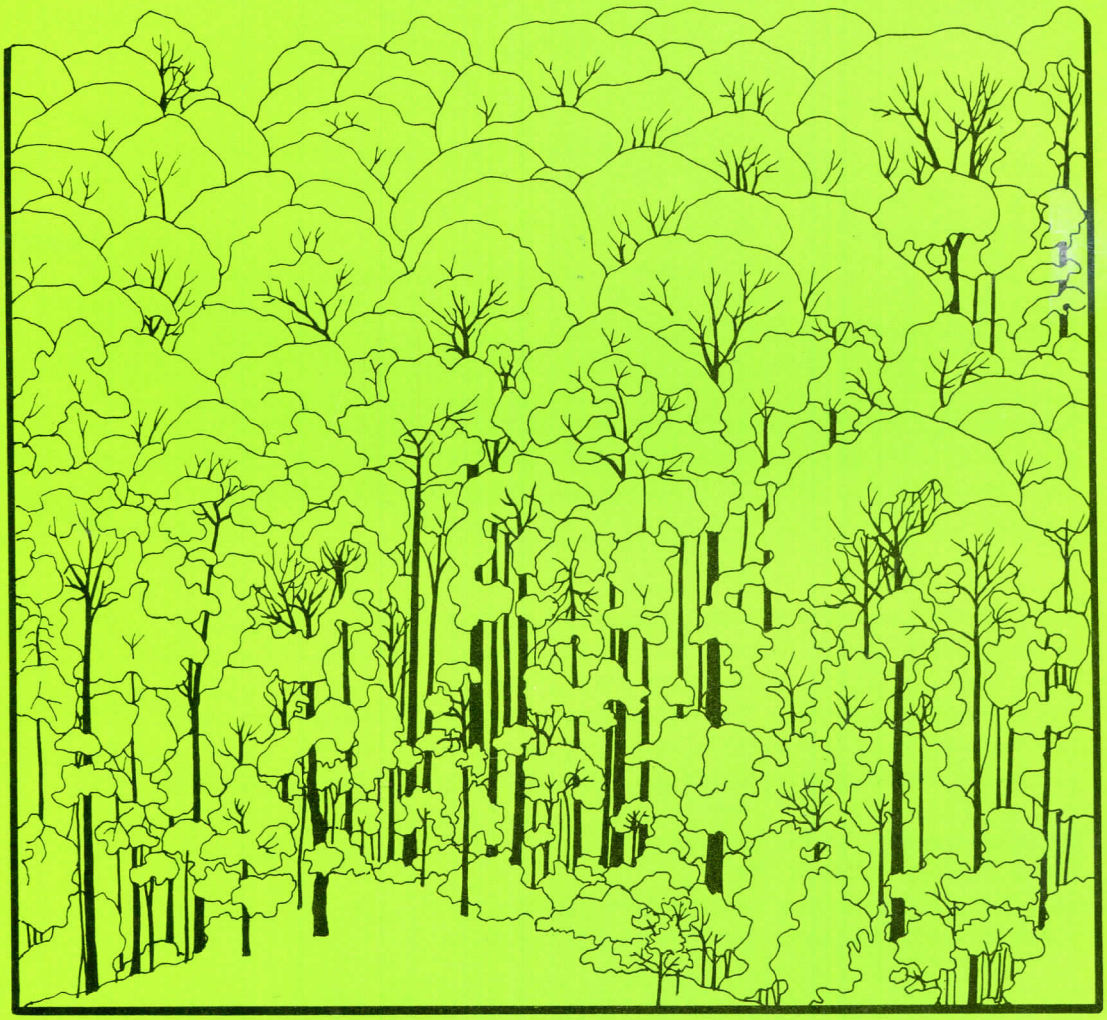
SANDAKANIA

No. 4 July, 1994



An occasional series of botanical papers
published by the Forest Research Centre, Forestry Department,
Sabah, Malaysia

ISSN 0128-5939

SANDAKANIA

AN OCCASIONAL SERIES OF BOTANICAL PAPERS
PUBLISHED BY THE FOREST RESEARCH CENTRE, SEPILOK,
SANDAKAN, SABAH, MALAYSIA

SANDAKANIA is produced with the financial support of the
Bundesministerium für Wirtschaftliche Zusammenarbeit und Entwicklung (BMZ)
of the Federal Republic of Germany, through the
Deutsche Gesellschaft für Technische Zusammenarbeit (GTZ) GmbH and
The Malaysian-German Sustainable Forest Management Project,
a technical cooperation project of the Malaysian and German Governments.

We acknowledge also the kind support of
Sanda Jaya Timber Sdn. Bhd.
for a financial contribution towards covering the cost of
layout, artwork and colour reproduction for this issue.

Communications address The Editor (Sandakania), Forest Research Centre, Forestry Department, P.O. Box 1407, 90008 Sandakan, Sabah, Malaysia.

SANDAKANIA No. 4 July, 1994

CONTENTS

SANDAKANIA 4 (1994): 1-29

A Tribute to Benjamin C. Stone, 1933-1994

K.M. Wong

Forest Research Centre, Sepilok,
P.O. Box 1407, 90008 Sandakan,
Sabah, Malaysia

Ben Stone, whose full name was Benjamin Clemens Masterman Stone, died from a heart attack on 19th March, 1994, while working in the Philippine National Herbarium at the Philippine National Museum in Manila. Born 26th July, 1933 in Shanghai, China, Ben Stone was to later become one of the world's most eminent tropical botanists, specialising in a number of tropical plant families, and its leading authority on the screwpine family, Pandanaceae.

Shanghai to Hawaii: early leanings towards the tropics

Ben was the only child born to a family based at the time in Shanghai, where his English father was engaged in the civil service. As the Sino-Japanese war became imminent, his mother brought young Ben to California, where they had relatives. Ben went to school in the San Diego area, where they lived. Ben's father, who had been interned in a prisoner's camp in Japan, was reunited with them only after the war.

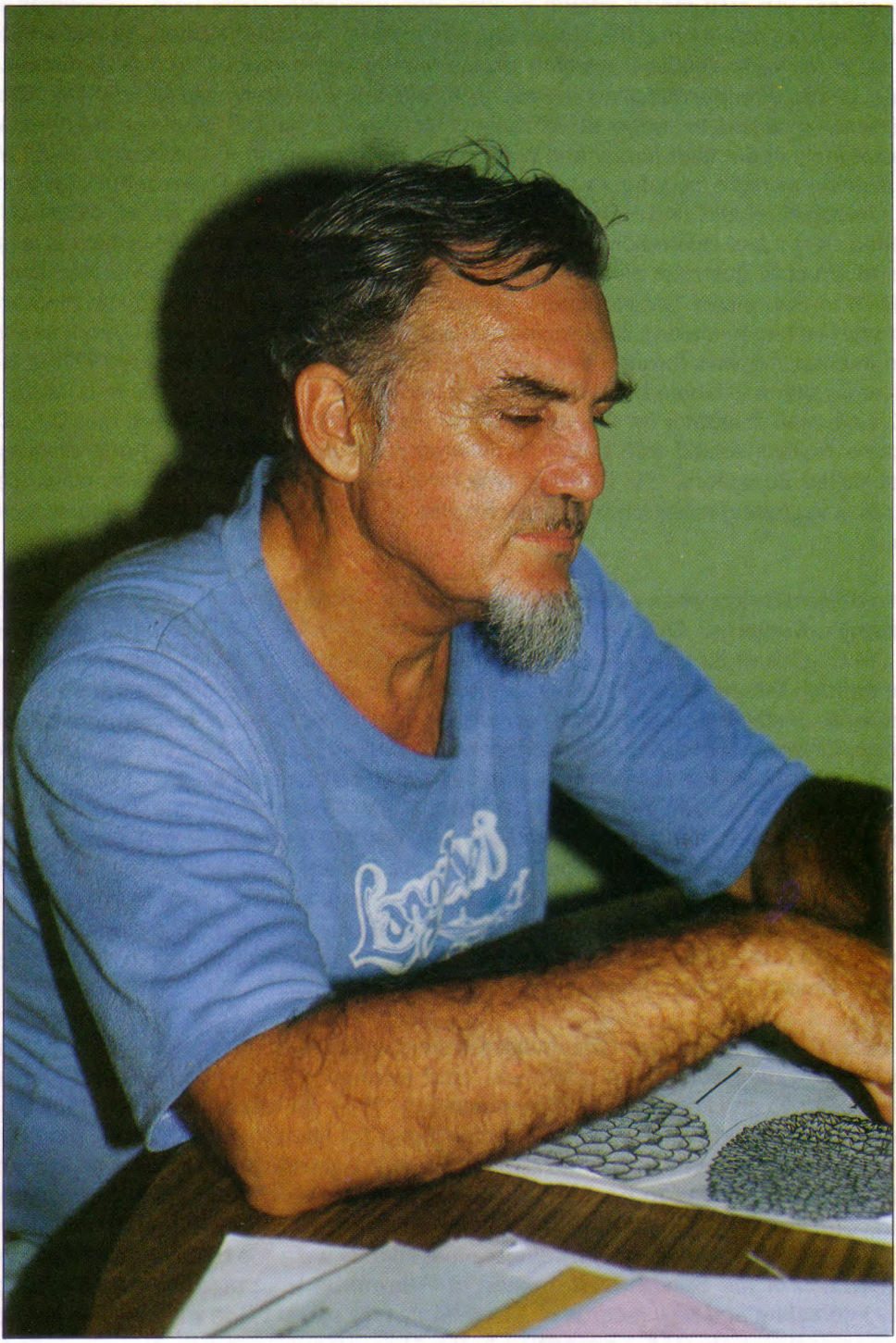
Ben graduated from Pomona College, Claremont, in California with a B.A. (*cum laude*) in botany in 1954, and began his botanical career as a Teaching Assistant at the Washington University in St. Louis, Missouri, during 1954-55. In 1955, he began a research assistantship at the Botany Department, University of Hawaii (where some friends knew him as "Skip" Stone), and there in 1957 began a revision of the genus *Pelea* (Rutaceae) (which later in 1989 he and T.G. Hartley reduced to *Melicope*). Working with Harold St. John, he obtained his Ph.D. in 1960, based on a dissertation on *Pandanus* in the Marshall Islands. Ben credited St. John for introducing him to the rich Hawaiian flora. Having worked with Hawaiian and Pacific plants, and based in a floristically and geologically exciting Hawaii during his early research days, Ben became very inclined towards understanding more about the flora of the Indo-Pacific area.

Guam and Malesia

Ben then spent a year as a Research Assistant at the Museum of Natural History, Smithsonian Institution, in Washington. His interest in the floras of the Polynesian and Micronesian islands found a suitable base when in 1961 he was appointed Assistant Professor of Biology at the College (now University) of Guam in Agana, Guam. Subsequently full Professor at the College, Ben began to work on the flora of Guam, and founded the journal Micronesica in 1964. He was the founding editor and afterwards, from 1969 until his death, a member of the editorial board of Micronesica, which had grown to be the journal of the University of Guam. During his last year there in 1965, he married Michiko Muraoka. In 1965, he joined the University of Malaya, Kuala Lumpur as Reader in the Botany Department, and stayed until 1984. Ben carried with him his interests from the days in Hawaii and Guam, and published his first monograph, of the genus *Pelea*, in 1969. His "Flora of Guam" was published in Micronesica in 1971. But is was largely the flora and plant life of Malesia, that phytogeographic area that includes Indonesia, Malaysia, Papua New Guinea and the Philippines, which had occupied Ben since he moved to Kuala Lumpur in Malaysia.

At the University of Malaya, Ben supervised many students, both undergraduate and post-graduate, who were attracted to study with him by his scholarly and casual style, wit and knowledge. His colleagues and students found his thoughts and ideas inspiring, and indeed many have been spurred on by his example to excel in their chosen fields. An active member of the Malayan Nature Society centred in Kuala Lumpur and someone whom the Museum fraternity felt was a scholarly resource for many subjects, Ben was sometime editor of the Malayan Nature Journal, and botanical editor for the Federation Museums Journal. He was Honorary Curator of Botany at the Malaysian National Museum from 1979 until he left for the United States in 1984. At the same time he served as review editor for a number of journals, including Pacific Science, Economic Botany, Blumea, Nature Malaysiana, The Journal of Japanese Botany, The American Journal of Botany, Biotropica, and the Gardens' Bulletin, Singapore. He was also a Fellow of the Linnean Society of London, a Fellow of the American Association for the Advancement of Science, and member of the Malayan Branch of the Royal Asiatic Society, the Malaysian Forestry Society, the Sabah Society, the Botanical Society of America, the International Association for Plant Taxonomy, and the Torrey Botanical Club. He maintained correspondence with botanists and academics worldwide, and collaborated in botanical research with the Forest Research Institute of Malaysia (1970-1984) and the Department of Forests at Lae in Papua New Guinea (1971). In 1981 he was a Mercer Fellow to the Arnold Arboretum of Harvard University. The journals and books in his immense and valuable personal library, testimony to a scholarly appreciation for books and the documentation of knowledge, were available to students and colleagues alike.

Not a few visitors to his room at the University, and others who have had occasion to spend time with Ben at meal times or in the field, have discovered his talent at weaving together historical, cultural and scientific information into extremely interesting episodes. Some of his associates have learnt of his deep interest in jazz music, and his extensive collection of jazz records and tapes, a leaning developed from younger days. He read music, and colleagues and friends alike enjoyed his flute playing at some evenings and



Benjamin C. Stone, a 1984 picture.

gatherings. An avid model-aircraft builder, Ben frequently spent time, sometimes even after late-night research at the University, assembling the latest models he had acquired. He could tell some fantastic wartime stories related to the various models of aircraft. To some of his aircraft-modelling friends in Kuala Lumpur, Ben was simply "Mr Stone", eminently qualified to judge at exhibitions and model aircraft displays, as they went passionately about their hobby and botany was put temporarily in the background. Many an evening or night, colleagues or students working late in the Department of Botany at the University would find Ben busy at his typewriter, or whistling as he diligently and methodically inked illustrations for his manuscripts. A great admirer of botanical art and, indeed, an able illustrator himself, Ben met an amateur illustrator of insects during a visit in 1976 to Sandakan, Sabah, where he had been consulting the Sandakan Herbarium, and swayed him to making illustrations of the Rutaceae, a family in which Ben had a long-time interest. It was through this urging to illustrate plants seriously in 1977 at Ben's University office in Kuala Lumpur, and his introduction of the meticulous work of the late H.S. Lau, staff illustrator for the University of Hawaii Botany Department, that C.L. Chan became more involved with botanical illustration, eventually becoming one of botany's most skilled illustrators. Yet Ben had time for students and colleagues who would call at his office regarding research problems; he was an accessible mentor to those who knew him.

Ben's determination when collecting material of his favourite plant groups is remembered by many colleagues. Once, in 1972, on his way to a field trip in Peninsular Malaysia in his Old English white sporty M.G., he startled companions by driving from the road edge right through the vegetation of a dry, disused ricefield to a clump of *Pandanus kaida* (the commonly cultivated *mengkuang* screwpine which was much used in mat-making throughout Southeast Asia) that was spotted flowering, as the species has been known in Peninsular Malaysia only through staminate material, and pistillate material was much desired for studies. His students on a field trip with him to some limestone outcrops in Taman Negara in Pahang, Peninsular Malaysia, had watched with anxiety as a somewhat bulky Ben, then, paid little attention to balancing on sharp karst limestone while reaching for a *Pandanus* specimen. At other times, students were amazed that a learned professor could be found, when staff help was scarce, sitting by himself in the herbarium of the University of Malaya Botany Department and diligently mounting and stitching specimens; for Ben, simply, the work had to be done.

His interest in floristics and conservation was developed in very pragmatic ways, as a scientist providing summaries and facts, and advancing knowledge through first-hand ground surveys and knowledgeable syntheses. In 1976, he was consultant botanist to the World Wildlife Fund (WWF, now Worldwide Fund for Nature) expedition to the Danum Valley in Sabah, where a concerted effort by various agencies was in swing to strengthen proposals for the area to be a special conservation site. The following year, he was again consultant botanist on the WWF expedition to Pulau Balambangan off the northern tip of Borneo, which together with several other islands were the botanically little explored northern bits of the Sunda Shelf, related to Palawan in Philippine territory and holding many interesting and new records of exceedingly rare plants. Ben was also on the Royal Geographical Society (U.K.) expedition to the Mulu area in Sarawak in 1978, in its fact-finding mission to help develop conservation management plans for the National Park

there. Quite special to him was the development of the University of Malaya's then fledgling botanical garden, called *Rimba Ilmu* (Malay, meaning "the forest of knowledge"), where Ben encouraged its *ex situ* conservation functions, with himself emphasizing such plants as the wild citruses. He was never obtrusive or demanding in his approach about conservation, but always sought to support, in his capacity as a research botanist with a wide field of experience, those others who have identified themselves as "front-line fighters" in the conservation cause, whether they were from government agencies or represented learned societies. Eloquent a speaker as Ben was, he was all too ready to support colleagues who wanted to make the major arguments for environmental and conservation issues.

The Philippines

From 1984 until 1990, Ben was Chairman of the Department of Botany at the Academy of Natural Sciences of Philadelphia. During this time he had prepared a proposal to collaborate with the Sabah Forestry Department for the completion of the "Trees of Sabah" project, but that encountered difficulties as the department did not then have sufficient botanical personnel to undertake the coordination effectively. In his proposal (dated 1st March, 1985), Ben remarked: "No exact figure can yet be given for the number of species of plants which occur in Sabah, but an estimate of about 10,000 (of vascular plants alone) is certainly not unlikely, and the real total may be greater ... Although the flora of Borneo has been studied for more than a century, and although the floras of Sabah and Sarawak are probably better known than that of Kalimantan, there are numerous, often large and diverse areas which are botanically unknown or little known. The number of as yet undescribed and undiscovered species in Sabah alone is certainly high, perhaps in the order of several hundreds ..."

He returned to Hawaii in 1990, at the urging of his long-time friend and colleague, S.H. Sohmer, as a senior research botanist with the Flora of the Philippines project coordinated at the Bernice P. Bishop Museum in Honolulu, and carried out in collaboration with the Philippine National Herbarium under the charge of Domingo Madulid. The project was in its first phase then, supported by the U.S. National Science Foundation (NSF), the United States Agency for International Development (USAID), and the MacArthur Foundation. In 1993, Ben moved to Fort Worth, Texas, as principal investigator for the Philippine Plant Inventory when the coordination of the Flora project moved to the Botanical Research Institute of Texas there, to begin its second phase, again with NSF support. The urgency of the situation was underscored by increasing evidence gathered by the project that more than 50% of the endemic forest flora of the Philippines may have already become extinct (Sohmer, *in litt.*, 22 March, 1994). In many ways, the dire need to understand the Philippine flora properly in the modern context required the effort and experience of people like Ben.

Travel and field work

Throughout his professional life, Ben continued to travel for field work and herbarium

research, building up through his numerous papers the documentation of the Pandanaceae, Araliaceae, Rutaceae and Myrsinaceae. He collected in Australia, Borneo (Sabah and Sarawak), California, Cambodia, East Africa, Hawaii, Hong Kong, Illinois, India, Java, Kenya, Madagascar, the Malay Peninsula, the Mascarene Islands, Micronesia (the Marianas, Caroline and Marshall Islands), Missouri, Montana, New Caledonia, New Hebrides, Papua New Guinea, the Philippines, Singapore, the Society Islands, the Solomon Islands, Sri Lanka, Switzerland, Tanzania, and Thailand. His collections, numbering more than 18,000, were largely numbered in his own personal series (sometimes marked "BCS") but he had also many collections in the NGF/LAE series (New Guinea) and the SAN series (Sandakan Herbarium, Sabah) (see also Appendix 1 here). These have represented general collections as well as specialised collections of the Pandanaceae and the insular floras of Southeast Asia and the Pacific region. Duplicates of his collections have been principally deposited at the following institutions: San Diego Natural History Museum (California), the Berlin Botanical Museum, University of Guam, Bishop Museum, University of Malaya, the Singapore Botanic Gardens, the Forest Research Centre at Sepilok (Sandakan, Sabah, Malaysia), the Sarawak Forestry Department Herbarium, the Herbarium of the Forest Research Institute Malaysia at Kepong, the Academy of Natural Sciences in Philadelphia, the Rijksherbarium (Leiden), the Royal Botanic Gardens at Kew, the Museum of Natural History in Paris, the University of Aarhus (Risskov, Denmark), the Conservatory and Botanic Gardens in Geneva, the University of Firenze (Italy), the British Museum of Natural History, the University of California at Berkeley, Harvard University Herbaria, the University of Tokyo, the Philippine National Herbarium, the Herbarium Bogoriense (Java, Indonesia), the Queensland Herbarium in Brisbane, the Lae Herbarium (Papua New Guinea), the ORSTOM Herbarium in Noumea (New Caledonia), the Herbarium of the Botanic Gardens at Tzimbazaza (Tananarive, Madagascar), the Missouri Botanical Garden at St. Louis, the U.S. National Herbarium (Washington, DC.), and the Peradeniya Botanic Gardens Herbarium (Sri Lanka).

During the Flora of the Philippines project, Ben was able to collect in many parts of the Philippines, and was particularly enthusiastic about dealing with the Palawan flora again, resuming his interest in the floristic links between northern Borneo (Sabah), Palawan, and the southern Philippines. He was otherwise charged with an urgency to extend the collecting to as many areas of remaining forest as possible, remarking in one instance, "This deforested landscape, routinely burned over and baking in the heat and drought of the 1992 E1 Nino summer, provides a sobering example of habitat degradation. Despite sporadic efforts at reforestation, thousands of hectares of formerly forested terrain in the Philippines now look like this."

