowers are quite different, rather resembling those of *H. grandis*. The species is peculiar because of its smallish, subglobose, densely tomentose fruits. In all related species the fruits (and ovary) are glabrous.

3. If sterile, *H. pulcherrina* may superficially resemble and be confused with the stout-leaved *Gymnacranthera bancana*, but the latter has a different tomentum, and lacks the blackish dots on the lower leaf surface.

59. *Horsfieldia flocculosa* (King) Warb.

Fig. 1C(59)

Myristica flocculosa King, Ann. Roy. Bot. Gard. Calc. 3 (1891) 302, pl. 131 — *Horsfieldia flocculosa* (king) Warb., Mon. Myrist. (1897) 297; Sinclair, Gard. Bull. Sing. 16 (1958) 398, f. 38. — Type: Malaya, Selangor, King's Coll. 8618 (CAL, n.v.; iso: BM, K, L, P; B \dagger , Fl. G. KEP, Z. n.v.).

Tree 10-28 m. Twigs stout, terete, towards the apex 6-10(-12) mm diam., densely felty-woolly pubescent with yellow brown or pale brown hairs (1.0-) 1.5-2 mm, late glabrescent, bark coarsely striate, soon longitudinally cracking, in older wood also transversely cracking and \pm flaking; lenticels absent or indistinct. Leaves in 2 rows, chartaceous, oblong to oblong-lanceolate, broadest at about the middle, 18-40(-45) \times 6-13(-18) cm, base broadly to narrowly rounded or subcordate, tip acute-acuminate; upper surface drying usually olivaceous to (light) brown, finely pustule-

late and wrinkled, glabrous, not scabrous, lower surface with dense persistent woolly tomentum of hairs 1.5-2 mm long, without blackish dots; midrib flat above; nerves 15-20 pairs, above sunken, marginal arches rather distinct and regularly shaped; tertiary venation forming a lax network, \pm faint above, on lower surface much obscured by the tomentum; petiole 7-14(-20) \times 5-7 mm, densely pubescent; leaf bud stout, 10-15 mm long. Inflorescences behind the leaves, densely woolly-pubescent, in σ^7 : rather stout, many-flowered, 3 or 4 times ramified, (8-) 12-20 \times 5-14 cm, common peduncle stout, 3-5 mm diam., 1-10 mm long; in f : little ramified, 1.5-3 cm long, rather few-flowered. Flowers solitary or 2-3(-4) together, generally not clustered, glabrous, (3- or) 4-valved in σ^7 , (2- or) 3-valved in f ; pedicels at base inarticulate, glabrous; bracts ovate to lanceolate, densely pubescent, 5-20 mm long, caducous. Male perianths broadly ellipsoid to obovoid, or sometimes subglobose, not or slightly laterally compressed, (2.0-) 2.2-3.0 \times 2.0-2.7 mm, top broadly rounded, base rounded, pedicel slender, not tapered, (1.5-)3.0-4.0 mm long; perianth at anthesis cleft to $\frac{1}{5}$ - $\frac{1}{4}$, valves c. 0.2 mm thick. Androecium \pm ellipsoid or broadly obovoid, subtruncate, c. 1.2-1.5(-2.0) \times 1.0-1.3(-1.5) mm, not or only little laterally compressed, base broadly rounded, often faintly 4-angular in transverse section; anthers 10-13 entirely sessile, (not? septate), the apices slightly curved into the shallow hollow, c. 0.2-0.3 mm deep in the apex of the broad and solid column; androphore short, c. 0.1 \times 0.4 mm, usually hidden by the slightly sagged anthers. Female perianth broadly ellipsoid, c. 3.5 \times 3.0 mm, cleft at anthesis to c. $\frac{1}{6}$ - $\frac{1}{5}$, valves c. 0.4-0.5 mm thick; pedicel stoutish, c. 2 mm long, glabrous; ovary broadly ovoid, c. 1.8 \times 2.0 mm, glabrous except for a few minute hairs (always?) on the suture below the stigma, stigma minute, faintly 2-lobed, c. 0.3 mm long. Fruits (almost mature, according to Sinclair) subglobose to slightly ellipsoid, glabrous, c. 3.0 \times 2.5 cm, pericarp c. 5 mm thick; stalk 5 mm long; perianth (at first) persistent.

Distribution. Malaya: Only seen from Selangor, Negri Sembilan, Pahang and Johore.

MALAYA. (Whitmore) FRI 0048; Hassan & Kadim H. 98; Kep. 104653, 110225, 77746; King's Coll. 8618; SFN 16394, 32314.

Ecology. Lowland rain forest, also swampy forest, regenerated forest; 0-300 m alt. Flowers mainly February-June.

NOTES

1. *Fieldnotes.* Buttresses absent. Bark distantly superficially fissured, blackish brown; inner bark pinkish brown, laminated; sapwood whitish. Exudate watery, red. Young leaves flocculose. Margins of leaves slightly revolute when dry. Leaves somewhat bullate, thickish, shiny medium green above, golden below. Flowers yellow, or waxy light yellow. The perianths are described by Sinclair (1958, p. 400) as 'covered with circles which are hyaline in the centre and brown round the circumference'.

2. Apparently much related to *H. superba*, *H. fulva* (the f flowers \pm similarly shaped as the σ^7), and also to the group of *H. grandis*, and others but is distinguished by many characters. The species is presently accepted in the same sense as by Sinclair and earlier authors.

60. *Horsfieldia motleyi* Warb.

Fig. 1C(60)

Horsfieldia motleyi Warb., Mon. Myrist. (1897) 304; Merr., En. Born. J. Str. Br. R. As. Soc. spec. number (1921) 268; Sinclair, Gard. Bull. Sing. 28 (1975) 81 — *Myristica motleyi* (Warb.) Boerl., Handl. Fl. Ned. Ind. (1900) 85. — Type: SE. Borneo, Banjarmasin, *Motley* 355 (K, iso. CGE, *n.v.*).

Horsfieldia macrobotrys Merr., Pl. Elm. Born. in Univ. Cal. Publ. Bot. 15 (1929) 76 — Type: Sabah, Tawau, Elmer 21882 (PNH, †; iso: BM, K, L; BO, SING, and others not seen).

Tree 12-35 m. Twigs terete, towards the apex (2.5-)3-5(-10) mm diam., late-glabrescent from dense rusty tomentum of hairs c. 0.5(-1.0) mm, bark lower down finely striate; lenticels not conspicuous; bark of older twigs not flaking. Leaves in 2 rows, membranous, not bullate, elliptic to oblong, broadest usually at about the middle, 9-27 × 4-12 cm, base rounded to attenuate, top obtusish to acute-acuminate; upper surface drying dull dark-olivaceous to greenish brown, glabrous, lower surface with persistent rather dense tomentum of stellate-dendroid hairs of mixed size, c. 0.3-1.0 mm long, without larger blackish dots; midrib flattish above, sometimes late-glabrescent; nerves 9-21 pairs, slender above, often late-glabrescent, flat or usually sunken, the lateral arches not very distinct; tertiary venation forming a lax network, faint above; petioles 13-22 × 1.5-4 mm, rather late-glabrescent; leaf bud c. 15-20 × 3-4 mm, densely pubescent by hairs c. 0.5 mm long. Inflorescences densely pubescent with stellate-dendroid yellow-brown to rusty hairs c. 0.5-1.0 mm long, in ♂: 4 or 5 times ramified, many-flowered, 12-20 × 10-14 cm, common peduncle 20-40 mm, the flowers before maturity often densely clustered and in submature buds often ± angular; in ♀: much ramified, rather many-flowered, 3-6(-10) cm long; bracts densely pubescent, broadly ellipsoid, acutish, 2-5 mm long. Flowers in clusters of 5-20, 3-valved, perianth and pedicel pubescent by hairs 0.1-0.3 mm, the pedicels slender, at base inarticulate. Male perianth subglobose or broadly obovoid, 0.8-1.0 × 0.7-1.0(-1.1) mm, top broadly rounded, base rounded, pubescent or late-glabrescent; pedicel slender, 1-1.5 mm long; perianth at anthesis cleft to c. half-way; valves c. 0.1 mm thick. Androecium (incl. androphore) broadly obovoid, above somewhat flattish and depressed in the centre, sub-circular in transverse section, 0.5-0.7 × (0.3-)0.5-0.6 mm; anthers 5, almost completely sessile, towards the top not or hardly incurved, 0.25-0.4 mm long; column broad, solid except for the shallow, broad, apical hollow to c. 1/10; androphore conspicuous, about as long as the anthers, broad, tapering, c. 0.2-0.3 mm long, continuous with the anthers. Female perianth ellipsoid, c. 2.4 × 1.8-2.0 mm, pubescent, cleft at anthesis to c. 1/4-1/3, valves c. 0.2 mm thick; pedicel c. 1.5 mm long; ovary broadly ellipsoid, 1.5 × 1.2 mm, top and base broadly rounded, conspicuously grooved at one side, glabrous, stigma broad, shallowly 2-lobed, c. 0.2 mm high. Fruits 5-15 per infructescence, broadly ellipsoid, top and base rounded, 1.9-2.3 × 1.6-1.8 cm, glabrous, drying brown, without lenticel-like wartlets, dry valves c. 2 mm thick; stalk 2-4 mm long; perianth not persistent under mature fruit.

Distribution. Whole of Borneo: Sarawak, Sabah, W., S., SE. and E. Kalimantan.

BORNEO. Sarawak: *S (Chai)* 36774, (*Martin*) 37945 — Sabah: *Elmer* 12882; *San.* 19007, 27443, 29966, 77428 — Kalimantan, West: *Hallier* 347 — South: *Kostermans* 8117 — SE.: *b.b.* 18449, 26178; *Korthals* (39); *Motley* 355 — East: *Kostermans* 4864, 6859, 10428.

Ecology. Primary forest, disturbed forest, poor forest, Dryobalanops forest, or hill Dipterocarp forest, usually on dry sandy soils, sandy clay, also loam with lime; often on ridge tops; 0-600 m alt. Flowers and fruits throughout the year.

NOTES

1. *Fieldnotes*. Bole sometimes with steep buttresses to 5 m high, c. 30 cm out, c. 9 cm thick, merging into the stem. Bark usually distinctly fissured, often scaly, strips 3-4 cm wide, to c. 10 mm thick, dark brown, black-brown, chocolate, or red-brown; living bark 10-12 mm thick, undulate in cross section, dark brown, or brown-red, inner bark red-laminated; cambium pinkish. Sapwood whitish, reddish white, heartwood reddish or pinkish or brown; exudate of bark a red watery latex, sometimes recorded as sticky, appearing fast. Flowers (dark) yellow. Fruits orange-red, with sticky exudate; aril reddish.

2. In Sinclair's conception this species contains a number of specimens which are in the present revision regarded as a different species, *H. affinis*. The latter differs in many characters, such as the pedicel being articulate at base, a differently shaped androecium, a larger glabrous perianth, a different tomentum on the lower leaf surface, the perianth being persistent under the fruit, etc.

3. *H. motleyi*, especially in a young stage, may be confused with *Endocomia rufirachis*, formerly *Horsfieldia macrocoma* var. *rufirachis*, a species also with pubescent flowers.

61. *Horsfieldia tomentosa* Warb.

