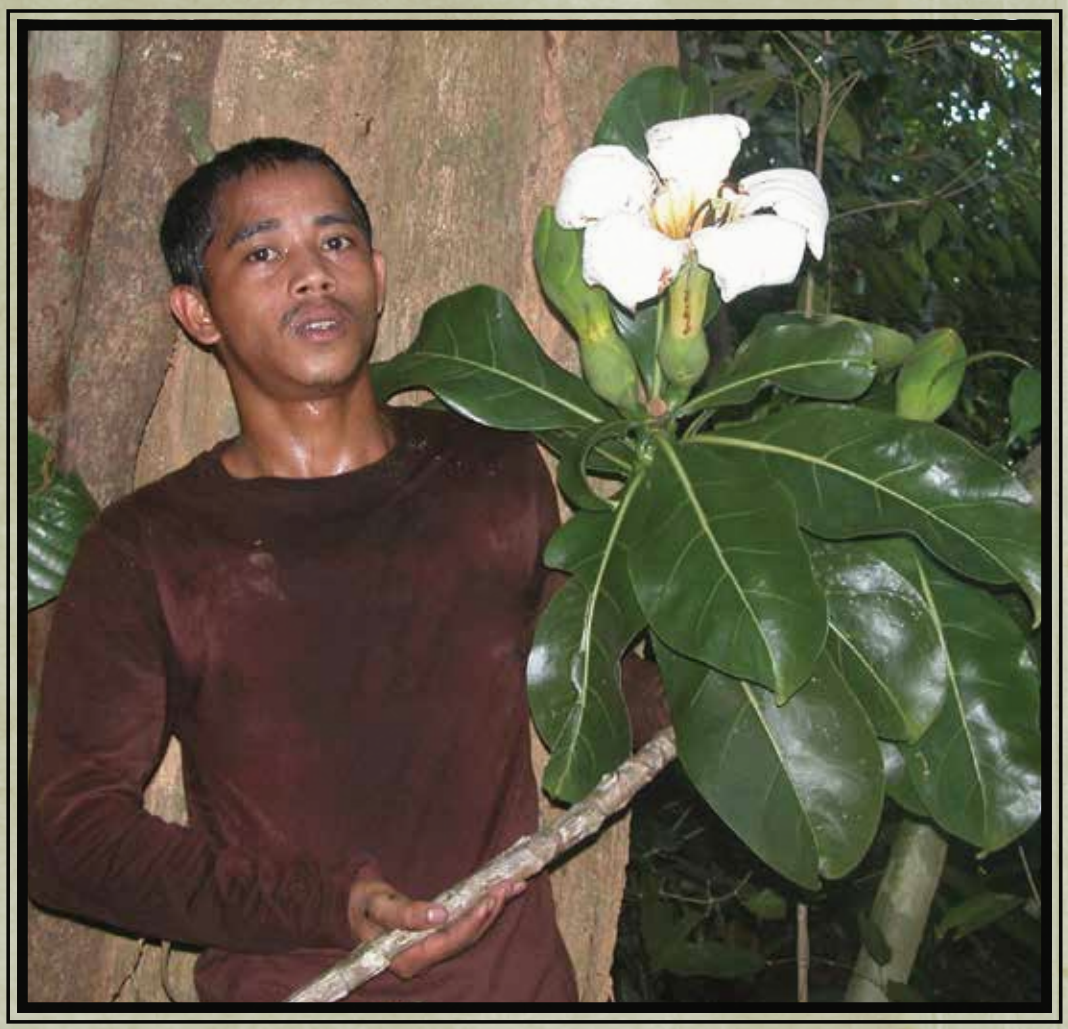
SANDAKANIA

No. 21 **July, 2016**

Centenary of the Sandakan Herbarium 1916–2016



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SANDAKANIA

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SANDAKANIA No. 21 **July, 2016**

Centenary of the Sandakan Herbarium 1916–2016

CONTENTS

Page

Datuk Sam Mannan
Introduction — The Centenary of the Sandakan Herbarium iii

J.B. Sugau, J.T. Pereira, Y.F. Lee & K.M. Wong
The Sandakan Herbarium turns a hundred 1

K.M. Wong & J.T. Pereira
A taxonomic treatment of the Asiatic allies of *Rothmannia* (Rubiaceae: Gardenieae), including the new genera *Ridsdalea* and *Singaporandia* 21

K.M. Wong & M. Sugumaran
Studies in Malesian Gentianaceae, VII. A revision of *Fagraea* in the Malay Peninsula with five new species 65

T.J. Barkman, R. Repin & J.B. Sugau
The parasitic plant families Loranthaceae and Viscaceae in Sabah, Malaysia 131

INTRODUCTION

The Centenary of the Sandakan Herbarium

The Sandakan Herbarium turns a hundred years old this year. It was set up in 1916, after D.M. Matthews initiated his forest surveys and inventories around Sandakan and the east coast of Sabah. Although the Sandakan Herbarium experienced two major catastrophic setbacks, first due to war, and then to fire, the great efforts and dedication of forest conservators, forest botanists and many plant collectors have ensured the survival and continuation of the herbarium. In its long and varied history, we must recall the contributions of Dr Willem Meijer, who had put all his energy into reorganization of the Sandakan Herbarium after the fire in 1961.

The present Sandakan Herbarium is housed in its own building at the Forest Research Centre in Sepilok, with about 200,000 accessions, and has become a veritable scientific archive of the vegetation and flora of Sabah and Borneo. Due to its significant role in supporting various forestry programmes and plant science, the Sabah Forestry Department's Sandakan Herbarium is undoubtedly a special heritage.

The achievements of the herbarium and those who have been associated with it are tangible and something we are all proud of. The excellence of the Herbarium lives on through the everyday tasks done well by its staff members—from plant collecting, specimen processing, mounting, through the identification process and incorporation into the Herbarium as a reference item, to documentation. As befitting a forestry-centred facility, the Herbarium supports forest inventories carried out for management purposes, assessing the diversity and special value of the plant life in an area, whether a district, forestry compartment, or even site, informing decisions made in the management process, and often supporting special conservation plans. As Sabah is an important part of Borneo with its own floristic specializations, the activities of the Herbarium in scientific documentation, from botanical studies of species and families to the publication of such results, are highly relevant to our understanding of the flora on this island.

To mark this special milestone in the history of the Sabah Forestry Department, the centenary of the Sandakan Herbarium is celebrated over two special issues of our botanical journal *Sandakania*. I am pleased to introduce the first of these issues.

Datuk Sam Mannan
Director,
Sabah Forestry Department

SANDAKANIA 21 (2016): 1–20

The Sandakan Herbarium turns a hundred

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Summary. The Sabah Forestry Department's Sandakan Herbarium attained its centenary in 2016. Its history since inception has witnessed challenging episodes, including re-establishment following wartime destruction at the end of the 2nd World War and a fire in 1961, followed by intensive collection rebuilding programmes to support botanical documentation of a spectacularly biodiverse region. The Herbarium moved to Sepilok with the newly established Forest Research Centre there in 1974 and subsequently into its own building by 2000, when the collection had exceeded 200,000. Its expanding role includes supporting forestry programmes and plant science into the future. Modern imperatives for Sabah's conservation and forest management objectives include ecological-floristic assessments and botanical inventories towards Forest Management Plans (FMPs), Conservation Management Plans (CMPs) and High Conservation Value Forests (HCVFs), as well as consolidating conservation habitats and corridors that contribute to the Heart of Borneo programme. Wider afield, plant taxonomic research continues to emphasize the flora of Borneo and the Malesian region, with in-house specializations having included Dipterocarpaceae, Gentianaceae, Pentaphylacaceae, Rubiaceae, Sapotaceae, Poaceae-Bambusoideae and various other tree families.

The Sandakan Herbarium (international acronym SAN; Thiers, continuously updated) was established in 1916. The herbarium's initial functions were modest, set up to support the identification of forest plants, especially timber trees, in tune with the Forestry Department's then limited explorations and operations. The present article recounts how its historical development has transcended the vicissitudes of a century, its long-standing archival functions are now more widely appreciated as relevant to the unfolding importance of natural

resources conservation, and how it moves forward with active application to the aspirations of forestry at home and the wider science of botany in the region.

OPENING SCENARIOS

The Herbarium came into being just 35 years following the initial organization towards a modern state entity. The earlier history of North Borneo is recorded to different detail by various authors but, as Fyfe (1964) put it, "is somewhat confused, being a welter of rivalries between sultanates and pirates, the latter dominating the scene until well into the nineteenth century." By the 1870s and 1880s, trading visitation to the Sandakan Bay area, much focussed on minor forest products and birdnest, had become significant and human settlement became more organized in the township of Elopura founded by William Pryer. Organized governance began with the British North Borneo Chartered Company, which was incorporated in London in 1881 to manage the territory that the British colonial merchant Alfred Dent had acquired from the Austrian Baron Gustav von Overbeck, who held a lease from Brunei for North Borneo. Dent and his associates formed a treaty with the Sultan of Brunei in 1877. Although the Sultan appointed Dent and his associates or successors as 'Maharajah of Sabah' (North Borneo) and 'Rajah of Gaya and Sandakan' with absolute authority ("with power of life and death over the inhabitants...") (Kahin 1947), the Company's appointed head of government was called a Governor. The development of North Borneo was geared towards making profits for its investors and proceeded with an emphasis on planting tobacco, collecting 'jungle produce' such as birds' nests, rattan, gutta-percha and camphor, and cutting timber. In 1888 North Borneo became a protectorate of Great Britain.

Although the British North Borneo Company had to overcome an acute shortage of labour, its request for forestry personnel was turned down by the Colonial Office, who could not make available any of their officers from India, Ceylon or Malaya (Ibbotson 2014). In 1913, Acting Governor of British North Borneo A.C. Pearson issued an encouragement for more Japanese migrants to North Borneo (Yoji 2008). In the same year, the Chairman of the British North Borneo Company Sir Joseph West Ridgeway visited Japan and was recommended the services of an experienced forester and dendrologist Fusaji Goto, who arrived in late 1913 and was employed in British North Borneo from 1914 until 1916 (Shimomoto 2010, Ibbotson 2014). Pearson had also travelled to the Philippines to learn more about forestry administration and training, and thereafter recommended appointment of an American forester (Pearson 1914). Donald M. Matthews from the Philippine Bureau of Forestry was appointed as Chief Forestry Officer in November 1914 and the older Goto, then designated his assistant, was terminated at the end of 1915 at Matthews' recommendation because Goto appeared unable to negotiate effectively with companies and investors. The Forestry Department of North Borneo was thus established in Sandakan by late 1914 (Ibbotson 2014), to manage the commercial exploitation of timber, previously a function of the Land Office that lacked the necessary expertise for forest management (Doolittle 2005).

Matthews appointed three Filipino rangers he knew: José A. Agama, Aniceto Villamil and Mariano Castillo. Together with F.W. Foxworthy, Matthews' associate from Los Baños, he conducted a study of the timber resources in the east coast, resulting in the inaugural issue of the Bulletin No. 1, *Timbers of British North Borneo and Minor Forest Products* (Foxworthy 1916) and No. 2, *British North Borneo Forests: Opportunities for Timber Investment* (Matthews 1916). Matthews appointed another American, D.D. Wood, as Assistant Conservator of Forests and then Acting Conservator in 1916; Wood replaced Matthews as Conservator when the latter resigned in January 1920 to join British Borneo Timbers (Ibbotson 2014).

E.D. Merrill, who began his appointment as a botanist with the Bureau of Science in Manila in 1902 and first visited North Borneo in 1906, instigated the organization of the Sandakan Herbarium. This was begun in 1916, after Matthews initiated his surveys and inventories around Sandakan and the east coast and saw the worth of starting a herbarium. Villamil and Foxworthy started the first North Borneo Forestry Department collection in 1915. Certainly, North Borneo specimens had been gathered at the Manila Herbarium even before then. Merrill, who became highly interested in the Bornean flora, subsequently compiled a bibliographic enumeration of Bornean plants (Merrill 1921).
Ibbotson (2014) wrote—

> "Although Matthews had little time available for botanical work, visits by his friend and colleague from Los Baños, Dr F.W. Foxworthy, assisted by José Agama and [Maximo] Ramos, a trained botanical collector from Manila loaned by [E.D.] Merrill in 1920, had got the herbarium started. This work was continued by D.D. Wood, a keen botanist, who by the time of his retirement had personally collected 2555 specimens. Harry Keith, another keen botanist, continued this botanical work and in 1940 the herbarium at Sandakan contained 10,803 sheets of mounted specimens representing 672 species."

Later, Merrill assumed the Deanship at the College of Agriculture at the Berkeley University, California, where he impressed H.G. Keith, a young Englishman who would later succeed Wood when the latter retired in 1931. Keith was appointed Assistant Conservator of the North Borneo Forestry Department in 1925. Because of Merrill's special interest in Borneo, many duplicate botanical collections were directed to him, through his career at Berkeley and later his directorships at the New York Botanical Garden (from 1929) and the Arnold Arboretum of Harvard University (from 1935).

Keith published *A Preliminary List of North Borneo Plant Names* (Keith 1937, revised 1952) and *The Timbers of North Borneo* (H.G. Keith 1947). Herbarium specimen duplicates were also sent to Kew, where H.K. Airy Shaw gave attention to much of the identification. Keith married Agnes Newton in 1934, who became the celebrated author of *Land Below The Wind* (Keith 1939), an account of their life in North Borneo.

WAR, MISHAP AND FIRE

As the Second World War progressed, Sandakan was occupied in January 1942, just before the fall of British Singapore in February 1942. The harsh conditions of internment of European officers and others after Sandakan was occupied by the Japanese on 18 January 1942 is a story that can never be retold too often. The Keiths were interned and some of their hardship described in A.N. Keith (1947).

Just after the cessation of the War, Kahin (1947) had written—

> "North Borneo is reported to have been one of the most completely devastated of all the areas overrun by the Japanese. Nearly every important town was demolished, largely by Allied bombings... In fact, the material condition of the country is described as having reverted to that at the beginning of chartered rule."

And although Meijer (1968) also recorded, from information available to him, that the Sandakan Herbarium was bombed and destroyed during Australian air raids in [November] 1944, Ibbotson (2014) was inclined to believe that before their retreat, the Japanese had systematically torched sawmills "like the rest of the town and the isolated European houses overlooking it" and summarized—

> "The Forestry herbarium and library were also destroyed in 1945 by the Japanese. The former building contained the collections made by Matthews and Dr Foxworthy, D.D. Wood and Keith himself, all dedicated forest botanists… In all, more than 10,800 sheets were destroyed. To add to this loss to science, the herbarium in Manila, which contained many duplicates of the Borneo specimens, was also destroyed in the war. The saving grace for the taxonomic dendrology of North Borneo's forests was that duplicates of many of the specimen sheets were available in the collections made by E.D. Merrill at Berkeley, C.F. Symington at Singapore and the Royal Botanic Gardens at Kew.
>
> "…when the Australian troops landed in Sandakan on 12 September 1945 they were met with a scene of utter devastation. Not a single building remained standing."

Ibbotson (2014) cites from the memoirs of Assistant Conservator G.S. Brown, who had also been interned during the war and then recalled from his leave in Edinburgh to resume duty in North Borneo, which he did, arriving back in Sandakan in May 1946:

> "Allied air attacks had been responsible for some of the destruction—damage is not a strong enough word—but mostly it was the work of the Japanese. Sandakan was a wooden town and they set it on fire in an insane fury of destruction…The completeness of the destruction was due to the fact that it was done by hand, systematically, using fire."

Meijer (1968) elaborated:

> "Since 1922 it was the American Botanist E.D. Merrill of the Bureau of Science in Manila who worked at the Botanical Exploration of the Philippines… Collections made by Forest Officers in Sabah, mainly Filipino Forest Rangers like Castro, Melegrito, Apostol, Orolfo and Agama were sent to Merrill for determination. Extensive collections were made by the American plant collector…Elmer for the Bureau of Science in Manila during 1921–

1923 near Sandakan and Tawau. Merrill published a special paper about these collections in the University of California, Publ. Bot. 15: 1–316 (1929)."

Following the implementation of British Military Administration, subsequently the British Borneo Civil Administration Unit (BBCAU), José Agama and other forestry staff who had stayed on in North Borneo reported for duty in December 1945. Agama, then Assistant Conservator, was tasked to restore the Forestry Department (Ibbotson 2014). When North Borneo became a British colony on 15 July 1946, Chartered Company administration ended, but Keith and Brown were respectively appointed Conservator and Assistant Conservator of Forests. The Sandakan Herbarium resumed, abandoning the older British North Borneo (B.N.B.) and Sandakan Herbarium (S.H.) collecting number series and beginning the post-war A series (Keith 1952). The B.N.B. and S.H. numbers are in fact in the same series, and there is a bit of confusion because labels inscribed "B.N.B. Forestry Department" were printed at Kew and applied partly to pre-1945 collections but also partly to post-1945 "A" and "SAN" numbers. The A series ranged 1–5000.

Apparently Keith and Brown were not satisfied with responses from the colonial administration regarding the post-War development of forestry resources and the timber industry and left North Borneo in 1952 and 1954, respectively, the former on retirement and the latter on transfer to the Malayan Forest Service (Ibbotson 2014). The background as regards timber was essentially the same: within just five years following the War, Australia, the United Kingdom, South Africa, Hong Kong/ Shanghai and even Japan were increasing their imports of North Borneo logs once again. The demand for timber seemed insatiable. Notwithstanding, Ibbotson (2014) points out that post-war concessions were based on a 100-year rotation, with still a 70% forest cover in Sabah in 1963, of which some 2.59 million ha was lowland dipterocarp forest (i.e., lowland forest dominated by the tree-family Dipterocarpaceae). Nevertheless, timber production in Sabah rose from nearly 100,000 m^3 in 1947 to around 5 million m^3 for the period 1947–1959, some 10 million m^3 in 1974, and 13 million m^3 in 1978 (Reynolds et al. 2011). After 1959, the value of timber exports exceeded that of rubber, and the timber industry "has made Sandakan one of the great timber ports of the world" (Lee 1965). North Borneo became Sabah in 1965, when the British withdrew and Sabah joined the Federation of Malaysia, with sweeping socio-political transformations to follow.

The Forest Department's Herbarium had difficulty treading a more stable path in the immediate two decades following the War. In 1947, the Sandakan Herbarium was allocated a building which had housed the Public Works Department, allowing the collection programme to resume. By 1952, when A.B. Walton succeeded Keith as Conservator, the need for a Forest Botanist and proper botanical research was acutely felt. That year the collection amounted to 7400 sheets. Dipterocarp inventory and collection continued to dominate botanical work, as that group of trees were among those that formed the backbone of the timber industry. Walton sought the advice of Wyatt-Smith, the botanist at Kepong. The following year, the

Sandakan Herbarium moved to a building known as the Bird's House Godown and was about to engage its first dedicated forest botanist. Meijer (1968) recorded—

> "A very suitable candidate was found in Geoffrey Wood, who arrived in Sabah on the 8th March 1954. He started an energetic collecting drive throughout the State in 1954... accompanied by the Forest Botanist from Malaya, Mr. J. Wyatt-Smith on a trip on the West Coast including an ascent on Mt. Kinabalu. The great year for Geoffrey Wood was 1955 when trees flowered and fruited all over the State. He collected more than 1625 specimens of which 481 belonged to the Dipterocarps. During 1956 he worked on the distribution of these specimens and on the manuscript of a Record of Common Dipterocarps. He went that year on leave and returned to Sabah. His first new trip was in Brunei with B.E. Smythies, and P.S. Ashton then Botanist in Brunei."

It was during that trip to Brunei in May 1957 when Wood died of burns from an accident at camp. Smythies (1960) wrote: "As a party they [Wood and his Dusun expert tree climbers Kanis and Kalukut] were perhaps the most efficient collecting unit the forests of Borneo had seen up till then. Not since the days of Beccari, nearly a century ago, had any botanist collected the trees month after month over a period of years, as Geoffrey did." Just a year before, a checklist of the forest flora of North Borneo by Wood and Agama (1956) was published. It was also Wood who started the SAN series (beginning with SAN 15000 to avoid any possible overlap with past series) in 1954 that has continued until today. Willem Meijer, primarily a bryologist who had earlier worked on general identifications based at the Bogor Botanical Garden and taught botany at the Universitas Andalas in Central Sumatra, and who was forced to leave as civil war broke out in Sumatra, succeeded Wood as Forest Botanist in North Borneo, serving from May 1959 until 1968 (Wong 2004). Meijer continued and completed a detailed botanical documentation of dipterocarps begun by Wood (Meijer & Wood 1964).

Another disaster was soon to strike. Meijer (1968) wrote:

> "...this country was botanically far less explored than, for example, Malaya. Up to 1950... the total number of specimens collected per 100 sq.km. [was in]...Sabah 35, and on [the] Malay Peninsula 110... Not more than 10 percent of the...State was...known botanically... It was also clear that it would not be possible to continue work in Sandakan if the Herbarium would have to remain in the old wooden building of the bird nested godown, where on [a] floor space of 10 x 10 m, 15,000 postwar collections, places for [the] Ecologist with 2 Assistants, Botanist with 2 Assistants, typists, map cabinets, files, card indexes, wood samples and recently mounted specimens would have to remain cramped together. All our efforts to get a new building were fruitless..."

On the night of 31 January 1961, fire spread from an adjacent veneer factory belonging to the British Borneo Timber Co. and razed the Herbarium to the ground (Fig. 1). Meijer recorded that "everything except the manuscripts of the Forest Records, the photographs taken by the Forest Botanist and the unmounted 1959–1960 collections went up in smoke and ashes." Some 15,000 herbarium specimens and several hundred wood specimens were lost in that fire (Fig. 2).

Fig. 1 (above). The night of the fire, 31 January 1961, when flames spread from an adjacent veneer factory and razed the wooden building housing the Sandakan Herbarium to the ground. (Forest Research Centre archives)

Fig. 2 (right). Scorched remains: a specimen of *Timonius flavescens* Baker (Rubiaceae) by Meijer, collected in 1959 before the disastrous fire. (Forest Research Centre archives)

In retrospect, Meijer observed—

> "After the fire I was asked by a Government Official [what was] the value of these collections and why we collect plants for the Forest Department. It seems not superfluous to repeat the answer here. Botanical collections are the records on which our studies of the Flora of this country are based. A rational use of the plants including timber trees, medicinal plants and weeds is not possible without describing, naming and classifying these

plants. This is basic research. Studies of forest regeneration are impossible without the use of floras with which the plants in the forest can be named. Doubtful namings have always to be checked by reference to the well arranged collections which are kept as far as possible up-to-date by inserting the results of our own research on Dipterocarps and the results of other botanists who are studying other families. When we want to educate local people in Forestry and Agriculture, we need an Herbarium and books on the Flora of Sabah."

THE MODERN-DAY SANDAKAN HERBARIUM

Meijer's energy after this catastrophic destruction of the scientific archive of Sabah displayed an astonishing determination put into practice. Collectors, including staff augmented from the Forest District Offices, were stationed in various parts of Sabah, collecting all year round and sending material back to the Sandakan Herbarium (Fig. 3). Between 1962 and 1964, the furious pace of collecting brought in over 10,000 specimens each year. W.J. Pereira, Aban Gibot and Leopold Madani were Meijer's principal sources of assistance. In 1964, Meijer reported a total holdings of 17,200 accessions for the Sandakan Herbarium. In the same year, the new Herbarium was ready near the Ching Meng School, the first permanent home of the Forest Department Research Branch in Sabah (Fig. 4). Abdul Rahim, James Ah Wing, J. Ampuria, David Brand, Muin Chai, David Charington, George Mikil, Jaswir Singh, Masirom Rundi and Henry

Fig. 3. *Borneodendron aenigmaticum* Airy Shaw, found only on soils derived from ultramafic rocks in Sabah, was described based on the type specimen gathered just several months following the January 1961 fire that destroyed the Sandakan Herbarium. (Photo: M. Sugumaran)

Fig. 4. The Sandakan Herbarium was housed in a building on the Ching Meng School premises in 1964. (Forest Research Centre archives)

Sinanggul were among the main contributors of specimens at that time. In 1965, Andries Kanis, a Dutch botanist, was deployed to the Sandakan Herbarium by the Dutch Ministry of Foreign Affairs, and was acting head of the Herbarium for about nine months; he returned to Leiden in 1966. By 1968, the collection had 27,575 specimens. By Meijer's reckoning, "The general policy of the Sandakan Herbarium is to work steadily on a botanical survey of Sabah. It is not a stuffy museum for specimens of plants which we are going to rescue for Herbarium workers while we let them disappear in the jungle but the active centre of botanical field research" (Meijer 1964). Meijer was not an exception in appreciating Mount Kinabalu as a special site of biological richness (Meijer 1965, 1971) and collected very many specimens from that truly special mountain, these forming a special archive at the Sandakan Herbarium today. Thus the re-establishment of the modern-day Sandakan Herbarium was very much launched by Willem Meijer.

Meijer championed many things on the Sabah landscape (Wong 2004). Aside from making his full support known for conserving Kinabalu, he had special remarks about Sepilok and Kebun China on the Sandakan Peninsula. In a 1966 departmental memo, he wrote, "…Sepilok Forest Reserve is so far the only area larger than 2000 acres of virgin lowland Dipterocarp

forest set aside for [the] purpose of research, education and wildlife protection…". He also began to build up a flora of the Kebun China forest, just several kilometers from Sandakan town, which was not a forest reserve but was the only near-pristine site on the Sandakan peninsula aside from Sepilok and some mangrove patches there.

Following the departure of Meijer, P.F. Cockburn was appointed Forest Botanist in 1969; he wrote up a number of families for the *Trees of Sabah* (Cockburn 1976, 1980) and left in 1977. Gary Shea, a Canadian University Service Overseas Volunteer, was attached to the Sandakan Herbarium in 1971–72.

In 1974, the Herbarium moved into the newly opened Forest Research Centre in Sepilok and by 1976 the collection had amounted to 53,024 sheets. In 1977, K.K. Tiong was appointed Forest Botanist but left in 1979, when Aban Gibot took charge of the Herbarium. Then Lee Ying Fah was appointed Forest Botanist in 1983, followed by Jumrafiah Abdul Shukor in 1987. Julius Kulip was put in charge of forest botany in 1989. Then Lee sought the appointment of K.M. Wong, who had been in Brunei as Forest Botanist since 1987, and before that in the Forest Research Institute Malaysia (FRIM), to head the Sandakan herbarium in 1992. Wong helped to spearhead the first two volumes of the newly organized *Tree Flora of Sabah and Sarawak* with FRIM, and was liaison officer for the project at the Royal Botanic Gardens, Kew, for a few months in 1994, before leaving at the end of 1996 for the University of Malaya in Kuala Lumpur. His own specializations were in the Rubiaceae, bamboos and Gentianaceae. Berhaman Ahmad was recruited as Forest Botanist in June 1992, working on the Alangiaceae and Bignoniaceae, but left in November 1997 to join the Universiti Malaysia Sabah. John B. Sugau, joined in 1993 and worked on Pittosporaceae, Chloranthaceae, Gentianaceae, and Pentaphylacaceae/Theaceae for the Tree Flora project. After Wong left, Lee Ying Fah headed the Sandakan Herbarium until 2002. Sugau was in charge of the Sandakan Herbarium since Lee became the Head of the Forest Research Centre in 2002 and until the present time, assisted by Joan T. Pereira, the latter recruited in 1994 and then revising the Staphyleaceae, Crypteroniaceae and *Payena* (Sapotaceae). Pereira completed her doctoral studies under Wong and A.L. Lim in 2009 on the *Rothmannia* complex (Rubiaceae). Suzana Sabran joined the Sandakan Herbarium in 2003 and specialized in *Ternstroemia* (Pentaphylacaceae) and *Sarcosperma* (Sapotaceae). Later in 2012, Andi Maryani binti Mustapeng joined the Herbarium, working on bryophytes, lycophytes and ferns. Lee, Wong and Robert C. Ong founded Sandakania as the Forest Research Centre's botanical journal in 1992. This has a plant systematics and natural history focus, compared with the Sepilok Bulletin, begun in 2004 by Lee and V.K. Chey, which includes both plant and animal, as well as ecological articles of contemporary interest in Sabah.

CENTURY XXI

The present Sandakan Herbarium building was ready in 1999 (Fig. 5), built with funding from the Federal Government under the 7th Malaysia Plan. It provided a bigger area for

Fig. 5. The Sandakan Herbarium in its own building, 2016. (Photo: Ubaldus Majawal)

storing specimens in steel compactors with an annexe for drying, as well as pressing and poisoning specimens. The move into the new building was completed in 2000, and this latest premise became the new botanical nerve centre, although the building itself was officiated in 2003.

Today, the Sandakan Herbarium holds a total of some 200,800 accessions (including 272,000 specimen sheets). In 2015, moving in tandem with modern classification, the SAN Herbarium began adopting the Angiosperm Phylogeny Group (APG) classification. Specimens were digitized and stored in the Botanical Research and Herbarium Management System (BRAHMS), which was developed by Oxford University, allowing easy access of specimen data and the collation of plant checklists and production of specimen labels. SAN also curates ancillary spirit-preserved collections amounting to 4359 numbers, and keeps 1852 carpological collections. Since 2004, the processing and curation of herbarium specimens at SAN was placed under MS ISO 9001:2008 certification.

Following the timber boom, the premature re-logging allowed in the 1970s and 1980s, and onslaught of conversion to oil palm cultivation (Fig. 6) in the early 1980s brought huge changes in land use, and by 1990 just 500,000 ha of primary lowland forest remained (Marsh & Greer 1992). Sabah now addresses a course that follows up on the 1983 decision to maintain half of its total land area as a permanent forest estate and by 2011 the gazetted

Fig. 6. A vastly changed Sabah landscape in the 1990s, when large-scale oil palm plantation agriculture began to take up most of the accessible lowlands, intensifying pressure on forested land. (Photo: K.M. Wong)

area of Forest Reserves and State Parks was some 53% of land area (Ibbotson 2014). Sabah has experienced an approximate 35% reduction in natural forest cover in the past 60 years (McMorrow & Talip 2001, Reynolds et al. 2011), with the loss further exacerbated by much degradation and fragmentation of some remaining forest areas (Mannan & Awang 1997, Bryan et al. 2013). The Forestry Department has felt the urgent need to conserve the remaining forests and ensure more sustainable timber-related programmes. Presently, the State Government through the Forestry Department has set aside 21% or 1.5 million ha of Sabah's land area as Totally Protected Areas (TPAs), including forest reserves within the categories Class 1 (Protection Forest Reserve), Class 6 (Virgin Jungle Reserve) and Class 7 (Wildlife Reserve) (Anonymous 2014). The 3-fold increase of TPAs in Sabah within the last ten years has resulted from this renewed commitment to habitat conservation for biodiversity and other environment-related values.

The Botany Section was at the core of conceiving and establishing two of Sabah's major facilities that engaged public awareness for forests and the environment, both located in the Sandakan area. Both efforts garnered the participation of colleagues in the Conservation, Ecology, Entomology and Silviculture sections at the Forest Research Centre. The Rainforest Interpretation Centre and Rain Forest Walk (*Rintis Belantara*) were established at the Arboretum in Sepilok, Sandakan, in May 1994, with funding support through the

Deutsche Gesellschaft Fuer Technische Zusammenarbeit (GTZ), Germany. After 2007, this was transformed into the present-day Rainforest Discovery Centre (Fig. 7), which has become a model facility for tropical forest conservation and environmental education. The continuing development of this Centre (Fig. 8) is led by the energetic Silviculturist Robert C. Ong. Nearer to Sandakan town, the Kebun China forest which had received the emphasis of Meijer, followed by Lee, and then the special interest of the Director of Forestry Datuk Sam Mannan, became gazetted in 2007 as a Forest Reserve; at the edge of the Reserve was developed the 148-ha Sandakan Rainforest Park jointly managed with the Sandakan Municipal Council (Damit 2013). This reserve is the type locality of more than a hundred species of plants described over the course of the Sandakan Herbarium's century.

The Herbarium is actively involved in spearheading newer initiatives including the internationally sanctioned Heart of Borneo (HoB) initiative (Fig. 9), RAMSAR site studies, IUCN Red-Listing of plants, as well as collaborating in research studies with both local and overseas research institutes. With this strengthened emphasis in the Forestry Department, the Herbarium has intensified its involvement in botanical inventories supporting Forest Management Plans (FMPs), Conservation Management Plans (CMPs), and the identification

Fig. 7. The Rainforest Discovery Centre at the Forest Research Centre's Sepilok Arboretum. (Photo: K.M. Wong)

Fig. 8. Part of an impressive canopy walkway system, Sepilok Arboretum. (Photo: K.M. Wong)

Fig. 9. Participants in the 2014 Northern Gunung Rara Scientific Expedition, part of Sabah's Heart of Borneo programme, pressing their plant specimens. (Photo: Ubaldus Majawal)

and characterization of High Conservation Value Forests (HCVFs). As the world generally now discovers, degradation of landscapes and natural resources are least profitable and most impactful when not informed by, or heeding, the insights from careful inventories of life forms and the natural biota. The reduction of ecological and biological diversity exacts a vengeance that impoverishes human societies.

Effective support for these programmes and ideals simply means that both science and practical involvement need to be pursued hand-in-hand. Floristic documentation under the *Tree Flora of Sabah and Sarawak* project and the more recent *Flora of Peninsular Malaysia* continues to engage botanists based at SAN. Under the 9th and 10th Malaysia Plans, SAN botanists have also increased cross-discipline collaborations with other sections in the Forest Research Centre that look into promoting the medicinal documentation and ornamental use of indigenous plants. With the build-up of reference materials over the years and better-equipped facilities available at the Herbarium, the provision of tree identification courses to students at the Sabah Forestry Institute, local universities, Sustainable Forest Management Licencee Agreement holders (SFMLA), and other governmental or non-governmental agencies, is now better served. These courses help develop expertise in tree identification

and create a stronger awareness and interest in plants among students who eventually hold a stake in the forestry endeavour. The Forestry Department targets to have as many forest areas as possible certified under the internationally recognized forest certification scheme with the Forest Stewardship Council (FSC), so that staff in Forest Management Units (FMUs) skilled in various basic areas including plant identification becomes a prerequisite. Botanical staff members are also engaged in providing talks or poster presentations on the state's natural heritage in local and international seminars, conferences, and workshops, adding stimulus to the promotion of ecotourism and environmental education.

INTO THE FUTURE

Over its century, the Sandakan Herbarium has emerged as one of the largest herbaria in Malaysia, and one of the most important collections and reference centres for the Bornean flora. Yet, it plays a key role in coupling to forestry and conservation management efforts on the ground. In spite of the Herbarium being an important asset to the Department and the state of Sabah, it has its own challenges. With an estimated 7400 species of seed plants in Sabah (Maycock et al. 2015), it is impossible to study each of the species, let alone to complete a Flora account of Sabah in a short span of time. The Forest Research Centre currently has but four trained plant taxonomists, and their specializations are both important to maintain and balance with other functions.

As the Forestry Department's purview over forest resources increases in scope and intensity, and the need for botanical specialization to better cover a highly diverse floristic region becomes more obvious, the imperative for more taxonomists and other botanical staff to join the effort is more greatly felt than ever before. Aspirations to fully digitize its herbarium collection and develop a geo-mapping system for the geographic location of specimens via BRAHMS will help make it possible to provide fundamental plant and vegetation data, such as distribution patterns and endemicity, conservation status and the ability to assess the potential impacts of environmental and landscape changes on species. There is no doubt that support from within and without, both in terms of staffing expertise and funding needs, will be increasingly important determinants of success. The Sandakan Herbarium moves into its second century more accomplished and focussed than ever before, and with a fundamental mission firmly entrenched in the environmental, economic and social well-being of Sabah.

* * * * *

> "It is clear to all taxonomists and all systematic botanists, that in spite of the imperfections in our current system of naming and describing plant species, and in spite of the distinctly Rafinesquian character of the work of certain individual botanists who can see differences where tangible differences scarcely exist, that taxonomy and the accurate identification of plants is basic to a proper understanding of myriads of

problems in the general field of economic botany, pharmacology, agriculture, plant breeding, plant pathology, genetics, forestry, morphology, physiology, and many other fields into which plant science or botany, *sensu latiore* has been subdivided.

"Let us take the broader view, live and let live, keep our respective houses in order, avoid egregious blunders, and attain a realization of the fact that after all there is a unity in plant science in spite of its diversity, and that the entire field is interlaced with the binding bonds of system and order; and this is taxonomy."

E.D. Merrill (1943)

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Appendix: Forest Botanists in charge (or Curators) of the Sandakan Herbarium.

Year	***Forest botany purview*** **or Forest Botanist in charge**
1916–1920	(*under Forest Conservator Donald M. Matthews*)
1920–1931	(*under Forest Conservator Devillo D. Wood*)
1931–1952	(*under Forest Conservator Henry G. Keith*)
1952–1954	(*under Forest Conservator A.B. Walton*)
1954–1957	Geoffrey Howorth Spencer Wood
1959–1968	Dr Willem Meijer
1969–1977	Peter Francis Cockburn
March 1977–December 1977	(*under Asst Forest Conservator Wilfred James Peter Pereira*)
1977–1979	Stephen K.K. Tiong
1980–1983	Aban Gibot
1983–1987	Lee Ying Fah
1987–1989	Jumrafiah Abdul Shukor
1989–1992	Julius Kulip
1992–1995	Dr Wong Khoon Meng
1995–2002	Dr Lee Ying Fah
2002–present	John Baptist Sugau

SANDAKANIA 21 (2016): 21–64

A taxonomic treatment of the Asiatic allies of *Rothmannia* (Rubiaceae: Gardenieae), including the new genera *Ridsdalea* and *Singaporandia*

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Summary. *Rothmannia* was formerly considered a highly variable genus ranging from Africa to mainland Asia and the Malay Archipelago. The central taxonomic problem had been the difficulty in reconciling morphological variation among key groups of taxa, namely a core group including the African type, or *Rothmannia* Thunb. *sensu stricto*, that has corolla lobes overlapping to the right (a comparatively rare and distinctive condition in the Rubiaceae generally) *vs* other African and all Asian-Malay Archipelago taxa that have corolla lobes overlapping to the left. Also, the array of taxa from Africa into Asia and beyond has corolla forms ranging from infundibular and campanulate to hypocrateriform, and mere division based on corolla type still included other highly variable characteristics. Recent molecular phylogenetic analysis of *Rothmannia sensu stricto* and allies has unequivocally demonstrated distinct clades correlated with unique, possibly synapomorphic, morphological states among the alliance members in Africa. The Asian-Malay Archipelago taxa together form a separate major clade, but further resolution within the group could not be obtained with only some 30% taxa sampled using only a few DNA regions. However, the availability of a rich spectrum of morphological evidence recently obtained can now be used to support a morphological classification of the Asiatic taxa based on floral characteristics including corolla form and pollen characteristics, as well as plant architecture and other characters. Of the three genera recognized, *Kochummenia* K.M.Wong is distinct by its subhypocrateriform corolla with linear lobes exceeding the tube, anthers inserted near the tube base and leaf epidermal cells with deeply sinuated anticlinal walls, which are clearly synapomorphic characters defining a genus so far known only from the Malay Peninsula. The new genus *Ridsdalea* J.T.Pereira

& K.M.Wong is characterized by a hypocrateriform or campanulate corolla and reduction of only one member of the distal leaf pair on a 2-node branch module, resulting in a trifoliate leaf cluster formed with the proximal leaf pair. *Ridsdalea* is widespread with c. 30 species, through mainland Asia and the Malay Peninsula into East Malesia. The newly described genus *Singaporandia* K.M.Wong is monotypic, based on *Rothmannia* (*Randia*) *macrophylla*. It is distinguished by an infundibular corolla, exceptionally long anthers with large pollen and ectocolpus, and complete reduction of the distal leaf pair on a 2-node branch module; it is distributed in the Malay Peninsula including Singapore, and Sumatra. *Kochummenia terengganuensis* K.M.Wong is newly described and the necessary taxonomic combinations into *Ridsdalea* are effected for 25 published taxa across tropical and subtropical Asia and Malesia. A number of lectotypifications and neotypifications are designated.

Rothmannia Thunberg was first described in 1776 after Georgius Rothman (1739–1778), a Swedish physician and botanist. Its type species is the South African *Rothmannia capensis* Thunb. Over 70 published binomials for *Rothmannia* have been documented in the International Plant Names Index (IPNI 2016), representing taxa from tropical and subtropical Africa, the Seychelles, Myanmar, Thailand, Cambodia, Laos, Vietnam, the Andaman Islands, South China, the Malay Peninsula, Java, Sumatra, Borneo and Papua New Guinea. Out of these, 14 binomials have been described for parts of Malesia (Fagerlind 1943, Bremekamp 1957, Tirvengadum 1983; Wong 1984, 1989; Pereira & Ridsdale 2012) (see also Puff & Wong 1993). Although Wong (1984) reviewed the whole assemblage of *Randia* s.l. for Peninsular Malaysia and segregated *Rothmannia* as a genus, a complete revision for Malesia has not been made.

A HISTORICAL PERSPECTIVE OF *ROTHMANNIA*

The delimitation of *Rothmannia* had been superficial and contentious. In earlier times, several species that were transferred to *Rothmannia* had been included in the broad concept of *Randia* in the "classical" Gardenieae, as *Randia* sect. *Euclinia* in De Candolle (1830), Hooker (1873), and Schumann (1891); *Randia* sect. *Gardenioides* in Hooker (1880); and *Randia* sect. *Grandiflorae* in Ridley (1923). In that "classical" view, *Randia* was in fact a heterogeneous pantropical genus (Fagerlind 1943, Wong 1984). The genus *Randia* Houst. ex L. was originally described with two species, *R. mitis* L. and *R. aculeata* L. Although in 1929, Hitchcock & Green had lectotypified the genus with *R. mitis*, a New World species, *Randia* spp. were generally supposed to share only a few common characters, viz., bisexual flowers with contorted corolla lobes; bilocular fruits that are indehiscent or irregularly splitting, with each locule containing many compressed or angular seeds, allowing a loose interpretation worldwide. Many *Rothmannia* species had been placed under *Randia* s.l. in floras and checklists by Oliver (1877), King & Gamble (1903), Merrill (1921), Pitard (1923), Hutchinson & Dalziel (1931), Craib (1932), Masamune (1942) and Backer & Bakhuizen (1965).

In some cases, species later considered to be better accommodated within *Rothmannia* had been originally placed in *Gardenia* s.l., e.g., *Gardenia* s**e**ct. *Rothmannia* in Endlicher (1838), Hooker (1873) and Schumann (1891), and also in floras and checklists by Miquel (1856), Merrill (1921) and Masamune (1942). As early as 1781, even the type species *Rothmannia capensis* was transferred to the genus *Gardenia,* under the name *G. rothmannia* L.f.*,* by Linneaus in the *Supplementum Plantarum Systematis Vegetabilium*.

The inclusion of such species in *Randia* s.l. and *Gardenia* s.l. had been arbitrarily based on character-states such as bilocular ovaries in defining '*Randia'* and unilocular ovaries in '*Gardenia'*, and also placentation. The difference between the bilocular and unilocular ovaries and their placentation were not reliable characters and created ambiguity for taxonomists in the placement of species in these two genera (*Randia* and *Gardenia* Ellis) when used in isolation. Hutchinson & Dalziel (1931) concluded that "The genera *Gardenia* and *Randia* are in much need of revision and recasting on the lines other than the placentation of the ovary."

Fagerlind (1943) was the pioneer in demonstrating the heterogeneity of *Randia* through the use of characters including branching patterns and pollen grain features. As a consequence, he re-established three genera including *Rothmannia* and made several new combinations in *Rothmannia*, including the New Guinean *Rothmannia macromera* (Lauterb. & K.Schum.) Fagerl. Later, *v*arious authors accepted *Rothmannia* as a distinct genus in Africa, including Keay (1958), Hepper & Keay (1963), Hallé (1970), Dyer (1975), Bridson & Verdcourt (1988), Palgrave (1988), Somers & Robbrecht (1991) and Sonké & Simo (1996). Keay's work greatly influenced taxonomists working on the African and Asiatic Rubiaceae (Tirvengadum 1982). Likewise, a number of Asiatic species have been described or recombined in *Rothmannia*, in Bremekamp (1957) for Laos, Indo China; Yamazaki (1970) for East Asia, Tirvengadum (1982, 1983) for South and Southeast Asia (describing three new species and making three new combinations for *Rothmannia*); Wong (1984, 1987, 1989) for Peninsular Malaysia; and Pereira & Ridsdale (2012) for the Philippines.

In spite of this, and perhaps sensing that a wide range of material was once again being swept into the concept of a widespread genus, Bakhuizen (1975), in his synoptical key to the *Genera of the Rubiaceae of Thailand*, retained Schummann's classification of Rubiaceae based on the character of "single ovule per ovary" versus "more than one ovule per ovary", and treated *Randia* in its widest sense, rejecting the views on segregating the various groups as genera as done by Keay (1958) and other botanists. However, for Thailand, a recent account of the *Rubiaceae of Thailand* by Puff et al. (2005) recognized some eight species of *Rothmannia* in Thailand. Meanwhile, in South China, a new species *Rothmannia daweishanensis* Y.M.Shui & W.H.Chen was published by Shui et al. (2003). Puff & Wong (1993) presented a synoptic listing of the genera of Bornean Rubiaceae, including mention of several *Rothmannia* species. Coode et al. (1996) listed an unidentified *Rothmannia* in their Brunei checklist. Beaman & Anderson (2004), with the assistance of Pereira, recognized two unidentified *Rothmannia* species for the area around Mt Kinabalu, Sabah. For the Balikpapan-Samarinda area of East

Kalimantan, Indonesia, Kessler et al. (1992) documented a single species of *Rothmannia*, but subsequently a new species was mentioned (but not named) in *Trees of the Balikpapan-Samarinda Area* (Kessler & Sidiyasa 1994).

Although *Rothmannia* has been accepted generally by most taxonomists as an entity distinct from *Randia* and *Gardenia*, a more thorough analysis taking into account both the African and Asiatic species had not been carried out and the limits of the genus itself have become somewhat arguable, as demonstrated through the work of Bremekamp (1957), Keay (1958), Wong (1984) and Bridson & Verdcourt (1988). Keay (1958) had pointed out the occurrence of two types of corolla aestivation within the African species, i.e., corolla lobes contorted to the right in the type species and its allies, and corolla lobes overlapping to the left in the other species. Wong (1984) considered that this kind of variation (right and left contortion of corolla lobes), which also occurs in *Alstonia* R.Br. (Apocynaceae), may have some value in distinguishing infrageneric groups. He recommended a critical examination of both the African and Asiatic *Rothmannia* species to better understand their relationships, as well as to confirm characters that are generically important. Additionally, Wong (1984) also concluded that there did not appear to be a single corolla shape for distinguishing *Rothmannia* as a whole. This can be seen by a range of corolla form, from infundibular and campanulate to salverform (= hypocrateriform) (Wong 1984, Bridson & Verdcourt 1988), found among the species.

There is also a need to consider the relationship between *Rothmannia*, *Kochummenia* K.M.Wong and *Heinsenia* K.Schum., which share some interesting characters. *Heinsenia* is a monotypic African genus that was placed by Robbrecht & Puff (1986) in its own tribe, Aulacocalyceae. Keay (1958) and Bridson & Verdcourt (1988) have pointed out that *Heinsenia* and *Rothmannia* share the same branching pattern and have similar corolla speckling (i.e., white with coloured spots inside). In a phylogenetic analysis using *rbcL* sequence data and a combined cladistic analysis using morphological and molecular data (Andreasen & Bremer 2000), *Heinsenia* emerged as weakly associated with *Rothmannia* (the two emerging as a minor clade with poor bootstrap support). The African *Aulacocalyx* Hook.f. was also placed in the same tribe as *Heinsenia* by Robbrecht & Puff (1986), and in fact at some point, *Heinsenia* was placed as a synonym of *Aulacocalyx* by Petit (1962). Later, *Heinsenia* was even proposed as a subgenus of *Aulacocalyx* by Verdcourt (1981). Both these genera share a small number of seeds, (1–)2–4 per fruit, seed coats that are lacking or strongly reduced, and superior embryo radicals (Robbrecht & Puff 1986). *Kochummenia* (endemic to Peninsular Malaysia) also has the same branch architecture as *Rothmannia*. However, in *Kochummenia*, the corolla form is what we term subhypocrateriform, in having a short tube with linear lobes that are much longer, a feature unique to that genus (Wong 1984, Robbrecht & Puff 1986), whereas in *Rothmannia* s.l. the corolla can be campanulate, infundibular and salverform, but with broad lobes shorter than the tube. A phylogenetic study by Persson (1996), based on morphological characters, demonstrated *Kochummenia* as being distinct from (the African species of) *Rothmannia*.

It is this complex—based around the African concept of *Rothmannia* as accepted by Keay (1958) and subsequent workers, and the associated genera both in Africa (including *Aulacocalyx*, *Heinsenia* and *Phellocalyx* Bridson) and Asia (including *Kochummenia*), as well as a handful of earlier described species that have resemblance to elements within this group but which obviously remain aberrant if maintained within *Randia* or *Gardenia*—that we refer to as the *Rothmannia* taxonomic complex.

RECENT TAXONOMIC INDICATIONS

A number of cladistic studies have addressed classification of higher-level groups in the Rubiaceae, viz., the subfamily Ixoroideae (Andreasen & Bremer 1996, 2000) and the tribe Gardenieae (Persson 1996, 2000; Puttock & Quinn 1999). In these studies, *Rothmannia* was only represented by African species. These studies reaffirmed the notion that *Randia* s.s. is not closely related to many of the genera that have been lumped together as *Randia* s.l. Andreasen & Bremer (1996) analyzed the phylogeny of the Ixoroideae and confirmed that *Randia* s.s. is entirely neotropical, in accordance with the views of previous authors including Bremekamp (1957) and Keay (1958). Also, the position of *Rothmannia* (represented by *R. longiflora* Salisb.) in their cladistic analysis was unresolved. Persson (1996) conducted a cladistic analysis using both morphological and anatomical characters of the Gardenieae based on Robbrecht's (1988) classification. *Randia* s.s. and *Gardenia* s.s. were recovered as sister taxa in one of the major clades (the so-called "tetrad group") in the strict consensus tree of equally parsimonious cladograms, as well as in the strict consensus tree after successive character reweighting. In Persson's analysis, neither *Kochummenia* nor *Rothmannia* was clearly allied to any of the well-supported clades within the Gardenieae group of genera. Andreasen & Bremer (2000) performed a combined phylogenetic analysis using morphology, nuclear and chloroplast DNA data, to assess tribal and generic relationships in the Ixoroideae subfamily. This phylogenetic analysis showed that *Rothmannia* associated weakly with *Heinsenia* but their position was unclear although clearly nested within the Gardenieae. *Heinsenia* had been placed within the Aulacocalyceae by Robbrecht & Puff (1986), so Andreasen & Bremer (2000) suggested that this tribe should be included within the Gardenieae. Persson (2000) performed a molecular phylogenetic analysis (combining *rps* 16 intron and *trn*L-F intergenic spacer sequences) to evaluate the relationship among members of the Gardenieae. In that analysis, *Rothmannia* (represented by members of the type alliance, *R. annae* (E.P.Wright) Keay and *R. fischeri* (K.Schum) Bullock ex Oberm.) was unresolved within a very weakly supported core Gardenieae clade. *Rothmannia* was also included in a supertree analysis (Robbrecht & Manen 2006). These authors stressed, however, that in general, phylogenetic and morphological knowledge of the Gardenieae was still too poor.

The first modern analysis taking into account both the African and Asiatic species of the *Rothmannia* complex was carried out by Pereira (2008), investigating morphological as well as palynological and anatomical characteristics, and offering a morphological phylogenetic

analysis. Pereira (2008) also made a preliminary analysis with 8 taxa using the chloroplast *trnQ-rps* intergenic spacer gene, which demonstrated the clear divergence of an African clade from an Asian clade. However, phylogenetic structure within each of these two main *Rothmannia* groups could not be addressed because of the minimal taxon sampling.

The Gardenieae study of Mouly et al. (2014) showed five statistically well-supported groups: an *Aidia* Lour. group, a *Gardenia* group, a *Porterandia* Ridl. group, a *Randia* group, a *Rothmannia* group, and the monogeneric lineages *Massularia* (K.Schum.) Hoyle and *Schumanniophyton* Harms & R.D.Good. Their *Rothmannia* group indicated *Aulacocalyx* and *Heinsenia* together as a clade, sister to another comprising the genera *Phellocalyx*, *Rothmannia* and *Kochummenia*, with weak support. Subsequent phylogenetic analyses which are being prepared for publication by Mouly et al. (in prep.), using data for three cpDNA and one nrDNA regions, have now confirmed that the *Rothmannia* complex is indeed paraphyletic. These analyses indicate, as earlier shown by Pereira (2008) in a preliminary manner, that the Asiatic allies *Kochummenia*, various species presently named as *Rothmannia*, the species named *Gardenia pseudoternifolia* Valeton, and other unnamed Asiatic taxa generally identified with *Rothmannia* s.l., all fall entirely within their own distinct clade. These Asiatic elements are clearly separate from *Rothmannia* s.s., *Phellocalyx*, the closely allied pair *Aulacocalyx* and *Heinsenia*, and an entire suite of African taxa with left-contorted corolla lobes (Mouly et al. in prep.). Unfortunately, the molecular sampling of the Asiatic taxa has been limited, so that further elucidation of their taxonomy—as taxa outside of the immediate African alliance of *Rothmannia* s.s.—proceeds with the morphological, palynological and anatomical analyses in this paper.

THE ASIATIC ALLIES OF *ROTHMANNIA*

Once the disposition of the African taxa including *Rothmannia* s.s. could be reconciled as an entirely distinct genetic lineage (Pereira 2008, Mouly et al. in prep.), the treatment of the Asiatic allies could proceed uncomplicated by parallels in morphological development found in the African taxa. Our objective in the present paper is to elucidate the major taxa in the Asia-Pacific region based on morphological, palynological and anatomical assessments carried out for a representative number of Asiatic taxa, as well as comparisons with selected African taxa, of the *Rothmannia* complex.

Inflorescence development

The inflorescences in nearly all members of the *Rothmannia* complex (including *Rothmannia* s.s. and *Kochummenia*) are distinctly terminal and typically formed at the end of a branch segment or modular unit consisting of a proximal node with a pair of normally expanded leaves and a distal node with one reduced leaf and one normally developed leaf, i.e., a 2-node segment that carries three leaves at closely occurring nodes (Fig. 1: A1 & A2). Due to the

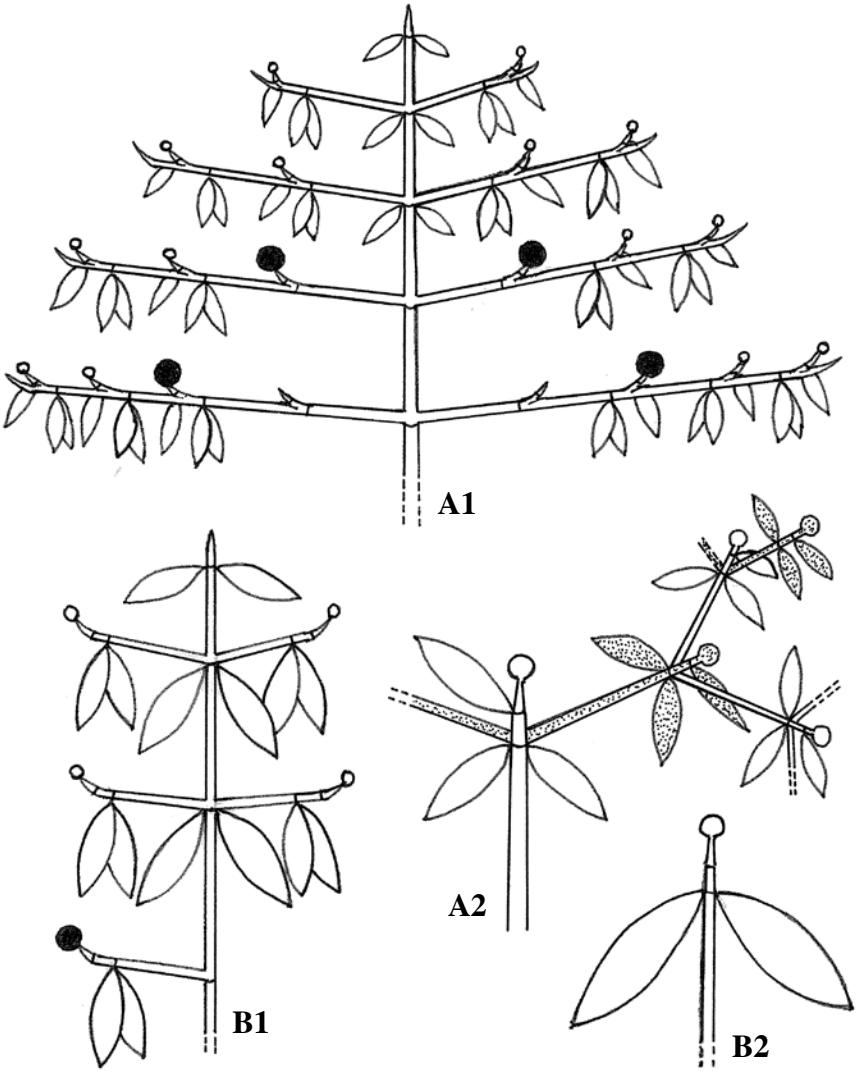

Fig 1. Idealized representations of branch module construction in *Kochummenia*, *Ridsdalea* (previously part of the Asian *Rothmannia* complex) and *Singaporandia* (based on *Rothmannia macrophylla*). The profile view of the plant architecture in *Kochummenia* and *Ridsdalea* (**A1**) shows continuous stem growth and branch production; branching is extended via substitution by successively higher-order modules. The plan view of this branching system (**A2**) shows a succession of branch modules; each branch module consists of an elongate first internode, a proximal node bearing a pair of normal leaves and a second (distal) node with one leaf reduced, presenting a trifoliate cluster. The profile view of plant architecture in *Singaporandia* (**B1**) also shows continuous stem growth and branch production, but the branch module bears a pair of normal leaves only at the first node, with both leaves reduced at the second (distal) node; the primary module is not normally extended; plan view of primary branch module (**B2**) with a single pair of leaves. (Small circles represent inflorescence development; solid larger circles indicate fruiting in older modules.)

displacement to one side during sympodial branch development, the inflorescence sometimes appears to be lateral**.** When they develop, inflorescences or infructescences are produced at the end of the branch segment or module. This was illustrated and highlighted by Bridson & Verdcourt (1988) and simply termed the "*Rothmannia*-type" of branch development. The inflorescences can potentially be produced at the end of every modular unit of an adult plant. In contrast, in *Rothmannia macrophylla* (R.Br. ex Hook.f.) Bremek., the terminal inflorescence is produced following the distal (second) node that has both leaves vestigial (vastly reduced in size), the proximal node bearing a pair of normally developed leaves (Fig. 1: B1 & B2).