The passing of a scholar

In mid-March of 1994, Ben was again in the Philippines during the commencement stage of the second phase of the Philippine Plant Inventory, one of the three components of the Flora of the Philippines Project, and was studying specimens in the Philippine National Herbarium on 19th March, in the afternoon of a Saturday, when he suffered a heart attack. A security guard and one of the staff members who found him were unable to revive him.

Ben lay in state at the Funareria Paz in Quezon City, Metro Manila, until the morning of the 23rd March, and in the afternoon a memorial service for him was held at the Manila Memorial Park. Friends and colleagues in the Philippines who had come to know him well paid emotional tribute to a great botanist and a wonderful friend, as his associates and botanical institutions around the world learnt of his passing. His ashes were returned to Fort Worth, Texas, U.S.A., where a memorial service for a widely admired scholar was held on 4th April, 1994, aptly titled "A Celebration of the Life of Benjamin C. Stone", in view of how much this man loved life all around him, and how he so significantly contributed to it.

It is well to recall Sohmer's tribute to Ben Stone, when he said (Sohmer, *in litt.*, 6 April 1994), " ... I had never met anyone who had less interest in material possessions and trappings, or who had as high a degree of scientific knowledge, moral integrity, and intellectual curiosity. He was a delightful mixture of wisdom and innocence that defied description ... Perhaps one of his most endearing traits was an eagerness to impart his knowledge of botany to others." This scholarly figure of tropical botany, who has authored, co-authored or edited more than 300 books and papers (see "The Writings of B.C. Stone" in Appendix 2 at the end of this tribute), may have gone, but the legacy of his example will live on. Ben witfully opened his summary address to Botany students at the University of Malaya in 1978, at the conclusion of their research seminar series, with the analogy that "science is like a layered cake", in fact warning that much of botanical science is built upon time-consuming and painstaking research, moving from phase to phase, the culmination of which depends on a strong and massive base. In retrospect, Ben has certainly, in his time contributed vastly to that layered cake of science.

Ben is survived by his wife, Michiko and their son, David, and daughter, Sylvia, born in 1969 and 1973, respectively, in Kuala Lumpur, Malaysia, when Ben and Michiko lived there.

ACKNOWLEDGEMENTS

Dr S.H. Sohmer and Ms June Cunningham of the Botanical Research Institute of Texas (BRIT), U.S.A., have been of great assistance with information and notes about Ben Stone.

APPENDIX 1. The plant collections of B.C. Stone.

(compiled with assistance from
June Cunningham and D.A. Madulid)

Ben Stone's plant collections, in all more than 18,000, were mostly of vascular plants, with small numbers of bryophytes, algae, lichens, and fungi. Most of his collections were numbered in his personal series, sometimes marked "BCS". The last number under this

series, according to the collections list that he kept, is 16080, of a *Pandanus* collected on 14th May, 1988 at the Jaya Supermarket premises in Petaling Jaya, Selangor, in Peninsular Malaysia.

Prior to 1965, he had collected mainly in the U.S.A. mainland, in Hawaii, the Society Islands, and the Mariana and Caroline Islands in the Pacific, although in June 1963 he made some collections (BCS 4780-4836) from Gunong (Mount) Panti in Johore, Peninsular Malaysia. His numbers 4837-5512 were from Micronesia. Thereafter, between 1965 and 1984, he collected largely in Malaysia while based at the University of Malaya in Kuala Lumpur, and the first set of these collections is at the University of Malaya Herbarium (KLU). The second (collector's research) set was kept by Ben, but was later lodged at the herbarium of the Academy of Natural Sciences, Philadelphia (PH). This collector's set, as is the set at KLU, is rich in material of the Pandanaceae, Rutaceae, Araliaceae, and Myrsinaceae, as these were families in which Ben specialised. Besides these, there were about 50,000 duplicates distributed (largely through the KLU herbarium), and large sets of these duplicates may be found at the Arnold Arboretum of Harvard University (A), the Bishop Museum in Honolulu (BISH), the Rijksherbarium in Leiden (L), and the Smithsonian Institution (US). However, during this period there were also visits to, and collections from the Philippines, Java, Singapore, Thailand, Cambodia, Hong Kong, Sri Lanka, India, Madagascar, Kenya, Tanzania, Mauritius, and Australia.

Between 1984 and 1989, when Ben was at the Academy of Natural Sciences of Philadelphia, the first set of his collections numbered in his series was lodged there (PH). He collected in the Philippines in March-April 1987 (for the U.S. National Cancer Institute (NCI) Project, Stone numbers 15810-15900); Malaysia in April-May 1987 (also for the NCI Project, numbers 15901-15979), and again in April-May 1988 (numbers 16028-16080); the Marianas in June 1987 (for NCI, numbers 15980-16024); in Pennsylvania in August 1987 (one number, 16025); and Japan in April 1988 (numbers 16026-16027). The holotype specimens among Ben's plant collections are mostly at KLU and PH.

There are three notable instances when Ben Stone's collections were made under other series. He collected numbers 53001-53801 of the LAE series (of the Lae Herbarium, Papua New Guinea), although on each specimen label there is also a Stone number. The first set of these collections is at Lae. He also collected under the SAN series (of the Forest Research Centre, Sandakan, Sabah, Malaysia) when he visited Sabah, using the numbers SAN 85129-85327 while in the Danum Valley, 85501-85600, 86701-86825 and 87051-87100 on Balambangan Island, and 86826-86870 on Gaya Island near Kota Kinabalu. The first set of these Sabah collections is at the Sandakan Herbarium (SAN) of the Forest Research Centre, Sabah. There are no Stone numbers on the labels of these, for although he gave Stone numbers to these collections, the numerical sequence of the SAN numbers is not strictly coordinate with that of the Stone numbers. After he joined the Flora of the Philippines Project, his collections in the Philippines were numbered under the Philippine Plant Inventory (PPI) series. These total 2111 collections, made from 1990 to 1993, as follows: Palawan (PPI 0001-0435), Mindoro (PPI 0491-0874), Bicol (PPI 3710-3912), Mt Canlaon (PPI 6131-6500), Sibuyan (PPI 6678-6986), Baler (PPI 5456-5500, 9774-9848), and Siargao Island (PPI 9336-9500, 12001-12133). The first set of these collections is at the Philippine National Herbarium.

APPENDIX 2. The Writings of B.C. Stone.
(courtesy of the Botanical Research Institute of Texas)

1957 Rediscovery of a rare Lobelioid, *Brighamia insignis* forma *citrina*, in Kauai, Hawaiian Islands. Bull. Torrey Bot. Club 84 (3): 175-177.

1958 (With Irwin Lane). A new *Hedyotis* from Kauai, Hawaiian Islands. Pac. Sci. 12 (2): 139-145.

1959 The flora of Namonuito and the Hall Islands. Pac. Sci 13: 88-104.

1960a Corrections and additions to the flora of the Hall Islands and to the flora of Ponape. Pac. Sci. 14 (4): 408-410.

1960b (With Irwin Lane). On a small collection of Ferns from the New Hebrides and Solomon Islands. Bot. Not. 112: 371-376.

1960c Flora Malesiana: a review. Pac. Sci. 14 (4): 423-424.

1960d Summary of the Dissertation, University of Hawaii. The Wild and Cultivated *Pandanus* of the Marshall Islands. University of Hawaii Graduate School, June 1960. Dupl. in diss. Abst. L.C. card No. Mic.

1960e (With Tetsuo Koyama). The genus *Scirpus* in the Hawaiian Islands. Bot. Mag. Tokyo 73: 288-294. (Partly reprinted in O. & I. Degener, Flora Hawaiiensis, Dec. 28, 1960).

1961a The genus *Sararanga* (Pandanaceae). Brittonia 13 (2): 212-214.

1961b (With D.L. Plucknett). The principal weedy Melastomaceae in Hawaii. Pac. Sci. 15 (2): 301-303.

1961c (With Peter J.R. Hill). The vegetation of Yanagi Islet. Truk, Caroline Islands. Pac. Sci. 15 (4): 561-562.

1961d *Pandanus pistillaris* in the Caroline Islands: an example of long-range oceanic dispersal. Pac. Sci. 15 (4): 610-613.

1961e A note on chromosome number in *Pandanus*. J. Japan. Bot. 36 (8): 279-284.

1961f Studies in Hawaiian Rutaceae III. On the New Caledonian species of *Pelea* and a misunderstood species of *Platydesma*. Adansonia (Paris) n.s. 1,2: 94-99.

1962a *Boerlagiodendron* (Araliaceae) in Eastern Melanesia. Proc. Biol. Soc. Washington DC. 75: 25-32.

1962b (With Albert C. Smith). Studies of Pacific Island Plants XVII. The genus *Geniostoma* (Loganiaceae) in the New Hebrides, Fiji, Samoa, and Tonga. Contrib. U.S. Natl. Herb. 37 (1): 1-41, 3 pls.

1962c Studies in Hawaiian Rutaceae, Taxonomic and nomenclatural notes on *Platydesma* (Hawaii) and new name for a *Melicope* (Solomon Islands). Madrono 16 (5): 161-166.

1962d Studies in the Hawaiian Rutaceae, II. Identity of *Pelea sandwicensis*. Pac. Sci. 16 (4): 366-373.

1962e Two new Asiatic Pandanaceae. J. Arn. Arb. 43: 348-350.

1962f Studies in Hawaiian Rutaceae, VI. A monograph of the genus *Platydesma*. (Rutaceae). J. Arn. Arb. 43: 410-427.

1962g Studies in Hawaiian Rutaceae, V. Rutaceae, genus *Pelea*. In: O. & I. Degener, Flora Hawaiiensis. Privately printed, Honolulu. (unpaged).

1963a *Myrtomera*, a new generic name for *Spermolepis* Brongn. & Gris. (Myrtaceae). Pac. Sci. 16 (2): 241.

1963b The genus *Freycinetia* (Pandanaceae) in the Solomon Islands. Proc. Biol. Soc. Washington DC. 76: 1-8.

1963c The genus *Portulaca* in the Hawaiian Islands. Adv. Front. Plant Sciences (New Delhi) 4: 141-149.

1963d The role of *Pandanus* in the culture of the Marshall Islands. In: J. Barrau, ed., Symposium on Plants and the Migrations of Pacific Peoples. 10th Pacific Science Congress, Honolulu, 1961. B.P. Bishop Museum Press. pp. 61-82.

1963e Studies in the Hawaiian Rutaceae, IV. Pac. Sci. (47): 407-420.

1963f Archipelagic refuge: endemic floras abound in Hawaiian chain. Nat. Hist. Mag. (N.Y.) November 1963: 32-39.

1964a A review of the new botanical names published in Safford's 'Useful Plants of Guam'. Micronesica 1: 123-129.

1964b Additions to the flora of Guam. Micronesica 1: 131-135.

1964c *Ophioglossum pendulum* in the Marshall Islands. Micronesica 1: 155.

1964d (Book review) Miller, Whittier, & Bonner: Bryoflora of the Atolls of Micronesia. Micronesica 1: 164-165.

1964e (Book review) H.L. Li: Woody Flora of Taiwan. Micronesica 1: 165-166.

1964f The Trees of Guam. Guan Times Weekly (8 Aug.) 21-24.

1964g The Ferns of Guam. Guam Times Weekly (5 Dec.) 18-23.

1965a The genus *Freycinetia* (Pandanaceae) in Fiji, Tonga, and Samoa. Proc. Biol. Soc. Washington DC. 78: 81-82.

1965b Melanesian Plant Studies I and II. With Micronesian Supplement. 1: 1-5 (Sept.), II:1. (Oct). Kuala Lumpur.

1965c Notes on the Type Species of *Polyscias* J.R. & G. Forst. (Araliaceae). Taxon 14 (8): 281-285.

1965d On the purpose of a University herbarium. The Malayan Scientist 2: 23-26.

1965e Further additions to the flora of Guam. Micronesica 2 (1): 47-50.

1965f Notes on *Polyscias* (Araliaceae) from Micronesia. Micronesica 2 (1): 51-59.

1965g (With F.R. Fosberg). *Leucaena insularum* in Guam. Micronesica 2 (1): 67-70.

1965h *Pandanus* Stickm. in the Malayan Peninsula, Singapore and Lower Thailand. Malay. Nat. J. 19 (4): 203-213.

1966a Studies in Hawaiian Rutaceae, VIII. *Pelea Saint-Johnii* and *P. kaalaensis*. In: O. & I. Degener, Flora Hawaiiensis 5 Jan. 1966. 2 p.

1966b *Polyscias verticillata* (Araliaceae), a new species from the Solomon Islands. J. Arn. Arb. 47 (3): 270-272.

1966c Phytogeography of Guam (Abstract). In Abstracts (Biology), Proc. 11th Pacific Science Congress, Tokyo, 1966.

1966d Studies in the Hawaiian Rutaceae, VII. A conspectus of species and varieties and some further new taxa in the genus *Pelea* A. Gray. Occas. Pap. B.P. Bishop Mus. 23 (10): 147-162.

1966e *Pandanus* Stickm. in the Malayan Peninsula, Singapore, and lower Thailand. Malay. Nat. J. 19 (5): 291-301.

1966f Cultivated *Pandanus* in Kapingamarangi Atoll. J. Polynes. Soc. 75 (4): 430-436. (actually publ. mid-1967).

1966g Some vernacular names of plants from Kapingamarangi and Nukuoro Atolls, Caroline Islands. Micronesica 2 (2): 131-132.

1966h Further additions to the Flora of Guam, III. Micronesica 2 (2): 133-141.

1967a The flora of Romonum Island, Truk Lagoon, Caroline Islands. Pac. Sci. 21 (1): 98-114.

1967b *Pelea honoluluensis* St. John, and *Pelea peduncularis* Levl. In: O. & I. Degener, Flora Hawaiiensis 6 Jan. 1967.

1967c (With M.S. Doty). Two new species of *Halophila* (Hydrocharitaceae). Brittonia 18 (4): 303-306.

1967d Notes on the plant genus *Pandanus* in Fiji, Tonga, the New Hebrides, and Niue. Proc. Biol. Soc. Washington DC. 80: 47-60.

1967e (With T.K. Newell). *Flagellaria* (*Chortodes*) *plicata* Hook. fil. is a *Joinvillea*. Taxon 16: 192-194.

1967f The Phytogeography of Guam, Marianas Islands. Micronesica 3 (1): 67-73.

1967g (Book review) T.C. Whitmore: Guide to the Forests of the British Solomon Islands. Micronesica 3 (1): 75-79.

1967h Note on an unusual form of *Pandanus odoratissimus* from Ryukyu Is. with copious extra-marginal foliar spines. Bull. Natl. Sci. Mus. Tokyo 10 (1): 37-38.

1967i Identity of the *Pelea* species (Rutaceae) described by H. Leveille. Notes Roy. Bot. Gard. Edinburgh 27 (3): 259-264.

1967j A new species of *Pandanus* from Sarawak, with notes on Sect. *Multidens* St. John. Fedn. Mus. J. n.s. for 1966, 11: 113-119.

1967k Carpel number as a taxonomic criterion in *Pandanus*. Amer. J. Bot. 54 (8): 939-944.

1967l A review of the endemic genera of Hawaiian plants. Bot. Rev. 33 (3): 216-259.

1967m Notes on the Hawaiian Flora. Pac. Sci. 21 (4): 550-557.

1967n (With M.S. Doty). Typification of the generic name *Halophila* Thouars. Taxon 16: 414-418.

1967o A new species of *Pandanus* from East Malaysia. The Malayan Scientist 3: 23-25. ("1966-1967").

1967p Materials for a monograph of *Freycinetia* (Pandanaceae) I. Gard. Bull. Singapore 22 (2): 129-152.

1967q Studies of Malesian Pandanaceae, I. Gard. Bull. Singapore 22 (2): 231-257.

1967r The genus *Pandanus* in Micronesia. I. The Marianas Species. Micronesica 3 (2): 105-128.

1968a The genus *Pandanus* in Malaya, Singapore, and lower Thailand. Part 3. Malay. Nat. J. 21 (1): 3-16.

1968b The genus *Pandanus* in Malaya, Singapore, and lower Thailand. Part 4. Malay. Nat. J. 21 (2): 125-141.

1968c Studies of Malesian Pandanaceae, II. Two new species of *Pandanus* Sect. *Fusiforma* St. John. Reinwardtia 7 (4): 411-420.

1968d The correct name for the *Freycinetia* of Tahiti. Taxon 17: 174-176.

1968e Theophrastaceae: a family wrongly attributed to the Hawaiian Flora. Pac. Sci. 22 (3): 425.

1968f Notes on *Pandanus* in the Line Islands. Micronesica 4 (1): 85-93.

1968g Materials for a monograph of *Freycinetia* (Pandanaceae) III. *Freycinetia corneri*, a new species from Malaya. Brittonia 20 (3): 198-202.

1968h The conservation of vegetation. The Malayan Scientist 4: 42-48.

1968i Typification of *Schizostegeopsis* Copeland. Philipp. J. Sci. 95 (4): 425.

1968j (With J.J. Gaudet). Plant life of Malaysia. (Book Reviews). Quart. Rev. Biol. 43 (3): 308-310.

1968k (With Albert C. Smith). Studies of Pacific Island Plants, XIX. The Araliaceae of the New Hebrides, Fiji, Samoa, and Tonga. J. Arn. Arb. 49 (4): 431-492, pls 1-8.

1968l Materials for a monograph of *Freycinetia* (Pandanaceae) IV. Subdivision of the genus, with fifteen new sections. Blumea 16 (2): 361-372.

1968m Morphological Studies in Pandanaceae. I. Staminodia and Pistillodia of *Pandanus* and their hypothetical significance. Phytomorphology 18 (4): 498-509.

1969a National Parks as a national resource. In: B.C. Stone, ed., Symposium on Natural Resources and Conservation (STREMS II) in Malaysia and Singapore. Series-Symposia on Scientific and Technological Research in Malaysia and Singapore, 1-4 Feb. 1967, University of Malaya, Kuala Lumpur, Malaysia. Pp. 1-8.

1969b Studies in Malesian Pandanaceae. III. Notes on *Pandanus* Section *Solmsia*, sect. nov. Fedn. Mus. J. n.s. for 1967, 12: 105-110. With 4 plates.

1969c Studies in Malesian Pandanaceae. IV. A Revision of *Asterostigma* and *Asterodontia*, two sections of the genus *Pandanus*. Fedn. Mus. J. n.s. for 1967, 12: 111-116.

1969d Studies in Malesian Pandanaceae. V. Two new subsections of *Pandanus* section *Acrostigma* Kurz, *Scabridi* and *Dimissistyli*. Fedn. Mus. J. n.s. for 1967, 12: 117-121.

1969e *Pandanus decus-montium*, a new species from the Solomon Islands. Proc. Biol. Soc. Washington DC. 84: 439-442.

1969f Additions to the Malayan flora, I. *Zanthoxylum acanthopodium*. Malay. Nat. J. 23: 31-32.

1969g Materials for a monograph of *Freycinetia* Gaud. X. Chronological List of all Binomials. Taxon 18 (6): 672-680.

1969h (With H. St. John). Materials for a monograph of *Freycinetia* Gaud. XI. *Freycinetia* of Viet Nam and Cambodia and the identity of *F. webbiana* Gaud. Adansonia (Paris) n.s. 2, 9 (3): 361-367.

1969i Gaudichaud's species of *Pandanus* in the Atlas of the Botany of the voyage of "La Bonite". Malayan Scientist 5: 14-19. Pt 1.

1969j (With A.H. Loo). Cytotaxonomic notes on some species of *Polyscias* (Araliaceae). J. Japan. Bot. 44 (11): 321-327.

1969k Materials for a monograph of *Freycinetia* Gaud. VII. Species of Ceylon and the Andaman and Nicobar Islands. Webbia 23 (2): 591-596, 3 pls.

1969l Materials for a monograph of *Freycinetia* Gaud. VIII. A revised list of Philippine species with critical notes and some new taxa. Webbia 23 (2): 597-607.

1969m Studies in Malesian Pandanaceae VI. The identity of *Pandanus pilaris* Ridley. Webbia 23 (2): 607-610.

1969n The genus *Pelea* A. Gray. a Taxonomic Monograph. Phan. Mon. Tom. III. J. Cramer, Lehre (Germany).

1970a Materials for a monograph of *Freycinetia* Gaud. IX. The genus *Freycinetia* in the Solomon Islands. Kew Bull. 24 (2): 335-375.

1970b Observations on the genus *Pandanus* in Madagascar. Bot. J. Linn. Soc. 63 (2): 97-132, 18 pls.

1970c New and critical species of *Pandanus* from Madagascar. Webbia 24 (2): 579-618.

1970d Malayan climbing pandans: the genus *Freycinetia* in Malaya. Malay. Nat. J. 23: 84-91.

1970e Morphological Studies in Pandanaceae, II. The 'coniferoid' habit in *Pandanus* section *Acanthostyla*. Bull. Torrey. Bot. Club 97 (3): 144-149.

1970f Fruits and seeds of the frangipani (*Plumeria*). Malay. Nat. J. 23: 143-144.

1970g (With J.L. Guillaumet). *Une nouvelle et remarquable espece de Pandanus de Madagascar*. Adansonia n.s. 2, 10 (1): 127-134.