Fig. 1C(61)

Horsfieldia tomentosa Warb., Mon. Myrist. (1897) 302; Sinclair, Gard. Bull. Sing. 16 (1958) 403, fig. 40; 28 (1975) 149 — *Myristica tomentosa* Hook. f. & Th., Fl. Ind. (1855) 161, nom. illeg., not of Thunberg (1782); A. DC., Prod. 14, 1 (1856) 204; Miq., Fl. Ind. Bat. 1 (2), 1 (1858) 68; Hook. f., Fl. Br. Ind. 5 (1886) 105; King, Ann. Roy. Bot. Gard. Calc. 3 (1891) 301, pl. 129 — Type: *Wallich Cat. 9025* ("Myristicea?") (K-Wall.; iso: K, BM; CAL, G, SING, *n.v.*).

Tree 5-20(-40) m. Twigs terete, towards apex 2-5(-10) mm diam., late-grabescent from dense, rusty tomentum of woolly hairs c. 1.0-1.5 mm, bark of older twigs striate, not flaking; lenticels usually abundant, rather conspicuous. Leaves in 2 rows, membranous, elliptic or obovate to oblong-lanceolate, broadest at \pm or slightly above the middle, 9-27 \times 4-10(-12) cm, base nearly rounded to attenuate, tip acute-acuminate; upper surface drying brown, faintly minutely pustulate or not, glabrous or glabrescent, lower surface with persistent tomentum of dense dendroid hairs all of about the same size, c. 0.1-0.8 mm long, without blackish larger dots; midrib above flattish, glabrescent; nerves 7-15 pairs, flattish or sunk above, the marginal arches on lower surface rather distinct, rather regular of shape; tertiary venation forming a lax network usually indistinct or invisible above; petiole 10-18 \times 1.5-3 mm, densely pubescent; leaf bud narrowly ovoid-ellipsoid, c. 1-1.5 cm long, densely pubescent with hairs c. 1.5 mm. Inflorescences densely pubescent with woolly hairs 1.5-2.0 mm long, in σ : rather many-flowered, 3 or 4 times ramified, 3-12 \times 1.5-7 cm, common peduncle 3-23 mm; in ρ : \pm few-flowered, 2-6 cm long; bracts elliptic, densely woolly pubescent, 2-4 mm long, caducous. Flowers in small fascicles, 3-(or 4- or 5-) valved, glabrous; pedicels slender, at base not articulated, in σ glabrous, in ρ late-glabrescent, hairs c. 0.2 mm. Male perianth globose, 1.4-2.5 mm diam., base and apex rounded; pedicels 1-3 mm long; perianth at anthesis cleft to nearly $\frac{1}{2}$ -way, valves c. 0.1 mm thick. Androecium much-depressed globose, above flattish or usually impressed in the centre, circular to blunt-triangular in transverse section, 0.6-0.9 \times 1.2-1.7 mm; anthers 9-12(-15?), almost completely sessile, incurved towards the top; column broad, solid except for apical hollow c. 0.2 mm deep; androphore rather narrow, c. 0.4-0.5 mm long. Female perianths broadly ellipsoid, c. 2.5 \times 2.3 mm, cleft at anthesis to c. $\frac{1}{3}$,

valves c. 0.2 mm thick; pedicel 1-2 mm long, late-glabrescent; ovary subglobose, c. 1.5 mm diam., appressed-pubescent by hairs 0.1-0.2 mm, stigma minute, faintly 2-lobed, c. 0.1 mm long. Fruits 1-5 per infructescence, ellipsoid, top and base rounded, 1.5-2.0 × 1.3-1.6 cm, glabrescent, usually with minute tomentum remaining towards the base, drying dark brown, without lenticels but usually minutely pustulate, dry valves c. 1.5 mm thick; stalk 2-6 mm; perianth not persisting.

Distribution. S. Peninsular Thailand, Malaya (Kedah, Penang, Perak, Trengganu, Pahang, Selangor, Malacca, Johore, Kelantan), Singapore (doubtful, see Sinclair, l.c. p. 150), Sumatra (E. Coast, *vide* Sinclair; no specimens seen).

THAILAND. S. Peninsular: *Geesink* 7229, *A.F.G. Kerr* 17252, 17482; *Phusomsaeng* 142, 424 (*BKF* 51976); *Smitinand* 10378.

MALAYA. *Cantley* 30; *Cuming* 1846; *Curtis* 1197, 1748; *Derry* 967; *FRI* 0880, 3408, 15957, 16300, 25099; *Gaudichaud s.n.*, 44; *Hb. Hooker s.n.*; *KEP* 94965, 98507, 99205, 99403, 104304; *King's Coll.* 4165, 5671, 6102, 8532, 8642, 10557; *Shah (& Noor)* MS. 1319, 1536, 1864; *Phillips s.n.*; *Ridley s.n.*, 44, 7205, 10240; *SFN* 1082, 21751, 35134; *Sinclair* 9878, 10158; *Unesco Limestone Exp.* 159; *Wall. Cat.* 9025.

Ecology. Lowland and foot hill forest, in S. Thailand in evergreen forest, old secondary forest; 0-300 m alt. Flowers mostly in March, fruits mostly in July.

NOTES

1. *Fieldnotes.* Small or moderate, sometimes big tree to c. 40 m. alt. Bark recorded as fissured, not flaky or scaly, brown to blackish, soft. Inner bark pale reddish or pale yellowish, laminated, fibrous; exudate pink-red; sapwood whitish or pink. Flowers yellow, with a fine perfume. Fruits yellow to orange, aril red; perianth persistent in fruit.

2. The lobes of the male perianths in fully mature flowers are often slightly outward recurved.

3. *H. tomentosa* is in the present revision accepted in the same sense as by Sinclair and earlier authors. It belongs in the alliance with *H. grandis*, *H. flocculosa*, *H. motleyi*.

4. The name *tomentosa* should be attributed to Warburg because *Myristica tomentosa* Hook. f. and Thoms. is illegitimate; being a later homonym.

62. *Horsfieldia gracilis* de Wilde, *sp. nov.*

Horsfieldia paucinervis Warburg differt habitu gracili, foliis tenuiter membranaceis, tomento persistente, nervis paribus 14-17, fructibus ellipsoideis, c. 1.5 cm longis, glabris, perianthio persistente. — Type: Sarawak, *Ilias Pai'e* S 16604 (L: iso: K: S, n. v.).

Tree c. 5 m. Twigs terete, towards the apex 1.5-2.5 mm diam., rather late glabrescent, tomentum light brown with stellate-dendroid hairs 0.3-0.5 mm, bark of older twigs striate, neither cracking nor flaking; lenticels minute and inconspicuous or absent. Leaves in 2 rows, thinly membranous, oblong-lanceolate, broadest at about or slightly above the middle, 12-21 × 4-6(-6.5) cm, base (rounded-) attenuate, tip acute-acuminate; upper surface drying dull olivaceous, glabrous, lower surface pale olivaceous-brownish, with subpersistent tomentum consisting of scattered pale dendroid-stellate hairs 0.3(-0.5) mm; without larger brownish or blackish dots or marks; midrib raised above, beneath with persistent tomentum;

nerves 14-17 pairs, slightly raised to flat above, the marginal arches regularly shaped, slightly impressed and obvious; tertiary venation forming a lax network, indistinct; petiole 8-14 × 1.5(-2) mm, late glabrescent; leaf bud c. 6-7 × 1.5 mm, densely pale-brown pubescent, with hairs 0.3-0.5 mm long. Male flowers not seen. Female inflorescences not or only once ramified, 2-5-flowered, 1-1.5 cm long, pubescent with hairs 0.3-0.5 mm long; bracts not seen. Female flowers 3-valved, glabrous, pedicel at base apparently inarticulate (male flowers not seen); perianth (persistent as judged from the fruit) c. 2.0 × 1.5 mm, at anthesis cleft to c. ½-way, valves c. 0.3 mm thick, glabrous; pedicel c. 1 mm long, glabrous; pistil not seen. Fruits 1-3 per infructescence, ellipsoid, top and base subobtuse, 1.4-1.5 × 1.0-1.1 cm, glabrous, drying dark brown, with a finely granulate structure, lenticel-like tubercles absent, dry valves 0.5-1.0 mm thick; stalk 1-1.5 mm; perianth persistent under the fruit.

Distribution. Borneo: Sarawak, Miri Dist., only known from the type.

Ecology. Primary lowland forest.

NOTES

1. This species is known only from the type collection, in fruit. It was recorded as a small tree, 15 feet high and 4 inches in girth, and identified by Sinclair as *Horsfieldia* sp. Although only the fruits are known, it is obvious from its general habit that the present new species belongs to the group of *H. paucinervis*, beside which it keys out. It is inferred that the male flowers have the following characteristics: inflorescences rather tiny, c. 6 cm long, pubescent with hairs c. 0.4 mm long; perianth subglobose (likely c. 1-1.5 mm diam.), 3-(or 4-)valved, splitting in bud to c. ½-way, glabrous; pedicel glabrous, at base inarticulate; androecium globose or depressed-globose, sessile or with a short androphore, in transverse section ± circular, anthers largely sessile, the column at the apex with a shallow hollow.

Horsfieldia gracilis is readily recognized by its slender habit, thin membranous leaves and (sub)persistent though not very conspicuous, rough tomentum on the leaf bud, twig apex and lower leaf surface, especially on the midrib and nerves, and by the small fruits with a persistent perianth. Superficially the species may be taken for *H. tenuifolia* or *H. macilenta*.

63. *Horsfieldia paucinervis* Warb.

Fig. 1C(63)

Horsfieldia paucinervis Warb., Mon. Myrist. (1897) 345, t. 22; Merr., En. Born., J. Str. Br. R. As. Soc., spec. number (1921) 268; Sinclair, Gard. Bull. Sing. 28 (1975) 93 — *Myristica paucinervis* (Warb.) Boerl., Handl. Fl. Ned. Ind. 3.1(1900) 87 — Type: Sarawak, *Beccari 3279* (♀ fl.) (FI, n.v.).

Tree 3-8 m. Twigs terete, 2-3 mm diam., late glabrescent, tomentum reddish to yellow-rusty, of shaggy hairs 1.5-2 mm long, bark of older twigs dark grey, striate, not cracking; lenticels not conspicuous. Leaves in 2 rows, thinly chartaceous, not bullate, elliptic to elliptic-oblong, broadest at about the middle, 7-15 × 3-6.5 cm, base rounded to attenuate, tip acute to acute-acuminate; upper surface drying olivaceous to brown, glabrous, lower surface dull brown with persistent, thin tomentum of dendroid hairs of mixed sizes, c. 0.5-0.1 mm long; larger blackish dots or stripes present (always?); midrib flat above, indistinct, with persistent tomentum or late glabrescent; nerves 5-9 pairs, flat or sunken, the marginal arches indistinct;

tertiary venation very indistinct or invisible; petioles 6-12 × 1.5-2.5 mm, pubescent; leaf bud c. 8-10 × 3-4 mm, long pubescent. Inflorescences densely woolly pubescent with hairs (0.7-) 1.0-2.0 mm long, in ♂: many-flowered, 3 or 4 times ramified, 5-9 × 3-5 cm, common peduncle up to 15 mm long; in ♀: 4-6 cm long; bracts not seen, caducous. Flowers in ♂ in loose clusters, 3-valved, perianth glabrous, pedicels glabrous, at base inarticulate. Male perianth subglobose, 0.8-1.0 × 1.0-1.4 mm, top and base broadly rounded; pedicels slender, 0.5-1.0 mm long; perianth at anthesis cleft to c. 1/3 to nearly 1/2-way, valves c. 0.1 mm thick. Androecium small, ± depressed-globose, c. 0.3-0.5 × 0.4-0.8 mm, ± circular in transverse section (not 3-angled); anthers 4 or 5 (thecae 8 or 10), almost completely sessile, the tips incurved; column broad, solid except for a minute hollow at the top c. 1/5 deep, androphore narrow, somewhat tapering, c. 0.1-0.2 mm long. Female perianth (according to Warburg, Sinclair) ovoid-globose, c. 2.0 mm diam., cleft at anthesis to somewhat over 1/2-way; pedicel c. 2 mm long, glabrous; ovary subglobose, glabrous, stigma minute. Fruits (immature) with persistent perianth, oblong, glabrous, obtuse at both ends, c. 1.0 × 0.7 cm; stalk c. 2 mm long.