It is noteworthy that the species with right-contorted corolla lobes (i.e., the type alliance of *Rothmannia*) always have truly solitary flowers (without any bracteoles on the flower-bearing axis that could represent sites of reduced cyme branches), whereas the African species with left-contorted corolla buds have typically 1-flowered, reduced cymes, although among the latter group, cymes may be (2–)3–5-flowered (in *R. manganjae* (Hiern) Keay and *R. lujae* (De Wild.) Keay) or even much-branched and 3–17-flowered (in *R. engleriana* (K.Schum.) Keay). In the majority of the Asian and SW Pacific species, the inflorescences are typically much-branched with a larger number of flowers, typically more than 3 flowers per cyme (in *Randia anisophylloides* Wernham, there are typically 40–130 flowers). Reduced, 1-flowered cymes may be the only form in some species, e.g., *Rothmannia daweishanensis, R. kampucheana* Tirveng., and *R. thailandica* Tirveng. (all in mainland Asia), or occur together with many-flowered branched cymes (e.g., *Gardenia forsteniana* Miq., *G. pseudoternifolia*; *Rothmannia lagunensis* (Merr.) J.T.Pereira & Ridsdale and *R. merrillii* (Elmer) J.T.Pereira & Ridsdale; and in the mainland Asian species, *Rothmannia sootepensis* (Craib) Bremek. and *R. venalis* Bremek.). Asian species with more than 3 flowers per cyme include *Rothmannia attopevensis* (Pit.) Bremek., *R. eucodon* (K.Schum.) Bremek., *R. sootepensis, R. vidalii* Bremek., and *R. wittii* (Craib) Bremek. In *Rothmannia macrophylla,* the flowers are 1–3 together in a cyme. In *Kochummenia*, the flowers are never solitary and are borne in 3–9 flowered cymes.

Plant architecture: stem growth and branching patterns

Based on the branch and inflorescence development discussed above, the plant architecture so far known of *Rothmannia* complex species can be identified with the models of Petit and Fagerlind as defined by Hallé, Oldeman & Tomlinson (1978). Both Petit's and Fagerlind's models share the following similar key features: an orthotropic main axis and plagiotropic branch development by substitution. The difference between the two models lies in the continuous growth of the stem or trunk axis (in Petit's model) (Fig. 1, 2), as opposed to rhythmic or episodic growth (in Fagerlind's model). *Gardenia grandis* Korth., *G. pseudoternifolia, Rothmannia merrillii* and *R. schoemanii* (Teijsm. & Binn.) Tirveng. (Asia) and *Rothmannia annae* and *R. whitfieldii* (Lindl.) Dandy (*Rothmannia* s.s., Africa) conform to Petit's model, with branches produced at every stem node. *Rothmannia longiflora* appears

Fig. 2. Continuous stem growth and branch production in a young sapling of *Ridsdalea schoemanii* (syn. *Rothmannia schoemanii*). (Photo: J.T. Pereira)

to conform to Fagerlind's model in seasonal Africa (Hallé, 1967, Hallé & Oldeman, 1975, Hallé, Oldeman & Tomlinson, 1978), and to Petit's model when cultivated in everwet Peninsular Malaysia according to our observations, but even in Malaysia, branch production is episodic, as in Africa, with non-branching stem nodes produced between branching episodes. Whereas more observations need to be made and transplants of such species from one environmental regime to another may serve as interesting experiments, it is clear that Petit's and Fagerlind's models are very closely related. Also, *Gardenia grandis* has been documented as having Fagerlind's model in the collector's label for one Sumatran collection of this species (*Laumonier TFB 356*) but this was not the case for a plant we studied at Endau Rompin, Johor, Malaysia. The main stem clearly branches regularly and has continuous growth. In *Kochummenia,* the tree architecture conforms to Petit's model, whereas *Rothmannia macrophylla* shows a somewhat reduced version of Petit's model with successive nodes along the stem axis producing either solitary or paired lateral branches.

In most of the investigated *Rothmannia* and *Kochummenia* spp. (Fig. 1: A1 & A2), the branches are modular, and plagiotropic by substitution, i.e., each module is terminated by the apex becoming inactive or bearing an inflorescence, and then substituted by new modules of a higher order developing from axils of the leaf pair in the horizontal plane (from the proximal node). However, in *Rothmannia macrophylla* (Fig. 1: B1 & B2), the branch system is reduced to a single module typically (with very rare occurrence of a second module indicating the essentially reduced modular construction). Each modular unit in the branch system of *Rothmannia* and *Kochummenia* typically has a proximal long internode (more than 5 times the length of the internode distal to it) with a pair of fully developed

Fig. 3. *Ridsdalea pseudoternifolia* (at first named *Gardenia pseudoternifolia*), detail of branch module apex showing the proximal node with a pair of normal leaves (and a pair of axillary branches from their axils, which are higher-order modules), and the distal node with only a single normal leaf developing. (Photo: K.M. Wong)

leaves at the first node (end of this long internode) and subsequently one short internode with one leaf of a pair reduced and the other normally developed (Fig. 3), just before the terminal bud ceases growth (and sooner or later) producing a terminal inflorescence (Fig. 4). Thus, each branch segment produces two nodes bearing, between them, three expanded leaves (Fig. 1: A2). When these nodes are very close, each branch segment appears to bear leaves in a trifoliate group or cluster (Fig. 3, 4). In the sense of Hallé, Oldeman & Tomlinson (1978), each modular unit is determinate, with complete transformation of the shoot apical meristem into a flowering axis after a period of vegetative growth. Subsequent branch extension by higher-order modular units is continued from either one or both leaf axils at the proximal node (i.e., in the horizontal plane) of the previous module. In all the species observed (except in *Rothmannia macrophylla*), the lateral branches produced from the axils of the primary branch are normally paired and subsequent higher-order branching can either be solitary or in pairs. When a series of higher-order branches are produced solitarily, they can form a zig-zag pattern.

In *Rothmannia macrophylla*, after the production of the proximal long internode in the primary branch axis with a pair of fully developed leaves at the first node, followed by a subsequent node with both leaves reduced (often vestigial and microscopic in size), further growth is typically terminated by inflorescence development (Fig. 1: B2; Fig. 5). Very exceptionally, one or two second-order branches develop from the leaf axils of the first node of the primary branch, and then these second-order branches also bear a pair of normal leaves, a pair of vestigial leaves and a terminal inflorescence.

Fig. 4. A zig-zag series of branch modules of *Ridsdalea pseudoternifolia*, with the two youngest trifoliate leaf clusters intact, and infructescences. (Photo: Suzana Sabran)

Fig. 5. Lateral branch of *Singaporandia* (based on *Rothmannia macrophylla*) bearing a single pair of leaves and a terminal flower. (Photo: Cerlin Ng)

Lower leaf epidermis

The lower leaf micromorphology of the *Rothmannia* complex has been studied by one of us (Pereira 2008). Anticlinal wall outlines of epidermal cells can be categorized into three general types. Type A has straight to gently curved sections of the cell outline, with basically low-frequency, low-amplitude sinuations corresponding to Types 1 and 2 of the system of Stace (1965) and Wilkinson (1979). Type B has pronounced sinuations of higher frequency and low to medium amplitudes, including Types 3, 4 and 5 of Stace and Wilkinson. Type C (Stace's and Wilkinson's Type 6) has pronounced sinuations of high frequency and large amplitudes (i.e., deep sinuations) in addition to these features.

Type A outlines (straight to gently curved) are found in the African species only, viz., *Rothmannia engleriana, R. globosa* (Hochst.) Keay, *R. manganjae* and *R. whitfieldii*. Type B outlines (with pronounced waves of low to medium amplitudes) are by far the most common condition. This type is found in both the Asian taxa, such as *Randia anisophylloides, Gardenia grandis, Rothmannia eucodon, R. schoemanii,* and *R. vietnamensis* Tirveng., as well as the African species, e.g., *Rothmannia capensis*, *R. fischeri* ssp. *morambollae* (Hiern) Bridson, *R. longiflora*, and *R. lujae*. Type C outlines (deep sinuations, i.e. waves with very large amplitudes) are known only in *Kochummenia stenopetala* (King & Gamble) K.M.Wong.

In terms of anticlinal wall outline, *Rothmannia macrophylla* is not specially distinguished from most of the other *Rothmannia* species. However, the anticlinal wall outline in *Kochummenia stenopetala* appears to be unique among members of the complex.

Floral morphology

Corolla form. Four types of corolla form occur in the *Rothmannia* complex (including *R. macrophylla* as well as *Kochummenia*), viz., hypocrateriform (salver-shaped), campanulate (bell-shaped), infundibular (funnel-shaped), and subhypocrateriform with long lobes.

A hypocrateriform corolla is typical of *Rothmannia* complex species in Asia and SW Pacific but is generally not found in African species of the complex except in some species of *Aulacocalyx*. This corolla form is found in, e.g., *Rothmannia macromera* from New Guinea, *Rothmannia merrillii* (Fig. 6A) from Borneo and the Philippines, and *Rothmannia sootepensis* from mainland Asia. The campanulate form occurs commonly among *Rothmannia* complex species in both Africa (*R. annae, R. capensis, R. engleriana, R. fischeri* (ssp. *fischeri* and ssp. *moramballae*), *R. manganjae*, *R. ravae* (Chiov.) Bridson and *R. urcelliformis* (Hiern) Robyns and *R. globosa*) and Asia and the SW Pacific (*R. attopevensis* (Pit.) Bremek., *R. daweishanensis, R. eucodon, R. pulcherrima* (Kurz) Tirveng., *R. schoemanii, R. vidalii, R. wittii* (Fig. 6B), and *Gardenia forsteniana*). In Malesia, the common type of corolla form among *Rothmannia* complex species is hypocrateriform, while the campanulate form is only found in two species, *R. schoemanii* and *Gardenia forsteniana*. The infundibular corolla form

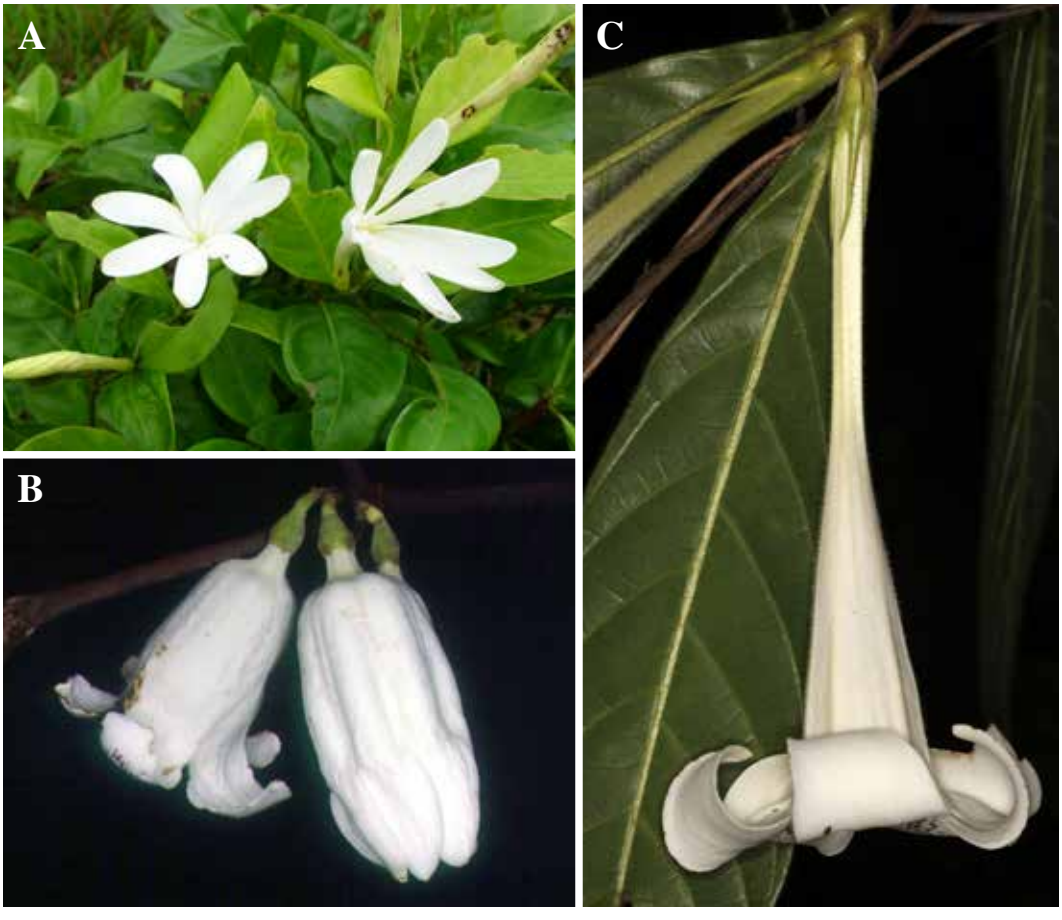

Fig. 6. Corolla forms of Asian taxa formerly placed in *Rothmannia*: hypocrateriform in *Ridsdalea merrillii* (**A**), campanulate in *Ridsdalea wittii* (**B**), and infundibular in *Singaporandia macrophylla* (**C**). Note corollas with more than five lobes in A. (Photos: A, R. Nilus; B, C. Puff; C, Ang Wee Foong)

occurs in Africa and is common among *Rothmannia* complex species there, e.g., *R. lujae*, *R. longiflora*, *R. fischeri* ssp. *verdcourtii* Bridson, and *R. whitfieldii*. However, in Malesia, it is only known in *Rothmannia macrophylla* (Fig. 6C). The other uncommon corolla form is here described as subhypocrateriform with long lobes. It is only found in the genus *Kochummenia* (Fig. 9).

Corolla lobe characters. The corolla lobes are contorted and overlap either to the right (only in Africa: *Rothmannia annae, R. capensis*, *R. fischeri*, *R. hispida, R. lateriflora* (K.Schum.) Keay, *R. liebrechtsiana* (De Wild. & T.Durand) Keay, *R. octomera* (Benth. & Hook.f.) Fagerl., *R. ravae* and *R. urcelliformis*) or left (all the rest of the complex in Africa, Asia

and SW Pacific; Fig. 6A–6C). According to Robbrecht (1988), species with contorted lobe aestivation usually have left-contorted lobes. In the *Rothmannia* complex, right-contorted corolla lobes seem to be confined to the nine African species mentioned earlier. This type has also been documented in *Hyperacanthus* E.Mey. ex Bridson and *Phellocalyx* of the Gardenieae (Robbrecht 1988). The corolla lobes for *Kochummenia* are contorted to the left.

Rothmannia complex species typically have five corolla lobes, but this may increase to 6–8, as in *R. merrillii* (Fig. 6A) and *R. negrosensis* (Merr.) J.T.Pereira & Ridsdale (Malesia), and *R. octomera* (Africa). The shape of the corolla lobes in the Malesian species is very variable: elliptic (narrowly to broadly), ovate, ovate-elliptic, or lanceolate. In *Kochummenia* the corollas are pentamerous and corolla lobe shape is linear. The corolla lobe apices in the African species with right-contorted corolla are always all acute or pointed, whereas species with left-contorted corolla have both pointed to obtuse corolla lobes. In the Asian and SW Pacific species of the *Rothmannia* complex, most have obtuse corolla lobe apices; only in *Kochummenia*, *Gardenia forsteniana* and *Rothmannia macrophylla* are they pointed.

Coloration. The outer part of the corolla tube can be white or creamy-white (e.g., the mainland Asian *Rothmannia wittii* and the Malesian *R. merrillii*) (Fig. 6A, B) to greenish (e.g., the African *R. annae*) in Asian, SW Pacific and some African taxa; or yellowish brown to brownish (e.g., the African *R. whitfieldii*, *R. munsae* (Schweinf. ex Hiem.) E.M.A.Petit subsp. *megalostigma* (Wernham) Somers); or suffused pink-crimson (e.g., *R. longiflora*) in some African taxa. In the Malesian *Rothmannia macrophylla*, the outer surface of the tube is white (Fig. 6C) or sometimes with a maroon tinge at the base.

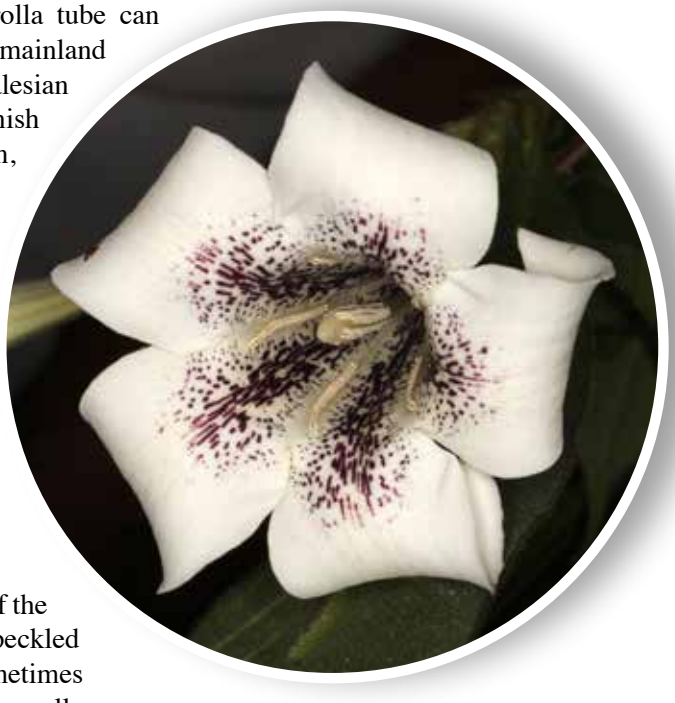

Fig. 7. Freshly opened flower of *Singaporandia macrophylla*, showing speckling of the inner tube surface and secondary pollen presentation (with pollen from early-dehiscent anthers deposited on the still-immature stigma just prior to floral opening). (Photo: Ang Wee Foong)

The corolla mouth and uppermost part of the corolla tube (corolla throat) may be speckled to non-speckled. These speckles can sometimes be seen on the base or central part of the corolla lobes. The majority of the African species have speckled corollas (in *Rothmannia lujae* speckling has not been documented but in *R. whitfieldii*, non-speckled corollas are typical). In mainland Asia (i.e., Thailand, Indo-China,

Myanmar, South China) and the Andaman Islands, the corollas are speckled. In Malesia, *Rothmannia schoemanii* and *R. macrophylla* (Fig. 7) have speckled corolla, the rest are without colouration (e.g., *R. merrillii*). The colour of the speckling may vary from pink (e.g., *Rothmannia annae* from Africa) to purple or reddish purple (e.g., the African *R. longiflora*, and the Asian *R. thailandica*, *R. wittii* and *R. macrophylla*) and rarely said to be "deep blue" (in *R. vietnamensis*, Tirvengadum 1982). The corolla throat is non-speckled in *Kochummenia*.

Corolla indumentum. The inner surface of the tube is glabrous in the Malesian *Gardenia forsteniana, G. pseudoternifolia*; *Kochumennia*; *Randia anisophylloides*, *Rothmannia graciliflora* (Merr.) J.T.Pereira & Ridsdale, *R. lagunensis, R. leytensis* J.T.Pereira & Ridsdale and *R. macromera*. In Malesia, corolla tube hairiness on the inside may be recognized as two types: with a hairy zone covering part or all of the tube from the mouth downwards in *Gardenia grandis, Rothmannia merrillii, R. negrosensis* and *Timonius nigrescens* Valeton, or with a hairy zone covering part or all of the tube below the level of the anthers in *R. schoemanii* and *R. macrophylla*. In Africa, the majority of species are with a hairy zone covering part or all of the tube below the level of the anthers downwards, e.g., *Rothmannia capensis*, *R. engleriana*, *R. ravae*, *R. longiflora*, *R. whitfieldii*, and *R. lujae*. A few African species (e.g., *Rothmannia globosa*, *R. hispida* (K.Schum.) Fagerl. and *R. manganjae*) have the hairy zone covering part or all of the corolla tube from the mouth downwards. *Rothmannia* complex species from mainland Asia (including the Andaman Islands) also have two types of hair distribution on the inner surface of the corolla tube. Most mainland Asian species have a hairy zone covering part of the tube below the level of the anthers, as in, e.g., *Rothmannia pulcherrima*, *R. venalis*, *R. sootepensis*, but a few species (e.g., *R. vidalii* and *R. wittii*) have a hairy zone covering part of the tube from the mouth downwards. None of the *Rothmannia* complex species in mainland Asia (including Andaman Islands) has a glabrous inner corolla tube surface.

The distribution of indumentum on the outer surface of the corolla lobes can be distinguished as three main types as follows:

(i) glabrous or with minute hairs sparsely distributed at the margin or fringes of the lobes (e.g., *Rothmannia annae, R. capensis, R. fischeri, R. lujae* and *R. ravae* (all African) and *R. lagunensis, R. merrillii, R. pulcherrima, R. sootepensis, R. thailandica, R. venalis,* and *R. vietnamensis*; all Asian and SW Pacific);

(ii) sparsely to densely hairy on the uncovered half of the corolla lobes (e.g., *Gardenia forsteniana, G. grandis, G. pseudoternifolia; Kochummenia*; *Randia anisophylloides*; *Rothmannia daweishanensis, R. eucodon, R. graciliflora, R. kampucheana, R. leytensis, R. macromera*, *R. macrophylla, R. negrosensis*, and *R. schoemanii*: all Asian and SW Pacific);

(iii) hairs uniformly covering the entire lobe outer surface (e.g., *Rothmannia wittii* and *R. vidalii* (Asian) and all the left-contorted African species (except *R. lujae*) and right-contorted African species (*R. hispida, R. lateriflora*, and *R. octomera*).

Placentation and ovules. The common placentation type in the Rubiaceae is axile (Puff 2001). Parietal placentation (2 parietal placentas opposite each other and sometimes partially fused) has been described for African species of the *Rothmannia* complex (Hallé 1970, Bridson & Verdcourt 1988, and Sonké & Simo 1996). We have verified parietal placentation in a few of the African species: *Rothmannia capensis, R. engleriana, R. fischeri* (ssp. *fischeri* and ssp. *verdcourtii*) and *R. manganjae*. However, our examination of two African species, *Rothmannia longiflora* and *R. whitfieldii* has revealed that placentation is in fact axile, and so is different from that recorded by others. Similarly, Tirvengadum (1982), who studied the South and Southeast Asian species, mentioned that the placentation is parietal with 2 placentas, the base of which sometimes forms an incomplete septum. However, we have found that most of the species studied by Tirvengadum (1982) (e.g., *Rothmannia eucodon, R. kampucheana, R. sootepensis, R. venalis*, *R. vietnamensis* and *R. wittii*) have axile placentation with complete septum development in the ovary. Shui et al. (2003), who described *Rothmannia daweishanensis* from South China, documented the seemingly 2-locular ovary as having a parietal placentation. In all the Malesian species (including *Rothmannia macrophylla*), the placentation is axile, as has been noted by Wong (1984, 1989). Our investigation of this character for most of the African and some of the mainland Asian species was not possible because of insufficient flowering material. Nevertheless, based on present studies, both parietal and axile placentations exist within the *Rothmannia* complex. In *Kochummenia* spp., the placentation is axile, as noted by Wong (1989).

In all the *Rothmannia* species, the number of ovules is numerous, as mentioned by Tirvengadum (1982), Robbrecht & Puff (1986), Bridson & Verdcourt (1988), Sonké & Simo (1996), and Puff et al. (2005). This is also true for the species of *Kochummenia*.

Stamens. The anthers in all *Rothmannia* s.l. species are (dorsi-)medifixed, sessile or subsessile and linear in shape. There are typically 5, rarely 6, anthers but in a few species this may increase in number, e.g., *Rothmannia merrillii* (6–10), *R. negrosensis* and *R. octomera* (6–8). The anthers in all the *Rothmannia* complex species are attached above the basal 1/3 of the corolla tube and they may be fully included within the tube (or sometimes the anther tips slightly protrude from the corolla tube) or partially exsert. In the Malesian species (including *Rothmannia macrophylla*), all the anthers are typically included within the tube (above the basal 1/3 of the corolla tube) but sometimes the tips of anthers may protrude slightly, e.g., in *R. lagunensis*, *R. leytensis, R. macrophylla* and *R. schoemanii*. Included anthers were also documented in some of the African species, e.g., *Rothmannia globosa*, *R. longiflora*, *R. manganjae* and *R. whitfieldii* (Bridson & Verdcourt 1988) and some of the mainland Asian species (e.g., *R. eucodon, R. pulcherrima, R. vidalii* and *R. wittii*). In the majority of the African species (e.g., *Rothmannia annae*, *R. capensis* and *R. ravae*) and mainland Asian species (e.g., *R. kampucheana*, *R. sootepensis, R. thailandica, R. venalis* and *R. vietnamensis*), the anthers are partially exsert; this is not found in the Malesian species. The anther length in the Malesian species typically range from 5 mm to 15 mm long; however, the longest, 20–25 mm, is found in *Rothmannia macrophylla*. The extremely long anthers

of *Rothmannia macrophylla* distinguished this taxon from the rest of the Malesian species. Many of the African species have longer anthers, more than 20 mm long, and may reach up to 60 mm long (e.g., in *Rothmannia macrocarpa* (Hiern) Keay, Hallé 1970).

In *Kochummenia,* the anthers are also (dorsi-)medifixed, sessile or on short filaments, and linear in shape. There are 5 included anthers, 10–12 mm long, attached at the lower 1/3 of the corolla tube; the low insertion of the anthers within the corolla tube differentiates *Kochummenia* from the rest of the *Rothmannia* complex.

Secondary pollen presentation and pollen characteristics

Secondary pollen presentation (SPP) is the condition when pollen is shed onto the outside of the immature style-stigma complex, sometimes also just referred to as the "stylar head" (Robbrecht & Puff 1986). As the flower matures, the style elongates and the stylar head or stigma comes into proximity with the anthers, which dehisce just before floral opening, depositing the pollen onto the still-immature stigma. When the flower opens, the stylar head acts as a "pollen presenter". Only subsequently does the stigma become receptive. Although this is a frequent phenomenon in the Gardenieae, our observations do not show a consistent presence of SPP in all species of the *Rothmannia* complex. Fresh flowering material of three Malesian species (i.e., *Gardenia pseudoternifolia*, *Rothmannia merrillii* and *R. schoemanii*) were investigated for the occurrence of SPP.

In both *Gardenia pseudoternifolia* and *Rothmannia merrillii*, dissected buds of advanced development revealed that the pollen sacs were still intact (without signs of dehiscence) although the style and stigma were located only up to 2/3 the length of the corolla tube and much below the anthers; furthermore, the stigmatic lobes were already parted (indicating female receptivity). In these species, SPP does not seem to be present, although the occurrence of heterostyly was not ascertained. On the other hand, in *Rothmannia schoemannii* (Fig. 8), buds of advanced development had the already-dehisced anthers appressed to the stigma, with pollen deposition on the style-stigma complex, so that it can be concluded that SPP definitely occurs. Examination of herbarium material of

Fig. 8. *Ridsdalea schoemanii*, longitudinal section through floral buds just prior to floral opening, with pollen already shed from dehisced anthers and deposited onto the stigma, which acts as a pollen presenter as the flower opens. (Photo: E.M. Lai)

several other Malesian species of the *Rothmannia* complex, e.g., *Gardenia forsteniana, G. grandis*, *Randia macromera* var. *uvarioides* Valeton, *Rothmannia lagunensis, R. leytensis, R. macromera*, and also one African species, *R. lujae,* also indicated the likely occurrence of SPP. In some cases, the stigmatic lobes had grooves (in *Randia macromera var. uvarioides* and *Rothmannia macromera*) and hairs (in *Randia macromera* var. *uvarioides*), which according to Robbrecht & Puff (1986) assisted pollen deposition. SPP is also present in *Rothmannia macrophylla* (Fig. 7), but there are no observations for *Kochummenia*.

Pollen of the following species of the *Rothmannia* complex in Asia were also studied by one of us (Pereira 2008): *Gardenia forsteniana*, *G. grandis*, *G. pseudoternifolia*; *Randia anisophylloides*; *Rothmannia graciliflora, R. kampucheana, R. leytensis*, *R. macromera*, *R. merrillii*, *R. negrosensis*, *R. pulcherrima*, *R. schoemanii*, *R. sootepensis*, *R. venalis*, *R. vidalii*, *R. vietnamensis*, *R. wittii*; *Timonius nigrescens*, and several unnamed species. Prior to this study, only a small number of the *Rothmannia* complex members have been palynologically studied (*Rothmannia capensis, R. engleriana, R. longiflora* and *R. globosa* (African) by Persson (1993) and *R. fischeri* (African) by Verdcourt (1958); *R. macrophylla* (Sharma 1968), *R. schoemanii* (Sharma 1968, Mitra 1969), *R. sootepensis* (Sharma 1968, Persson 1993) and *Randia* (= *Kochummenia*) *stenopetala* (Asian) by Sharma (1968) and Persson (1993). The findings of these previous investigations have conformity as well as contradiction with the results we have obtained. The detailed pollen characteristics, as compared with *Kochummenia parviflora*, *K. stenopetala* and *Rothmannia macrophylla*, will be reported in a separate contribution, and only the most consistent differences for the groups are mentioned here.

Although only four species of the African type alliance (*Rothmannia* s.s.) were surveyed for the pollen studies, the results were consistent in that their pollen have luminal processess that are not present in the rest of the other *Rothmannia* species or *Kochummenia*. Igersheim (1991) commented that the occurrence of luminal processes is uncommon in the Rubiaceae and is known in only a limited number of groups, e.g., *Paederia* subgenus *Lecontea* and several genera in the *Morindeae* (Johansson 1987).

The main diagnostic characters differentiating *Rothmannia macrophylla* from the rest of the Asian *Rothmannia* complex and *Kochummenia* lie in the very wide ectocolpus (7.1–11.8 μm) and large average pollen size (polar axis P=34 μm, equatorial diameter E=35.9 μm), compared to the other species of *Rothmannia* and *Kochummenia* (ectocolpus width only up to 5 μm wide and moderate pollen size with P=26.5 μm, E=32.3 μm). The reticulate to microreticulate sexine ornamentation in *Kochummenia* is quite similar to that in other taxa of the *Rothmannia* complex including *R. macrophylla*; however, the difference is in the ectoaperture. In *Kochummenia,* the ectoaperture margin is vague and the length is only up to 1/2 the grain margin-pole distance in polar view, whereas in the other *Rothmannia* complex taxa including *Rothmannia macrophylla*, the ectocolpus margin is always distinct and the length reaches 3/4 of the grain margin-pole distance in polar view.

SYSTEMATIC PART:
MORPHOLOGICAL DISTINCTION OF THREE ASIATIC GENERA

For the Asiatic allies of the *Rothmannia* complex, our analyses have revealed three major groupings that could be recognized as distinct genera. Each has at least two unique characteristics among the complex in Asia, and confirmed or possibly unique differences from their African allies (these having been shown to belong to a completely different genetic clade or alliance) and incomplete surveys of other character-states indicate there could be more differences found as study opportunities increase in the future.

Kochummenia is distinct by its subhypocrateriform corolla with linear lobes exceeding the tube (Fig. 9) and anthers inserted near the tube base (and likely also leaf epidermal cells with deeply sinuated anticlinal walls). The first two are unique character states defining a genus so far known only from the Malay Peninsula (as far as we know, only within Peninsular Malaysia). *Ridsdalea* J.T.Pereira & K.M.Wong, one of the two new genera recognized here, is characterized by a hypocrateriform or campanulate corolla (Fig. 6A, B; Fig. 10) and reduction of only one member of the distal leaf pair on each branch segment that results in a trifoliate leaf cluster formed with the proximal leaf pair (Fig. 1: A2; Fig. 3, 4, 11). *Ridsdalea* is the most widespread of the three, occurring across subtropical and tropical Asia to Malesia.

Fig. 9. Inflorescences of *Kochummenia stenopetala*. (Photo: Ahmad Fitri Zohari)

The other new genus, *Singaporandia* K.M.Wong, is based on *Rothmannia macrophylla*, and is distinguished by an infundibular corolla (Fig. 6C), exceptionally long anthers with large pollen and ectocolpus, and a distinctive plant architectural form characterized by complete reduction of the second (distal) leaf pair on a branch segment (Fig. 1: B2, 5). This monotypic genus is distributed in the Malay Peninsula (Peninsular Malaysia and Singapore) and Sumatra.

Kochummenia K.M.Wong

Malay. Nat. J. 38 (1984) 31; Wong, Tree Fl. Malaya (1989) 366. TYPE SPECIES: *Kochummenia stenopetala* (King & Gamble) K.M.Wong.

Gardenia sensu King & Gamble, J. As. Soc. Beng. 72 (1903) 218, pro parte quoad *Gardenia stenopetala* King & Gamble.

Randia sect. *Grandiflorae* Ridl., Fl. Malay Penins. 2 (1923) 71, pro parte quoad *R. stenopetala* Ridl.

Rothmannia sensu Bremek., pro parte, Proc. Kon. Ned. Akad. Wetensch. C 60(1) (1957) 6, in obs., quoad *Rothmannia stenopetala* (Rild.) Bremek. (*sic!*).

Shrubs or treelets with typically solitary trunk; unarmed. ***Trunk*** orthotropic with continuous production of branches. ***Branches*** opposite and decussate on the trunk, plagiotropic by substitution, sympodial in development; primary branch and successive higher-order modular branch units each with only 2 nodes and a terminal inflorescence each, new modular units developing from either or both leaf axils at the proximal node of the previous module. ***Stipules*** interpetiolar, free, persistent, inner surface hairy with 2–3 rows of colleters at the basal part. ***Leaves*** typically in groups of 3's, each trifoliate group based on a distal node with only one leaf normally developed (the other vestigial or very much reduced in size), and the proximal node with a pair of normal leaves; petiolate to subsessile, axils of the midrib and lateral veins frequently with domatia on the lower leaf surface, margin entire. ***Inflorescences*** terminal in origin but later appearing lateral because of displacement to one side during sympodial branch development; distinctly pedunculate to subsessile, distinctly branched cymes. ***Flowers*** bisexual; small or medium, corolla tube typically not more than 3 cm long; typically pedicellate, sometimes subsessile. Calyx 5-lobed, colleters present in small groups on the inner surface, hairy on the outside. Corolla 5-merous; subhypocrateriform; the tube creamy-white to greenish, the lobes creamy-white to greenish; the outer surface glabrous or hairy, the inner surface glabrous; lobes contorted to the left in the flower bud, distinctly longer than the tube; stamens dorsifixed, attached at the lower part of the corolla tube, fully included within the tube, anthers sessile or on short filaments, linear; style shorter than the corolla tube, glabrous; stigma included, narrowly subovoid, 2-lobed, smooth when dried;

ovary 2-celled; ovules many, placentation axile. Mature ***fruits*** berry-like, medium, to 3.5 cm across; ellipsoid, crowned with persistent calyx, outer surface glabrescent to sparsely hairy, drying smooth or wrinkled; 2-loculate. ***Seeds*** many, immersed in a pulp-like placental tissue.

DISTRIBUTION. Three species, endemic to the Malay Peninsula (so far known only in Peninsular Malaysia).

NOTES. The genus is named after K.M. Kochummen (1931–1999), Malaysian botanist based at the Forest Research Institute Malaysia. The type species, *Randia stenopetala* Ridl., was placed under *Randia* sect. *Grandiflorae* by Ridley (1923), who considered it closely related to *Randia macrophylla* (= *Singaporandia macrophylla* in the present account).

1. *Kochummenia parviflora* K.M.Wong

Malay Nat. J. 38 (1984) 32; Wong, Tree Fl. Malaya (1989) 366. TYPE: *Sinclair & Kiah SFN 39935*, Peninsular Malaysia, Terengganu, 36th mile Terengganu-Besut road, 13 Jul 1953 (holotype SING; isotypes K, L).

DISTRIBUTION. Thus far endemic to Terengganu state, Peninsular Malaysia. Only known from a few collections (Wong 1984).

2. *Kochummenia stenopetala* (King & Gamble) K.M.Wong

Malay. Nat. J. 38 (1984) 32; Wong, Tree Fl. Malaya (1989) 366. Basionym: *Gardenia stenopetala* King & Gamble, J. As. Soc. Beng. 72 (1903) 218. *Randia stenopetala* (King & Gamble) Ridl., Fl. Malay Penins. 2 (1923) 79; Corner, Wayside Trees Malaya 1 (1952) 557. *Rothmannia stenopetala* (Ridl.) Bremek. (*sic!*), Proc. Kon. Ned. Akad. Wetensch. C 60(1) (1957) 6, in obs. [First-step] LECTOTYPE (designated by Wong 1984): *Curtis 3144*, Perak, Bujong Malacca, Dec 1895 (SING) (isolectotype CAL). [Second-step] LECTOTYPE (designated here): *Curtis 3144*, Perak, Bujong Malacca, Dec 1895 (SING: barcode SING 0059292) (isolectotypes CAL, SING: barcode SING 0059294).

(Fig. 9)

DISTRIBUTION. So far endemic to Perak state, Peninsular Malaysia. Most of the collections were from the early to mid-20th century. Only recently recollected from Bujang Melaka and the Kledang Saiong Forest Reserve, Perak.

3. *Kochummenia* terengganuensis K.M.Wong, **sp. nov.**

This new species is closely related to *K. parviflora* K.M.Wong in having shorter corolla lobes than *K. stenopetala* (King & Gamble) K.M.Wong, but differs in the shorter (less than

1 cm long), hispid inflorescence rachis and hispid lower leaf surface (in *K. parviflora*, the inflorescence rachis is 1–2 cm long and, like the lower leaf surface, is sparsely pubescent).

TYPE: *Whitmore FRI 20362*, Terengganu, Kemaman Hills, 3 miles SW of Kg Ayer Putih, near Sg Buaya, 20 Aug 1971 (holotype KEP; isotypes SAR, SING).

Kochummenia sp.,Wong, Tree Fl. Malaya (1989) 366.

Treelet, to 1.5 m high. Twigs hispid. ***Stipules*** triangular, 4–6 mm long, 3.5–4 mm wide, hispid outside; apex long-acuminate, 2.5–3 mm long. Young ***leaves*** on shoot tips hispid on both sides. Mature leaves with petiole to 1 cm long, 1.5–2 mm thick, hispid; lamina narrowly elliptic, 20–30 cm long, 4–7 cm wide, upper and lower surfaces hispid, leaf base cuneate to sometimes unequal; leaf apex acute to acuminate, acumen to 1 cm long; chartaceous when dry; midrib on upper side flat to slightly raised, hispid, on lower side distinctly raised, hispid; secondary veins 10–13 pairs, on upper side flat, hispid, on lower side raised, hispid; tertiary venation visible as a much-branched network between pairs of secondary veins. ***Inflorescence (bud)***: peduncle to 0.2 cm long, *c*. 3 mm thick, hispid; habit compact, with *c*. 2 distinct branching orders, rachis 0.2 cm long, primary branches along rachis 1–2 pairs, *c*. 0.3 cm long; bracts narrowly ovate, *c*. 3 mm long, 2.5–3 mm wide, hispid. Flowers 6 per cyme; pedicels very short, *c*. 2 mm long, *c*. 1 mm thick; calyx tube 4–6 mm long, 2.5–3 mm wide, hispid, hairs erect, surface visible; calyx limb cup-shaped; calyx lobes 5, long-linear, 9–10 mm long, hispid; corolla subhypocrateriform, greenish white, the tube *c*. 0.6 cm long; non- speckled inside, outer surface pubescent to hispid, inner surface glabrous; corolla lobes 5, linear, 1.8–2.4 cm long, *c*. 0.1 cm wide, outside hispid on the half uncovered in the bud, inside glabrous. ***Fruits*** not seen.

DISTRIBUTION. Thus far, endemic to Terengganu state, Peninsular Malaysia. Known only from the type collection. Recorded in logged kapur forest, on shale.

Ridsdalea J.T.Pereira & K.M.Wong, **genus novum**

The new genus *Ridsdalea* is distinguished from *Rothmannia* Thunb. by its corolla lobes contorted to the left (the lobes in *Rothmannia* s.s. are contorted to the right), and from other related genera in the Asiatic *Rothmannia* alliance by its hypocrateriform or campanulate corolla (contrasting with the subhypocrateriform corolla with long linear lobes of *Kochummenia* K.M.Wong, and the infundibular corolla of *Singaporandia* K.M.Wong); and reduction of only one member of the distal leaf pair on each 2-node branch module resulting in a trifoliate leaf cluster formed with the proximal leaf pair (contrasting with *Singaporandia*).

TYPE SPECIES: *Ridsdalea grandis* (Korth.) J.T.Pereira

Gardenia sensu Linn., sensu Miq., Fl. Ind. Bat. 2 (1856) 228, pro parte quoad *G. grandis* Korth. & *G. schoemanii* Teijsm. & Binn.; sensu Merrill, J. Str. Br. Roy. As. Soc. Spec. No. (1921) 564 & sensu Masamune, En. Phan. Born. (1942) 682, pro parte quoad *G. grandis* Korth. & *G. merrillii* Elmer.

Randia sect. *Gardenioides* Hook.f., Fl. Brit. India 3 (1880) 114, pro parte quoad *R. exaltata* Griff.; Ridley, Fl. Malay Penins. 2 (1923) 71.

Randia sensu Koord. & Valeton, Bijdr. 8 (1902) 88 & sensu King & Gamble, J. As. Soc. Beng. 72 (1903) 214–215, pro parte quoad *R. exaltata*; sensu Merrill, J. Str. Br. Roy. As. Soc. Spec. No. (1921) 562–564, pro parte quoad *R. grandis* (Korth.) Valeton ex Winkler & *R. kuchingensis* W.W. Sm.; sensu Masamune, En. Phan. Born. (1942) 708, pro parte quoad *R. grandis* (Korth.) Valeton ex Winkler, *R. keithii* C.E.C.Fischer & *R. kuchingensis* W.W.Sm.; sensu Backer & Bakhuizen, Fl. Java 2 (1965) 310, pro parte quoad *R. schoemanii* (Teijsm. & Binn.) Bakh.f.

Rothmannia pro parte sensu Bremekamp, Proc. Kon. Ned. Akad. Wetensch. C 60(1) (1957) 3; Backer & Bakhuizen, Fl. Java 2 (1965); Tirvengadum, Nord. J. Bot. 3 (1983) 466; Wong, Malay. Nat. J. 38 (1984) 46; Wong, Tree Fl. Malaya (1989) 324; Puff & Wong, Sandakania 2 (1993) 13; Beaman & Anderson, Pl. Mt. Kinabalu 5 (2004) 340.

Treelets to small, medium or large trees with typically solitary trunk, unarmed. ***Trunk*** or above ground shoot an orthotropic system with continuous production of branches. ***Branches*** opposite and decussate on the trunk, typically plagiotropic by substitution, sympodial in development; primary branch (and successive higher-order modular branch units) with only 2 nodes and a terminal inflorescence each; higher-order modular units developing from either one or both leaf axils at the proximal node of the previous module. ***Stipules*** interpetiolar, free or only very slightly fused at the base, persistent to caducous, inner surface hairy with colleters restricted to 1–several rows at the basal part or forming a central triangular area. ***Leaves*** typically in groups of 3's, each trifoliate group based on a distal node with only one leaf normally developed (the other vestigial or very much reduced in size) and the proximal node with a pair of normal leaves; petiolate to subsessile, axils of the midrib, secondary veins, and sometimes other vein junctions frequently with domatia on the lower leaf surface; margin entire. ***Inflorescences*** terminal in origin, later appearing lateral because of displacement to one side during sympodial branch development; distinctly cymose or sometimes much reduced to a 1-flowered structure (but always with bracts marking potential branching on the main inflorescence axis); distinctly pedunculate to subsessile. ***Flowers*** bisexual; small or large, corolla tube typically not more than 15 cm long; typically pedicellate, sometimes subsessile. Calyx 5–8(–10)-lobed, colleters present in small groups on the inner surface, glabrous or glabrescent to hairy on the outside. Corolla typically 5-merous (in Malesia, 2 species, *R. merrillii* and *R. negrosensis*, often 6–8); hypocrateriform, or campanulate (e.g., *R. forsteniana* and *R. schoemanii*); the tube creamy-white, the lobes creamy-white, in some

species (e.g., *R. schoemanii*) with purple or reddish purple speckles or blotches running down the corolla throat; the outer surface glabrous or hairy, the inner surface glabrous or with hairs covering part or all of the tube from either the corolla mouth downwards (*R. grandis, R. merrillii, R. negrosensis*, *R. nigrescens*) or below the level of the anthers (*R. schoemanii*); lobes contorted to the left in the flower bud, distinctly shorter than or more-or-less as long as the tube; stamens (dorsi-)medifixed, attached at the upper part of the corolla tube or sometimes the tips slightly protruding (inserted above the basal 1/3), anthers sessile or on short filaments, linear; style shorter than, as long as, or slightly exceeding the corolla tube, or (rarely) of two lengths in a heterostylous condition, mostly glabrous, but sometimes (e.g., *R. schoemanii*) with scattered hairs; stigma included or (rarely) partially exsert, clavate to fusiform and sometimes narrowly oblong, 2-lobed, smooth to ribbed or grooved when dried; ovary 2-celled; ovules many, placentation axile. Mature ***fruits*** berry-like, indehiscent, medium to large, 2–5 cm or more across; globose or sub-globose or broad ellipsoid, outer surface drying smooth; 2-loculate. ***Seeds*** many, immersed in a pulp-like placental tissue.

DISTRIBUTION. *Ridsdalea* is widespread, through mainland Asia and the Malay Peninsula into East Malesia.

NOTES. There are c. 30 species in this genus, which is named after Colin E. Ridsdale (b. 1944), Rubiaceae specialist based in the Netherlands. The necessary combinations for 25 published names are effected here, with their synonyms where applicable. Full species descriptions and new species will be included in a forthcoming revision of the Malesian species.

1. *Ridsdalea anisophylloides* (Wernham) J.T.Pereira, **comb. nov.**

Basionym: *Randia anisophylloides* Wernham, J. Bot. 56 (1918) 74. TYPE: *Forbes 626*, Papua New Guinea, Central Prov., Sogere region, Mt Korroro, 2000 ft [609 m] alt, 29 Jan 1886 (holotype BM; isotype P).

DISTRIBUTION. Thus far known from the Windowoi Mountain in West Irian Jaya Province, Indonesia, and Papua New Guinea (Central, Madang, Northern, and East Sepik Provinces).

2. *Ridsdalea attopevensis* (Pit.) J.T.Pereira, **comb. nov.**

Basionym: *Randia attopevensis* Pit., Fl. Gén. Indo-Chine 3 (1923) 246. *Rothmannia attopevensis* (Pit.) Bremek., Proc. Kon. Ned. Akad. Wetensch. C 60(1) (1957) 6, in obs. LECTOTYPE (here designated): *Harmand per Pierre 6206*, Laos, Attopeu (P: accession MNHN-P-P00196978) (isolectotype P: accession MNHN-P-P00196979).

DISTRIBUTION. Vietnam and Laos.

3. *Ridsdalea daweishanensis* (Y.M.Shui & W.H.Chen) J.T.Pereira, **comb. nov.**

Basionym: *Rothmannia daweishanensis* Y.M.Shui & W.H.Chen, Novon 13 (2003) 322; Zhang et al., Acta Phytotax. Sin. 45(1) (2007) 92. TYPE: *Shui et al. 14496*, China, Yunnan, Maguan, Gulinqing, Woody Station nearby Nanxi Community of Hekou (holotype KUN; isotypes KUN, MO).

DISTRIBUTION. SW China (Yunnan province), Vietnam.

4. *Ridsdalea eucodon* (K.Schum.) J.T.Pereira, **comb. nov.**

Basionym: *Randia eucodon* K.Schum. in Schmidt, Fl. Koh Chang (1902) 183. *Rothmannia eucodon* (K.Schum.) Bremek., Proc. Kon. Ned. Akad. Wetensch. C 60(1) (1957) 7, in obs. TYPE: *Schmidt 717*, Thailand, Koh Chang 717 (holotype C; isotype K).

Randia exaltata var. *griffithiana* Pierre ex Pit., Fl. Gén. Indo-Chine 3 (1923) 245. LECTOTYPE (here designated): *Pierre 1625*, Vietnam, Bienhoa, Bao Chiang (P: barcode P00199261) (isolectotypes K, NY, P: barcode P00199260).

DISTRIBUTION. Thailand and Vietnam.

5. *Ridsdalea forsteniana* (Miq.) J.T.Pereira, **comb. nov.**

Basionym: *Gardenia forsteniana* Miq., Ann. Mus. Bot. Lugduno-Batavi 4 (1869) 236; Koorders, Meded. 's Lands Plantentuin 19 (1898) 494; Koords.-Schum., Syst. Verz. 11 (1914) 121; Koorders, Suppl. Fl. N.O. Celebes Part II (1922) 59, pl. 125. LECTOTYPE (here designated): *Forsten 386*, Celebes, Amurang, Nov 1860 (L: sheet n. 908.216-335).

Gardenia pelenkahuana Teijsm. & Binn. ex Koord., Meded. 's Lands Plantentuin 19 (1898) 495. LECTOTYPE (here designated): *Koorders Kds. 19707β*, Celebes, Minahasa, 20 Mar 1895 (BO).

Rothmannia forsteniana Miq., nom. invalid., Kessler et al., Checkl. Woody Plants Sulawesi, Blumea Supp. 14 (2002) 121.

DISTRIBUTION. Confined to Sulawesi (North, Central, Gorontalo and South Provinces).

6. *Ridsdalea graciliflora* (Merr.) J.T.Pereira, **comb. nov.**

Basionym: *Randia graciliflora* Merr., Philipp. J. Sci., C 10 (1915) 109; Merrill, Enum. Philip. Fl. Pl. 3 (1923) 527. *Rothmannia graciliflora* (Merr.) J.T.Pereira & Ridsdale, Sandakania 18

(2012) 17. LECTOTYPE (designated by Pereira & Ridsdale 2012): *Miranda F.B. 17988*, Philippines, Mindanao, Misamis, Mt Malindang, Jan–Feb 1913 (US) (isolectotypes K, L, NY, P, SING).

Gardenia negrosensis sensu Merrill, Philip. Fl. Pl. 3 (1923) 527 pro parte quoad *Ramos & Edaño B.S. 36787*; non Merrill (1915).

DISTRIBUTION. Southern Philippines (Mindanao and Basilan).

7. *Ridsdalea grandis* (Korth.) J.T.Pereira, **comb. nov.**

Basionym: *Gardenia grandis* Korth., Ned. Kruidk. Arch. 2 (1851) 191; Walp., Ann. Bot. Syst. 2 (1851) 796; Miq., Fl. Ind. Bat. 2 (1856) 231; Miq., Ann. Mus. Bot. Lugduno-Batavi 4 (1869) 236; Merrill, Bibl. En. Born. Pl., J. Straits Branch Roy. Asiat. Soc., Sp. No. (1921) 564; Masamune, En. Phan. Born. (1942) 708. *Randia grandis* (Korth.) Valeton ex Winkler, Bot. Jahrb. Syst. 44 (1910) 559; Merrill, Bibl. En. Born. Pl., J. Straits Branch Roy. Asiat. Soc., Sp. No. (1921) 562; Masamune, En. Phan. Born. (1942) 708; Coode et al., Checkl. Flow. Pl. & Gymn. Brunei (1996) 289. TYPE: *Korthals s.n.*, Borneo, Kalimantan, Mt Sakoembang, sine datum (holotype L: sheet no. 908.216-321).

Randia kuchingensis W.W. Smith, Notes Roy. Bot. Gard. Edinb. 8 (1915) 326; Merrill, Bibl. En. Born. Pl., J. Straits Branch Roy. Asiat. Soc., Sp. No. (1921) 562; Masamune, En. Phan. Born. (1942) 708. *Rothmannia kuchingensis* (W.W. Smith) K.M.Wong, Malay. Nat. J. 41 (1987) 270, Tree Fl. Malaya 4 (1989) 406. LECTOTYPE (designated by Wong et al., 1987): *Haviland 676*, Sarawak, Kuching, 29 Dec 1892 (SING) (isolectotypes BM, L).

Rothmannia malayana K.M.Wong, Malay. Nat. J. 38 (1984) 51, Tree Fl. Malaya 4 (1989) 406. TYPE: *Loh FRI 19252*, Kelantan, proposed Batu Papan F.R., 22 Feb 1972 (holotype KEP; isotypes K, SING).

DISTRIBUTION. Peninsular Malaysia (Kelantan, Pahang and Johor states), Sumatera (West, South and Riau Provinces) and Borneo (Kalimantan, Sarawak and Brunei).

8. *Ridsdalea kampucheana* (Tirveng.) J.T.Pereira, **comb. nov.**

Basionym: *Rothmannia kampucheana* Tirveng., Nord. J. Bot. 3(4) (1983) 466. TYPE: *Poilane 14676*, Cambodia, nord de Kampot, 5 Feb 1928 (holotype P).

DISTRIBUTION. Cambodia.

9. *Ridsdalea lagunensis* (Merr.) J.T.Pereira, **comb. nov.**

Basionym: *Gardenia lagunensis* Merr., Philip. J. Sci., C 10 (1915) 110; Enum. Philip. Fl. Pl. 3 (1923) 530. *Rothmannia lagunensis* (Merr.) J.T.Pereira & Ridsdale, Sandakania 18 (2012) 18. NEOTYPE (designated by Pereira & Ridsdale 2012): *Ramos Bur. Sci. 14934*, Philippines, Luzon, San Antonio Province, Laguna, Jun 1912 (L) (isoneotype P).

DISTRIBUTION. Known only from Luzon island of the Philippines

10. *Ridsdalea leytensis* (J.T.Pereira & Ridsdale) J.T.Pereira, **comb. nov.**

Basionym: *Rothmannia leytensis* J.T.Pereira & Ridsdale, Sandakania 18 (2012) 27. TYPE: *Wenzel 641*, Philippines, Leyte, 8 Mar 1914 (holotype A; isotype BM).

Gardenia negrosensis sensu Merrill, Enum. Philip. Fl. Pl. 3 (1923) 530, pro parte quoad *Wenzel 741, 641*; *Sandique 26596*; non Merrill (1915).

DISTRIBUTION. Endemic to the Philippines (Leyte).

11. *Ridsdalea macromera* (Lauterb. & K.Schum.) J.T.Pereira, **comb. nov.**

Basionym: *Randia macromera* Lauterb. & K.Schum., Fl. Deutsch. Schutzgeb. Südsee (1900) 562; Valeton, Bot. Jahrb. Syst. 60 (1926) 90 excl. var. *uvarioides* Valeton (= *Ridsdalea uvarioides*); Merrill & Perry, J. Arnold Arbor. 25 (1944) 202. *Rothmannia macromera* (Lauterb. & K.Schum.) Fagerl., Ark. Bot. 30 A (7) (1943) 39. NEOTYPE (here designated): *Schlechter 16215*, Papua New Guinea, Kaiser Wilhelmsland, 29 Jun 1907 (L: sheet no. 927.320-165).

NOTES. In the original publication of the basionym, *Randia macromera* in the Fl. Deutsch. Schutzgeb. Südsee (1900), Lauterbach and Schumann cited two specimens, *Lauterbach 1286* (flowering) and *Lauterbach 1524* (flowering and fruiting), both from *Kaiser Wilhelmsland* (formerly the German colony of the northeastern part of mainland New Guinea), and collected in 1890. Both these specimens (together with their duplicates) were not located. According to Van Steenis-Kruseman (1950) in *Cyclopaedia of Collectors* Vol. 1, collections from Lauterbach's trip to *Kaiser Wilhelmsland* in 1890 were deposited in the Berlin Herbarium. There is a possibility that these specimens were destroyed during the Second World War. Attempts were made to locate the syntypes in the Berlin Herbarium and other herbaria where Lauterbach's collection were believed to have been deposited, i.e., BO, BM, K, L, and the US (Van Steenis-Kruseman 1950). However, the search was futile.

A later publication by Valeton (1926), *Die Rubiaceae von Papuasien*, listed again two of the specimens (i.e., *Lauterbach 1286* and *Lauterbach 1524*) cited by Lauterbach & Schumann (1900) and three other collections under *Randia macromera*. One of the specimens cited in this account was *Schlechter 16215*, collected on 29 June 1907 from Kaiser Wilhelmsland, found at L. This is the only specimen possible to find and which also matches the original description. As such, the specimen at Leiden (Herb. Ludg. Bat. accession no. 927.320-165) is designated as the neotype for this species.

DISTRIBUTION. Found so far only in Papua New Guinea (Morobe Province).