1970h Materials for a monograph of *Freycinetia* Gaud. (Pandanaceae). XIII. A new species from Ternate Island, Moluccas. Pac. Sci. 24 (3): 417-419.

1970i (With Y.K. Kam). Morphological Studies in Pandanaceae, IV. Stomate structure in some Mascarene and Madagascar *Pandanus* and its meaning for infrageneric taxonomy. Adansonia ser. 2, 10 (2): 219-246.

1970j Materials for a monograph of *Freycinetia* Gaud. (Pandanaceae). V. Singapore, Malaya, and Thailand. Gard. Bull. Singapore 25 (2): 189-207.

1970k Materials for a monograph of *Freycinetia* Gaud. (Pandanaceae). VI. Species of Borneo. Gard. Bull. Singapore 25 (2): 208-233.

1970l The botanical identity of Mengkuang, a common *Pandanus* in cultivation in Malaya. Malayan Agriculturist 9: 34-44, 4 pls.

1970m (Stone, B.C., ed.) Kam, Y.K., Morphological studies in Pandanaceae III. Comparative systematic foliar anatomy of Malayan *Pandanus*. Bot. J. Linn. Soc. 64 (4): 315-351.

1971a Additions to the Malayan Flora II. *Scirpus confervoides* & *c.* Malay. Nat. J. 24: 91-94.

1971b (With T.C. Whitmore). Notes on the systematy of Solomon Islands plants and some of their New Guinea relatives. XI. Reinwardtia 8 (1): 3-11.

1971c America's Asiatic Flora: the plants of Guam. Amer. Scientist 59 (3): 308-319.

1971d Studies in Malesian Pandanaceae VIII. Some new and little-known sections of *Pandanus*. Fedn. Mus. J. n.s. for 1968, 13: 138-149.

1971e Studies in Malesian Pandanaceae IX. Taxonomic notes on *Pandanus*, species and synonyms. Fedn. Mus. J. n.s. for 1968, 13: 150-154.

1971f Materials for a monograph of *Freycinetia* Gaud. XII. Fedn. Mus. J. n.s. for 1968, 13; 155-165.

1971g (With A.L. Lim). Notes on systematic foliar anatomy of the genus *Freycinetia* (Pandanaceae). J. Japan. Bot. 46 (7): 14-24.

1971h Another calciphilous *Pandanus* from the Massif de l' Ankarana, North Madagascar. Adansonia ser. 2, 11 (2): 319-323.

1971i (With C.H. Cheah). Reports on Pandanaceae. In: IOPB Chromosome number Reports XXXII. Presented by Askell Love. Taxon 20: 356.

1971j A preliminary survey of the Pandanaceae of Thailand and Cambodia. Nat. Hist. Bull. Siam Soc. 24 (1/2): 1-32.

1971k The flora of Guam, A manual for the identification of the plants of the Island. Micronesica 6: 1-659.

1972a A reconsideration of the evolutionary status of the Family Pandanaceae and its significance in Monocotyledon phylogeny. Quart. Rev. Biol. 47 (1): 34-45.

1972b Rutaceae. In: T.C. Whitmore, ed., Tree Flora of Malaya 1: 367-387. Longmans, Malaya.

1972c Studies in Malesian Pandanaceae VII. A review of Javanese Pandanaceae, with notes on plants cultivated in the Hortus Borgoriensis. Reinwardtia 8 (2): 309-318.

1972d A new wild *Citrus* species from Malaya. The Planter (Kuala Lumpur) 48: 90-92.

1972e The genus *Pandanus* in the Solomon Islands, with notes on adjacent regions. Malaysian J. Sci. 1A: 93-132.

1972f Studies in Malesian Pandanaceae X. Four new Malesian species of *Pandanus* and notes on *P. sarawakensis*. Fedn. Mus. J. n.s. for 1969, 14: 127-136.

1972g *Athrodactylis* and *Pandanus*: a brief comment on the *"Characteres Generum Plantarum"* of J.R. & G. Forster. Gard. Bull. Singapore 26 (1): 113-114.

1972h *Glycosmis calcicola*, n. sp. (Rutaceae). In: Forest Research Institute, Kepong, Malaysia: Notes on the systematy of Malayan Phanerogams XVI. Gard. Bull. Singapore 26 (1): 55-67.

1972i A new Madagascar species of *Pandanus* cultivated in Mauritius. Mauritius Inst. Bull. 7 (1): 13-16, Pl. 1.

1972j Studies in Malesian Pandanaceae XI. A new species of *Pandanus* from Johore,

and two additions to the Malayan pandan flora. Fedn. Mus. J. n.s. for 1970, 15: 199-202.

1972k Materials for a monograph of *Freycinetia* Gaud. (Pandanaceae). XV. The Sumatran species. Fedn. Mus. J. n.s. for 1970, 15: 20-27.

1972l Additions to the Malayan flora, III. *Gastonia papuana*. Malay. Nat. J. 25: 164-165.

1972m Pandans. Malaysian Panorama 2 (2): 15-18. (6 figs. in colour). Ministry of Foreign Affairs, Kuala Lumpur.

1972n Additions to the Malayan flora, IV. *Bellucia*: a South American fruit tree found in Malaya. The Planter (Kuala Lumpur) 48 (558): 276-278.

1972o The genus *Pandanus* in Micronesia. II. Sect. *Microstigma*. Micronesica 7 (1/2): 85-93.

1972p The genus *Pandanus* in Micronesia. III. *Pandanus patina* Martelli. Micronesica 7 (1/2): 95-98.

1972q (Book review) C. Den Hartog: Sea Grasses of the World. Quart. Rev. Biol. 47 (3) 343.

1972r The Interface between teaching and research. In: K.S. Nijhar, ed., The role of Asian Universities in a Changing World. Selected Papers from the International Conference on Universities held in Kuala Lumpur, Aug. 24-29, 1970. Academic Staff Assoc., Univ. Mal. Kuala Lumpur Pp. 29-32.

1972s On the genus *Pandanus* in New Caledonia. Adansonia n.s. 2, 12 (3): 409-420.

1972t (With J.L. Guillaumet). *Un nouveau Pandanus* (Pandanaceae) *subaquatique de Madagascar*. Adansonia n.s. 2, 12 (4): 525-530.

1973a (With S.P. Chu). Morphological Studies in Pandanaceae V. A further survey of foliar anatomy in the genus *Pandanus*. J. Japan. Bot. 48 (2): 55-64; 48 (3): 74-82.

1973b The genus *Pandanus* in the Solomon Islands with notes on adjacent regions. (Concluded). Malaysian J. Sci. 2A: 59-80.

1973c The systematic position of *Pandanus obovatus* and *P. calcis*, two Thailand Pandanaceae. Malay. Nat. J. 26: 53-54.

1973d (Book review). P.F. Allen: Natural Rubber and the Synthetics. The Planter (Kuala Lumpur) 49 (566): 208-209.

1973e Materials for a monograph of *Freycinetia* Gaudich. XIV. On the relation between *F. banksii* A. Cunn. of New Zealand and *F. baueriana* Endl. of Norfolk Island, with notes on the structure of the seeds. New Zeal. J. Bot. 11 (2): 241-246.

1973f (With J.B. Lowry, R.W. Scora & K. Jong). *Citrus halimii*: a new species from Malaya and Peninsular Thailand. Biotropica 5 (2): 102-110.

1973g (With C.H. Cheah). Studies in the Malesian Pandanaceae, XIV. *Pandanus*. Bot. Jahrb. 93 (4): 498-529.

1973h A synopsis of the African species of *Pandanus*. Ann. Missouri Bot. Gard. 60: 260-272.

1973i (With D.W. Lee & J.B. Lowry). Effect of drought on Mt. Kinabalu. Malay. Nat. J. 26 (3/4): 178-179.

1973j *Copelandiopteris*, a new genus of Philippine ferns. Webbia 28: 491-494.

1973k Citrus. Malaysian Panorama 3 (4): 2-5. Ministry of Foreign Affairs, Kuala Lumpur.

1974a (With K. Jong & E. Soepadmo). Malaysian tropical forests: an underexploited genetic reservoir of edible fruit tree species. In: E. Soepadmo & K. G. Singh, eds., Symposium on Biological Resources and National Development, Proceedings. Malayan Nature Society, Kuala Lumpur. Pp. 113-121 ("1973", actually issued February 1974).

1974b *Pandanus lauterbachii* K. Schum. & Warb. in Australia. Proc. Roy. Soc. Queensland 85 (6): 77-78.

1974c Studies in Malesian Pandanaceae XIII. New and Note-worthy Pandanaceae from Papuasia. Contrib. Herb. Austral. 4: 7-40.

1974d A review of the Australian species of *Pandanus* Section *Semikeura* (Pandanaceae). Contrib. Herb. Austral. 5: 41-44.

1974e Studies in Malesian Pandanaceae XII. *Pandanus* sections *Solmsia* and *Rykiopsis*, and *Rykia* subsect. *Gressittia*. Fedn. Mus. J. n.s. for 1972. 17: 99-163.

1974f A white-flowered variant of the Beach Morning Glory, *Ipomoea pes-caprae*. Malay. Nat. J. 27 (1 & 2): 17-19.

1974g (Book review) Malayan Nature Society: Proceedings of the Symposium on Biological Resources and National Development. The Planter (Kuala Lumpur) 50 (576): 114-115.

1974h The correct botanical name of the breadfruit. J. Polynesian Soc. 83 (1): 92-93.

1974i Towards an improved infrageneric classification in *Pandanus* (Pandanaceae). Bot. Jahrb. Syst. 94: 459-540.

1974j Taxonomists for Malaysia: a vital need. (Editorial). The Planter (Kuala Lumpur) 50 (580): 199-200.

1974k National Ecosystems Reserves: Key to success in nature conservation. In: Lim Wah Ching & R. Singh, eds., Battle for the Environment: the Malaysian Experience. Proc. Seminar on Modernization and the Environment, Malay. Nat. Soc. and Consumers' Assoc. of Penang, 30-31 March 1974. Pp. 44-46.

1974l Langkawi Landscape. Malaysian Panorama 4 (2): 2-7.

1975a Quinine: time for a revival? The Planter (Kuala Lumpur) 51 (586): 14-15.

1975b (With K.M. Kochummen). A new *Alangium* (Alangiaceae) from Sarawak. Blumea 22 (2): 35-38.

1975c Studies in Malesian Pandanaceae XV. Two new species of *Pandanus* from Mt. Kinabalu, Sabah (Borneo) with notes on the Pandanaceae of Mt. Kinabalu. Malaysian J. Sci. 3 (A): 69-74.

1975d New and noteworthy *Pandanus* species from Madagascar collected by J.L. Guillaumet and G. Cremers. Adansonia, n.s. 2, 14 (4): 17-28.

1975e Appendix to Henderson's "Malayan Wild Flowers". Malay. Nat. J. 28: 57-83. Also available as a separate pamphlet, pp. 1-27.

1975f Notes on the Pandanaceae of Ceylon with a review of the species cultivated in the Royal Botanic Gardens, Peradeniya, and those found in its Herbarium. Ceylon J. Sci. (Bio.) 11 (2): 109-122 and 3 pls.

1975g (Book review) J.F. Rock: Indigenous Trees of the Hawaiian Islands. (Reprint ed.). Quart. Rev. Biol. 50: 321-322.

1975h Scholarly serial publication of Academic Institutions and Societies in Malaysia today: a Review and commentary. In: Beda Lim, ed., Scholarly Publishing in S.E. Asia (Assoc. of S.E. Asian Institutes of Higher Learning). Kuala Lumpur, December 1975. Universiti Malaya Press. Pp. 36-42.

1975i (With C.H. Cheah), Embryo sac and microsporangium development in *Pandanus* (Pandanaceae). Phytomorphology 25 (2): 228-238.

1976a Studies in Malesian Pandanaceae XVI. Notes on Philippine taxa. Kalikasan. Philipp. J. Biol. 5: 19-36.

1976b *Freycinetia*. In: E.H. Walker, Flora of Okinawa and the Southern Ryukyu Islands. Smithsonian Inst. Press, Washington DC. Pp. 138-139.

1976c The Pandanaceae of the New Hebrides, with an essay on intraspecific variation in *Pandanus tectorius*. Kew Bull. 31 (1): 47-70.

1976d Pandanaceae. In: C.J. Saldanha & D.H. Nicolson, Flora of Hassan District, Karnataka, India. Smithsonian Inst. / Natl. Science Foundation. Amerind Publ. Co., New Delhi. 1-915. pp. 777-781.

1976e (Book review) Underexploited tropical plants. (Natl. Acad. Sci., 1975). The Planter (Kuala Lumpur) 52 (606): 384.

1976f Sandbur (*Cenchrus echinatus*), an addition to the Malaysian grass flora. The Planter (Kuala Lumpur) 52 (607): 397-399.

1976g On the biogeography of *Pandanus* (Pandanaceae). *Compte rendu du Societe de Biogeographie (Paris), Seance* 458: 69-90.

1976h Germination and early seedling growth in *Melanorrhoea woodsiana*, a Malaysian species of Rengas. Malayan Naturalist 3 (1 & 2): 49.

1976i *Copelandiopteris endoneura* (Price) Stone, comb. nov. (Pteridophyta). Kalikasan, Philipp. J. Biol. 5 (3): 329-331.

1977a (Book review) T.C. Whitmore: Tropical Rain forests of the Far East. (Clarendon Press, London, 1975). Quart. Rev. Biol. 52 (1): 39-90. Reprinted in: Malay. Nat. J. 30 (1): 115-118 and in Wallaceana no. 3.

1977b (Book review) T.C. Whitmore: Tree Flora of Malaya. (Longmans, Malaysia). Quart. Rev. Biol. 52 (1): 91-93. (Book review) C.F. Symington: Forester's Manual of Dipterocarps. (Penerbit Universiti Malaya, Kuala Lumpur). Quart. Rev. Biol. 52 (1): 91-93.

1977c (Book review) P.F. Cockburn: Trees of Sabah, vol. 1. (Borneo Literature Bureau, 1975). Quart. Rev. Biol. 52 (1): 91-93.

1977d On the identity of the 'Nicobar breadfruit' and a new record of *Pandanus leram* fruit in beach drift on Pulau Langkawi. Malay. Nat. J. 30 (1): 93-102.

1977e (With H.J. M. Bowen & J.F. Veldkamp) European weeds introduced to Gunung Ulu Kali, Pahang, Malaya. Malay. Nat. J. 30 (1): 103-108.

1977f (Review) The Pterocarpus (Philippine Science Journal of Forestry). Malay. Nat. J. 30 (1): 109.

1977g (Book review) C.J. Saldanha & D.H. Nicolson, eds.: Flora of Hassan District, Karnataka, India. (Amerind Publ. Co., New Delhi, 1976). Malay. Nat. J. 30 (1): 111-114.

1977h Pandanaceae. In: Asahi Weekly Encyclopaedia of Plants of the World. No. 89 (7 August 1977). Tokyo, Asahi Shimbun Co. (In Japanese). pp. 2096-2099.

1977i The morphology and systematics of *Pandanus* (Pandanaceae) today. Gard. Bull. Singapore 29: 137-142 (Corner Jubilee).

1977j Notes on the Systematy of Malayan Phanerogams, XXV. Araliaceae. Gard. Bull. Singapore 30: 275-291 (Holttum Jubilee).

1977k (With D.W. Lee, M. Ratnasabapathy, & Khoo Teng Tiang). The Natural History of Pulau Tioman. Merlin Samudra Tioman Sdn. Bhd., Kuala Lumpur, 1977. 69 pp.

1978a Notes on the genus *Pandanus* (Pandanaceae) in Western Australia. Nuytsia 2 (4): 236-253.

1978b A proposal for a Malaysian National Park Service. Malay. Nat. J. 29 (4): 257-263.

1978c (Editor) "The Role and Goals of Tropical Botanical Gardens." Proc. Symposium following Ceremonial Opening of the Rimba Ilmu, Botanic Gardens, Universiti Malaya, in Aug. 1974. Universiti Malaya Press, Kuala Lumpur. "Research Themes for the University of Malaya Botanic Garden" pp. 63-68.

1978d (Book review) William Jack: Descriptions of Malayan Plants 1-III (reprint ed. by Boerhave Press, 1977). J. Malay. Br. Roy. Asiat. Soc. 51 (1): 122-124.

1978e (Book review) K. Paijmans: New Guinea Vegetation. (Elsevier Co.) Quart. Rev. Biol. 53 (2): 171-172.

1978f *Revisio Pandanacearum*, Part 1. *Pandanus* subgenera *Coronata* and *Acrostigma*; Flora Malesiana Precursores. Fedn. Mus. J. n.s. (for 1978) 232: 1-74, Pls. I-VI.

1978g Studies in Malesian Rutaceae, I. Notes toward a revision of the genus *Glycosmis* Correa. Fedn. Mus. J. n.s. (for 1978) 23: 75-110, 1 Pl.

1978h Studies in Malesian Rutaceae, II. New records and new taxa of Aurantioideae from Borneo. Fedn. Mus. J. n.s. (for 1978) 23: 111-116.

1978i A new orchid from Gunung Ulu Kali, Pahang. Fedn. Mus. J. n.s. (for 1978) 23: 116-123, 2 Pls.

1978j Additions to the Malayan Flora, no. 6. The genus *Ornithochilus* (Orchidaceae) new to Malaysia. J. Malay. Br. Roy. Asiat. Soc. 51 (2): 139-142.

1978k (Book review) J. Burley & B.T. Styles: Tropical Trees: Variation, Breeding, and Conservation. (Linn. Soc. Lond. Sympos. ser. no. 2; Academic Press). Malay. Nat. J. 30 (3/4): 609-612.

1978l (Book review) E.J.H. Corner: The Freshwater Swamp Forests of South Johore and Singapore. (Gard. Bull. Singapore Suppl. 1). Malay. Nat. J. 30 (3/4): 613-616.

1978m Araliaceae (*Schefflera* by D.G. Frodin). In: F.S.P. Ng, ed.: Tree Flora of Malaya 3: 10-25. Longmans.

1978n (With D.H. Nicolson). Arguments for *Limonia acidissima* L. (Rutaceae) and against its rejection as a *nomen ambiguum*. Taxon 27 (5/6): 551-552.

1978o (With R. Kiew). *Ilex micrococca* Maxim. and *I. polyneura* (Hd. Mzt.) Hu (Aquifoliaceae): new records for Malaya and Thailand. Malay. Nat. J. 32 (2): 149-156. (Publ. in 1979).

1979a *Barclaya*, the Malaysian waterlily. Malay. Naturalist, for Sept. 1978: pp. 20-22 (Feb. 1979).

1979b (With D.W. Lee & J.B. Lowry). Abaxial anthocyanin layer in leaves of tropical rainforest plants, enhancer of light capture in deep shade. Biotropica 11 (1): 70-77.

1979c Studies in Malesian Pandanaceae XVII. On the taxonomy of 'Pandan wangi' a *Pandanus* cultivar with scented leaves. Economic Botany 32: 285-293.

1979d (With S. Bien). Genetic resources of essential oil plants in Malaysia. Malays. J. Appl. Biol. 8: 53-58.

1979e Protective coloration of young leaves in certain Malaysian plants. Biotropica 11 (2): 126.

1980a *Balanophora elongata* (Balanophoraceae) new to the Malay Peninsula. Malay. Nat. J. 32 (2): 129-132 (dated "Dec. 1979").

1980b A new species and new section of the genus *Freycinetia* (Pandanaceae) from New Caledonia. Pac. Sci. 33 (2): 149-151 (dated 1979, but issued March 1980).

1980c Additions to the Malayan flora VIII. The Malaysian Forester 43 (2): 244-262.

1980d The vegetation and plant communities of Pulau Balambangan, Sabah, East Malaysia. J. Roy. Asiat. Soc. Malays. Br. 53 (1): 68-89.

1980e (With W.R. Philipson, *et al.* The systematic position of *Aralidium* Miq. - a multidisciplinary study. Taxon 29 (4): 391-416.

1980f Rediscovery of *Thismia clavigera* (Becc.) F.v.M. (Burmanniaceae). Blumea 26: 419-425.

1980g (With M. Ratnasabapathy). *Thismia clavigera* (Burmanniaceae), a saprophyte new to the Malayan flora, and notes on other *Thismia* species in the Peninsula. Sains Malaysiana 9 (2): 209-214.

1980h (Review) T. Smitinand & Kai Larsen, eds.: Flora of Thailand. Nat. Hist. Bull. Siam Soc. 28: 182-184.

1980i A nomenclatural change in Malaysian Araliaceae: *Eleutherococcus malayanus* (Henderson) comb. nov., instead of *Acanthopanax malayanus* Henderson. The Malaysian Forester 43 (3): 395.

1980j The significance and future prospects of wild orchids in Malaysia. In: Proceedings, 3rd ASEAN Orchid Congress (Ministry of Agriculture, Malaysia), Kuala Lumpur. Pp. 132-144.

1981a The need for natural history museum reference collection research facilities in Malaysia. In: H.M. Collier, ed., Proceedings, Silver Jubilee Congress on Science & Technology in Resource Development, Sept. 1980. Malaysian Scientific Association, Kuala Lumpur. Pp. 199-206.

1981b A new species of *Pandanus* (Pandanaceae) from Burma. Gard. Bull., Singapore 34 (1): 177-179.

1981c (With Kim-Lang Huynh). On a new subsection of *Pandanus* section *Cauliflora* (Pandanaceae) with paniculate staminate inflorescence structure, distinctive leaf anatomy and pollen morphology. Bot. J. Linn. Soc. 83: 213-220.