Distribution. Borneo: Sarawak (1st, 2nd, 4th Divisions).

BORNEO. Sarawak: Beccari 3279, *n.v.*; Haviland 1735, 3075; Purselove P 4403.

Ecology. Coastal kerangas and secondary forest on eroded white sand; 0-50 m. Flowers throughout the year.

NOTES

1. *Fieldnotes.* Shrub or slender tree to c. 8 m tall. Sap pale pink, watery. Flowers yellow.

2. Apparently a member of the group of which leaves are pubescent and to which also belong *H. splendida*, *H. reticulata*, *H. rufo-lanata* and *H. tomentosa*, and somewhat more remotely, *H. grandis*. *H. paucinervis* is readily recognized by its few nerves, almost invisible reticulation and small male flowers, with few anthers.

3. I have seen only a few male flowering specimens, incl. *Haviland 3075* and *Purselove P 4403* but not the type which is *Beccari 3279*, a female flowering one. This last is described and depicted by Warburg; Sinclair apparently also saw a specimen with immature fruits. It is odd that ovaries and fruits are reported as glabrous as they are pubescent in most related species though glabrous in *H. motleyi*.

64. *Horsfieldia splendida* de Wilde, *sp. nov.*

Fig. 1C(64); 24

Ramuli validi, tarde glabrescentes, pilis 1-1.5 mm longis obtecti, foliis ± oblongis, 18-45 cm longis, subtus tomento persistente. Perianthium masculinum subglobosum, 1.5-2 mm diam., 3- vel 4- valvatum, androecio depresso-globoso, apice moderate excavato, antheris 8-10, sessilibus, androphoro angusto, 0.3-0.5 mm longo, pedicello gracili, basi non-articulato, fructibus late ellipsoideis, c. 2 cm longis, pubescenti, perianthio persistente. — Type: Sarawak, *Othman Ismawi S 33723* (L; iso: NO, SAN, *n.v.*).

Tree 10-20(-30) m. Twigs stout, terete, towards apex 4-7(-13) mm diam., late glabrescent, tomentum densely woolly, yellow-brown to rusty, with hairs 1.0-1.5 mm, bark of older twigs usually dark brown or blackish, coarsely longitudinally striate and fissured, later on cracking and ± flaking; lenticels few, indistinct.

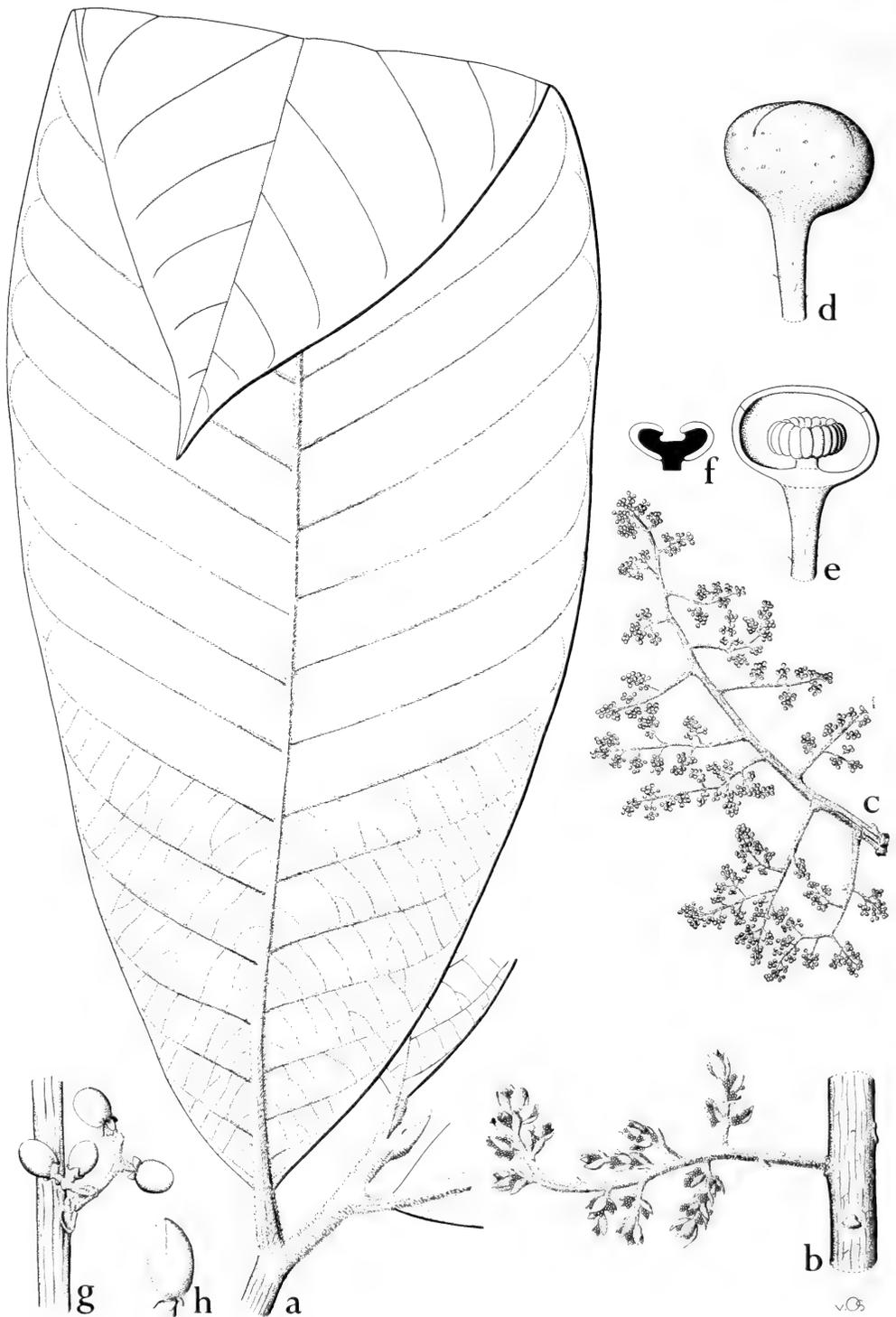


Fig. 24. *Horsfieldia splendida* de Wilde.
 a. apical part of leafy twig, $\times \frac{1}{2}$; b. portion of twig with immature male inflorescence axillary to leaf scar, note bracts, $\times \frac{1}{2}$; c. mature male inflorescence, $\times \frac{1}{2}$; d. mature male flower, lateral view, $\times 12$; e. ditto, longitudinally opened, showing androecium, $\times 12$; f. androecium, longitudinal section, schematic, $\times 12$; g. portion of twig with infructescence, fruits immature, $\times \frac{1}{2}$; h. mature fruit, note persistent perianth, $\times \frac{1}{2}$. — a, b from *Anderson 12916*; c-f. from *B.N.B. For. Dept. 4782*; g. from *San. 16927*; h. from *SFN 35606*.

Leaves in 2 rows, membranous to chartaceous, elliptic-oblong to oblong-ob lanceolate, broadest usually above the middle, 18-45 × 6.5-17 cm, base almost rounded to attenuate, tip acute-acuminate; upper surface drying dull olivaceous to brown, not minutely pustulate, glabrous (early glabrescent), lower surface with conspicuous rather dense tomentum of loosely branched, stalked dendroid hairs, ± evenly spaced and of about the same size, hairs 0.5-1.5 mm long; without larger blackish dots; midrib above late glabrescent, flat or slightly raised; nerves 18-25 pairs, above sunken, early glabrescent, the marginal arches usually distinct and regularly shaped; tertiary venation forming a lax network, generally distinct above; petioles 12-17 × 3.5-5 mm, pubescent; leaf bud c. 15(-20) × 5 mm, with hairs 1-1.5 mm long. Inflorescences densely woolly pubescent with dendroid hairs 1-1.5 mm, in ♂: many-flowered, 4(or 5) times ramified, 6-16 × 3-12(-16) cm, common peduncle 5-20 mm; ♀ inflorescences rather few-flowered, 3-5 cm long; bracts ± ovate-triangular, acuminate, 0.4-1 cm long, densely pubescent, caducous. Flowers in ♂ in loose clusters, 3-(or 4)-valved, glabrous or thinly pubescent, pedicels slender, glabrous or subglabrescent, hairs 0.3-0.5 mm long, at base inarticulate. Male perianths subglobose, usually somewhat depressed, 1.4-2 × 1.6-2 mm, top broadly rounded, pedicels 1-1.5 mm long, slender; perianth at anthesis cleft to 1/3 to nearly 1/2-way, valves c. 0.2 mm thick. Androecium depressed-subglobose, usually ± impressed in the centre, circular or faintly 3-angular as seen from above, 0.5-0.6 × 1-1.3 mm; anthers 8-10, completely sessile, incurved towards the top; column broad, solid, leaving a small apical hollow of c. 1/3-(1/2-way) deep; androphore rather slender, 0.3(-0.5) mm long. Female perianth not seen, according to the persistent remnants under the fruit c. 3.0 × 2.5 mm, 3- or 4-valved, outside pubescent; pedicel 0.5-1.0 mm long, pubescent; ovary ovoid-ellipsoid, pubescent; stigma minutely 2-lobed, c. 0.1 mm high. Fruits 2-7 per infructescence, broadly ellipsoid, obtuse at apex, base rounded, 2.0-2.2 × 1.5-1.8 cm, pubescent (hairs c. 0.5 mm), drying brown, without lenticels or tubercles, dry valves c. 3 mm thick; stalk c. 1 mm long; perianth persistent.

Distribution. Borneo. Sarawak, Brunei, Sabah, E. Kalimantan; probably W. Kalimantan (see notes).

BORNEO. Sarawak: *Anderson 12916, 15526; Galau* (tree nr Semengo For. Res) 3500; *Motley* in Hb. Hooker 178; *Zen Osman 5140; S 33723; Seal 547; SFN 35606; Sinclair & Kadim 10227* — Sabah: *B.N.B. For. Dept. 4782; SAN 15390, 15487, 16656, 16927, 23739, 36333, 36592, 36660, 44688, 73393, 74992, 78355; Sinclair (Kapis & Kadim) 9292* — E. Kalimantan (W. Kutai): *Endert 5010*.