12. *Ridsdalea merrillii* (Elmer) J.T.Pereira, **comb. nov.**

Basionym: *Gardenia merrillii* Elmer, Leafl. Philipp. Bot. 1 (1906) 5; Leafl. Philipp. Bot. 4 (1912) 1330; Gibbs, Journ. Linn. Soc. Bot. 42 (1914) 94; Merr., Enum. Philip. Fl. Pl. 3 (1923) 530; Merr., Philipp. J. Sci. 29 (1926) 421, pro parte excl. Celebes specimens; Merr., Bibl. En. Born. Pl., J. Straits Branch Roy. Asiat. Soc., Sp. No. (1921) 564 pro parte quoad *Gibbs 4340*, *Foxworthy 600*; Masamune, En. Phan. Born. (1942) 682. *Rothmannia merrillii* (Elmer) J.T.Pereira & Ridsdale, Sandakania 18 (2012) 20. LECTOTYPE (designated by Pereira & Ridsdale 2012): *Merrill 669*, Philippines, Island of Calomian, Culion, Feb 1903 (US) (isolectotypes A, K, NY, SING: barcode SING0093444).

Randia keithii C.E.C.Fisch., Bull. Misc. Inform. Kew (1932) 180; Masamune, En. Phan. Born. (1942) 708. *Rothmannia keithii* (C.E.C.Fisch.) Bremek., Proc. Kon. Ned. Akad. Wetensch. C 60(1) (1957) 6, in obs. TYPE: *Keith 1215*, North Borneo, Sandakan, 500 ft [152 m] alt, 20 Feb 1929 (holotype K). (Fig. 6A)

DISTRIBUTION. Endemic to the Philippines and Borneo (Sabah).

13. *Ridsdalea negrosensis* (Merr.) J.T.Pereira, **comb. nov.**

Basionym: *Gardenia negrosensis* Merr., Philipp. J. Sci., C 10 (1915) 111–112, pro parte quoad *Celestino Bur. Sci. 7333*, Merr., Enum. Philip. Fl. Pl. 3 (1923) 530, pro parte quoad *Ramos & Edaño Bur. Sci. 31358* & *Cardona FB 23868*, excl. *Ramos & Edaño Bur. Sci. 36787* (= "*Rothmannia graciliflora*"), *Sandique FB 26596*, *Wenzel 641* (= "*R. leytensis*"). *Rothmannia negrosensis* J.T.Pereira & Ridsdale, Sandakania 18 (2012) 25. LECTOTYPE (designated by Pereira & Ridsdale 2012): *Celestino Bur. Sci. 7333*, Philippines Negros, Cadiz, Feb–Mar 1909 (L).

DISTRIBUTION. Thus far only found in the Philippines (Negros, Mindoro and Palawan islands).

14. *Ridsdalea nigrescens* (Valeton) J.T.Pereira, **comb. nov.**

Basionym: *Timonius nigrescens* Valeton, Engl. Bot. Jahrb. Syst. 61 (1927) 46. LECTOTYPE (here designated): *Ledermann 9560*, New Guinea, Sepik, 1912–13 (L) (isolectotype A).

Randia bartlettiana Merr. & Perry, J. Arnold Arbor. 29 (1948) 165. TYPE: *Clemens 41856*, Papua New Guinea, Morobe district, Boana, 2500–4500 ft [762–1371 m] alt, 26 Sep 1940 (holotype A; isotypes L, UC).

DISTRIBUTION. Widespread in Papua New Guinea (Madang, Morobe, Western, Milne Bay, Southern, Northern, Central and East Sepik Provinces).

NOTES. Valeton (1927) had clearly indicated the type specimen *Ledermann 9560* from Sepik, Papua New Guinea, taken during the Sepik Expedition in 1912–13. According to Van Steenis-Kruseman (1950), Ledermann's holotype collections from this expedition were deposited in the Berlin Herbarium (B) and the duplicates distributed to L, K, SING and US. The holotype of this collection was destroyed during the Second World War. The sheet from L, which is a duplicate of *Ledermann 9560*, is designated as the lectotype.

15. *Ridsdalea pseudoternifolia* (Valeton) J.T.Pereira, **comb. nov.**

Basionym: *Gardenia pseudoternifolia* Valeton, Icon. Bogor. 4 (1912) 123, t. CCCXXXVIII. TYPE: *Teysmann 19411*, Insula Liengga, prope Sapientjan, Feb 1911 (holotype BO; isotype L). (Fig. 4)

Rothmannia kuchingensis sensu Coode et al., Checkl. Flow. Pl. & Gymn. Brunei (1996) 290, non (W.W.Smith) K.M.Wong (= *Ridsdalea grandis*).

Rothmannia schoemanii sensu Kessler et al., Checkl. Tree Flora Balikpapan-Samarinda area, East Kalimantan, Indonesia (1992) 67, non (Teijsm. & Binn.) Tirveng.

Rothmannia sp. nov. in Kessler & Sidiyasa, Trees Balikpapan-Samarinda area, East Kalimantan, Indonesia (1994) 202, fig. 16.

Rothmannia sp. 2 in Beaman & Anderson, Pl. Mt. Kinabalu 5 (2004) 340.

DISTRIBUTION. Endemic to Sumatra and Borneo (Sabah, Sarawak, Brunei & Kalimantan).

16. *Ridsdalea pulcherrima* (Kurz) J.T.Pereira, **comb. nov.**

Basionym: *Gardenia pulcherrima* Kurz, J. Asiat. Soc. Bengal, Pt. 2, Nat. Hist. 41(4) (1872) 312; For. Fl. Br. Burma 2 (1877a) 43. *Randia andamanica* N.P.Balakr., nom. nov., Bull. Bot.

Surv. India 22 (1980 pub. 1982) 175. *Rothmannia pulcherrima* (Kurz) Tirveng., Nord. J. Bot. 3 (4) (1983) 469. TYPE: *Kurz s.n.*, South Andaman, sine datum (holotype CAL; isotypes K, P).

DISTRIBUTION. Andaman Islands.

17. *Ridsdalea schoemanii* (Teijsm. & Binn.) J.T.Pereira, **comb. nov.**

Basionym: *Gardenia schoemanii* Teijsm. & Binn., Nat. Tijdschr. Ned. Ind. 3 (1852) 327; Teisjm. & Binn., Catalogus van 's Lands Plantentuin te Buitenzorg (1854) 98; De Vriese & Dozy, Ned. Kruidk. Arch. 3 (1855) 403; Miq., Fl. Ind. Bat. 2 (1856) 232. *Randia schoemanii* (Teijsm. & Binn.) Bakh. f., in Backer, Bekn. Fl. Java 15 (1956) 86; Backer & Bakhuizen, Fl. Java 2 (1965) 310; Corner, Wayside Trees Malaya 2 (1988) 648. *Rothmannia schoemanii* (Teijsm. & Binn.) Tirveng., Nord. J. Bot. 3 (1983) 469; Wong, Malay. Nat. J. 38 (1984) 49; Tree Fl. Malaya 4 (1989) 406; Ng, Manual Forest Fruits, Seeds & Seedlings, Malay. For. Rec. 34 (1992) 491, Figs. 809–810; Lemmens & Wulijarni-Soetjipto, Plant Resources South-East Asia 3 (1992) 151. NEOTYPE (here designated)**:** *Koorders Kds. 6859* β, Res. Bantam (Bogor), 16 Jul 1892 (neotype BO: sheet no. BO-1334900) (isoneotype K). (Fig. 10, 11)

Fig. 10 (left). *Ridsdalea schoemanii*, open flower and young buds. (Photo: E.M. Lai) **Fig. 11** (right). View from above: branching system in *Ridsdalea schoemanii*. (Photo: J.T. Pereira)

Randia exaltata Griff., Notul. ad Plantas Asiaticas 4 (1854) 262; Kurz, For. Fl. Br. Burma 2 (1877a) 46, J. Asiat. Soc. Bengal 46 (2) (1877b) 157; Hooker, Fl. Br. India 3 (1880) 114, pro parte quoad *Kew. Dist. 2826*, excl. *Kurz* s.n. (= *Ridsdalea pulcherrima*); Koord. & Valeton, Bijdr. Booms. Java 8 (1902) 88 pro parte, excl. *Gardenia pulcherrima* Kurz in syn. (= *Ridsdalea pulcherrima*); King & Gamble, J. Asiat. Soc. Bengal 72 (1903) 214, pro parte, excl. Andaman Islands (= *Ridsdalea pulcherrima*); Brandis, Ind. Trees (1906) 383, pro parte, excl. *G. pulcherrima* in syn.; Koord., Exkursionflora Java 3 (1912) 256; Koord.-Schum., System. Verzeichen. Part I, 1 Fam 270 (1913) 84; Koord. & Valeton, Atlas der Baumarten van Java 3 (1915) Figs. 527, 528; Pitard, Fl. Gén. Indo-Chine 3 (1923) 245, pro parte, excl. *G. pulcherrima* Kurz in syn.; Ridley, Fl. Malay Penins. 2 (1923) 78; Craib, Fl. Siam. Enum. 2, 1 (1932) 101, pro parte, excl. *G. pulcherrima* in syn.; Burkill, Dictionary Econ. Prod. Malay Penins. 2 (1966) 1897. *Rothmannia exaltata* (Griff.) Bremek., Proc. Kon. Ned. Akad. Wetensch. C 60(1) (1957) 7, in obs. TYPE: *Griffith 962*, Myanmar, sine datum (holotype K).

DISTRIBUTION. Myanmar, Thailand, Peninsular Malaysia, Sumatra, and Java.

18. *Ridsdalea sootepensis* (Craib) J.T.Pereira, **comb. nov.**

Basionym: *Randia sootepensis* Craib, Bull. Misc. Inform. Kew (10) (1911) 391; Fl. Siam. Enum. 2(1) (1932) 112; Pitard, Fl. Gén. Indo-Chine 3 (1923) 230. *Rothmannia sootepensis* (Craib) Bremek., Proc. Kon. Ned. Akad. Wetensch. C 60(1) (1957) 6, in obs. *Rothmannia sootepensis* (Craib) T.Yamaz., J. Jap. Bot. 45 (1970) 340. TYPE: *Kerr 1651*, Thailand, Chiang Mai (holotype K; isotypes BM, TCD).

DISTRIBUTION. Thailand.

19. *Ridsdalea thailandica* (Tirveng.) J.T.Pereira, **comb. nov.**

Basionym: *Rothmannia thailandica* Tirveng., Nord. J. Bot. 3(4) (1983) 466. TYPE: *Phusomsaeng 18* (Flora of Thailand *BKF 35922*), Thailand, Ubon Ratchathani, Chong Mek, 23 Feb 1967 (holotype BKF; isotypes AAU, C, K, L).

DISTRIBUTION. Northeast Thailand.

20. *Ridsdalea uranthera* (C.E.C.Fisch.) K.M.Wong, **comb. nov.**

Basionym: *Randia uranthera* C.E.C.Fisch., Bull. Misc. Inform. Kew (10) (1929) 314; Hook. Icon. (1933) t. 3143. *Rothmannia uranthera* (C.E.C.Fisch.) Tirveng., Nord. J. Bot. 3(4) (1983) 469. TYPE: *Ba Pe per Parkinson 8108*, Burma, Tavoy, Ba Wa Forest Reserve (holotype K).

DISTRIBUTION: Myanmar, Thailand.

21. *Ridsdalea uvarioides* (Valeton) J.T.Pereira, **comb. nov.**

Basionym: *Randia macromera* var. *uvarioides* Valeton, Bot. Jahrb. Syst. 60 (1926) 91. NEOTYPE (here designated)**:** *Ledermann s.n.*, Papua New Guinea, Sepik, 1912–13 (SING).

DISTRIBUTION. Recorded so far only in Papua New Guinea (East Sepik Province).

NOTES. The var. *uvarioides* of Valeton (1926) is here raised to specific rank because it is sufficiently distinct from the typical var. *macromera*. Features distinguishing var. *uvarioides* from var. *macromera* include the glabrous to scabrid lower leaf surface in var. *uvarioides* (densely velvety hairy in var. *macromera*), longer stipules (10–23 mm long in var. *uvarioides*, 5–8 mm long in var. *macromera*), colleters inside the stipules of var. *uvarioides* that are confined to a triangular area with more than 5 rows at the central part (colleters are arranged in a narrow zone usually of 1–2 rows at sparse intervals, and along the bottom edge of the stipule base in *var. macromera*), 5–10 flowers per cyme in var. *uvarioides* (more flowers, 11–24 per cyme in var. *macromera*), and a longer corolla tube, (3.5–)4–5 cm long in var. *uvarioides* (1–1.5 cm long in var. *macromera*). Attempts have been made to locate the holotype of Ledermann's collection listed in Valeton's account from the Berlin Herbarium (where most of Ledermann's collections were kept) and duplicates in the other herbaria, i.e. L, K and SING (Van Steenis- Kruseman 1950). We could not track down any of these.

However, an unnumbered flowering collection of this species made by Ledermann in the Sepik region during the Sepik Expedition in 1912–13 (the same collecting time and area as the specimens listed in Valeton's account) was discovered at the Singapore Herbarium. This is the only specimen found which matches the original description, and is designated as the neotype for this species.

22. *Ridsdalea venalis* (Bremek.) J.T.Pereira, **comb. nov.**

Basionym: *Rothmannia venalis* Bremek., Proc. Kon. Ned. Akad. Wetensch. C 60(1) (1957) 6, in obs. TYPE: *Vidal 798*, Laos, Vientiana, 23 Jan 1949 (holotype U; isotype P).

DISTRIBUTION. Laos.

23. *Ridsdalea vidalii* (Bremek.) J.T.Pereira, **comb. nov.**

Basionym: *Rothmannia vidalii* Bremek., Proc. Kon. Ned. Akad. Wetensch. C 60(1) (1957) 7, in obs. TYPE: *Vidal 1741*, Laos, Savannakhet, 25 May 1952 (holotype U; isotype P).

DISTRIBUTION. Laos.

24. *Ridsdalea vietnamensis* (Tirveng.) J.T.Pereira, **comb. nov.**

Basionym: *Rothmannia vietnamensis* Tirveng., Nord. J. Bot. 3(4) (1983) 469. TYPE: *Poilane 24313*, Vietnam, Annam, col de Braian Haut Douai, 14 Feb (rec. Jul) 1935 (holotype P).

DISTRIBUTION. Vietnam.

25. *Ridsdalea wittii* (Craib) J.T.Pereira, **comb. nov.**

Basionym: *Randia wittii* Craib, Bull. Misc. Inform. Kew (1911) (10): 392; Fl. Siam. Enum. 2 (1932) 114. *Rothmannia wittii* (Craib) Bremek., Proc. Kon. Ned. Akad. Wetensch. C 60(1) (1957) 7, in obs. TYPE: *Witt s.n.*, Thailand, Rachasma, Korat (K, *n.v.*).

(Fig. 6B)

DISTRIBUTION. Northeast Thailand.

Singaporandia K.M.Wong, **genus novum**

This new genus is distinguished from *Rothmannia* Thunb. by its corolla lobes contorted to the left (the lobes in *Rothmannia* s.s. are contorted to the right), and from other related genera in the *Rothmannia* alliance by its distinctive plant architectural form characterized by continuous growth of the orthotropic stem axis with branch production at successive nodes, and 2-node primary branch modules in which the proximal node bears a pair of normal leaves and the distal node has complete reduction of both leaves, with only rare development of a secondary branch module by substitution growth. The new genus also differs from other Asian members of the alliance by its infundibular corolla with exceptionally long (20–25 mm) anthers and large pollen and ectocolpus (polar axis P=34 μm, equatorial diameter E=35.9 μm, ectocolpus width 7.1–11.8 μm) (the other taxa have 5–20 mm long anthers, P=26.5 μm, E=32.3 μm, ectocolpus width only up to 5 μm wide).

TYPE SPECIES: *Singaporandia macrophylla* (R.Br. ex Hook.f.) K.M.Wong

Randia sect. *Euclinia* DC., sensu Hook.f., in Benth. & Hook.f., Gen. Pl. 2 (1873) 89 pro parte & Fl. Brit. India 3 (1880) 114, pro parte quoad *R. macrophylla* R.Br.; sensu K.Schum., in Engl. & Prantl, Nat. Pflanzenf. 4, 4 (1891) 76 pro parte quoad *R. macrophylla* (R.Br.) Hook.f.

Randia sect. *Grandiflorae* Ridl., Fl. Malay Penins. 2 (1923) 71, pro parte quoad *R. macrophylla* R.Br. ex Hook.f.

Randia sensu Koord. & Valeton, Bijdr. 8 (1902) 88 & sensu King & Gamble, J. As. Soc. Beng. 72 (1903) 214–215, pro parte quoad *R. macrophylla* Benth. & Hook.f. (*sic*!).

Rothmannia pro parte quoad *R. macrophylla* sensu Bremek., Proc. Kon. Ned. Akad. Wetensch. C 60(1) (1957) 7; Wong, Malay. Nat. J. 38 (1984) 46; Wong, Tree Fl. Malaya (1989) 324; Kochummen, Tree Fl. Pasoh Forest (1997) 385.

Treelets to small trees, sometimes shrub-like plants; unarmed. ***Stem*** orthotropic with continuous production of branches. ***Branches*** opposite and decussate or only one produced at each node on the trunk, plagiotropic by substitution when a rare second module develops; terminated by inflorescence development. ***Stipules*** interpetiolar, free, persistent, inner surface hairy with 3–4 rows of colleters at the basal part; apex long-acuminate. Branch ***leaves*** in pairs at the proximal node and completely vestigial at the distal node; secondary veins 10–21 pairs. ***Inflorescence*** a compact, much-reduced cyme, 1–3-flowered. ***Flowers*** bisexual; calyx tube pubescent, velvety to hispid; calyx limb cup-shaped; calyx lobes 5–6, narrowly triangular; corolla infundibular, the tube white with maroon tinged at the base on the outside, the tube 9–15 cm long, (20–)30–55 mm wide at the throat, 3–5 mm wide at the base; speckled inside, outer surface pubescent to hispid hairy, inner surface with hairy zone covering part of the tube from below the level of the anthers; corolla lobes 5, ovate with acute apex, 2.5–5.5 cm long, 1.5–2.5 cm wide, outside pubescent on the uncovered half of the lobes, inside glabrous; anthers 5, fully included within the tube (inserted at the upper 1⁄3), 20–25 mm long; stigma fusiform, slightly ribbed when dried, style and stigma included but reaching just below the corolla mouth and the level of the anthers, style smooth, glabrous. ***Fruits*** ellipsoid, 4–7 cm long, 2–3.5 cm wide, hispid when young. ***Seeds*** ellipsoid, 5–8.5 × 6–8 mm.

NOTES. This monotypic genus is named after the island republic of Singapore, where the species is well conserved in step with a heightening awareness of the value of the remaining lowland forests. A Singapore specimen collected in 1822 is also on the type sheet in Wallich's Herbarium at Kew. Its name also recalls the historical connection to *Randia*, the genus in which the type species was first placed. In the Bukit Timah long-term dynamics study plot, the population seems stable over time, with recruitment and mortality roughly in balance (LaFrankie et al. 2005). The branching and whole-plant architecture is quite unique among the *Rothmannia* alliance and perhaps also among the Rubiaceae in general.

DISTRIBUTION. A Sundaland endemic genus, restricted to west Malesia, naturally occurring in the Malay Peninsula (Peninsular Malaysia and Singapore) and Sumatra.

1. *Singaporandia macrophylla* (R.Br. ex Hook.f.) K.M.Wong, **comb. nov.**

Basionym: *Randia macrophylla* R.Br. ex Hook.f., Fl. Brit. India 3 (1880) 114; King & Gamble, J. As. Soc. Beng. 72 (1903) 215; Ridley, Fl. Malay Penins. 2 (1923) 78; Corner, Wayside Trees Malaya 2 (1988) 648. *Rothmannia macrophylla* (R.Br. ex Hook.f.) Bremek., Proc. Kon. Ned. Akad. Wetensch. C 60(1) (1957) 7, in obs.; Wong, Malay. Nat. J. 38 (1984)

Fig. 12. Attractive large blooms of *Singaporandia macrophylla*. (Photo: Cerlin Ng)

46; Wong, Tree Fl. Malaya (1989) 324; Kochummen, Tree Fl. Pasoh Forest (1997) 385; LaFrankie et al., Forest Trees Bukit Timah (2005) 142. LECTOTYPE (designated by Wong, 1984): Penang and Singapore, *Wallich*, *Cat*. *8304A*, 1822 (K-W).

(Fig. 12)

DISTRIBUTION. Endemic to West Malesia. It is found in Singapore, throughout Peninsular Malaysia and also in Sumatra (Jambi, Central Sumatra) and the Riau Islands.

NOTES. Although Robert Brown's name *Rothmannia macrophylla* R.Br. was used in Wallich's Catalogue (no. 8304), this was not validly published; Fagerlind (1943) had also accepted this taxon as a species of *Rothmannia* prior to Bremekamp's (1957) combination. Ridley (1923) had thought that it is closely allied to *Randia stenopetala* (=*Kochummenia stenopetala*) as both shared a similar habit (shrub) and membranous, more-or-less hairy leaves, as well as conspicuous flowers, and so he placed them in the same section, *Randia* sect. *Grandiflorae*. Wong (1984) pointed out that although the infundibular corolla shape of "*R. macrophylla*" is superficially similar to that of the type species of *Euclinia* Salisb. (*E. longiflora* Salisb.), the latter differs from *Rothmannia* s.l. species in having tetrad pollen grains instead of single grains; chaffy instead of firm stipules; and leaves clustering at the ends of twigs which are simultaneously deciduous instead of leaves at the ends of twigs and not deciduous.

As the species has large showy flowers produced regularly, Lemmens & Wulijarni-Soetjipto (1992) suggested it may be a good prospect for ornamental horticulture.

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SANDAKANIA 21 (2016): 65–130

Studies in Malesian Gentianaceae, VII. A revision of *Fagraea* in the Malay Peninsula with five new species

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Summary. *Fagraea* Thunb., as distinguished from various taxa now moved to the genera *Cyrtophyllum*, *Limahlania*, *Picrophloeus* and *Utania*, is revised for the Malay Peninsula. A review of useful characters and morphological variation is provided. Out of 18 species enumerated, five are new and provided with descriptions and illustrations: *Fagraea cameronensis* K.M.Wong & M.Sugumaran, *F. fraserensis* K.M.Wong & M.Sugumaran, *F. kinghamii* K.M.Wong & M.Sugumaran, *F. larutensis* M.Sugumaran, and *F. latibracteata* M.Sugumaran. *Fagraea calcarea* M.R.Hend. is placed under *F. curtisii* King & Gamble as a newly recombined variety.

A study of the highly polymorphic *Fagraea* complex using both morphological and molecular approaches has shown that the group is represented by five distinct genera (Sugumaran & Wong 2012, Wong & Sugumaran 2012a). Of these, *Limahlania* K.M.Wong & M.Sugumaran is a monotypic genus (Wong & Sugumaran 2012a), *Cyrtophyllum* Reinwardt and *Picrophloeus* Blume have been revised (Wong & Sugumaran 2012b, Wong 2012), and *Utania* Don has been revised for the Malay Peninsula (Sugumaran & Wong 2014). The present contribution is a revision of the Malay Peninsula species of *Fagraea* Thunb., a genus distributed from Sri Lanka and India, through tropical South East Asia, reaching east to Polynesia (Struwe et al. 2002).

Early accounts since those by Wallich in Roxburgh (1824) and Clark (1883) in Hooker's *Flora of British India* have included representatives of the different genera mentioned above.

In terms of *Fagraea* in the strict sense as the present revision addresses, Clark (1883) listed only *F. auriculata* Jack and *F. obovata* Wall. Later, six species of *Fagraea* s.s. were listed by King & Gamble (1904), whereas Ridley (1923) recorded an impressive 11 species. This represented a 5-fold increase of species enumerated in a 40-year period between Clarke (1883) and Ridley (1923), during a time of active botanical exploration and documentation.

Wong & Sugau (1996) have drawn attention to the difficulty of using the generally broad species concepts adopted by Leenhouts (1962), which they consider in many cases to be artificial assemblages of distinct species. They provided some striking examples to support their argument. For instance, they explained that Leenhouts' concept of *Fagraea ceilanica* included specimens from the type provenance (Sri Lanka) with 8–9-cm-long corolla tubes as well as specimens with corolla tubes not more than 3 cm long (from India and Malesia), without any intermediate forms. Wong & Sugau (1996), working primarily on Borneo, also treated six taxa of *Fagraea* s.s. that were relevant to the Malay Peninsula, resurrecting two names (*F. oblonga* King & Gamble, *F. splendens* Blume) and diagnosed another species previously confused with others (*F. renae* K.M.Wong & Sugau). The present account enumerates 18 species, including five new species and relegates *Fagraea calcarea* M.R.Hend. to a newly combined variety of *F. curtisii* King & Gamble.

MORPHOLOGY

Several important characters that help set apart *Fagraea* from the other genera of the complex include the smooth to lightly scaly-dippled stem bark (in contrast to fissured bark), a fresh fruit pericarp that produces copious amounts of pale creamy to yellowish latex (instead of small amounts of translucent or gummy latex, or none at all) and an ellipsoid-rounded (rather than polygonal) seed shape (Sugumaran & Wong 2012, Wong & Sugumaran 2012a).

Growth habit and architecture

Species of *Fagraea* have growth habits ranging from free-standing trees, erect or scrambling shrubs, to climbers, epiphytes, and hemi-epiphytes (Fig. 1 & 2). The term "hemi-epiphyte" has come to refer to initially terrestrial plants, such as some aroids (Araceae), with stems that creep up tree trunks and then lose connection with the ground through breakage or decomposition of the proximal parts, as well as to the growth habits of "strangling" figs (*Ficus* spp., Moraceae) (Putz & Holbrook 1989). In the latter case, the fig plants begin life newly germinated on a tree branch, as an epiphyte, and then develop roots that encircle the supporting trunk and at the same time growing down into the forest floor (Corner 1988). As a number of *Fagraea* species have growth habits similar to strangling figs, here the term "hemi-epiphyte" is likewise adopted to refer to their growth habit. In some cases noted for the so-called strangling figs, the "host" tree eventually dies because the fig develops a crown of its own that shades out that of the host and its anastomosing root-lattice prevents further

Fig. 1. Growth habits of *Fagraea* species. **A.** *Fagraea splendens*, climbing. **B.** *Fagraea splendens* developing multiple shoots from stems growing over a rock. **C.** *Fagraea imperialis* with a thick stem and adventitious roots binding around its support tree (*Sugumaran et al*. SM 230). **D.** *Fagraea gardenioides* sapling establishing on a mossy tree trunk in upper montane forest. (Photo credits: A, Ang Wee Foong; B & D, K.M. Wong; C. M. Sugumaran)

Fig. 2. Growth habits and cultivation of *Fagraea* species. **A.** Erect tree-shrubby habit of *Fagraea auriculata* at Menchali Forest Reserve, Pahang, with Zulkapli Ibrahim. **B.** Planted *Fagraea auriculata* at Singapore's Hort Park. **C.** *Fagraea auriculata* in a pot in open garden landscaping, Rimba Ilmu Botanic Garden, University of Malaya. **D.** *Fagraea splendens* established in a Singapore garden setting. (Photo credits: A & C, K.M. Wong; B & D, Ang Wee Foong)

host thickening. The same effect has been implied for the hemi-epiphytic *Fagraea imperialis* Miq., which Ridley (1930) says, "begins life as an epiphyte on a Palm or other tree, and, eventually killing its host, descends to the ground and forms a widely-spreading shrub or a tree..." Some other species are scramblers that form untidy tangles and twines, on small trees or on rocky surfaces (e.g., *F. carnosa* Jack).

We have also noticed root suckers forming in *Fagraea auriculata* plants in the sandy substrates of the Menchali Forest Reserve in Pahang, Malaysia. Generally, in plants with a growth habit varying from a shrub or free-standing tree to a hemi-epiphyte, the branches or roots may easily sprout new shoots as well as root. The work reported by Yeo et al. (2011) confirms the relative ease of air-layering for propagation of this species. In view of the big beautiful blooms, attractive leathery foliage and tidy plant form, as well as ease of propagation, we expect this species, as well as others like *Fagraea splendens*, to become more popular as potential garden and landscaping species in the future (Fig. 2). The plants do very well in open sites and thus have much potential in tropical urban settings.

All *Fagraea* s.s. species studied conform to the growth architectural model of Scarrone, in common with *Picrophloeus* but distinct from *Cyrtophyllum* (Aubreville's model), *Limahlania* (Fagerlind's model) or *Utania* (Roux's model) (Hallé et al. 1978, Sugumaran & Wong 2012).

Leaves

Generally, the species known so far have leaf sizes ranging from several cm to over 20 cm long. Within this range, a number of species characteristically have leaves within the upper part of the range (such as *Fagraea auriculata*, *F. imperialis*, *F. ridleyi* King & Gamble). Typically, *Fagraea* leaves are thick-coriaceous.

Leenhouts (1962) recorded that a few species of *Fagraea* have ant-associations, with ants attracted to extra-floral nectaries at the base of the leaves, on the leaf lamina (a drawing of *F. ridleyi* as Fig. 16 in his work illustrates this; see also Fig. 3A) and on the calyces (Fig. 3 C & D). He also stated that the conspicuously developed leaf-base auricles of a few *Fagraea* species housed ants underneath (Fig. 3B). Elias (1983) lists *Fagraea* under the "hollow nectaries" group among the six extra-floral nectary groups he recognised, based on a classification of Angiosperm extra-floral nectaries by Zimmerman (1932).

Petiole-base appendages

The structures at the petiole base in *Fagraea* species have been discussed by Leenhouts (1962), who considered the cup-like or sheathing structure as a kind of "*vaginae connatae*" (fusion of sheaths) between the petioles of a leaf pair, as typically expressed in the New Guinean *Fagraea salticola* Leenh., or the Malayan *F. gardenioides* Ridl. (Fig. 4), where two "axillary scales" meet but are not conspicuously joined along the interpetiolar median. These structures

Fig. 3. *Fagraea* and ants. **A.** Conspicuous pale dot-glands (extra-floral nectaries) in *Fagraea carnosa* leaves (*Sugumaran & Lee* SM 186). **B.** Ant-cartons built around the leaf stalk auricles of *Fagraea auriculata*. **C.** Ants on the calyces of floral buds in *Fagraea auriculata* (*Sugumaran* SM 25). **D.** Ants on calyces of *Fagraea splendens*. (Photo credits: A & C, M. Sugumaran; B, K.M. Wong; D, Ang Wee Foong)

were accepted as stipules by Leenhouts (1962). Struwe et al. (2002) consider stipules to be absent in the Gentianaceae (including *Fagraea*) but that interpetiolar lines or sheaths are conspicuous in many cases. They noted that low, interpetiolar sheaths between leaf bases or around stems can be found in several genera. The term "stipule" was also not favoured by Wong & Sugau (1996), who simply described the petiole bases as basally elaborated with axillary scales. They observed that, among the entire *Fagraea* taxonomic complex, the axillary scales form just above the petiole base and only loosely clasp the node in *Fagraea* s.s. and another taxon later placed in *Limahlania*. In the present account we adopt the term petiolar sheath as Struwe et al. (2002) have used. In contrast, what we now know as *Cyrtophyllum*, *Picrophloeus* and *Utania* have the petiolar sheaths fused at the node into a cup-like ochrea (Sugumaran & Wong 2012).

Fig. 4. Detail of apical shoot portion in *Fagraea gardenioides*, showing petiolar sheaths. (Photo: M. Sugumaran)

Leenhouts (1962) also discussed the taxonomic utility of auricles, which he considered as appendages to the base of the leaf blade, and distinct from the "stipules". He noted how auricles may be only slightly developed in some species, large in others, and reflexed or not. These auricles are very conspicuous in species such as *F. auriculata* and *F. imperialis* (Fig. 3B & 14). Struwe et al. (2002) also noted that among the tribe Potalieae, which includes *Fagraea*, auricles are not common although winged petioles are frequent both in that tribe and among gentians in general.

Inflorescence position and form

The position of the inflorescence is terminal, as in *Limahlania*, *Picrophloeus* and *Utania*. In comparison, *Cyrtophyllum* has axillary inflorescences. *Fagraea* s.s. has an inflorescence without branching (with just a single flower on a very condensed axis, where all branches are entirely suppressed), or which develops distinct primary branches that rebranch 1–3 times (Wong & Sugau 1996).

Leenhouts (1962) also used the character of "warty-lenticellate" inflorescence axes to separate *Fagraea blumei* G.Don in his key to species, but Wong & Sugau (1996) pointed

out that this interpretation included several distinct species throughout Southeast Asia. This character is not used by other workers.

Floral size, involucrate bracts, corolla, and stamens

Fagraea s.s. species have flowers ranging from small (corolla tubes under 2 cm long) to medium, to large (corolla tubes around 15 cm long) (Leenhouts 1962). Very large corollas are not found in *Cyrtophyllum*, *Limahlania*, *Picrophloeus* and *Utania*, where corollas are small to medium (just several cm long)

Leenhouts drew attention to some species where the floral bracts are enlarged, to an extent that they partly covered the calyx. Wong & Sugau (1996) described the structure formed by such enlarged bracts as an involucre. Such involucres are seen, for example, in the Malayan *Fagraea kinghamii* K.M.Wong & M.Sugumaran (Fig. 15) and the Bornean species, *F. involucrata* Merr. and *F. macroscypha* Baker.

Fagraea s.s. and *Limahlania* have stamens that are only slightly to medium-exsert, whereas *Cyrtophyllum* and *Picrophloeus* have long-exsert stamens. *Utania* has stamens that are included to medium-exsert (Sugumaran & Wong 2012). Leenhouts (1962) cites Burck (1892) for the observation that the flowers of species such as *F. auriculata* are protandrous. We have noticed the style and stigma remain fresh for a long time and the stigma probably becomes receptive after the male phase is over, when the filaments and anthers begin to wither (Fig. 5).

Ovary, styles and stigmas

Leenhouts (1962) and Kochummen (1973) described ovaries in *Fagraea* as either two-celled with axile placentation or one-celled with two parietal placentas. However, Leenhouts (1962) had remarked that although he could not conduct a thorough study with herbarium specimens, he had observed inconsistent placentation within a single taxon in one case, although he admitted that the single or few sections made for the few taxa surveyed may not be adequate for understanding this character properly. Wong & Sugau (1996) stated that in their observation of ovaries seen in many species of *Fagraea* across the three sections that now represent the five genera of the *Fagraea* complex, the ovaries were all unilocular with two parietal placentas. We have, however, also noted *Fagraea auriculata* fruits that are 2-celled with axile placentation (Fig. 6D).

Fagraea s.s. and *Limahlania* have styles that are not to slightly exsert, whereas *Cyrtophyllum* and *Picrophloeus* have long-exsert styles. *Utania* has styles not to slightly exsert (Sugumaran & Wong 2012). Sugumaran & Wong (2012) pointed out that the stigma remains knoblike or capitate in *Cyrtophyllum* and *Picrophloeus*, but its basal part develops a rim as it matures, producing an overall peltate form in *Fagraea* s.s., *Limahlania* and *Utania*.

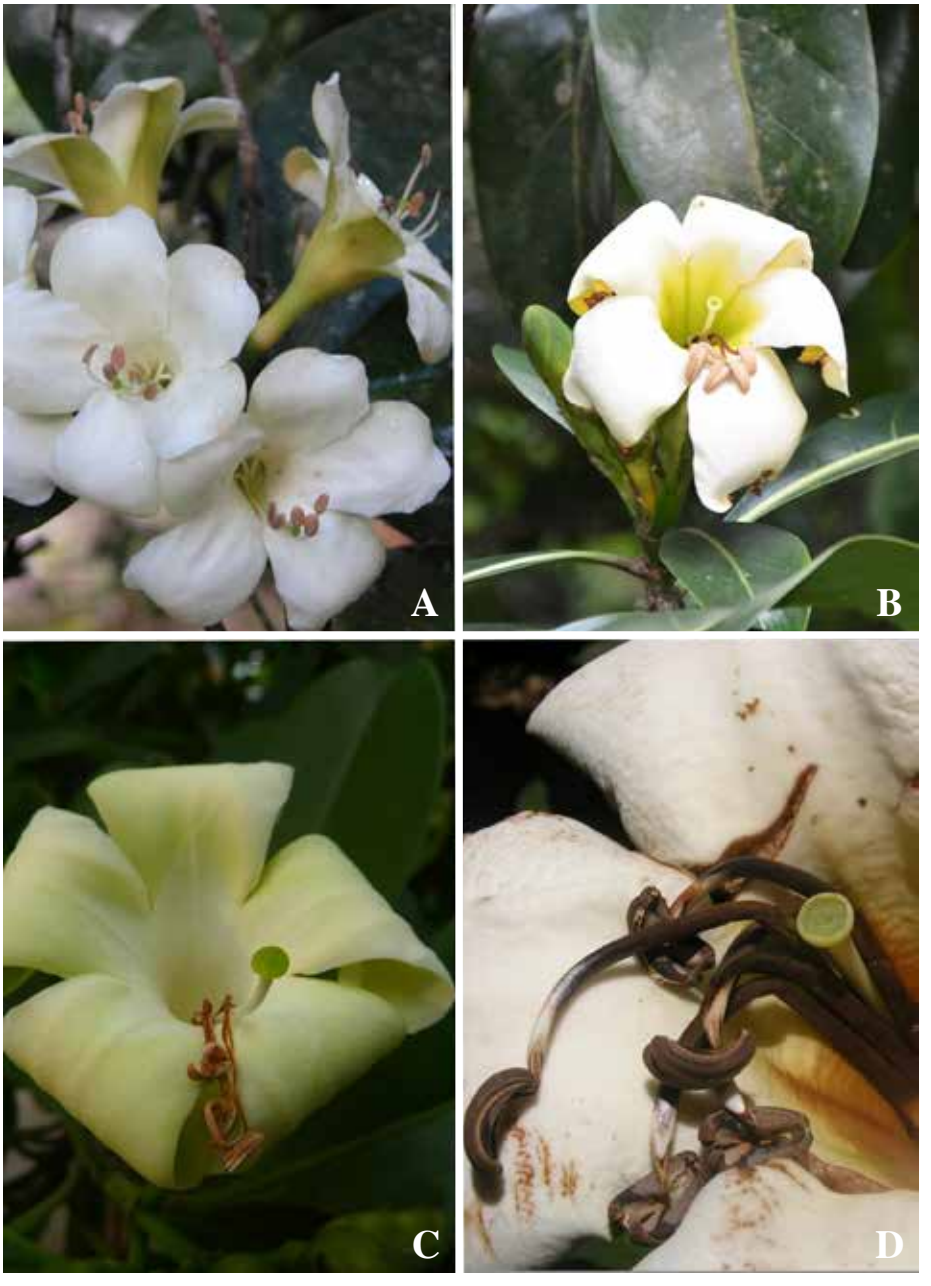

Fig. 5. Protandry in *Fagraea* flowers. **A.** Freshly open blooms of *Fagraea fraserensis* (*Sugumaran & Low* SM163). **B.** *Fagraea auriculata* flower with near-dehicing anthers and young cup-like stigma with ascending rim (*Sugumaran* SM 25). **C.** *Fagraea splendens* flower with senescent stamens and stigma in receptive stage, with mound-like structure. **D.** *Fagraea imperialis* flower with long-senescent stamens and a stigma past its prime, with an incurved rim (*Sugumaran et al*. SM 230). (Photo credits: A, B & D, M. Sugumaran; C, Ang Wee Foong)

Fig. 6. *Fagraea auriculata*. **A.** Flowers. **B.** Fruits. **C.** Creamy yellowish latex oozing from torn fruit calyx. **D.** Axile placentation demonstrated with serial sectioning of a fruit from apex (top right downwards, to base (upper and lower left). (B–D, *Sugumaran* SM 25) (Photo credits: A, Ang Wee Foong; B, C & D, K.M. Wong)

Fruits and seeds

The fruit in *Fagraea* is a berry (Leenhouts 1962). The shape of the fruit varies from globular to narrowly ellipsoid and the only confident records of dehiscence upon fruit maturity appear to be for *Fagraea auriculata* (Ridley 1908; also Leenhouts 1962) and *F. imperialis* (Ridley 1930). Ripe fruit colour ranges from pale greenish-grey to mild yellow to red (Leenhouts 1962, Kochummen 1973). In *Fagraea auriculata*, the placenta of the fruit often remains erect in the centre following dehiscence and is very attractive to birds and ants, in contrast to the unpleasant bitter fruit pericarp (Ridley 1908). Ridley (1930) records bulbuls dispersing this species' seeds. Ridley (1930) noted that seeds of *Fagraea imperialis* were dispersed by birds drawn to eating the sweet orange fruit pulp.

Sugumaran & Wong (2012) noted that fruits in *Fagraea* s.s. are typically large at maturity (when dried, more than 4 cm diameter), and smaller (1.5 cm or less) in the related genera *Cyrtophyllum*, *Limahlania*, *Picrophloeus* and *Utania*. In *Utania*, the fruit epidermis remains intact and does not detach upon drying, compared to the other four genera including *Fagraea* s.s., in which the epidermis separates easily as a tough translucent 'peel' (Sugumaran & Wong 2012).

Leenhouts (1962) merely notes irregularly angular seeds for *Fagraea* as a whole. Wong & Sugau (1996) pointed out two seed forms: angular in *Cyrtophyllum*, *Limahlania*, *Picrophloeus* and *Utania*, and ellipsoid-rounded in *Fagraea* s.s.

TAXONOMIC TREATMENT

Fagraea Thunb.

Kongl. Vetensk. Acad. Handl. 3 (1782) 132, t. 4. TYPE SPECIES: *Fagraea ceilanica* Thunb., Kongl. Vetensk. Acad. Handl. 3 (1782) 132, t. 4. LECTOTYPE (Wong & Sugumaran 2012a): *Thunberg s.n.*, "e Ceilona" (UPS: no. 004308; isolecto S: no. S07-8227, isolecto SBT: barcode SBT12824, isolecto UPS: no. 004309).

Epiphytes, hemi-epiphytes, scramblers and small trees. ***Trunk*** with episodic growth; bark smooth to lightly scaly-dippled. Vegetative shoot tips with creamy yellowish resin. ***Leaves***: arrangement on branches decussate; leaf margin entire; petiolar sheaths of a leaf pair not to slightly fused at the edges, each with a scale-like ligular structure in the axillary position. ***Inflorescences*** terminal; of a solitary flower or a many-flowered and branched cyme with basal branches nearly as long as, or longer than, the rachis. ***Flowers*** small to large (up to 50 mm wide at the mouth); stamens slightly to medium exsert; ovary unilocular with two parietal placentas or bilocular with axile placentas; style not to slightly exsert; mature stigma peltate. ***Fruits*** small to big (up to about 40 mm in diameter); colour at maturity often creamy

pale grey-green ranging to red; with copious creamy pale yellowish latex in fruit epidermis and fruit wall; epidermis separating as a thin translucent film from pericarp (fruit surface appear crinkled on herbarium specimens). ***Seeds*** ellipsoid-rounded.

KEY TO *FAGRAEA* SPECIES AND VARIETIES IN THE MALAY PENINSULA

(Note: Although only flower buds and fruits (not corollas) are known for *Fagraea cameronensis*, it is assumed to have infundibular corollas, as do all other species in the genus in the Malay Peninsula that, like it, also have smaller flowers in branched cymes.)

1a. Leaf base attenuating at the base and forming rounded auricles just above the petiolar sheath. ..... **6. *F. fastigiata***

1b. Leaf base not decurrent to the petiole base and without auricles, or, if decurrent and auricles present, the auricles formed at the petiole base below the petiolar sheath,

2a. Petiole base with narrow, rimlike to broad, rounded, auricular lateral extensions,

3a. Corolla very big, the tube 9.5–17 cm long, the lobes 6.5–7.5(–8) cm long. Leaves located several nodes below inflorescences often very big, to 25–36 cm long. Branch internodes each developing a pair of keels 2–5 mm broad along the inter-petiolar region. ... . **9. *F. imperialis***

3b. Corollas smaller, the tube shorter than 9 cm, the lobes less than 6 cm long. Leaves located several nodes below inflorescences usually smaller, shorter than 25 cm (only exceptionally to 31 cm long). Branch internodes each developing only 2–several ridges at most 1 mm high along the inter-petiolar region, not plate-like keels,

4a. Flowers 2-several in cymes. Floral bracts small, acute, less than 14 mm long and located clearly below the calyx. Petiole base auricles typically large and rounded, (3–)8–15(–20) mm broad. Leaves located several nodes below inflorescences 16–22(–31) cm long. ..... **1. *F. auriculata***

4b. Flowers solitary. Floral bracts small to large, rounded, (7–)15–30(–35) mm long, often forming an involucre-like arrangement around the calyx together with a pair of expanded inflorescence bracts (when these are present). Petiole base auricles often smaller, varying from narrow lateral extensions 1–2 mm broad to lobelike structures 2–7 mm broad. Leaves located several nodes below inflorescences 11–18(–22) cm long. .. .. **10. *F. kinghamii***

2b. Petiole base without auricular structures,

5a. Leaf secondary veins distinct and prominent on the lower surface upon drying,

6a. Flower calyx larger, the lobes 13–15 mm long. Cymes little-branched, with 1–2 pairs of primary branches, the basal pair just 10–30 mm long, these typically rebranching just once (exceptionally to 2 orders). Inflorescence rachis thicker, 5–8 mm thick. Leaves very thick-coriaceous, with rounded apices. ..... **16. *F. ridleyi***

6b. Flower calyx smaller, the lobes only 5–10 mm long. Cymes more branched, with 2–3 pairs of primary branches, the basal pair (10–)28–50(–60) mm long, these rebranching 1–2(–3) orders. Inflorescence rachis more slender, 2.5–3(–4) mm thick. Leaves thin-coriaceous, with short-cuspidate apices. ..... **15. *F. renae***

5b. Leaf secondary veins indistinct or, if faintly visible, immersed in the lamina and not prominent upon drying,

7a. Calyx lobes with auriculate bases. ..... **7. *F. fraserensis***

7b. Calyx lobes without auriculate bases,

8a. Leaf surface drying parchment-like, with a smooth surface, and greenish or grayish. Floral bracts inconspicuous, present only as very tiny structures below the calyx base or on the pedicel, measuring less than 0.5 mm long. ..... **14. *F. oblonga***

8b. Leaf surface drying shagreen or grainy, and light greenish brown to dark brown. Floral bracts conspicuously larger and overlapping the calyx base, or small and acute and located below the calyx base, measuring 1 mm or longer in either case,

9a. Flower calyx longer, (12–)15 mm long or more,

10a. Corolla tube essentially cylindrical or slender trumpet-shaped, with only a very gradual increase in width from the base to mouth,

11a. Flowers solitary. Corolla tube 10–14 cm long. ..... **3. *F. carnosa***

11b. Flowers in a 1–several-flowered cyme. Corolla tube 4–5.3 cm long. .... **8. *F. gardenioides***

10b. Corolla tube infundibular with a narrow tubular basal part and widely flared upper portion,

12a. Corolla lobes larger, 35–40 mm long × 25–30 mm wide. Corolla mouth wider, 30–32 mm wide. (Occurring only in limestone outcrops and their vicinity.) (**5. *F. curtisii***)

13a. Floral bracts smaller, 3–5 mm long. (Northwest and west-coast Peninsular Malaysian limestones.) ..... *F. curtisii* var. *curtisii*

13b. Floral bracts larger, 7–18 mm long. (Pahang and east-coast Peninsular Malaysian limestones.) ..... *F. curtisii* var. *calcarea*

12b. Corolla lobes smaller, 15–27 mm long × 9–20 mm wide. Corolla mouth narrower, 16–18 mm wide. (Occurring in lowlands and lower montane forests.)

14a. Flowers solitary. Floral bracts bigger, 17–18 mm long, rounded and overlapping the calyx base. ..... **12. *F. latibracteata***

14b. Flowers in a cyme. Floral bracts smaller, less than 7 mm long, acute, and located below the calyx base,

15a. Calyx smaller, 17–18 mm long and 5–6 mm wide. Corolla lobes smaller, 15–16 mm long and 9–10 mm wide. Corolla tube shorter, 20 mm long or less. ..... **11. *F. larutensis***

15b. Calyx bigger, 20–26 mm long and 9–10 mm wide. Corolla lobes bigger, 20–27 mm long and 15–20 mm wide. Corolla tube longer, 26–30 mm long. .... **4. *F. crassifolia***

9b. Flower calyx shorter, 10 mm long or less,

16a. Inflorescence branches indistinct or extremely short, not longer that 3–4 mm, with few to many flowers crowded together,

17a. Corolla tube slender, essentially cylindrical, not exceeding 6 mm across at the mouth. Leaves ovate. ..... **18. *F. tubulosa***

17b. Corolla tube infundibular, 10–15 mm across at the mouth. Leaves elliptic to obovate. ..... **17. *F. splendens***

16b. Inflorescence branches distinct, the basal branches longer, more than 11 mm long and often much longer, the flowers not tightly bunched together,

18a. Fruits broadly ovoid or subglobbose, 13–15 mm in diameter. Mature fruit calyx recurved (folding backwards) away from the fruit base in dried material. Basal inflorescence branch pairs not rebranching. (Coastal areas.) .... **13. *F. littoralis***

18b. Fruits narrowly ellipsoid, not more than 8 mm across. Mature fruit calyx tightly clasping the fruit base in dried material. Basal inflorescence branch pairs rebranching once. (Highlands.) ..... **2. *F. cameronensis***

1. *Fagraea auriculata* Jack

Mal. Misc. 2, no. 7 (1822) 82; Wallich ex Roxburgh, Fl. Ind. 2 (1824) 34; Craib & Kerr, Fl. Siam. Enum. 3 (1) (1951) 54; Griffin & Parnell, Fl. Thailand 6 (3) (1997) 204. NEOTYPE (Wong & Sugau, Sandakania 8 (1996) 51): *Wray 2913*, Perak (L).

Fagraea auriculata auct. pro parte, excl. *F. imperialis* Miquel in syn.: Clarke in Hooker f., Fl. Brit. Ind. 4 (1885) 83; King & Gamble, J. As. Soc. Beng. 74 (2) (1908) 605; Ridley, Fl. Malay. Pen. 2 (1923) 416.

Fagraea auriculata sensu Leenhouts, Fl. Males. I, 6 (2) (1962) 326 pro parte, excl. *F. imperialis* Miq. in syn., ssp. *borneensis* (= *F. borneensis* Scheffer & *F. euneura* Scheffer) & ssp. *parviflora* (= *F. euneura* Scheffer & *F. epiphytica* Elmer).

Fagraea auriculata sensu Kochummen, Tree Fl. Malaya 2 (1973) 270 pro parte, tantum speciminia altitudine infra 1000 m peninsulae Malayensis neque speciminia montium.

Fagraea auriculata sensu Wong & Sugau, Sandakania 8 (1996) 51 pro parte, excl. Fig. 16, *Symington KEP 36092*, *Whitmore FRI 12214*, *15551* (= *F. kinghamii* K.M.Wong & M.Sugumaran).

(Fig. 2A–C, 3B, 5B, 6)

Small tree to large terrestrial shrub or hemi-epiphyte, 5–18 m tall trees or 5–20 m tall on trees as hemi-epiphytes; trunk/stems to c. 10 cm diameter; bark smooth, grey-brown to reddish brown, smooth becoming scaly-dippled; branch internodes often with 2-several low ridges 1 mm broad along the inter-petiolar region. **Leaves** elliptic to oblanceolate; (12–)18–27(–31) cm long, (4.5–)5.5–9(–11) cm wide; *base* narrowly decurrent with 1–2 mm broad wings towards the petiole base; *apex* rounded to shortly pointed; *margin* entire, recurved in dried material; thick-coriaceous; upper and lower *surfaces* glabrous, lower surface relatively smooth; *midrib* prominent above, more prominent below with a slight median keel upon drying; *secondary veins* 4–6(–7) pairs, faint and immersed in the lamina on both sides; *tertiary and higher-order veins* faint; petioles 15–25(–35) mm long, 3–5 mm thick, *petiolar sheaths* not fused along the interpetiolar median, each developing a scale-like ligule (1.5–)2–3 mm high adaxially; *auricles* developing below the petiole base, distinct from the lamina base, typically forming broad, rounded, reflexed lobes (3–)8–15(–20) mm broad (very rarely raised lateral rims just 1–2 mm high). **Inflorescence** terminal, a 2- to few-flowered cyme, the whole about (1.5–)2–3(–4) cm long; *peduncle* indistinct; inflorescence *rachis* (1.5–)2–3(–4) cm long, 5–7 mm diameter, with 1(–2) pairs of primary branches; basal primary *branch pairs* c. 12–22 mm long, 5–8 mm diameter and not rebranched. **Flowers** fragrant, bisexual; *pedicels* 3–10(–20) mm long, 8–10 mm diameter; *floral bracts* small, acute, 8–10(–13) mm long, located below the calyx; *calyx* 27–33 mm long (from the base to the lobe apices), glabrous, not lenticellate, *calyx cup* 15–18 mm diameter, *calyx lobes* 5, broad-elliptic to rounded, 20–27 mm long, 12–17 mm wide, margins glabrous,

base not auriculate; *corolla* broadly infundibular (the mouth more than 3–4 times the width of the lower narrowed part of the tube); cream to white; *lower subcylindrical part of the corolla tube* 30–35(–45) mm long, 10–12(–17) mm wide basally, *upper flared part* of the tube slightly inflated, 30–37 mm long, 40–56(–60) mm wide at the top; *corolla lobes* 5, broad-obovate to suborbicular, 36–42 mm long, 23–31 mm wide, overlapping to the right; *stamens* 5, inserted at the upper portion of the lower narrowed tubular part of the corolla tube or the lowermost portion of the upper flared part of the corolla tube; *filaments* 45–60 mm long, protruding to 15–23 mm from the corolla mouth; *anthers* versatile, hastate, 13–15 mm long, 6–8 mm wide, each anther sac somewhat ellipsoid; *style* 70–90 mm long, protruding to 8–10 mm from the corolla mouth in the open flower; *stigma* basically shallowly 2-lobed, the lobes broadly suborbicular and recurving when receptive, the whole 3–4 mm across. **Infructescence** peduncle indistinct. **Fruit** narrowly ellipsoid, *apex* conspicuously attenuate; smooth, the epidermis conspicuously wrinkling and separating upon drying; when mature to (65–)80–101 mm long, 25–35(–40) mm diameter; the base tightly clasped by the erect calyx lobes. **Seeds** numerous; ellipsoid to subovoid; 2–2.5 mm long, c. 1.5 mm wide; testa surface areolate.

DISTRIBUTION. Borneo, Java, Sumatra, Malay Peninsula, Indo-China.

HABITAT. Coastal sites, including behind sea beaches, rocky outcrops, swamp forests; also limestone and quartz outcrops in coastal lowlands.

SPECIMENS EXAMINED—PENINSULAR MALAYSIA. Johor. Batu Pahat, Patani, *Ridley s.n.*, FR, no precise date, 1900 (SING); Kota Tinggi, Nam Heng Estate, *Teruya 229*, FL (SING); Pontian, Pengkalan Raja, *Ngadiman SFN 36752*, FL, 3 Jul 1939 (SING); Sedili Kechil, *Corner s.n.*, FB, 22 Jun 1934 (SING); Sungei Tebrau, *Ridley 11639*, FR, no precise date, 1903 (SING). **Melaka.** *Alvins 2053*, FL, no date (SING), *Griffith s.n.*, FL, 1845 (BR), *Maingay 1025*, FL, no date (L); Alor Gajah, *Bland s.n.*, FR, 24 Aug 1902 (SING); Merlimau, *Derry 1218*, FL, Jul 1892 (SING). **Pahang.** Bukit Nipah, cliff, *Samsuri SA 915*, FR, 24 Feb 1974 (SING); Kuantan, Baloh F.R. Compt. 1, sandy, *Rahim KEP 97950*, FB, 30 Jul 1966 (KEP, SING), FB, FL (SING); Menchali Forest Reserve, *Sugumaran SM 25*, FB, FR, 19 Apr 2004 (KLU), *Sugumaran SM 217*, leafy twig only, 4 Jun 2008 (KLU); Nenasi, Merchong, *Sugumaran SM 13*, leafy twig only, 17 Apr 2004 (KLU); Pekan, *Ahmad AS 119*, FR, 9 Mar 1973 (SING), *Ridley 2170*, FB, FL, no precise date, 1891 (SING); Pulau Tioman, west coast near Kampong Paya, rocky shore, *Ratnasabapathy s.n.*, FB, 26 May 1974 (KLU); Telok Kuantan, *Henderson s.n.*, FB, 19 Aug 1929 (SING). **Perak.** Dindings, Bruas, *Ridley 7998*, FB, FL, Mar 1896 (SING); Pangkor, *Foxworthy CF 1726*, FR, 30 Mar 1918 (KEP, SING); Sungai Krian Estate, sea level, *Spare SFN 36007*, FB, FL, 10 Jul 1938 (SING). **Selangor.** Bukit Takun, *Boey 421*, leafy twig only, 19 Sep 1971 (KLU), Bukit Takun, *Stone 5915*, leafy twig only, 11 Jul 1965 (KLU); Klang Gates ridge, *Boey 398*, leafy twig only, 12 Sep 1971 (KLU), *Carrick 659*, leafy twig only, 19 Mar 1960 (KLU), *Mahmud s.n.*, FR, Jul 1970 (KLU), *Sugumaran SM 28*, leafy twig only, 20 Jan 2005 (KLU), 800 [244 m]

alt, *Stone 14110*, leafy twig only, 22 Jul 1979 (KLU), 1000 ft [305 m] alt, *Henderson SFN 10490*, FB, FL, 6 Aug 1923 (SING). **Terengganu.** Dungun, *Soepadmo KLU 9103*, FR, 30 Apr 1968 (KLU); Gong Balai near beach, *Shah & Sidek MS 4045*, FR, 24 Nov 1978 (SING); Jambu Bongkok, *Johnson AJ 4036*, FR, 3 Mar 1967 (KLU). **PENINSULAR THAILAND. Nakawn Sritamarat.** Songkla Kau Keo, *Kerr 15962*, FL, 1 Jul 1928 (BK). **Phuket.** Krabi, Tambon Kao Panom, *Kerr 18837*, FR, 3 Apr 1930 (BK); Ranawng, Kaw Chang, *Kerr 16603*, FL, 11 Jan 1929 (BK). **SINGAPORE.** no locality, *Hullett 164*, FR, Jul 1885 (SING); *Wallich s.n.*, 1822, FL (calyx fragment) (BM: barcode BM001014285), Pulau Pawai, Tanjong Berhala Kuda, *Sinclair SFN 38900*, leafy branch only, 14 Mar 1950 (SING), Pulau Pawai, *Sinclair s.n.*, leafy branch only, 26 Mar 1951 (L); Pulau Ubin, *Ridley 9582*, FB, FL, no precise date, 1898 (SING), near Outward Bound School, *Lim SING 2011-285*, FL, 27 Jul 2011 (SING). **SUMATRA** (INDONESIA). Riouw, Indragiri, Bovenlanden, Kuala Belilas, swampy, *Buwalda 6774*, FB, 29 Apr 1939 (SING). **THAILAND.** Lower Siam, Pulau Song Pinang, *Haniff & Nur s.n.*, FR, 12 Dec 1918 (SING).