1982a Additions to the Malayan flora, no. 5. A new *Geostachys* (Zingiberaceae) from Gunung Ulu Kali, Pahang, Malaysia. Malays. J. Sci. 6A:75-81. (Vol. 6 is dated on cover and title page as 1980, but actual date of publication is 10 January 1982).

1982b New Guinea Pandanaceae: first approach to ecology and biogeography. In: J.L. Gressitt, ed., Biogeography and Ecology of New Guinea, Vol. 1 (of 2); in Monographiae Biologicae, J. Illies, ed., vol. 42. Dr. W. Junk, The Hague. Pp. 401-436.

1982c Materials for a monograph of *Freycinetia*, XVII. East Polynesian species of *Freycinetia* Gaudichaud (Pandanaceae). Micronesica 17: 47-57. (Dated Dec. 1981).

1982d The summit flora of Gunung Ulu Kali (Pahang, Malaysia). Fedn. Mus. J. n.s. (for 1981) 26 (1): 1-157.

1982e *Pandanus tectorius* in the Hawaiian Islands. Notes from the Waimea Arboretum 8 (2): 4-10.

1982f Contributions to the flora of the Solomon Islands. Gard. Bull., Singapore 34 (2): 209-222.

1982g Nomenclature of *Joinvillea* (Joinvilleaceae). Gard. Bull., Singapore 34 (2): 223-225.

1982h In Memoriam: Dr. Monte Gregg Manuel, bryologist, 1947-1981. Gard. Bull., Singapore 34 (2): 227.

1982i New and noteworthy Malaysian Myrsinaceae, I. The Malaysian Forester 45 (1): 101-121.

1982j A new combination for *Barclaya kunstleri* of the Nymphaeaceae. Gard. Bull., Singapore 35 (1): 69-71.

1982k The Australian species of *Freycinetia* (Pandanaceae). Brunonia 5: 79-94.

1982l Two new species of *Pandanus* from Gunung Mulu National Park. In: A.C. Jermy & K.P. Kavanagh, eds., *Notulae et Novitates Muluenses*. Bot. J. Linn. Soc. 85: 31-35.

1982m *Pandanus tectorius* Parkins. in Australia: a conservative view. Bot. J. Linn. Soc. 85: 133-146.

1983a (With K.L. Huynh.) The identity, affinities, and staminate floral structure of *Pandanus pendulinus* Martelli (*Pandanaceae*). Gard. Bull., Singapore 35 (2): 199-207.

1983b (Book review) E.E. Henty, ed.: Handbooks of the Flora of Papua New Guinea, vol. II. (Melbourne Univ. Press). Gard. Bull., Singapore 35 (2): 231-232.

1983c Botanical authors and the International Code of Botanical Nomenclature. Notes from Waimea Arboretum 9 (2): 4-8.

1983d Studies in Malesian Pandanaceae 19. New species of *Freycinetia* and *Pandanus* from Malesia and southeast Asia. J. Arn. Arb. 64 (2): 309-324.

1983e *Revisio Pandanacearum*, Part II. *Pandanus* subgenus *Rykia* (de Vr.) Kurz (sections *Gressittia, Rykiopsis,* and *Solmsia* excepted). Fedn. Mus. J. n.s. 28: 1-100.

1983f Studies in Malesian Pandanaceae, 20. The genus *Pandanus* in Sumatra. Fedn. Mus. J. n.s. 28: 101-122.

1983g (Review) K.M. Kochummen: Effects of elevation on vegetation of Gunung Jerai, Kedah (Res. Pamphlet 87, Forest Research Institute, Kepong (1982) 129 p.). Malay. Nat. J. 36 (4): 289-291.

1983h Studies in Malesian Rutaceae III. *Melicope suberosa*, a new species and new generic record for the Malayan flora. Gard. Bull., Singapore 36 (1): 93-100.

1983i Contributions to the flora of the Solomon Islands. II. Five new combinations in Araliaceae (*Osmoxylon*). Gard. Bull., Singapore 36 (1): 101-102.

1983j Pandanaceae. In: *Flore du Cambodge, Laos et Viet-nam,* Fasc. 20: 3-48. Museum d'Histoire Naturelle, Paris.

1983k A new Western Australian species of *Pandanus* subgenus *Pandanus* section *Semikeura* (Pandanaceae). Nuytsia 4 (3): 427-434.

1983l (With D. T. Jones) Two new Rutaceae from Genting Highlands. Nature Malaysiana 6 (3): 4-11.

1983m (Book review) P.S. Ashton: Dipterocarpaceae. (Flora Malesiana, Ser. I, 9 (2): 237-552; 1982). Taxon 32 (4): 694-696.

1983n A guide to collecting Pandanaceae (*Pandanus*, *Freycinetia*, and *Sararanga*). Ann. Missouri Bot. Gard. 70: 137-145.

1983o Some new and critical *Pandanus* species of Subgenus *Acrostigma*. I. Supplement to *Revisio Pandanacearum*. Gard. Bull., Singapore 36 (2): 205-212.

1984a (With Ruth Kiew). A new endemic species of *Ilex* (Aquifoliaceae) from Gunung Ulu Kali, Pahang, Peninsular Malaysia. Malay. Nat. J. 37: 193-198.

1984b Additions to the Malayan flora. IX. New and noteworthy species, wild and introduced, in Peninsular Malaysia and Sarawak. Malay. Nat. J. 37: 185-191.

1984c A new species of *Pandanus* (Pandanaceae) from New Caledonia, with a synopsis of *Pandanus* sect. *Veillonia*. Bull. Mus. natn. Hist. Nat. J. (Paris), ser. 4, 6: (1984), sect. B, Adansonia, no. 1: 57-62.

1984d *Pandanus* from Ok Tedi Region, Papua New Guinea, collected by Debra Donoghue. Economic Botany 38 (3): 304-313.

1984e A field key and enumeration of the species of Pandanaceae in Gunung Mulu National Park. In: A.C. Jermy, ed., Studies on the flora of Gunung Mulu National Park, Sarawak. Kuching: Forest Department HQ. Pp. 77-83.

1984f A preliminary survey of Rutaceae of Gunung Mulu National Park. In: A.C. Jermy,

ed., Studies on the flora of Gunung Mulu National Park, Sarawak. Kuching: Forest Department HQ. Pp. 137-143.

1985a On the second collection of *Pandanus halleorum*. Kew Bull. 40 (2): 287-289.

1985b Rutaceae. In: M. Dassanayake & F.R. Fosberg, eds., Revised Flora of Ceylon, 5: 406-476.

1985c Forest by the Sea. Creatures of the Mangrove. In: National Geographic Society, A Resource Guide to the 1986 National Geographic Specials (TV). Natl. Geogr. Soc. Educational Media Div., Washington, D.C. Pp. 8-9.

1985d Studies in Malesian Rutaceae III. A conspectus of the genus *Glycosmis* Correa. Proc. Acad. Natural Sci. Philadelphia 137 (2): 1-27.

1985e New and noteworthy paleotropical species of Rutaceae. Proc. Acad. Natural Sci. Philadelphia 137 (2): 213-228.

1986a The human equation in species extinction. (Letter to the Editor). Bioscience 36 (8): 524-525.

1986b The genus *Pandanus* (Pandanaceae) on Christmas Island, Indian Ocean. Gard. Bull. Singapore 39 (2): 193-202.

1986c (Book Review) D.J. & S.G.M. Carr: Eucalyptus I, new or little known species of the Corymbosae. (Canberra: Phytoglyph Press, 1985). Recent Publ. in Nat. Hist. (Dept. of Library Serv. Am. Mus. Nat. Hist.) 4 (4): 4-6.

1986d Yellow Stars: a brief introduction to the Hypoxidaceae. Herbertia 42: 51-57.

1987a (Book review) B. Oliver-Bever: Medicinal Plants in Tropical Africa. (Cambridge Univ. Press 1986). Bartonia 53: 50-52.

1987b (Book review). S.M. Walters, *et al.*: The European Garden Flora. Vol. I. Pteridophytes to Monocotyledons. (Cambridge Univ. Press, 1986). Bartonia 53: 55-56.

1987c New taxa of *Pandanus* (Pandanaceae) from Malesia and Papuasia. Blumea 32 (2): 427-441.

1987d Collecting botanical specimens: do's and don'ts. Orang Asli Studies Newsletter (Dartmouth College) no. 6: 5-11.

1987e (With A. Weber). A new species of *Phyllagathis* (Melastomataceae) from the Endau-Rompin proposed National Park, Malaysia. Proc. Acad. Natural Sci. Philadelphia 139: 303-317.

1988a Notes on the genus *Pandanus* (Pandanaceae) in Tahiti. Bot. J. Linn. Soc. 97: 33-48.

1988b Notes on the genus *Labisia* (Myrsinaceae). Malay. Nat. J. 42: 43-51.

1988c (With D.T. Jones). New and noteworthy Rutaceae-Aurantioideae from Northern Borneo. Proc. Acad. Natural Sci. Philadelphia 140 (2): 267-274.

1988d New and noteworthy Malesian Myrsinaceae II. *Emblemantha*, a new genus from Sumatra. Proc. Acad. Natural Sci. Philadelphia 140 (2): 275-280.

1989a (With T.G. Hartley). Reduction of *Pelea* with new combinations in *Melicope* (Rutaceae). Taxon 38 (1): 119-123.

1989b Myrsinaceae. In: F.S.P. Ng, ed., Tree Flora of Malaya, vol. 4: 264-284. Longmans.

1989c New and noteworthy Malesian Myrsinaceae, III. On the genus *Ardisia* in Borneo. Proc. Acad. Natural Sci. Philadelphia 141: 263-306.

1989d New and noteworthy Malesian Myrsinaceae, IV. Two new species in *Embelia* Burm. f. and *Maesa* Forssk. from Borneo. Proc. Acad. Natural Sci. Philadelphia 141: 307-311.

1990a (With W.L. Wagner & D.R. Herbst). Rutaceae. In: W.L. Wagner, D. Herbst & S.H. Sohmer, eds., Manual of the Flowering Plants of Hawaii, vol.2. Honolulu: University of Hawaii Press & Bishop Muesum Press. Pp. 1174-1216.

1990b Pandanaceae. In: W.L. Wagner, D. Herbst & S.H. Sohmer, eds., Manual of the Flowering Plants of Hawaii, vol. 2. Honolulu: University of Hawaii Press and Bishop Museum Press. Pp. 1477-1481.

1990c New evidence for the reconciliation of floral organization in Pandanaceae with normal angiosperm patterns. In: P. Baas, *et al.*, eds., The Plant Diversity of Malesia, Chapter V. Leiden: Rijksherbarium. Kluwer Academic Publ. Pp. 33-55.

1990d Studies in Malesian Myrsinaceae, V. Additional New Species of *Ardisia* Sw. Proc. Acad. Natural Sci. Philadelphia 142: 21-58.

1991a The genus *Loheria* Merrill (Myrsinaceae). Micronesica 24 (1): 65-80.

1991b (With E.W.M. Verheij). *Citrus* L. In: Plant Resources of South-East Asia, No. 2. Edible Fruits and Nuts (PROSEA 2): 119-126.

1991c *Pandanus* Parkinson. In: Plant Resources of South-East Asia, No. 2. Edible Fruits and Nuts (PROSEA 2): 240-243.

1992a A Note on the repaged reprint by William Griffith of Jack's "Descriptions of Malayan Plants" (Calcutta, 1843) Bartonia no. 57: 32-35.

1992b (Book review) J.B. Comber: Orchids of Java; and B.A. Lewis & P.J. Cribb: Orchids of the Solomon Islands and Bougainville. Micronesica 25 (1): 133-136.

1992c New and noteworthy Malesian Myrsinaceae. VI. Revision of the genus *Hymenandra* A.DC. Gard. Bull. Singapore 43: 1-43.

1992d Myrsinaceae as an example of plant diversity in Malesia with special reference to the species in Borneo. Malay. Nat. J. (Golden Jubilee Issue) Proc. Internatl. Confer. on Conserv. Tropical Biodiversity 45 (1-4): 230-237.

1992e A revision of the genus *Tetrardisia* Mez (Myrsinaceae) Malay. Nat. J. 46: 1-11.

1992f *Systellantha*, a new genus of Myrsinaceae from Borneo. Malay. Nat. J. 46: 13-24.

1992g The New Guinea species of *Pandanus* section *Maysops* St. John (Pandanaceae). Blumea 37: 31-61.

1992h (Book review). P.J. Cribb, ed.: Orchids of Borneo. Micronesica 25: 219.

1993a Reduction of the genus *Parardisia* (Myrsinaceae). Nord. J. Bot. 13: 55-57.

1993b Studies in Malesian Pandanaceae 21. The genus *Pandanus* in Borneo. Sandakania 2: 35-84.

1993c Pandanaceae. In: A.S. George, ed., Flora of Australia. Vol. 50, Oceanic Islands, 2: 434-437; 571.

1994a A note on *Pandanus* in Taiwan. Botanical Bulletin of Academia Sinica Vol. 35 No. 2.

1994b New and noteworthy Malesian Myrsinaceae, VI. *Scherantha*, a new subgenus of *Ardisia*. Pac. Sci. 47 (3): 276-294.

1994c A new species of *Clausena* (Rutaceae) from India. Nord. J. Bot. 14. (In Press).

Completed manuscripts

(1994d) (With Paul Alan Cox and Kim-Lang Huynh). Evolution and systematics of Pandanaceae.

(1993e) The Australian species of *Pandanus* (Pandanaceae).

(1994f) *Revisio Pandanacearum* III. *Pandanus* Section *Cristate* Martelli (Synonym, *Jeanneretia*) of subgenus *Kurzia*.

(1994g) Citrus fruits of Assam: A new key to species, and remarks on *Citrus assamensis* Bhattacharya and Dutta, 1956.

(1994h) Supplement to the Rutaceae in Peninsular Malaysia.

(1994i) New and noteworthy Malesian Myrsinaceae, VIII.

SANDAKANIA 4 (1994): 31-39

Notes on the genus *Alangium* (*Alangiaceae*) in Sabah and Sarawak

A. Berhaman

Forest Research Centre, Sepilok,
P. O. Box 1407, 90008 Sandakan,
Sabah, Malaysia

Summary. Nine species of *Alangium* are recognised in Sabah and Sarawak, including *A. kurzii* Craib, which is newly recorded and thus far known only from Sabah. *A. hirsutum* Bloemb. is reduced to synonymy under *A. longiflorum* Merr. Notes are provided on the *A. javanicum* complex, where three varieties are recognised in Borneo. Lectotypes for *A. griffithii* (Clarke) Harms, *A. nobile* (Clarke) Harms and *A. scandens* Bloemb., as well as for *Marlea ebenacea* (basionym of the new combination *A. javanicum* var. *ebenaceum*) and *A. meyeri* (basionym of the new combination *A. javanicum* var. *meyeri*), are selected.

The most comprehensive revision of the genus *Alangium* in Borneo is that by Bloembergen (1939). Subsequent to this, Stone & Kochummen (1975) described *A. circulare* from Sarawak. The genus has also been briefly treated for Sabah by Cockburn (1980) and for Sarawak by Ashton (1988). Kochummen (1972) treated the genus for Peninsular Malaysia. One of the major problems in this genus has been the apparently large variation of vegetative and flower characters in *A. javanicum*.

In the present paper, a key to the species recognised in Sabah and Sarawak, and notes on the genus including the *A. javanicum* complex, are provided.

Alangium kurzii Craib, new for Borneo

A. kurzii Craib was described in 1911, and is hitherto known to occur in Myanmar (Burma), China, Thailand, Sumatra, Java and the Malay Peninsula. Recent flowering and fruiting collections from Sabah are identifiable with this species, extending its range to Borneo. In Sabah, it occurs in secondary forest on ultramafic and sandstone soils.

SPECIMENS EXAMINED - BORNEO. SABAH: Tambunan District, Trusmadi Range, *Kambira* & *Donggop* SAN 113555 (SAN); Kota Marudu District, Ulu Sg. Torintidon, *Aban Gibot* SAN 99531 (SAN); Ranau District, Sosopodon Forest Reserve, *Aban Gibot* SAN 62010 (SAN).

This species is distinguished from others in Sabah and Sarawak in the key given below.

Alangium hirsutum Bloemb. reduced to synonymy

The type of *A. hirsutum* Bloemb. is *Hallier* B. 3238, Kalimantan, Amai Ambit (holotype BO, isotype L) and that of *A. longiflorum* Merr. is *Darling* 14773, Philippines, Cagayan Province, Malueg (holotype L, isotype BO). These two collections are conspecific, the only difference being the denser hair covering on the leaves in *A. hirsutum.* As *A. hirsutum* was published in 1935, it has to be considered a synonym of *A. longiflorum* Merr., published earlier in 1912.

Notes on typification

Alangium griffithii (Clarke) Harms

This name is based on *Marlea griffithii* Clarke in Hk. f., Fl. Br. India 2 (1879) 742, where a type was not indicated among the two specimens cited. Harms, in making the combination *A. griffithii,* in Engl. & Prantl, Nat. Pflanzenfam. 3, 8 (1898) 262, and Bloembergen (1935, 1939) also did not select any lectotypes for this.

Here we select *Griffith* 3387, Malay Peninsula, Malacca (K) as the lectotype.

Alangium nobile (Clarke) Harms

This name is based on *Marlea nobilis* Clarke in Hk. f., Fl. Br. India 2 (1879) 743, where four collections were cited, without indicating a holotype. Likewise, Harms, making the combination *A. nobile,* in Engl. & Prantl, Nat. Pflanzenfam. 3, 8 (1898) 262, and Bloembergen (1935, 1939) did not designate any lectotype.

Here we select *Griffith* 3385, Malay Peninsula, Malacca (K) as the lectotype; isolectotypes are found in B and BM.

Alangium scandens Bloemb.

In his original description, Bloembergen (1935) designated *Endert* 4076 as the "first type" and *Endert* 4052 as the "second type".

Here we choose *Endert* 4076 (BO), Sarawak, Long Petah, as the lectotype for this species.

The *Alangium javanicum* complex

Bloembergen (1939) apparently included a large degree of variation in this species. Cockburn (1980) used the name *A. ebenaceum* (Clarke) Harms for this and enumerated as many as six varieties in Sabah (of which only one, *A. ebenaceum* var. *tutela* (Ridley) Kochummen had been formally named). Ashton (1988), who used the name *A. javanicum* for this species, considered there to be three different forms in Sarawak, and that the typical variety (*A. javanicum* var. *javanicum*) was not found in Borneo. We have compared the Bornean material with typical material of *A. javanicum* from Java, and have found that Bornean material belonging to what Merrill (1922) called *A. borneense* is identical with the Javanese taxon.

We have also found that corolla hair type, fruit calyx size and leaf colouration in dried specimens (possibly reflecting chemical character differences) can be the bases for distinguishing three varieties in Borneo.

The varieties are distinguished as follows.

1a. Corolla densely covered by silky long hairs (velutinous). Lower side of leaf short-hairy on midrib only ..... var. *javanicum*

1b. Corolla sparsely to densely covered with stellate hairs, not long-hairy. Lower side of leaf glabrous, or sometimes velvety all over.

2a. Leaves drying pale olive brown, typically smaller (8-22 cm long) but exceptionally reaching 27 cm long. Calyx limb on mature fruit smaller, 1-2 mm high and 2-5 mm wide ..... var. *meyeri*

2b. Leaves drying purplish brown (at least markedly so on the lower side), typically longer or larger (24-39 cm long). Calyx limb on mature fruit larger, 2-5 mm high and 3-10 mm wide ..... var. *ebenaceum*

The synonymy of these three varieties is as follows:

A. javanicum var. ***ebenaceum*** (Clarke) Berhaman, **comb. & stat. nov.**

Basionym: *Marlea ebenacea* Clarke in Hk. f., Fl. Br. Ind. 2 (1879) 742.

Lectotype (here chosen): *Griffith* 3383, Malay Peninsula, Malacca (K).