Ecology. Lowland mixed Dipterocarp forest, edges of swamp forest, kerangas forest (with *Dryobalanops fusca* dominant), also montane forest; brown soil, yellowish soil, tuff-plateau; 0-600(-1500) m alt. Flowers and fruits throughout the year.

NOTES

1. *Fieldnotes.* Bark of trunk usually recorded as blackish, brown, or red-brown and fissured or flaking. Inner bark soft, light brown or reddish, laminated, exudate reddish. Wood yellowish or whitish, recorded as soft or medium hard. Flowers yellow, fragrant (like the odour of Peru-balsam). Fruits recorded as red or orange.

2. The present new species contains the majority of the specimens which were determined as *H. reticulata* by Sinclair. However, the type of *H. reticulata*, *Beccari 3475* (FI, n.v.; iso: K) clearly represents a different species, one with the male

pedicels articulate at base, much smaller, more coriaceous, more distinctly reticulate leaves, and a much less pronounced indumentum on the lower surface. Its flowers, however, are almost similar, only a trifle larger. See further under that species.

3. I have not seen *Hans Winkler 388* (HBG), from West Kalimantan, determined by Sinclair as *H. reticulata*; may be it is our present new species *H. splendida*.

4. *H. splendida* is closely related to *H. reticulata*, *H. rufolanata*, *H. tomentosa*, and also *H. grandis* and less so to *H. flocculosa*; all these having similarly shaped and constructed male flowers. The perianth remains persistent under the fruit in these species except in *H. tomentosa* and *H. rufolanata*.

65. *Horsfieldia rufo-lanata* Airy-Shaw

Fig. 1C(65)

Horsfieldia rufo-lanata Airy-Shaw, Kew Bull. 10, 1939 (1940) 440; Sinclair, Gard. Bull. Sing. 28 (1975) 111 — Type: Richards 1667 (K).

Tree 8-17 m. Twigs terete, towards the apex 3.5-5(-7) mm diam., late glabrescent, tomentum dark rusty to reddish-brown, of hairs 1-1.5 mm long, coarsely striate, bark of older twigs dark brown, \pm longitudinally cracking, not flaking; lenticels present but indistinct. Leaves in 2 rows, chartaceous, slightly or not bullate, elliptic to oblong, broadest at the middle, 10-23 \times 5-10(-12) cm, base nearly rounded to subattenuate, tip acute to acute-acuminate; upper surface drying olivaceous to brown, glabrous except the nerves, lower surface with dense to sparse tomentum of rather harsh hairs of mixed sizes ranging from sessile-stellate, c. 0.3 mm, to short-armed, dendroid emerging hairs up to c. 1.5 mm long; without larger blackish dots; midrib above \pm raised, late glabrescent; nerves 11-16 pairs, raised, pubescent or late glabrescent, the marginal arches distinct and regularly shaped; tertiary venation forming a lax network, sunken, distinct or not; petioles 10-16 \times 3-4.5 mm, pubescent; leaf bud 15-20 \times 3-5 mm with hairs 1-1.5 mm. Inflorescences densely woolly-shaggy pubescent, hairs 2.0-3.0 mm long, in σ : many-flowered, 3 or 4 times ramified, 8-12 \times 5-7 cm, common peduncle 15-30 mm; in ρ : few-flowered, c. 3 cm long; bracts densely shaggy pubescent, oblong-triangular to lanceolate, 3-8 mm long. Flowers in σ in loose clusters, 3- or 4-valved, perianth glabrous, pedicel glabrous, at base indistinctly articulate. Male perianths subglobose, hardly or not depressed, c. 2 \times 2.3 mm, rather firm; pedicels not very slender, c. 0.5 mm thick, 0.5-1 mm long; perianth at anthesis cleft to nearly $\frac{1}{2}$ -way, valves 0.2(-0.3) mm thick. Androecium globose (not depressed-globose), c. 1.2 mm diam., not or only slightly apically impressed, circular in transverse section; anthers c. 15 (c. 28-30 thecae, very closely appressed), completely sessile, incurved towards apex; column broad, solid except for the small apical hollow to c. $\frac{1}{5}$, deep; androphore slender, c. 0.2 mm long. Female perianth not known. Fruits 2-4 per infructescence, broadly ovoid-ellipsoid, top and base rounded, 2.0-2.2 \times 1.5-1.6 cm, glabrescent, remnants of minute hairs c. 0.1 mm at the base, drying brown, without distinct lenticels or tubercles, dry valves c. 2 mm thick; stalk 1-3 mm long; perianth not persisting in mature fruit.

Distribution. Borneo: Sarawak (4th & 5th Div.), Sabah.

BORNEO. Sarawak: (Brüinig) S 10599, n.v.; Richards 1667 — Sabah: (Wood) SAN 16295; (Meijer) 26423.

Ecology. Montane forest, upper Dipterocarp forest on sandstone; 900-1400 m alt. Flowers in June and September, fruits in September.

NOTES. A montane species closely related to *H. splendida* and especially *H. reticulata*. Differs by the longer woolly tomentum of the inflorescences, the almost globose, hence not depressed-globose, male perianth, the near-globose androecium, more anthers, 13-15(-20) as against 8-10 and 10-12 in *H. splendida* and *H. reticulata* respectively. The nerves on the upper leaf surface apparently remain pubescent for a much longer time, and are generally raised. In contrast with *H. splendida*, the blades are generally smaller and more elliptic and have a tomentum of stiffer hairs on the lower surface; *H. reticulata* has a much less conspicuous tomentum on the lower leaf surface.

66. *Horsfieldia affinis* de Wilde, *sp. nov.*

Fig. 1C(66)

Folia membranacea, in sicco fusco-brunnea, subtus pilis persistentibus 0.5-1 mm longis obtecta. Flores masculi glabri, perianthio depresso-globose, 1.2-1.5 × 1.5-2.0 mm, 3 vel 4 -valvato, androecio subglobose, c. 1 mm diam., apice excavato usque ad ½, antheris 11, sessilibus, pedicello tenere, basi articulato, fructibus ellipsoideis, c. 2.5 cm longis, glabris, perianthio persistente. — Type: Sarawak, *E. Wright S 24718* (L; iso: K).

Tree 7-15 m. Twigs terete, towards the apex 3-6(-9) mm diam., late-glabrescent, tomentum of rusty hairs 0.5-1.0 mm long, lower down with the bark finely striate, when older not flaking; lenticels absent or small and inconspicuous. Leaves in 2 rows, membranous, not bullate, elliptic-oblong to lanceolate, broadest at or below the middle, 18-35 × 5-11 cm, base rounded to attenuate, top acute-acuminate; upper surface drying bright to dark or blackish brown, glabrous, lower surface with persistent, rather sparse tomentum of dendroid hairs or mixed with sessile stellate, dendroid hairs 0.5-1.0 mm long; scattered larger blackish dots absent; midrib flattish or slightly raised above, often late glabrescent; nerves 17-20 pairs, slender, raised, glabrous above, the lateral arches usually regularly shaped and distinct; tertiary venation forming a lax network, rather faint to distinct above; petioles 12-20 × 2-4 mm, pubescent; leaf bud rather slender, 10-15 × 3-4 mm, densely pubescent with hairs 0.5-1 mm. Inflorescences densely pubescent with rather shaggy hairs 0.5-2.0 mm long, in ♂: many-flowered, c. 4 or 5 times ramified, 12-25 × 8-14 cm, common peduncle 15-60 mm long; ♀ inflorescences 5-6 cm long, fewer-flowered than the males; bracts broad-triangular to elliptic-oblong, acute, 3-9 mm long, densely pubescent, caducous. Flowers in ♂ in loose clusters of 2-6 each, 3- or 4-valved; perianth glabrous, pedicel slender, glabrous, at base inarticulate. Male perianth depressed-globose, 1.2-1.5 × 1.5-2.0(-2.2) mm, top and base broadly rounded; pedicel slender, 1.5-2 mm long; perianth at anthesis cleft to c. ¼-½; valves c. 0.1 mm thick. Androecium subglobose or depressed globose, slightly impressed at the centre, ± circular in transverse section, c. 0.7-0.8 × 1.0-1.2 mm; anthers 11, completely sessile, incurved towards the apex; column broad, solid except the apical hollow up to c. ½-way deep; androphore slender or rather broad, 0.2-0.3 mm long, hidden or not by the anthers. Female flowers not seen; perianth as judged from remnants under the fruit 2.5-3.0 × 2-2.5 mm, valves 3, splitting the bud to over ½-way, glabrous or probably with very weak tomentum. Fruits 4-7 per infructescence, ellipsoid, top and base rounded, 2.3-2.7 × 1.7 × 2.1 cm, glabrous, drying brown, without lenticels but paler, wart-like tubercles present, dry valves 1.5-2.0 mm thick; stalk 3-4 mm long; perianth persistent under the fruit.

Distribution. Borneo: Sarawak; Brunei; Central, East and SE. Kalimantan.

BORNEO. Sarawak (Kapit, 3rd Div.): *Wright S 24718*; (*Chai S 36018* — Brunei: (*Abdul Latip BRUN 5654* — Kalimantan, East & SE.: *Enderi 2595*; *Kostermans 9535, 21760*; *Leighton 700, 737 930*; *Sauveur 1 14, 126*; Central: *Nooteboom 4847*).

Ecology. Forest on alluvial soils, riverbanks; sandy clay soil, sandy ridges, sandstone; 0-600 m alt. Flowers May to November, fruits in July.

Vernacular name. Kumpang balau (Iban name, Kapit area, Sarawak).

NOTES

1. *Fieldnotes*. Small tree, crown pyramidal, no buttresses. Bark rough, dark brown, lenticellate; outer bark 1-2 mm thick, brown-red, inside red. Flowers dark or golden yellow, fragrant or with strong sweet smell of Peru-balsam. Fruits ramiflorous, in bunches behind the leaves, pinkish-orange.

2. Most specimens of the present new species were included by Sinclair in *H. motleyi*, which differs by the inarticulate pedicels, the much smaller pubescent flowers with a quite different androecium, the leaves drying to a dull olivaceous brown colour, and the sunken lateral nerves.

3. *H. affinis* is among its closest relatives characterized by the distinctly articulate, glabrous, male pedicels, the male flowers being arranged in small clusters at the end of the slightly thickened hairy inflorescence-ramifications. A second related species with articulate pedicels is *H. reticulata*, and possibly *H. rufo-lanata* the position of which is unconfirmable because there are not enough flowers available.

67. *Horsfieldia reticulata* Warb.

Fig. 1C(67)

Horsfieldia reticulata Warb., Mon. Myrist. (1897) 304, t. 22 fig. 1-3; Merr., En. Born. J. Str. Br. R. As. Soc. special number (1921) 268; Sinclair, Gard. Bull. Sing. 28 (1975) 107 — *Myristica reticulata* (Warb.) Boerl., Handl. Fl. Ned. Ind. 3, 1 (1900) 85 — Type: Sarawak, *Beccari 3475* (FI, n.v.; iso: K).