Jack (1822) had intended a lowland, predominantly coastal, taxon when he mentioned that his species was collected from Singapore and the west coast of Sumatra at Tapanuly. As there was no type provided (Merrill 1952), a neotype has been designated by Wong & Sugau (1996) which conforms to this. When the Peninsular Malaysian material grouped by both Leenhouts (1962) and Wong & Sugau (1996) under *F. auriculata* was sorted for the present study, three taxa were distinct.

The first, *Fagraea auriculata* Jack, represented by the neotype, is a coastal species with conspicuous leaf-stalk auricles and medium-sized flowers (corolla tube 30–35(–45) mm long) in cymose inflorescences, with distinct, slender pedicels (8–10 mm thick) and infundibular corolla. Floral bracts are small (8–10(–13) mm long), acute and found on the pedicels. This species also occurs at several other sites, such as limestone hills (e.g., Bukit Takun, Selangor) and quartz ridges (e.g., the Klang Gates ridge outside Kuala Lumpur).

The second species is *Fagraea imperialis*, also with conspicuous leaf-stalk auricles but huge, highly distinctive flowers (corolla tube (40–)90–100 mm long), either solitary or in small numbers in cymes. The corollas are infundibular with overall much larger dimensions than in *F. auriculata* and with a thicker tube. The floral bracts are larger (typically 20–30 mm long) and rounded compared to those of *Fagraea auriculata*. This species is found in (and typified by material from) Sumatra but is now adequately represented by good material recently gathered from Perak, Peninsular Malaysia (*Sugumaran SM 238*) (see under that species), allowing diagnosis of several other Peninsular Malaysian collections from both coastal and inland sites. A further difference between *Fagraea imperialis* and *F. auriculata* is the development of strong, sharp keels along the inter-petiolar median of internodes in the former, whereas in *F. auriculata* the internodes are either smooth or at most provided with low ridges without any plate-like keels developing.

The third component of the Peninsular Malayan material (here named *Fagraea kinghamii*) is distinctive by the typically solitary flowers with much shorter pedicels (indistinct or to only 10 mm long) and a montane provenance (so far documented only from the Peninsular Malaysian Main Range). The leaf-stalk auricles are poorly developed, ranging from narrow rim-like structures to distinct auricles just several mm wide, not as pronounced as those of *Fagraea auriculata* or *F. imperialis*. The corollas are medium-sized (corolla tube 22–30 mm long), infundibular and similar to those in *Fagraea auriculata*. The floral bracts are large (typically 30 mm long), rounded, and can approach the size of calyx lobes. This species is illustrated in Wong & Sugau (1996) as their Fig. 16, which they placed under *Fagraea auriculata*.

2. *Fagraea cameronensis* K.M.Wong & M.Sugumaran, **sp. nov.**

Fagraeae rarissimae similis sed cymis pauci ramosis, bracteis floralibus inconspicuis et floribus minoribus differt.

TYPE: *Burkill HMB 818*, Pahang, Cameron Highlands, Sungai Uruil, below Golf Course, 4800 ft [1463 m], 4 Sep 1956 (holo SING).

Fagraea ceilanica auct. non Thunberg (1782): Leenhouts, Fl. Males. I, 6 (2) (1962) 315 pro parte, quoad *Burkill HMB 818*.

(Fig. 7)

Small tree or hemi-epiphyte, usually to 5 m tall or to 17 m high or more on trees; trunk/stems to c. 10 cm diameter; bark smooth, grey-brown. **Leaves** elliptic to obovate; (6–)8–11(–13.5) cm long, (2–)3–4(–4.3) cm wide; *base* cuneate, not decurrent; *apex* short blunt cuspidate; *margin* entire, plane in dried material; thin-coriaceous; upper and lower *surfaces* glabrous, lower surface relatively smooth; *midrib* flat to sunken above, prominent below; *secondary veins* 6–9 pairs if visible, otherwise obscure on both sides; *tertiary and higher-order veins* obscure; petioles 8–10 mm long, 1.5–2.5 mm thick, *petiolar sheaths* not fused along the interpetiolar median, each developing a scale-like ligule 0.5–1 mm high adaxially; petiole base without *auricles*. **Inflorescence** terminal, a 2- to few-flowered branched cyme, the whole about 2.1–3.3 cm long; *peduncle* indistinct; inflorescence *rachis* 21–33 mm long, 2–2.5 mm diameter, with 1–2 pairs of primary branches; basal primary *branch pairs* 18–26 mm long, 1.5–2 mm diameter and rebranched to 1 order, more distal branch pairs not so. **Flowers** bisexual; *pedicels* 2–3 mm long, 2–3 mm diameter; *floral bracts* small, acute, 1–2 mm long, located below the calyx; *calyx* 8–10 mm long (from the base to the lobe apices), glabrous, not to sometimes lenticellate, *calyx cup* 3–4 mm diameter, *calyx lobes* 5, broad-elliptic to rounded, 3–4 mm long, 4–5 mm wide, margins glabrous, base not auriculate; *corolla* not known; *stamens* not known; *style* not known. **Infructescence** peduncle indistinct. **Fruit** narrowly ellipsoid, *apex* conspicuously attenuate; smooth, the epidermis conspicuously wrinkling and separating upon drying; when mature to 12–20 mm long, 5–8 mm diameter;

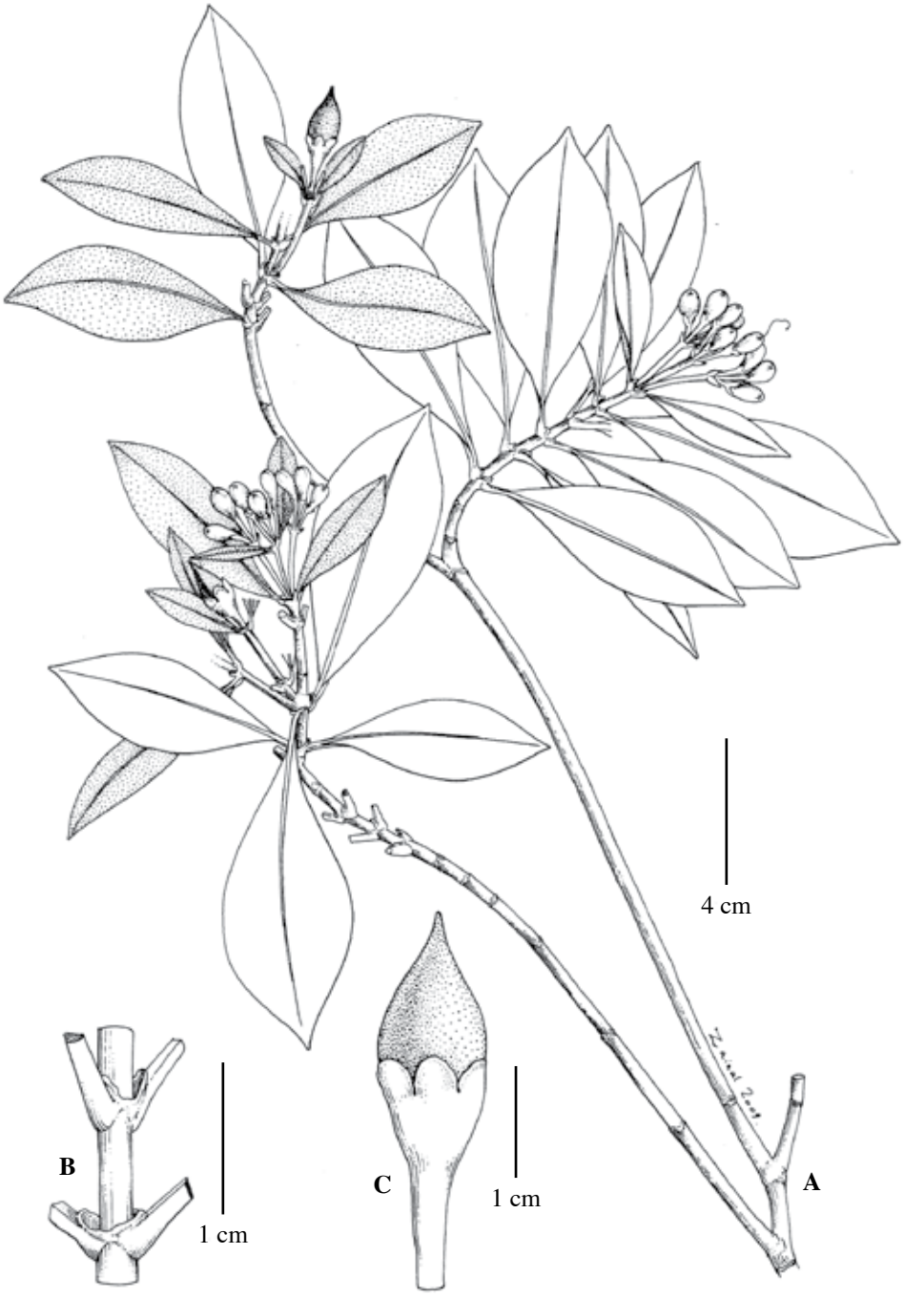

Fig. 7. *Fagraea cameronensis*. **A**. Leafy branch with buds and fruits. **B**. A portion of stem featuring leaf stalk bases with scale-like ligules on adaxial side. **C**. Fruit. All from *Burkill HMB 818* (holotype, SING). (Drawing by Zainal Mustafa)

the base tightly clasped by the calyx lobes. **Seeds** numerous; ellipsoid to subovoid; 1.5–2 mm long, 1–1.5 mm wide; testa surface areolate.

DISTRIBUTION. Known only from Peninsular Malaysia (Cameron Highlands).

HABITAT. Lower montane forest.

SPECIMENS EXAMINED—PENINSULAR MALAYSIA. Pahang. Cameron Highlands, Sungai Uruil, below Golf Course, 4800 ft [1463 m] alt, *Burkill HMB 818*, FB, FR, 4 Sep 1956 (SING); Cameron Highlands, trail to G. Berembun, 5500 ft [1676 m] alt, *Ng FRI 5930*, FR, 1 Mar 1968 (KEP, SING); Cameron Highlands, Gunung Brinchang, *Low LYW 138*, leafy twig only, 29 Jul 2007 (KLU).

This species is similar to *Fagraea rarissima* K.M.Wong & Sugau and *F. longipetiolata* K.M.Wong & Sugau from Borneo in having relatively small flowers 1-several together in little-branched cymes (without floral-bract involucres), indistinct leaf veins and non-auriculate leaf-stalk bases. It can be distinguished from these species even in the absence of corollas. *Fagraea cameronensis* has smaller flower calyx lobes, 3–4 mm long (4–5 mm long in *F. rarissima*, 6–8 mm long in *F. longipetiolata*). The central inflorescence axis in *Fagraea cameronensis* is 12–24 mm long, whereas in *F. rarissima* it is only up to 10 mm long. The leaf margins are not recurved when dry (unlike in *Fagraea rarissima*), and the leaf apices are acute to cuspidate (unlike in *F. longipetiolata*, where they are consistently caudate).

ETYMOLOGY. Named after the Cameron Highlands, Peninsular Malaysia, where this species occurs.

3. *Fagraea carnosa* Jack

Mal. Misc. 2, no. 7 (1822) 81; Cammerloher, Bull. Jard. Bot. Btzg. III, 5 (1923) 323. NEOTYPE (here chosen): *Teysmann HB 998*, Sumatra, Sibogo (U: barcode U0003706 & acc. no. 38976; isoneotype L: barcode L0004965 & acc. no. 908127-712).

Fagraea flavidula Ridl., Fl. Malay. Pen. 5 (1925) 322. TYPE: *Henderson SFN 11673*, Pahang, Cameron Highlands (holo K: barcode K000883556; iso K: barcode K000883557, L, SING).

Fagraea monantha Miq., Fl. Ind. Bat. 2 (1857) 373. TYPE: *Teysmann HB 998*, Sumatra, Sibogo (holo U: barcode U0003706 & acc. no. 38976; iso L: barcode L0004965 & acc. no. 908127-712).

Fagraea uniflora Merr., J. Str. Br. R. As. Soc. 77 (1917) 235. TYPE: *Foxworthy 114*, Sarawak, Santubong (iso L).

Fagraea rotundifolia Ridl., J. Str. Br. R. As. Soc. 50 (1908) 117. TYPE: *Rostado s.n.*, Tringganu, Bundi (holo K).

Fagraea carnosa sensu Clarke in Hooker f., Fl. Brit. Ind. 4 (1885) 82 pro parte, excl. speciminia origine 'Tenasserim'.

Fagraea carnosa auct. pro parte, excl. speciminia origine 'Burma': King & Gamble, J. As. Soc. Beng. 74 (2) (1908) 604; Ridley, Fl. Malay. Pen. 2 (1923) 416; Leenhouts, Fl. Males. I, 6 (2) (1962) 331; Kochummen, Tree Fl. Malaya 2 (1973) 271.

(Fig. 8)

Scrambler or hemi-epiphyte, usually to 2–3 m high or more on trees; stems to c. 5 cm diameter; bark smooth, grey-brown. **Leaves** elliptic-obovate to orbicular; (6–)8–13(–16.5) cm long, (2.8–)4–6(–7) cm wide; *base* cuneate to rounded, not decurrent; *apex* short cuspidate to rounded; *margin* entire, recurved in dried material; thick-coriaceous; upper and lower *surfaces* glabrous, lower surface relatively smooth; *midrib* flat above, prominent below; *secondary veins* obscure on both sides; *tertiary and higher-order veins* obscure; petioles (7–)15–22 mm long, 2–4 mm thick, *petiolar sheaths* not fused along the interpetiolar median, each developing a scale-like ligule 1–3 mm high adaxially; petiole base without *auricles*. **Inflorescence** terminal, consisting of a solitary flower; *peduncle* distinct, (3–)4–6 mm long, 4–6 mm diameter; the rachis internode between peduncle and pedicel inconspicuous. **Flowers** very fragrant; bisexual; *pedicels* 3–5 mm long, 4–6(–7) mm diameter; *floral bracts* small, acute, 3–5 mm long, located below the calyx; *calyx* 15–21(–34) mm long (from the base to the lobe apices), glabrous, not to sometimes lenticellate, *calyx cup* 7–10 mm diameter, *calyx lobes* 5, broad-elliptic to rounded, 10–12(–16) mm long, 7–10 mm wide, margins glabrous, not auriculate; *corolla* subsalverform (with an elongate narrow lower tubular part and a much shorter upper flared part, spreading to erect lobes); cream to white; *lower subcylindrical part of the corolla tube* 10–13 cm long, 8–10 mm wide basally, *upper flared part* of the tube (when distinct) slightly inflated, 6–10 mm long, 10–15 mm wide at the top; *corolla lobes* 5, broad-obovate to suborbicular, 22–35(–46) mm long, 10–18 mm wide, overlapping to the right; *stamens* 5, inserted at the upper portion of the lower narrowed tubular part of the corolla tube or the lowermost portion of the upper flared part of the corolla tube; *filaments* 12–15 mm long, protruding to c. 5 mm from the corolla mouth; *anthers* versatile, hastate, 5–6 mm long, 2–3 mm wide, each anther sac somewhat ellipsoid; *style* 12.3–12.6 cm long, not or protruding to 10–17 mm from the corolla mouth in the open flower; *stigma* basically shallowly 2-lobed, the lobes broadly suborbicular and recurving when receptive and the whole sometimes resembling a subpeltate structure 3–4 mm across. **Infructescence** *peduncle* distinct, 5–7 mm long, 5–6 mm thick. **Fruit** broadly ovoid to ellipsoid, *apex* conspicuously attenuate; smooth, the epidermis conspicuously wrinkling and separating upon drying; when mature to 35–50(–57) mm long, 20–28 mm diameter; the base tightly clasped by the calyx lobes. **Seeds** numerous; ellipsoid to subovoid; 2–2.5 mm long, 1.5–2 mm wide; testa surface areolate.

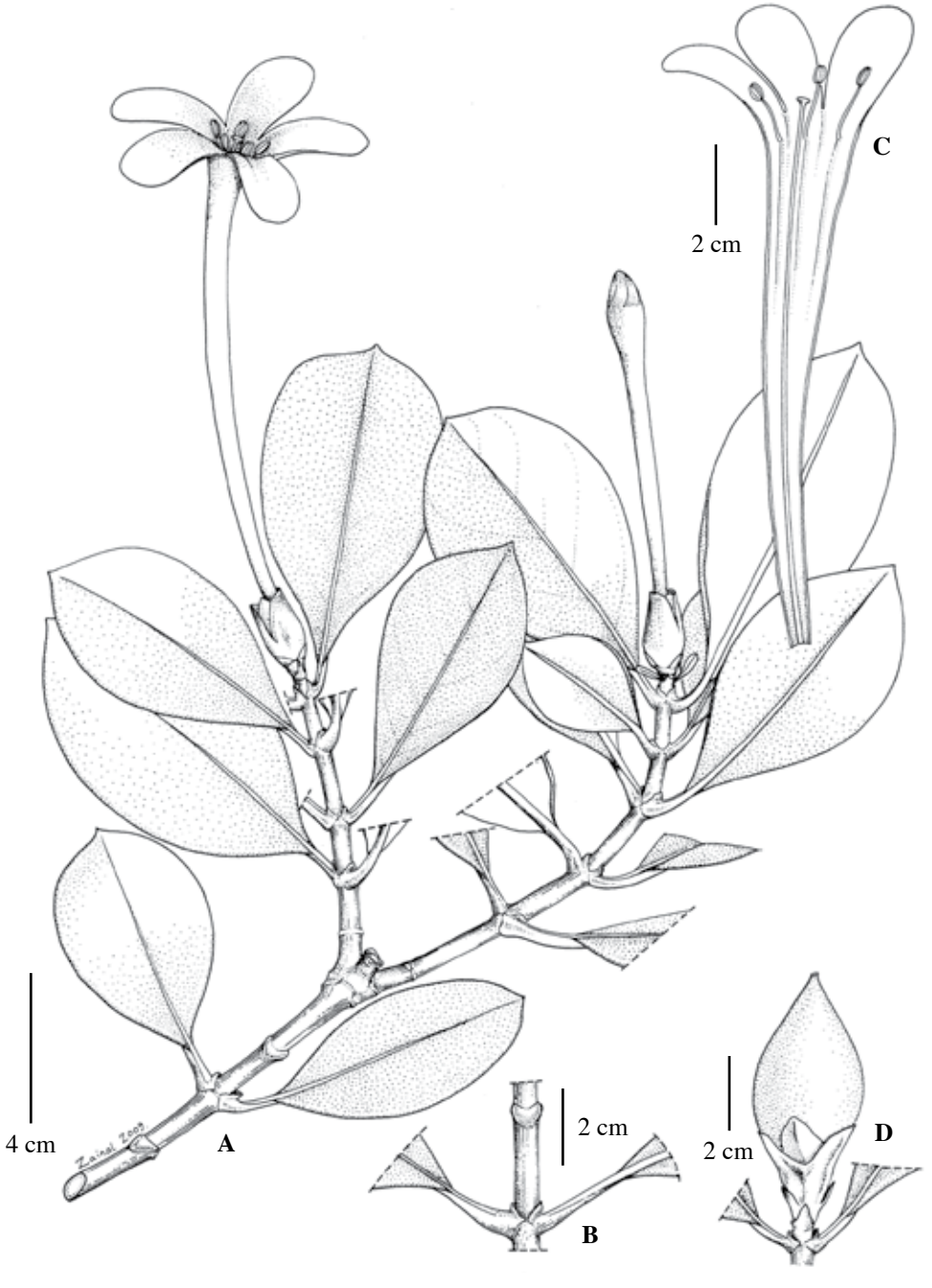

Fig. 8. *Fagraea carnosa*. **A**. Leafy branch with flowers. **B**. Portion of stem with scale-like ligules on the adaxial side of the petiole bases. **C**. Longitudinal section of corolla showing the attachment of stamens. **D**. Fruit. A & B from *Chin 367* (KLU), C from *Yao FRI 53078* (KEP) and D from *Chin 566* (KLU). (Drawing by Zainal Mustafa)

DISTRIBUTION. Borneo (Sarawak), Malay Peninsula, Sumatra. There seems to be no clear record of this species in Thailand (Griffin & Parnell 1997).

HABITAT. Coastal islands, lowland rain forest to lower montane forest; in the lowlands also found on some limestone hills.

SPECIMENS EXAMINED—PENINSULAR MALAYSIA. Kedah. Gunong Bintang F.R., 1000 ft [304 m] alt, *Sidek S 282*, FR, 8 Apr 1968 (SING). **Kelantan.** Gunung Stong, eastern face, granite cliff, 1000 ft alt [304 m] alt, *Whitmore FRI 12518*, FB, FL, 15 Aug 1969 (KEP, SING). **Pahang.** Bukit Serdam, 1300 ft [396 m] alt, *Henderson s.n.*, FL, FR, 6 Oct 1931 (SING); Cameron Highlands, 4800 ft [1463 m] alt, *Henderson SFN 11673*, FB, FL, FR, 16 Jan 1924 (K, SING); Cameron Highlands, Tanah Rata, 5000 ft [1524 m] alt, *Henderson SFN 17729*, FR, 17 Nov 1925 (SING); Fraser's Hill, 4000 ft [1219 m] alt, *Nur SFN 11288*, FR, 7 Sep 1923 (SING); Fraser's Hill, 'dekat tepi Padang Gof', *Medan KEP 45409*, FL, FR, 9 Nov 1937 (KEP); Pahang, Lesong F.R., *Chan FRI 25183*, FR, 8 Jun 1979 (KEP); Raub, Gua Kechil limestone hill, 350 m alt, *Chin 1151*, leafy branch only, 21 Jun 1971 (KLU). **Penang.** Pulau Boetong, *Curtis 3394*, FL, no date (SING). **Perak.** Dindings, Lumut, *Ridley 10297*, FL 1899 (SING); Pangkor Island, *Curtis s.n.*, FL, Feb 1900 (SING), north coast, rocky headland, *Whitmore FRI 3009*, 17 Feb 1967, FR (KEP), FB (SING). **Selangor.** Batu Caves, *Wyatt-Smith KEP 85211*, FR, 29 Dec 1957 (KEP), 800 ft [244 m] alt, *Ng FRI 1627*, leafy branch only, 14 May 1966 (KEP, SING); Bukit Takun, *Allen s.n.*, FL, 27 Jan 1957 (SING), *Boey 422*, leafy branch only, 19 Sep 1971 (KLU), *Sinclair s.n.*, FL, 27 Jan 1957 (SING), *Sow & Tachun KEP 35092*, FB, FL, 17 Sep 1940 (KEP), *Sugumaran & Lee SM 186*, leafy branch only, 20 Mar 2008 (KLU), 500 m alt, *Chin 566*, FR, 31 Dec 1970 (KLU), near summit, 1000 ft [304 m] alt, *Stone 11079*, FR, 4 Mar 1973 (KLU), summit, *Chin 367*, FB, FL, 27 Sep 1970 (KLU). **Terengganu.** Bundi, *Rostado s.n.*, FL, Feb 1904 (K); Dungun, Tanjong Gadong Forest Reserve, rocky seashore, *Yao FRI 53078*, FL, FR, 26 Sep 2006 (KEP, KLU, SAN, SAR). **SUMATRA** (INDONESIA). Sibogo, *Teysmann HB 998*, no precise date FB (L), FB (U).

In his description, Jack (1822) states only "In the neighbourhood of Bencoolen" with no mention of other localities and so had clearly intended a Sumatran taxon. His description of "Flowers. . . solitary, nearly sessile. . . Corolla. . . tube about four inches long" and "Leaves. . . subrotund with a short reflexed point, entire with reflexed margins, very. . . thick and fleshy" distinguishes the species adequately. However, no original material that could be regarded as typifying Jack's name could be found. Leenhouts (1962) remarks, "Among the few Sumatran specimens at my disposal none fits his description very well, and there is no later collection from. . . Bencoolen, S. Sumatra". The specimens *Rahmat 6254* and *Jacobs 4610* (L) are both fruiting collections without corollas and the meagre flowering material in *Teysmann HB 998* (also the type of *Fagraea monantha* Miq.) is represented by two half-calyx portions at L and a very young flower bud at U. Neotypification is essential and should be based on Sumatran material, so we choose the Teysmann specimen at U as it is the best, including a good leafy branch and a flower bud.

In the Kew herbarium, the type of Ridley's *Fagraea rotundifolia* has a neotype label for the name *F. carnosa* on it. This should not be accepted as a neotype because it had not been clearly designated by Leenhouts (1962), who, however, stated "The only specimen which is well in accordance with the original diagnosis is Rostado s.n. . . . the type of *F. rotundifolia* Ridl." Although we accept some variation that includes this specimen, it has a flower with a bigger calyx than the Sumatran or other Malayan material and more closely resembles the calyces in Bornean material. In addition to this, the leaves in the Rostado collection are atypically rotund (all other material has elliptic to obovate leaves with mostly rounded apices).

4. *Fagraea crassifolia* Blume

Rumphia 2 (1838) 31, t. 78 f. 1; Mus. Bot. 1 (1850) 166. TYPE**:** *Collector unknown*, Java (holo L: acc. no. 908127-756 & barcode L0004983).

Fagraea sparei M.R.Hend., Gard. Bull. S.S. 7 (1933) 114. TYPE: *Spare F952*, Johore, Sungai Tukong Estate (holo SING; iso K).

Fagraea ceilanica auct. non Thunberg (1782): Leenhouts, Fl. Males. I, 6 (2) (1962) 315 pro parte, quoad *F. crassifolia* Blume & *F. sparei* M.R.Hend. in syn; Kochummen, Tree Fl. Malaya 2 (1973) 271 pro parte, quoad *F. sparei* M.R.Hend. in syn.; Griffin & Parnell, Fl. Thailand 6 (3) (1997) 201 pro parte, quoad *F. obovata* Wall. in syn.

Fagraea lanceolata auct. non Blume (1826): King & Gamble, J. As. Soc. Beng. 74 (2) (1908) 607, quoad *Kunstler 6848* & *Wray 3202*.

Hemi-epiphyte, 20–30 m high or more on trees; trunk/stems to c. 15 cm diameter; bark smooth, grey-brown. **Leaves** elliptic to subobovate; (5.5–)8–12(–13.5) cm long, (2.3–)3.8–5.5 cm wide; *base* cuneate, not decurrent; *apex* short cuspidate; *margin* entire, recurved in dried material; thin-coriaceous; upper and lower *surfaces* glabrous, lower surface relatively smooth under magnification; *midrib* flat above, prominent below; *secondary veins* obscure on both sides; *tertiary and higher-order veins* obscure; petioles 10–20 mm long, 2–3 mm thick, *petiolar sheaths* not fused along the interpetiolar median, each developing a scale-like ligule 0.5–1 mm high adaxially; petiole base without *auricles*. **Inflorescence** terminal, a 2- to few-flowered branched cyme, the whole about 10–15 mm long; *peduncle* indistinct; inflorescence *rachis* 10–15 mm long, 2–3 mm diameter, with 1 pair of primary branches; basal primary *branch pairs* 5–15 mm long, 2–4 mm diameter and not rebranched. **Flowers** bisexual; *pedicels* indistinct or to 7 mm long, to 4 mm diameter; *floral bracts* small, acute, 5–6 mm long, located below the calyx; *calyx* 20–26 mm long (from the base to the lobe apices), glabrous, not to sometimes lenticellate, *calyx cup* 9–10 mm diameter, *calyx lobes* 5, broad-elliptic to rounded, 10–13 mm long, 10–12 mm wide, margins glabrous, base not

auriculate; *corolla* broadly infundibular (the mouth more than 3–4 times the width of the lower narrowed part of the tube); cream to white; *lower subcylindrical part of the corolla tube* 16–17 mm long, 5–6 mm wide basally, *upper flared part* of the tube (when distinct) slightly inflated, 10–13 mm long, 16–18 mm wide at the top; *corolla lobes* 5, broad-obovate to suborbicular, 20–27 mm long, 15–20 mm wide, overlapping to the right; *stamens* not seen (broken off in available material); *style* 28–30 mm long, protruding to c. 2 mm from the corolla mouth in the open flower; *stigma* basically shallowly 2-lobed, the lobes broadly suborbicular and recurving when receptive and the whole sometimes resembling a subpeltate structure 2–3 mm across. **Infructescence** *peduncle* indistinct. **Fruit** broadly ovoid, *apex* conspicuously attenuate; smooth, the epidermis conspicuously wrinkling and separating upon drying; when mature to 40–50 mm long, 25–32 mm diameter; the base tightly clasped by the calyx lobes. **Seeds** numerous; ellipsoid to subovoid; 2–2.5 mm long, 1.5–2 mm wide; testa surface areolate.

DISTRIBUTION. Java, Malay Peninsula.

HABITAT. Lowland rain forest to lower montane forest.

SPECIMENS EXAMINED—PENINSULAR MALAYSIA. Johor. Kluang State Land, *Yeob CF 5849*, FR, 17 Feb 1922 (KEP, SING); Sungai Tukang Estate, *Spare F952*, FB, 13 Sep 1931 (K). **Melaka.** *Griffith 3737*, FL, no precise date, 1845 (K). **Pahang.** Ulu Telom, Cameron Highlands, *Jaamat & Lasah FMS 27672*, FL, FR, 30 Aug 1931 (KEP, SING). **Perak.** Maxwell's Hill, *Wray 3202*, FR, Sep 1838 (K, SING). **JAVA** (INDONESIA). *sine coll*. FB, FR, no date (L: acc. no. 908127-756 & barcode L0004983).

Wallich's name *Fagraea obovata* has a number of confusing elements and is not used. In the original description (Roxburgh 1824), Wallich includes material from both Silhet (now Bangladesh) as well as Singapore. Clarke in Hooker (1885) pointed out that the "corolla in Wallich's Silhet example is considerably larger than in his Singapore one." Yet in his description, Wallich appears to describe the flowers of the taxon from Silhet (which Clarke points out has leaves with distinct primary nerves), and leaves that are "fleshy, without veins or nerves" (that would conform to Peninsular Malaysian material, not the taxon from Silhet). The next oldest name, *Fagraea crassifolia*, is used as there is no conflict of material or description. The range of Thai material cited under *Fagraea obovata* by Craib & Kerr (1951) needs to be critically assessed; the Peninsular Thai material represents *F. splendens*.

5. *Fagraea curtisii* King & Gamble

J. As. Soc. Beng. 74 (2) (1908) 605; Ridley, Fl. Malay. Pen. 2 (1923) 417; Craib & Kerr, Fl. Siam. Enum. 3 (1951) 55; Leenhouts, Fl. Males. I, 6 (2) (1962) 332; Kochummen, Tree Fl. Malaya 2 (1973) 271; Griffin & Parnell, Fl. Thailand 6 (3): 197–205. TYPE: *Curtis 1676*, Langkawi, Teluk Woh (holo K; iso SING).

Fagraea curtisii* var. *curtisii

Small tree or hemi-epiphyte, usually to 13 m tall or 10 m high or more on trees; trunk/stems to c. 30 cm diameter; bark smooth, creamy to grey-brown. **Leaves** elliptic to subobovate; (8.5–)10–22(–28) cm long, (3–)5–7.5(–9.2) cm wide; *base* cuneate, not decurrent; *apex* short cuspidate; *margin* entire, plane in dried material; thin-coriaceous; upper and lower *surfaces* glabrous, lower surface relatively smooth; *midrib* flat above, prominent below; *secondary veins* 4–5 pairs if visible, upper side obscure, lower side faint and immersed in the lamina to obscure; *tertiary and higher-order veins* faint to obscure; petioles (1.3–)2–3(–3.5) cm long, 2–3(–4) mm thick, *petiolar sheaths* not fused along the interpetiolar median, each developing a scale-like ligule 1–3 mm high adaxially; petiole base without *auricles*. **Inflorescence** terminal, a solitary flowered or 2- to few-flowered cyme, the whole about 10–20 mm long; *peduncle* indistinct or to 7 mm long, to 5 mm diameter; inflorescence *rachis* 10–12 mm long, 4–5 mm diameter, with 0–1 pair of primary branches; basal primary *branch pairs* 8–20 mm long, 3–4 mm diameter and not rebranched. **Flowers** bisexual; *pedicels* indistinct or to 5 mm long, to 5 mm diameter; *floral bracts* small, acute, 3–5 mm long, located below the calyx; *calyx* 17–33 mm long (from the base to the lobe apices), glabrous, not to sometimes lenticellate, *calyx cup* 9–10 mm diameter, *calyx lobes* 5, broad-elliptic to rounded, (12–)17–20 mm long, 10–20 mm wide, margins glabrous, base not auriculate; *corolla* broadly infundibular (the mouth more than 3–4 times the width of the lower narrowed part of the tube); light orange to cream to white; *lower subcylindrical part of the corolla tube* 17–25 mm long, 9–10 mm wide basally, *upper flared part* of the tube slightly inflated, 18–30 mm long, 30–32 mm wide at the top; *corolla lobes* 5, broad-obovate to suborbicular, 35–40 mm long, 25–30 mm wide, overlapping to the right; *stamens* 5, inserted at the upper portion of the lower narrowed tubular part of the corolla tube or the lowermost portion of the upper flared part of the corolla tube; *filaments* 32–40 mm long, protruding to c. 10 mm from the corolla mouth; *anthers* versatile, hastate, 17–20 mm long, 2–3 mm wide, each anther sac somewhat ellipsoid; *style* not seen [*fide* Griffin & Parnell (1997): ovary and style c. 6 cm long]; *stigma* not seen [*fide* Leenhouts (1962): stigma peltate, c. 2.5 mm across]. **Infructescence** peduncle indistinct or to 7 mm long, 5–7 mm thick. **Fruit** broadly ovoid to subglobose, *apex* conspicuously attenuate; smooth, the epidermis conspicuously wrinkling and separating upon drying; when mature to 35–45 mm long, 20–25(–36) mm diameter; the base loosely surrounded to tightly clasped by the calyx lobes. **Seeds** numerous; ellipsoid to subovoid; 2–3 mm long, 1–2 mm wide; testa surface areolate.

DISTRIBUTION. Malay Peninsula (including peninsular Thailand, the extreme northwest and west-coast areas of Peninsular Malaysia).

HABITAT. Restricted to limestone outcrops and their vicinity.

SPECIMENS EXAMINED—PENINSULAR MALAYSIA. Kedah. Langkawi, Pulau Dayang Bunting, *Corner SFN 38129*, FR, 13 Nov 1941 (KEP, SING); Langkawi, Pulau

Langgon, *Imin FRI 68437*, FR, 4 Nov 2009 (KEP, L, SAN, SING), Pulau Langgon, Tanjong Dalam, *Boey 528*, FR, 4 Nov 1971 (KLU); Langkawi, Pulau Segai, *Haniff SFN 15584*, FR, Feb 1911 (SING); Langkawi, Pulau Timun, *Chia & Chin LT 372*, FR, 13 Nov 1979 (KLU), *Henderson SFN 29109*, FR, 24 Nov 1934 (SING); Langkawi, Pulau Timun, south coast, on limestone, *Whitmore FRI 15103*, FR, 16 Dec 1969 (KEP, SING); Langkawi, Pulau Timun, sandy beach, *Sim B-112*, FR, 13 Nov 1979 (KLU); Langkawi, Tanjong Sirie, *Curtis 1696*, FB, FL, Sep 1890 (SING); Langkawi, Telok Apau, *Haniff & Nur SFN 7089*, FR, 17 Nov 1921 (SING); Langkawi, Teluk Woh, *Curtis 1676*, Aug 1888, FL (K), FB (SING). **Perak.** Gua Puteri limestone, 500 ft [152 m] alt, *Samsuri & Mahmud SA 628*, FR, 13 Mar 1971 (KLU, SING); Kuala Kangsar, Sg. Siput, rockface near cave mouth, *Tan FRI 81814*, FR, 27 Jan 2015 (BKF, K, KEP, SAN, SING); Lenggong, Kampong Gelok, Gua Putri limestone, 100 m alt, *Chin 967*, leafy twig, 13 Mar 1971 (KLU); Padang Rengas, Gua Pondok limestone, 300 m alt, *Chin 910*, FR, 12 Mar 1971 (KLU). **PENINSULAR THAILAND.** Phuket, Trang, Kao Kao, *Rabil 276*, FR, 1929 (BK).

Fagraea curtisii* var. *calcarea (M.R.Hend.) K.M.Wong & M.Sugumaran, **comb. & stat. nov.**

Basionym: *Fagraea calcarea* M.R.Hend., Gard. Bull. S.S. 7 (1933) 113, t. 28B; Leenhouts, Fl. Males. I, 6 (2) (1962) 332; Kochummen, Tree Fl. Malaya 2 (1973) 271. TYPE: *Henderson SFN 25036*, Pahang, Bukit Chintamani (holo SING; iso K).

The only clear morphological difference between this variety and *Fagraea curtisii* var *curtisii* is the larger floral bracts in this variety (7–18 mm long) that are rounded and apically clasping the calyx base. The floral bracts in *Fagraea curtisii* var. *curtisii* are smaller (3–5 mm long), acute and not conspicuously overlapping the calyx.

DISTRIBUTION. Malay Peninsula (known only from Kelantan and Pahang states in Peninsular Malaysia).

HABITAT. Restricted to limestone outcrops and their vicinity.

SPECIMENS EXAMINED—PENINSULAR MALAYSIA. Kelantan. Gua Musang, *Teo & Wintz KL 4819*, FL, 7 Oct 1998 (KEP), Gua Musang, *Boey 298*, FB, 18 Aug 1971 (KLU); Sungai Nenggiri, Gua Jaya, limestone, *Whitmore FRI 4243*, FB, 27 Jul 1967 (KEP, SING); Ulu Kelantan, Gua Musang, path to Sungai Ketil, *Shah & Ali MS 2855*, FR, 30 Jan 1973 (SING). **Pahang.** Bukit Chintamani, limestone cliff, *Henderson SFN 25036*, FB, FL, 4 Oct 1931 (K, SING); Merapoh, Gua Layang limestone, 100 m alt, *Chin 1524*, FB, 13 Aug 1971 (KLU).

Fagraea curtisii var. *calcarea* is found on the Pahang and east coast limestones, whereas the typical variety is recorded from limestone in the region including Peninsular Thailand,

the extreme northwest of Peninsular Malaysia, Kedah and Perak, i.e., west of the Peninsular Malaysian Main Range.

6. *Fagraea fastigiata* Blume

Rumphia 2 (1838) 30, t. 76 f. 1; Leenhouts, Fl. Males. I, 6 (2) (1962) 324; Kochummen, Tree Fl. Malaya 2 (1973) 270. TYPE**:** *Hasselt*, *s.n.*, Lesser Sunda Islands (holo L: acc. no. 908127-218 & barcode L0005009).

Fagraea fastigiata sensu Cammerloher, Bull. Jard. Bot. Btzg. III, 5 (1923) 322 pro parte, tantum speciminia Javanica.

Fagraea fastigiata sensu Ridley, J. Str. Br. R. As. Soc. 30 (1897) 167 pro parte, excl. *Ridley 7552* (= *F. crenulata* Maingay ex Clarke).

Hemi-epiphyte, up to 17 m high or more on trees; stems to c. 10 cm diameter; bark smooth, grey-brown. **Leaves** elliptic to suborbicular; (10–)18–23(–26) cm long, (4.5)8.5–12(–13.5) cm wide; *base* narrowly decurrent with 1–2 mm broad wings towards the petiole base; *apex* acute; *margin* entire, plane in dried material; thin-coriaceous; upper and lower *surfaces* glabrous, lower surface relatively smooth under magnification; *midrib* prominent and sometimes keeled upon drying on both sides; *secondary veins* 3–5 pairs, upper side faint and immersed in the lamina, lower side prominent; *tertiary and higher-order veins* obscure; petioles 5–10 mm long, 3–5 mm thick, *petiolar sheaths* not fused along the interpetiolar median, each developing a scale-like ligule 2–3 mm high adaxially; *auricles* developing above the petiolar sheath, continuous from the lamina base, forming small rounded lobes 4–7 mm broad. **Inflorescence** terminal, a few- to many-flowered cyme, the whole about 6–7 cm long; *peduncle* indistinct; inflorescence *rachis* 6–7 cm long, 2–4 mm diameter, with 2–3 pairs of primary branches; basal primary *branch pairs* (3.5–)5–6 cm long, 2–3 mm diameter and rebranched to 1–2 orders. **Flower** bisexual; *pedicels* c. 5 mm long, c. 2 mm diameter; *floral bracts* small, acute, c. 3 mm long, located below the calyx; *calyx* 5–6 mm long (from the base to the lobe apices), glabrous, lenticellate, *calyx cup* 4–5 mm diameter, *calyx lobes* 5, broad-elliptic to rounded, apically clasping the corolla tube, 4–5 mm long, 3–4 mm wide, margins glabrous, base not auriculate; *corolla* not seen [*fide* Leenhouts (1962): corolla tube widely funnel-shaped, 3 cm long]; *stamens* not seen [*fide* Leenhouts (1962): anthers ovate-lanceolate, 7 mm long]; *style* not seen. **Infructescence** peduncle indistinct. **Fruit** broadly ovoid, *apex* rounded; smooth, the epidermis conspicuously wrinkling and separating upon drying; when mature to 20–30 mm long, 20–28 mm diameter; the base loosely surrounded by the erect calyx lobes. **Seeds** numerous; subovoid; 2–2.5 mm long, 1–2 mm wide; testa surface areolate.

DISTRIBUTION. Java, Malay Peninsula.

HABITAT. Lowland rain forest.

SPECIMENS EXAMINED—PENINSULAR MALAYSIA. Kelantan. SE border near Trengganu, Ulu Sungai Lebir Kechil, 500 m alt, *Cockburn FRI 7121,* FR, 17 Sep 1967, (KEP, SING), *Whitmore FRI 4386* (KEP, SING). **Perak.** Ijok Forest Reserve, *Sow KEP 48648*, FB, 11 Feb 1939 (KEP). **LESSER SUNDA ISLANDS** (INDONESIA). *Hasselt s.n.*, FB, no date (L: acc. no. 908127-218 & barcode L0005009).

This species is distinctive by its leaf base, which attenuates towards the petiole base and forms rounded auricles just above the petiolar sheath. In the other species that have auricular structures associated with the leaves, the leaf base is either not completely decurrent to the petiole base or, if decurrent, the auricles are formed at the petiole base below the petiolar sheath.

7. *Fagraea fraserensis* K.M.Wong & M.Sugumaran, **sp. nov.**

Inter species malayenses valde peculiaris basi lobis calycis auriculatis.

TYPE: *Sugumaran & Low SM 163*, Pahang, Fraser's Hill, beside path to Jeriau waterfall, 12 Oct 2007 (holo KLU).

(Fig. 5A, 9, 10)

Fig. 9. Habit of flowering *Fagraea fraserensis*. (Photo credit: M. Sugumaran)

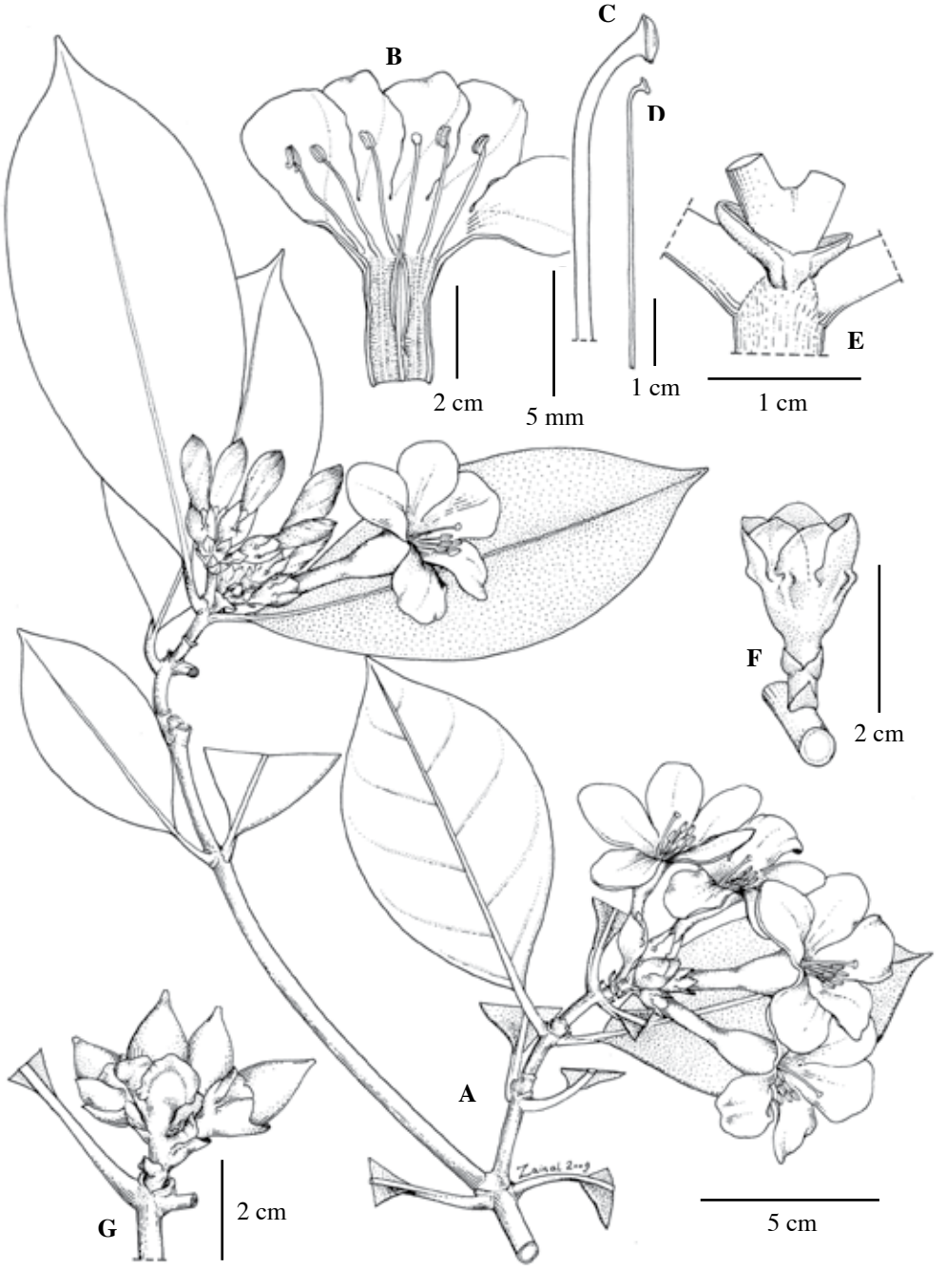

Fig. 10. *Fagraea fraserensis*. **A**. Leafy branch with inflorescences. **B**. Sectioned corolla showing attachment of stamens. **C** & **D**. Stigma. **E**. Portion of stem node with ligules at the adaxial side of petiole bases. **F**. Calyx with basally auriculate lobes. **G**. Branch with an infructescence. A–F from *Sugumaran* & *Low SM 163* (holotype, KLU). G from *Sugumaran et al*. *SM 164* (KLU). (Drawing by Zainal Mustafa)

Hemi-epiphyte (probably also occasionally a shrub or small tree), usually 1–2 m high (or probably more) on trees; trunk/stems to c. 10 cm diameter; bark smooth, dark-brown. **Leaves** elliptic to subobovate; (6.8–)10–17(–19) cm long, (3.3–)5.5–7.6 cm wide; *base* cuneate, not decurrent; *apex* short cuspidate; *margin* entire, plane in dried material; thin-coriaceous; upper and lower *surfaces* glabrous, lower surface relatively smooth under magnification; *midrib* sunken above, prominent below; *secondary veins* 5–7 pairs if visible, otherwise often obscure on both sides; tertiary and higher-order veins obscure; petioles 20–30 mm long, 2–4 mm thick, petiolar sheaths not fused along the interpetiolar median, each developing a scale-like ligule 1–2 mm high adaxially; petiole base without *auricles*. **Inflorescence** terminal, a few- to many-flowered branched cyme, the whole about 1.6–1.8 cm long; *peduncle* indistinct or to 6 mm long, to 4 mm diameter; inflorescence *rachis* 9–18 mm long, 3–4 mm diameter, with 1–2 pairs of primary branches; basal primary *branch pairs* 5–16 mm long, 3–4 mm diameter and rebranched to 1 order, more distal branch pairs not so. **Flowers** fragrant; bisexual; *pedicels* indistinct or to 4 mm long, to 4 mm diameter; *floral bracts* small, acute, 3–4 mm long, located below the calyx; *calyx* 10–12 mm long (from the base to the lobe apices), glabrous, not to sometimes lenticellate, *calyx cup* 4–5 mm diameter, *calyx lobes* 5, broad-elliptic to rounded, 8–10 mm long, 8–10 mm wide, margins glabrous, base auriculate; *corolla* broadly infundibular (the mouth more than 3–4 times the width of the lower narrowed part of the tube); cream to white; *lower subcylindrical part of the corolla tube* 16–18 mm long, 4–5 mm wide basally, *upper flared part* of the tube slightly inflated, 10–18 mm long, 13–18 mm wide at the top; *corolla lobes* 5, broad-obovate to suborbicular, 9–10 mm long, 8–10 mm wide, overlapping to the right; *stamens* 5, inserted (at the upper portion of the lower narrowed tubular part of the corolla tube or the lowermost portion of the upper flared part of the corolla tube); *filaments* 20–24 mm long, protruding to 6–10 mm from the corolla mouth; *anthers* versatile, hastate, 4–5 mm long, 2–3 mm wide, each anther sac somewhat ellipsoid; *style* 35–42 mm long, protruding to 6–9 mm from the corolla mouth in the open flower; *stigma* basically shallowly 2-lobed, the lobes broadly suborbicular and recurving when receptive and the whole sometimes resembling a subpeltate structure 1–1.5 mm across. **Infructescence** peduncle indistinct or to 5 mm long, to 4 mm thick. **Fruit** narrowly ovoid, *apex* conspicuously attenuate; smooth, the epidermis conspicuously wrinkling and separating upon drying; when mature to 20–25 mm long, 15–18 mm diameter; the base loosely surrounded to tightly clasped by the calyx lobes. **Seeds** numerous; ellipsoid to subovoid; 2–3 mm long, 1–1.5 mm wide; testa surface areolate.

DISTRIBUTION. Known only from Peninsular Malaysia (Fraser's Hill area).

HABITAT. Lower montane forest.

SPECIMENS EXAMINED—PENINSULAR MALAYSIA. Pahang. Fraser's Hill, beside path to Jeriau Waterfalls, *Sugumaran SM 79*, FR, 3 Nov 2006 (KLU), *Sugumaran et al. SM 164*, FR, 3 Jan 2008 (KLU), beside path to Jeriau Waterfalls, 3°43'N 101°42'E, 970 m, *Sugumaran & Low SM 163*, FB, FL, FR, 12 Oct 2007 (KLU), waterfall, epiphyte, *Kiew 3320*, FL, 9 Sep 1991 (SING).

The auriculate bases of the calyx lobes are highly distinctive and appear to be unique among Malay Peninsula species of *Fagraea*. This species also differs from most other *Fagraea* species because of the faint but still discernable secondary veins in the dried leaves. The only other Malay Peninsula species with distinct leaf veins in dried material are *Fagraea auriculata*, *F. imperialis*, *F. kinghamii* (where flowers are very large in comparison, and large leaf-stalk auricles are present in the former two species), *F. fastigiata* (with leaf blades bearing basal auricles), *F. oblonga* (more pairs of secondary veins, typically more branched inflorescences), *F. renae* (more branched inflorescences), and *F. ridleyi* (with more robust inflorescence axes, 4–6 mm diameter, and even larger calyx lobes, 14–18 mm long).

In the exauriculate leaf-stalk bases, indistinct leaf veins, and relatively small, non-involucrate flowers in small, little-branched cymes, *Fagraea fraserensis* approaches *F. splendens*, but its inflorescence has distinct 1st order branches 3–12 mm long (in *F. splendens* they are only 3–4 mm long). The larger calyces (with lobes 8–10 mm long, 8–10 mm broad) also distinguish it from *Fagraea splendens* (lobes 4–6 mm long and 4–6 mm broad). The large, thin calyx lobes wrap tightly around the corolla base or young fruit, giving a spindle-shape to the whole calyx structure, compared to the cup-shaped structure in *Fagraea splendens*, where the calyx lobes are held loosely erect. Also, the fruits of *Fagraea fraserensis* are narrowly ovoid with a long attenuate apex when dry, whereas those of *F. splendens* maintain a broad ellipsoid shape with rounded apex. Other species with similar corolla sizes and generally infundibular shapes, such as *Fagraea littoralis* and *F. oblonga*, are also different in their non-auriculate calyx lobes, among other characters.

ETYMOLOGY. Named after Fraser's Hill, where this species was discovered.

8. *Fagraea gardenioides* Ridl.

J. Fed. Mal. St. Mus. 5 (1914) 42. TYPE: *Robinson s.n.*, 22 Jan 1913, Selangor, Gunung Mengkuang (holo K; iso SING).

Fagraea gardenioides sensu Leenhouts, Fl. Males. I, 6 (2) (1962) 331 pro parte, excl. ssp. *borneensis* Leenhouts (= *F. havilandii* K.M.Wong & Sugau).

Fagraea gardenioides sensu Kochummen, Tree Fl. Malaya 2 (1973) 270 pro parte, excl. speciminia origine 'Borneo'.