Synonyms: *A. ebenaceum* (Clarke) Harms, Engl. & Prantl, Nat. Pflanzen. 3, 8 (1898) 262; Kochummen, Tree Flora of Malaya 1 (1972) 57; Turner, Gard. Bull. Sing. 45 (1993) 24. *A. ridleyi sensu* Ashton, Manual of Non-Dipterocarp Trees of Sarawak (1988) 14, *non* King

(1902). *A. mezianum* Wang. in Fedde, Repert. 4 (1906) 338. *A. sessiliflorum* Merr., Univ. Calif. Publ. Bot. 15 (1929) 232. *A. javanicum sensu* Bloemb., Bull. Jard. Bot. Buit. 3, 16 (1939) 218, *pro parte, quoad Marlea ebenacea, A. ebenaceum, A. mezianum, A. sessiliflorum in syn. A. javanicum* "Form C" of Ashton, Manual of Non-Dipterocarp Trees of Sarawak (1988) 11, *pro parte. A. ebenaceum* "var. B" of Cockburn, Trees of Sabah 2 (1980) 18, *pro parte. A. ebenaceum* "var. G" of Cockburn, Trees of Sabah 2 (1980) 18, *pro parte.*

SPECIMENS EXAMINED - BORNEO. SABAH: Beluran District, Kiabau, *Ag. Amin* SAN 93875 (K, L, SAR, SAN). Keningau District, Crocker Range Forest Reserve, *Dewol* SAN 84018 (K, KEP, L, SAN, SAR, SING). Kalabakan District, Gunung Rara Forest Reserve, *Fedilis* SAN 91906 (KEP, L, SAN, SAR, SING). Kunak District, Tingkayu, *A. Johari* SAN 59621 (SAN). Lahad Datu District, Kennedy Bay, *Charington* SAN 47002 (SAN); Takun Kennedy Bay Section 42, *Muin Chai* SAN 26087 (SAN). Nabawan District, Ulu Sg. Nabawan, *Fedilis* SAN 128375 (SAN). Sandakan District, Kebun China, *J. Singh* SAN 60863 (SAN); Kabili-Sepilok Forest Reserve, *Wood* & *Charington* SAN 15400 (K, KEP, SAN), *Charington* SAN 29886 (SAN), *Keith* SAN 7214 (K, KEP, SAN), *Zain* SAN 62888 (SAN). Tawau District, Brantaian Mile 5.5, *Saikeh* SAN 69278 (K, L, SAN, SAR, SING); T.N.T. Coupe, *Binson, Bongsu* & *Yunus* SAN 62783 (SAN, SAR); Balong, *Aban Gibot* SAN 32485 (SAN); Mile 30 Kawa road, *Henry Sinanggul* SAN 40523 (SAN); Umas-Umas Forest Reserve, *Leopold* & *Saikeh* SAN 67678 (SAN); between Balong and Quoin Hill, *Meijer* SAN 28698 (SAN); Mile 4 Sepaku, *Fedilis* & *Sumbing* SAN 88144 (KEP, SAN, SAR). Tenom District, ridge above Sg. Paal, *Masirom* SAN 43238 (SAN). **SARAWAK:** 1st Division, Kuching, Arboretum, *Bujang* S.12763 (SAN, SAR). 4th Division, Baram, Nanga Birau, Sg. Melinau, *Anderson* S.30725 (SAN, SAR), Tinjar, Ulu Sg. Sikawa, *Tong* S.34940 (SAR); Bintulu, Segan Forest Reserve, *Chai* S.31737 (SAR); Marudi, Batang Tinjar, *Fuchs* S.21208 (SAR); Ulu Mayeng, Kakus, *Sibat* S.21754 (K, L, SING). 7th Division, Sg. Semawat, Ulu Belaga, *Othman* S.43620 (SAR).

A. javanicum var. ***meyeri*** (Merr.) Berhaman, **comb. & stat. nov.**

Basionym: *A. meyeri* Merr., Publ. Govern. Labor. 35 (1906) 54.

Lectotype (here chosen): *Meyer* F.B 2284, Philippines, Luzon, Cagayan Province (BO) (isolectotypes B, K, NY, S).

Synonyms: *A. tutela* Ridl., J. Roy. As. Soc., Str. Br. 61 (1912) 10. *A. ebenaceum* var. *tutela* (Ridl.) Kochummen, Fed. Mus. J. 13 (1970) 133; Keng, Concise Flora of Singapore (1990) 130; Turner, Gard. Bull. Sing. 45 (1993) 24. *A. javanicum sensu* Bloemb., Bull. Jard. Bot. Buit. 3, 16 (1939) 218, *pro parte, quoad A. meyeri, A. tutela in syn. A. javanicum* "Form C" of Ashton, Manual of Non-Dipterocarp Trees of Sarawak (1988) 11, *pro parte. A. javanicum* "Form D" of Ashton, Manual of Non-Dipterocarp Trees of Sarawak (1988) 11. *A. ebenaceum* "var. B" of Cockburn, Trees of Sabah 2 (1980) 18, *pro parte. A. ebenaceum* "var. D" of Cockburn, Trees of Sabah 2 (1980) 18. *A. ebenaceum* "var. E"

of Cockburn, Trees of Sabah 2 (1980) 18. *A. ebenaceum* "var. G" of Cockburn, Trees of Sabah 2 (1980) 18, *pro parte.*

SPECIMENS EXAMINED - BORNEO. SABAH: Beluran District, Sg. Sapi Camp, *Suah Tingguan* SAN 37373 (K, L, SAN); Karamuak, *Termiji* SAN 81648 (SAN). Beaufort District, Pangie, *Charington* SAN 22287 (K, L, SAN, SING). Kalabakan District, Gunung Rara Forest Reserve, *Shea* SAN 75771 (A, K, KEP, L, SAR, SING). Keningau District, Crocker Range Forest Reserve, *Dewol* SAN 84017 (SAN). Kinabatangan District, Lamag, Bolungun Hill, *Ampuria* SAN 36521 (K, KEP, L, SAN, SAR); Malus Virgin Jungle Reserve, *Banang* SAN 54079 (SAN); Ulu Sg. Inarat, *Saikeh* SAN 83186 (A, K, KEP, L, SAN, SAR, SING); Lamag, *Ag. Ahmad* SAN 98859 (SAN). Kunak District, Mostyn, near Madai Forest Reserve, *Kanis & Henry Sinanggul* SAN 49342 (SAN), *Minjulu* SAN 77013 (K, KEP, L, SAN, SAR, SING); Kelumpang Forest Reserve, *Henry Sinanggul* SAN 54534 (K, L, SAN); Tingkayu, *Johari* SAN 59619 (SAN); Sepang Ayer Forest Reserve, *Henry Sinanggul* SAN 56985 (K, SAN). Lahad Datu District, Malambabula, *Muin Chai* SAN 15545 (K, SAN); Silabukan, Mile 9 Bagahak, *Muin Chai* SAN 26904 (BO, K, KEP, L, SAN, SAR, SING). Nabawan District, KM 18 Nabawan to Padewan Road, *Sawan* SAN 128491 (SAN). Ranau District, Kinabalu National Park, *Lajangah* SAN 44650 (K, L, SAN, SAR); Tenompok, *Aban Gibot* SAN 62255 (SAN). Sandakan District, Sepilok, Kabili Forest Reserve, *Meijer* SAN 21221 (K, KEP, L, SAN, SAR), *Patrick* SAN 36750 (BO, K, KEP, L, SAN, SAR, SING); Arboretum, Sepilok, *Lakising* SAN 82100 (K, KEP, L, SAN, SAR, SING); Lungmanis Forest Reserve, *Mikil* SAN 31567 (K, SAN); Segaliud Lokan Forest Reserve, *James Ah Wing* SAN 34873 (K, KEP, L, SAN, SAR, SING); Kebun China, Sibuga Road, *James Ah Wing* SAN 46930 (SAN); Sg. Kundor, *Leopold* SAN 76049 (K, L, SAN); Sekong Kecil, *James Ah Wing* SAN 39004 (K, KEP, L, SING). Tambunan District, Trus Madi Forest Reserve, above Ulu Koingaran river, *Mikil* SAN 41761 (K, L, SAN). Tawau District, Kelumpang Balong, *Bakar* SAN 17317 (K, L, SAN, SAR, SING); Apas Road, Mile 14, *Aban Gibot* SAN 35907 (K, L, SAN), SAN 31250 (K, KEP, L, SAN, SAR), Kalabakan Road, Mile 32, *Bongsu & Binson* SAN 63059 (BO, KEP, SAN, SAR, SING); Quoin Hill Road, Mile 15, *Aban Gibot* SAN 30521 (BO, K, KEP, L, SAN, SAR, SING); Ulu Imbak, Luasong, *Philip & Sumbing* SAN 89007 (SAN); Umas-Umas, *Nordin* SAN 46105 (K, L); Merotai Besar, *Aban* SAN 37144 (K, KEP, L, SAN, SAR); Tawau Hill Forest Reserve, *Fedilis & Sumbing* SAN 88264 (SAN); Ulu Sg. Kinabutan, *Aban Gibot* SAN 35945 (K, L, SAN). Telupid District, Ulu Sg. Melikop, *Mansus, Tuyuk & Good* SAN 109216 (SAN); Tangkulap, Sg. Kun-Kun, *Aban Gibot* SAN 97219 (SAN). Tenom District, Gunung Lumaku, *Nooteboom* 1111 (L, SAN), *Buntar* SAN 27284 (BO, K, KEP, L, SAN, SAR, SING); Crocker Range, *Leopold* SAN 40486 (K, L); Kalang Waterfall, *Meijer* SAN 121372 (SAN). Tongod District, Sungai Imbak, *Wong* WKM 2286 (K, KEP, L, SAN, SAR). **SARAWAK:** 2nd Division, Gunung Lesong, Lingga, *Lee* S.44284 (K, KEP, L, SAN, SAR); Lubuk Antu, Bukit Ubah Ribu, Ulu Sg. Kaup, *Chai* S.33760 (K, KEP, L, MO, SAN, SAR); Gunung Buri, 75 Mile in 1st and 2nd Division boundary, *Martin & Othman* S.36657 (K, KEP, L, MO, SAN, SAR). 3rd Division, Bukit Mabong, Melinau, Kapit *Ilias Paie* S.25710 (A, K, L, SAN, SAR, SING); Bukit Raya, Kapit, *Wright* S.23965 (A, BO, K, L, SAN, SAR, SING). 4th Division, Bintulu Segan Forest Reserve, *Ilias Paie* S.15123 (A, BO, K, L, SAN, SAR, SING), Nyabau Forest Reserve, *Sibat* S.24910 (A, BO, K, KEP, L, MEL, SAN, SAR); Bt. Mersing Anap, *Sibat* S.21882 (A, BO, K, KEP, L, MEL, SAN, SAR, SING); Baram District, Mata Kuching, Ulu Tinjar, *Chai* S.34780 (K, KEP, L, MO, SAN, SAR), Sg. Chipidi, Btg. Tinjar, S.34677 (K,

KEP, L, MO, SAN, SAR); Bintulu District, Nyabau, *Hou* 403 (L, SAR); Marudi, Bukit Mentagai, *Benang* S.23021 (A, BO, K, KEP, L, SAN, SAR, SING), Bukit Mersing, Ulu Mayeng, Sungai Anap, *Ilias Paie* S.28242 (BO, E, K, L, MEL, SAN, SAR, SING); Miri, Suai, *Ilias Paie* S.39202 (A, K, KEP, L, SAN, SAR). 7th Division, Belaga, Ulu Sg. Mengiong, Baleh, Blitcher, *Rantai et al.* S.59888 (AAU, K, KEP, L, MO); Kapit, Bukit Pendam, Menyiong, *Othman* S.41531 (K, KEP, L, MO, SAN, SAR); Ulu Sg. Kapit, *Chai* S.36086 (K, KEP, L, MO, SAN, SAR).

A. javanicum (Bl.) Wang. var. ***javanicum***

Basionym : *Styrax javanicum* Bl., Bijdr. 13 (1825) 671.

Type: *Blume s.n.*, Java (holotype BO, isotype NY).

Synonyms: *Marlea javanica* Koord. & Valet., Bull. Inst. Bot. Buit., 2 (1899) 2. *A. bogoriense* Wang. in Fedde, Repert. 4 (1907) 338. *A. borneense* Merr., Journ. As. Soc., Str. Br. 86 (1922) 342. *A. javanicum sensu* Bloemb., Bull. Jard. Bot. Buit. 3, 16 (1939) 218, *pro parte, quoad Styrax javanicum, Marlea javanica, A. bogoriense, A. borneense in syn. A. javanicum* "Form A" and "Form B" of Ashton, Manual of Non-Dipterocarp Trees of Sarawak (1988) 11. *A. ebenaceum* "var. C" of Cockburn, Trees of Sabah 2 (1980) 18.

SPECIMENS EXAMINED - BORNEO. SABAH: Beaufort District, Beaufort Hill, *Saikeh* SAN 72185 (SAN); Beaufort Hill, *Ampuria* SAN 43581 (K, L, SAN, SAR); Beaufort Hill Forest Reserve, *Cockburn* SAN 66252 (SAN); Mile 63, *Talib* SAN 84703 (K, KEP, L, SAR, SING); Beaufort Hill, *Stephen Madius* SAN 49295 (SAN), *Lajaingah* SAN 44529 (K, L, SAN); Ulu Sg. Lingkungan, *Aban Gibot* SAN 66631 (L, SAN). Beluran District, Sg. Sapi Camp, *Suah Tingguan* SAN 37355 (K, L, SAN, SAR). Kalabakan District, Bukit Tuku, Mile 8, Luasong Road, *Fedilis* SAN 95878 (L, SAN, SAR). Keningau District, Ulu Sg. Pingas-Pingas, *Dewol & Karim* SAN 77976 (SAN). Kinabatangan District, Ulu Sg. Lokan, *Dewol* SAN 92371 (SAN); Fico Plantation, Bilit, *Dewol* SAN 107499 (SAN). Nabawan District, *Asik Mantor* SAN 110170 (K, L, SAN, SAR, SING). Sandakan District, Lungmanis Forest Reserve, *Leopold & Chow* SAN 62871 (SAN), *Mansun* SAN 116780 (K, KEP, L); Kebun China Forest Reserve, *Henry Sinanggul* SAN 38371 (SAN); Sepilok, Kabili Forest Reserve, *Meijer* SAN 24882 (K, L, SAN, SAR), *Singh* SAN 21379 (BO, K, KEP, L, SAN, SAR, SING), Path along R.P. 19 to ridge, *Patrick P. Sam* SAN 2258 (BO, K, KEP, L, SAN, SAR, SING); Segaliud Forest Reserve *Leopold & Kodoh* SAN 81391 (SAN); Labuk Road to Telupid, KM 92, *Julius Kulip* SAN 124199 (K, KEP, L, SAN), *Saikeh* SAN 87836 (KEP, SAN, SAR, SING), Mile 60, *Leopold, Singh & James Ah Wing* SAN 39285 (K, L, SAN). Sipitang District, Lumaku Forest Reserve, *Dewol & Karim* SAN 77724 (K, L, SAN). Telupid District, Telupid-Ranau Road, Mile 75.5, *Aban Gibot* SAN 91285 (K, L, SAN, SAR), Mile 110, *Leopold* SAN 89251 (SAN), West of Mile 58, *Dewol* SAN 79084 (K, KEP, L, SAR). Tongod District, Sg. Enodol, *Dewol* SAN 99451 (K, KEP, L, SAN, SAR, SING), Hap Seng Plantation road to Sg. Tangkulap, Karamuak, *Dewol* SAN 90398 (SAN, SAR). **SARAWAK:** 3rd Division, Belaga, *Jacobs* 5359 (BO, CANB, G, K, SAR, SING, US). 4th Division, Ulu Mayeng, Kakus, *Sibat* S.21769 (A, BO, K, KEP, L, MEL, SAN, SAR, SING);

Bt. Mersing, Anap, *Sibat* S.22402 (A, BO, K, KEP, L, MEL, SAN, SAR, SING). 5th Division, Sg. Medamit, Limbang, *Othman* S.32202 (K, KEP, L, SAN, SAR, SING).

Key to the Bornean species of *Alangium*

1a. Lianas. ..... *A. scandens* Bloemb.

1b. Trees.

2a. Leaf base tri- or palmately nerved.

3a. Leaves markedly obovate with narrowed base, or if elliptic then base rounded and secondary veins 6-7 pairs ..... *A. longiflorum* Merr.

3b. Leaves rounded to broadly ovate with rounded to cordate base, or if elliptic then base narrowed and secondary veins only 4-5 pairs.

4a. Leaf length twice the width or more .... *A. griffithii* (Clarke) Harms

4b. Leaf length not reaching twice the width.

5a. Leaf stalk densely hairy; secondary veins 9-12 pairs. Inflorescence stalk less than 8 mm long, flowers sessile to subsessile ..... *A. nobile* (Clarke) Harms

5b. Leaf stalk glabrous to sparsely hairy; secondary veins less than 8 pairs. Inflorescence stalk more than 10 mm long, flowers distinctly stalked.

6a. Leaf apex blunt to emarginate, secondary veins 4-5 pairs. Flowers comparatively large, corolla 2 cm long and 5mm wide at base, covered by tiny stellate scales ..... *A. circulare* Stone & Kochummen

6b. Leaf apex acute to acuminate, secondary veins 5-7 pairs. Flowers smaller, corolla less than 1.5 cm long and only 1-2 mm wide at base, covered by straight hairs.

7a. Leaf lower surface velvety (seldom sparsely) hairy; midrib and main veins on upper surface densely hairy.

Calyx densely hairy, teeth to only about 0.5 mm long ..... *A. kurzii* Craib

7b. Leaf lower surface glabrous to sparsely hairy, never velvety; midrib and main veins on upper surface glabrous. Calyx sparsely hairy, teeth more than 1 mm long .... *A. rotundifolium* (Hassk.) Bloemb.

2b. Leaf base pinnately nerved.

8a. Plants of mixed swamp forest. Leaf base typically asymmetric. Calyx limb with distinct triangular teeth. Style thickly yellow hairy. Filament broadened and thickly woolly hairy at base .... *A. havilandii* Bloemb.

8b. Plants of lowland dipterocarp forest. Leaf base typically symmetric (rarely asymmetric). Calyx limb subtruncate. Style sparsely white-hairy. Filaments uniformly thick throughout, subglabrous to sparsely short-hairy at base ..... *A. javanicum* (Bl.) Wang.

ACKNOWLEDGEMENTS

I thank the curators and keepers of the Bogor, Singapore, Sarawak, Kepong and Kew herbaria for allowing consultation of their specimens and for loans. Dr K.M. Wong kindly gave comments and suggestions during the preparation of this paper. I am grateful to Dr John Dransfield for his comments and help. I thank Prof. E. Soepadmo and Mr Y.F. Lee for their encouragement. This work is part of a revision carried out for the Tree Flora of Sabah and Sarawak, which receives support from the Overseas Development Administration (ODA), U.K., the International Tropical Timber Organisation (ITTO), and the Malaysian Government.

REFERENCES

Ashton, P.S. (1988) Manual of the Non-Dipterocarp Trees of Sarawak. Vol 2. Dewan Bahasa dan Pustaka, for Forest Department, Sarawak: Kuching.

Bloembergen, S. (1935) The genus *Alangium* in Netherlands Indies. Blumea 1: 241-350.

Bloembergen, S. (1939) A revision of the genus *Alangium*. Bull. Jard. Bot. Buit. 3, 16: 139-235.

Cockburn, P.F. (1980) Trees of Sabah. Vol. 2. Forest Department, Sabah.

Kochummen, K.M. (1972) Alangiaceae. In: T.C. Whitmore (ed.), Tree Flora of Malaya. Vol. 1. Pp. 56-60.

Merrill, E.D. (1922) New or noteworthy Bornean plants, Part 2. J. Roy. As. Soc., Str. Br.. 86: 342.

Stone, B.C. & K.M. Kochummen (1975) A new *Alangium* (Alangiaceae) from Sarawak. Blumea 22: 219-22.

SANDAKANIA 4 (1994): 41-45

Two new species of *Pittosporum* (*Pittosporaceae*) from Borneo

John B. Sugau

Forest Research Centre, Sepilok
P.O. Box 1407, 90008 Sandakan
Sabah, Malaysia

Summary. Two new species of *Pittosporum, P. silamense* and *P. linearifolium*, from Sabah, are described. Keys to all the species occurring in Borneo are provided. *P. resiniferum* Hemsl. is newly recorded for Sarawak.

The Pittosporaceae are an Old World and a largely Australian family. Only one of nine genera in this family occurs in Borneo. The genus *Pittosporum* was established in 1788 and is typified by *P. tenuifolium* Banks ex Solander from New Zealand. For Borneo, Bakker & van Steenis (1957) described four species (*P. ferrugineum* Ait., *P. ramiflorum* (Zoll. & Mor.) Zoll. ex Miq., *P. resiniferum* Hemsl. and *P. longisepalum* Bakker), and later, Bakker (1962) erroneously added a new record, *P. pentandrum* (Blanco) Merr. (here shown to be a distinct and unnamed species). These five species are found in Sabah. In Sarawak, Ashton (1988) recorded only one species, *P. ferrugineum*, but there is a second species there, *P. resiniferum*, represented by *Chai* S.33994, S.39881 and S.39795.

With a revision of the genus for the Tree Flora of Sabah and Sarawak, two new species have been diagnosed, both so far known only in Sabah. One, *P. silamense* J.B. Sugau, is known from Mt. Silam in the Lahad Datu District, at about 812 m. Vegetatively, it is very close to *P. ferrugineum* but the leaves are persistently rusty hairy on the lower side, with markedly recurved margins when dry. The other, *P. linearifolium* J.B. Sugau, is known from Bukit Ampuan in the Ranau District, at about 1200 m, and was wrongly identified as *P. pentandrum* by Bakker (1962). The species differs from the other *Pittosporum* species chiefly by its very narrowly elliptic to linear leaves, and its specific differences from *P. pentandrum* are discussed at the end of its description in this paper.

Two keys are provided in the present paper to distinguish the two new species from others in Borneo. The first key is based mainly on leaf characters. The second key is based on infructescence and fruit characters; the new taxa are not known by flowering specimens.

Key to *Pittosporum* species in Borneo
(based mainly on vegetative characters)

1a. Leaves very narrowly elliptic to linear, mostly 0.5-1.1 cm wide ..... *P. linearifolium*, sp. nov.

1b. Leaves elliptic, oblanceolate or obovate, typically wider (more than 1.5 cm wide).

2a. Leaves persistently thickly hairy on the lower side, and conspicuously bullate between the nerves on the upper side; margins markedly recurved when dry ..... *P. silamense*, sp. nov.

2b. Leaves never persistently hairy (glabrous or, if hairy, only when very young), and not bullate or only finely so on the upper side; margins not recurved when dry.