Tree to c. 20 m. Twigs terete, towards the apex 2.5-4(-8) mm diam., late glabrescent, tomentum rusty, of rather coarse hairs c. 1.0 mm long, bark of older twigs dark grey, coarsely striate, later on finely longitudinally and transversely cracked; no lenticels seen. Leaves in 2 rows, chartaceous, \pm bullate, elliptic to oblong-oblancheolate, broadest at or above the middle, 8-24 \times 4-6.5 cm, base rounded, top acute-acuminate; upper surface drying blackish brown, glabrous, lower surface bright dark brown, with persistent tomentum composed of rather spaced hairs of various sizes, i.e., stellate sessile hairs, and long-emergent short-armed dendroid hairs up to c. 0.7 mm long as well as intermediate forms; larger blackish dots absent; midrib raised above, glabrous; nerves 9-19 pairs, sunken, glabrous, the marginal arches distinct and regular; tertiary venation forming a lax network, very distinct on both surfaces; petioles 7-15 \times 2-3 mm, pubescent; leaf bud not seen. Inflorescences in σ^7 : on the older wood, densely pubescent with hairs 0.5-1.0 mm, many-flowered, c. 4 times ramified, c. 18 \times 12 cm, common peduncle 20-25 mm; bracts not seen, caducous. Flowers 3(-5)-valved in small loose clusters; perianth glabrous; pedicels glabrous, at base articulate. Male perianth somewhat depressed-globose, 1.5-2.0 \times 2.0-2.5 mm, top and base broadly rounded; pedicel slender, 0.5-1.5 mm long; perianth at anthesis cleft to c. $\frac{1}{4}$ to nearly $\frac{1}{2}$ -way; valves 0.1-0.2 mm thick. Androecium much depressed-globose, impressed in the centre, c. 0.6-0.7 \times 1.2-1.5 mm, in transverse section \pm ellipsoid or faintly 3-angular; anthers c. 10-12 or c. 15 (see notes), \pm completely sessile, incurved towards the

top; column broad, solid except for an apical hollow with flattish bottom reaching to depth of c. $\frac{1}{3}$ to nearly $\frac{1}{2}$ -way; androphore rather slender, 0.3-0.4 mm long, largely hidden by the anthers. Female flowers and fruits not seen.

Distribution. Borneo: Sarawak (2nd. Div.), East & West Kalimantan.

BORNEO. Sarawak (2nd Div.): *Beccari* 3475 — Kalimantan: West, *Hans Winkler* 388; East, *Leighton* 655 (possibly, material incomplete).

Ecology. Forest at c. 100 m. alt. Flowers in November.

NOTES

1. *Fieldnotes.* Flowers yellow. Fruits sourish, eaten by the Dajaks.

2. This species appears to be represented only by the type and two collections from West-Central and East Kalimantan. Most specimens considered by Sinclair as conspecific (Sinclair, p. 107, 108) belong to a presently described new species, *H. splendida*. Sinclair observed that the *Beccari* specimen looked somewhat different, but regarded it as a relatively glabrous specimen from which most tomentum had dropped off. *H. splendida* differs, in addition to the inarticulate pedicels, by the much less bullate and larger leaves, by the tomentum (of the lower leaf surface) of a different structure; the dendroid hairs being more widely branched, all \pm evenly long-stalked, and by its somewhat smaller male perianth. It should be noted, however, that the male flower including the androecium, is much the same in all species of the group of obviously related species to which *H. grandis*, *H. tomentosa*, *H. flocculosa* also belong. Because of the articulate pedicels, *H. reticulata* seems most related to *H. affinis*.

3. The general habit of the leaves and inflorescences of the few collections seen by me is very much the same, the leaves being brittle-chartaceous, drying dark brown, with a tomentum rather harsh and a very pronounced reticulation which is impressed above. The last gives the leaves a distinct bullate appearance, more so because the leaf-margin is revolute. The androecia of the two male flowering specimens seen, however, are rather different. In *Beccari* 3475 I counted (9 or) 10-12 anthers, in *Winkler* 388 there are apparently c. 15 anthers (c. 30 thecae), and the apical hollow of the column in the collection is generally broader, and has a wide, flattish bottom.

68. *Horsfieldia crassifolia* (Hook. f. & Th.) Warb.

Fig. 1C(68); 25

Myristica crassifolia Hook. f. & Th., Fl. Ind. (1855) 160; A. DC., Prod. 14, 1 (1856) 204; Miq., Fl. Ind. Bat. 1 (2), 1 (1858) 68; Hook. f., Fl. Brit. Ind. 5 (1886) 108; King., Ann. Roy. Bot. Gard. Calc. 3 (1891) 308, pl. 140 — *Horsfieldia crassifolia* (Hook. f. & Th.) Warb., Mon. Myrist. (1897) 323 (p.p); Sinclair, Gard. Bull. Sing. 16 (1958) 386, fig. 34, Pl. X A: 28 (1975) 23; Anderson, Gard. Bull. Sing. 20 (1963) 195 — *M. irya* var. *crassifolia* Miq. ex Hook. f., Fl. Brit. Ind. 5 (1886) 108, *pro syn.* — Type *Griffith* 4350 (K; iso: CAL, *n.v.*) (see notes by Sinclair, l.c. pag. 25).

M. horsfieldia auct. non. Bl.: Wall. Cat. (1832) No 6806, p.p. (other parts are *H. polyspherula* and *H. wallichii*).

M. subglobosa Miq., Fl. Ind. Bat. Suppl. 1, 3 (1861) p.p. (other part is *H. irya*).

M. paludicola King, Ann. Roy. Bot. Gard. Calc. 3 (1891) 328, pl. 169 — *H. fulva* (King) Warb. var. *paludicola* (King) Warb., Mon. Myrist. (1897) 299 — Type: *King's Coll.* 4267 (CAL, *n.v.*; iso: L, BM), 4706 (CAL, *n.v.*; iso: L, K, BM), 6688 (CAL, *n.v.*; iso: K); *Wray* 3071 (CAL, *n.v.*; iso: K, L).

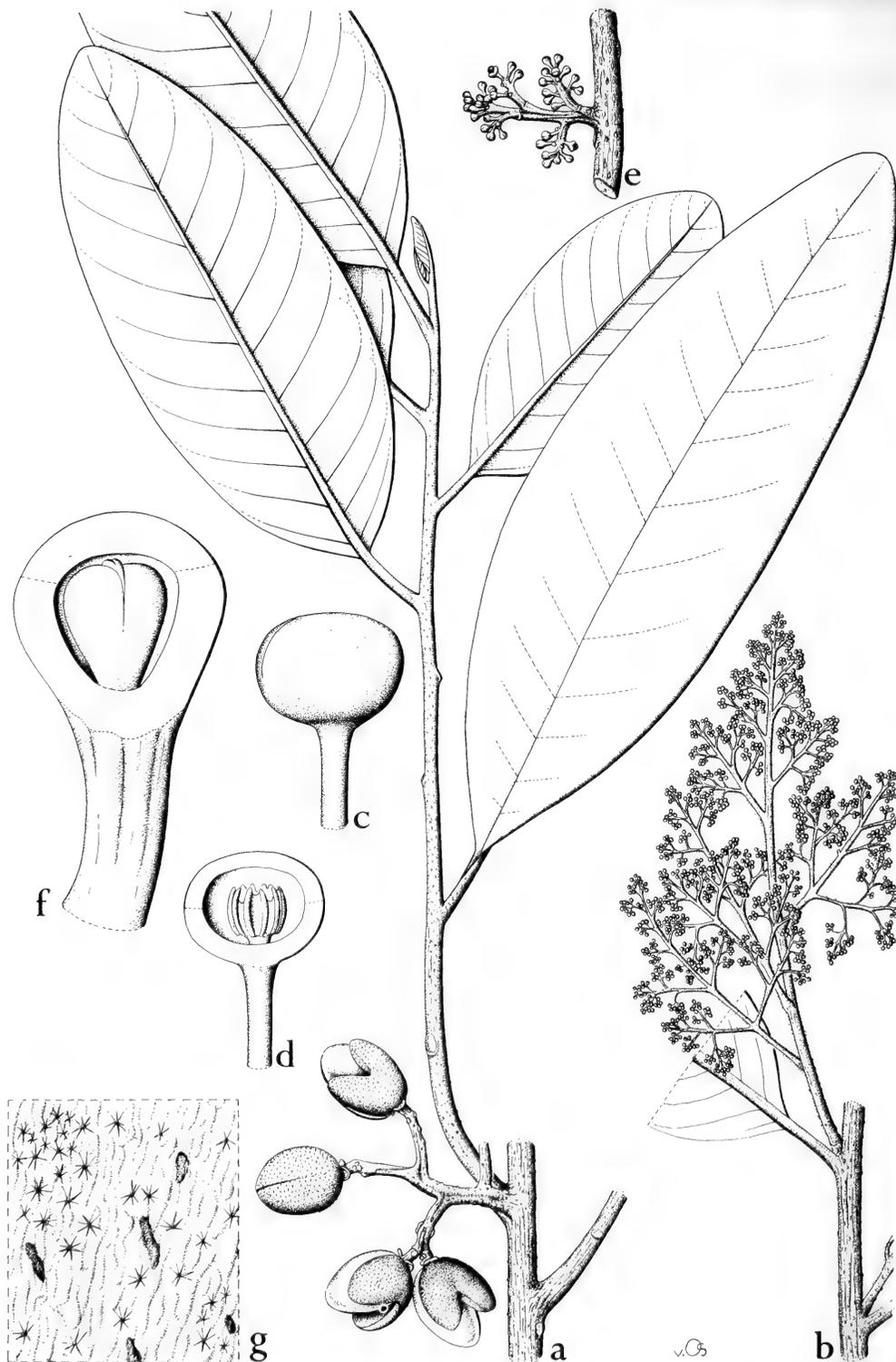


Fig. 25. *Horsfieldia crassifolia* (Hook.f. & Th.) Warb.
a. branch with leafy twig and infructescence with mature fruits, note persistent perianth and aril completely closed, $\times \frac{1}{2}$; *b.* portion of twig with male inflorescence, $\times \frac{1}{2}$; *c.* mature male flower, lateral view, $\times 12$; *d.* ditto, longitudinally opened, showing androecium, $\times 12$; *e.* portion of older twig with female inflorescence axillary to leaf scar, $\times \frac{1}{2}$; *f.* mature female flower, opened, showing glabrous ovary and 2-lipped stigma, note flower considerably larger than male flower, $\times 12$; *g.* portion of lower leaf surface with persistent tomentum and irregularly shaped dark-coloured dots, $\times 25$. — *a.* from *Mondi 51*; *b-d.* from *S 9226*; *e-g.* from *San. 27183*.