(Fig. 1D, 4, 11)

Small tree or hemi-epiphyte, usually to 4 m tall or 2 m high or more on trees; trunk/stems to c. 5 cm diameter; bark smooth, grey to dark-brown. **Leaves** broad elliptic to obovate; (7.5–)9–13(–15.3) cm long, (4–)5–6(–7.6) cm wide; *base* cuneate to not conspicuously decurrent with up to 1 mm-broad wings towards the petiole base; *apex* rounded; *margin* entire, recurved in dried material; thick-coriaceous; upper and lower *surfaces* glabrous,

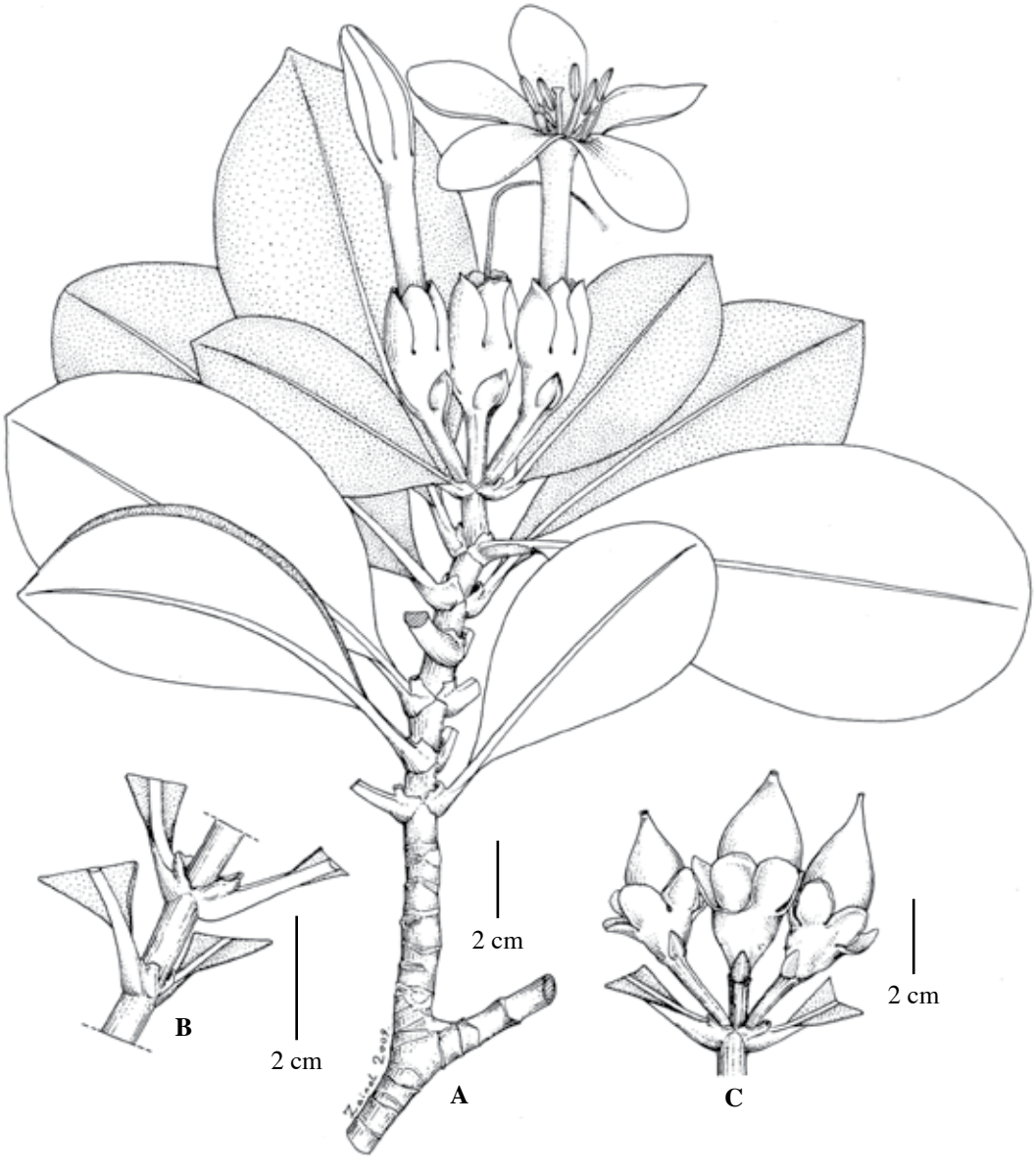

Fig. 11. *Fagraea gardenioides*. **A**. Leafy branch with an inflorescence. **B**. Portion of stem with ligules on the adaxial side of the petiole bases. **C**. An infructescence. All from *Poore 749* (KLU). (Drawing by Zainal Mustafa)

lower surface relatively smooth; *midrib* prominent on both sides towards the leaf base but flat to sunken nearer the leaf apex; *secondary veins* obscure on both sides; *tertiary and higher-order veins* obscure; petioles (3–)7–12(–15) mm long, 2–4 mm thick, *petiolar sheaths* not fused along the interpetiolar median, each developing a scale-like ligule 3–4 mm high adaxially; petiole base without *auricles*. **Inflorescence** terminal, a 1- to few-flowered cyme, the whole about 1–2.2 cm long; *peduncle* indistinct; inflorescence *rachis* 1–2.2 mm long, 4–6 mm diameter, with 1–2 pairs of primary branches; basal primary *branch pairs* 15–21 mm long, 3–5 mm diameter and not rebranched. **Flowers** fragrant; bisexual; *pedicels* 5–6 mm long, 4–5(–7) mm diameter; *floral bracts* small, acute, 7–10 mm long, located below the calyx; *calyx* 22–30 mm long (from the base to the lobe apices), glabrous, not to sometimes lenticellate, *calyx cup* 10–13 mm diameter, *calyx lobes* 5, broad-elliptic to rounded, 14–20 mm long, 10–15 mm wide, margins glabrous, base not auriculate; *corolla* slender trumpet shaped (tubular and very gradually widening towards the apex); cream to white; *corolla tube* 40–53 mm long, 8–15 mm wide at the top; *corolla lobes* 5, broad-obovate to suborbicular, 30–42 mm long, 14–25 mm wide, overlapping to the right; *stamens* 5, inserted at the upper portion of the lower narrowed tubular part of the corolla tube or the lowermost portion of the upper flared part of the corolla tube; *filaments* 20–27 mm long, protruding to 12–17 mm from the corolla mouth; *anthers* versatile, hastate, 8–10 mm long, 3–4 mm wide, each anther sac somewhat ellipsoid; *style* 50–55 mm long, protruding 2–10 mm from the corolla mouth in the open flower; *stigma* basically shallowly 2-lobed, the lobes broadly suborbicular and recurving when receptive and the whole sometimes resembling a subpeltate structure 3–4 mm across. **Infructescence** peduncle indistinct or to 6 mm long, to 5 mm thick. **Fruit** narrowly to broadly ovoid, *apex* conspicuously attenuate; smooth, the epidermis conspicuously wrinkling and separating upon drying; when mature to 30–40 mm long, 13–20 mm diameter; the base loosely to tightly clasped by the calyx lobes. **Seeds** numerous; ellipsoid to subovoid; 2–3 mm long, 1–2 mm wide; testa surface areolate.

DISTRIBUTION. Malay Peninsula (Main Range mountains, Gunung Bubu and Gunung Korbu).

HABITAT. Upper reaches of lower montane forest and upper montane mossy forest, common in stunted vegetation on ridges.

SPECIMENS EXAMINED — PENINSULAR MALAYSIA. Pahang. Cameron Highlands, Gunung Brinchang, 6000 ft [1829 m] alt, *Poore 749*, FL, 3 Jul 1961 (KLU), 6666 ft [2032 m] alt, *Ng FRI 5975*, FR, 3 Mar 1968 (K, KEP, SING), 6500 ft [1981 m] alt, *Stone 7251*, FB, FL, 1 Aug 1967 (KLU); Fraser's Hill, Pine Tree Hill, *Symington KEP 29482*, leafy twig, 14 Apr 1933 (KEP), 4750 ft [1448 m] alt, *Burkill, Shah & Noor HMB 2384*, FL, 18 Aug 1960 (SING), 4780 ft [1457 m] alt, *Purseglove P 4231*, FB, FL, 19 Apr 1955 (SING); Pahang/Selangor border, Gunung Ulu Kali, *Imin FRI 66475*, FR, 3 Feb 2010 (K, KEP, L, SAN, SING), summit of Ulu Kali, 5000–6000 ft [1524–1829 m] alt, *Soepadmo HUM 9002*, FB, FR, 4 Apr 1968 (KLU); Gunung Ulu Kali, 5500 ft [1676 m] alt, *Stone 14071*, FL, 31 Mar 1979 (KLU), 5600

ft [1707 m] alt, *Siew 144*, FL, 18 Jun 1977 (KLU). **Perak.** Gunung Bubu summit, *Symington KEP 30843*, FB, FL, 8 Apr 1933 (KEP); Gunung Korbu, 5500–7000 ft [1676–2134 m] alt, *Symington KEP 32235*, FL, 22 Jul 1933 (KEP, SING); Gunung Raya, 5700 ft [1737 m] alt, *Strugnell & Tachun KEP 45890*, FB, 31 Jan 1938 (KEP). **Selangor.** Gunung Mengkuang, 5000–5600 ft [1524–1707 m] alt, *Robinson s.n.*, FL, 22 Jan 1913 (K, SING); Ulu Selangor, Genting Highlands, G. Genting Chin-Chin, 1680 m alt, 3°27'N 101°47'E, *Chua et al. FRI 40798*, FB, FL, 6 May 1999 (KEP); Ulu Selangor, Gunung Moyang, 5500 ft [1676 m] alt, *Symington KEP 56665*, FR, 3 Nov 1940 (KEP).

Leenhouts (1962) placed Sarawak material as a subspecies (ssp. *borneensis*) of this species, but that has been distinguished as a different species, *Fagraea havilandii* by Wong & Sugau (1996).

9. *Fagraea imperialis* Miq.

Fl. Ind. Bat. 2 (1857) 372; Wong & Sugau, Sandakania 8 (1996) 68. TYPE**:** *Teysmann HB 599*, Sumatra, Siboga (iso L: acc. no. 908127-58 & barcode L0004930).

Fagraea auriculata auct. non Jack (1822), pro parte, quoad *F. imperialis* Miq. in syn.: Clarke in Hooker f., Fl. Brit. Ind. 4 (1885) 83; King & Gamble, J. As. Soc. Beng. 74 (2) (1908) 605; Ridley, Fl. Malay. Pen. 2 (1923) 416; Leenhouts, Fl. Males. I, 6 (2) (1962) 326.

(Fig. 1C, 5D, 12, 13, 14)

Fig. 12. *Fagraea imperialis* (*Sugumaran et al.* SM 230) demonstrated by field assistant Yusuf. (Photo: M. Sugumaran)

Fig. 13. *Fagraea imperialis*. **A.** (From left) Floral buds, open flower, young fruit and leaf. **B.** Inflorescence with flower buds flanking a young fruit in the middle of the cyme. (Photo credits: M. Sugumaran)

Fig. 14. Fresh shoots of *Fagraea imperialis* (left) and *F. auriculata* compared. (Photo: M. Sugumaran)

Hemi-epiphyte, up to 25 m high or more on trees; stems to c. 15 cm diameter; bark smooth, grey-brown; branch internodes typically with a pair of keels 2–5 mm broad along the interpetiolar region. **Leaves** elliptic to subovate; (5–)25–34(–38) cm long, (4–)10–13(–17) cm wide; *base* narrowly decurrent with (0.5–)1–2 mm-broad wings towards the petiole base; *apex* acute to slightly pointed; *margin* entire, recurved in dried material; thick-coriaceous; upper and lower *surfaces* glabrous, lower surface relatively smooth under magnification; *midrib* slightly prominent above, more prominent below with a low median keel upon drying; *secondary veins* 5–7(–8) pairs, upper side faint and immersed in the lamina, lower side prominent; *tertiary and higher-order veins* faint; petioles 5–15(–20) mm long, 5–7(–9) mm thick, *petiolar sheaths* not fused along the interpetiolar median, each developing a scale-like ligule 1–2(–4) mm high adaxially; *auricles* developing below the petiole base distinct from the lamina base, forming broad rounded reflexed lobes (0.6–)1–1.8(–2) cm broad (in fresh materials measuring up to 3 cm broad). **Inflorescence** a 2- to few-flowered cyme, the whole about 1.5–3.5(–5) cm long; *peduncle* indistinct; inflorescence *rachis* 1.5–3.5(–5) cm long, 1–1.5 cm diameter, with 1(–2) pairs of primary branches; basal primary *branch pairs* 2–4 cm long, 1–1.2 cm diameter and not rebranched. **Flowers** very fragrant; bisexual; *pedicels* inconspicuous; *floral bracts* conspicuous, (1–)2–3(–3.5) cm long, rounded, these and a pair

of conspicuous inflorescence-branch bracts forming a loose involucre around the calyx; *calyx* 6.5–7 cm long (from the base to the lobe apices), glabrous, not lenticellate, *calyx cup* 2.5–3(–4) cm diameter, *calyx lobes* 5, broad-elliptic to rounded, (4.5–)5–5.5(–5.7) cm long, (3–)3.4–3.7(–4) cm wide, margins glabrous, base not auriculate; *corolla* broadly infundibular (the mouth more than 3–4 times the width of the lower narrowed part of the tube); cream to white; *lower subcylindrical part of the corolla tube* (4–)9–10 cm long, (1.5–)2.5–3 cm wide basally, *upper flared part* of the tube slightly inflated, 5–6 cm long, 6.5–7.5(–8) cm wide at the top; *corolla lobes* 5, broad-obovate to suborbicular, 6.5–7.5(–8) cm long, 4.5–5.5(–7) cm wide, overlapping to the right; *stamens* 5, inserted at the upper portion of the lower narrowed tubular part of the corolla tube or the lowermost portion of the upper flared part of the corolla tube; *filaments* (5.5–)8–9 cm long, protruding to (0.5–)2.7–4 cm from the corolla mouth; *anthers* versatile, hastate, 1.5–1.7 cm long, c. 1 cm wide, each anther sac somewhat ellipsoid; *style* 9–10(–11.5) cm long, slightly protruding to c. 5 mm from the corolla mouth in the open flower; *stigma* basically shallowly 2-lobed, the lobes broadly suborbicular and recurving when receptive, 4–6 mm across. **Infructescence** peduncle indistinct. **Fruit** narrowly ellipsoid, *apex* rounded; smooth, the epidermis conspicuously wrinkling and separating upon drying; when mature to c. 9.5 cm long, c. 4.5 cm diameter; the base tightly clasped by the erect calyx lobes. **Seeds** numerous; ellipsoid to subovoid; 2.5–3 mm long, 2–2.2 mm wide; testa surface areolate.

DISTRIBUTION. Sumatra, Malay Peninsula.

HABITAT. Swamp forests and lowland terrestrial forests from coastal to inland sites.

SPECIMENS EXAMINED—PENINSULAR MALAYSIA. Locality unknown, *Teruya 2421*, FL, Jul–Aug 1933 (SING). **Kelantan.** W Kelantan, Sungai Perias at Kuala May, *Whitmore FRI 4164*, leafy twig only, 21 Jul 1967 (KEP); Ulu Kelantan, Gua Musang, summit of limestone hill, *Ng FRI 5563*, leafy twig only, 22 Jun 1967 (KEP). **Pahang.** Taman Negara, Batu Subuh, summit, *Kiew 1485*, FR, 8 Oct 1984 (KEP, SING); Taman Negara, Gua Luas, summit, *Ng FRI 27054*, leafy twig only, 4 Mar 1977 (KEP). **Perak.** Bubu Forest Reserve, *Symington FMS 28571*, FB, 30 Mar 1933 (SING); Gunung Bubu, banks of Sungai Kenas at dam, 250 ft [76 m] alt, *Whitmore FRI 963*, leafy twig only, 15 Feb 1967 (KEP); Tasik Temenggor, Sungai Gadong, *Sugumaran et al. SM 230*, FL, 29 Jul 2008 (KLU), *SM 238*, FB, FL, 5 Aug 2008 (KLU). **Selangor.** Weld Hills F.R., (*Collector name indistinct*) *CF 908*, FB, FL, 12 Aug 1916 (KEP). **SUMATRA** (INDONESIA). Atjeh, Gunung Leuser Nature Reserve, *deWilde & deWilde-Duyfjes 14047*, FR, 5 Jul 1972 (SING), Oneng Oneng, 1180 m alt, *Steenis 6583a*, leafy branch only, no precise date, 1934 (SING); Siboga, *Teysmann HB 599*, FL (drawing), no date (L).

This species has often been confused with *Fagraea auriculata* because of the development of large, leathery, rounded auricles at the petiole bases and the generally big, distinctive creamy flowers. However, the larger flowers of *Fagraea imperialis* and other characters adequately distinguish the two.

10. *Fagraea kinghamii* K.M.Wong & M.Sugumaran, **sp. nov.**

Fagraeae auriculatae similis sed floribus solitariis, bracteis floralibus magnis et distributione montana differt.

TYPE: *Henderson SFN 23289*, Pahang, Cameron Highlands, 4800 ft [1463 m] alt, 1 Apr 1930 (holo SING, iso KEP).

Fagraea auriculata auct. non Jack (1822): Leenhouts, Fl. Males. I, 6 (2) (1962) 331 pro parte, tantum speciminia montium peninsulae Malayensis sub 'ssp. auriculata', e.g. *Henderson SFN 31081*; Kochummen, Tree Fl. Malaya 2 (1973) 270 pro parte, tantum speciminia montium peninsulae Malayensis; Wong & Sugau, Sandakania 8 (1996) 51 pro parte, incl. Fig. 16, quoad *Symington KEP 36092*, *Whitmore FRI 12214*, *15551*.

(Fig. 15)

Small tree or hemi-epiphyte, usually to 5 m tall or 5 m high or more on trees; trunk/stems to c. 5 cm diameter; bark smooth to shallowly fissured, grey-brown; branch internodes often developing a pair of low ridges or keels up to 1 mm high in the inter-petiolar region. **Leaves** elliptic to subobovate; (7.5–)13–16(–22) cm long, (3.8–)5–6.2(–7.2) cm wide; *base* narrowly decurrent with 1–2 mm broad wings towards the petiole base; *apex* shortly pointed; *margin* entire, recurved in dried material; thick-coriaceous; upper and lower *surfaces* glabrous, lower surface relatively smooth; *midrib* flat above, prominent below and sometimes developing a low median keel upon drying; *secondary veins* 5–7 pairs, upper side faint and immersed in the lamina, lower side faint and immersed in the lamina; *tertiary and higher-order veins* obscure; petioles (1–)5–7(–17) mm long, (2–)3–4 mm thick, *petiolar sheaths* not fused along the interpetiolar median, each developing a scale-like ligule 2–3 mm high adaxially; auricles developing below the petiolar base, distinct from the lamina base, forming narrow rim-like structures (2–)3–5(–7) mm broad. **Inflorescence** terminal, consisting of a solitary flower, the whole about 5–15 mm long; *peduncle* indistinct or to 5–10(–15) mm long, to 8 mm diameter; the rachis internode between peduncle and pedicel indistinct. **Flowers** very fragrant; bisexual; *pedicels* indistinct or to 10 mm long, to 10 mm diameter; *floral bracts* small to large, rounded, (7–)15–30(–35) mm long, typically overlapping the calyx base and forming a loose involucre around the calyx together with a pair of expanded inflorescence bracts (when the latter are present); *calyx* (30–)35–50 mm long (from the base to the lobe apices), glabrous, lenticellate, *calyx cup* (10–)15–25 mm diameter, *calyx lobes* 5, broad-elliptic to rounded, 23–35(–40) mm long, 17–25 mm wide, margins glabrous, base not auriculate; *corolla* broadly infundibular (the mouth more than 3–4 times the width of the lower narrowed part of the tube); cream to white; *lower subcylindrical part of the corolla tube* 22–30 mm long, 10–17 mm wide basally, *upper flared part* of the tube slightly inflated, 23–30 mm long, 28–40(–50) mm wide at the top; *corolla lobes* 5, broad-obovate to suborbicular, 32–50(–60) mm long, 30–37 mm wide, overlapping to the right; *stamens* 5, inserted at the upper portion of the lower narrowed tubular part of the corolla tube or the lowermost portion of the upper flared part of the corolla tube; *filaments* 40–50 mm long,

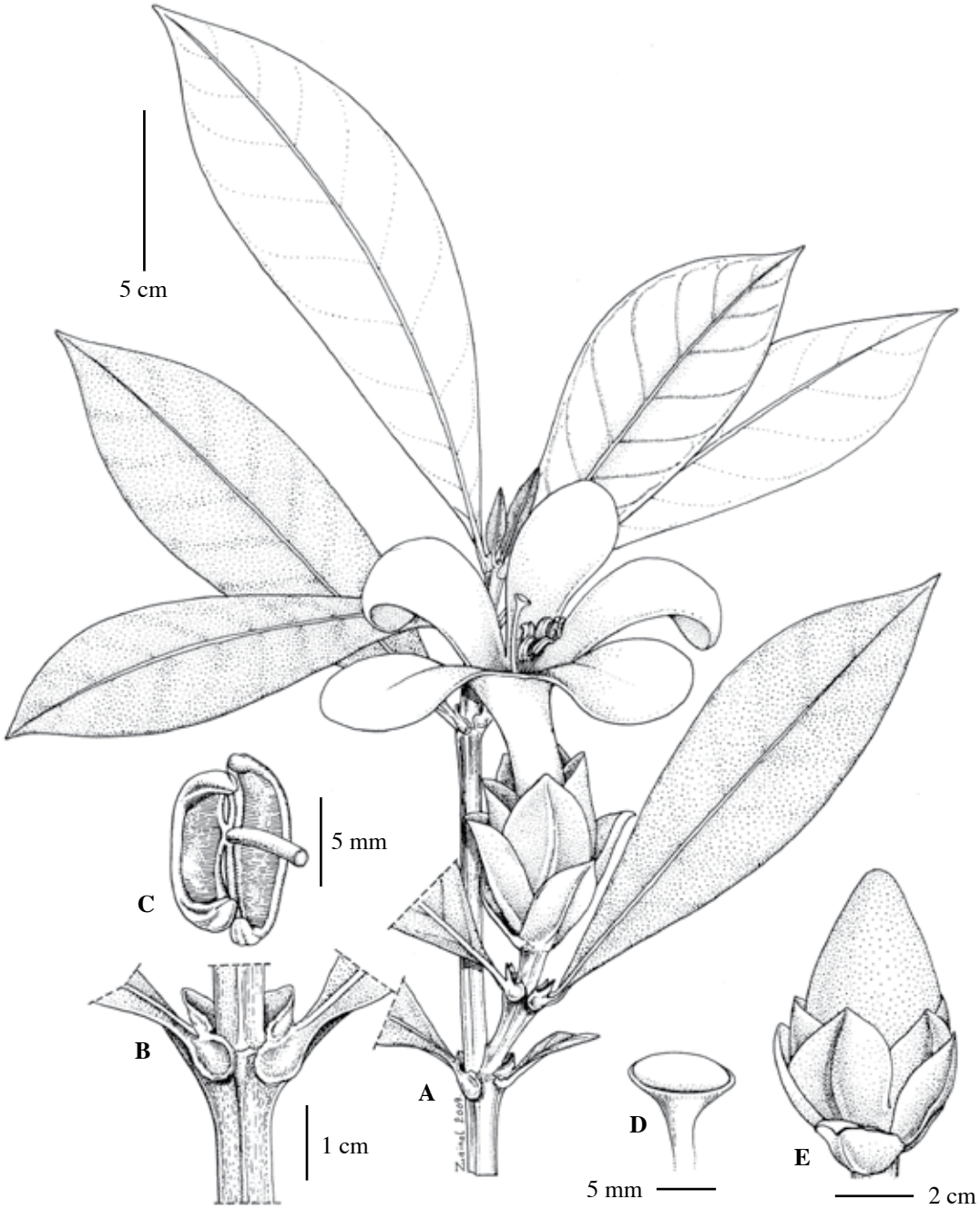

Fig. 15. *Fagraea kinghamii*. **A**. Leafy branch with a solitary flower. **B**. Portion of stem with ligules on the adaxial side of the petiole bases, which also develop auricles. **C**. Ventral view of anther. **D**. Peltate stigma. **E**. Fruit basally enveloped by the calyx and involucre of floral bracts. A, C & D from *Hislop* s.n. (SING), B & E from *Whitmore FRI 12214* (KEP). (Drawing by Zainal Mustafa)

protruding to 17–20 mm from the corolla mouth; *anthers* versatile, hastate, 8–10 mm long, 5–6 mm wide, each anther sac somewhat ellipsoid; *style* 65–70 mm long, protruding to 10–22 mm from the corolla mouth in the open flower; *stigma* basically shallowly 2-lobed, the lobes broadly suborbicular and recurving when receptive, the whole sometimes resembling a subpeltate structure c. 8 mm across. **Infructescence** peduncle indistinct or to 5 mm long, to 7 mm thick. **Fruit** narrowly to broadly ovoid, *apex* conspicuously attenuated; smooth, the epidermis conspicuously wrinkling and separating upon drying; when mature to 45–55(–60) mm long, 20–35 mm diameter; the base tightly clasped by the erect calyx lobes. **Seeds** numerous; ellipsoid to subovoid; 2–2.5 mm long, c. 1.5 mm wide; testa surface areolate.

DISTRIBUTION. Malay Peninsula.

HABITAT. Lower montane forest.

SPECIMENS EXAMINED—PENINSULAR MALAYSIA. **Pahang.** Bentong, Fraser's Hill, *Kochummen KEP 98161*, FB, 11 Dec 1961 (KEP, SING); Cameron Highlands, *Symington KEP 36092*, FL (L), FR (K, KEP, SING), 4800 ft [1463 m] alt, *Henderson SFN 23289*, FL, FR, 1 Apr 1930 (KEP, SING); Cameron Highlands, Mardi Trail 7, 1450 m [442 m] alt, *Garcia FRI 32703*, FR, 5 Apr 1988 (KEP); Cameron Highlands, route 7 to G. Beremban, 1500 m alt, *Perumal et al. FRI 41624*, FB, 3 Mar 1994 (KLU); Gunung Benom, main NE ridge, boundary of Krau Game Reserve, 4800 ft [1463 m] alt, *Whitmore FRI 3328*, FR, 20 Mar 1967 (KEP, SING); Selangor border, Ulu Kali, *Whitmore FRI 15551*, FL, 2 Oct 1970 (K, KEP, L, SING), 5000 ft [1524 m] alt, *Whitmore FRI 12214*, FL, FR, 24 Aug 1968 (KEP), FB, FR (SING); Ulu Telom, *Jaamat KEP 27295*, FR, 29 Aug 1931 (KEP). **Perak.** Birch's Hill, *Fox s.n.*, FR, Oct 1899 (SING), *Burkill & Haniff SFN 12643*, FR, 4 Mar 1924 (SING), *SFN 12861*, FR, 29 Feb 1924 (SING); near the Cottage, *Fox* s.n., FB, FL, Dec 1899 (SING); Taiping Hill, 4050 ft [1234 m] alt, *Haniff & Nur SFN 2344*, FR, 14 Feb 1917 (SING), 4100 ft [1250 m] alt, *Henderson SFN 11805*, FR, 4 Mar 1924 (SING). **Terengganu.** Gunung Padang, *Hislop s.n.*, FL, Jul 1952 (SING), 4000 ft [1219 m] alt, *Moysey & Kiah SFN 31081*, FB, FL, Jun 1937 (SING).

This is easily distinguished from both *Fagraea auriculata* and *F. imperialis* by its always solitary flowers, smaller leaves and montane provenance; also in its large floral bracts (different from *F. auriculata*, similar to *F. imperialis*) and smaller flowers (different from the very big flowers of *F. imperialis*, just slightly smaller than those of *F. auriculata*; see discussion under *F. auriculata* for a more detailed comparison of these three species).

Both this and the Bornean *Fagraea resinosa* develop large, rounded floral bracts around the calyx. Both also have a slight auricular structure at the petiole bases. However, this species has a broadly infundibular corolla, unlike the subsalverform corolla with a long narrow tube in *Fagraea resinosa*.

ETYMOLOGY. James Jay Kingham (b. 1936) is a Malaysian horticulturist *par excellence* specially interested in native forest species, who made substantial donations of nursery-raised introductions from Malaysian forests to the University of Malaya's Rimba Ilmu Botanic Garden. His active interest in bringing forest species into cultivation in a systematic manner has encouraged many agencies throughout the country to use native species to augment the conservation potential of their projects, and led to broader possibilities for *ex situ* conservation of this biodiversity.

11. *Fagraea larutensis* M.Sugumaran, **sp. nov.**

Fagraeae crassifoliae similis sed calycibus minoribus (17–18 mm longis, 5–6 mm latis), lobis corollae minoribus (15–16 mm longis, 9–10 mm latis) et tubo corollae breviore differt.

TYPE: *King's Collector 7518*, Perak, Larut, 300–500 ft [91–152 m] alt, Apr 1885 (holo SING).

Fagraea ceilanica auct. non Thunberg (1782): Leenhouts, Fl. Males. I, 6 (2) (1962) 315 pro parte, quoad *Sinclair & Kiah SFN 38660* & *Burkill & Haniff 12585*.

Fagraea obovata auct. non Wallich ex Roxburgh (1824): King & Gamble, J. As. Soc. Beng. 74 (2) (1908) 606 pro parte, quoad *King's coll. 7578*.

(Fig. 16)

Scrambler or hemi-epiphyte, 10–30 m high or more on trees; trunk/stems to c. 10–15 cm diameter; bark smooth, grey-brown. **Leaves** elliptic; (6.5–)8–11(–12) cm long, (2–)3–5 cm wide; *base* cuneate, not decurrent; *apex* short-cuspidate; *margin* entire, plane in dried material; thin-coriaceous; upper and lower *surfaces* glabrous, lower surface relatively smooth; *midrib* flat above, prominent below; *secondary veins* 4–5 pairs if visible, otherwise obscure on both sides; *tertiary and higher-order veins* obscure; petioles 13–20 mm long, 1–2 mm thick, *petiolar sheaths* not fused along the interpetiolar median, each developing a scale-like ligule 0.5–1 mm high adaxially; petiole base without *auricles*. **Inflorescence** terminal, a few- to many-flowered branched cyme, the whole about 15–25 mm long; *peduncle* indistinct; inflorescence *rachis* c. 10 mm long, c. 4 mm diameter, with 2–3 pairs of primary branches; basal primary *branch pairs* 10–12 mm long, 3–4 mm diameter and not rebranched. **Flowers** bisexual; *pedicels* indistinct or to 3 mm long, to 4 mm diameter; *floral bracts* small, acute, 3–4 mm long, located below the calyx; *calyx* 17–18 mm long (from the base to the lobe apices), glabrous, not to sometimes lenticellate, *calyx cup* 5–6 mm diameter, *calyx lobes* 5, broad-elliptic to rounded, 9–10 mm long, 7–8 mm wide, margins glabrous, base not auriculate; *corolla* broadly infundibular (the mouth more than 3–4 times the width of the lower narrowed part of the tube); creamy yellow to white; *lower subcylindrical part of the corolla tube* c. 10 mm long, c. 5 mm wide basally, *upper flared part* of the tube (when distinct) slightly inflated, c. 10 mm long, c. 16 mm wide at the top; *corolla lobes* 5, broad-obovate to

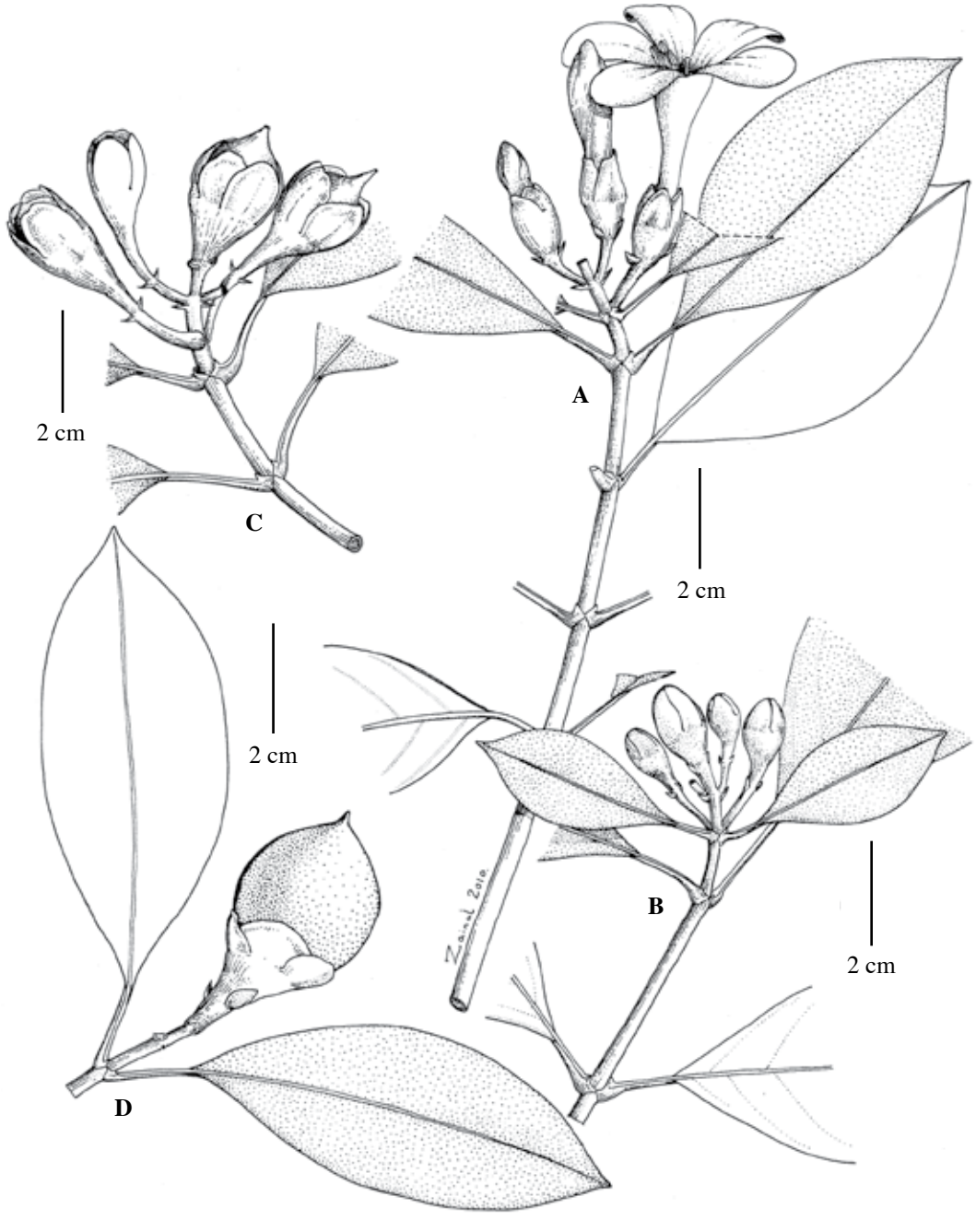

Fig. 16. *Fagraea larutensis*. **A**. Leafy branch with an inflorescence. **B**. Leafy branch with flower buds. **C**. Leafy branch with infructescence. **D**. Leafy branch with a single mature fruit. A from *King's Collector 7518* (holotype, SING), B from *Sidek SK 438* (SING), C from *Sinclair & Kiah SFN 38660* (SING), D from *Burkill & Haniff SFN 12585* (SING). (Drawing by Zainal Mustafa)

suborbicular, 15–16 mm long, 9–10 mm wide, overlapping to the right; *stamens* not seen; *style* not seen. **Infructescence** peduncle indistinct. **Fruit** broadly ovoid, *apex* conspicuously attenuate; smooth, the epidermis conspicuously wrinkling and separating upon drying; when mature to 30–32 mm long, 20–30 mm diameter; the base loosely surrounded by the calyx lobes. **Seeds** numerous; ellipsoid–subovoid; 2–2.5 mm long, 1–1.5 mm wide; testa surface areolate.

DISTRIBUTION. Known only from Peninsular Malaysia (at Maxwell Hill, also known as Bukit Larut).

HABITAT. Lower montane forest.

SPECIMENS EXAMINED—PENINSULAR MALAYSIA. Perak. Gunung Hijau, 4400 ft [1341 m] alt, *Burkill & Haniff SFN 12585*, FR, 2 Mar 1924 (SING), Larut, 300 to 500 ft [91–152 m] alt, *King's Coll. 7518*, FB, FL, Apr 1885 (SING), Maxwell's Hill, between Birch's Hill and the Cottage, *Sinclair & Kiah SFN 38660*, FR, 10 Sep 1949 (SING), Maxwell's Hill, 3000–3700 ft [914–1128 m] alt, *Sidek SK 438*, FB, 15 Feb 1976 (SING); Taiping Hill, 4100 ft [1250 m] alt, *Henderson SFN 11807*, FR, 4 Mar 1924 (SING).

This species closely resembles *Fagraea crassifolia* Blume and *F. latibracteata* Sugumaran (described next). In *Fagraea crassifolia*, the calyx lobes (20–26 mm long) and corolla lobes (20–27 mm long) are larger and the corolla tube (16–17 mm long) is also shorter. *Fagraea larutensis* has small and acute floral bracts that are located below the calyx base and that are only 3–4 mm long, whereas *F. latibracteata* has larger and rounded floral bracts that overlap the calyx base and 17–18 mm long. Also, *Fagraea larutensis* is confined only to higher elevations in lower montane forests, whereas *F. crassifolia* and *F. latibracteata* are both lowland species.

ETYMOLOGY. Named after Larut, the type locality of this species.

12. *Fagraea latibracteata* M.Sugumaran, **sp. nov.**

Fagraeae larutensis similis sed floribus solitariis et bracteis floralibus rotundatis superpositis basi calycis differt.

TYPE: *Cockburn FRI 7252*, Kelantan, Ulu Kelantan, Relai Forest Reserve, ridge top, 18 Oct 1967 (holo KEP; iso SING).

Fagraea carnosa auct. non Jack (1822): Leenhouts, Fl. Males. I, 6 (2) (1962) 331 pro parte, quoad *Sinclair & Kiah SFN 39931*.

(Fig. 17)

Small tree or hemi-epiphyte, height not recorded; trunk/stem diameter not recorded; bark smooth, grey-brown. **Leaves** narrow elliptic; (5–)6.5–10(–13.2) cm long, (1.5–)2–4 cm

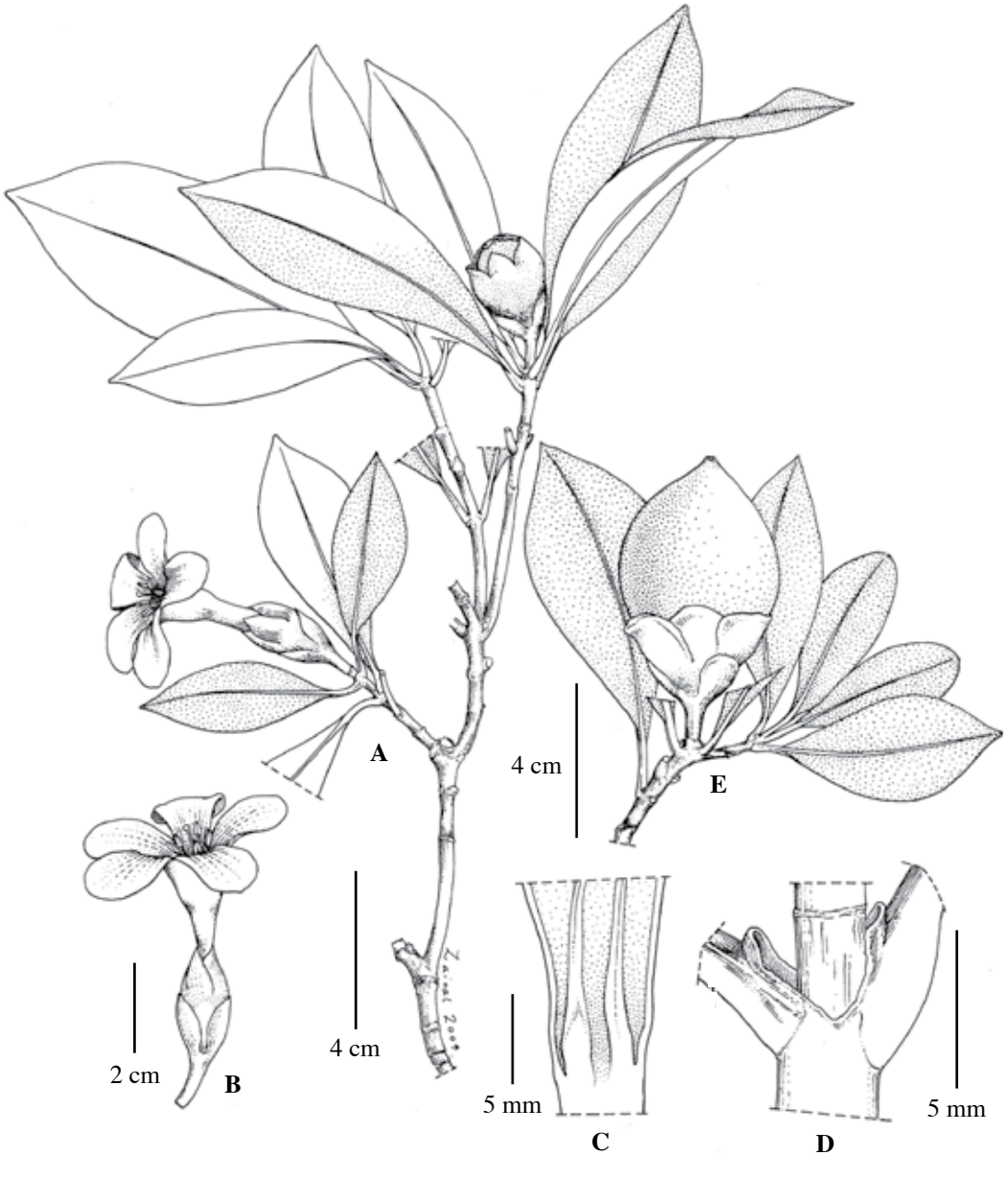

Fig. 17. *Fagraea latibracteata*. **A**. Leafy branch with a flower and a young fruit. **B**. Flower. **C**. Sectioned upper part of the corolla tube showing the attachment of the filament. **D**. Portion of stem node with ligules at the adaxial side of the petiole base. **E**. Leafy branch with fruit. A, D & E from *Cockburn FRI 7252* (holotype, KEP), B & C from *Sugumaran SM55* (KLU). (Drawing by Zainal Mustafa)

wide; *base* cuneate, not decurrent; *apex* short blunt cuspidate; *margin* entire, plane in dried material; thin-coriaceous; upper and lower *surfaces* glabrous, lower surface relatively smooth; *midrib* flat to sunken above, prominent below; *secondary veins* not visible on both sides; *tertiary and higher-order veins* obscure; petioles (8–)10–15 mm long, 1.5–2.5 mm thick, *petiolar sheaths* not fused along the interpetiolar median, each developing a scale-like ligule 0.5–1 mm high adaxially; petiole base without *auricles*. **Inflorescence** terminal, of a solitary flower, the whole about 0.8–1.3 cm long; *peduncle* indistinct or to 6 mm long, to 4 mm diameter; the rachis internode between peduncle and pedicel indistinct or to 7 mm long, 5 mm diameter. **Flowers** bisexual; *pedicels* inconspicuous; *floral bracts* conspicuous, rounded, 17–18 mm long, overlapping the calyx base; *calyx* 20–22 mm long (from the base to the lobe apices), glabrous, not to sometimes lenticellate, *calyx cup* 8–10 mm diameter, *calyx lobes* 5, broad-elliptic to rounded, 10–12 mm long, 10–12 mm wide, margins glabrous, base not auriculate; *corolla* broadly infundibular (the mouth more than 3–4 times the width of the lower narrowed part of the tube); cream to white; *lower subcylindrical part of the corolla tube* 13–15 mm long, 5–7 mm wide basally, *upper flared part* of the tube slightly inflated, 10–15 mm long, 16–22 mm wide at the top; *corolla lobes* 5, broad-obovate to suborbicular, 16–18 mm long, 13–15 mm wide, overlapping to the right; *stamens* 5, inserted (at the upper portion of the lower narrowed tubular part of the corolla tube or the lowermost portion of the upper flared part of the corolla tube); *filaments* 16–20 mm long, protruding 5–6 mm from the corolla mouth; *anthers* not seen; *style* not seen. **Infructescence** peduncle indistinct or to 3 mm long, to 3 mm thick. **Fruit** broadly ovoid to subglobose, *apex* conspicuously attenuate; smooth, the epidermis conspicuously wrinkling and separating upon drying; when mature to 32–55 mm long, 32–40 mm diameter; the base tightly clasped by the calyx lobes. **Seeds** numerous; ellipsoid to subovoid; 2–2.5 mm long, 1–1.5 mm wide; testa surface areolate.

DISTRIBUTION. North-eastern part of Peninsular Malaysia, in the states of Kelantan, Pahang and Terengganu.

HABITAT. Lowland forest.

SPECIMENS EXAMINED—PENINSULAR MALAYSIA. Johor. Endau-Rompin, Selai, trail to Takah Tinggi, *Sugumaran & Wong SM 55*, FL, 18 Oct 2005 (KLU). **Kelantan.** Ulu Kelantan, Relai Forest Reserve, *Cockburn FRI 7252*, FL, FR, 18 Oct 1967 (KEP). **Pahang.** Lipis, Taman Negara, K. Relau-K. Juram road, 440 m alt, *Saw FRI 44801*, FB, 8 Aug 1996 (KEP). **Terengganu.** 23rd mile Trengganu-Besut road, Belara F.R., *Sinclair & Kiah SFN 39931*, FB, 13 Jul 1953 (SING); Ulu Besut, near Bt. Jebak Puyoh, 200 ft [61 m] alt, *Cockburn FRI 8279*, FR, 2 May 1968 (KEP, SING).

Fagraea latibracteata closely resembles *F. larutensis* and *F. crassifolia*. The marked difference from these two species is that *Fagraea latibracteata* has larger floral bracts which are 17–18 mm long and overlap the calyx bases. *Fagraea larutensis* and *F. crassifolia* have small and acute floral bracts that are 6 mm long or less and located below the calyx base.

Another difference is that both *Fagraea larutensis* and *F. crassifolia* have branched 2- to few-flowered cymes, whereas *F. latibracteata* has solitary flowers.

ETYMOLOGY. In Latin, *lati-* and *bractea* mean broad bracts, referring to a key floral character of this species.

13. *Fagraea littoralis* Blume

Bijdr. (1826) 1021, Rumphia 2 (1838) 28, t. 74; Wong & Sugau, Sandakania 8 (1996) 73. TYPE: *Blume s.n.*, Java, Nusa Kambangan (holo L: acc no. 908127-530).

Fagraea forstenii Blume, Mus. Bot. 1 (1850) 166. TYPE: *Forsten s.n.*, Celebes (holotype L: acc. no. 908127-228)

Fagraea littoralis var. *amboinensis* Blume, Rumphia 2 (1838) 28, t. 74. TYPE: *Zippelius*, Moluccas, Ambon (L: acc. no. 908127-67).

Fagraea littoralis sensu Cammerloher, Bull. Jard. Bot. Btzg. III, 5 (1923) 328 pro parte, excl. *F. crassifolia* Blume in syn.

Fagraea ceilanica auct. non Thunberg (1782): Leenhouts, Fl. Males. I, 6 (2) (1962) 315 pro parte, quoad *F. littoralis* Blume & *F. forstenii* Blume in syn.

Fagraea obovata auct. non Wallich ex Roxburgh (1824): King & Gamble, J. As. Soc. Beng. 74 (2) (1908) 606 pro parte, quoad *Wray 2714 & 4269*; Ridley, Fl. Malay. Pen. 2 (1923) 418 pro parte, quoad 'Kamunting' (= *Wray 4269*).

(Fig. 18)

Hemi-epiphyte, height not recorded; trunk/stems diameter not recorded; bark smooth, grey-brown. **Leaves** elliptic to suborbicular; (5–)7–9(–10.5) cm long, (2.5–)3–5(–5.5) cm wide; *base* cuneate to rounded, not decurrent; *apex* short cuspidate; *margin* entire, plane in dried material; thin-coriaceous; upper and lower *surfaces* glabrous, lower surface minutely wrinkled under magnification; *midrib* flat above, prominent below; *secondary veins* 7–10 pairs if visible, obscure on both sides; *tertiary and higher-order veins* obscure; petioles 10–15 mm long, 1–3 mm thick, *petiolar sheaths* not fused along the interpetiolar median, each developing a scale-like ligule 0.5–1 mm high adaxially; petiole base without *auricles*. **Inflorescence** terminal, a 2- to few-flowered branched cyme, the whole about 3 cm long; *peduncle* indistinct or to 8 mm long, to 3 mm diameter; inflorescence *rachis* c. 22 mm long, c. 2.5 mm diameter, with 1–3 pairs of primary branches; basal primary *branch pairs* c. 12 mm long, c. 2 mm diameter and not rebranched. **Flowers** bisexual; *pedicels* 2–3 mm long, 2–3 mm diameter; *floral bracts* small, acute, 1.5–2 mm long, located below the calyx; *calyx* 8–10 mm long (from the base to the lobe apices), glabrous, to sometimes lenticellate, *calyx*

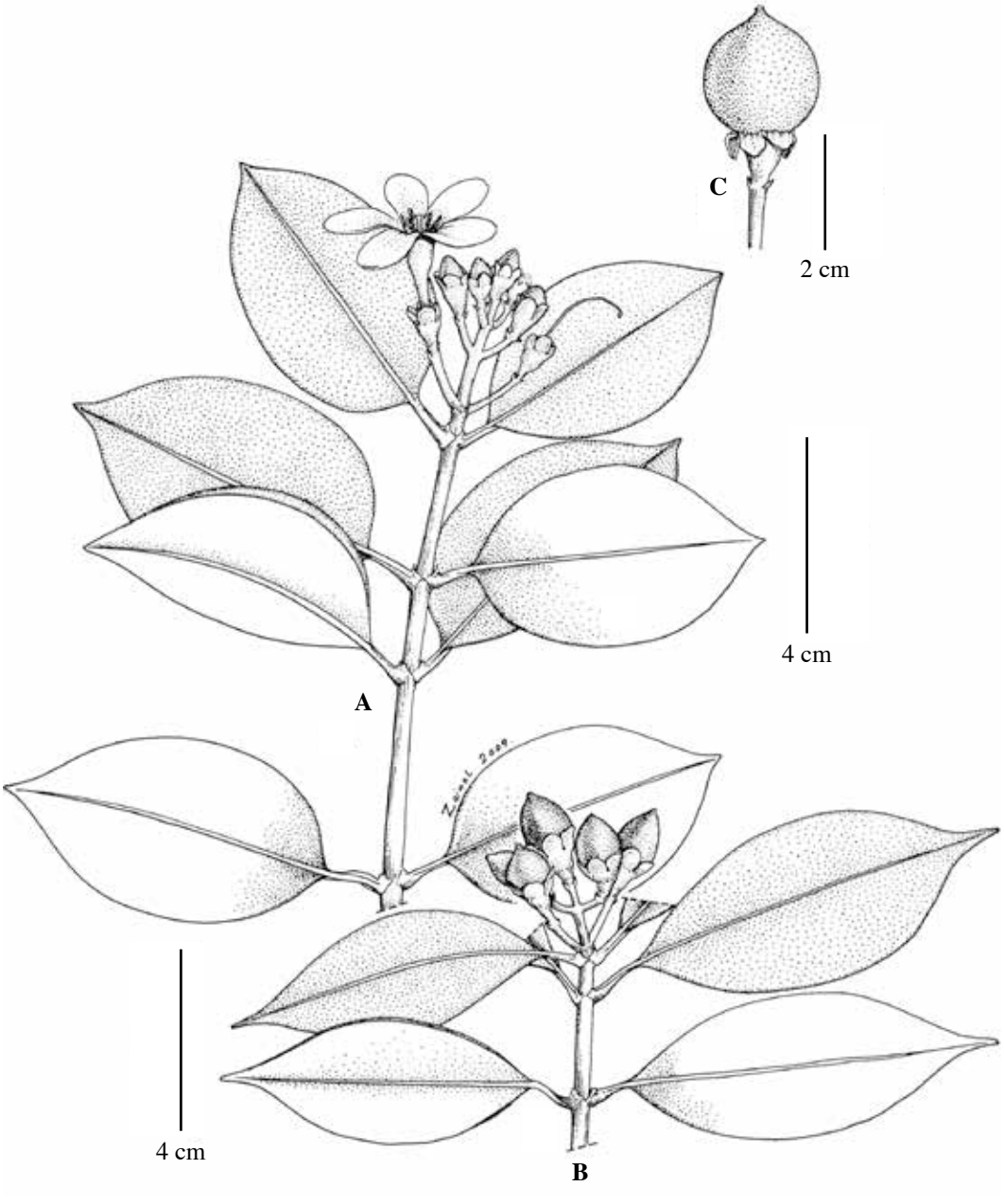

Fig. 18. *Fagraea littoralis*. **A**. Leafy branch with an inflorescence and open flower. **B**. Leafy branch with an infructescence. **C**. Fruit. A from *Wray 4268* (SING), B from *Wray 2714*, C from *Spare SFN 36006*. (Drawing by Zainal Mustafa)

cup 2.5–3 mm diameter, *calyx lobes* 5, broad-elliptic to rounded, 5–6 mm long, 5–7 mm wide, margins glabrous, base not auriculate; *corolla* broadly infundibular (the mouth more than 3–4 times the width of the lower narrowed part of the tube); cream to white; *lower subcylindrical part of the corolla tube* 10–16 mm long, 3–3.5 mm wide basally, *upper flared part* of the tube slightly inflated, 15–16 mm long, 12–14 mm wide at the top; *corolla lobes* 5, broad-obovate to suborbicular, 15–22 mm long, 10–13 mm wide, overlapping to the right; *stamens* 5, inserted at the upper portion of the lower narrowed tubular part of the corolla tube or the lowermost portion of the upper flared part of the corolla tube; *filaments* 23–25 mm long, protruding to 12–13 mm from the corolla mouth; *anthers* versatile, hastate, 4–5 mm long, 1.5–2 mm wide, each anther sac somewhat ellipsoid; *style* 32–35 mm long, protruding to 3–7 mm from the corolla mouth in the open flower; *stigma* basically shallowly 2-lobed, the lobes broadly suborbicular and recurving when receptive and the whole sometimes resembling a subpeltate structure 1.5–2 mm across. **Infructescence** peduncle indistinct or to 4 mm long, 3 mm thick. **Fruit** broadly ovoid to subglobose, *apex* slightly pointed to rounded; smooth, the epidermis conspicuously wrinkling and separating upon drying; when mature to 18–20 mm long, 13–15 mm diameter; the base loosely surrounded by the calyx lobes (recurved and folding backwards in dried material). **Seeds** numerous; ellipsoid to subovoid; 1.5–2 mm long, 1–1.5 mm wide; testa surface areolate.

DISTRIBUTION. Java, Malay Peninsula, Sulawesi, Maluku.

HABITAT. Coastal sites not far from the sea.

SPECIMENS EXAMINED—PENINSULAR MALAYSIA. Kelantan. Sungai Kelantan, *Ridley 9157*, FL, Dec 1897 (SING). **Perak.** Larut, Kamunting, *Wray 4269*, FL, 1894 (SING); Matang, *Wray 2714*, FR, Aug 1888 (SING); Sungai Krian Estate, sea level, *Spare SFN 36006*, FR, 10 Jul 1938 (SING); Simpang, plains, *Wray 2248*, FR, no date (SING). **Selangor.** Batang Berjuntai, *Ridley 7551*, FB, FR, Mar 1891 (SING). **JAVA** (INDONESIA). Nusa Kambangan, *Blume s.n.*, FR, no date (L). **SULAWESI** (CELEBES) (INDONESIA). Tondano, *Forsten s.n.*, FR, no date (L).

The taxon in Peninsular Malaysia is the typical variety as represented by Javanese material; Wong & Sugau (1996) described *Fagraea littoralis* var. *borneensis* from Borneo, which has longer primary branches of the inflorescence (2–6 cm long) and longer calyx lobes (7–10 mm long).

14. *Fagraea oblonga* King & Gamble

J. As. Soc. Beng. 74 (2) (1908) 612; Ridley, Fl. Malay. Pen. 2 (1923) 417; Wong & Sugau, Sandakania 8 (1996) 78. LECTOTYPE (Wong & Sugau, Sandakania 8 (1996) 78): *King's Coll. 5430*, Perak, Larut (K).

(Fig. 19)

Fagraea ceilanica auct. non Thunberg (1782): Leenhouts, Fl. Males. I, 6 (2) (1962) 315 pro parte, quoad *Burkill & Haniff SFN 12982*, *Henderson FMS Mus. 11128*, *Purseglove P 4141*, *Ridley 12069* & *s.n.*, March 1892, Perak Tea Gardens; Kochummen, Tree Fl. Malaya 2 (1973) 271 pro parte, quoad *F. oblonga* King & Gamble in syn.

Fig. 19. *Fagraea oblonga*. **A.** Habit of tree developing on rocky streambank. **B.** Leafy branch with infructescence. (Photos: M. Sugumaran)

Small tree or hemi-epiphyte, usually to 12 m tall or 10 m high or more on trees; trunk/stems to c. 15 cm diameter; bark smooth, grey to dark-brown. **Leaves** elliptic-lanceolate to subobovate; (11–)15–28(–36) cm long, 4–8(–10.7) cm wide; *base* cuneate to rounded, not decurrent; *apex* cuspidate; *margin* entire, recurved in dried material; thin-coriaceous; upper and lower *surfaces* glabrous, lower surface relatively smooth; *midrib* flat above, prominent below; *secondary veins* 7–10 pairs if visible, upper side faint and immersed in the lamina, lower side obscure; *tertiary and higher-order veins* obscure; petioles (20–)25–50(–60) mm long, 2–3 mm thick, *petiolar sheaths* not fused along the interpetiolar median, each developing a scale-like ligule 0.5–1.5 mm high adaxially; petiole base without *auricles*. **Inflorescence** terminal, a few- to many-flowered branched cyme, the whole about 1.2–3.6 cm long; *peduncle* indistinct or to 4 mm long, to 5 mm diameter; inflorescence *rachis* 1.2–2.7(–3.2) cm long, (1–)3–4 mm diameter, with 2–3 pairs of primary branches; basal primary *branch pairs* 8–27 mm long, 1–3 mm diameter and not or rebranched to 1(–2) orders, more distal branch

pairs less so. **Flowers** fragrant; bisexual; *pedicels* 5–10 mm long, 1.5–3 mm diameter; *floral bracts* indistinct or present as a very small structure less than 0.5 mm long below the calyx; *calyx* 10–15 mm long (from the base to the lobe apices), glabrous, lenticellate, *calyx cup* 4–5 mm diameter, *calyx lobes* 5, broad-elliptic to rounded, 5–7 mm long, 5–6 mm wide, margins glabrous, base not auriculate; *corolla* broadly infundibular (the mouth more than 3–4 times the width of the lower narrowed part of the tube); cream to white; *lower subcylindrical part of the corolla tube* 10–20 mm long, 3–4 mm wide basally, *upper flared part* of the tube (when distinct) slightly inflated, 11–16 mm long, 10–15 mm wide at the top; *corolla lobes* 5, broad-obovate to suborbicular, 12–18 mm long, 8–10 mm wide, overlapping to the right; *stamens* 5, inserted at the upper portion of the lower narrowed tubular part of the corolla tube or the lowermost portion of the upper flared part of the corolla tube; *filaments* 18–22 mm long, protruding to c. 8 mm from the corolla mouth; *anthers* versatile, hastate, 5–6 mm long, 1.5–2 mm wide, each anther sac somewhat ellipsoid; *style* 22–30 mm long, protruding to 1–6 mm from the corolla mouth in the open flower; *stigma* basically shallowly 2-lobed, the lobes broadly suborbicular and recurving when receptive and the whole sometimes resembling a subpeltate structure 1–1.5 mm across. **Infructescence** peduncle indistinct or to 3 mm long, to 4 mm thick. **Fruit** broadly ovoid, *apex* rounded; smooth, the epidermis conspicuously wrinkling and separating upon drying; when mature to 32–46 mm long, 20–28 mm diameter; the base loosely surrounded to tightly clasped by the calyx lobes. **Seeds** numerous; ellipsoid to subovoid; 2–2.5 mm long, 1–1.5 mm wide; testa surface areolate.

DISTRIBUTION. Borneo, Malay Peninsula, Sumatra.

HABITAT. Lower montane forest, occasionally lowland forest on the foothills of mountains.