3a. Veins on upper leaf surface finely impressed; sepals 6-7 mm long in flower ..... *P. longisepalum*

3b. Veins on upper leaf surface flat, not impressed; sepals shorter, generally less than 4-5 mm long.

4a. Leaves markedly obovate, the apex abruptly cuspidate. Inflorescences borne on bare branches.

5a. Leaf stalks 8-18 mm long. Flower larger, the petals 9-12 mm long. Infructescence stalk not conspicuous or up to 0.5 cm long only. Mature fruits 1.7-2 cm long ..... *P. resiniferum*

5b. Leaf stalks longer, 15-25 mm long. Flower smaller, the petals only 4-7 mm long. Infructescence stalk longer, 1-3 cm long. Mature fruits 1-1.5 cm long ..... *P. ramiflorum*

4b. Leaves elliptic, or if oblanceolate to obovate, then gradually acuminate. Inflorescences borne in the leafy portions of branches ..... *P. ferrugineum*

Key to *Pittosporum* species in Borneo
(based mainly on reproductive characters)

1a. Inflorescences mainly on bare branches.

2a. Petals 4-7 mm long. Infructescence stalk 1-3 cm long. Fruit 1-1.5 cm long ..... *P. ramiflorum*

2b. Petals longer, 9-12 mm long. Infructescence stalk inconspicuous or only to about 0.5 cm long. Fruit 1.7-2 cm long ..... *P. resiniferum*

1b. Inflorescences among leaves on the branches.

3a. Seeds attached to a placenta to halfway to apex of the fruit .... *P. ferrugineum*

3b. Seeds attached to the basal portion of the fruit only.

4a. Ovary glabrous, or at most slightly hairy at the base. Leaves very narrow, 0.5-1.1 cm wide only ..... *P. linearifolium*, sp. nov.

4b. Ovary hairy all over. Leaves broader than 1.5 cm wide, typically much broader.

5a. Seeds up to 11 per fruit. Lower leaf surface persistently rusty hairy ..... *P. silamense*, sp. nov.

5b. Seeds only 1-4 per fruit. Lower leaf surface glabrous .... *P. longisepalum*

The new species

Pittosporum linearifolium *J.B. Sugau* **sp. nov.** *P. pentandro (Blanco) Merr. sed foliis angustissime-ellipticis vel linearibus (0.5-1.1 cm latis), pedunculis brevissimis (minus 1 cm longis), seminibus paucis (2-4 in quoque fructu) differt. Typus: Madani SAN 89542, Sabah, Ranau, Bukit Ampuan (holotypus SAN; isotypus KEP).*

Medium-sized tree, up to 8 m tall. Bark smooth, whitish; inner bark creamy grey; sapwood white to brown. Leaves very narrowly elliptic to linear, 4-7 x 0.5-1.1 cm, apex narrowly acute, base narrowly cuneate, margins slightly recurved when dry, chartaceous, brown to dark brown on both sides, midrib slightly sunken on the upper side but raised on the lower side; secondary veins 5-6 pairs, not very conspicuous; reticulations very fine; glabrous; leaf stalks 1-5 mm long, slender, grooved on the upper side. Inflorescence a simple thyrse. Fruits 1-4 per infructescence, a capsule, subglobose, 0.8-1.1 cm long, notched and mucronate apically, narrowed towards the base, glabrous, rugose;infructescence stalk very short (less than 1 cm long), glabrous. Seeds 2-4 per fruit, attached to a placenta at the base of the fruit only, shiny black.

SPECIMENS EXAMINED - BORNEO. SABAH: Ranau, Bukit Ampuan, *Madani* SAN 89542 (holotype SAN, isotype KEP); *Meijer* SAN 20289 (K).

The species is known only from hill forest at Bukit Ampuan, in the Kinabalu area, at about 1200 m. It appears to be endemic there.

This species was wrongly identified as *P. pentandrum* by Bakker (1962), who had seen only one specimen, *Meijer* SAN 20289. Although it approaches *P. pentandrum* in having a subglabrous ovary, it differs by its very short inflorescence stalks (less than 1 cm long), fewer flowers per inflorescence (1-4, compared to more than 10 in *P. pentandrum*), and fewer seeds (2-4) per fruit. Compared with *P. ferrugineum*, it differs by its subglabrous ovary, very short inflorescence stalk, and fewer seeds attached to the basal part of the fruit. *P. linearifolium* differs from all other *Pittosporum* species in Malesia by its very narrowly elliptic to linear leaves.

Pittosporum silamense J.B. Sugau **sp. nov.** *P. longisepalo Bakker affinis sed pagina inferiore laminae dense persistenterque pilosa, pagina superiore valde bullata, marginibus folii in siccitate recurvatis pedunculis brevissimis, 0.8-1.2 cm longis, multis seminibus (usque 11 in quoque fructu) differt. Typus: Joseph et al. SAN 120894, Sabah, Lahad Datu, Mt. Silam (holotypus SAN).*

Small tree, bole *c.* 5 cm diameter. Bark smooth, brownish; inner bark yellowish; sapwood yellowish. Young parts densely persistently ferrugineous hairy. Leaves generally elliptic, *c.* 5.5-10 x 2.5-4 cm, apex narrowly acute to acuminate, base cuneate, margins markedly recurved when dry, rather thick, midrib sunken on the upper side but raised on the lower side; secondary veins 6-9 pairs, deeply impressed on the upper side; conspicuously bullate between the veins on the upper side; persistently thickly rusty hairy on the lower side; leaf stalks 8-18 mm long, slender, grooved on the upper side. Inflorescence a many-flowered thyrse. Fruit 10-18 per infructescence, a capsule, greenish to blue when unripe, subglobose, 0.8-1.1 cm long, notched and mucronate apically, base narrowed to about 2 mm long, covered with rusty hairs; infructescence stalks very short, 0.8-1.2 cm long, hairy. Seeds up to 11 per fruit, attached on a placenta at the base only, black.

SPECIMENS EXAMINED - BORNEO. SABAH: Lahad Datu, Mt. Silam, *Joseph et al.* SAN 120894 (holotype SAN), *Maikin & Lideh* SAN 67521 (SAN), *George & Patrick* SAN 138314 (SAN).

This species appears to have a very restricted distribution. It is so far known only from hill forest on Mt. Silam, an ultramafic coastal mountain in Sabah, at about 812 m. It is very likely endemic there. A study by Proctor *et al.* (1988) of this mountain stated that none of their identified tree species is endemic to Mt. Silam; the present species was, however, not collected by them.

P. silamense differs from all other *Pittosporum* species by its persistently thick brown hair covering on the lower leaf surface and its coarsely bullate upper leaf surface. Although it is related to *P. longisepalum* in having a hairy ovary, it differs by its very short inflorescence stalks (0.8-1.2 cm long) and more (up to 11) seeds per fruit. Vegetatively, it is close to *P. ferrugineum* in having brown hairs on the leaves but in *P. ferrugineum*, the leaves are hairy only when very young and the hairs fall off when the leaves become mature. Moreover, compared with *P. ferrugineum*, it differs by having more (up to 11) seeds per fruit, and its seeds are attached only to the basal part of the fruit.

ACKNOWLEDGEMENTS

I am grateful to the Keepers of the herbaria of the Royal Botanic Gardens, Kew and Kepong for permission to borrow their specimens, and to the curator of the herbarium at Kuching for permission to check their specimens. I thank Dr John Dransfield for providing the Latin diagnoses of the two new species, and Prof E. Soepadmo for providing some references. My thanks go to Dr Wong Khoon Meng for his comments on a draft of this paper. The research here is part of a revision carried out for the Tree Flora of Sabah and Sarawak, supported by the Overseas Development Administration (ODA), U.K., the International Tropical Timber Organisation (ITTO) and the Malaysian Government.

REFERENCES

Ashton, P.S. (1988) Manual of the Non-Dipterocarp Trees of Sarawak. Vol. 2 Dewan Bahasa dan Pustaka, for Forest Department, Sarawak: Kuching.

Bakker, K. & van Steenis, C.G.G.J. (1957) Pittosporaceae. Flora Malesiana 1, 5: 345-360.

Bakker, K. (1962) Notes on New Collections of Malaysian *Pittosporum*. Blumea 11: 426.

Proctor, J., Y.F. Lee, A.M. Langley, W.R.C. Munro & T. Nelson (1988) Ecological Studies on Gunung Silam, a small Ultrabasic Mountain in Sabah, Malaysia. 1. Environment, Forest Structure and Floristics. Journal of Ecology 76: 320-340.

SANDAKANIA 4 (1994): 47-74

The genus *Melicope* (*Rutaceae*) in Borneo

T.G. Hartley

Australian National Herbarium,
CSIRO Division of Plant Industry,
P.O. Box 1600,
Canberra, Australia 2601

Summary. *Melicope* J.R. & G. Forster is represented in Borneo by 13 or perhaps 14 species. Full descriptions and notes on main diagnostic features are given for the genus and the species and a key to the latter is provided. Twelve new binomials are proposed. Of these, *M. clemensiae* T. Hartley, *M. jugosa* T. Hartley, and *M. sororia* T. Hartley are new species, *M. hookeri* T. Hartley and *M. incana* T. Hartley are new names, and *M. accedens* (Blume) T. Hartley, *M. bonwickii* (F. Muell.) T. Hartley, *M. denhamii* (Seem.) T. Hartley, *M. glabra* (Blume) T. Hartley, *M. latifolia* (DC) T. Hartley, *M. lunu-ankenda* (Gaertn.) T. Hartley, and *M. subunifoliolata* (Stapf) T. Hartley are new combinations. The occurrence of *M. glabra* in Borneo requires verification.

The purpose of this paper is to provide an account of the Bornean species of *Melicope* J. R. & G. Forster which will serve as a basis for the treatment of the genus to be prepared by Dr David T. Jones for the forthcoming *Tree Flora of Sabah and Sarawak*. I am preparing a revision of the Indo-Pacific (excepting Hawaii) species of the genus, but it is not likely to be published in time for the names and details of the Bornean species to be utilized by Dr Jones.

The genus *Melicope*

Shrubs (rarely scandent) or trees. Leaves opposite or whorled, digitately trifoliolate or unifoliolate. Inflorescences cymose or thyrsiform or sometimes reduced to solitary flowers, axillary or ramuligerous (i.e., on branchlets below leaves) or rarely terminal, ramigerous, or cauligerous. Flowers small, bisexual or functionally unisexual; sepals 4; petals 4,

distinct, valvate or narrowly imbricate; stamens (rudimentary in female flowers) 8 or 4 or rarely 8-4, distinct; disc intrastaminal, pulvinate to annular or cupular; gynoecium (rudimentary or sometimes obsolete in male flowers) 4-carpellate, the carpels connate basally or up to their full length, with a common apical or subapical style or the stylar elements rarely becoming divergent, the stigma punctiform to capitate, peltate, or 4-branched, the ovules 2 or 1 per carpel. Fruit of 1-4 basally connate follicles (the abortive carpels, if any, persistent) or grading to syncarpous (carpels united into a 4-locular, loculicidally dehiscent capsule); endocarp pergamentaceous to cartilaginous, adnate to or separate from epicarp in mature fruit but not expelled at dehiscence. Seeds solitary or in pairs, remaining attached in dehisced fruit; testa with thick inner layer of dense, black sclerenchyma and spongy outer layer bounded externally by a shiny, black pellicle; endosperm copious; embryo straight or slightly curved, the cotyledons somewhat flattened, elliptic, planate, the hypocotyl superior.

DISTRIBUTION. Malagasy and Indo-Himalayan regions eastward to the Hawaiian and Marquesan Islands and south to New Zealand. About 230 species, 13 or 14 of which occur in Borneo.

Melicope is characterized mainly by its combination of opposite or whorled, digitately trifoliolate or unifoliolate leaves, dehiscent fruit, and shiny, black, pelliculose seeds which remain attached in the dehisced fruit. *Euodia* J.R. & G. Forster, with which *Melicope* was long confused, consists of seven species and ranges from New Guinea and northeastern Australia east to Samoa, Tonga, and Niue. Like *Melicope*, it has opposite, digitately trifoliolate or unifoliolate leaves and dehiscent fruit, but its seeds are neither shiny nor pelliculose and they are forcibly expelled, along with the endocarp, when the fruit dehisces. This classification of the two genera was first proposed in a revision of the southeast Asian genus *Tetradium* Lour. (Hartley, 1981), which itself was long confused with *Euodia*, and was presented a second time (Hartley & Stone, 1989) in a paper in which the mainly Hawaiian genus *Pelea* A. Gray was reduced to *Melicope*.

The manner of attachment of the seed in the dehisced fruit of *Melicope* is variable and provides a useful taxonomic character. In some species, the attachment is either by a partially detached axile strip of pericarp tissue or by a partially detached raphe, or by both. This kind of attachment, which is seen in species 1-3 as enumerated below, is designated as Type A. In other species, neither the pericarp nor the raphe detaches and the two are connected by a funiculus which ranges up to about 3 mm in length. This manner of attachment, which is seen in species 4-14 below, is designated as Type B.

Seeds of *Melicope* are often irregularly angled when two develop in a single fruiting carpel. These shapes, which are caused by crowding, are not given in the descriptions.

Several of the Bornean species of *Melicope* are wide-ranging and widely variable, particularly *M. triphylla* and *M. denhamii*, and have a number of taxonomic synonyms. The synonymies given herein are limited mainly to names of taxa (plus their nomenclatural synonyms) described or otherwise reported from Borneo. With one exception (see *Evodia sensu* Gaertner, mentioned in the synonymy of *M. lunu-ankenda*), the original spelling

Euodia is used throughout the synonymies, correcting the orthographic variant *Evodia*, which was used by most of the authors.

Key to species of *Melicope* in Borneo

1a. Stamens 8; seed attachment Type A; leaves trifoliolate and/or unifoliolate.

2a. Sepals 1-2 mm long; fruiting carpels 10-13 mm long; leaves trifoliolate and/or unifoliolate.

3a. Terminal bud glabrous ..... 1. *M. jugosa*

3b. Terminal bud puberulent or sparsely so ..... 2. *M. sororia*

2b. Sepals 0.5-0.6 mm long; fruiting carpels 3-5 mm long; leaves, or most of them, trifoliolate ..... 3. *M. triphylla*

1b. Stamens 4; seed attachment Type B; leaves, or most of them, trifoliolate, or, in *M. subunifoliolata*, sometimes exclusively unifoliolate.

4a. Flowers bisexual; stigma punctiform or capitellate, neither lobed nor undulate, 0.1-0.3 mm wide; inflorescences axillary and/or ramuligerous.

5a. Pedicels 4-6 mm long at anthesis, in fruit 6-8.5 mm long; petals sericeous-villous adaxially, 4-5.5 mm long, deciduous in fruit; fruiting carpels 4-6 mm long; leaflet blades entire ..... 4. *M. bonwickii*

5b. Pedicels 0.5-1.5 mm long at anthesis and in fruit; petals glabrous, 1.2-2 mm long, usually persistent or subpersistent in fruit; fruiting carpels 2-3 mm long; leaflet blades entire, or, in cultivated or possibly escaped plants, lobed, sinuate, or repand. ..... 5. *M. denhamii*

4b. Flowers usually functionally unisexual; functional stigma capitate or peltate, lobed or undulate, 0.3-1 mm wide; inflorescences axillary.

6a. Trichomes, or most of them, simple.

7a. Sepals connate in proximal 1/3-2/3; fruiting carpels connate in proximal 1/4-1/2; petiolules obsolete; lateral leaflet blades cordate to rounded or obtuse at base ..... 14. *M. latifolia*

7b. Sepals and fruiting carpels connate at base or up to 1/3 their length; petiolules obsolete or up to 20 mm long; lateral leaflet blades obtuse to attenuate at base.

8a. Petals 1.3-1.8 mm long; fertile anthers about 0.5 mm long; infertile anthers (female flowers) 0.2-0.4 mm long; inflorescences several- or somewhat laxly many-flowered; young branchlets 1.6-3 mm wide in third internode; leaflet blades 1.5-5.5 cm wide.

9a. Leaflet blades glabrous or the midrib, especially below, sparsely and minutely puberulent; fruiting carpels 7-9 mm long, the exocarp glabrate. ..... 9. *M. clemensiae*

9b. Leaflet blades pubescent to velutinous on midrib below, glabrous above; fruiting carpels 10-10.5 mm long, the exocarp hirsutulous ..... 10. *M. subunifoliolata*

8b. Petals 1.5-3 mm long; fertile anthers 0.7-1.5 mm long; infertile anthers (female flowers) 0.3-1 mm long; inflorescences several- to densely many-flowered; young branchlets 2.5-15 mm wide in third internode; leaflet blades 2.5-21 cm wide.

10a. Raphe of seeds contorted, especially in chalazal region (the often somewhat enlarged end of the seed); adaxial surface of petals sericeous or sericeous-pubescent. ..... 6. *M. confusa*

10b. Raphe of seeds not contorted; adaxial surface of petals sparsely puberulent to pilosulose in proximal 1/4-1/2 or glabrous.

11a. Terminal leaflet blades obovate or broadly so, (7.5-) 9-16.5 cm long, the main veins plane or impressed above, 9-15 on each side of the midrib, divergent at angle of 50-60°, the apex usually abruptly and obtusely short-acuminate; main branches of inflorescences ascending; fruiting carpels 3-4 mm long. ..... 7. *M. glabra*

11b. Terminal leaflet blades elliptic to obovate, 3.5-46 cm long, the main veins prominulous to impressed above, 8-24 on each side of midrib, divergent at angle of (50-)60-75°, the apex usually acuminate; main branches of inflorescences spreading or ascending; fruiting carpels 3-10(-12) mm long.

12a. Leaflet blades glabrous or nearly so, up to 23 cm long, the main veins prominulous above; main branches of inflorescences usually ascending; fruiting carpels 6-10(-12) mm long. ..... 8. *M. lunu-ankenda*

12b. Leaflet blades nearly glabrous to pubescent below, up to 46 cm long, the main veins usually impressed above; main branches of inflorescences usually spreading; fruiting carpels 3-5 mm long. .... 11. *M. accedens*

6b. Trichomes mostly fasciculate or stellate.

13a. Leaflet blades nearly glabrous to puberulent below. .... 12. *M. hookeri*

13b. Leaflet blades densely whitish tomentose below. .... 13. *M. incana*

Systematic Enumeration

1. Melicope jugosa T. Hartley, **sp. nov.**

Frutex vel arbor 1.8-3 m alta, trichomatibus si praesentibus pro parte maxima simplicibus; ramulis novellis ut gemma terminali et foliis glabris; foliis oppositis, trifoliolatis et/vel unifoliolatis; foliis trifoliolatis 7.5-12.5 cm longis; petiolo 2-5 cm longo; petiolulo in foliolis lateralibus 1-1.5 mm longo, in foliolo terminali 1.5-2 mm longo; foliolii lamina in foliolo terminali elliptico-obovata vel obovata, 4.5-7 x 2-3 cm; foliis unifoliolatis 5.5-16.5 cm longis; petiolo 0.8-3 cm longo; petiolulo obsoleto; foliolii lamina elliptica vel raro elliptico-obovata, 4.8-13.5 x 2.3-5.8 cm; inflorescentiis axillaribus, glabris usque sparse puberulis, pauci- vel plurifloris, 1-2 x 1-1.3 cm, pedunculo 0.3-1 cm longo; floribus ubique glabris vel sepalis irreguliter ciliolatis, unisexualibus (plantae dioeciae); sepalis basi connatis, 1.3-2 mm longis, in fructu deciduis vel subpersistentibus; petalis 3.5-4 mm longis, in fructu deciduis; staminibus 8, staminibus antesepalis in floribus masculis ca. 2.5 mm longis (in floribus femineis ca. 1.7 mm longis), filamento apice anguste obtusa, anthera ca. 1.2 mm longa (in floribus femineis ca. 1 mm longa); gynoecio in floribus femineis 2-2.3 mm longo (in floribus masculis 1.3-1.5 mm longo); carpellis fructificantibus ubique glabris, basi connatis, divaricatis, ellipsoideis, ca. 10 mm longis, exocarpio sicco, endocarpio soluto; seminibus paulo immaturis, per Type A affixis, ca. 8 mm longis.

Typus: J. & M.S. Clemens 51184, Borneo, Sabah, Pantai Barat, Mt. Kinabalu, Gurulau Spur (holotypus A; isotypi K, NY, UC).