Tree 10-25 m. Twigs terete, not ridged, towards apex 2-6(-8) mm diam., rather early glabrescent, tomentum yellow-brown to rusty woolly, with hairs 0.2-0.5 mm; bark coarsely striate, when older not flaking, lenticels sparse to dense, distinct or not. Leaves in 2 rows, coriaceous, elliptic to oblong, 10-20(-28) × 3.5-7(-10) cm, base rounded to attenuate, top rounded to subacute or rarely emarginate; upper surface drying dull greenish brown to dark brown, not finely pustulate, lower surface either largely or partly covered with subpersistent tomentum consisting of interwoven stellate scales c. 0.1 mm high (when very young with dendroid emergents), or glabrescent and then showing distinct hair scars and usually scattered blackish dots or dashes; midrib above flattish; nerves 11-16 pairs, above thin and flattish or sunken; tertiary veins indistinct or invisible on both surfaces; petiole 9-20(-30) × 1.5-4.5 mm, leaf bud 7-12 × 2-3 mm with hairs 0.2-0.5 mm. Inflorescences situated in between or usually behind the leaves, late glabrescent or with a persistent, rather dense, woolly tomentum of dendroid hairs 0.2-0.5 mm; in ♂: 3-5 times ramified, broadly paniculate, many-flowered, 6-20 × 4-15 cm, common peduncle 5-20 mm; in ♀: 3-14 cm long; bracts elliptic-lanceolate, 2-5(-7) mm long, pubescent, caducous. Flowers in loose clusters of 2-7, glabrous; perianths 2-valved; pedicels slender, glabrous, at base inarticulate. Male perianth globose or slightly transversely ellipsoid, (0.8-)1.0-1.3 × 1-1.5 mm, the upper part broadly rounded, the base broadly rounded to flattish, pedicel c. 0.3-1 mm long; perianth at anthesis cleft to c. $\frac{1}{3}$ - $\frac{1}{2}$ ($-\frac{2}{3}$), valves 0.2-0.3 mm thick. Androecium globose or ± transversely ellipsoid, not or only faintly laterally compressed, c. 0.4-0.5 × 0.5-0.8 mm; anthers 4-6(thecae 8-12), ± septate before maturity, widely spaced, and with broad connectives (giving the androecium an angular appearance), the anthers free for almost the upper half or more; androphore c. 0.2(-0.3) mm long, slender. Female perianth broadly obovoid, 2-3 × 2-2.5 mm, split at anthesis for $\frac{1}{5}$ - $\frac{1}{3}$ only, valves 0.6-1 mm thick; pedicel 1.5-2.5 mm long; ovary obovoid, glabrous, 1.5 × 1.2-1.5 mm, stigma minute, consisting of 2 small lobes c. 0.1-0.2 mm high, running out into a faint ridge at one side of the ovary. Fruits (1-)2-10 per infructescence, ovoid to obovoid, base and top rounded, 1.5-2.2 × 1.2-1.8 cm, glabrous, drying dark brown, with few or no lenticel-like tubercles; dry valves 1.5-2 mm thick; stalk 2-5(-7) mm long; perianth persisting under the fruit.

Distribution. Malaya (Perak, Trengganu, Selangor, Negri Sembilan, Malacca, Johore), Singapore, Sumatra (incl. Indragiri, Riau, Bangka & Belitung), Borneo; absent in S. Thailand.

MALAYA. *Anderson* 9; *Derry* 1163; *FRI* 0021 7727, 17634; *Hb. Griffith* 4350; *KEP* 70486; *King's Coll.* 4267, 4706, 6688; *K.C. Liew* 166; *SFN* 32105, 40567, 40898; *Wray* 3071.

SINGAPORE. *Ridley* 1819, 1828, 3831, 5826, 6126, 6909, 10695; *SFN* 34542, 34905, 37710, 39533, 40256.

SUMATRA. Tapanuli: *b.b.* 28169, 28399, 29545; *Rahmat si Toroes* 4829; *Theunissen* 59, 60 — W. Coast: *b.b.* 5952; *Korthals s.n.* — E. Coast: *b.b.* 21290 — Riau: *b.b.* 20375 — Bangka: *Grashoff* 117.

BORNEO. Sarawak: *Anderson* 9028; *Haviland & Hose* 1941; *S* 9226, 12325, 32021; *Sanusi bin Tahir* 5204, 9279; *SFN* 36078 — Brunei: *Brun.* 375, 838; *Sinclair & Kadim* 10473 — Sabah: *B.N.B. For. Dept.* 10604; *Kokawa & Hotta* 326; *SAN A* 4562, 4598, 24313, 27131, 27183, 27826, 78031, 84511 — Kalimantan: West, *Mondi* 51 — East & SE.: *b.b.* 9937, 32404, *Kostermans* 4189, 9857A, 10097; *de Vriese s.n.*

Ecology. Mostly in marshy forest, freshwater and peat swamp-forest; on sandy soils, c. 0-200 m alt. Flowers and fruits throughout the year.

Vernacular names. Jangkang paya (Malay); Kajoe haroeja (Batak), Kumpang ensulie, Kumpang sadara, Terada'a, Ta'dara (Sarawak, *vide* Anderson).

NOTES

1. *Fieldnotes*. A few stilt roots or low buttresses occasionally recorded. Flowers often recorded as yellow, strongly scented. Bark greyish, fissured, flaking in small rectangular scales.

2. The lower surface of the leaves of Bornean material tend to become somewhat earlier glabrescent as compared with those in Sumatra and Malaya.

3. May be confused with *H. fulva*, a species also with \pm coriaceous leaves and a persistent perianth on the fruit, but this has a 3-merous perianth. Sterile specimens of the present species may be recognized by the coriaceous leaves, and on the lower surface by the usually persistent 'scaly' tomentum, and the usually present sparse to rather dense irregularly-shaped dark-brown dots and streaks. Sinclair (1975, p. 26) remarks that the species can easily be recognized from a distance by its rusty or cinnamon-brown colour of the lower leaf surface. The species is very constant in habit, characters, and habitat.

It has few (only c. 4-6) well separated anthers, the androecium being typically narrowly attached to the base of the perianth.

It is one of the few West Malesian species with a 2-valved perianth.

69. *Horsfieldia carnosa* Warb.

Fig. 1C(69); 26

Horsfieldia carnosa Warb., Mon. Myrist. (1897) 348, 619; Merr., En. Born. J. Str. Br. R. As. Soc. spec. number (1921) 268; Sinclair, Gard. Bull. Sing. 28 (1975) 21. — *Myristica carnosa* (Warb.) Boerl., Handl. Fl. Ned. Ind. 3, 1 (1900) 87 — Type: *Beccari 344* (FI Acc. 7624), young male fl. (FI, n.v.); 1242 (FI Acc. 7625), fr. (FI, n.v.; iso: K, P).

Tree 4-10 m. Twigs terete, stoutish, towards apex 3-10(-16) mm diam., early glabrescent from a grey-brown tomentum composed of hairs c. 0.1 mm, bark of older twigs coarsely or finely striate, with a tendency to flake, drying somewhat pale, yellow-brown or light grey-brown, generally rather contrasting with the blackish brown colour of the dry petioles, lenticles usually not conspicuous. Leaves in 2 rows, chartaceous-coriaceous, rarely \pm membranous, elliptic-oblong to oblong, broadest at or slightly above the middle, 13-35 \times 5-11 cm, base long- or sometimes short-attenuate, top acute-acuminate; upper surface drying bright dark brown, with a finely wrinkled-granulate structure, glabrous, lower surface early glabrescent (glabrous), without blackish dots; midrib above flat; nerves 13-18 pairs, flat above, the marginal arches indistinct; tertiary venation forming a lax network, faint or invisible on both surfaces; petioles 10-16 \times 2-4 mm, glabrous or early glabrescent; leaf bud 9-13 \times 2-3 mm, with grey-brown tomentum of hairs c. 0.1 mm long. Inflorescences densely to rather sparsely set with hairs c. 0.1 mm or less, in σ : many-flowered, 3 or 4 times ramified, 6-17 \times 5-14 cm, common peduncle 10-30 mm; in ρ : ramiflorous, rather many-flowered, c. 1-2 cm long, the flowers rather clustered; bracts elliptic to oblong, 4-10 mm long, pubescent, caducous. Flowers 3-valved, glabrous, in σ in loose clusters of 3-9 each, pedicels 1-1.5 mm long, rather slender, glabrous, at base inarticulate. Male perianths globose or subglobose, 1.9-2.1 \times 1.8-2.0 mm, top and base (broadly) rounded; pedicels 1.0-1.5 mm long; perianth at anthesis cleft to $\frac{1}{3}$ - $\frac{1}{2}$, valves c. 0.2 mm thick, perianth not collapsing on drying. Androecium (sub)globose, 1.0-1.2 \times 1.0-1.3 mm, circular in transverse section; anthers 9-11 (thecae 18-22), completely sessile (free apices \pm 0),

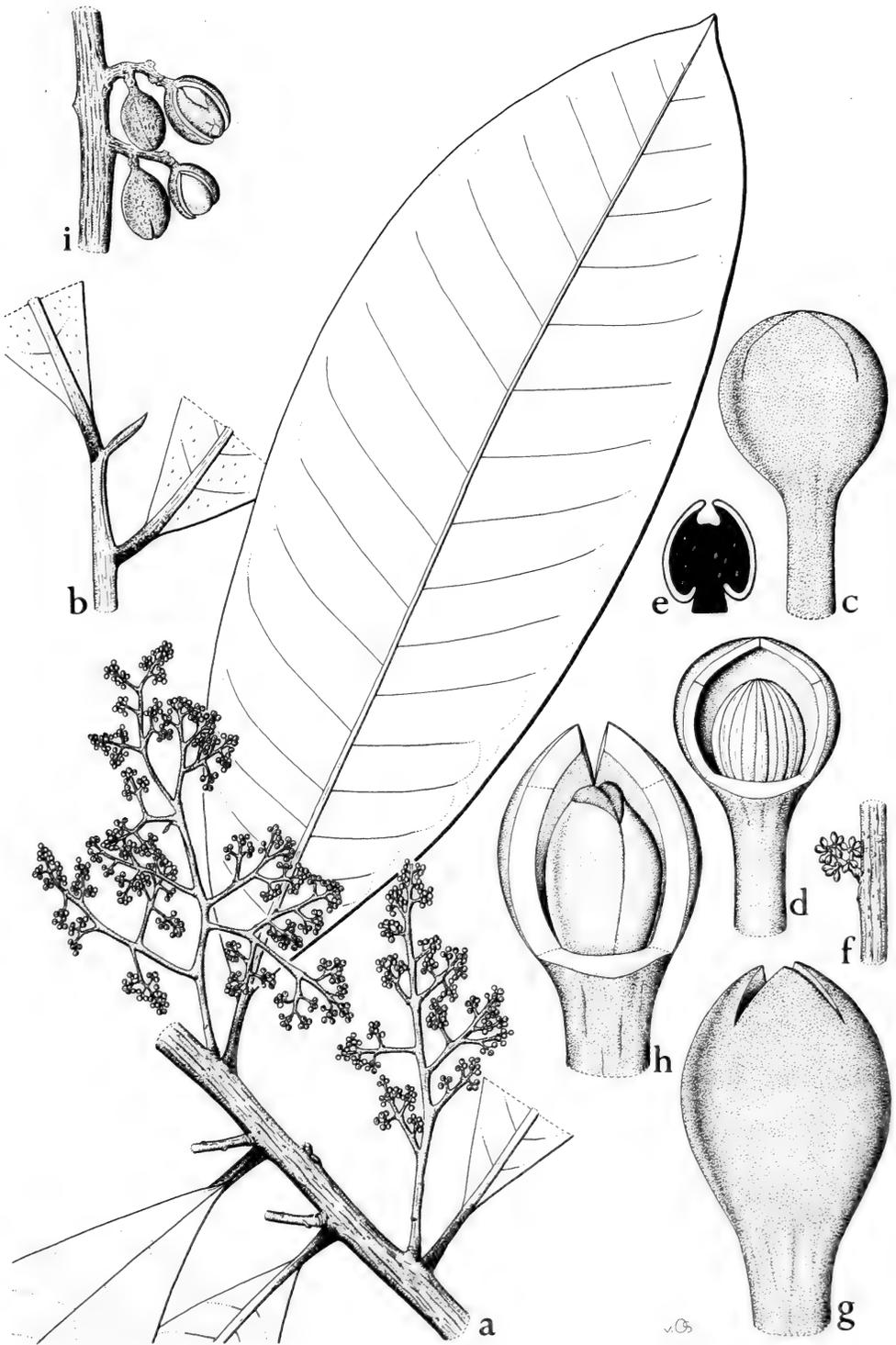


Fig. 26. *Horsfieldia carnosus* Warb.