SPECIMENS EXAMINED—PENINSULAR MALAYSIA. Kelantan. Gua Musang, Gunung Chamah, 947 m alt, *Hairul FRI 72264*, FR, 31 Jul 2010 (A, K, KEP, L, SAN, SAR, SING). **Negeri Sembilan.** Jelebu, Berembun F.R., Gunung Telapak Buruk, 1085 m alt, *Lim FRI 56592*, FR, 9 Apr 2008 (A, K, KEP, L, SAN, SING), *Imin FRI 63057*, FR, 11 Apr 2008 (K, KEP, L, SAN, SAR, SING). **Pahang.** Cameron Highlands, 3500 ft [1067 m] alt, *Henderson SFN 32967*, FL, 1 May 1937 (KEP), 4000 ft [1219 m] alt, *Quaife s.n.*, FR, Oct 1940 (SING), Boh Plantations, *Nur SFN 32967*, FB, 1 May 1937 (SING), Sungai Bertam, below Robinson's Falls, 3500 ft [1067 m] alt, *Henderson SFN 11128*, FB, FL, 18 Jun 1923 (SING); Fraser's Hill, waterfall, 3800 ft [1158 m] alt, *Manurung 27*, FR, 17 Jun 1972 (KLU), 4000–4370 ft [1219–1332 m] alt, *Burkill & Holttum SFN 7861*, FR, 16–30 Sep 1922 (KEP, SING), 4500 ft [1372 m] alt, *Mohd Shah MS 2730*, FR, 30 Aug 1972 (KEP, SING), Bukit Jeriau, *Kochummen FRI 19451*, FL, 11 May 1976 (KEP, SING), Farm Road, 3800 ft [1158 m] alt, *Purseglove P 4141*, FR, 17 Apr 1955 (SING), Gap, *Hashim KEP 1084*, FR, 3 Aug 1917 (KEP), *Sugumaran & Lee SM 176*, leafy branch only, 5 Mar 2008 (KLU), Jeriau (Farm) road, 3500-4000 ft [1067–1219 m] alt, *Burkill, Shah & Noor HMB 2421*, FR, 20 Aug 1960 (KEP, SING), Jeriau Road, *Stone, Mahmud & students BCS 10804*, FR, 17 Jun 1972 (KLU), Jeriau Waterfalls, *Sugumaran et al. SM 165*, FR, 3 Jan 2008 (KLU), SM 214,

FR, 22 May 2008 (KLU), Ulu Jeriau, 3500 ft [1067 m] alt, *Loh FRI 19156*, FR, 27 Aug 1971 (KEP, SING); Genting Highlands, around Awana Area, *Sugumaran & Lee SM 175*, leafy branch only, 4 Mar 2008 (KLU); Telom, *Ridley 13838*, FR, Nov 1908 (SING); Ulu Sungai Boh, 3000 ft [914 m] alt, *Whitmore FRI 20117*, FR, 3 Jun 1971 (KEP). **Perak.** *Scortechini s.n.*, FR, 21 Jun 1909 (K, SING); Cottage, *Ridley 5558*, FR, Jun 1893 (SING); Maxwell's Hill, *Wray s.n.*, FB, FL, no precise date, 1889 (SING), *Wray 2992*, FR, Sep 1888 (SING); Birch's Hill, 3800 ft [1158 m] alt, *Burkill & Haniff SFN 12982*, FL, FR, 3 Mar 1924 (SING); Larut, 2500–3000 ft [762–914 m] alt, *King's Coll. 5430*, FR, no precise date, Jan 1884 (K); Larut Hill, 1100 m alt, *Damahuri FRI 36505*, FR, 18 Oct 1988 (KEP); Maxwell's Hill, 3100 ft [945 m] alt, *Burkill & Haniff SFN 12685*, FR, 6 Mar 1924 (SING), *Sugumaran SM 4*, leafy branch only, 12 Sep 2003 (KLU); Taiping Hill, 3100 ft [945 m] alt, *Henderson SFN 11838*, FR, 6 Mar 1924 (SING); Tea Gardens, *Ridley s.n.*, FR, Mar 1892 (SING). **Selangor.** Selangor border, Semangkok Pass, *Ridley 12069*, FR, Aug 1904 (SING); near Ginting Highlands College site, 3000 ft [914 m] alt, *Kochummen FRI 16514*, FL, FR, 9 May 1972 (KEP, SING); Selangor/Pahang, Gunung Ulu Kali, 5200 ft [1585 m] alt, *Mahmud s.n.*, FR, Apr 1970 (KLU).

Leenhouts (1962) acknowledged that *Fagraea oblonga* is "a very characteristic form" (of his heterogeneous *F. ceilanica*). The generally elongate, clearly petiolate leaves with parchment-like lower surfaces when dried afford ready recognition of this species.

15. *Fagraea renae* K.M.Wong & Sugau

Sandakania 8 (1996) 82, excl. *Rena S 40346* (= *F. ridleyi* King & Gamble). TYPE**:** *Anderson S 19121*, Sarawak, Bau, Bidi (holo SAN; iso K, L, SAR, SING). x

Fagraea vaginata King & Gamble, J. As. Soc. Beng. 74 (2) (1908) 610 pro parte, excl. speciminia origine Javae (= *F. blumei* G. Don).

Fagraea blumei auct. non G. Don (1837): Leenhouts, Fl. Males. I, 6 (2) (1962) 320 pro parte, excl. *F. plumeriaeflora* DC. & *F. vaginata* King & Gamble in syn., excl. speciminia origine 'Java' & 'Celebes'.

(Fig. 20)

Small tree or hemi-epiphyte, usually to 10–13 m tall or 10–12 m high on trees; trunk/stems to c. 15 cm diameter; bark smooth, grey-brown; branch internodes terete, smooth. **Leaves** elliptic to subobovate; (10–)15–21(–23.5) cm long, (4.5–)6–10(–11.5) cm wide; *base* cuneate, not decurrent; *apex* short cuspidate; *margin* entire, plane recurved in dried material; thin-coriaceous; upper and lower *surfaces* glabrous, lower surface relatively smooth; *midrib* flat above, prominent below; *secondary veins* (4–)5–7 pairs, upper side faint and immersed in the lamina, lower side prominent; *tertiary and higher-order veins* obscure; petioles (2–)2.5–3.5(–4) cm long, 2–3(–4) mm thick, *petiolar sheaths* not fused

Fig. 20. *Fagraea renae*, habit. (Photo: M. Sugumaran)

along the interpetiolar median, each developing a scale-like ligule 1–2 mm high adaxially; petiole base without *auricles*. **Inflorescence** terminal, a few- to many-flowered branched cyme, the whole about 3.5–5.5(–6.2) cm long; *peduncle* indistinct; inflorescence *rachis* 3.5–5.5(–6.2) cm long, 2.5–3(–4) mm diameter, with 2–3 pairs of primary branches; basal primary *branch pairs* (1–)2.8–5(–6) cm long, 2–4(–5) mm diameter and rebranched to 1–2(–3) orders, more distal branch pairs less so. **Flowers** fragrant; bisexual; *pedicels* 5–10 mm long, 3–4 mm diameter; *floral bracts* small, acute, 2–4 mm long, located below the calyx; *calyx* (from the base to the lobe apices) 15–22 mm long, glabrous, lenticellate, *calyx cup* 5–6 mm diameter, *calyx lobes* 5, broad-elliptic to rounded, 5–10 mm long, (6–)14–16 mm wide, margins glabrous, base not auriculate; *corolla* slender trumpet-shaped (tubular and very gradually widening towards the apex); cream to white; *lower subcylindrical part of the corolla tube* 18–22 mm long, 4–6 mm wide basally, *upper flared part* of the tube slightly inflated, (5–)10–12 mm long, 10–15 mm wide at the top; *corolla lobes* 5, broad-obovate to suborbicular, 19–27 mm long, 10–15 mm wide, overlapping to the right; *stamens* 5, inserted at the upper portion of the lower narrowed tubular part of the corolla tube or the lowermost portion of the upper flared part of the corolla tube; *filaments* 20–26 mm long, protruding

to 10–14 mm from the corolla mouth; *anthers* versatile, hastate, 5–6 mm long, 2–2.5 mm wide, each anther sac somewhat ellipsoid; *style* 28–32 mm long, not to slightly protruding to c. 5 mm from the corolla mouth in the open flower; *stigma* basically shallowly 2-lobed, the lobes broadly suborbicular and recurving when receptive sometimes resembling a subpeltate structure 1.5–2 mm across. **Infructescence** peduncle indistinct. **Fruit** broadly ovoid, *apex* conspicuously attenuate; smooth, the epidermis conspicuously wrinkling and separating upon drying; when mature to 35–40(–47) mm long, 2–2.5 mm diameter; the base tightly to loosely surrounded by the erect calyx lobes. **Seeds** numerous; ellipsoid to subovoid; 2–2.5 mm long, 1–1.5 mm wide; testa surface areolate.

DISTRIBUTION. Borneo (Sabah, Sarawak), Malay Peninsula.

HABITAT. Lowland to lower montane forests, often by streams; also in secondary forests and on limestone outcrops.

SPECIMENS EXAMINED—PENINSULAR MALAYSIA. Johor. Gunung Panti West, 1000 ft [305 m] alt, *Whitmore FRI 15697*, FB, 13 Dec 1970 (KEP); Pahang border, Labis Forest Reserve, 500 ft [152 m] alt, *Samsuri & Ahmad SA 516*, FR, 19 Feb 1971 (KEP). **Kedah.** Gunung Inas F.R., compt. 8, 3000 ft [914 m] alt, *Whitmore FRI 4661*, FR, 7 Feb 1968 (KEP). **Pahang.** Ulu Kuantan, 400 ft [122 m] alt, *Symington & Kiah SFN 28923*, FB, FL, 17 Jun 1934 (SING). **Perak.** *Wray 1992*, FL, FR, 1885 (SING); Huks Kenas, *Scortechini 817*, FB, May 1884 (SING); Larut, 300 ft [91 m] alt, *King's Coll. 4238*, FL, May 1883 (SING), 500–600 ft [152–183 m] alt, *King's Coll. 3868*, FL, FR, Feb 1883 (L, SING); Slim Hills F.R., banks of Sungai Geliting, 2000 ft [610 m] alt, *Whitmore FRI 730*, FR, 5 Sep 1966 (KEP, SING); Tapah Hills, Sungai Woh, *Ng FRI 1373*, FB, 14 Jul 1966 (K, KEP, L); Ulu Bubong, *King's Coll. 10124*, FB, FL, Jun 1886 (SING). **Selangor.** Bukit Takun, northeast side, 500 ft [152 m] alt, *Chin 569*, leafy twig only, 31 Dec 1970 (KLU); Genting Sempah ridge, 800 m alt, *Stone 15168*, FR, 21 May 1982 (KLU); Gunung Ulu Kali, 5200 ft [1585 m] alt, *Mahmud s.n.*, FR, May 1972 (KLU); Rawang, *Ridley 7607*, FL, FR, May 1896 (SING); Sungai Tua, *Sugumaran et al. SM 26*, FR, 20 Jan 2005 (KLU, SING), recreation site, *Sugumaran et al. SM 177*, FR, 6 Mar 2008 (KLU); Templer Park, Bukit Anak Takun, *Sang JS 67*, FB, FR, 6 Dec 1995 (KEP); Templer Park Country Club Golf Course, stone outcrop 100 m from Bukit Takun, *Sugumaran & Vijayandra SM 98*, FR, 8 Jul 2007 (KLU); Ulu Langat, *Gadoh KL 1592*, FR, 8 Jul 1959 (KEP, SING); Ulu Gombak, 2000 ft [610 m] alt, *Saw FRI 34065*, FB, FR, Apr 1985 (KEP). **Terengganu.** Ulu Brang, Gunung Padang, Camp 1 near K. Lallang, 300 ft [91 m] alt, *Whitmore FRI 12610*, FB, 16 Sep 1969 (KEP, SING).

A number of specimens of *Fagraea renae* from Peninsular Malaysia have been earlier misidentified by Kochummen in the Kepong herbarium (KEP) as *F. ridleyi*, although this is not evident through the descriptions in his brief key (Kochummen 1973). These include: *Gadoh KL 1592*, *Whitmore FRI 4661*, *12610* and *15697*.

Bornean material of *Fagraea renae* available after the account of Leenhouts (1962) were also misidentified as *F. ridleyi*. These include *Aban SAN 81130*, *Aban & Leopold SAN 80987*, *Cockburn SAN 84984 & 85112*, *Dadau SAN 44903*, *Free & Sumbing SAN 79152* and *Muin Chai SAN 25981* (all at L and SAN).

16. *Fagraea ridleyi* King & Gamble

J. As. Soc. Beng. 74 (2) (1908) 612; Ridley, Fl. Malay. Pen. 2 (1923) 417; Leenhouts, Fl. Males. I, 6 (2) (1962) 320; Kochummen, Tree Fl. Malaya 2 (1973) 271; Wong & Sugau, Sandakania 8 (1996) 87. LECTOTYPE (Leenhouts, Fl. Males. I, 6 (2) (1962) 320): *Ridley 5845*, Singapore (SING; isolecto K).

Fagraea renae K.M.Wong & Sugau, Sandakania 8 (1996) 82 pro parte, quoad *Rena S 40346*.

(Fig. 21)

Small tree or hemi-epiphyte, usually to 6 m tall or up to 30 m high or more on trees; trunk/stems to c. 13 cm diameter; bark smooth to lenticellate, dark-brown; branch internodes terete, smooth. **Leaves** broad elliptic to subobovate; (13–)17–22(–25.5) cm long, (7.5–)9–12(–16) cm wide; *base* cuneate, not decurrent; *apex* rounded; *margin* entire, plane in dried material; thick-coriaceous; upper and lower *surfaces* glabrous, lower surface relatively smooth; *midrib* prominent above towards the leaf base but flat to sunken nearer the leaf apex, prominent below; *secondary veins* (3–)4–5, upper side faint and immersed in the lamina, lower side prominent; *tertiary and higher-order veins* obscure; petioles (1.5–)2–3(–4.3) cm long, 3–5(–6) mm thick, *petiolar sheaths* not fused along the interpetiolar median, each developing a scale-like ligule 1–3 mm high adaxially; petiole base without *auricles*. **Inflorescence** terminal, a 2- to few-flowered branched cyme, the whole about 5–6 cm long; *peduncle* distinct, 2.5–3.5 cm long, 7–9 mm diameter; inflorescence *rachis* 25–30 mm long, 5–8 mm diameter, with 1–2 pairs of primary branches; basal primary *branch pairs* 20–30 mm long, 3–4 mm diameter and rebranched to 1(–2) orders, more distal branch pairs less so. **Flowers** bisexual; *pedicels* 15–17 mm long, 3–5 mm diameter; *floral bracts* small, acute, 3–4 mm long, located below the calyx; *calyx* 33–35 mm long (from the base to the lobe apices, glabrous, lenticellate, *calyx cup* 8–10 mm diameter, *calyx lobes* 5, broad-elliptic to rounded, 13–15 mm long, 13–15 mm wide, margins glabrous, base not auriculate; *corolla* broadly infundibular (the mouth more than 3–4 times the width of the lower narrowed part of the tube); cream to white; *lower subcylindrical part of the corolla tube* 18–20 mm long, 3–6 mm wide basally, *upper flared part* of the tube slightly inflated, 14–17 mm long, 14–18 mm wide at the top; *corolla lobes* 5, broad-obovate to suborbicular, 17–20 mm long, 10–15 mm wide, overlapping to the right; *stamens* 5, inserted at the upper portion of the lower narrowed tubular part of the corolla tube or the lowermost portion of the upper flared part of the corolla tube; *filaments* 25–28 mm long, protruding to c. 10 mm from the corolla mouth; *anthers* versatile, hastate, 8–10 mm long, 2–4 mm wide, each anther sac somewhat ellipsoid; *style* 40–45 mm long, protruding to c. 8 mm from the corolla mouth in the open flower; *stigma* basically shallowly 2-lobed, the

Fig. 21. *Fagraea ridleyi*. **A.** Fruiting leafy branches, with (inset) fruit cluster. **B.** Resinous shoot tip and leaves with glands (extrafloral nectaries). **C.** Node with petiolar sheath. (Photo credits: K.M. Wong except inset in A, M. Sugumaran)

lobes broadly suborbicular and recurving when receptive, the whole sometimes resembling a subpeltate structure c. 2 mm across. **Infructescence** *peduncle* distinct, 15–20(–35) mm long, 4–6 mm thick. **Fruit** broadly ovoid to subglobose, *apex* conspicuously attenuated; smooth, the epidermis conspicuously wrinkling and separating upon drying; when mature to 40–50(–55) mm long, 20–32(–42) mm diameter; the base tightly clasped by the calyx lobes. **Seeds** numerous; ellipsoid to subovoid; 2–2.5 mm long, 1–1.5 mm wide; testa surface areolate.

DISTRIBUTION. Borneo, Malay Peninsula, Lingga.

HABITAT. Lowland rain forest (including some *kerangas* forest sites in Borneo).

SPECIMENS EXAMINED—PENINSULAR MALAYSIA. Johor. Mt. Ophir, 800 ft [244 m] alt, *Wong FRI 32191*, FR, 19 Mar 1981 (KEP); Ulu Endau, 1200 ft [366 m] alt, *Cockburn FRI 8026*, FR, 31 Mar 1968 (KEP, SING). **Melaka.** Mt. Ophir, *Ridley 3785*, FR, no precise date, 1892 (SING). **Pahang.** Bukit Ibam, Muazam Shah, *Low LYW 227*, FR, 27 Nov 2008 (KLU, SING); Jalan Sepadan, *Machado* s.n., FR, 13 May 1903 (SING). **LINGGA** (INDONESIA). Sungai Bei, *Hullett s.n.*, FB, FR, 23 Jul 1893 (SING). **SINGAPORE.** Botanic Gardens, *Henderson SFN 1381*, FR, Dec 1921 (SING), cultivated near Bandstand, probably from Bukit Timah, *Ridley s.n.*, FR, Aug 1899 (SING: barcode SING0011372), Lawn H, *Nur SFN 18191*, FR, 28 Feb 1928 (KEP); Bukit Timah, *Ridley* (no. indistinct), leaves only, 12 Aug 1889 (SING), *Ridley 2767*, FR, no precise date, 1891 (SING), *Ridley 5845*, FR, no precise date, 1894 (K, SING), *Ridley 11363*, FL, no precise date, 1902 (SING); between Sungai Karang and Sungai Morai, *Sinclair SFN 40176*, leafy branch only, 19 Dec 1953 (SING).

The non-auriculate, distinctly petiolate leaves with a very coarsely thick-coriaceous texture and prominent secondary veins on the lower surface when dried, and robust inflorescence axes and flower calyces, readily distinguish this species (see Key).

17. *Fagraea splendens* Blume

Mus. Bot. 1 (1850) 168; Wong & Sugau, Sandakania 8 (1996) 87. TYPE: *Korthals s.n.*, Borneo (holo L: acc. no. 908127-639 & barcode L0004984).

Fagraea acuminatissima Merr., J. Str. Br. R. As. Soc. 77 (1917) 232; Leenhouts, Fl. Males. I, 6 (2) (1962) 319; Kochummen, Tree Fl. Malaya 2 (1973) 271. TYPE: *Native coll. 686*, Sarawak (iso K, L).

Fagraea heterophylla Blume, Mus. Bot. 1 (1850) 168. TYPE: *Korthals*, *s.n.*, Borneo, Banjermarsing (holo L: acc. no. 908127-518 & barcode L0004986).

Fagraea longicuspis Gand., Bull. Soc. Bot. Fr. 65 (1918) 58. TYPE: *Curtis 3013*, Pulau Penang, May 1893 (iso SING).

Fagraea ceilanica auct. non Thunberg (1782): Leenhouts, Fl. Males. I, 6 (2) (1962) 315 pro parte, quoad *F. heterophylla* Blume & *F. splendens* Blume in syn.

Fagraea obovata auct. non Wallich ex Roxburgh (1824): King & Gamble, J. As. Soc. Beng. 74 (2) (1908) 606 pro parte, quoad *Curtis 246*, *King's coll. 4878*, *Wray 2115*, *3075*, *4181*; Ridley, Fl. Malay. Pen. 2 (1923) 418 pro parte, quoad specim. *Curtis* (Kwala Lumpur), *Burn-Murdoch* (Gombak), *King's coll.* (Ulu Bubong), *Wray* (Batu Togoh); Craib & Kerr, Fl. Siam. Enum. 3 (1) (1951) 56.

(Fig. 1A & B, 2D, 3D, 5C, 22)

Small shrub or hemi-epiphyte, usually to 3 m tall or 10 m high or more on trees; trunk/stems to c. 10 cm diameter; bark smooth, grey to dark-brown. **Leaves** elliptic to obovate; (5.5–)10–20(–23) cm long, (2.8–)4–8(–9.3) cm wide; *base* cuneate to rounded, not decurrent; *apex* short cuspidate; *margin* entire, recurved in dried material; thin-coriaceous; upper and lower *surfaces* glabrous, lower surface relatively smooth under magnification; *midrib* flat to sunken above, prominent below; *secondary veins* 5–7 pairs if visible, otherwise obscure on both sides; *tertiary and higher-order veins* obscure; petioles (5–)20–35(–47) mm long, (1.5–)2–3(–4) mm thick, *petiolar sheaths* not fused along the interpetiolar median, each developing a scale-like ligule 0.5–1 mm high adaxially; petiole base without *auricles*. **Inflorescence** terminal, a few- to many-flowered branched cyme, the whole about 5–10 mm long; *peduncle* indistinct or to 5 mm long, to 5 mm diameter; inflorescence *rachis* 4–8 mm long, 2–4 mm diameter, with (1–)2 pairs of primary branches; basal primary *branch pairs* 3–4 mm long, 2–3 mm diameter and not rebranched. **Flowers** bisexual; *pedicels* 2–4 mm long, 2.5–4 mm diameter; *floral bracts* small, acute, 2–3 mm long, located below the calyx; *calyx* 6–10 mm long (from the base to the lobe apices), glabrous, not to sometimes lenticellate, *calyx cup* 3–5 mm diameter, *calyx lobes* 5, broad-elliptic to rounded, 4–6 mm long, 4–6 mm wide, margins glabrous, base not auriculate; *corolla* broadly infundibular (the mouth more than 3–4 times the width of the lower narrowed part of the tube); cream

Fig. 22. *Fagraea splendens*, infructescences terminating leafy shoots. (Photo: K.M. Wong)

to white; *lower subcylindrical part of the corolla tube* 12–18(–20) mm long, 2–4 mm wide basally, *upper flared part* of the tube slightly inflated, 13–17 mm long, 10–15 mm wide at the top; *corolla lobes* 5, broad-obovate to suborbicular, 13–20(–23) mm long, 6–12 mm wide, overlapping to the right; *stamens* 5, inserted (at the upper portion of the lower narrowed tubular part of the corolla tube or the lowermost portion of the upper flared part of the corolla tube); *filaments* 20–25 mm long, protruding to 7–8 mm from the corolla mouth; *anthers* versatile, hastate, 5–6 mm long, 2–2.5 mm wide, each anther sac somewhat ellipsoid; *style* 40–45 mm long, protruding to 8–15 mm from the corolla mouth in the open flower; *stigma* basically shallowly 2-lobed, the lobes broadly suborbicular and recurving when receptive and the whole sometimes resembling a subpeltate structure 1–2 mm across. **Infructescence** peduncle indistinct or to 5 mm long, to 4 mm thick. **Fruit** narrowly ellipsoid, *apex* conspicuously attenuate; smooth, the epidermis conspicuously wrinkling and separating upon drying; when mature to 20–30 mm long, 12–16 mm diameter; the base tightly clasped by the calyx lobes. **Seeds** numerous; ellipsoid to subovoid; 2–2.5 mm long, 1–1.5 mm wide; testa surface areolate.

DISTRIBUTION. Borneo, Malay Peninsula, Sumatra.

HABITAT. Sea level to lower montane forest; also in peat swamp and freshwater swamp forests.

SPECIMENS EXAMINED—PENINSULAR MALAYSIA. Johor. Kota Tinggi-Mersing road, *Sinclair SFN 10608*, FB, 23 Jun 1961 (SING); Gunung Panti Forest Reserve, 1700 ft [518 m] alt, *Samsuri SA 315*, FL, 5 Jul 1970 (SING); Gunung Panti, Recreational forest, *Sugumaran SM 208*, leafy twig only, 29 Apr 2008 (KLU); Gunung Panti West, 1684 ft [513 m] alt, *Stone 14616*, FR, 25 Nov 1980 (KLU), below 1500 ft [457 m] alt, *Heaslett 7*, FL, 25 Jun 1967 (SING); Mawai-Jemaluang road, *Corner s.n.*, FR, 15 May 1935 (SING); Pontian, Pengkalan Raja, peat forest, *Henderson SFN 36671*, FR, 30 Jun 1939 (KEP); Tanjung Bunga, *Ridley 6312*, FL, 1894 (SING). **Kedah.** Langkawi, Gunung Raya Virgin Jungle Reserve, *Zahid et al. ZMS 42*, FL, 27 Apr 2004 (KLU), road to Ayer Hangat, Kisap F.R., *Allen KEP 79285*, FL, 13 May 1957 (KEP), Telaga Tujuh, c. 125 m alt, *Stone 15938*, FB, FL, 26 Apr 1987 (KEP); Polo Songsong, *Curtis s.n.*, FB, FL, Jun 1890 (SING), *Ridley s.n.*, FB, Jun 1890 (SING); Sik, Bukit Enggang, *Shah & Tan MS 5051*, FR, 5 May 1993 (SING). **Kelantan.** Jeli F.R., Compt. 20, *Chelliah FRI 6513*, FR, 30 Jun 1968 (KEP, SING). **Melaka.** no locality, *Alvins 179*, FR, 10 Dec 1884 (SING); stream below Gunung Mering, *Ridley 3182*, FL, Jun 1892 (SING). **Pahang.** Fraser's Hill, *Keng, Wee & Honours students T3/48*, FR, 11 Nov 1981 (SING); Gunung Tapis, 1500 ft [457 m] alt, *Chan FRI 19905*, FR, 29 Sep 1971 (KEP, SING); Jerantut, confluence of Sungai Tekam and Sungai Balol, *Ng & Beltran FRI 6389*, FR, 25 Jun 1972 (KEP); Rompin, Pulau Lang, *Mohamad KEP 14972*, FB, FL, 13 Jun 1929 (KEP); Sungai Bebar, *Sugumaran SM 38*, leafy twig only, 11 Apr 2005 (KLU). **Penang.** *Curtis 346*, FB, FL, Jul 1885 (SING); Batu Feringy, *Curtis 3013*, FR, May 1894 (SING); Penang Hill near Craig Hotel, *Henderson SFN 21412*, FL, 19 Jun 1937 (SING); Penang

Hill near Richmond Hotel, *Sugumaran & Vijayandra SM 167*, leafy twig only, 16 Feb 2008 (KLU); Waterfall stone quarry, *Haniff SFN 3755*, FL, 18 Jun 1918 (SING). **Perak.** Assam Kumbang, *Wray 3075*, FB, FL, FR, Sep 1888 (SING), *Wray 2115*, FB, FL, Jun 1888 (SING); Chenderiang, Gunung Bujang Melaka, Sungai Rias, 2000 ft [610 m] alt, *Shah & Ahmad MS 3408*, FR, 12 Feb 1975 (KEP, SING); Larut, 300 to 800 ft [91–244 m] alt, *King's Coll. 4878*, FR, Aug 1883 (SING), *King's Coll. 6162*, FL, May 1884 (SING); Larut, 500–700 ft [152–213 m] alt, *King's Coll. 10634*, FR, Jul 1886 (SING); Larut, Batu Togoh, *Wray 4181*, FB, Jun 1892 (SING). **Selangor.** Gombak, *Burn-Murdoch 117*, FL, no date (SING); Kwala Lumpur, *Curtis 2356*, FR, Feb 1890 (SING); Ulu Langat, *Gadoh KL 2167*, FR, 1 Aug 1960 (KEP), *Gadoh KL 2215*, FL, 16 Nov 1960 (KEP). **PENINSULAR THAILAND.** Pattani. Kao Kalakiri, *Kerr 7778*, FL, 10 Sep 1923 (BK). Phuket. Krabi, Tambon Kao Panom, *Kerr 18837A*, FR, 4 Apr 1930 (BK); Ranawng, Kao Pawta Chongdong, *Kerr 16775*, FL, 20 Jan 1929 (BK); Satul, *Kerr 13674*, FR, 27 Dec 1927 (BK). **SINGAPORE.** Mandai road, swampy forest, *Kiah & Henderson SFN 37739*, FR, 12 Aug 1940 (KEP). **BORNEO** (INDONESIA). *Korthals s.n.*, FB, no date (L: acc. no. 908127-639 & barcode L0004984); Banjermasing, *Korthals s.n.*, FR, no date (L: acc. no. 908127-518 & barcode L0004986).

This is a very common species in the Malay Peninsula. The flowers in subsessile, tight clusters, small infundibular corollas and obscure leaf veins distinguish the species quite well.

18. *Fagraea tubulosa* Blume

Mus. Bot. 1 (1850) 167; Miquel, Fl. Ind. Bat. 2 (1857) 373; King & Gamble, J. As. Soc. Beng. 74 (2) (1908) 604; Cammerloher, Bull. Jard. Bot. Btzg. III, 5 (1923) 326; Ridley, Fl. Malay. Pen. 2 (1923) 415; Leenhouts, Fl. Males. I, 6 (2) (1962) 320; Kochummen, Tree Fl. Malaya 2 (1973) 270. TYPE**:** *Blume*, *s.n.*, in sylvis montanis insulae Sumatrae (holo L: acc. no. 908127-615 & barcode L0005079; iso L: acc. no. 908127-626 & barcode L0005080).

Scrambler to hemi-epiphyte, usually to 5 m high or more on trees; bark smooth, grey-brown; branch internodes terete, smooth. **Leaves** ovate; (10–)13–19.5 cm long, 5.5–8 cm wide; *base* rounded not decurrent; *apex* short cuspidate; *margin* entire, plane in dried material; thin-coriaceous; upper and lower *surfaces* glabrous, lower surface minutely wrinkled under magnification; *midrib* flat above, prominent below; *secondary veins* 5–7 pairs if visible, obscure on both sides; *tertiary and higher-order veins* obscure; petioles 20–32 mm long, 2–3 mm thick, *petiolar sheaths* not fused along the interpetiolar median, each developing a scale-like ligule 0.5–1 mm high adaxially; petiole base without *auricles*. **Inflorescence** terminal, a 2–3-flowered cyme; *peduncle* indistinct or to 3 mm long, to 4 mm diameter; inflorescence *rachis* very condensed, with 1 pair of primary branches; basal primary *branch pairs* 1–2 mm long, 3–4 mm diameter and not rebranched. **Flowers** bisexual; *pedicels* 4–5 mm long, 3–4 mm diameter; *floral bracts* small, acute, 1–2 mm long, located below the calyx; *calyx* 5–7 mm long (from the base to the lobe apices), glabrous, not lenticellate, *calyx*

cup 3–4 mm diameter, *calyx lobes* 5, broad-elliptic to rounded, 4–5 mm long, 4–5 mm wide, margins glabrous, base not auriculate; *corolla* subsalverform (with a long narrow lower tube and patent to erect lobes); cream to white; *lower subcylindrical part of the corolla tube* 70–85 mm long, 2–4 mm wide basally, *upper flared part* of the tube slightly inflated, 5–8 mm long, 5–6 mm wide at the top; *corolla lobes* 5, broad-obovate to suborbicular, 10–13 mm long, 5–7 mm wide, overlapping to the right; *stamens* 5, inserted at the upper portion of the lower narrowed tubular part of the corolla tube or the lowermost portion of the upper flared part of the corolla tube; *filaments* 15–18 mm long, protruding to c. 10 mm from the corolla mouth; *anthers* versatile, hastate, 3–4 mm long, 1.5–2 mm wide, each anther sac somewhat ellipsoid; *style* 85–88 mm long, protruding 5–10 mm from the corolla mouth in the open flower; *stigma* shallowly 2-lobed, the lobes broadly suborbicular and recurving when receptive and the whole sometimes resembling a subpeltate structure 1–2 mm across. **Infructescence** not seen. **Fruit** not seen.

DISTRIBUTION. Sumatra, Malay Peninsula (collected only once, in Perak).

HABITAT. Lowland rain forest.

SPECIMENS EXAMINED—PENINSULAR MALAYSIA. Perak. Bujang Malacca, *Ridley 9738*, FL, no precise date, 1898 (SING). **SUMATRA** (INDONESIA). *Blume s.n.*, FB, FL, no precise date (L: acc. no. 908127-615 & barcode L0005079), FB, FL (L: acc. no. 908127-626 & barcode L0005080).

The slender, non-infundibular corolla shape is shared with *Fagraea gardenioides* and *F. carnosa*. Both these other species have thicker corolla tubes with longer lobes (more than 20 mm long) and also differ by their elliptic to obovate, thick-coriaceous leaves with recurved margins when dry (in *F. tubulosa*, the leaves are ovate, thin-coriaceous and do not have recurved margins).

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INDEX TO COLLECTIONS

The numbers following each herbarium specimen (generally listed by collector name and number) refer to the following taxa:
1. *Fagraea auriculata* Jack; **2.** *Fagraea cameronensis* K.M.Wong & M.Sugumaran; **3.** *Fagraea carnosa* Jack; **4.** *Fagraea crassifolia* Blume; **5a.** *Fagraea curtisii* King & Gamble var. *curtisii*; **5b.** *Fagraea curtisii* var. *calcarea* (M.R.Hend.) K.M.Wong & M.Sugumaran; **6.** *Fagraea fastigiata* Blume; **7.** *Fagraea fraserensis* K.M.Wong & M.Sugumaran; **8.** *Fagraea gardenioides* Ridl.; **9.** *Fagraea imperialis* Miq.; **10.** *Fagraea kinghamii* K.M.Wong & M.Sugumaran; **11.** *Fagraea larutensis* M.Sugumaran; **12.** *Fagraea latibracteata* M.Sugumaran; **13.** *Fagraea littoralis* Blume; **14.** *Fagraea oblonga* King & Gamble; **15.**

Fagraea renae K.M.Wong & Sugau; **16.** *Fagraea ridleyi* King & Gamble; **17.** *Fagraea splendens* Blume; **18.** *Fagraea tubulosa* Blume.

Ahmad AS 119: **1** — Allen KEP 79285: **17;** Allen s.n. 27 i 1957: **3** — Alvins 179: **17**; 2053: **1**.

Bland s.n. 24 viii 1902: **1** — Blume s.n. no date (L: acc no. 908127-530): **13**, s.n. no date (L: acc. no. 908127-615 & barcode L0005079): **18**, s.n. no date (L: acc. no. 908127-626 & barcode L0005080): **18** — Boey 298**: 5b**, 398: **1**, 421: **1**, 422: **3**, 528: **5a** — Burkill HMB 818: **2** — Burkill & Haniff SFN 12585: **11**, SFN 12643: **10**, SFN 12685: **14**, SFN 12861: **10**, SFN 12982: **14** — Burkill & Holttum SFN 7861: **14** — Burkill, Shah & Noor HMB 2384: **8**, HMB 2421: **14** — Burn-Murdoch 117: **17** — Buwalda 6774: **1**.

Carrick 659: **1** — CF 908 (Collector name indistinct): **9** — Chan FRI 19905: **17**, FRI 25183: **3** — Chelliah FRI 6513: **17** — Chia & Chin LT 372: **5a** — Chin 367: **3**, 566: **3**, 569: **15**, 910: **5a**, 967: **5a**, 1151: **3**, 1524**: 5b** — Chua et al. FRI 40798: **8** — Cockburn FRI 7121: **6**, FRI 7252: **12**, FRI 8026: **16**, FRI 8279: **12** — Corner SFN 38129: **5a**; Corner s.n. 15 v 1935 (SING): **17**, s.n. 22 vi 1934: **1** — Curtis 346: **17**, 1676: **5a**, 1696: **5a**, 2356: **17**, 3013: **17**, 3394: **3**; Curtis s.n. ii 1900: **3**, s.n. vi 1890 (SING): **17**.

Damahuri FRI 36505: **14** — Derry 1218: **1** — deWilde & deWilde-Duyfjes 14047: **9**.

Forsten s.n. no date (L: acc. no. 908127-228): **13** — Fox s.n. x 1899 (SING): **10** — Foxworthy CF 1726: **1**.

Gadoh KL no. 1592: **15**, KL no. 2167: **17**, KL no. 2215: **17** — Garcia FRI 32703: **10** — Griffith 3737: **4**; Griffith s.n. 1845: **1**.

Hairul FRI 72264: **14** — Haniff SFN 3755: **17**, SFN 15584: **5a** — Haniff & Nur SFN 2344: **10**, SFN 7089: **5a**; Haniff & Nur s.n. 12 xii 1918: **1** — Hashim KEP 1084: **14** — Hasselt s.n., FB, no date (L: acc. no. 908127-218 & barcode L0005009): **6** — Heaslett 7: **17** — Henderson SFN 1381: **16**, SFN 10490: **1**, SFN 11128: **14**, SFN 11673: **3**, SFN 11805: **10**, SFN 11807: **11**, SFN 11838: **14**, SFN 17729: **3**, SFN 21412: **17**, SFN 23289: **10**, SFN 25036**: 5b**, SFN 29109: **5a**, SFN 32967: **14**, SFN 36671: **17**; Henderson s.n. 19 viii 1929: **1**, s.n. 6 x 1931: **3** — Hislop s.n. vii 1952 (SING): **10** — Hullett 164: **1**; Hullett s.n. 23 vii 1893 (SING): **16**.

Imin FRI 63057: **14**, FRI 66475: **8**, FRI 68437: **5a**.

Jaamat KEP 27295: **10** — Jaamat & Lasah FMS 27672: **4** — Johnson AJ 4036: **1**.

Keng, Wee & Honours students T3/48: **17** — Kerr 7778: **17**, 13674: **17**, 15962: **1**, 16603: **1**, 16775: **17**, 18837: **1**, 18837A: **17** — Kiah & Henderson SFN 37739: **17** — Kiew 1485: **9**, 3320: **7** — King's Coll. 3868: **15**, 4238: **15**, 4878: **17**, 5430: **14**, 6162: **17**, 7518: **11**, 10124: **15**, 10634: **17** — Kochummen FRI 16514: **14**, FRI 19451: **14**, KEP 98161: **10** — Korthals s.n. no date (L: acc. no. 908127-518 & barcode L0004986): **17**, s.n. no date (L: acc. no. 908127-639 & barcode L0004984): **17**.

Lim FRI 56592: **14** — Lim SING 2011-285: **1** — Loh FRI 19156: **14** — Low LYW 138: **2**, LYW 227: **16**.

Machado s.n. 13 v 1903 (SING): **16** — Mahmud s.n. iv 1970 (KLU): **14**, s.n. vii 1970: **1**,

s.n. v 1972 (KLU): **15** — Maingay 1025: **1** — Manurung 27: **14** — Medan KEP 45409: **3** — Mohamad KEP 14972: **17** — Moysey & Kiah SFN 31081: **10**.

Ng FRI 1373: **15**, FRI 1627: **3**, FRI 5563: **9**, FRI 5930: **2**, FRI 27054: **9** — Ng & Beltran FRI 6389: **17** — Ngadiman SFN 36752: **1** — Nur SFN 11288: **3**, SFN 18191: **16**, SFN 32967: **14**.

Perumal et al. FRI 41624: **10** — Poore 749: **8** — Purseglove P 4141: **14**, P 4231: **8**.

Quaife s.n. x 1940 (SING): **14**.

Rabil 276: **5a** — Rahim KEP 97950: **1** — Ratnasabapathy s.n. 26 v 1974: **1** — Ridley 2170: **1**, 2767: **16**, 3182: **17**, 3785: **16**, 5558: **14**, 5845: **16**, 6312: **17**, 7551: **13**, 7607: **15**, 7998: **1**, 9157: **13**, 9582: **1**, 9738: **18**, 10297: **3**, 11363: **16**, 11639: **1**, 12069: **14**, 13838: **14**; Ridley (no. indistinct) 12 viii 1889 (SING): **16**; Ridley s.n. vi 1890 (SING): **17**, s.n. iii 1892 (SING): **14**, s.n. viii 1899 (SING: barcode SING0011372): **16** — Robinson s.n. 22 i 1913: **8** — Rostado s.n. ii 1904: **3**.

Samsuri SA 315: **17**, SA 915: **1** — Samsuri & Ahmad SA 516: **15** — Samsuri & Mahmud SA 628: **5a** — Sang JS 67: **15** — Saw FRI 34065: **15**, FRI 44801: **12** — Scortechini 817: **15**; Scortechini s.n. 21 vi 1909: **14** — Shah MS 2730: **14** — Shah & Ahmad MS 3408: **17** — Shah & Ali MS 2855**: 5b** — Shah & Sidek MS 4045: **1** — Shah & Tan MS 5051: **17** — Sidek S 282: **3**, SK 438: **11** — Siew 144: **8** — Sim B-112: **5a** — Sinclair SFN 10608: **17**, SFN 38900: **1**, SFN 40176: **16**; Sinclair s.n. 26 iii 1951: **1**, s.n. 27 i 1957: **3** — Sinclair & Kiah SFN 38660: **11**, SFN 39931: **12** — Soepadmo HUM 9002: **8**, KLU 9103: **1** — Sow KEP 48648: **6** — Sow & Tachun KEP 35092: **3** — Spare F952: **4**, SFN 36006: **13**, SFN 36007: **1** — Steenis 6583a: **9** — Stone 5915: **1**, 7251: **8**, 11079: **3**, 14071: **8**, 14110: **1**, 14616: **17**, 15168: **15**, 15938: **17** — Stone, Mahmud & students BCS 10804: **14** — Strugnell & Tachun KEP 45890: **8** — Sugumaran SM 4: **14**, SM 13: **1**, SM 25: **1**, SM 28: **1**, SM 38: **17**, SM 79: **7**, SM 208: **17**, SM 217: **1** — Sugumaran & Lee SM 175: **14**, SM 176: **14**, SM 186: **3** — Sugumaran & Low SM 163: **7** — Sugumaran & Vijayandra SM 98: **15**, SM 167: **17** — Sugumaran & Wong SM 55: **12** — Sugumaran et al. SM 26: **15**, SM 164: **7**, SM 165: **14**, SM 177: **15**, SM 230: **9** — Symington FMS 28571: **9**, KEP 29482: **8**, KEP 30843: **8**, KEP 32235: **8**, KEP 36092: **10**, KEP 56665: **8** — Symington & Kiah SFN 28923: **15**.

Tan FRI 81814: **5a** — Teo & Wintz KL no. 4819: **5b** — Teruya 229: **1**, 2421: **9** — Teysmann HB599: **9**, HB998: **3**.

Wallich s.n. 1822 (barcode BM001014285): **1** — Whitmore FRI 730: **15**, FRI 963: **9**, FRI 3009: **3**, FRI 3328: **10**, FRI 4164: **9**, FRI 4243**: 5b**, FRI 4386: **6**, FRI 4661: **15**, FRI 12214: **10**, FRI 12518: **3**, FRI 12610: **15**, FRI 15103: **5a**, FRI 15551: **10**, FRI 15697: **15**, FRI 20117: **14** — Wong FRI 32191: **16** — Wray 1992: **15**, 2115: **17**, 2248: **13**, 2714: **13**, 2992: **14**, 3075: **17**, 3202: **4**, 4181: **17**, 4269: **13**; Wray s.n., 1889 (SING): **14** — Wyatt-Smith KEP 85211: **3**.

Yao FRI 53078: **3** — Yeob CF 5849: **4**.

Zahid et al. ZMS 42: **17**.

sine coll. no date (L: acc. no. 908127-756 & barcode L0004983): **4**.

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The parasitic plant families Loranthaceae and Viscaceae in Sabah, Malaysia

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Summary. We report 52 species of Loranthaceae and Viscaceae occurring in Sabah, Malaysia based on study of more than 800 specimens and extensive field work. A new species of *Macrosolen* endemic to Mount Tambuyukon is described. The 52 species reported more than doubles the number previously reported from Mount Kinabalu, with most of the non-Kinabalu species occurring at low elevations, particularly in East Sabah. We also report three new records (*Helixanthera pulchra*, *Korthalsella japonica* and *Viscum scurruloideum*) for Borneo in addition to six new records for Mount Kinabalu (*Amylotheca duthieana*, *Elytranthe albida*, *Korthalsella geminata*, *Lepidaria kingii*, *Viscum nepalense* and *Viscum scurruloideum*). A characteristic feature of the mistletoe flora of Sabah is that numerous species are known from only a few collections. The apparent rarity of many plant species in tropical rainforests substantially challenges our abilities to accurately inventory these diverse regions.

Loranthaceae and Viscaceae are two diverse parasitic families in Sabah. Both are twig epiphytes or occasionally hyperparasites on various woody hosts. Neither family displays a high degree of host specificity although a few species may be found predominantly, or exclusively, on one or a couple of host species. Both families are members of Santalales, which includes both root and shoot parasites as well as non-parasitic plants. Three additional families of the order, Santalaceae, Olacaceae, and Opiliaceae, do occur in Sabah but are not

discussed in this treatment because they were recently covered in the Tree Flora of Sabah & Sarawak (Chua 1996). The species reported here are distributed at elevations from sea level to as high as 3400 m. Many species appear to be restricted to primary vegetation while others are found predominantly in secondary or disturbed forest settings. Host information is lacking for most of the specimens we observed and it is hoped that future collections will attempt to provide these data when possible.

The most recent treatment of both families was that of Barlow (1997a, b). That comprehensive treatment for the entire Flora Malesiana region included descriptions of species and general distributions. Thus, the primary purpose of this work is to specifically detail the diversity and geographic distribution of Loranthaceae and Viscaceae in Sabah, Malaysia (northern Borneo). Checklists of the species of Loranthaceae and Viscaceae occurring on Mount Kinabalu were published as recently as 2001 and 2004, respectively ((Beaman et al. 2001, Beaman & Anderson 2004). We used those works as nuclei for our expanded study of the two families thoughout Sabah. It is remarkable that although the treatment for Mount Kinabalu was based on extensive specimen citations, we report six additional species to add to the 24 species included in those treatments, a 25% increase. No key to species is provided in this treatment because the Barlow keys are useful and complete in most cases; however, *Dendrophthoe* and *Macrosolen* require revision.

VISCACEAE IN SABAH: *GINALLOA*, *KORTHALSELLA*, *NOTOTHIXOS* AND *VISCUM*

The 10 species in this family reported in Sabah can usually be easily separated from Lorathaceae by fact that no secondary haustoria are formed and the flowers lack a colourful corolla. Barlow also uses persistent tepals on fruits as a useful character to separate species of the families when flowers are not present. This family is not terribly well-collected in Sabah but a total of 58 specimens were studied here. The fact that all are stem/twig parasites and often grow high in the canopy of lowland and montane forests may be the primary reason for the paucity of collections. Seven out of 10 (70%) species reported here are known from less than five collections in Sabah. We report two new records for Borneo (*Korthalsella japonica* and *Viscum scurruloideum*). The report of *K. japonica* from Borneo is not surprising given its otherwise very widespread distribution in Malesia. *Viscum scurruloideum* was previously only reported from Java. Three of the reported species represent new records for Mount Kinabalu thereby nearly doubling the previous number reported (Beaman & Anderson 2004).

1. *Ginalloa arnottiana* Korth.

This species bears vegetative resemblance to some *Viscum* species like *V. ovalifolium*, yet, its elongate inflorescences (3–9 cm long) allow for immediate distinction. It is found at sites distributed throughout much of Sabah with recorded hosts being *Schima* (Theaceae) and *Parinari* (Chrysobalanaceae).

Elevational range: 700–1800 m.

SPECIMENS EXAMINED—BORNEO. SABAH: Kota Belud, Mt. Kinabalu, *Berhaman SAN 134886*, 16 September 1993 (SAN); Beluran, Sugut FR, , *Meijer SAN 27650a*, 6 October 1961 (K, L, SAN, SAR); Ranau, Bukit Kolong, *Singh SAN 28316*, 20 November 1964 (K, L, SAN); Tenom, Crocker Range, 9 Disember 1962, *Mikil SAN 31939* (SAN); Penampang, *Cockburn SAN 65467*, 13 October 1969 (K, L, SAN); Ranau, Kundasang, *Sario SAN 28965*, 31 January 1964 (SAN); Tenom, *Meijer SAN 43916*, 22 June 1964 (K, SAN); Nabawan, Sapulut FR, *Sumbing SAN 101326*, 19 October 1983 (SAN); Tawau, Tawau Hill Park, *Aban SAN 79777*, 17 July 1974 (SAN); Ranau, Mamut, *Gambating* SAN 114300, 22 April 1986 (SAN); Ranau, *Gambating SAN 129227*, 13 June 1989 (SAN); Keningau, *Fidilis SAN 118816*, 21 May 1987 (SAN); Pun Batu, Pensiangan, *Berhaman A. Berhaman 126*, 24 Oct 1996 (SAN); Lohan River, 700-750m, *Beaman J., J. H. Beaman 9074*, 24 Mar 1984 (UKMB).

2. *Ginalloa nuda* Danser

No specimens were observed for this species but Beaman and Anderson (2004) cite collections from BO, BM, K. The type is from Mount Kinabalu and it appears to be endemic there. No collections have been made since the Clemenses collected it four times in the 1930s. All of those specimens, including the type, are from either Penigupan ('Penibukan') or the adjacent Tahubang River. Intensive collecting at Penigupan may result in its rediscovery because the habitat is largely intact for the elevations recorded by the Clemenses.

Elevational range: 900–1500 m (from Beaman & Anderson 2004).

SPECIMENS EXAMINED: none.

3. *Korthalsella japonica* (Thunb.) Engl.

This appears to be a new record for Borneo. While many *Korthalsella* species are difficult to distinguish, the identity of this specimen is clear because the flowers are produced in flattened, not terete, spicate conflorescences, thereby excluding both *K. papuana* and *K. geminata*. The plants are longer than 3 cm but less than 10 cm long thus excluding *K. dacrydii* and *K. rubra*. The specimen was collected from heath forest in Taman Sumaki, Sipitang. Anthea Phillips (pers. comm.) reported having seen *Korthalsella* in nearby Long Pa Sia but we have not observed specimens from that locality.

Elevational range: around 1550 m.

SPESIMENS EXAMINED—BORNEO. SABAH: Sipitang, Meligan FR, *Sugau SAN 144717*, 14 April 2002 (K, L, SAN).

4. *Korthalsella geminata* (Korth.) Engl.

This represents a new record for the flora of Mount Kinabalu because it was collected from the contiguous Mount Tambuyukon of Kinabalu Park. The specimens were parasitizing *Leptospermum*, consistent with other reported Myrtaceae hosts (Barlow 1997). The small size of these plants makes them fairly inconspicuous and may explain the fact that the species escaped collection from the Kinabalu Park region over the past 100 years in spite of intense collecting efforts there. Alternatively, the paucity of collections of this species may indicate that it is truly localized and rare. The young fruits appear orange-red.

Elevational range: 2500–2700 m.

SPECIMENS EXAMINED—BORNEO. SABAH: Mount Kinabalu, Bukit Babi 1250 m, *Van der Ent & Sukaibin SNP 19940*, 15 May 2011 (SNP); Mt. Tambuyukon, Plot 16, 2499 m, *Van der Ent, Cameron Kilquor, Rossiti, Sukaibin, Benedict et al. SNP 26012*, 4 May 2011 (SAN); Mt. Tambuyukon, Plot 16, 2499 m, *Van der Ent, Cameron Kilquor, Rossiti, Sukaibin, Benedict et al. SNP 26884*, 6 May 2011 (SAN).

5. *Notothixos sulphureus* Merr.

This species was collected from Mt. Trus Madi and Mt. Silam and is particularly striking due to the conspicuous orange-yellow dense indumentum found on the leaves and stems which make it hard to overlook, especially when young. The specimen *SAN 89529* has cream-coloured dendritic hairs that appear to be lost rather early in development because the fruiting individual was mostly glabrous. *Notothixos suphureus* is reported as having cream-coloured hairs that disappear at maturity so *SAN 89529* is probably best placed here. Further collecting of Mt. Silam is necessary to determine if the material represents a distinctive species. Additionally, since *Notothixos* has not been collected since 1988 it remains to be seen if it is still extant in Sabah. Although *N. floccosus* is known from Borneo, it differs by its much narrower leaves and shorter less floriferous inflorescence.

Elevational range: not given.

SPECIMENS EXAMINED—BORNEO. SABAH: Tambunan, Trus Madi, *Sumbing SAN 122148*, 10 August 1988 (SAN); Lahad Datu, Mt. Silam, *Madani SAN 89529*, 4 Januari 1979 (SAN).

6. *Viscum articulatum* Burm.f.

This species can be difficult to distinguish from specimens of *V. nepalense*. A discussion of differences between them follows below. The only recorded hosts are species of Santalaceae making it a hyperparasite, as has been reported previously (Barlow 1997). All of the specimens cited here are from low elevations in the state near Sandakan and Keningau.

Elevational range: none provided.

SPECIMENS EXAMINED—BORNEO. SABAH: Keningau, Trusmadi FR, *Bousi SAN 123999*, 4 May 1988 (SAN); Sabah, s.n., *SAN 55011*, 1965 (SAN); Sandakan, Sepilok FR, *Meijer SAN 24906*, 20 April 1961 (K, L, SAN); Sandakan, Leila FR, *P.F. Stevens et al. 708*, 29 January 1976 (SAN); Sandakan, Leila FR, *Kumin SAN 74164*, 18 August 1971 (SAN); Sandakan, Leila FR, *Meijer SAN 37868*, 17 August 1963 (SAN).

7. *Viscum nepalense* Spreng. (Fig. 1)

This is a new record for Mt. Kinabalu. This species and *V. articulatum* are difficult to distinguish but the usually sharply quadrangular stems of *V. articulatum* make it possible to distinguish from *V. nepalense*, which has wider flattened stems. Even when internodes of *V. articulatum* are flattened in herbarium specimens, they have an angular ridge making them distinguishable from *V. nepalense* which lacks the ridge on its narrow, flattened stems. In addition, *V. articulatum* is reported to have white fruits while those of *V. nepalense* are yellow. Whether *V. articulatum* and *V. nepalense* are sufficiently distinctive to warrant species status requires future study.

Elevational range: around 1500 m.

SPECIMENS EXAMINED—BORNEO. SABAH: Bundu Tuhan, Rangkam, 1100 m, *T.J. Barkman SNP 15594*, 22 Sep 2000 (SNP).

8. *Viscum ovalifolium* DC. (Fig. 2)

This is the most commonly encountered species of the family in the state and it is often found in secondary forest. The warty fruits (at least when young) and broad ovate leaves make this species distinctive in the genus, at least in Sabah. It is reported as parasitic on Tarap (*Artocarpus*, Maraca).

Elevational range: 500–1400 m.

SPECIMENS EXAMINED—BORNEO. SABAH: Bundu Tuhan, 4000 ft, *Ansoe & Lucas Tinggal SNP 3403*, 9 Jul 1987 (SNP); Bundu Tuhan, 1400 m, *Todd Barkman SNP 15901*, Nov 1999 (SNP); Nabawan, Sapulut FR, *Fidilis SAN 101318*, 18 Mar 1983 (SAN); Tenom, Tomani, *Talip SAN 50563*, 20 Oct 1966 (K, L, SAN); Papar, Mandahan, *Madani SAN 122874*, 26 Jan 1990 (SAN); Ranau, Mamut Cooper Mine, *Gambating SAN 105605*, 17 Mar 1986 (SAN); Ranau, Peransangan, *Gambating SAN 117846*, 14 Mar 1987 (SAN); Ranau, Bundu Tuhan, *Maikin SAN 110001*, 14 Aug 1985 (SAN); Ranau, *Gambating SAN 121624*, 22 Jul 1988 (SAN); Ranau, Takutan, *Shea SAN 77141*, 23 May 1973 (SAN); Keningau, Witti Range, *Sumbing SAN 110184*, 23 Aug 1985 (SAN); Tambunan, Kiawayan, *Bousi SAN 113740*, 28 May 1986 (SAN); Tenom, Crocker Range (National Park), *Mikil SAN 31910*, 1 Nov 1962 (SAN); Tenom, Tomani, *Talip SAN 50563*, 20 Oct 1966 (K, L, SAN); Tenom, Mt.

(Above left and right) **Fig. 1.** *Viscum nepalense* stem showing yellow fruit which serves to distinguish it from *V. articulatum*. **Fig. 2.** *Viscum ovalifolium* with flowers and fruits. In Sabah, this species has the largest leaves in the genus. (Below left and right) **Fig. 3.** *Viscum scurruloideum* showing young fruits produced on an elongate stipe. **Fig. 4.** *Amyema beccarii* shown with its umbellate flowers.

Mandalom F.R, *Sumbing SAN 136124*, 14 Aug 1993 (SAN); Tenom, Tomani, *Madani SAN 90758*, 18 Jun 1976 (SAN); Tenom, *Mikil SAN 31946*, 10 Dec 1962 (K, L, SAN); Tambunan, *H.P. Nooteboom 1308*, 15 Mar 1969 (SAN); Ranau, Sosopodon, *Badak SAN 32307*, 5 Nov 1962 (K, L, SAN); Ranau, Badukan, *Gambating SAN 117950*, 17 Jun 1987 (SAN); Beluran, *Lideh SAN 55949*, 8 Dec 1983 (SAN); Papar, *Mikil SAN 30317*, 31 May 1962 (K, L, SAN); Tenom, Sapong, *Sadau SAN 42593*, 22 Mar 1965 (SAN); Keningau, Sungai Bersanon, *Asik SAN 128172*, 9 Aug 1990 (SAN); Tenom, Melalap, *Fidilis SAN 139186*, 6 Jul 1995 (SAN); Nabawan, Pensiangan Penantaman, *Sumbing SAN 131463*, 9 Jul 1991 (SAN); Lahad Datu, Danum Valley, *E.J.F. Campbell-Gasis 216*, 19 Feb 1992 (SAN); Kinabatangan, Pinangah, *Sumbing SAN 136828*, 9 Jul 1993 (SAN); Ranau, *Gambating SAN 116199*, 27 Aug 1986 (SAN).