Shrub or tree 1.8-3 m high, trichomes, if present, mostly simple. Young branchlets like the terminal bud and leaves glabrous, becoming rather corky, 2.5-4 mm wide in third internode. Leaves opposite, trifoliolate and/or unifoliolate. Trifoliolate leaves 7.5-12.5 cm long; petiole 2-5 cm long, 1-1.5 mm wide at middle; petiolule in lateral leaflets 1-1.5 mm long, in terminal leaflet 1.5-2 mm long; leaflet blades coriaceous, elliptic-obovate or obovate or in lateral leaflets elliptic, in terminal leaflet 4.5-7 x 2-3 cm, the base in lateral leaflets acute to subattenuate, in terminal leaflet subattenuate to attenuate, the margin usually few-crenulate toward apex, the apex rounded or obtuse or abruptly short-acuminate, the midrib plane or slightly impressed above, the main veins prominulous or plane above, in terminal leaflet 7-11 per side, divergent at angle of about 60°, the veinlet reticulation obscure. Unifoliolate leaves 5.5-16.5 cm long; petiole 0.8-3 cm long, 1-2 mm wide at middle; petiolule obsolete; leaflet blade elliptic or rarely elliptic-obovate, 4.8-13.5 x 2.3-5.8 cm, the base rounded or obtuse or rarely narrowly subcordate or acute, the main veins 9-13 per side, divergent at angle of 60-70°, the veinlet reticulation prominulous below or obscure; otherwise similar to trifoliolate leaves. Inflorescences axillary, glabrous to sparsely puberulent, few- or several-flowered, 1-2 x 1-1.3 cm, the peduncle 0.3-1 cm long, the pedicels 2.5-3.5 mm long (about 5 mm long in fruit). Flowers glabrous throughout or sepals irregularly ciliolate, unisexual, plants dioecious; sepals connate at base, suborbicular or ovate, 1.3-2 mm long, deciduous or subpersistent in fruit; petals yellowish green, narrowly imbricate, elliptic, 3.5-4 mm long, deciduous in fruit; stamens 8, the antesepalous ones in male flowers about 2.5 mm long (about 1.7 mm long in female flowers), the filament narrowly obtuse at apex, the anther about 1.2 mm long (about 1 mm long in female flowers); gynoecium in female flowers 2-2.3 mm long (1.3-1.5 mm long in male flowers), the carpels 2-ovulate, the style including stigma about 1.5 mm long, the stigma capitate-peltate, weakly 4-lobed, about 0.6 mm wide. Fruiting carpels glabrous throughout, connate at base, divaricate, ellipsoid, about 10 mm long, the exocarp dry, the endocarp separate; seed attachment Type A; seeds slightly immature, ellipsoid, about 8 mm long.

DISTRIBUTION. Endemic to Sabah; forest from 2250 to 2400 m.

OTHER SPECIMENS EXAMINED - BORNEO. SABAH: Pantai Barat: Mt. Tambuyukon, *Aban Gibot* SAN 55416 (SAN); Mt. Kinabalu, Pig Hill, *Chew & Corner* RSNB 4515 (L, Sing); Mt. Kinabalu, Gurulau Spur, *J. & M.S. Clemens* 51077 (A, K, L, NY, UC).

Melicope jugosa is very closely related to *M. sororia*, differing mainly in its glabrous terminal bud, shorter petiolules, and larger petals and anthers. The two differ from other Bornean species of the genus mainly in their combination of 8-staminate flowers, comparatively large fruiting carpels, endocarp which is separate from the epicarp in mature fruit, and Type A seed attachment.

The specific epithet is from the Latin *jugosus*, of the mountains, referring to the habitat of the plant.

2. Melicope sororia T. Hartley, **sp. nov.**

Frutex vel arbor 1-4 m alta, trichomatibus pro parte maxima simplicibus; ramulis novellis ut foliis glabris; gemma terminali puberula vel sparse puberula; foliis oppositis, trifoliolatis et/vel unifoliolatis (raro foliis infrequentibus bifoliolatis); foliis trifoliolatis 7.5-25 cm longis; petiolo 3-10 cm longo; petiolulo in foliolis lateralibus 3-10 mm longo, in foliolo terminali 5-15 mm longo; foliolii lamina in foliolo terminali obovatis, 6.5-14 x 3-6 cm; foliis unifoliolatis 6-22 cm longis; petiolo 1-6 cm longo; petiolulo obsoleto vel usque 10 mm longo; foliolii lamina elliptica usque obovata, 5-16 x 2.5-8 cm; inflorescentiis axillaribus, glabris vel pedicellis sparse puberulis, pluri- vel multifloris, 2.5-10 x 1.3-4 cm, pedunculo 1.2-7 cm longo; floribus ubique glabris vel sepalis irregulariter ciliolatis, unisexualibus (plantae dioeciae); sepalis basi connatis, 1-1.5 mm longis, in fructu deciduis vel subpersistentibus; petalis 2-2.5 mm longis, in fructu deciduis; staminibus 8, staminibus antesepalis in floribus masculis ca. 1.5 mm longis (in floribus femineis 1-1.3 mm longis), filamento apice obtuso vel acuto, anthera ca. 0.6 mm longa (in floribus femineis ca. 0.5 mm longa); gynoecio in floribus femineis ca. 1.5 mm longo (in floribus masculis 0.8-1 mm longo); carpellis fructificantibus ubique glabris, basi connatis, divaricatis, ellipsoideis, 10-13 mm longis, exocarpio sicco, endocarpio soluto; seminibus per Type A affixis, 9-10 mm longis.

Typus: J. & M.S. Clemens 29477, Borneo, Sabah, Pantai Barat, Mt. Kinabalu, Tenompok (holotypus NY; isotypi A, B, BO, L, UC).

Shrub or tree 1-4 m high, trichomes mostly simple. Young branchlets like the leaves glabrous, becoming rather corky, 2-4 mm wide in third internode; terminal bud puberulent or sparsely so. Leaves opposite, trifoliolate and/or unifoliolate (rarely occasional leaves bifoliolate). Trifoliolate leaves 7.5-25 cm long; petiole 3-10 cm long, 1-2 mm wide at middle; petiolule in lateral leaflets 3-10 mm long, in terminal leaflet 5-15 mm long; leaflet blades chartaceous or subcoriaceous, in lateral leaflets elliptic to obovate, in terminal leaflet obovate, 6.5-14 x 3-6 cm, the base in lateral leaflets acute to subattenuate, somewhat inequilateral, in terminal leaflet subattenuate or attenuate or rarely acute, the margin entire or in occasional leaflets few-crenulate toward apex, the apex acuminate or rarely rounded or obtuse, the midrib plane or slightly impressed above, the main veins prominulous or plane above, in terminal leaflet 7-11 per side, divergent at angle of 60-75°, the veinlet reticulation prominulous to subobscure. Unifoliolate leaves 6-22 cm long; petiole 1-6 cm long; petiolule obsolete or up to 10 mm long; leaflet blade elliptic to obovate, 5-16 x 2.5-8 cm, the base subattenuate or rarely subrounded; otherwise similar to trifoliolate leaves. Inflorescences axillary, glabrous or with sparsely puberulent pedicels, several- or many-flowered, 2.5-10 x 1.3-4 cm, the peduncle 1.2-7 cm long, the pedicels 1.5-3.5 mm long (5-6.5 mm long in fruit). Flowers glabrous throughout or sepals irregularly ciliolate, unisexual, plants dioecious; sepals connate at base, suborbicular, ovate, or elliptic, 1-1.5 mm long, deciduous or subpersistent in fruit; petals white, greenish, or cream, narrowly imbricate, ovate-elliptic or broadly elliptic, 2-2.5 mm long, deciduous in fruit; stamens 8, the antesepalous ones in male flowers about 1.5 mm long (1-1.3 mm long in female flowers), the filament narrowly obtuse or acute at apex, the anther about 0.6 mm long (about 0.5 mm long in female flowers); gynoecium in female flowers about 1.5 mm long (0.8-1 mm long in male flowers), the carpels 2-ovulate, the style including

stigma about 1 mm long, the stigma capitate-peltate, weakly 4-lobed, about 0.6 mm wide. Fruiting carpels glabrous throughout, connate at base, divaricate, ellipsoid, 10-13 mm long, the exocarp dry, the endocarp separate; seed attachment Type A; seeds ellipsoid, 9-10 mm long.

DISTRIBUTION. Endemic to Sabah; forest from 1500 to 2400 m.

OTHER SPECIMENS EXAMINED - BORNEO. SABAH: Pendalaman: Gunung Alab, *Meijer* SAN 21892 (SAN). Pantai Barat (all from Mt. Kinabalu and vicinity): Kamborongoh, *Carr* SF 27490 (SING), SF 27663 (SING), *Sinanggul* SAN 38319 (SAN); Bembangan River, *Chew & Corner* RSNB 4547 (K, L, SING), RSNB 4558 (K, L, SING); eastern shoulder, *Chew et al.* RSNB 197 (BO, CANB, K, SING); Kumburanga, *J. & M.S. Clemens* 29810 (A, B, BO, L, NY, UC); Penataran River, *J. & M.S. Clemens* 33623 (A, BO, L, NY, UC); Penibukan, *J. & M.S. Clemens* 31408 (A, BO, L, NY); Marai Parai, *J. & M.S. Clemens* 32652 (A, BO, L, NY, UC); Gurulau Spur, *J. & M.S. Clemens* 51052 (A, K, L, NY, UC); Bukit Tupai loop trail, *Aban Gibot* SAN 79591 (SAN); below Layang Layang, *Mikil* SAN 46579 (L); descent trail from Panar Leban, *Stone* 11398 (L); without precise locality, *Griswold* 45 (A), *Hou* 232 (L).

Melicope sororia is very closely related to *M. jugosa* (*q.v.*). The specific epithet (from the Latin *sororius*, sisterly) refers to this relationship.

3. Melicope triphylla (Lam.) Merr. in Philipp. J. Sci. (Bot.) 7 (1913) 375. *Fagara triphylla* Lam. Encycl. 2 (1788) 447. *Euodia triphylla* (Lam.) DC, Prodr. 1 (1824) 724. *Zanthoxylum lamarckianum* Cham., in Linnaea 5 (1830) 58, as *lamarkianum*, *nom. illeg.* *Zanthoxylum triphyllum* (Lam.) G. Don, Gen. Hist. 1 (1831) 804. *Euodia lamarckiana* (Cham.) Benth. Fl. Hongk. (1861) 59, *nom. illeg.* *Ampacus triphylla* (Lam.) Kuntze, Revis. Gen. Pl. 1 (1891) 98. Type: *Sonnerat*, Philippines (holotype P).

Shrub or tree 1.5-15 m high, trichomes (if present) simple. Young branchlets like the petioles glabrous to pubescent and sometimes glaucous, 1-7 mm wide in third internode; terminal bud glabrous to velutinous. Leaves opposite, trifoliolate and/or unifoliolate. Trifoliolate leaves 4.5-42 cm long; petiole 1-15 cm long, 0.5-3.5 mm wide at middle; petiolule in lateral leaflets obsolete or up to 35 mm long, in terminal leaflet 1-40 mm long; leaflet blades chartaceous or subcoriaceous or rarely coriaceous, glabrous to rather sparsely puberulent below, glabrous above, elliptic or narrowly so to obovate or oblanceolate or rarely rather narrowly ovate, in terminal leaflet 3-28 x 0.9-10.5 cm, the base acute to attenuate (sometimes inequilateral in lateral leaflets), the margin entire, the apex acute to acuminate or rarely rounded, obtuse, or emarginate, the midrib prominent to plane above, the main veins prominent to plane above, in terminal leaflet 7-19(-25) per side, divergent at angle of 60-80°, the veinlet reticulation obscure or rarely prominent or prominulous. Unifoliolate leaves 5-40 cm long; petiole 0.8-5.5 cm long, 1-4 mm wide at middle;petiolule obsolete or up to 20 mm long; leaflet blade ovate-elliptic or narrowly so to obovate or oblanceolate, 4-34 x 1.8-17 cm, the base acute to attenuate or rarely

obtuse, the apex rounded to acuminate, the veinlet reticulation prominulous to obscure; otherwise similar to trifoliolate leaves. Inflorescences axillary and/or ramuligerous, few- to densely many-flowered, 1-13 x 0.8-11 cm, the axis and branches glabrous to puberulent or hispidulous, the peduncle obsolete or up to 3 cm long, the pedicels glabrous to sparsely hispidulous, obsolete or up to 4 mm long (of similar length in fruit). Flowers unisexual or sometimes bisexual, plants dioecious or sometimes monoclinous or andromonoecious; sepals glabrous or with a few trichomes at apex, connate at base or up to 3/4 their length, 0.3-0.8 mm long, the free portion ovate-triangular to rounded, persistent in fruit; petals white, greenish, or pale yellow, valvate or narrowly imbricate, glabrous, lanceolate to ovate, elliptic, or narrowly elliptic, 1.5-3.5 mm long, deciduous in fruit; stamens 8 or sometimes 4, the antesepalous ones in male and bisexual flowers (1.2-)1.5-4 mm long (0.5-3.5 mm long in female flowers), the filament sparsely pilosulose to villosulous in proximal 1/4-1/2 adaxially or glabrous, acute to subulate at apex, the anther 0.2-0.6 mm long (0.1-0.6 mm long in female flowers); disc glabrous to villosulous; gynoecium glabrous, in female and bisexual flowers 0.8-1.6 mm long (subobsolete or up to 0.5 mm long in male flowers), the carpels 2-ovulate, the style including stigma 0.5-1 mm long, the stigma capitate and 4-lobed or 4-branched, 0.3-1 mm wide. Fruiting carpels glabrous throughout, connate at base or up to 1/3 their length, ascending or divaricate, subglobose to broadly ellipsoid, 2.5-5 mm long, the exocarp subfleshy, the endocarp adnate, at least toward apex; seed attachment Type A; seeds subglobose to broadly ellipsoid, 2.5-4.5 mm long.

DISTRIBUTION. Taiwan and Ryukyu Islands southward to Borneo and thence eastward to New Guinea and New Britain; in Borneo, the species grows in primary and secondary forest, from sea level to 1300 m.

OTHER SPECIMEN EXAMINED - BORNEO. SARAWAK: 7th Division: Gunung Dulit, *Asah ak Luang* S.22764 (A, L, SING). 5th Division: Lawas, *Brooke* 10276 (L, SING, US); Ba Kelalan, *Brooke* 10356 (L). **SABAH**: Pendalaman: Kampung Kapalu, *Lantoh* SAN 73521 (L, SAN); Kemabong to Katubu, mile 4, *Cockburn & Saikeh* SAN 70055 (L). Sandakan: Lamag, Bukit Korong Karamuak, Kinabatangan, *Lejangah* SAN 44421 (L). Tawau: Lahad Datu, Dam Segama, *Muin bin Chai* SAN 31676 (L); Silam, *Ahmad Talip* SAN 52864 (L, SAN); Semporna, *D.D. Wood (leg. Evangelista)* 1237 (A, K, UC). **KALIMANTAN**: Timur: West Kutai, Longibut, *Endert* 2624 (BO, L), 2668 (BO, L); West Kutai, Longpetak, *Endert* 3324 (A, BO, L).

As seen in Borneo, *Melicope triphylla* has glabrous, mostly trifoliolate leaves 11.5-36 cm long. The petiolules are 2-15 mm long and the leaflet blades, which are 8-25 X 2.5-6 cm, are chartaceous, elliptic or narrowly so to oblanceolate, and are acuminate at apex. The plants are dioecious and the flowers are 8-staminate with ovate-triangular sepals which are connate in their proximal 1/4.

From its congeners in Borneo, *Melicope triphylla* differs mainly in its combination of 8-staminate flowers, comparatively small fruiting carpels, and Type A seed attachment.

4. Melicope bonwickii (F. Muell.) T. Hartley, **comb. nov.** *Euodia bonwickii* F. Muell., Fragm. 5 (1865) 56. Type: *Dallachy*, Australia, Queensland, North Kennedy, Seaview Range *apud sinum litoralem* Rockingham Bay, 1 June 1865 (holotype MEL).

Euodia speciosa Rchb. f. & Zoll. ex Teijsm. & Binnend. in Natuurk. Tijdschr. Ned.-Indie 29 (1867) 255. Type: *Zollinger,* Java, Timur, prope Banjoe-Wangie [Banjuwangi] (not seen?). *Zollinger* 3929 (W), from Blambangan [about 25 km S of Banjuwangi], may be a type. At any rate, Teijsmann & Binnedijk's protologue is adequate for the identification of this plant.

Euodia villamilii Merr. in Philipp. J. Sci. (Bot.) 9 (1914) 296. Type: *Villamil* FB 20653, Philippines, Luzon, Laguna, Mt. Maquiling (isotype US).

Tree 6-40 m high, trichomes simple. Young branchlets glabrous or glabrate or rarely sparsely pubescent, 5-9 mm wide in third internode; terminal bud appressed-pubescent. Leaves opposite, trifoliolate, 14-40 cm long; petiole glabrous, 2-14.5 cm long, 2-4 mm wide at middle; petiolules obsolete or up to 4 mm long; leaflet blades chartaceous or subcoriaceous, with scattered trichomes on venation below or glabrous, in lateral leaflets elliptic to obovate, in terminal leaflet obovate, 10-30 x 5-15 cm, the base acute to attenuate (often inequilateral in lateral leaflets), the margin entire, the apex acuminate, the midrib plane or impressed above, the main veins prominulous or plane above, in terminal leaflet 14-24 per side, divergent at angle of 50-70°, sometimes with domatium-like cavities in axils below, the veinlet reticulation prominulous to obscure. Inflorescences ramuligerous and rarely axillary, many-flowered, 3.5-10 x 5.5-13 cm, the axis and branches nearly glabrous or sparsely puberulent, the peduncle sometimes corky-exfoliating, 0.5-4 cm long, the pedicels pubescent or sparsely so, 3-8 mm long (3.5-10 mm long in fruit). Flowers bisexual; sepals nearly glabrous to puberulent abaxially, glabrous adaxially, connate at base, suborbicular, 1.5-2 mm long, persistent in fruit; petals pink or rarely white, narrowly imbricate, glabrous or sparsely puberulent abaxially, sericeous-villous adaxially, ovate to elliptic or elliptic-oblong, 3.5-5.5 mm long, deciduous in fruit; stamens 4, 5-10 mm long, the filament glabrous, subulate to filiform at apex, the anther 1.5-2 mm long; disc pubescent to sericeous-villous; gynoecium 5-10 mm long, the ovary sericeous-villous, the carpels 2-ovulate, the style glabrous, including stigma 4-9 mm long, the stigma punctiform or capitellate, 0.2-0.3 mm wide. Fruiting carpels connate at base, ascending or divaricate, subglobose to broadly obovoid, 4-6 mm long, the exocarp somewhat dry, sparsely pilose or glabrate, the endocarp glabrous, adnate, at least toward apex; seed attachment Type B, the funiculus 1-3 mm long, 0.2-0.5 mm wide at middle; seeds subglobose to ellipsoid or subhemispherical, 3-4.5 mm long.

DISTRIBUTION. Philippines southward to Java and thence east to New Guinea and northeastern Australia; in Borneo, the species grows in primary and secondary forest, from near sea level to 750 m.

OTHER SPECIMENS EXAMINED - BORNEO. SABAH: Pendalaman: Kaingaran, 10 miles E of Tambunan, *Alabazo* A 3623 (L), *Wood & Charington* SAN 17022 (A, L, SAN); Tenom, Pangi, mile 81, *Singh* SAN 27457 (BO, L). **KALIMANTAN**: Timur: Kaliurang, S of

Sangkulirang, *Kostermans* 4936 (L). Selatan: Martapura, *Dachlan* bb 2150 (BO); Pleihari, Tandjung, *Anon.* bb 10157 (L, U).

As seen in Borneo, *Melicope bonwickii* has pedicels that are 4-6 mm long at anthesis and 6-8.5 mm long in fruit. The petals are 4-5.5 mm long.

From its congeners in Borneo, *Melicope bonwickii* is distinguishable by its comparatively long pedicels, comparatively large flowers, and usually pink petals.

5. Melicope denhamii (Seem.) T. Hartley, **comb. nov.** *Picrasma denhamii* Seem., Fl. Vit. (1865) 33. Type: *McGillivray* 46, New Hebrides, Aneitum [Aneityum] (holotype BM).

Euodia tenuistyla Stapf in Trans. Linn. Soc. London, Bot. 4 (1894) 137. Type: *Haviland* 1376, Borneo, Sabah, Pantai Barat, Mt. Kinabalu, Kowng, (holotype K; isotype SING).

Euodia ridleyi Hochr. in Icon. Bogor. 2 (1905) tab. 151. *Euodia schullei* var. *ridleyi* (Hochr.) Lauterb. in Bot. Jahrb. Syst. 55 (1918) 230. *Euodia suaveolens* var. *ridleyi* (Hochr.) Bakh. f. in Blumea 6 (1950) 365. Probable type: *Backer*, Java, Bot. Gard. Bogor (ex Bot. Gard. Singapore), Dec. 1904 (isotype U).

Shrub or tree 0.5-25 m high, trichomes simple, fasciculate, or stellate. Young branchlets like the petioles glabrous to velutinous or tomentose, 1.5-9 mm wide in third internode; terminal bud nearly glabrous to velutinous or tomentose. Leaves opposite, trifoliolate (occasional leaves unifoliolate) 3-38 cm long; petiole 1-13(-16) cm long, (0.5-)0.7-4 mm wide at middle; petiolules obsolete or up to 7(-10) mm long; leaflet blades chartaceous to coriaceous, glabrous to pubescent below, glabrous to sparsely puberulent, or midrib pubescent, above, broadly ovate or broadly elliptic to lanceolate or linear or in terminal leaflet broadly obovate to oblanceolate, in terminal leaflet 2-27 x 0.2-15 cm, the base subcordate or broadly rounded to attenuate, the margin entire to repand, sinuate, or strongly lobed, sometimes undulate, the apex gradually tapering or acuminate to caudate, the midrib plane or impressed or rarely prominent above, the main veins prominent to impressed above, in terminal leaflet 10 to about 60 per side, divergent at angle of 55-90°, the veinlet reticulation prominulous to obscure below and above or impressed above. Inflorescences axillary and/or ramuligerous, several- to densely many-flowered, 2-17 x 0.8-16 cm, the axis and branches glabrous to velutinous or tomentose, the peduncle 0.5-5 cm long, the pedicels glabrous to pubescent, 0.2-1.5(-2.3) mm long (of similar length in fruit). Flowers bisexual or sometimes female, plants monoclinous or sometimes female; sepals nearly glabrous to villosulous abaxially, glabrous adaxially, connate at base or up to 1/3 their length, ovate to triangular, 0.2-0.8 mm long, persistent in fruit; petals white to green or yellowish, narrowly imbricate, glabrous, ovate-elliptic or elliptic, 1.2-2.2 mm long, usually persistent or subpersistent in fruit; stamens 4, 1.5-4 mm long, the filament glabrous, subulate to filiform at apex, the anther 0.6-1.2 mm long (similar in size but without pollen in female flowers); disc glabrous to villosulous; gynoecium 1.2-3.5 mm long, the ovary glabrous to villosulous, the carpels 2-ovulate, the style glabrous or rarely sparsely pilosulose, including stigma 0.7-3 mm long, the stigma punctiform or capitellate,

0.1-0.2 mm wide. Fruiting carpels connate at base, ascending or divaricate, subglobose, 2-3 mm long, the exocarp dry or subfleshy, glabrous to sparsely hispidulous or sparsely pilosulose, the endocarp glabrous, adnate, at least toward apex; seed attachment Type B, the funiculus 0.6-1.5 mm long, 0.2-0.6 mm wide at middle; seeds subglobose or somewhat hemispherical, 1.5-2.5 mm long.