a. portion of twig with leaf and male infloresces, $\times \frac{1}{2}$; b. apical part of leafy twig, note pale colour of stem contrasting with dark drying colour of the petioles, $\times \frac{1}{2}$; c. mature male flower, lateral view, $\times 12$; d. ditto, opened, showing androecium, $\times 12$; e. androecium, longitudinal section, schematic, $\times 12$; f. portion of twig with female inflorescence axillary to leaf scar, $\times \frac{1}{2}$; g. female flower in anthesis, lateral view, $\times 12$; h. ditto, longitudinally opened, showing glabrous ovary with broadly 2-lipped stigmas, $\times 12$; i. portion of older twig with infructescences, fruits mature, aril complete but torn by drying, $\times \frac{1}{2}$. — a. from van Niel 5419; b-e. from S. 18011; f-h. from San. 63191; i. from San. 17438.

curved, at apex concealing a small apical cavity 0.2-0.4 mm deep; column broad, \pm spongy, androphore rather narrow, distinct, 0.2-0.5 mm long, completely hidden by the anthers. Female perianth ellipsoid, c. 3.5×2.5 mm, glabrous, cleft to c. $\frac{1}{3}$, valves c. 0.3-0.4 mm thick, pedicels c. 1-1.5 mm long, ovary ellipsoid, c. 2.0×1.5 mm, glabrous, stigma consisting of two broad lips c. 0.2 mm high. Fruits 2-11 per infructescence, ellipsoid, top and base rounded, $1.6-2.0 \times 1.2-1.5$ cm, glabrous, drying brown with a finely granulated surface; pericarp c. 1.5 mm thick; stalk 1-2 mm long; perianth not persisting.

Distribution. Borneo: Sarawak, Brunei, Sabah, West Kalimantan (G. Klam).

BORNEO. Sarawak: *Beccari 1242; Clemens 22345; Haviland & Hose 2096; Native Coll. 676, 1970; S 15456, 15955, 18011, 32713; Sinclair & Kadim 10428* — Brunei: *Fuchs et al. 21193; Van Niel 4519; Brünig S. 1071* — Sabah: *B.N.B. For Dept. 2378; SAN 17438, 63191, 73218, 80063* — West Kalimantan, G. Klam: *H. Hallier 2381.*

Ecology. Heath forest, wet kerangas forest, peat swamp forest, *Agathis-Casuarina* forest; on white sandy soils; 0-100m alt; flowers mainly in July to November, fruits collected throughout the year. An extensive note on the ecology is given by Sinclair on p. 22.

NOTES

1. *Fieldnotes.* A low tree with slender trunk to 10 m high. Bark often flaking or shallowly fissured. Twigs light brown. Inner bark yellowish, thin, Sap watery, clear, not red or reddish. Sapwood whitish. Flowers greenish-yellow, anthers whitish. Fruits (immature) greenish-yellow, aril orange.

2. This is a well-characterized species of low trees of the Kerangas or peat swamp forest, on white sand soils. It is distantly related to *H. glabra*, but easily distinguished by its usually stout habit, pale twigs with the bark tending to flake, the large and usually chartaceous-coriaceous (possibly somewhat fleshy) leaves, globose male flowers, the pedicels inarticulate at the base, the globose androecium with distinct but hidden androphore, and the small often \pm clustered fruits of c. 1.6-2 cm length.

70. *Horsfieldia sterilis* de Wilde, *sp. nov.*

Fig. 1C(70)

Folia membranacea, in sicco nigrescentia. Perianthium masculum late obovoideum. \pm carnosum, c. 1.7 mm longum, 2-valvatum, alabastro in anthesi usque ad $\frac{1}{4}$ fisso, androecio late obovoideo, c. 0.8 mm longo, apice non-excavato, antheris 3, c. 0.4 mm longis, sessilibus. — Type: Sabah, *Aban Gibot SAN 30597* (L; iso: K; SING, *n.v.*).

Tree or shrub, 3-12 m. Twigs terete, not lined or winged, towards the apex 2.5-4(-8) mm diam., dark brown or greyish brown, sometimes rather contrasting with the blackish colour of the dry petioles, bark early glabrescent, tomentum rusty to grey-brown, with hairs 0.1-0.2 mm; bark lower down finely striate, not tending to crack or flake; lenticels conspicuous or not. Leaves in 2 rows, membranous, elliptic-oblong to oblong(-lanceolate), broadest at or slightly above the middle, $13-33 \times 4.5-9$ cm, base attenuate, top acute-acuminate; upper surface glabrous, drying rather dark brown to blackish, lower surface glabrous, drying brownish, without scattered larger dark-coloured dots; midrib flat above, glabrous; nerves 11-17 pairs, flattish or slightly raised above, lateral arches not particularly distinct; tertiary venation forming a lax network, faint or invisible on both surfaces; petioles $7-20 \times 2-3.5$ mm, glabrous (early glabrescent); leaf bud slender, $7-12 \times 2-2.5$ mm,

densely (pale) rusty pubescent with hairs 0.1-0.2 mm long. Inflorescences sub-glabrescent, tomentum rather weak, of hairs 0.1-0.2 mm long, in ♂: rather lax, 10-20 × 5-8 cm with rather few side-branches, 2 or 3 times ramified, moderately densely flowered, common peduncle long, with several bract-scars, 30-90 mm long, flowers in loose clusters of 2-6 each; ♀ inflorescences elongate, slightly-branched, almost spike-like, 5-10 cm long; perianths glabrous, 2-valved, pedicel glabrous, at base inarticulate; bracts ablong-lanceolate, 3-8 mm long, acute, pubescent with hairs 0.1-0.3 mm especially at the margins, caducous. Male perianth broadly obovoid-subglobose, 1.5-1.7 mm diam., top broadly rounded or somewhat depressed, base sub-attenuate, glabrous; pedicel 1-1.5 mm long, slender; perianth at anthesis cleft to c. ¼, valves rather thick-fleshy, 0.3-0.4 mm thick, the perianth shrinking, not collapsing on drying. Androecium broadly obovoid, c. 0.8 × 0.6-0.7 mm, top ± rounded, subcircular in transverse section; anthers 3 or (6?) (i.e. with 5-6 thecae), completely sessile, c. 0.4 mm long, occupying only the apical part of the androecium, connectives broad, ± triangular, with narrow thecae; column broad and solid, apical cavity absent or very inconspicuous; androphore conspicuous, broad, tapering to below, c. 0.4 mm long. Female flowers not seen; according to persistent perianths under immature fruits: perianth c. 2.5 mm long, 2-valved, glabrous. Fruits (immature ones, *B.N.B. For. Dept. 27*) 4-10 per spike-like infructescence, ellipsoid, top and base rounded, c. 2.2 × 1.8 cm, glabrous, drying blackish, not tubercled, pericarp c. 2 mm thick; perianth persisting under immature fruit; stalk 3-4 mm long.

Distribution. Borneo: Sabah, a local endemic of SE. Sabah.

BORNEO. Sabah, Tawau Dist.: (*Orolfo*) *B.N.B. For. Dept. 27*; (*Aban Gibot*) SAN 30597; (*Shea*) SAN 75748, 95959.

Ecology. Small trees or shrubs in forest on hillsides and riverbanks; at. 80-500 m alt. Flowers April to July.

Vernacular name. Duria (Sabah, Tawau Dist.).

NOTES

1. *Fieldnotes.* Small trees or shrubs; bark greybrown, non-fissured. Inner bark with orange-red sap. Sapwood pale yellow.

2. A species notable by its 2-valved perianth and the subconical broadly obovoid androecium of which only the apical half bears 3 or 6 rather much-reduced anthers; the basal part of the androecium or androphore is sterile, broad and tapering. Whether there are actually 6 anthers or only 3 anthers each with 2 thecae requires further confirmation.

The structure of the androecium is reminiscent of that of species like *H. crux-melitensis* and *H. clavata* from New Guinea, but in these species the androecium is much more elongate. In general habit the new species resembles e.g. *H. pallidicaula* or *H. sucosa*, because of its rather pale twigs and blackish drying leaves, but our present species differs by much more elongated inflorescences.

3. The type specimen was not treated under *Horsfieldia* by Sinclair. A second specimen (*Orolfo*, *B.N.B. For. Dept. 27*) was identified by him as *H. bracteosa* var. *microcarya*.



Comparative Anatomy of the Stipe of the Fern Genus *Adiantum* L. (Adiantaceae)

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Abstract

The investigations carried out covering approximately half the species from virtually the entire geographical range of the genus *Adiantum* L. showed that there was a range of shape of the xylem strands proceeding by small steps from the simple (deep-crescent type) to the intricate form (tong-shaped). Eight types of xylem configurations were observed and the genus was subdivided accordingly.

Introduction

The fern genus *Adiantum* comprises about 150-200 species (Abraham *et al.*, 1962; Holttum, 1954; Tryon & Tryon, 1981) and has a nearly cosmopolitan distribution except in regions with extremely dry or cold climates. The genus was subdivided into a number of groups based on its diverse morphological forms by early taxonomists such as Hooker & Baker (1874), Smith (1896), Christ (1897) and Diels (1902). Meanwhile Wylie (1948) investigated the role of leaf epidermis in 18 species of *Adiantum* from America and Bidin (1980, 1984a, 1984b) looked at the cytology, leaf forms and leaf blade anatomy of the genus respectively.

Anatomical and morphological studies of the stipe have also been regarded as useful methods in solving taxonomic problems of ferns. Presl (1847) and Thomas (1886) investigated the structure and arrangement of vascular bundles in the stipes of a wide range of ferns and drew attention to the great variation found. Later authors used these characters in investigating particular taxonomic problems, e.g., Milde (1866) in distinguishing between *Athyrium* and *Asplenium*, whilst Ching (1940) used them in the subdivision of Polypodiaceae s.l. More recently Keating (1968) studied the stipe anatomy of the Dennstaedtioid genera, while Lucansky & White (1974) made comparative studies of the nodal and vascular anatomy of neotropical members of Cyatheaceae. In Taiwan, Lin & DeVol (1977) prepared a multiple choice key based on the study of stipe characters to the species, genera and families of local ferns.

Materials and Methods

Plant material for the study were gathered from various geographical areas by the authors. Live plants were grown at the Moorbank Experimental Garden, Newcastle University, whilst dried specimens were kept at the Herbarium of the Plant Biology Department of the same University.

Segments were cut from three positions along the stipe; i.e., at the base, in the lower region and the upper portion just below the first rachis or pinnule. The segments were each about 1 cm long. Fresh material was fixed in 70% alcohol. Extremely hard stipes and those obtained from the herbarium specimens were

softened by boiling in water for two hours prior to fixation. Various methods of sectioning were employed. In most cases sections were obtained by free hand or by use of the sliding microtome but for hard materials it was necessary to embed in paraffin wax before microtoming. Staining in all cases was in Safranin 0 and Light/Fast Green.