9. *Viscum scurruloideum* Barlow (Fig. 3)

This is a new record for Borneo and Mount Kinabalu. Although this species could be mistaken for a narrow-leaved form of *V. ovalifolium*, the smooth fruits and falcatiform leaves and elongate inflorescence with lateral male flowers separate it from all other species in Borneo. Our plants fit the description for the species well, especially in the falcate shape of the leaves that are 0.7–1.0 cm wide (although this is slightly wider than stated in Barlow's key) and the 4-merous flowers. The single specimen was collected from secondary vegetation in the Mount Kinabalu area (Kg. Bundu Tuhan) and it appears to parasitize Tikalod (*Quercus*). Parasitism of Fagaceae is consistent with the recorded host in Java which is *Castanopsis* (Barlow 1997). Mature fruits need to be studied in order to discern whether the tepals are persistent in Sabah material.

Elevational range: 1300 m.

SPECIMENS EXAMINED—BORNEO. SABAH: Hamadon, Kg. Bundu Tuhan, 1300 m, *T.J Barkman SNP 15591*, 22 Sep 2000 (SNP).

10. *Viscum wrayi* Gamble

The obovate to spathulate leaves make this species distinct from *V. ovalifolium* and all other species in the state. It is known from a single collection from the Maliau Basin.

Elevation: around 1050 m.

SPECIMENS EXAMINED—BORNEO. SABAH: Maliau Basin, Jalan Babi, 1005 m, *Henry & Sidkan MB152*, 11 Apr 2000 (SAN).

LORANTHACEAE IN SABAH

This family is fairly commonly collected in Sabah due to the showy nature of the flowers that can approach 100 mm in length. The colourful tubular flowers of many species are reported to be bird pollinated. All species are twig epiphytes that may form secondary haustoria and in some cases it is not uncommon to see parasites covering large portions of their host stems. The fact that many are high-growing epiphytes makes collection and study difficult. Fourteen out of 42 (24%) species are only known from < 5 specimens. A few species previously reported from Mount Kinabalu (Beaman et al. 2001) were not seen in Malaysian collections at SAN or SNP: *Trithecanthera superba*, *Dendrophthoe quadrifida*, *Dendrophthoe lanosa*, and *Helixanthera spicata*. One new species is described from Mt. Tambuyukon of Kinabalu Park and three species are new records for the Kinabalu flora: *Amylotheca duthieana*, *Elytranthe albida*, and *Lepidaria kingii*. One species reported here, *Helixanthera pulchra*, appears to be

a new record for Borneo. In general, identification of species is critically dependent on the collection of flowering material because fruits are usually insufficient alone, particularly due to variation in leaf size and shape.

In Sabah, the genera are fairly distinct and reliably identified. Yet, care must be taken because some traits appear to have arisen independently in multiple genera. For instance, quadrangular (4-sided) stems have apparently arisen in *Barathranthus productus*, *Lepeostegeres lancifolius* and *Macrosolen platyphyllus*. Whorled leaves have evolved in *Amyema beccarii*, *Amylotheca dutheiana* and *Lampas elmeri*. Development of brown-black scales along margins of leaves and midribs has evolved in *Lampas elmeri*, *Lepeostegeres* and *Amylotheca*. Although they appear to have evolved by convergence, it is not clear what selective value these traits provide.

Amyema

1. *Amyema beccarii* (Tiegh.) Danser (Fig. 4)

This is a fairly common species distributed at a wide range of elevations. Sterile specimens of *A. beccarrii* could be mistaken for *Lampas elmeri* because of the 4 leaves/node with thickened laminas but the latter species has an acute leaf apex while those of *A. beccarrii* are normally rounded. The flowers measure 13–22 mm long with mostly free petals and are sessile at nodes. The flowers are normally red or rarely orange below with the apical ¼ of buds (the reflexed lobes of the corolla) green.

Elevational range: 2–2000 m.

SPECIMENS EXAMINED—BORNEO. SABAH: Ranau, Nalumad, *Gambating SAN 114394*, 20 Jun 1986 (SAN); Nabawan, Pensiangan, Batu Punggul, *Kulip SAN 133505*, 28 Jan 1993 (SAN); Tambunan, Sungai Rampon, *Bousi SAN 123874*, Apr 1988 (SAN); Beaufort, Siaungau Forest Reserve, *Diwol SAN 78143*, 29 May 1974 (SAN); Beaufort, Binsulok FR, *Amin SAN 104138*, 20 Feb 1992 (SAN); Lahad Datu, Bukit Silam, *Wong WKM 2114*, 17 Apr 1992 (SAN); Kudat, Balambangan Island, *Stone SAN 86785*, 12 Apr 1977 (SAN); Kudat, Pulau Banggi Mangrove FR, *Sugau JBS 200*, 22 May 1996 (SAN); Beaufort, *Amin SAN 126350*, 24 Jun 1992 (SAN); Lahad Datu, Madai Caves, *Berhaman AB 87*, 10 Jun 1996 (SAN); Beaufort, Pimping, *Madani SAN 111368*, 10 Sep 1985 (SAN); Kinabatangan, Gunong Lotung, *Cockburn SAN 83293*, 17 May 1976 (SAN); Ranau, Bambangan, *Gambating SAN 118107*, 18 Jun 1987 (SAN); Beaufort, Binsulok FR, *Amin SAN 102589*, 28 Apr 1986 (SAN); Ranau, Sungai Segindai, *Gambating SAN 100216*, 23 Aug 1983 (SAN); Pitas, *Gambating SAN 121313*, 13 May 1987 (SAN); Kota Belud, Kinabalu National Park, *Chow SAN 76405*, 26 Sep 1972 (SAN); Kinabatangan, Dagat, *Ahwing SAN 35480*, 9 Apr 1963 (SAN); Lahad Datu, Pulau Tabawan, *Chai SAN 26686*, 18 Oct 1961 (SAN); Beaufort, Weston, *Aban SAN 66661*, 5 Dec 1969 (SAN); Penampang, Tamparuliyan FR, *Amin SAN 115579*, 23 Feb 1988 (SAN); Beaufort, Binsulok, *Amin SAN 98794*, 28 Jul

1993 (SAN); Kinabatangan, Bukit Tawai, 11 Apr 1994, *Sugau SAN 138843* (SAN); Ranau, Sungai Singgaron Baru, *Gambating SAN 114316*, 23 Apr 1986 (SAN); Ranau, *Soinin SAN 129142*, 27 Jul 1989 (SAN); Beluran, Labuk Sugut, Telupid, *Zainudin A. Zainudin 5035*, 11 Apr 1994 (SAN); Near Saat, Kg. Bundu Tuhan, 1400m, *Barkman T.J. Barkman 301*, 4 Dec 1997 (SNP); 3.5 km dari Melangkap Tomis, *Lugas PEK-L. Lugas 2128*, 12 May 1996 (SNP); Melangkap Tomis, Kawasan Taman, *Lugas PEK-L. Lugas 2551*, 7 Aug 1996 (SNP); tepi sungai Mekedau, Kg. Nalumad, *Andau PEK-D. Andau 164*, 8 May 1995 (SNP); Kg. Takutan, *Tadong PEK-D. Tadong 235*, 28 Mar 1993 (SNP); Kudat, Pingau-pingau, 10m, *Akin S. Akin 2475*, 16 Sep 1992 (UKMB); Kudat, XPDC Balambangan Island, mangrove forest, *Dolois, Park & Masius SNP 18705*, 26 May 2003 (SNP); Ranau, Summit of Mt. Mentapok, 1581 m, *Dolois, Park & Johnny SNP 09583*, 9 Jun 1999 (SNP); Saat, Kg. Bundu Tuhan, *T.J Barkman SNP 15590*, 22 Sep 2000 (SNP).

2. *Ameyema gravis* Danser

This is a mangrove species with small, obovate, opposite leaves and flowers that are up to 30 mm long.

Elevational range: none provided.

SPECIMEN EXAMINED—BORNEO. SABAH: XPDC Banggi Is., Penukaran Is., *Dolois S., Tisun G. & Bellia E. SNP 18832*, 27 Jul 2003 (SNP).

***Amyema* indet.**

There are other Bornean species not yet known from Sabah including *A. fasciculata* and *A. triantha*. Additional unidentified material at SAN is not referrable to either of them and thus may represent undescribed species. However, the material is insufficient for description at this time. The specimens include:
Lahad Datu, Ulu Segama FR, *Madani SAN 108710*, 10 Apr 1985 (SAN); Lahad Datu, Ulu Segama FR, *Madani SAN 108599*, 17 Mar 1985 (SAN); Tawau, Tawau Hill Park, *Madani SAN 111178*, 19 Oct 1985 (SAN); Beluran, Labuk Sugut, Segaliud Lokan FR, *Majawat SAN 125880*, 4 Oct 1988 (SAN); Kinabatangan, Tangkulap FR, *Gambating SAN 111673*, 5 Dec 1985 (SAN); Lahad Datu, Baturong Caves, *Berhaman AB 104*, 12 Jun 1996 (SAN); Kinabatangan, Lamag FR, 200m, *Pereira JTP 800*, 26 Apr 2001 (SAN).

Amylotheca

3. *Amylotheca duthieana* (King) Danser

This is a new record for Mount Kinabalu. Although not cited in Beaman et al. (2001), this species is known from one collection from Mt. Kinabalu and another from Tawau. It would

seem that this is a rare species in Sabah. This species is distinctive from others with its grey-green, glaucous leaves with a black petiole that are produced 3 per node (although they may be scattered even on the same stem). Leaf shape is also highly variable even on a single stem. The flowers appear to be mostly red. The only recorded host is Seraya tembaga (Dipterocarpaceae).

Elevational range: around 1000 m.

SPECIMENS EXAMINED—BORNEO. SABAH: Tawau, Quoin Hill FR, *Aban SAN 30528*, 4 Jul 1962 (SAN); 100 m dari sempadan Taman, Melangkap Tomis, *Lugas PEK-L. Lugas 975*, 13 Sep 1995 (SNP).

Barathranthus

4. *Barathranthus productus* (King) Tiegh.

This species is distinctive for its opposite leaves that are produced on a sharply angled/ ridged stems that bear essentially sessile flowers. The *SAN 105298* specimen has particularly narrow leaves but cannot represent *B. axanthus,* the only other species of the genus known in Borneo, because of the 4-angled stems and long corollas. Additional targeted collecting and molecular analysis could bear on the question of whether there is more than one species of *Barathranthus* in Sabah. Since no specimens of this genus have been collected since 1988, it also remains to be seen if the species still exists in Sabah.

Elevational range: around 200 m.

SPECIMENS EXAMINED—BORNEO. SABAH: Tambunan, Trus Madi FR, *Bousi SAN 124008*, 4 May 1988 (SAN); Keningau, Sapulut FR, Nabawan, *Fidilis SAN 105298*, 24 Jul 1984 (SAN); Lahad Datu, Pulau Baik, *Latiff A. Latiff 2889*, 27 Sep 1988 (UKMB).

Dendrophthoe

Material of this genus is fairly simply distinguishable from others in Sabah due to the alternate leaves and mostly 5-merous flowers that are borne singly with a solitary bract subtending them. However, the key provided in Barlow (1997) does not separate material very clearly for the Sabah collections, particularly for fruiting specimens since fruit features are not included in the key. Part of the confusion, even with flowering material, may be due to hybridization between several species (Barlow 1997). Most fruiting material is treated as *Dendrophthoe* indet. for the purposes of this study.

5. *Dendrophthoe clementis* (Merr.) Danser

Barlow (1997) describes this species as having acuminate anthers, white indumentum, leaves 5–10 cm long and a corolla that is > 30 mm. The specimens cited below are a bit short in

the corolla but otherwise fit nicely. The leaves are smaller and thinner than *D. constricta* and the styles seem persistent once the corolla falls. Also, the leaves do not have the strongly emergent venation of *D. constricta*. The only reported host is *Parashorea malaanonan* (Dipterocarpaceae).

Elevational range: not recorded.

SPECIMENS EXAMINED—BORNEO. SABAH: Lahad Datu, Mostyn, *Talip SAN 68337*, 16 May 1970 (SAN); Kinabatangan, Lamag, *Madani SAN 81187*, 14 Jun 1975 (SAN); Tawau, Bombalai, *Meijer SAN 41028*, 1 Dec 1963 (SAN).

6. *Dendrophthoe constricta* (Korth.) Danser (Fig. 5)

This variable species has acuminate anthers and a red-brown indumentum with leaves that measure 10–25 cm in length. The corolla is usually < 30 mm in length. This species is a fairly common one and may be found on *Sambucus*, *Melastoma* and *Ficus*. The leaves have fairly strongly arcuate veins that are raised on the undersurface. Interesting specimens have been collected from Pig Hill (*RSNB 4509*, *T.J. Barkman 119*) that have small leaves that are outside of the reported range of this species. While it is not uncommon to find reduced leaf size on species that occur on extreme ultramafic sites on Mount Kinabalu, it is not clear why a parasitic plant should exhibit such features. The *Cannon & Harting* and *Jusimin Duaneh* specimens cited below are also interesting in that the flowers are 4-merous. Both were collected from Kg. Kiau. While *D. quadrifida* is the only 4-merous species known from Mount Kinabalu, the specimen studied here had acuminate anthers and otherwise match the description of *D. constricta* well. Flower buds are yellow below with a greenish collar and red tip above.

Elevational range: 100–2300 m.

SPECIMENS EXAMINED—BORNEO. SABAH: Ranau, Kepangian, *Gambating SAN 106762*, 14 Feb 1986 (SAN); Keningau, Delayan, *Nordin SAN 84222*, 22 Jan 1977 (SAN); Keningau, Ulu Sungai Bersanon, *Fidilis SAN 128595*, 7 Aug 1990 (SAN); Keningau, Kampung Tiulan, *Nordin SAN 84285*, 16 Feb 1977 (SAN); Keningau, Ulu Sungai, *Asik SAN 128174*, 9 Aug 1990 (SAN); Ranau, Kampong Gona Gona, *Gambating SAN 116296*, 25 Sep 1986 (SAN); Tambunan, Kaingaran, *Bousi, J. SAN 113557*, 26 May 1986 (SAN); Ranau, Lohan, *Aban SAN 56677*, 6 Apr 1967 (SAN); Ranau, Mamut, *Gambating SAN 116339*, 9 Oct 1986 (SAN); Ranau, Marakau, *Gambating SAN 114304*, 22 Apr 1986 (SAN); Ranau, Lohan, *Gambating SAN 105626*, 24 Mar 1986 (SAN); Tenom, Ulu Sungai Tomani, *Madani SAN 90841*, 13 Jun 1979 (SAN); Keningau, Tulid, *Nordin SAN 84317*, 14 Mar 1977 (SAN); Ranau, Tenompok FR, *Mikil SAN 38742*, 1 Oct 1963 (SAN); Tenom, Melalap, *Asik SAN 96313*, 16 Apr 1985 (SAN); Lahad Datu, Silam FR, *Madani SAN 133918*, 14 Apr 1992 (SAN); Tambunan, Trus Madi, *Sugau JBS 147*, 9 Mar 1995 (SAN); Kinabatangan, Maliau

Basin, *Hendry MB89*, 9 Apr 2000 (SAN); Lahad Datu, Silam, *Talip SAN 52851*, 24 Sep 1965 (SAN); Ranau, Pig Hill, *Chew RSNB 4509*, 24 Feb 1964 (SAN); Koko plantation, Tawau Park Hill, 250 m, *Rimi Repin, Kinahim & Gusili SNP 16048*, 15 Mar 2001 (SNP); Bukit Bombalai, outside Taman Bukit Tawau, *Dolois & Hendry SNP 12518*, 13 Jan 2006 (SNP); Twin Bed cabin, PHQ, 1600 m, *T.J Barkman KNP 15587*, 22 Sep 2000 (SNP); Kinabalu Park, Pig Hill, 2,200 m, *Alim Biun & Reed Beaman KNP 05859*, 17 Feb 1994 (SNP); Kota Belud, Kinabalu National Park, *Chew RSNB 2511*, 28 Jul 1961 (SAN); Pig Hill, 2,300 m, *Barkman T.J. Barkman 119*, 25 Feb 1995 (SNP); 600 ft, on Ficus, *Sato UKM-Sato 4*, 18 Jun 1981 (UKMB); Kg. Kiau, coffee plantation, 1400 m, *Cannon & Harting C. H. Cannon & J. R. Harting 97.524*, 21 Dec 1997 (SNP); Kg. Kiau Nuluh, *Duaneh PEK-J. Duaneh 38*, 16 Sep 1992 (SNP); Kg. Nalumad, 5 batu dari kg. Kawasan Taman, *Andau PEK-D. Andau 895*, 25 Oct 1996 (SNP).

7. *Dendrophthoe curvata* (Blume) Miq.

All Sabah collections match descriptions of this species in that the anthers are blunt and the corolla tube is more-or-less curved; however, the corolla only measures c. 20–28 mm which is less than the lower limit (30 mm) described for the species (Barlow 1997). Barlow (1997) suggested that there could be hybrids between *D. curvata* and *D. pentandra*, particularly in Borneo, and our observations of the specimens cited below are consistent with that hypothesis. This polymorphic species requires study and molecular data may provide clarity with regard to the putative hybrid nature of Sabah material. Most of the material placed here was collected from particularly low elevations.

Elevational range: 20–100 m.

SPECIMENS EXAMINED—BORNEO. SABAH: Sipitang, Marintaman, *Amin SAN 86508*, 14 Jul 1985 (SAN); Beaufort, Siaungau FR, *Amin SAN 105997*, 24 Jul 1991 (SAN); Papar, Mandahan, *Amin SAN 114659*, 8 Jul 1987 (SAN); Beaufort, Binsulok, *Amin SAN 127397*, 28 Nov 1992 (SAN); Papar, Mandahan, *Marsal SAN 86194*, 11 Feb 1981 (SAN); Beaufort, Pimping, *Amin SAN 115336*, 18 Jan 1990 (SAN); Sipitang, Marintaman, *Amin SAN 86473*, 11 Jul 1985 (SAN); Beaufort, Siaungau FR, *Amin SAN 127096*, 25 Nov 1990 (SAN); Siaungau FR, Beaufort, *Talib SAN 80612*, 24 Jun 1976 (SAN); Kota Kinabalu, Pulau Gaya National Park, *Kanis SAN 56118*, 16 Feb 1966 (SAN); Ranau, Poring, *Gambating SAN 129347*, 20 Oct 1988 (SAN); Ranau, Kilimu, *Gambating SAN 120446*, 23 Oct 1987 (SAN); Ranau, Pig Hill, *Chew RSNB 4497*, 24 Feb 1964 (SAN); Marintaman Mengalong National Park, Sipitang, *Argent G. Argent 1555*, 24 Mar 1980 (SAN); Sipitang, 40 m, Kerangas area, *Beaman J.H. Beaman 8423*, 2 Feb 1984 (UKMB); Menggatal, Teluk Karambunai, 30 m, *Akin S. Akin 2376*,10 Jan 1992 (UKMB); Melangkap Tomis, 100 m dari Belai raya, *Lugas PEK-L. Lugas 840*, 14 Aug 1995 (SNP); Melangkap Tomis, 3 km dari Kg., *Lugas PEK-L. Lugas 2474*, 9 Jul 1996 (SNP); Melangkap Tomis, 10 rantai dari Kg., *Lugas PEK-L. Lugas 406*, 26 May 1995 (SNP).

8. *Dendrophthoe lanosa* (Korth.) Danser

In this species, the anthers are acuminate, the bracts are foliaceous and longer than the ovary with a dense indumentum and the flowers are sessile. *Dendrophthoe lanosa* is cited in Beaman et al. (2001) as occurring on Kinabalu based on a single collection from Tenompok.

Elevational range: around 1500 m (from Beaman et al. 2001).

SPECIMEN EXAMINED: none.

9. *Dendrophthoe locellata* Danser

This species has flowers usually borne on galls and the petioles are more or less thickly winged. In Sabah, specimens have corollas that are shorter (25–28 mm) than that reported by Barlow (1997) for this species and in some material the leaves are less than 3 cm wide and at the lower limit listed for length (6–7 cm) in Barlow (1997). The anthers vary in length from 2.5 mm to 4 mm, which is also shorter than that described for *D. locellata*. Many salt deposits are evident upon leaves of our specimens.

Elevational range: 0–30 m.

SPECIMENS EXAMINED—BORNEO. SABAH: Kudat, Balambangan Island, *Sugau JBS 39*, 19 Oct 1994 (SAN); Kota Kinabalu, Pulau Gaya National Park, *Mikil SAN 46595*,13 Sep 1964 (SAN); Kudat, Balambangan FR, *Stone SAN 87090*, 7 Apr 1977 (SAN); Kudat, XPDC Balambangan Is., *Dolois & Masius SNP 18420*, 21 May 2003 (SNP); Kudat, XPDC Balambangan Is., *Dolois & Masius SNP 18704*, 26 May 2003 (SNP); Taman Tunku Abdul Rahman, Pulau Sapi, *Rimi, Dolois, Reed, Ansow & Sinail SNP 07266*, 22 Mar 1995 (SNP).

10. *Dendrophthoe longituba* (Elmer) Danser (Fig. 6)

The bright yellow, long (55–90 mm) flowers make this a distinctive species, which can form very long sprawling stems in the canopies of montane forest trees. It has acuminate anthers and the bracts are longer than the ovary. The corollas are yellow throughout.

Elevational range: 1300–1800 m.

SPECIMENS EXAMINED—BORNEO. SABAH: Nabawan, *Fidilis SAN 119351*, 23 May 1987 (SAN); Keningau, Sg. Pingas Pingas, *Fidilis SAN 115825*, 23 May 1986 (SAN); Kinabatangan, Maliau Basin, *MB46*8, 12 Aug 2000? (SAN); Kota Belud, Kinabalu National Park, *Kanis SAN 50117*, 22 Sep 1965 (SAN); Ranau, Kinasaraban, *Aban SAN 60749*, 28 Sep 1967 (SAN); Kota Belud, Mount Kinabalu, *Chew* RSNB 3001, 13 Sep 1961 (SAN); Penampang, Longkogunan, *Pereira JTP 507*, 15 Sep 1997 (SAN); PHQ, near generator,

1500 m, *Gusili, Bella & Barkman SNP 14898*, 22 Sep 2000 (SNP); Ranau, Sosopodon, *Mikil SAN 38655*, 13 Jul 1963 (SAN); Beaufort, *Nicholson SAN 41128*, 20 Jan 1964 (SAN); Lahad Datu, Bukit Silam, *Mujin SAN 37854*, 21 Jun 1963 (SAN).

11. *Dendrophthoe pentandra* (L.) Miq. (Fig. 7)

This species has the shortest flowers of the genus in Sabah. It is one of the species with blunt anthers and is reliably identified by its inflated corolla that is split 1/2 to base with white or grey tomentum produced over the corollas. The corollas are usually yellow-green in bud and then develop a uniform salmon to orange-red colour at anthesis.

Elevational range: 500–1100 m.

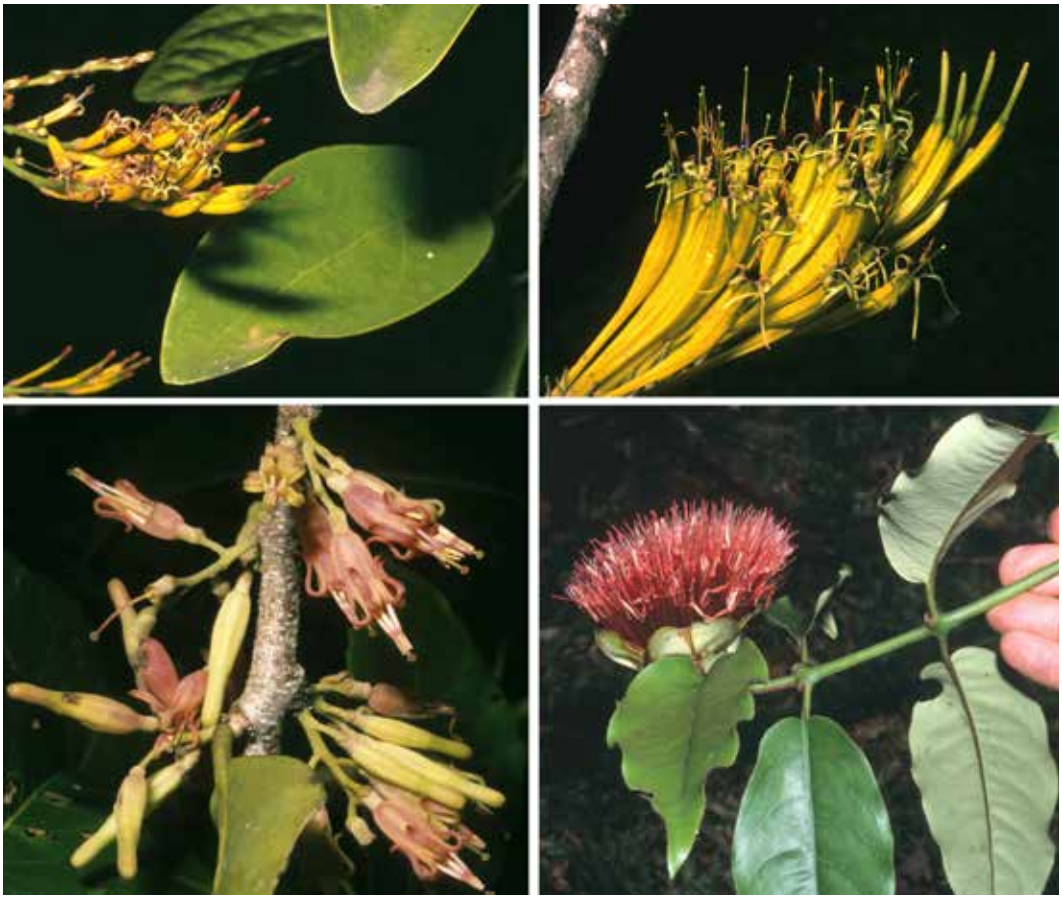
SPECIMENS EXAMINED—BORNEO. SABAH: Ranau, Kampong Takutan, *Shea SAN 77137*, 23 May 1973 (SAN); Beluran, Bonggaya FR, *Aban SAN 81972*, 16 Jul 1975 (SAN); Ranau, Tudangan, *Gambating SAN 115985*, 18 Jul 1986 (SAN); Beluran, Labuk Sugut, Sungai Ruku Ruku, *Rahim* SAN 94998, 22 Jun 1982 (SAN); 3 miles upriver from Long Pasia, 1000 m, Meganit, *Hoare* et al. *A. Hoare et al.128*, 10 Apr 2000 (SNP); Rangkam, Bundu Tuhan, 1100 m, *T.J Barkman SNP 15593*, 11 Sep 2000 (SNP); Ranau, Kamburongoh, *Meijer SAN 29142*, 7 Feb 1962 (SAN); Kota Belud, Mt. Kinabalu, *Aban SAN 76512*, 11 Feb 1973 (SAN); In front of staff quarters, Taman Bukit Tawau, *Rimi, Rahimah & Gusili SNP 09782*, 25 Aug 1999 (SNP); Beluran, Labuk Sugut, Sungai Ruku Ruku, *Aban SAN 60111*, 4 Jun 1984 (SAN); Sandakan, Leila FR, *Lee SAN 96270*, 22 Jul 1983 (SAN); Sipitang, Gunong Lumaku, *Diwol SAN 77862*, 21 Aug 1973 (SAN); Near Saat, Bundu Tuhan, 1400 m, *Barkman* T. Barkman 300, 4 Dec 1997 (SNP); Tambunan, Kitau, *Gambating SAN 95457*, 8 Sep 1982 (SAN); Beaufort, Klias FR, *Talib SAN 80718*, 26 Jul 1976 (SAN); Beluran, Telupid, *Diwol SAN 71482*, 5 Feb 1971 (SAN).

12. *Dendrophthoe quadrifida* Danser

This species is cited by Beaman et al. (2001) as occurring on Mount Kinabalu based on the type collection and one other by the Clemenses, both from Marai Parai. It is presumably very localized to Marai Parai, however, abundant collections made at that locality over the last 20 years by SNP has not resulted in its rediscovery. *Dendrophthoe quadrifida* has 4-merous flowers with blunt anthers making it distinctive from any other in the state. The only 4-merous collections we observed were those of *D. constricta* from Kiau but those specimens have acuminate anther appendages.

Elevation: 1200–1500 m (from Beaman et al. 2001).

SPECIMEN EXAMINED: none.



(Above left and right) **Fig. 5.** *Dendrophthoe constricta* collected at the Kinabalu Park Headquarters. **Fig. 6.** *Dendrophthoe longituba* is conspicuous due to its long yellow flowers and may be found at the Kinabalu Park Headquarters. (Below left and right) **Fig. 7.** *Dendrophthoe pentandra* is shown here with younger yellow-green flower buds and salmon-coloured flowers at anthesis. **Fig. 8.** *Lepeostegeres centiflorus* is commonly found in Sabah and conspicuous due to the production of a head of numerous red flowers.

***Dendrophthoe* indet.**

Sandakan, Leila FR, *Sam SAN 26397*, 20 Jul 1961 (SAN); Papar, Mandahan, *Sinanggul SAN 47856*, 24 Oct 1964 (SAN); Kinabatangan, Sukau, *Gambating SAN 68037*, 27 Feb 1985 (SAN); Sipitang, Usok, *Aban SAN 67117*, Jan 1971 (SAN); Ranau, Pinosok, *Gambating SAN 123478*, 19 Sep 1988 (SAN); Keningau, Sook, *Sadau SAN 49527*, 25 Apr 1965 (SAN); Sipitang, Marintaman, *Amin SAN 86473*, 11 Jul 1985 (SAN); Kota Belud, Kampong Lebong Lebong, *Maikin SAN 108967*, Aug 1985 (SAN); Beluran, Labuk Sugut, Sungai Tahid,

Gambating SAN 67362, 22 Jan 1985 (SAN); Ranau, *Mikil SAN 37719*, 28 Sep 1963 (SAN); Papar, Kimanis, *Pereira JTP 520*, 18 Sep 1997 (SAN); Kinabatangan, Lamag, *Burgess SAN 40426*, Aug 1961 (SAN); Ranau, Pig Hill, *Chew RSNB 4497*, 24 Feb 1964 (SAN); Sipitang, Bukit Sebuboh, 120 m, *Beaman J.H. Beaman 8728*, 1 Mar 1984 (UKMB); Tambunan, Trus Madi FR, *Mikil SAN 41836*, 11 Nov 1964 (SAN).

Elytranthe

13. *Elytranthe albida* (Blume) Blume

This is a new record for Mount Kinabalu. The woody bracts in fruit are distinctive and the flowers are very long (c. 50 mm). The corollas are reddish below and green at the tip.

Elevational range: 1400–1800 m.

SPECIMENS EXAMINED—BORNEO. SABAH: Ranau, Sosopodon, *Lajangah SAN 33132*, 25 Nov 1962 (SAN); Ranau, Sosopodon, *Meijer SAN 28590*, 20 Feb 1962 (SAN); Ranau, Sosopodon FR, *Aban SAN 62224*, 28 Oct 1967 (SAN); Kota Belud, Kinabalu National Park, *Adam SAN 56364*, Nov 1966 (SAN); Kota Belud, Kinabalu National Park, *Meijer SAN 57526*, 29 Nov 1966 (SAN); Kinabatangan, Gunong Rara FR, *Fidilis SAN 94717*, 30 Mar 1982 (SAN); Tambunan, Crocker Range (National Park), *Chow SAN 65046*, 13 Oct 1969 (SAN); Sipitang, Long Pa Sia, ? *MTED 383*, 27 Jun 1997 (SAN); Ranau, Sosopodon FR, *Meijer SAN 42788*, 17 Feb 1965 (SAN); Sipitang, Melingan FR, *Madani SAN 132719*, 13 Jul 1991 (SAN); Ranau, Kinabalu Park, PHQ, *Gusili SNP 18234*, 13 Jan 2004 (SNP).

Helixanthera

14. *Helixanthera coccinea* (Jack) Danser

In Sabah, this species is distinguished from others by its short, 4-merous corollas (<13 mm long) that are produced on short inflorescences (< 70 mm long). Most material have been collected from low elevations.

Elevational range: 150–200 m.

SPECIMENS EXAMINED—BORNEO. SABAH: Sipitang, SFI, *Amin SAN 86515*, 15 Jul 1985 (SAN); Lahad Datu, Orchid Plateau, *Kumin SAN 71094*, 25 Jul 1970 (SAN); Kinabatangan, Pinangah FR, *Sumbing SAN 110191*, 17 Sep 1985 (SAN); Ranau, Mesilau Trail, *Chow SAN 76404*, 26 Sep 1972 (SAN); Beluran, Labuk Sugut, Sungai Kibiribi, *Aban SAN 99313*, 18 Jul 1983 (SAN); Keningau, Sungai Milian, *Sumbing SAN 118641*, 13 Nov 1986 (SAN); Sandakan, *Singh SAN 58760*, 27 Oct 1966 (SAN); Sandakan, *Diwol SAN*

74976, 14 Dec 1971 (SAN); Tawau, Kinabutan Kechil, *Aban SAN 35884*, 21 May 1963 (SAN); Kota Belud, *Lorence PEK-L.Lugas 1967*, 18 April 1996 (SAN).

15. *Helixanthera crassipetala* (King) Danser

This is one of two species in Sabah with long corollas (>15 mm long). The other species with long corollas is *H. cylindrica* but material of it has pedicels that are longer than the ovary produced on a longer inflorescence axis. *Helixanthera crassipetala* specimens have flowers that are essentially lacking a pedicel and produce thick leaves that are coriaceous with indistinct venation, thus appearing finely striate.

Elevational range: none listed.

SPECIMENS EXAMINED—BORNEO. SABAH: Tambunan, Gunong Alab, *Sumbing SAN 121692*, 13 Aug 1987 (SAN); Tambunan, Gunung Trus Madi, *Sumbing SAN 125500*, 16 Aug 1988 (SAN).

16. *Helixanthera cylindrica* (Jack) Danser

This species is similar to *H. crassipetala* but the inflorescence length difference allows for discrimination of most material. Barlow (1997) suggests that the two species may hybridize so some material may be difficult to identify. However, the material we have separated is quite distinct. This species is known primarily from the Keningau-Tenom-Papar region of western Sabah.

Elevational range: around 1000 m.

SPECIMENS EXAMINED—BORNEO. SABAH: Nabawan, Bkt. Pisagan, *Sumbing SAN 127617*, 17 Jun 1989 (SAN); Keningau, Ulu Sungai Bersanon, *Fidilis SAN 128163*, 8 Aug 1990 (SAN); Tenom, Melalap, *Sumbing SAN 139220*, 8 Jul 1995 (SAN); Keningau, Ulu Sungai Bersanon, *Fidilis SAN 128598*, 7 Aug 1990 (SAN); Keningau, Bunang, *Nordin SAN 85801*, 22 Jul 1977 (SAN); Kinabatangan, Gunong Lotung, *Cockburn SAN 83131*, 15 May 1976 (SAN); Kuala Penyu, Mansud, *Amin SAN 103012*, 19 Feb 1986 (SAN); Papar, Mandahan, *Amin SAN 103135*, 18 Apr 1986 (SAN); Keningau, Sook, *Meijer SAN 50160*, Jul 1965 (SAN).

17. *Helixanthera maxwelliana* (Gibbs) Danser

Material of this species typically has short, 5-merous corollas (<13 mm long), with the style reaching the top of the anthers and a short inflorescence axis (c. 70 mm). Sabah material often have leaves that are broader than Barlow's description and ovary length may be longer than 3–4 mm. The flowers and inflorescence axis are red.

Elevational range: 100–1700 m.

SPECIMENS EXAMINED—BORNEO. SABAH: Ranau, Sosopodon, *Mikil SAN 56291*, 23 Mar 1966 (SAN); Ranau, Sosopodon FR, *Aban SAN 56717*, 26 Apr 1968 (SAN); Ranau, Sosopodon, *Mujin SAN 33796*, 20 Apr 1963 (SAN); Tuaran, Pahu, *Soinin SAN 101937*, 16 Oct 1989 (SAN); Lahad Datu, Silabukan FR, *Pereira SAN 29770*, 9 May 1962 (SAN); Kota Belud, Kinabalu National Park, *Lajangah SAN 36152*, 15 Jul 1963 (SAN); Tambunan, *Soinin SAN 124974*, 21 Oct 1989 (SAN); Ranau, Poring, *Lampangi SAN 24079*, 17 Feb 1961 (SAN); Tawau, *Fidilis SAN 89768*, 19 Mar 1979 (SAN); Kinabatangan, Gunong Rara FR, *Fidilis SAN 94715*, 29 Mar 1982 (SAN); Beluran, Sg. Ensuan, *Aban SAN 91646*, 17 Apr 1980 (SAN); Kinabatangan, Lamag, *Lassan SAN 70662*, 13 May 1970 (SAN); Kinabatangan, Tenegang Besar, *Singh SAN 51857*, 25 May 1965 (SAN); Kinabatangan, Tongod, *Diwol SAN 90311*, 14 Jun 1982 (SAN); Ranau, Sosopodon, *Mikil SAN 46506*, 29 Jul 1964 (SAN); Lahad Datu, Ulu Sungai Danum, *Cockburn SAN 85089*, 26 Aug 1976 (SAN); Kinabatangan, Sungai Tenegang Besar, *Majawat SAN 120955*, 25 Jul 1987 (SAN); Beluran, Labuk Sugut, Telupid, *Madani SAN 75379*, 28 Jul 1972 (SAN); Lahad Datu, Bukit Silam, *Talip SAN 52798*, 18 Sep 1965 (SAN); Mamut Copper Mine, *Beaman J.H. Beaman 10357*, 28 Jun 1984 (UKMB).

18. *Helixanthera parasitica* Lour.

This species has a rather wide elevational range and is recorded as parasitic on *Quercus* and species of Rutaceae in Sabah.

Elevational range: 20–1600 m.

SPECIMENS EXAMINED—BORNEO. SABAH: Ranau, Nalapak, *Gambating SAN 117397*, 9 Mar 1987 (SAN); Sandakan, Sibuga, *Bakar SAN 27711*, 3 Oct 1961 (SAN); Ranau, Mamut, *Gambating SAN 129376*, 19 Nov 1988 (SAN); Sandakan, Sibuga, *Singh SAN 27472*, 19 Oct 1961 (SAN); Ranau, Sungai Mesilau, *Chew RSNB 4318*, 10 Feb 1964 (SAN); Ranau, Sungai Kenipir, *Gambating SAN 106755*, 7 Feb 1986 (SAN); Ranau, Badukan, *Gambating SAN 117949*, 17 Jun 1987 (SAN); Papar, *Jawanting SAN 41379*; 25 Jan 1964 (SAN); Tambunan, Trus Madi FR, *Meijer SAN 122652*, 14 Nov 1987 (SAN); Tambunan-Ranau Rd., 1100 m, *Joseph JWT 07*, 5 Mar 1995 (SAN); Keningau, Sook, *Sadau SAN 49576*, 27 May 1965 (SAN); Sipitang, Mengalong FR, *Talip SAN 50616*, 22 Nov 1966 (SAN); Sipitang, Long Pa Sia, ? *MTED 229*, 23 Jun 1997 (SAN); Beluran, Labuk Sugut, Segaliud Lokan FR, *Gambating SAN 68198*, 20 Nov 1984 (SAN).

19. *Helixanthera pulchra* (DC.) Danser

This is a new record for Borneo. Its discovery in Sabah is not surprising given its widespread distribution in Thailand, Sumatra and Peninsular Malaysia (Barlow 1997). *Helixanthera apodanthes* is a synonym of *H. puchra* (Barlow 1997) and specimens in Sabah may be

annotated as such. The species is only known from forests in the Keningau-Tenom area at low elevations. Whether suitable forest still exists in the areas it has been collected from is unknown since the last specimens were collected in 1995.

Elevational range: 200–550 m.

SPECIMENS EXAMINED—BORNEO. SABAH: Nabawan, Bkt. Pisagan, *Fidilis SAN 139619*, 21 Feb 1995 (SAN); Keningau, Sungai Mantuluk, *Fidilis SAN 113297*, 20 Jan 1986 (SAN); Tenom, *Sumbing SAN 120116*, 13 Mar 1987 (SAN); Keningau, Sook, *Collenette J.S. Collenette 32/79*, Sep 1979 (SAN); Keningau, Pensiangan Kayu FR, *Asik SAN 136866*, 20 Jan 1994 (SAN); Tenom, Mandalom FR, *Fidilis SAN 136135*, 16 Aug 1993 (SAN); Keningau, Pensiangan Kayu FR, *Fidilis SAN 130065*, 7 Jul 1992 (SAN); Nabawan, Bkt. Pisagan, *Sumbing SAN 127619*, 17 Jun 1989 (SAN); Nabawan, Pensiangan, Penantaman, *Fidilis SAN 131455*, 9 Jul 1991 (SAN); Keningau, Bunang, *Nordin SAN 85814*, 23 Jul 1977 (SAN); Keningau, Tulid, *Talib SAN 80379*, 21 Feb 1976 (SAN); Keningau, Sook, *Madani SAN 87160*, 11 Aug 1977 (SAN); Keningau, Ulu Sungai Tinagalan, *Sumbing SAN 113093*, 18 Nov 1985 (SAN); Sipitang, Gunong Lumaku, *Sadau SAN 49491*, 8 Apr 1965 (SAN); Tambunan, *Ignatius SAN 140153*, 2 May 1995 (SAN); Keningau, Witti Range, *Fidilis SAN 118542*, (30 Oct 1986SAN); Keningau, Tulid, *Saikeh SAN 73291*, 21 May 1971 (SAN); Keningau, Tulid, *Diwol SAN 77529*, 13 Apr 1973 (SAN); Tenom, Tomani, *Majawat SAN 130788*, 15 Aug 1990 (SAN); Keningau, Kampung Binakaan, *Nordin SAN 85614*, 14 Apr 1977 (SAN).

20. *Helixanthera spicata* Danser

This species is cited by Beaman et al. (2001) as occurring on Mt. Kinabalu from two collections by the Clemenses, both from Penigupan. Therefore, it would seem very localized in its distribution there.

Elevational range: 1200–1500 m (from Beaman et al. 2001).

SPECIMENS EXAMINED: none.

Lampas

21. *Lampas elmeri* Danser

This monotypic genus appears to be endemic to Sabah and is recognized by its whorled leaves (3 or 4 per node) and a deflexed inflorescence that has upward-pointing flowers in a dense cluster at the apex. The flowers are brilliant orange-red with yellow, reflexed corolla lobes and acuminate anthers that are exserted well beyond the corolla lobes. Herbarium specimens of *Lampas elmeri* have leaves with a dark brown margin and midrib on the undersurface of the leaves due to the production of minute scales as in *Lepeostegeres bahajensis* and *L.*

lancifolius. In addition, the leaves of *Lampas* are distinctly whitened beneath as compared to the upper green surfaces, at least when fresh. It was recorded as parasitic on Dilleniaceae, *Mallotus* and *Meliosma*.

Elevational range: 50–500 m.

SPECIMENS EXAMINED—BORNEO. SABAH: Beluran, Labuk Sugut, Maliau, *Sigin SAN 99717*, 26 Jul 1983 (SAN); Lahad Datu, Bukit Silam, *Majawat SAN 138305*, 23 Oct 1993 (SAN); Lahad Datu, Ulu Segama, *Cockburn SAN 84915*, 17 Aug 1976 (SAN); Lahad Datu, Ulu Sungai Danum, *Cockburn SAN 85069*, 26 Aug 1976 (SAN); Kinabatangan, Pinangah, *Mansus SAN 109218*, 28 May 1985 (SAN); Kinabatangan,Ulu Sungai Pingas Pingas, *Asik SAN 110879*, 11 Mar 1985 (SAN); Lahad Datu, Danum Valley, *Campbell SAN 112301*, 21 Oct 1985 (SAN); Tawau, Tawau Hill Park, *Binson SAN 62929*, 18 Apr 1968 (SAN); Tawau, Tawau Hill Park, *Binson SAN 63915*, 5 Oct 1968 (SAN); Tawau, Bukit Tukok, *Bakar SAN 24954*, 3 May 1961 (SAN); Sandakan, Sungai Kapur, *Singh SAN 22876*, 17 Oct 1960 (SAN); Lahad Datu, Tabin FR, *Sugau JBS 321*, 7 Mar 1998 (SAN); Imbak Canyon, 550m, path from eight-tier waterfall up to ridge, *Gregson Gregson 21*, 13 May 2004 (SAN); Kinabatangan, Gunong Rara FR, *Shea SAN 75621*, 21 Apr 1972 (SAN); Kinabatangan, Gunong Rara FR, *Chow SAN 75658*, 14 Apr 1972 (SAN); Beluran, Labuk Sugut, Telupid, *Zainudin A.Zainuddin 4945*, 8 Apr 1994 (SAN); Kinabatangan, Sukau, *Lim LSP 1187*, 16 Sep 1996 (SAN); Kinabatangan, Pinangah, *Wong WKM 2347*, 2 Sep 1992 (SAN); Kinabatangan, Bukit Tinkar, *Wong WKM 2209*, 24 Aug 1992 (SAN); Beluran, Labuk Sugut, Bidu Bidu FR, *Kulip SAN 131040*, 22 Feb 1991 (SAN); Beluran, Labuk Sugut, Maliau, *Sigin SAN 99717*, 26 Jul 1983 (SAN); Kinabatangan, Lamag FR, *Diwol SAN 142956*, 26 Apr 2001 (SAN); Kinabatangan, Sukau, *Reza RA 274*, 29 Mar 1995 (SAN); *Lassan SAN 70743*, 10 May 1970 (SAN); Lahad Datu, Danum Valley, *Campbell SAN 110727*, 16 Jan 1987 (SAN); Kinabatangan, Sungai Menanggol, *Gambating SAN 69948*, 20 Feb 1985 (SAN); Beluran, Labuk Sugut, Lung Manis, *Fox SAN 58854*, 25 Jan 1967 (SAN); Kinabatangan, Tongod, *Diwol SAN 97305*, 10 Jun 1983 (SAN); Keningau, Sungai Maadun, *Fidilis SAN 118801*, 20 May 1987 (SAN); Tawau, Kalabakan, *Fidilis SAN 95805*, 21 Jun 1982 (SAN); Keningau, Nabawan/Pandewan, *Fidilis SAN 128582*, 29 Mar 1990 (SAN); Tawau, Luasong, *Fidilis SAN 82242*, 17 Mar 1977 (SAN); Kinabatangan, Dagat, *Majawat SAN 120668*, 20 Jul 1987 (SAN); Sandakan, Gomantong, *Bousi SAN 122774*, 21 Jan 1988 (SAN); Keningau, Witti Range, *Sumbing SAN 110168*, 22 Aug 1985 (SAN); Lahad Datu, Silam, *Talip SAN 68400*, 22 May 1970 (SAN); Kinabatangan, Tangkulap FR, *Diwol SAN 124669*, 26 May 1988 (SAN); Beluran, Labuk Sugut, Telupid, *Diwol SAN 79484*, 20 May 1978 (SAN); Lahad Datu, Takon, *Agam SAN 41633*, 20 Apr 1964 (SAN); Kinabatangan, Sungai Namatoi, *Madani SAN 88847*, 12 Jun 1978 (SAN); Lahad Datu, Danum Valley, *Campbell E.J.F. Campbell-Gasis 249*, 20 Feb 1992 (SAN); Nabawan, Pensiangan, Labang, *Sumbing SAN 125226*, 14 Oct 1988 (SAN); Kinabatangan, Sungai Pin, *Hepburn SAN 43348*, 24 Feb 1966 (SAN); Tawau, Balung hot springs area, Tawau Park Hill. 868 ft., *Dolois, Benedict, Jusimin, Johnny, & Jinulus SNP 17450*, 26 Sep 2002 (SNP); Telupid, XPDC Ulu Tongod, route to Mt. Moliou, *Dolois, Yabinus, Sinal& Gusili SNP 09859*, 19 Aug 2004 (SNP).

Lepeostegeres

22. *Lepeostegeres bahajensis* (Korth.) Miq.

This distinctive species has acute to acuminate leaves with an inflorescence of 9–12 flowers, each of which has corolla lobes reflexed at the 1/2 point of the tube. Perhaps most distinctive are the darkened stems and petioles due to the dense layer of scurfy black scales.

Elevational range: around 25 m.

SPECIMENS EXAMINED—BORNEO. SABAH: Penampang, Babagon, *Diwol SAN 77513*, 24 Mar 1973 (SAN); Papar, Kimanis, *Meijer SAN 36281*, 5 May 1963 (SAN); Papar, Mandahan, *Talib SAN 80654*, 19 Jul 1976 (SAN); Papar, Kimanis, *Udarbe SAN 28166*, 5 Sep 1962 (SAN); Sipitang, Mengalong FR, *Madani SAN 111409*, 14 Sep 1985 (SAN); Sipitang, Kuala Mengalong, *Amin SAN 132105* 24 May 1993 (SAN).

23. *Lepeostegeres becarrii* (King) Gamble

This species is distinctive due to its very long involucre (>50 mm) and corolla (> 80 mm). An interesting specimen was collected between Crocker Range Headquarters and Ulu Kimanis (*SJD 99203*) that fits well with the description of this species except that it has twice the number of flowers reported for this species (c. 50). It was recorded as parasitic on *Mallotus*.

Elevational range: 600–1000 m.

SPECIMENS EXAMINED—BORNEO. SABAH: Sandakan, Sibuga, *Nicholson SAN 48560*, 19 Feb 1965 (SAN); Keningau, Apin Apin, *Gambating SAN 95492*, 14 Sep 1982 (SAN); Lahad Datu, Mostyn, *Talip SAN 68336*, 16 May 1970 (SAN); Ranau, Bkt. Mentapok, *Gambating SAN 97251*, 14 Apr 1983 (SAN); Kota Marudu, Marak Parak, *Aban SAN 100018*, 18 Aug 1983 (SAN); Sipitang, Long Pa Sia, *Lamb MTED 482*, 30 Jun 1997 (SAN); Ranau, Randagong, *Gambating SAN 121430*, 11 Nov 1987 (SAN); Lahad Datu, Danum Valley Road, *George SAN 138404*, 27 Oct 1993 (SAN); Kota Belud, Mount Kinabalu, *Chew RSNB 527*, 8 Jun 1961 (SAN); Road from Crocker Range Headquarters to Ulu Kimanis, 1000m, *S. Davies SJD 99203*, 19 Oct 1999 (SNP).

24. *Lepeostegeres centiflorus* (Stapf) Tiegh. (Fig. 8)

This species is widespread in Sabah and highly variable in the number of red flowers produced per inflorescence (a range of 30–110 flowers was observed) as well as in terms of length of the flowers. In spite of the variation, it is reliably recognized as distinctive from other Sabah species by its spreading bracts in an inflorescence with numerous flowers. Only in one specimen did we ever observe less than 30 flowers (*SNP13326*). The post-anthesis spreading bracts also serve to separate this species from others. Extensive study may reveal the presence of distinct varieties.

Elevational range: 20–1600 m.

SPECIMENS EXAMINED—BORNEO. SABAH: Ranau, Sosopodon, *Mikil SAN 37728*, 29 Sep 1963 (SAN); Kota Belud, Mount Kinabalu, *Chew RSNB 2510*, 28 Aug 1961 (SAN); Tenom, *Sumbing SAN 120192*, 19 Mar 1987 (SAN); Ranau, Bambangan, *Gambating SAN 118101*, 17 Jun 1987 (SAN); Ranau, Salang, *Gambating SAN 121047*, 29 Sep 1987 (SAN); Sipitang, Sungai Melobid, *Lim SAN 143487*, 17 Apr 2000 (SAN); Ranau, Tudangan, *Aban SAN 60718*, 15 Sep 1967 (SAN); Ranau, Kampong Takutan, *Shea SAN 77143*, 23 May 1973 (SAN); Ranau, Badukan, *Gambating SAN 116073*, 22 Jul 1986 (SAN); Beluran, Labuk Sugut, Bukit Meliau, *Zainudin A.Zainudin 4817*, 4 Apr 1994 (SAN); Beaufort, Binsulok FR, *Amin SAN 102882*, 23 Feb 1987 (SAN); Tambunan, Kampong Mansorulong, *Nordin SAN 85920*, 10 Jul 1978 (SAN); Ranau, Badukan, *Gambating SAN 118275*, 24 Jul 1987 (SAN); Ranau, Minisalu, *Gambating SAN 116224*, 20 Sep 1986 (SAN); Kota Kinabalu, Telipok, *Meijer SAN 136194*, 29 Jun 1992 (SAN); Sipitang, Long Pa Sia, *Lamb MTED 377*, 27 Jun 1997 (SAN); Ranau, Bukit Taviu, *Aban SAN 79348*, 11 Mar 1974 (SAN); Ranau, *Gambating SAN 118141*, 22 Jun 1987 (SAN); Papar, Mandahan, *Amin SAN 132248*, 21 Apr 1992 (SAN); Ranau, Tegudon, *Sadau SAN 49220*, 6 Aug 1965 (SAN); Ranau, *Soinin SAN 129149*, 27 Jul 1989 (SAN); Ranau, Bambangan, *Gambating SAN 121178*, Nov 1987 (SAN); Ranau, Bundu Tuhan, *Aban SAN 57503*, 27 Nov 1966 (SAN); Ranau, Bundu Tuhan, *Aban SAN 56357*, 22 Oct 1966 (SAN); Ranau, Kinabalu Park PHQ, 1,600 m, *T.J Barkman KNP 19067*, 4 Jul 2004 (SNP); Kinabalu Park, Pandanus trail, 1600 m, *Gusili, Ramli & Hasbollah SNP 17204*, 19 Jul 2002 (SNP); Kinabalu Park, Sayap substation, Kementis trail, 956 m, *Dolois SNP 19360*, 13 Jul 2004 (SNP); Tawau, Tawau Hill Park, 200 m from hot springs, *Dolois, Hendry & Yabainus KNP 13326*, 14 Dec 2006 (SNP); Kg. Togop Laut (Kg. Lampaki), *Dolois, Masius & Johny SNP 18300*, 25 Feb 2004 (SNP); XPDC Ulu Tongod, along Salonsong River, 620 m, *Dolois, Yabainus, Sinail & Gusili SNP 10096*, 17 Aug 2004 (SNP); Mt. Tambuyukon, Rt to Kopuakan camp, 850 m, *Jamili, Dolois, Duali Ahmad & Paul SNP 12203*, 29 Sep 2005 (SNP); Kopuakan River, Kinabalu Park, 500 m, *Jamili SNP 4528*, 13 Mar 91 (SNP); Kg. Kiau Teburi, roadside, *Dolois & Gusili SNP 06981*, 24 Nov 1994 (SNP); Kg. Kiau Nuluh, *Duaneh* 1 *PEK-J. Duaneh 37*, 8 Sep 1992 (SNP); Kg. Monggis, *Rumutom PEK-M. Rumutom 277*, 23 May 1996 (SNP); Kg. Takutan, *Tadong PEK-D. Tadong 270*, 10 Apr 19930 (SNP); Bukit Kulung near Bk. Hampuan, 600m, *Beaman, J.H. Beaman 8346*, 23.1.84 (UKMB); 400m dari rumah gunong doa, *Lugas PEK-L. Lugas 304*, 19 May 1995 (SNP); Danum Valley Jungle Lodge, 152m, *Z. Azuro 12*, 23 Aug 1992 (UKMB); Tawau, Luasong, *Fidilis SAN 82199*, 10 Mar 1977 (SAN); Beluran, Segaliud Lokan FR, *Madani SAN 81449*, 12 Mar 1975 (SAN); Sandakan, *Diwol SAN 74973*, 14 Dec 1971 (SAN); Lahad Datu, Ulu Segama FR, *Madani SAN 108588*, 11 Mar 1985 (SAN); Kinabatangan, Pin Supu FR, *Lideh SAN 117966*, 28 Jul 1986 (SAN); Kinabatangan, Sungai Namatoi, *Madani SAN 88827*, 11 Jun 1978 (SAN); Lahad Datu, Ulu Segama, *Argent SAN 108389*, 27 Feb 1985 (SAN); Kinabatangan, Bukit Garam, *Kambira SAN 117556*, 20 Feb 1987 (SAN); Sandakan, Gomantong, *Kamideh SAN 66577*, 16 Sep 1970 (SAN); Lahad Datu, Danum Valley, *Campbell E.J.F. Campbell-Gasis 253*, 20 Feb 1992 (SAN); Ranau, *Gambating SAN 116198*, 27 Aug 1986 (SAN); Beaufort,

Binsulok FR, *Amin SAN 132210*, 22 Feb 1992 (SAN); Nabawan, Pensiangan, Penantaman, *Fidilis SAN 128000*, 20 Sep 1989 (SAN); Ranau, *Gambating SAN 123584*, 28 Sep 1988 (SAN); Tawau, Kalabakan, *Fidilis SAN 95783*, 27 Jan 1983 (SAN); Tawau, Tawau Hill Park, *Aban SAN 79657*, 5 Jul 1974 (SAN); Tawau, Kalabakan, *Fidilis SAN 95993*, 6 Oct 1982 (SAN); Penampang, Tamparuliyan FR, *Amin SAN 103339*, 21 Jun 1987 (SAN); Ranau, Sosopodon, *Adam SAN 56368*, Nov 1966 (SAN); Ranau, Pinosok, *Gambating SAN 121619*, 22 Jul 1988 (SAN); Lahad Datu, Silam, *Talip SAN 52931*, 21 Dec 1965 (SAN); Beaufort, Lumat, *Amin SAN 115380*, 22 Feb 1990 (SAN); Keningau, Kepayan FR, *Diwol SAN 80434*, 10 Mar 1976 (SAN); Tawau, Kalabakan, *Fidilis SAN 91376*, 16 Nov 1979 (SAN); Lahad Datu, Ulu Segama FR, *Madani SAN 108588*, 11 Mar 1985 (SAN); Beaufort, Binsulok, *Mat-Salleh K. Mat Salleh 1479*, 22 Sep 1987 (SAN).

25. *Lepeostegeres lancifolius* (Tiegh.) Danser

This species is very distinctive from others in the genus because of the quadrangular stems that bear acuminate-acute leaves and corolla lobes that are reflexed at the 4/5 point of the tube. The leaves are usually tan- to rust-coloured below. The midrib is faintly to strongly darkened. Leaf venation is obscure in this species unlike that of *L. centiflorus* which has visible lateral veins on the lower leaf surface. The darkened midrib and margins of leaves are due to the production of dense, rusty-coloured trichomes/scales. The lowermost bracts of the inflorescence have a dorsal pale patch that contrasts with the otherwise darker pigmentation of bracts. *Lepeostegeres lancifolius* appears to be limited to low elevations in the eastern part of the state.

Elevational range: 150–520 m.

SPECIMENS EXAMINED—BORNEO. SABAH: Tawau, Tawau Hill Park, *Fidilis SAN 88210*, 3 Feb 1978 (SAN); Tawau, Luasong, *Fidilis SAN 89839*, 12 Jul 1979 (SAN); Kinabatangan, Bkt. Tawai, *Mansus SAN 108486*, 19 Mar 1985 (SAN); Lahad Datu, Bukit Silam, *Meijer SAN 109846*, 3 Jun 1990 (SAN); Tawau, Luasong, *Postar SAN 143527*, 20 Jul 2001 (SAN); Lahad Datu, Bukit Silam, *Madani SAN 145399*, 22 Jun 2000 (SAN); Mile 58 Telupid, Sandakan, *SAN 79467*, 19 May1978 (SAN); Tawau, Ulu Sungai Kinabutan, *Aban SAN 34102*, 15 Feb 1963 (SAN); Beluran, Labuk Sugut, Sungai Ruku Ruku, *Aban SAN 94048*, 6 Aug 1981 (SAN); Sg. Binalik, Telupid, *SAN 111814*, 12 Dec 1985 (SAN); Beluran, Labuk Sugut, Sungai Sasau, *Gambating SAN 107368*, 15 Sep 1984 (SAN); Kinabatangan, Bkt. Tawai, *Ignatius SAN 139984*, 4 Feb 1995 (SAN); Ulu Tungod Forest Reserve Meliau, Beluran, 150 m, *SAN 131142*, 8 Aug 2003 (SAN); Tawau, Luasong, *Fidilis SAN 87347*, 19 Aug 1977 (SAN); Beluran, Labuk Sugut, Sungai Ruku Ruku, *Rahim SAN 95003*, 22 Jun 1982 (SAN); Beluran, Telupid, *Madani SAN 83526*, 23 Jun 1976 (SAN); Lahad Datu, Taliwas, *Bousi, J. SAN 119307*, 3 Aug 1987 (SAN); Tawau, Quoin Hill FR, *Bakar SAN 18535*, 17 Jun 1961 (SAN); Ulu Tongod, along Tensuon River, Telupid XPDC, 520 m, *Dolois,Yabainus, Sinal & Gusili SNP 09842*, 18 Aug 2004 (SNP); Lahad Datu, Gunung Silam, 300 m, *Rimi, Jamili, Dolois & Geofarry SNP 06230*, 13 Sep 1995 (SNP).

Lepidaria

26. *Lepidaria kingii* (King) Danser

This is a new record for the flora of Mount Kinabalu. It is known from two collections in the Poring area as well as Keningau and Kinabatangan. It is likely not commonly collected due to the fact that it grows in the canopy of tall lowland tropical tree species. This gorgeous species produces inflorescences that have an involucre > 50 mm long with 2–8 flowers, each of which has a curved corolla that measures > 60 mm in length. In addition, the leaves may reach 20 cm in length.

Elevational range: around 250 m.

SPECIMENS EXAMINED—BORNEO. SABAH: Ranau, Poring, *Gambating SAN 123587*, 5 Oct 1988 (SAN); Keningau, Crocker Range (National Park), *Fidilis SAN 120557*, 22 Aug 1986 (SAN); Sandakan, Labuk Buaya, *Meijer SAN 23633*, 11 Nov 1960 (SAN); Tawau, TBT, Road side, 250 m, *Dolois SNP 17766*, 10 Jun 2003 (SNP).

27. *Lepidaria puchella* Danser

Material of this species is fairly simple to identify because of the long leaves (> 9 cm) coupled with floral bracts that are recurved at the apex. It appears to be limited to low elevations mostly in the eastern or southern part of the state.

Elevational range: 0–700 m.

SPECIMENS EXAMINED—BORENO. SABAH: Beluran, Labuk Sugut, Sungai Kun Kun, *Aban SAN 97227*, 16 Jun 1983 (SAN); Kinabatangan, Malua FR, *Diwol SAN 129716*, 31 Jul 1990 (SAN); Keningau, Pensiangan Kayu FR, *Asik SAN 136036*, 24 Jul 1992 (SAN); Tawau, Luasong, *Fidilis SAN 87378*, 25 Aug 1977 (SAN); Kinabatangan, Sg. Lokan, *Sigin SAN 97518*, 4 Jul 1983 (SAN); Beluran, Labuk Sugut, Sungai Kaingaran, *Aban SAN 99246*, 15 Jul 1983 (SAN); Sandakan, Sepilok Kabili FR, *Sam SAN 39730*, 14 Oct 1963 (SAN); Sandakan, Sepilok Kabili FR, *Sam SAN 39673*, 23 Sep 1963 (SAN); Sipitang, Mesapol FR, *Sadau SAN 50322*, 18 Mar 1966 (SAN); Kinabatangan, Deramakot, *Aban SAN 66336*, 20 Sep 1984 (SAN); Keningau, *Sumbing SAN 119533*, 23 Jun 1987 (SAN); Sabah, *UM A2617* (SAN); Kinabatangan, Tangkulap, *Aban SAN 93978*, 1 Aug 1981 (SAN); Sandakan, *Singh SAN 39297*, 23 Aug 1963 (SAN); Beaufort, *Mikil SAN 34535*, 21 Mar 1962 (SAN); Tawau, Sungai Serudong, *Bakar SAN 26164*, 6 Sep 1961 (SAN); Beluran, Labuk Sugut, Bidu Bidu FR, *Madani SAN 130607*, 26 Jul 1990 (SAN); Lahad Datu, Bkt. Nicola, *Berhaman SAN 134459*, 26 Feb 1992 (SAN); Sandakan, Sepilok Kabili FR, *Sam SAN 64739*, 9 Aug 1969 (SAN); Sabah, UM A2882 (SAN); Kota Marudu, Bukit Templer, *Shea SAN 76252*, 25 Sep 1972 (SAN); Sandakan, Sepilok Kabili FR, *Singh SAN 22511*, 21 Aug 1960 (SAN); Lahad

Datu, Orchid Plateau, *Talip SAN 71076*, 25 Jul 1970 (SAN); Tawau, Mt. Wullersdorf FR, *Talip SAN 65859*, 25 Jun 1969 (SAN); Keningau, Sapulut FR, Nabawan, *Suali SAN 101361*, 24 Oct 1983 (SAN); Beluran, Ensuan, *Aban SAN 90030*, 29 Feb 1980 (SAN); Nabawan, Pensiangan FR, *Fidilis SAN 110372*, 18 Oct 1985 (SAN); Kinabatangan, Tawai FR, *Fox SAN 70416*, 19 Aug 1970 (SAN); Beaufort, *Talib SAN 84678*, 26 Jul 1977 (SAN); Nabawan, Sapulut, *Fidilis SAN 89895*, 11 Aug 1979 (SAN); Beluran, Telupid, *Aban SAN 91298*, 21 Aug 1979 (SAN); Tawau, Kalabakan, *Fidilis SAN 96483*, 18 Aug 1983 (SAN); Kinabatangan, Gunong Rara FR, *Fidilis SAN 96129*, 27 Jun 1983 (SAN); Keningau, Lanas, *Fidilis SAN 118402*, 15 Oct 1986 (SAN); Kinabatangan, Gunong Rara FR, *Pereira JTP 419*, 2 Apr 1997 (SAN); Keningau, Tulid, *Fidilis SAN 122168*, 22 Sep 1988 (SAN); Nabawan, Pensiangan, *Fidilis SAN 139578*, 29 Aug 1994 (SAN); Beaufort, Haligolat, *Diwol SAN 77600*, 10 May 1973 (SAN); Sandakan, Sepilok Kabili FR, *Lassan SAN 65339*, 15 Jun 1969 (SAN); Lahad Datu, Bukit Silam, *Talip SAN 52765*, 15 Sep 1965 (SAN); Tawau, TBT, Picnic area, *Dolois & Yapok SNP16883*, 3 Mar 2005 (SNP); G. Tawai, Plateau S. of mountain top, 700 m, *Vermeulen J.J. Vermeulen 884*, Nov 1986 (UKMB).

28. *Lepidaria sabaensis* (Stapf) Danser (Fig. 9)

This is, by far, the highest elevation *Lepidaria* species in Sabah where it appears to parasitize *Leptospermum* and *Rhododendron*. The only other high elevation member of Loranthaceae is *Macrosolen flammeus* from which this is easily distinguished by the dense set of imbricate red bracts surrounding the flowers. It has the smallest leaves of the genus and produces 2–8 flowers per inflorescence and the bracts are keeled. Besides Mount Kinabalu, it may also be found on the adjacent Mount Tambuyukon. Corollas are salmon to pink-red below with white to yellow apices.

Elevational range: 1500–3950 m.

SPECIMENS EXAMINED—BORNEO. SABAH: Kota Belud, Kinabalu National Park, *Pereira SAN 47203*, 19 Aug 1964 (SAN); Kota Belud, Kinabalu National Park, *Weber SAN 54718*, 20 Mar 1966 (SAN); Kota Belud, Kinabalu National Park, *Aban SAN 56344*, 19 Oct 1966 (SAN); Kota Belud, Kinabalu National Park, *Weber SAN 54748*, 22 Jul 1966 (SAN); Kota Belud, Kinabalu National Park, *Nais SNP 2704*, 16 Feb 1989 (SAN); Kota Belud, Mount Kinabalu, *Chew RSNB 1099*, 25 Jun 1961 (SAN); Kota Belud, Mount Kinabalu, *Chew RSNB 833*, 13 Jul 1961 (SAN); Kota Belud, Mount Kinabalu, *Stone B. Stone 11356*, 9 May 1973 (SAN); Kinabalu, 8500 ft., *Meng et al. W.K. Meng, C.L. Chan, J. Nais 93-27*, 4 June 1993 (SNP); Kota Belud, Kinabalu National Park, *Watkins SAN 57905*, 5 May 1968 (SAN); Kota Belud, Kinabalu National Park, *Meijer SAN 28573*, (16 Feb 1962SAN); Ranau, Layang Layang, *Lee SAN 69965*, 12 Sep 1983 (SAN); Kota Belud, Kinabalu National Park, *Mikil SAN 46541*, 11 Aug 1964 (SAN); Summit trail, Kinabalu Park, 12,000 ft, *Rimi SNP 05684*, 24 Apr 1994 (SNP); Summit trail, Kinabalu Park, 3950m, *F.L Tan, Helen & Ansow SNP 0684*, 6 July 1982 (SNP); Mt. Tambuyukon, 7,500 ft, *Anthea & Justin SNP 0183*, Jan

1982 (SNP); Summit trail, 7,000ft, *Y.F Lee, Aban & Dewol SNP 69965*, 12 Sep 1983 (SNP); Below Gunting Lagadan Hut, 11,200 ft, *Thomas & Mohd Zalni SNP 0462*, 20 Jan 1983 (SNP); Northern Ridge, Kinabalu, 2,200 m, *Alim SNP 05366*, 4 Apr 1995 (SNP); Summit trail, 3940 m, on Leptospermum tree near Panar Laban, *F. L. Tan, Ansow & Helen SNP 0679*, 6 Jul 1982 (SNP); Kinabalu Natinoal Park, back of Carson's camp, Summit Trail, 9,950m, *F. L. Tan, Ansow & Helen SNP 0678*, 6 July 1982 (SNP); Panar Laban, 11,000 ft, *Anthea & Tan SNP 1606*, 26 Oct 1983 (SNP); 11,000 ft, Gng. Kinabalu, Feb. 1974, *Rahim A. Rahim 277* (UKMB); Kinabalu, 9-10,000ft., *Sato* T. Sato 0780, 26 Jul 81 (UKMB); Mount Kinabalu 3140 m, *Sato T. Sato 1447*, Oct 1981 (UKMB).

Loxanthera

29. *Loxanthera speciosa* Blume

This appears to be an exceedingly rare species in Sabah and is known only from two collections by the Clemenses (Beaman et al. 2001) and one from SAN. However, the lovely long pink flowers are distinctive in the family and it is not easily confused with any other. No hosts were recorded.

Elevational range: not recorded.

SPECIMEN EXAMINED—BORNEO. SABAH: Beluran, Labuk Sugut, Kampung Baba, *Gambating SAN 90046*, 3 Mar 1980 (SAN).

Macrosolen

This genus is relatively easy to separate from others in Loranthaceae because of the 6-merous flowers subtended by 3 bracts on plants with opposite leaves. However, variability in leaf morphology makes distinguishing between species in Sabah difficult. In addition, unless mature flowers are collected, many species cannot be reliably identified because accurate corolla length must be determined. Thus, fruiting specimens are listed as "indet." below. Unfortunately, *Macrosolen* individuals are commonly collected in fruit or when flowers are immature.

30. *Macrosolen acunae* (Merr.) Danser

In Sabah, this species is distinctive due to its large sessile leaves that are associated with long corollas. The leaves tend to appear tan in colour and have venation obvious on both surfaces and flowers in the 50 mm range when mature with very short pedicels (1–2 mm). However, in general, the leaves of our specimens are not as large as those reported for this species in Barlow (1997). In Sabah, material has leaves that range 13–21 cm long by 5–8.5

cm wide. Because the leaves are sessile the material cannot be referred to *M. × tubiflorus*. Vegetatively, the plants fit *M. beccari*, but the floral lengths are too long for that species and the anther to filament proportions are out of the recorded range. Specimens from Ulu Tongod have leaves even narrower than reported above.

Elevational range: 20–600 m.

SPECIMENS EXAMINED—BORNEO. SABAH: Pitas, Paitan FR, *Jawanting SAN 32779*, 28 Jan 1963 (SAN); Beluran, Labuk Sugut, Lung Manis, *Diwol SAN 118076*, 19 Dec 1985 (SAN); Beluran, Labuk Sugut, *Ismail SAN 70684*, 16 Nov 1984 (SAN); Beluran, Labuk Sugut, *Cockburn SAN 82527*, 17 Oct 1975 (SAN); Beluran, Labuk Sugut, Kiabau, *Gambating SAN 93839*, 8 Jul 1981 (SAN); Beluran, Ensuan, *Aban SAN 94464*, 11 Mar 1982 (SAN); Beluran, Labuk Sugut, Sapi, *Madani SAN 81374*, 6 Mar 1975 (SAN); Beluran, Labuk Sugut, Sungai Ruku Ruku, *Aban SAN 94047*, 6 Aug 1981 (SAN); Kinabatangan, Bukit Tawai, *Mansus SAN 108458*, 15 Mar 1985 (SAN); Beluran, Labuk Sugut, Segaliud Lokan FR, *Majawat SAN 102428*, 11 Oct 1988 (SAN); Sandakan, *Ahwing SAN 43761*, 25 May 1964 (SAN); Beluran, Labuk Sugut, Wonod, *Aban SAN 79414*, 19 Mar 1974 (SAN); Kinabatangan, Sg. Lokan, *Aban SAN 90666*, 6 Nov 1979 (SAN); Beluran, Telupid, *Diwol SAN 71159*, 3 Nov 1971 (SAN); XPDC Telupid, Ulu Tongod, along Seronsong River, *Dolois, Yabainus, Sanail & Gusili SNP 09816*, 17 Aug 2004 (SNP); XPDC TBC, Kambongol river, Kg. Kambizaan, outside TBC, 200 m, *Dolois, Yabainus, Rahimah & Gusili SNP 17348*, 5 Sep 2002 (SNP); XPDC Ulu Tongod, along selongsong river, 600 m, *Dolois, Yabinus, Sinal & Gusili SNP 09801*, 17 Aug 2004 (SNP); Sandakan, Labuk Road FR, *Sigin SAN 56812*, 26 Mar 1984 (SAN); Beluran, Labuk Sugut, Kapoi, *Gambating SAN 90045*, 1 Mar 1980 (SAN).

31. *Macrosolen cochinchinensis* (Lour.) Tiegh. (Fig. 10)

This species tends to be easy to identify in Sabah because it has the shortest flowers in the genus (< 20 mm) that are cream to yellow-orange at the base with a dark red to maroon collar above the wings of the corolla tube. Also, in many of the specimens the leaves are cream or tan colour when dry.

Elevational range: 0–1800 m.

SPECIMENS EXAMINED—BORNEO. SABAH: Kampong Tamparuliyan, Penampang, *Amin SAN 104105*, 22 Oct 1991 (SAN); Sungai Bersanon, Keningau, *Asik SAN 128166*, 9 Aug 1990 (SAN); Kampong Dungkahang, Penampang, *Madani SAN 111264*, 5 Sep 1985 (SAN); Mempakul, Kuala Penyu, *Amin SAN 86453*, 26 May 1985 (SAN); Merungin, Ranau, *Madani SAN 82566*, 13 Nov 1975 (SAN); Bonggaya FR, Beluran, *Aban SAN 81970*, 16 Jul 1975 (SAN); Luasong, Tawau, *Fidilis SAN 101495*, 15 Feb 1984 (SAN); Mount Kinabalu, Kota Belud, *Chew RSNB 2774*, 5 Sep 1961 (SAN); Sungai Damit, Beaufort, *Amin SAN*

(Above left and right) **Fig. 9.** *Lepidaria sabaensis* is one of the highest elevation mistletoe species in Sabah and is distinguishable by its few-flowered inflorescence with keeled bracts. **Fig. 10.** *Macrosolen cochinchinensis* has short cream-coloured flowers making it easily distinguishable from all others in the state. (Below left and right) **Fig. 11.** *Macrosolen flammeus* is most likely to be found at high elevations on Mount Kinabalu and usually produces a few-flowered inflorescence. **Fig. 12.** *Macrosolen jamilii* shown here with flower buds and thickened reddish leaves from near the summit of Mount Tambuyukon (*SNP 14403*).

103281, 21 Nov 1986 (SAN); Labuk Sugut, Telupid, Beluran, *Madani SAN 75380*, 28 Jul 1972 (SAN); Marintaman FR, Sipitang, *Amin SAN 115649*, 19 Oct 1988 (SAN); Keningau, *Fidilis SAN 119573*, 26 Jun 1987 (SAN); Sook, Keningau, *Diwol SAN 80784*, 18 May 1976 (SAN); Bambangan, Ranau, *Gambating SAN 118102*, 17 Jun 1987 (SAN); Mamut Copper Mine, Ranau, *Aban SAN 66842*, 8 May 1970 (SAN); Sepilok Kabili FR, Sandakan, *Meijer*

SAN 28457, 24 Nov 1961 (SAN); Bukit Silam, Lahad Datu, *Shea SAN 74863*, 28 Feb 1972 (SAN); Bukit Templer, Kota Marudu, *Shea SAN 76298*, 28 Sep 1972 (SAN); Siaungau FR, Beaufort, *Jumatin SAN 72532*, 17 Feb 1973 (SAN); Babagon, Penampang, *Diwol SAN 77464*, 15 Mar 1973 (SAN); Gunung Trus Madi, Tambunan, *Mikil SAN 44322*, 27 Oct 1964 (SAN); Pahu, Tuaran, *Soinin SAN 101918*, 13 Oct 1989 (SAN); Tambunan, *Soinin SAN 124958*, 19 Oct 1989 (SAN); Sungai Mera, Lahad Datu, *Aban SAN 55381*, 17 Apr 1966 (SAN); Gunong Lumaku, Sipitang, *Karim SAN 78488*, 8 Mar 1975 (SAN); Beaufort, *Madius SAN 50053*, 14 Oct 1965 (SAN); Sungai Keramatoi, Keningau, *Sumbing SAN 121895*, 13 Jan 1988 (SAN); Tamparuliyan FR, Penampang, *Amin SAN 115587*, 24 Feb 1988 (SAN); Bukit Silam, Lahad Datu, *Bousi SAN 120760*, 31 Jul 1987 (SAN); Hamadon, Bundu Tuhan, 1,200 m, *T.J Barkman SNP 19064*, 30 Jun 2004 (SNP); Tambunan, Gunung Alab substation, 1,800 m, *Dolois, Rimi, Hendry & Gusili SNP 13635*, 6 Jul 2006 (SNP); Kg. Nalumad, *Andau PEK-D. Andau 204*, 22 Jun 1995 (SNP); Long Pa Sia, Sipitang, *Lamb MTED 427*, 29 Jun 1997 (SAN); Tenompok, road to Bundu Tuhan, 1500m, *Beaman J.H. Beaman 10526*, 7 Jul 1984 (UKMB); KK-Tambunan Rd, 1700-1800 m, *Beaman J.H. Beaman 6887*, 4 Sep 1983 (UKMB); Kampong Kilimu, Ranau, *Madani SAN 89507*, 24 Nov 1978 (SAN); Kg. Lubah, *Maidum, M. Lais 42*, 6 Nov 1997 (SNP); Ulu Liawan, Keningau, 300 m, *Geofarry, Beneditct, Gusili, Handry & Micheal SNP 07427*, 6 May 1996 (SNP).

32. *Macrosolen flammeus* Danser (Fig. 11)

This species is quite distinctive in Sabah due to its few-flowered inflorescence and small leaves. Also, it is the only species that is commonly found above 2600 m. Although it is commonly found on Mount Kinabalu, specimens have also been collected from Gunong Alab. Most of our specimens have leaves turning pale to more commonly dark chocolate when dry. Flower buds are red below, with a black neck and five black lines extending up towards the greenish-white apices. The ovary is bright yellow green that contrasts sharply with the corolla. It appears to primarily parasitize *Phyllocladus*.

Elevational range: 1800–3600 m.

SPECIMENS EXAMINED—BORNEO. SABAH: Kota Belud, Mount Kinabalu, *Chew RSNB 910*, 20 Jul 1961 (SAN); Tuaran, Gunong Alab, *Madani SAN 119259*, 18 Sep 1987 (SAN); Kinabalu, 8500 ft, *Meng et al. W.K. Meng, C.L. Chan, J. Nais 93-28*, 4 Jun 1993 (SNP); Kota Belud, Mount Kinabalu, *Chew RSNB 858*, 17 Jul 1961 (SAN); Kota Belud, Mount Kinabalu, *Watkins SAN 57902*, 5 May 1968 (SAN); Kota Belud, Mount Kinabalu, *Kitayama UKMS 3873*, 11 Jul 1984 (SAN); Mt. Kinabalu, 10,000 ft, *Gordon Smith & Charles S. SNP 0700*, 25 Apr 1981 (SNP); Mt. Kinabalu, Northern Ridge, 3,200 m, *Alim & Benedict SNP 05394*, 6 Apr 1995 (SNP); Gng. Kinabalu, 11,000 ft, *Rahim A. Rahim 277*, Feb. 1974 (UKMB); Tambunan, Gng. Alab, 1800 m, *Beaman J.H. Beaman 8054*, 23 Dec 1983 (UKMB); Kinabalu, *Syafei 0160*, 1973 (UKMB).

33. ***Macrosolen formosus*** (Blume) Miq.

This few-flowered species has long corollas (> 50 mm) and is most likely to be mistaken for *M. × tubiflorus*, yet it has fewer flowers and keeled bracts.

Elevational range: 360–1600 m.

SPECIMENS EXAMINED—BORNEO. SABAH: Tawau, Tawau Hill Park, *Jamnicky VLJ 28*, 28 Feb 2000 (SAN); Tawau, Kalabakan, *Fidilis SAN 79238*, 7 Feb 1977 (SAN); Danum Valley, Lahad Datu, 600 m, *SAN 112344*, 27 May 1986 (SAN); Kinabatangan, Gunong Rara FR, *Shea SAN 75744*, 20 Apr 1972 (SAN); Tawau, Luasong, *Phillipps SAN 89090*, 9 Aug 1978 (SAN); Nabawan, Pensiangan, Sungai Saburan, *Madani SAN 114456*, 28 Jun 1986 (SAN); Lahad Datu, Danum Valley, *Pereira JTP 203*, 19 Apr 1995 (SAN); Sipitang, Sungai Tamaki, *Lim SAN 143318*, 14 Apr 2000 (SAN); Nabawan, Pensiangan, Sungai Tibow, *Fidilis SAN 105272*, 20 Jul 1984 (SAN); Sipitang, Meligan Range, Kg. Ibul, 20 km dari SFI Mondolong station towards Meligan, 1100-1200m., *S. Akin 114*, 22 Aug 1988 (UKMB); Tawau, Tawau Hill, base camp, *Latiff A. Latiff 3391*, 29 Nov 1989 (UKMB); Crocker Range Park, *Rimi, Gofarry, Rahimah, Johny, Hendry & Masius SNP 07085*, 13 Feb 1996 (SNP).

34. ***Macrosolen jamilii*** T.J.Barkman, Repin, & Sugau, **sp. nov.** (Fig. 12)

This species is related to *M. × tubiflorus* but differs in having coriaceous leaves with a recurved margin and a corolla measuring 20 to 26 mm long (*M. × tubiflorus* has thin leaf blades that are not recurved and corollas measuring 70 to 90 mm long).

TYPE: *Yabainus et al. SNP 12056*, Sabah, Kinabalu Park, Summit of Mt Tambuyukon, 2500 m, 27 Sep 2005 (holotype SNP).

Leaves opposite, lamina broadly ovate to elliptic, 7–13 cm long by 4–8 cm broad, more or less cuneate at the base, petiole 5–7 mm long, blade very thick and coriaceous, recurved at the margin, acute to more commonly obtuse or broadly rounded at the apex, shiny and lustrous above, with a more or less dull luster below, venation pinnate but with lateral veins arcuate. Inflorescences produced at nodes, subtended at base by an involucre of sterile acute bracts, composed of 3–6 opposite pairs of flowers, axis 10–17 mm long, flowers borne on pedicels 1–2 mm long, subtended by 3 bracts, central one up to 3 mm long, sharply acuminate and brown at the tip, the other two of similar length and width, 1–1.5 mm long, rounded at apex, ovary 4–5 mm long with a circular flaring rim at apex, persisting in fruit, green, style extending to tip of anthers, with yellow style and red stigma, corolla 6-merous, 20–26 mm long, winged at middle, 5 mm wide at widest portion with wings, red below, with dark/black band at narrowed neck, with apex white above neck terminated by black tip of bud, and with black stripes connecting the collar and tip, reflexed petals white on inside, anther 3–4 mm

long, free part of filament c. 6 mm long, anthers and filaments yellow. Fruits 4–8 mm long, 4–5 mm wide when dried, persistent style 1–1.5 mm long in fruit even to maturity.

Elevational range: 2400–2500 m.

SPECIMENS EXAMINED—BORNEO. SABAH: Top summit of Mt. Tombuyukon, 2,500 m, *Yabainus, Benedict Gangku, Geofarry & Handry SNP 12056*, 27 Sep 2005 (SNP); Mt. Tombuyukon, 7,500 ft., *Justin SNP 0176*, Jan 1982 (SNP); Mt. Tombuyukon, trail to summit from Kg. Manggis, Jamili, *Alim, Ansow, Dolois, Benedict & Mikeprice SNP 05566*, 11 Mar 1993 (SNP); Between camp III and summit, Mt. Tombuyukon, 2,400 m, *Jamili, Dolois, Benedict, & Sinteyong SNP 4887*, 5 Oct 1990 (SNP); *SNP 0176, SNP 05566, SNP 4887*.

The extremely thickened, red-maroon-coloured leaves of this species separate it from all others. Although other species like *M. flammeus* and even *M. melintangensis* may reach comparable altitudes or even higher, their leaves are not nearly as thick as those of *M. jamilii*. However, the habitat near the summit of Mt. Tambuyukon is extreme ultramafic and although this species is not in direct contact with the substrate, conditions there may be inferred to have selected for its highly sclerophyllous leaves. The floral pigmentation is very similar to *M. × tubiflorus* but floral length and leaf morphology easily separates them. *Macrosolen jamilii* is so far only known from Mt Tambuyukon.

The name honours Dr. Jamili Nais, the first person known to have collected this species from Mt. Tambuyukon and current Director of Sabah Parks.

35. *Macrosolen melintangensis* (Korth.) Miq.

This species is more or less intermediate in flower length between *M. cochinchinensis* and *M. × tubiflorus* in Sabah. Its leaves are also nearly intermediate in size between the two species. Its leaves appear light chocolate or tan colour when dry. No hosts have been recorded.

Elevational range: 500–2000 m.

SPECIMENS EXAMINED—BORNEO. SABAH: Ranau, Sungai Mesilau, *Chew RSNB 4179*, 30 Jan 1964 (SAN); Long Pa Sia, Sipitang Camp at Rekong waterfall, *MTED 426*, 29 Jun 1997 (SAN); Beluran, Labuk Sugut, Telupid, *Majawat SAN 132986*, 14 May 1992 (SAN); Kinabatangan, Bukit Tawai, *Mat-Salleh K. Mat Salleh 3286*, 5 Apr 1994 (SAN); Ranau, Sungai Mesilau, *Chew RSNB 4665*, 11 Mar 1964 (SAN); Ranau, Sungai Bambangan, *Chew RSNB 4376*, 19 Feb 1964 (SAN); Ranau, Sungai Mesilau, *Chew RSNB 4271*, 7 Feb 1964 (SAN); Mt. Tombuyukon between camp 3 and summit, *Jamili Nais, Dolois, Benedict, & Sinteyong SNP 4887*, 5 Oct 1990 (SNP); Marai Parai spur, ridge crest, 7,000 ft, *Anthea SNP 1885*, 13 Feb 1985 (SNP); Power Station, Kinabalu National Park, 1600 m, *Dolois, Benedict,*

Yabainus & Gusili SNP 16590, 6 Nov 2001 (SNP); New Liwagu Trail, *Tan & Anthea SNP 1967*, no date (SNP); Above Mesilau west river, near dam, *Jumaat SNP 2636*, no date (SNP); Kinabalu Park, Bukit Ular Trail, 1,600 m, *Rimi, Geofarry, Rahimah, & Joefredin SNP 07386*, 23 Aug 1995 (SNP); Mount Kinabalu, Summit Trail, Carson Falls, *Handry & Yabainus SNP 10816*, 9 Aug 2005 (SNP); Nepenthes Rajah Trail, Mesilau, *Rimi, Rahimah,Gusili & Ansow SNP 09253*, 16 May 1999 (SNP).

36. *Macrosolen* cf. *retusus* (Jack) Miq.

The specimens we studied had leaves about right in size for this species (3–6 cm by 2–4 cm) but they are acute to rounded at the tip instead of acuminate. The leaves are brownish below and lighter above but the lateral veins are not conspicuous as in the description of *M. retusus*. The pedicels are also too long for *M. retusus*. The high elevation that most specimens were collected from may account for the sclerophyllous nature of these specimens. These collections are all from Mt. Trus Madi.

Elevational range: 1642–2600 m.

SPECIMENS EXAMINED—BORNEO. SABAH: Tambunan, Summit of Mt Trusmadi, 1642 m, *Jamili SNP 05007*, 23 Jan 1992 (SNP); Trus Madi, 1900m, upper montane forest, *Geofarry SNP 16676*, 1 Nov 2001 (SNP); Tambunan, Trus Madi, *Mikil SAN 41862*, 13 Nov 1964 (SAN).

37. *Macrosolen* × *tubiflorus* (Ridl.) Danser (Fig. 13)

This is one of the most commonly collected *Macrosolen* species in Sabah, probably due to the large size and showy nature of the flowers. The only recorded host was Fagaceae. Barlow indicates that this species may be a stabilized hybrid between *M. acunae* and *M. formosus*. Flowers are red below, with dark/black band at narrowed neck, with apex white above neck terminated by black tip of bud, and with black stripes connecting the dark collar and tip. The petals are white when reflexed.

Elevational range: (300) 800–2000 m.

SPECIMENS EXAMINED—BORNEO. SABAH: Kota Belud, Kinabalu National Park, *Mikil SAN 57716*, 13 Mar 1967 (SAN); Sipitang, Sungai Tamaki, *Lim SAN 143334*, 14 Apr 2000 (SAN); Ulu Meligan, Sipitang, 5714 ft, *SAN 144446*, 11 Apr 2002 (SAN); Sipitang, Melingan FR, *Kulip SAN 132793*, 12 Jul 1991 (SAN); Tambunan, Trus Madi FR, *Bousi SAN 124032*, 6 May 1988 (SAN); Kota Belud, Kinabalu National Park, *Aban SAN 60658*, 22 Aug 1967 (SAN); Penampang, Tagudon, *Fidilis SAN 131302*, 6 Sep 1991 (SAN); Kota Marudu, Bkt. Madalon, *Aban SAN 94279*, 19 Nov 1981 (SAN); Kinabatangan, Gunong Lotung, *Cockburn SAN 83265*, 15 May 1976 (SAN); Kota Belud, Mt. Kinabalu, *Cockburn SAN 70102*, 29 Sep 1972 (SAN); Tambunan, Trus Madi FR, *Mikil SAN 41784*, 3 Nov 1964

(SAN); Kota Belud, Kinabalu National Park, *Nais SNP 3582*, 7 Nov 1991 (SAN); Rd. to Kimanis, Crocker Range, 1,000 ft, *Rimi, Gusili, Florina & Johnny SNP 07558*, 20 Jun 1996 (SNP); Pinosuk Plateau, *Anthea, Ansow, Thomas, Tan, Helen, & Tidong SNP 1206*, 13 Dec 1982 (SNP); Kota Merudu, Bukit Madalon, below Trig., *Aban SNP 94279*, 19.11.81 (SNP); Sayap Substation, Kemantis Trail, 900m, *Dolois & Salaikum N. SNP 7678*, 13 Jul 1996 (SNP); KNP, ridge to Gunung Doa, Melangkap Tomis, 1000 m, *Gusili, Rimi, Barkman & Avelina SNP 19642*, 8 Jul 2004 (SNP); Hutan Simpan Komuniti Kiau, Lokos Kogiitan, 1,400 m, *Yabainus, Geofarry, Tisun* SNP 12794, 28 Jun 2006 (SNP); Ranau, Kinabalu Park, *Jamili SNP 12209*, 29 Sep 2005 (K, KEP, L, SAN, SAR, SING); Kg. Melangkap Tomis, 3km dari kampung, *Lugas PEK-L. Lugas 1280*, 16 Nov 1995 (SNP); 4 batu dari Kg. Nalumad, Kawasan Taman, *Andau PEK-D. Andau 921*, 28 Oct 1996 (SNP); route to Kopuakan River, Tombuyukon, 815m, *Dolois SNP 12128*, 26 Sep 2005 (SNP); Sayap, trail to Sg. Lumutuk Besar, 950m, *Latiff A. Latiff 3841*, 3 Jun 1992 (UKMB); Bukit ampuan, 1100m, *Akin S. Akin 2018* (UKMB); Kota Belud, Mount Kinabalu, *Chew RSNB 70*, 14 Jun 1961 (SAN); Kota Belud, Mount Kinabalu, *Chew RSNB 1036*, 16 Jun 1961 (SAN); Kota Belud, Kinabalu National Park, *Aban SAN 60658*, 22 Aug 1967 (SAN); Ranau, Morou Porou, 910m, *Rimi, Rahimah, Harry, Geofarry, Masius & Gusili SNP 06570*, 24 Aug 1995 (SNP); Kota Belud, Kinabalu National Park, *Sam SNP 4132*, 15 Jan 1992 (SAN); Ranau, Bukit Hampuan FR, *Madani SAN 89397*, 20 Nov 1978 (SAN); Sipitang, Long Pa Sia, *Lamb MTED 62*, 20 Jun 1997 (SAN).

***Macrosolen* indet:**

Keningau, Sook, *Sadau, F. SAN 49601*, 31 May 1965 (SAN); Sipitang, Long Pa Sia, *Lamb, A. MTED 427*, 29 Jun 1997 (SAN); Ranau, Paka, *Gambating SAN 116161*, 23 Aug 1986 (SAN); Beaufort, Montenior, *Talib SAN 86120*, 27 Aug 1980 (SAN); Tambunan, Kampong Mansorulong, *Nordin SAN 85907*, 7 Jul 1978 (SAN); Penampang, Kampong Dungkahang, *Madani SAN 111264*, 5 Sep 1985 (SAN); Beaufort, Membakut, *Talib SAN 84644*, 8 Jul 1977 (SAN); Ranau, Kampong Tentolob, *Madani SAN 92521*, 13 Jun 1980 (SAN); Sipitang, Mengalong FR, *Madani SAN 111412*, 14 Sep 1985 (SAN); Ranau, Kilimu, *Matin SAN 122262*, 27 Aug 1987 (SAN); Kota Belud, Kelawat FR, *Jawanting SAN 41364*, 8 Feb 1964 (SAN); Penampang, Tamparuliyan, *Diwol SAN 80422*, 9 Mar 1976 (SAN); Papar, Sungai Kimanis, *Banang SAN 49355*, 5 Apr 1966 (SAN); Lahad Datu, Orchid Plateau, *Kumin SAN 71093*, 25 Jul 1970 (SAN); Nabawan, Keningau, Sungai Pingas Pingas, *Fidilis SAN 113971*, 17 May 1986 (SAN); Ranau, Badukan, *Gambating SAN 121641*, 23 Jul 1988 (SAN); Penampang, Tamparuliyan FR, *Amin SAN 126485*, 25 Jul 1992 (SAN); Ranau, Kundasang, *Meijer SAN 23496*, 4 Jul 1960 (SAN); Ranau, Bkt. Ampuan, *Meijer SAN 20963*, 8 May 1960 (SAN); Kota Belud, Kinabalu National Park, *Aban SAN 56356*, 21 Oct 1966 (SAN); Kinabatangan, Gunong Lotung, *Madani SAN 124450*, 22 Apr 1988 (SAN); Nabawan, Keningau, *Asik SAN 127565*, 12 Jun 1989 (SAN); Lahad Datu, Ulu Segama FR, *Madani SAN 108599*, 17 Mar 1985 (SAN); Ranau, Kundasang, *Burgess SAN 25161*, 31 May 1961 (SAN); Sandakan, Labuk Road FR, *Sigin SAN 56812*, 26 Mar 1984 (SAN); Tawau, Sungai Serudong, *Bakar*

SAN 26152, 5 Sep 1961 (SAN); Beluran, Labuk Sugut, Sugut, *Cockburn SAN 82527*, 17 Oct 1975 (SAN); Kinabatangan,Tangkulap, *Rahim SAN 92986*, 4 Feb 1982 (SAN); Beluran, Labuk Sugut, Segaliud Lokan FR, *Majawat SAN 125880*, 4 Oct 1988 (SAN); Beluran, Labuk Sugut, Telupid, *Zainudin A.Zainudin 5035*, 11 Apr 1994 (SAN); Tambunan, Trus Madi FR, *Kulip SAN 133199*, 29 Nov 1992 (SAN); Kinabatangan, Gunong Rara FR, *Fidilis SAN 94718*, 30 Mar 1982 (SAN); Beluran, Kuala Sapi, *Johny & Masius SNP 08476*, 12 Oct 1997 (SNP).

Macrosolen notes: While it would not be surprising to find other Bornean species like *M. brevitubus* or *M. platyphyllus* in Sabah, we did not observe any material. Two specimens may represent undescribed species in the state. *Sukup Akin 1114* was collected from Sipitang, Meligan Range. This interesting specimen has rounded thick leaves, 50 mm long flowers and only 4 flowers per inflorescence. *PEK-L. Tadong 408* was collected from near Mt. Kinabalu and has leaves that are obovate, pedicels very short, and lateral veins that are not obvious below.

Scurrula

38. *Scurrula ferruginea* (Jack) Danser (Fig. 14)

This particularly common species is often found parasitizing woody plants in disturbed areas, especially *Citrus*. Differentiating between the two common Sabah *Scurrula* species is challenging on some specimens. *Scurrula ferruginea* possesses a layer of dense long dendritic hairs above a layer of shorter hairs on the corolla. Also, the indumentum of *S. ferruginea* appears more orange in colour compared to the more rusty brown to rusty red-coloured *S. parasitica*. Although distinguishing between the two species may be challenging, the stipitate fruits that are covered in rusty or orange-rusty trichomes makes this genus easy to distinguish from all others in the state. The flowers are zygomorphic.

Elevational range: 0–1500 m.

SPECIMEN EXAMINED—BORNEO. SABAH: Beaufort, Ulu Membakut, *Amin SAN 127109*, 15 Oct 1992 (SAN); Ranau, Bundu Tuhan, *Maikin SAN 131254*, 30 Oct 1990 (SAN); Kinabatangan, Sungai Menanggol, *Majawat SAN 117577*, 21 Feb 1987 (SAN); Kota Belud, Kampong Lebong Lebong, *Maikin SAN 108969*, 7 Aug 1985 (SAN); Beaufort, Siaungau FR, *Amin SAN 126732*, 19 Sep 1992 (SAN); Penampang,Tagudon, *Asik SAN 131379*, 13 Sep 1991 (SAN); Piyas, Pitas, *Gambating SAN 121317*, 13 May 1987 (SAN); Kota Belud, Mount Kinabalu, *Chew RSNB 2614*, 1 Sep 1961 (SAN); Ranau, Tudangan, *Gambating SAN 115987*, 18 Jul 1986 (SAN); Ranau, *Gambating SAN 114249*, 17 Mar 1986 (SAN); Ranau, Badukan, *Gambating SAN 114114*, 18 Feb 1986 (SAN); Beaufort, Brunei, *Amin SAN 102983*, 17 Mar 1986 (SAN); Ranau, Badukan, *Gambating SAN 116068*, 22 Jul 1986 (SAN); Tambunan,

Trus Madi, *Tangah JWT 23*, 10 Mar 1995 (SAN); Kudat, Loro FR, *Sinanggul SAN 51057*, 14 May 1965 (SAN); Beaufort, Lumat, *Talib SAN 84503*, 20 Oct 1976 (SAN); Kota Marudu, Kampong Marak Parak, *Aban SAN 99985*, 16 Aug 1983 (SAN); Penampang, *Gambating SAN 60473*, 23 Jul 1984 (SAN); Pitas, Bengkoka Peninsula FR, *Shea SAN 76090*, 11 Sep 1972 (SAN); Beaufort, Klias FR, , *Diwol SAN 80189*, 23 Aug 1975 (SAN); Ranau, Bundu Tuhan, *Aban SAN 56358*, 22 Oct 1966 (SAN); Ranau, Bambangan, *Gambating SAN 121569*, 8 Apr 1988 (SAN); Penampang, Kebambangan, *Majawat SAN 128767*, 10 Apr 1990 (SAN);

(Above left and right) **Fig. 13.** *Macrosolen × tubiflorus*. **A**, Habit. **B**, Closer view of inflorescences showing brilliant-red long-tubular flowers with reflexed white corolla lobes. (Below left and right) **Fig. 14.** *Scurrula ferruginea* is distinctive due to its dense rusty-coloured tomentum covering flowers, fruits and vegetative portions of the plants. **Fig. 15.** *Taxillus chinensis* is one of the most abundant mistletoe parasites in Sabah and is easily recognized by its 4-merous flowers and warty fruits.

Beluran, Labuk Sugut, Mamahat FR, *Jawanting SAN 32691*, 1 Dec 1962 (SAN); Beluran, Labuk Sugut, Sungai Tahid, *Gambating SAN 67306*, 18 Jan 1985 (SAN); Ranau, Kampong Takutan, *Shea SAN 77140*, 23 May 1973 (SAN); Beaufort, Maraba, *Karim SAN 80293*, 8 Nov 1975 (SAN); Ranau, *Soinin SAN 129105*, 26 Jul 1989 (SAN); Beluran, Bonggaya FR, *Kodoh SAN 82013*, 22 Jul 1975 (SAN); Papar, Ulu Kimanis, *Diwol SAN 80496*, 24 Mar 1976 (SAN); Ranau, Merungin, *Madani SAN 82608*, 17 Nov 1975 (SAN); Kudat, Pulau Malawali, *Diwol SAN 89966*, 25 Mar 1979 (SAN); Ranau, Kampong Tentolob, *Madani SAN 92512*, 11 Jun 1980 (SAN); Ranau, *Gambating SAN 109363*, 13 Jun 1985 (SAN); Kinabatangan, Kuala Meruap FR, *Aban SAN 107470*, 8 Nov 1984 (SAN); Beaufort, Lumat FR, *Amin SAN 102721*, 22 Oct 1986 (SAN); Ranau, Badukan, *Gambating SAN 118276*, 24 Jul 1987 (SAN); Kota Marudu, Bukit Templer, *Shea SAN 76288*, 28 Sep 1972 (SAN); Ranau, Mamut Copper Mine, ? *SAN 74029*, 25 Aug 1971 (SAN); Beaufort, Lumat, *Diwol SAN 77910*, 10 Sep 1973 (SAN); Ranau, Pinosok, *Gambating SAN 121629*, 22 Jul 1988 (SAN); Ranau, Pinosok, *Gambating SAN 116146*, 21 Aug 1986 (SAN); Kota Belud, roadside, Kg. Taginambur to Kg. Bongol, *Dolois, Duni & Gusili SNP 15576*, 5 Sep 2000 (SNP); Kota Marudu, Kg. Kias, Kias and Kanarem rivers confluence, *Bakia PEK-A. Bakia 48*, 26 May 1994 (SNP); Giman, Kg. Himbaan, Bundu Tuhan, *Soibeh PEK-D. Soibeh 622*, 19 Dec 1993 (SNP); Kg. Takutan, *Tadong PEK-D. Tadong 196*, 8 Aug 93 (SNP); Kiau Nuluh, *Duaneh PEK-J. Duaneh 39*, 18 Sep 1992 (SNP); Kg. Takutan, *Tadong PEK-D. Tadong 581*, 17 Dec 1993 (SNP); Kg. Sayap, *Surunda PEK-Y. Surunda 9*, 4 Mar 1995 (SNP); Kg. Sorinisim, Tepi Jalan, *Sibil PEK-J. Sibil 159*, 15 Mar 1993 (SNP); Kiulu, along trail to waterfall 30m, *PUA 017*, 6 Sep 1987 (UKMB); Kuala Penyu, Rd to Kg. Tanjung Aru, *Rimi, Dolois, Hendry, Benedict & Robert SNP 06618*, 26 Jul 1995 (SNP); Rd. to Melangkap Kapa, *Anthea SNP 1949*, 19 Nov 1984 (SNP); Bundu Tuhan, parasitic on old pumelo tree, 4,500ft, *Anthea, Ansow, & Lucas SNP 3404*, 9 Jul 1987 (SNP); Rangkam, Bundu Tuhan, 1,100m, *T.J Barkman SNP 15595*, 22 Sep 2000 (SNP).

39. *Scurrula parasitica* L.

This species has flowers that are narrower with a straighter tube, and often darker red-brown than *S. ferruginea*. In general, specimens of this species are less hairy than those of *S. ferruginea*.

Elevational range: 400–1050 m.

SPECIMENS EXAMINED—BORNEO. SABAH: Keningau, Sungai Keramatoi, *Sumbing. SAN 121945*, 19 Jan 1988 (SAN); Keningau, Tulid, *Nordin SAN 85806*, 22 Jul 1977 (SAN); *Meijer SAN 55020*, 1964 (SAN); Nabawan, Bkt. Pisagan, *Fidilis SAN 127647*, 21 Jun 1989 (SAN); Nabawan, Pensiangan, Penantaman, *Asik SAN 131478*, 10 Jul 1991 (SAN); Nabawan, Bkt. Pisagan, *Fidilis SAN 139396*, 18 Feb 1995 (SAN); Sandakan, Ulu Dusun, *Mikil SAN 35779*, 5 Apr 1963 (SAN); Nabawan, Pandewan, *Asik SAN 120100*, 12 Mar 1987 (SAN); Keningau, Ulu Sungai Punteh, *Fidilis SAN 125403*, 21 Feb 1989 (SAN);

Tenom, Melalap, *Sumbing SAN 139183*, 6 Jul 1995 (SAN); Ranau, Bkt. Ampuan, *Madani SAN 89496*, 22 Nov 1978 (SAN); Beluran, Labuk Sugut, Telupid, *Aban SAN 93961*, 31 Jul 1981 (SAN); Tenom, Ulu Sungai Tomani, *Madani SAN 90840*, 13 Jun 1979 (SAN); Kinabatangan, Pinangah FR, *Sumbing SAN 110203*, 18 Sep 1985 (SAN); Keningau, Sg. Pingas Pingas, *Sumbing SAN 110883*, 11 Mar 1985 (SAN); Kinabatangan, Gunong Lotung, 10 May 1976, *Aban SAN 83170* (SAN); Tenom, Mandalom FR, *Asik SAN 136126*, 16 Aug 1993 (SAN); Tambunan, Trus Madi, *Sugau JBS 157*, 10 Mar 1995 (SAN); Keningau, Tulid, *Sumbing SAN 122183*, 24 Sep 1988 (SAN); Papar, Mandahan, *Talib SAN 80670*, 20 Jul 1976 (SAN); Tawau, Outside Taman Bukit Tawau, Bukit Bombalai, *Dolois & Handry SNP 12519*, 13.1.2006 (SNP); Long Pasia, 1000m, *Dolois, Handry, Harry, Geofarry, Johny, Pius, Tisun, Gusili & Willson MTED 378*, 27.6.97 (SNP); Kg. Poring, *Sambuling PEK-S. Sambuling 103*, 13 Dec 1993 (SNP); 400m dari balai raya Melangkap Tomis, *Lugas PEK-L. Lugas 855*, 15 Aug 1995 (SNP).

Taxillus

40. *Taxillus chinensis* (DC.) Danser (Fig. 15)

This species is frequently found along roadsides and disturbed situations. The usually paired flowers and tuberculate fruits make this species relatively easy to recognize. The zygomorphic flowers are 4-merous and green outside with reddish hues inside of the tube. The corolla in bud has a swollen knob at the apex and is constricted at the summit of the ovary. Although it could be confused with *Scurrula*, the non-stipitate fruits of *Taxillus* allow it to be separated from that genus even on a depauperate specimen. The only recorded host was *Melastoma* although casual observation along roadsides in Sabah indicate that it parasitizes a wide range of species.

Elevational range: 0–2000 m.

SPECIMENS EXAMINED—BORNEO. SABAH: Kudat, Tg. Panbatu, *Stone SAN 86810*, 12 Apr 1977 (SAN); Kota Belud, Kinabalu National Park, *Mikil SAN 38658*, 13 Jul 1963 (SAN); Ranau, Kilimu, *Matin SAN 122233*, 24 Aug 1987 (SAN); Ranau, Bkt. Ampuan, *Madani SAN 89470*, 21 Nov 1978 (SAN); Kota Belud, Kinabalu National Park, *Chow SAN 76403*, 26 Sep 1972 (SAN); Tambunan, *Nooteboom H.P. Nooteboom 1309*, 16 Mar 1969 (SAN); Ranau, Mark Pang, *Gambating SAN 110532*, 24 Jul 1985 (SAN); Penampang, Tagudon, *Fidilis SAN 113780*, 17 Jul 1986 (SAN); Papar, Kimanis, *Fidilis SAN 120570*, 23 Aug 1986 (SAN); Ranau, Badukan, *Gambating SAN 116071*, 22 Jul 1986 (SAN); Tambunan, Pinawantai, *Shea SAN 76768*, 5 May 1973 (SAN); Sandakan, Leila FR, *Kodoh SAN 83688*, 16 Apr 1977 (SAN); Keningau, Crocker Range (National Park), *Diwol SAN 83997*, 13 Nov 1976 (SAN); Ranau, Kampong Tentolob, *Madani SAN 92504*, 11 Jun 1980 (SAN); Sandakan, Sungai Mayan, *Stevens P. Stevens et al. 382*, Jan 1976 (SAN); Tambunan, Kirokot, *Maikin SAN 56031*, 9 May 1984 (SAN); Ranau, Sungai Bambangan, *Chew RSNB 4632*, 3 Mar 1964

(SAN); Sandakan, Sepilok Kabili FR, *Meijer SAN 24766*, 26 Jul 1961 (SAN); Sandakan, Sibuga, *Bakar SAN 27710*, 3 Oct 1961 (SAN); Tambunan, Trus Madi FR, *Madani SAN 74431*, 30 Oct 1971 (SAN); Ranau, Tudangan, *Gambating SAN 115986*, 18 Jul 1986 (SAN); Ranau, Pinosok, *Gambating SAN 121623*, 22 Jul 1988 (SAN); Tambunan, Gunong Alab, *Sumbing SAN 121706*, 15 Aug 1987 (SAN); Ranau, Sosopodon FR, *Adam, SAN 56369*, Nov 1966 (SAN); Ranau, Sosopodon FR, *Sinanggul SAN 47909*, 19 Dec 1964 (SAN); Kota Belud, Kinabalu National Park, *Sadau SAN 42838*, 19 Feb 1965 (SAN); Tawau, Gemok Hill FR, *Sumbing SAN 103467*, 19 Mar 1984 (SAN); Beluran, Labuk Sugut, Nangoh, *Nawi SAN 55936*, 6 Dec 1983 (SAN); Ranau, Badukan, *Gambating SAN 116071*, 22 Jul 1986 (SAN); Ranau, Paka, *Gambating SAN 123450*, 23 Sep 1988 (SAN); Ranau, Poring, *Gambating SAN 123175*, 12 Apr 1988 (SAN); Kota Marudu, Kampong Marak Parak, *Aban SAN 99961*, 16 Aug 1983 (SAN); Park Headquarters, 5,120 ft, *Thomas Yusuf & Patrick SNP 1120*, 4 Mar 1983 (SNP); Bundu Tuhan, 4,000 ft, *Anthea, Ansow & Lucas SNP 3401*, 9 Jul 1987 (SNP); Rangkam, Bundu Tuhan, 1100 m, *T. J. Barkman SNP 15592*, 22 Sept 2000 (SNP); Kg. Melangkap Tomis, *Lugas PEK-L. Lugas 2774*, 13 Jul 1998 (SNP); 5 km dari Melangkap Tomis, *Lugas PEK-L. Lugas 1027*, 6 Oct 1995 (SNP); Kg. Poring, *Sambuling PEK-S. Sambuling 400*, 11 Aug 1994 (SNP); Kg. Poring, *Sambuling PEK-S. Sambuling 438*, 2 Sep 1994 (SNP); Kg. Poring, *Sambuling PEK-S. Sambuling 467*, 25 Nov 1994 (SNP); Ranau, Bundu Tuhan, *Doinis PEK-D. Soibeh 92*, 11 Feb 1993 (SAN); Kg. Sayap, Kebun Getah, *Surunda PEK-Y. Surunda 5*, 4 Mar 1995 (SNP); Kg. Takutan, *Tadong PEK-L. Tadong 98*, 18 Mar 1995 (SNP); Kg. Poring, 100m dari sungai, *Sambuling PEK-S. Sambuling 666*, 23 May 1996 (SNP); Kg. Takutan, tepi jalan raya ke SMK Timbua, *Tadung PEK-L. Tadung 251*, 30 Mar 1995 (SNP); 2 batu from Kg. Nalumad, *Andau PEK-D. Andau 1031*, 8 Oct 1998, (SNP); Kg. Poring, *Sambuling PEK-S. Sambuling 422*, 28 Aug 1994 (SNP); 1 km dari Melangkap Tomis, *Lugas PEK-L. Lugas 2475*, 9 Jul 1996 (SNP); 0.5 km dari Melangkap Tomis, *Lugas PEK-L. Lugas 87*, 6 Apr 1996 (SNP); Kawasan Melangkap Tomis, *Lugas PEK-L. Lugas 1898*, 17 Mar 1996 (SNP).

Trithecanthera

41. *Trithecanthera superba* Danser

Beaman et al. (2001) report this species from four collections by the Clemenses from three different localities around Mt. Kinabalu, all of which are known from ultramafic substrates and stunted forests: Gurulau Spur, Marai Parai, and Penigupan. With flowers borne singly and strongly reflexed upwards on the inflorescence axis it would not be easily confused with other taxa so perhaps it is locally rare if not extinct since no specimens have been collected since the 1930s.

Elevational range: 1200–3000 (from Beaman et al. 2001).

SPECIMENS EXAMINED: none.

42. *Trithecanthera sparsa*

Barlow (1995) reports that *T. sparsa* has been collected in Sabah (*de Vogel 8202*, Crocker Range; *Wood SAN A3436*) but we did not encounter any specimens.

Elevational range: not known.

SPECIMENS EXAMINED: none.

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CONTENTS

Page

Datuk Sam Mannan
Introduction — The Centenary of the Sandakan Herbarium iii

J.B. Sugau, J.T. Pereira, Y.F. Lee & K.M. Wong
The Sandakan Herbarium turns a hundred 1

K.M. Wong & J.T. Pereira
A taxonomic treatment of the Asiatic allies of *Rothmannia* (Rubiaceae: Gardenieae), including the new genera *Ridsdalea* and *Singaporandia* 21

K.M. Wong & M. Sugumaran
Studies in Malesian Gentianaceae, VII. A revision of *Fagraea* in the Malay Peninsula with five new species 65

T.J. Barkman, R. Repin & J.B. Sugau
The parasitic plant families Loranthaceae and Viscaceae in Sabah, Malaysia 131

Front cover: *Fagraea imperialis* (Gentianaceae), Peninsular Malaysia. Photo: M. Sugumaran.