Results and Discussion

The stipe of *Adiantum* is usually dark brown to black, slender and has a polished-glossy appearance. Some species are however sparsely hairy or scaly especially towards the base.

The anatomical structure of the stipe is fundamentally similar to that of the rhizome. It possesses a layer of longitudinally elongated epidermal cells, a cortex, an endodermis and a stele. In all cases the endodermis surrounds each vascular bundle and in certain species the stele is clearly visible in a cross-section even with the unaided eye. The stelar system in the stipe of *Adiantum* consists of one or two traces which are usually arranged in an adaxially curved arc and shows a wide range of variation. The stele in cross-section may have a terete or undulate outline or sometimes an intermediate form. In some species the outlines of the endodermis bear no specific relation to the cross-sectional shape of the stipe (Table 1). The arrangement of strands may change gradually from base to apex, and all the changes however minor should be noted, particularly those affecting the xylem.

Two bundles enter the base of the stipe, and later join upwards to form a four-angled strand. This can be clearly seen in the majority of the species. In some cases the double nature of the bundle is not just confined to the basal region but many extend upward to the middle or even the upper region of the stipe. Observations show that even the double nature of the bundle is not uniform throughout the genus. In the Reniforme and Caudatum groups there is only one bundle present even at the extreme base of the stipe and it persists up the entire length.

Except for the species showing an arc-shaped xylem throughout the entire length of the stipe, all members of *Adiantum* show two Onoclea-type strands in the basal region. Each of these strands contains a hippocampus-shaped xylem mass with hooked or blunt or even sharp ends towards the groove of the stipe. The protoxylem occurs on the inner surface, and a phloem layer surrounds the xylem mass. In some cases the two bundles are more widely separated towards the groove (adaxial) side of the stipe than at the opposite rounded (abaxial) side. Further up the stipe their abaxial ends come in contact and fuse to form a V-shaped, basin-shaped or tongs-shaped bundle with ends which differ in detail from one to another.

A more detailed examination of a large number of taxa (50) reveals that it is not only basin-shaped or V-shaped xylem strands which can be found in Onoclea-type meristemes in the upper region of the stipe (Plate 1). The shape develops gradually from a simple crescent configuration in the Caudatum and Reniforme groups (Fig. 1) to a more complex one in the shape of tongs as in *A. lucidum* and *A. tetraphyllum* (Fig. 8). The first sign of change is that the crescent-shaped strand begins to show a weak constriction in the middle which finally divides the strand into two halves. The tips of the halves curve downwards and are blunt with no hooks present (Fig. 3). This is a transitional shape between the simple crescent-like and the more complex, tongs-like configuration and is found in *A. lunulatum*.



Fig. 1: Deep crescent



Fig. 2: Light crescent



Fig. 3: Bird-shaped



Fig. 4: Slightly curved-upward



Fig. 5: Saucer-shaped



Fig. 6: V-shaped



Fig. 7: Basin-shaped



Fig. 8: Tongs-shaped

Plate 1. Shape of xylem strands in the stipe of *Adiantum*. The types are arranged in order of increasing complexity, which is believed to coincide with the direction of evolutionary change. The numbers in this figure correspond to the number of the groups in Table 1 of the types of stipe in *Adiantum*.

Table 1. Stipe Types of *Adiantum* L.

Species	Shape of T.S. of stipe	Strand	Xylem (base of stipe)	Xylem (middle & upper stipe)
1. <i>A. reniforme</i> L.	subterete at the base, terete above	terete	single stranded, deep crescent	single stranded, deep crescent
<i>A. reniforme</i> L. ssp. <i>asarifolium</i> Willd.	subterete at the base, terete above	terete	single stranded, deep crescent	single stranded, deep crescent
2. <i>A. caudatum</i> L.	terete	terete	single stranded, shallow crescent	single stranded, shallow crescent
<i>A. incisum</i> Forsk.	terete	terete	single stranded, shallow crescent	single stranded, shallow crescent
<i>A. malesianum</i> Ghatak	terete	terete	single stranded, shallow crescent	single stranded, shallow crescent
<i>A. zollingeri</i> Mett. ex Kuhn	terete	terete	single stranded, shallow crescent	single stranded, shallow crescent
<i>A. rhizophorum</i> Sw.	terete	terete	single stranded, shallow crescent	single stranded, shallow crescent
3. <i>A. lunulatum</i> Houtt.	subsulcate	subsulcate	2-stranded	slightly curved downward, bird-shaped
4. <i>A. formosum</i> R. Br.	subterete at the base, terete above	terete	2-stranded	slightly curved upwards
<i>A. diaphanum</i> Bl.	subterete at the base, terete above	terete	2-stranded	slightly curved upwards
<i>A. deltoideum</i> Sw.	terete	sulcate	2-stranded	slightly curved upwards
<i>A. capillus-veneris</i> L.	terete	sulcate	2-stranded	slightly curved upwards
<i>A. tenerum</i> Sw.	terete	sulcate	2-stranded	slightly curved upwards
<i>A. concinnum</i> Willd.	terete	sulcate	2-stranded	slightly curved upwards
<i>A. aethiopicum</i> L.	terete	sulcate	2-stranded	slightly curved upwards
<i>A. raddianum</i> Presl.	terete	sulcate	2-stranded	slightly curved upwards
<i>A. fragile</i> Sw.	terete	sulcate	2-stranded	slightly curved upwards
<i>A. venustum</i> Den.	terete	sulcate	2-stranded	slightly curved upwards
<i>A. henslovianum</i> Hook.	terete	sulcate	2-stranded	slightly curved upwards
5. <i>A. patens</i> Willd.	terete	sulcate	2-stranded	saucer-shaped
6. <i>A. hispidulum</i> Sw.	subterete	sulcate	2-stranded	V-shaped
<i>A. cunninghamii</i> Hk.	terete	sulcate	2-stranded	V-shaped
<i>A. affine</i> Hk.	subterete	sulcate	2-stranded	V-shaped
<i>A. silvaticum</i> Tindale	terete	subsulcate	2-stranded	V-shaped

Table 1. *Contd.*

Species	Shape of T.S. of stipe	Strand	Xylem (base of stipe)	Xylem (middle & upper stipe)
(6.) <i>A. pedatum</i> L.	subterete at the base, terete above	sulcate	2-stranded	V-shaped
7. <i>A. macrophyllum</i> Sw.	subterete at the base, terete above	sulcate	2-stranded	basin-shaped
<i>A. serrato-cristatum</i> Willd.	subciliate at the base, sulcate above	sulcate	2-stranded	basin-shaped
8. <i>A. tetraphyllum</i> Willd.	subterete at the base, terete above	sulcate	2-stranded	tongs-shaped
<i>A. lucidum</i> Willd.	subterete at the base, terete above	sulcate	2-stranded	tongs-shaped
<i>A. villosolicidum</i> Jeremy & T.G. Walker	subterete at the base, terete above	sulcate	2-stranded	tongs-shaped
<i>A. trapeziforme</i> L.	terete	sulcate	2-stranded	tongs-shaped
<i>A. polyphyllum</i> Willd.	terete	terete	2-stranded	tongs-shaped
<i>A. pulverulentum</i> L.	sulcate	sulcate	2-stranded	tongs-shaped
<i>A. petiolatum</i> Desv.	subterete at the base, terete	sulcate	2-stranded	tongs-shaped
<i>A. villosium</i> L.	subterete at the base, terete above	sulcate	2-stranded	tongs-shaped
<i>A. serratodentatum</i> Willd.	subterete at the base, terete above	sulcate	2-stranded	tongs-shaped
<i>A. cristatum</i> L.	terete	sulcate	2-stranded	tongs-shaped
<i>A. obliquum</i> Willd.	sulcate	sulcate	2-stranded	tongs-shaped
<i>A. kendalii</i> Jenn.	subterete	sulcate	2-stranded	tongs-shaped
<i>A. cristatum</i> × <i>A. pulverulentum</i>	terete	sulcate	2-stranded	tongs-shaped
<i>A. terminatum</i> Kunze ex Miquel	terete	sulcate	2-stranded	tongs-shaped
<i>A. malanoleucum</i> Willd.	terete at the base, sulcate above	sulcate	2-stranded	tongs-shaped
<i>A. latifolium</i> Lam.	terete	sulcate	2-stranded	tongs-shaped
<i>A. peruvianum</i> Kl.	terete	subsulcate	2-stranded	tongs-shaped
<i>A. pulverulentum</i> L. var. <i>caudatum</i> Jenn.	sulcate	sulcate	2-stranded	tongs-shaped
<i>A. ancitense</i> Cart.	terete	sulcate	2-stranded	tongs-shaped

The next type of xylem strand is still simple in form but in this case the tips of the two halves point upwards and are blunt and not hooked (Fig. 4). This shape is found in *A. formosum* and all members of the Capillus-Veneris group. The strands in *A. patens* is a modification of this; here the tips of the two halves are sharp and curve upwards, whilst the centre of the strand makes a shallow curve downwards forming a saucer-shaped strand (Fig. 5). A further development may be seen in *A. hispidulum*, *A. cunninghamii*, *A. affine*, *A. whitianum*, *A. silvaticum* and *A. pedatum*. In these examples the xylem strand has a very characteristic V-shaped configuration and the tips of the two halves are sharp and a little curved (Fig. 6).

In some species such as *A. macrophyllum* and *A. serratocristatum* where the fluting of the stipe is very deep the abaxial arms of xylem join to form a basin-shaped strand with a nearly flat base. The arms are very slender and well separated from each other in the central region (Fig. 7). In other cases the metaxylem portions although fusing with each other fail to develop fully in the central region of the abaxial part of the strand resulting in a shape similar to a pair of tongs with long curving handles (Fig. 8). This type is found in almost all members of the Polysorus group.

Conclusion

From the observations, it will be seen that there is a sequence of shapes of the xylem strands ranging by small steps from the deep-crescent type seen in *A. reniforme* to the rather intricate tongs-shaped type seen in *A. tetraphyllum*. This sequence is illustrated in Plate 1. Part of the sequence was described by Ogura (1972) but with important gaps present.

Lin & De Vol (1977) in their investigation of the ferns of Taiwan stated in the key to the identification of genera that *Adiantum* had a V-shaped type of xylem configuration. There is no indication of whether or not more than one species was examined and indeed no direct indication of what species it was. However Tsai (1972 and 1973) lists 53 ferns of Taiwan which he has cytologically examined and the only species figuring in the list is *A. capillus-veneris*. This species has indeed a shallowly V-shaped xylem configuration. It is evident that a key of this nature based on inadequate samplings would not necessarily work in other regions and such information may be misleading if indiscriminately applied.

Acknowledgements

This work is partially supported by Universiti Kebangsaan Malaysia Research Grant No. 18/82 for which we are very grateful.

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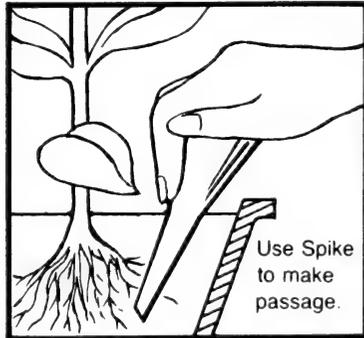
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