DISTRIBUTION. Borneo east to the southern Philippines and Caroline Islands and southeast throughout eastern Malesia to the Solomon Islands, New Hebrides, and Fiji; in Borneo, the species grows in primary and secondary forest and swamp land, from near sea level to 950 m.

OTHER SPECIMENS EXAMINED - BORNEO. SABAH: Pendalaman: Keningau, Kauraan, *Angian* 7744 (L, SING). Pantai Barat: N of Kepong Takutan, *Shea & Aban* SAN 77190 (SAN); Mt. Kinabalu, Kiau 2, *Sinanggul* SAN 51367 (L, SAN); Mt. Kinabalu, Kampung Kiau 1, *Nooteboom & Aban* 1598 (B, BISH, CANB, L, SAN); Mt. Kinabalu, Kalawat, *J. & M.S. Clemens* 27232 (A, BO, L, NY, UC). Sandakan: Sandakan, *D.D. Wood (leg. Puasa)* 1174 (UC). **KALIMANTAN**: Timur: West Kutai, *Marah, Endert* 2350 (A, BO, L); Balikpapan, Mentawir and vicinity, *Kostermans* 4530 (L), *10009* (CANB), *Sauveur* H 15a (BO, L, SING), 114 (BO, L). Kalimantan without precise locality, *Heutz* 807 (U).

The name *Euodia ridleyi*, given in the synonymy above, refers to a putative cultigen which apparently originated in Papuasia and is now cultivated elsewhere in Malesia as well as in Europe and North America. The plant, which is represented by the D.D. Wood collection cited above, has lobed, sinuate, or repand leaflet blades which are ± linear in outline and have about 20-60 main veins on either side of the midrib.

Two other putative cultigens of *Melicope denhamii* which may be cultivated in Borneo can be characterized as follows: 1) leaflet blades strongly lobed (sometimes trilaminate with lowermost sinuses reaching the midrib), usually ovate in outline; 2) leaflet blades repand or sometimes entire, often undulate, lanceolate to narrowly elliptic or oblanceolate, the main veins 18-28 per side.

Wild-type plants of *Melicope denhamii*, as seen in Borneo, have leaflet blades that are sparsely puberulent to pubescent on the midrib and main veins below, elliptic or narrowly so, 10-19 cm long, the base narrowly obtuse or acute to subattenuate, the margin entire, the apex acuminate, and the main veins are 15-22 on each side of the midrib. The axis and branches of inflorescences are pubescent and the pedicels are glabrous or nearly so. The flowers are bisexual with a glabrous disc and pubescent ovary.

From its congeners in Borneo, *Melicope denhamii* differs mainly in its combination of very small, bisexual flowers, punctiform or capitellate stigma, glabrous petals which are usually persistent or subpersistent in fruit, and its tendency to have ramuligerous inflorescences and fasciculate or stellate trichomes.

6. Melicope confusa (Merr.) Liu, I11. Native Introd. Lign. Pl. Taiwan 2 (1962) 876. *Euodia confusa* Merr. in Philipp. J. Sci. 20 (1922) 391. Type: *Ramos* BS 15055, Philippines, Luzon, Laguna Province (not seen). Many of the numerous paratypes were seen.

Tree 2-28 m high, trichomes simple. Young branchlets like the petioles glabrous to sparsely pubescent, 4-15 mm wide in third internode; terminal bud puberulent to velutinous. Leaves opposite, trifoliolate, 16-54 cm long; petiole 2.5-18.5 cm long, 1.5-5 mm wide at middle; petiolule in lateral leaflets 3-12 mm long, in terminal leaflet 4-15 mm long; leaflet blades chartaceous to coriaceous, glabrous to pubescent below, glabrous above, elliptic to obovate, or broadly so, or in lateral leaflets sometimes ovate or broadly so, in terminal leaflet 12-35 x 5-18 cm, the base acute to subattenuate (rarely inequilateral in lateral leaflets), the margin entire, the apex acuminate, the midrib and main veins prominulous to impressed above, the main veins in terminal leaflet 11-24 per side, divergent at angle of (55-)60-70°, the veinlet reticulation prominent or prominulous, at least below, or rarely obscure. Inflorescences axillary, often stout, many-flowered, 6-30 x 4-24 cm, the peduncle glabrous to puberulent, 3-12 cm long, the main branches ascending, the distal axis and branches nearly glabrous to pubescent, the pedicels puberulent or sparsely so, 1-3 mm long (2-6 mm long in fruit). Flowers unisexual or sometimes occasional flowers bisexual, plants dioecious or sometimes andromonoecious; sepals puberulent or sparsely so abaxially, glabrous adaxially, connate at base, suborbicular or ovate, 0.6-1 mm long, persistent or rarely deciduous in fruit; petals white or greenish white, narrowly imbricate, glabrous or nearly so abaxially, sericeous or sericeous-pubescent or rarely sparsely pubescent, at least in proximal 1/2, adaxially, ovate-elliptic to broadly elliptic, 1.5-3 mm long, deciduous in fruit; stamens 4, in male and bisexual flowers 2.5-4 mm long (1-2.8 mm long in female flowers), the filament sparsely pilosulose in proximal 1/5 adaxially or glabrous, subulate to filiform at apex, the anther 1-1.5 mm long (0.8-1 mm long in female flowers); disc pubescent; gynoecium in female and bisexual flowers 2-2.5 mm long (0.2-1.5 mm long in male flowers), the ovary pubescent, the carpels 2-ovulate, the style sparsely pilose to pubescent, at least in proximal 1/3, including stigma 1.5-2 mm long, the stigma capitate, weakly 4-lobed, 0.5-0.8 mm wide. Fruiting carpels connate in proximal 1/5-1/3, ascending or divaricate, subglobose to ellipsoid or obovoid, 4.5-6 mm long, the exocarp subfleshy, sparsely puberulent or glabrate, the endocarp glabrous, adnate, at least toward apex; seed attachment Type B, the funiculus 1-1.5 mm long, about 0.6 mm wide at middle; seeds subglobose to ovoid or broadly ellipsoid, 3.5-4 mm long, the raphe contorted, especially in chalazal region.

DISTRIBUTION. Philippines, northeastern Borneo, Celebes, and Moluccas; in Borneo, the species grows mainly in primary and secondary forest, from sea level to 90 m.

OTHER SPECIMENS EXAMINED - BORNEO. SABAH: Sandakan: Segaliud, *Cuadra* A 1015 (BO, SING), A 1106 (A, BO, BRI, SING); Lamag road, *Imbungan & Patrick* SAN 74190 (L, SAN, SING); Gomantong Forest Reserve, *Ahwing* SAN 38186 (L); Kretam, *Kadir & Kambatan* A 3537 (A, BO, L, SING). Tawau: Silam, Virgin Forest Reserve, *Ahmad Talip* SAN 68399 (L, SAN), *Sinanggul* SAN 57418 (L, SING); Tanjong Batu Hill 3 miles N of Tawau, *G.H.S. Wood* SAN 17204 (A, BRI, L, SING).

As seen in Borneo, *Melicope confusa* is dioecious, the pedicels are about 5 mm long in fruit, and the petals are 2.5-3 mm long and are sericeous or sericeous-pubescent adaxially.

From its congeners in Borneo, *Melicope confusa* is distinguishable by its unisexual flowers with adaxially sericeous or sericeous-pubescent petals and by its seeds, which have a contorted raphe.

7. Melicope glabra (Blume) T. Hartley, **comb. nov.** *Fagara glabra* Blume, Catalogus (1823) 40. *Euodia glabra* (Blume) Blume, Bijdr. (1825) 245. *Ampacus glabra* (Blume) Kuntze, Revis. Gen. Pl. 1 (1891) 98. Type: *Blume*, Java (Lectotype US, here designated). Blume did not precisely designate a type. In the 1825 reference he gave two localities (*Provinciarum Buitenzorg et Tjanjor*) and the local name *kisampang*. The lectotype is labelled "*Kisampang*, *Fagara glabra* Bl." in Reinwardt's hand. The specimen matches Blume's descriptions in having obovate leaflet blades that are attenuate at base and obtuse at apex, uppermost-axillary inflorescences, and male flowers. Specimens at A and L with the same label as the lectotype have female flowers and otherwise do not match Blume's descriptions. They are *Melicope lunu-ankenda* (Gaertn.) T. Hartley.

Euodia kingii Engl. in Engl. & Prantl, Nat. Pflanzenfam. 3, 4 (1896) 121. Type: Malakka [Malaya *sensu* Engler], "*E. glabra* King in herb." The B material of this was presumably lost. It was probably the same plant that King (in J. Asiat. Soc. Bengal, pt. 2, Nat. Hist. 62 (1893) 208. correctly identified as *Euodia glabra* (Blume) Blume.

Euodia krukoviii Merr. in Pap. Michigan Acad. Sci. 24 (1938) 75. Type: *Krukoff* 4315, Sumatra, Utara, Asahan, Hoeta [Huta] Padang (holotype NY; isotypes A, BRI, L, SING, US).

Tree 12-40 m high, trichomes simple. Young branchlets like the petioles glabrous to velutinous, 4-10 mm wide in third internode; terminal bud sparsely puberulent to velutinous. Leaves opposite, trifoliolate (occasional leaves unifoliolate), (10-)12-25 cm long; petiole (2-)3-8.5 cm long, 1.5-3.5 mm wide at middle; petiolules 1-20 mm long; leaflet blades subcoriaceous, nearly glabrous to pubescent on midrib and main veins below or glabrous, in lateral leaflets elliptic to obovate, or broadly so, in terminal leaflet obovate or broadly so, (7.5-)9-16.5 x 4-12 cm, the base acute to attenuate (somewhat inequilateral in lateral leaflets), the margin entire, the apex abruptly and usually obtusely short-acuminate or sometimes rounded, obtuse, or emarginate, the midrib impressed above, the main veins plane or impressed above, in terminal leaflet 9-15 per side, divergent at angle of 50-60°, the veinlet reticulation obscure or sometimes plane below, obscure above. Inflorescences axillary, usually stout, many-flowered, 7-30 x 4-20 cm, the axis and branches glabrous to velutinous, the peduncle 3.5-14 cm long, the main branches ascending, the pedicels sparsely puberulent to velutinous, 0.6-2 mm long (0.6-4 mm long in fruit). Flowers unisexual, plants dioecious; sepals glabrous to puberulent abaxially, glabrous adaxially, connate at base or rarely up to 1/4 their length, suborbicular to ovate, 0.6-0.8 mm long, persistent in fruit; petals white, narrowly imbricate, sparsely pubescent

in proximal 1/5-1/2 adaxially or glabrous, ovate-elliptic or elliptic, 2-2.5 mm long, deciduous in fruit; stamens 4, in male flowers 2.5-4.5 mm long (1-2 mm long in female flowers), the filament glabrous, subulate to filiform at apex, the anther 1-1.2 mm long (about 0.6 mm long in female flowers); disc glabrous to pubescent; gynoecium in female flowers 1.5-2.5 mm long (0.6-0.8 mm long in male flowers), the ovary nearly glabrous to pubescent, the carpels 2-ovulate, the style glabrous to pilosulose, including stigma 1-2 mm long, the stigma capitate or capitate-peltate, weakly 4-lobed, 0.3-0.5 mm wide. Fruiting carpels connate in proximal 1/6-1/3, ascending, subglobose or broadly ellipsoid, 3-4 mm long, the exocarp subfleshy, glabrous to sparsely pubescent, the endocarp glabrous, adnate, at least toward apex; seed attachment Type B, the funiculus about 1 mm long, about 0.6 mm wide at middle; seeds subglobose to broadly ovoid or broadly ellipsoid, 2.5-3 mm long.

DISTRIBUTION. West Malaysia, Singapore, Sumatra, and western Java; mostly in primary forest; below 500 m throughout the range and ascending to 900 m in Sumatra and to 1200 m in Java.

I have not seen material of *Melicope glabra* from Borneo, but a report of it from Sabah (Keith, 1952: 373, as *Evodia glabra*) may be valid. From the known Bornean species of the genus, it differs mainly in the following combination of features: trichomes simple, terminal leaflet blades obovate or broadly so (7.5-)9-16.5 x 4-12 cm, the apex abruptly and usually obtusely acuminate or sometimes rounded, obtuse, or emarginate, the midrib impressed above, the main veins plane or impressed above, 9-15 per side, divergent at angle of 50-60°; inflorescences 7-30 cm long, the main branches ascending; fruiting carpels 3-4 mm long.

8. Melicope lunu-ankenda (Gaertn.) T. Hartley, **comb. nov.** *Fagara lunu-ankenda* Gaertn. Fruct. Sem. Pl. 1 (1788) 334, *tab. 68, fig. 9. Fagara zeylanica* J.F. Gmelin, Syst. Nat. 2 (1791) 258 (not seen); Syst. Veg. 1 (1796) 258. *nom. illeg. Zanthoxylum zeylanicum* (J.F. Gmelin) DC, Prodr. 1 (1824) 728, *nom. illeg. Euodia lunu-ankenda* (Gaertn.) Merr. in Philipp. J. Sci. (Bot.) 7 (1912) 378, as *lunur-ankenda*. Type: *Konig*, Ceylon (holotype L).

Euodia aromatica Blume, Bijdr. (1825) 246, as Evodia, *non Evodia* (*sensu* Gaertn.) *aromatica* (Sonn.) Pers., 1806. *Zanthoxylon aromaticum* (Blume) Miq., Fl. Ned. Ind. 1 (2) (1859) 670. *Ampacus aromatica* (Blume) Kuntze, Revis. Gen. Pl. 1 (1891) 98. Type: *Blume* 137, Java, Timur, Gunung Parang (holotype L).

[*Fagara triphylla sensu* Roxb. Fl. Ind. 1 (1820) 436, excl. syn., *non* Lam., 1798.] *Zanthoxylum roxburghianum* Cham. in Linnaea 5 (1830) 58. *Euodia roxburghiana* (Cham.) Benth., Fl. Hongk. (1861) 59. *Ampacus roxburghiana* (Cham.) Kuntze, Revis. Gen. Pl. 1 (1891) 98. *Euodia malayana* Ridl., Fl. Malay Penins. 1 (1922) 342, *nom. illeg.* Type: cult. Bot. Gard. Calcutta; introduced by Roxburgh from Penang (not seen). Roxburgh's description, apparently drawn up from living material at Calcutta, is reasonably adequate for the identification of this plant. I doubt if a type was preserved. Roxburgh incorrectly

gave Linnaeus as the author of *Fagara triphylla*. In the reference he cited (Sp. Pl. ed. Willd. 1 (1798) 666), Willdenow correctly referred the species to Lamarck.

Euodia arborea Elmer, Leafl. Philipp. Bot. 8 (1915) 2806. Type: *Elmer* 13159, Philippines, Palawan, Puerto Princesa, Mt. Pulgar (isotypes A, BISH, GH, L, NSW, NY, U, US, W).

Euodia punctata Merr. in J. Straits Branch Roy. Asiat. Soc. 86 (1922) 315. Type: *Ramos* 1289, Borneo, Sabah, Sandakan, Batu Lima, near Sandakan (holotype PNH, not seen, presumably lost, photo at A; isotypes A, L, P, US).

Euodia triphylla var. *pubescens* Ridl. in Kew Bull. (1930) 77. Syntypes: *Creagh*, Borneo, Sabah, east coast (holosyntype K); *Motley* 681, "Sarawak, Banjermassin" (holosyntype K). The Motley syntype was probably collected in Kalimantan at Bandjarmasin.

Euodia concinna Ridl. in Kew Bull. (1930) 78. Type: *Haviland* 2039, Borneo, Sarawak, 4th Division, Mt. Buan (holotype K).

Euodia obtusifolia Ridl. in Kew Bull. (1930) 78, *non* DC. 1824. Type: *Hose* 513 (as 512 in protologue), Borneo, Sarawak, 4th Division, Baram, Miri River (holotype K; isotype L).

Shrub or tree 1.5-27 m high; trichomes mostly simple. Young branchlets like the petioles glabrous to short-velutinous, 2.5-8 mm wide in third internode; terminal bud sparsely puberulent to velutinous. Leaves opposite, trifoliolate (occasional leaves unifoliolate), 6-37 cm long; petiole 1.5-15 cm long, 1-2.8 mm wide at middle; petiolule in lateral leaflets 0.5-10 mm long, in terminal leaflet 1-15 mm long; leaflet blades chartaceous or subcoriaceous or rarely coriaceous, puberulent or sparsely so on midrib, especially below, and sometimes on main veins below, or glabrous, elliptic to obovate or sometimes ovate-elliptic, in terminal leaflet 3.5-23 x 2.5-7 cm, the base in lateral leaflets obtuse to attenuate, often inequilateral, in terminal leaflet acute to attenuate, the margin entire, the apex acuminate or caudate or rarely rounded or emarginate to acute, the midrib prominulous to slightly impressed above, the main veins prominulous or plane above, in terminal leaflet 8-17 per side, divergent at angle of 60-70°, the veinlet reticulation prominulous to obscure. Inflorescences axillary, sometimes stout, usually many-flowered, 2-32 x 1-16 cm, the axis and branches glabrous to short-velutinous, the peduncle 0.8-15 cm long, the main branches usually ascending, the pedicels nearly glabrous to short-velutinous, 0.3-3 mm long (2.5-5 mm long in fruit). Flowers unisexual or rarely bisexual, plants dioecious or rarely andromonoecious or monoclinous; sepals glabrous to puberulent abaxially, glabrous adaxially, connate at base or up to 1/4 their length, suborbicular to ovate or ovate-triangular, 0.5-1.2 mm long, persistent in fruit; petals white or pale green to yellow or cream, narrowly imbricate, glabrous to sparsely puberulent abaxially, pilosulose in proximal 1/4-1/2 or glabrous adaxially, ovate to elliptic, 1.5-3 mm long, deciduous or subpersistent in fruit; stamens 4, in male and bisexual flowers 2-4 mm long (0.5-3 mm long in female flowers), the filament pilosulose in proximal 1/5-1/3 adaxially or glabrous, subulate to filiform at apex, the anther 1-1.5 mm long (0.3-1 mm long in female flowers); disc nearly glabrous to pubescent or short-velutinous; gynoecium in female and bisexual flowers 1-3 mm long (0.2-1 mm long in male flowers), the ovary nearly glabrous to densely pubescent,

the carpels 2-ovulate, the style glabrous to pilosulose, including stigma 0.5-2.5 mm long, the stigma capitate, weakly 4-lobed, 0.3-0.8 mm wide. Fruiting carpels connate at base, ascending or divaricate, ellipsoid to obovoid, 4-10(-12) mm long, the exocarp subfleshy, glabrous to sparsely puberulent, the endocarp glabrous, adnate, at least toward apex; seed attachment Type B, the funiculus 0.5-3 mm long, 0.2-1.4 mm wide at middle; seeds subglobose to ovoid or ellipsoid, sometimes somewhat compressed, 3-6 mm long.

DISTRIBUTION. Himalaya southward to Ceylon, Java, Celebes, and southwestern Philippines; in Borneo, the species grows in primary and secondary well-drained or swampy forest and montane shrubbery, from sea level to 2200 m.

OTHER SPECIMENS EXAMINED - BORNEO. SARAWAK: 1st Division: Kuching, *E. Bartlett, 1893* (SING); Bidi Cave, *J. & M.S. Clemens* 20623 (A, B, BISH, BO, L, UC); Bau, Bukit Kolong, *Chai & Seng* S.16190 (L); Pedawan road, Gunung Mantawa, *J.A.R. Anderson* 12529 (L, SING). 5th Division: Gunung Murud, *Burtt & Martin* 5458 (E), *Nooteboom & Chai* 2050 (L). Sarawak without precise locality, *Haviland & Hose* 559C (CAL), 559E (L), *native collector* 135 (A), 795 (A, BO, L). **BRUNEI**: Belait, Lumut Hills, *van Niel* 4444 (L). **SABAH**: Pendalaman: Lumat, *P. Binideh* SAN 58427 (L, SAN), *Saikeh Lantoh* SAN 73399 (L, SAN, SING); Klias, *Apostal* 41 (UC, W); Keningau, Sook Plain Forest Reserve, *Dewol Sundaling* SAN 80751 (SAN), SAN 80789 (SAN), *Saikeh Lantoh* SAN 73280 (L, SAN); N of Pangi, mile 81, *Jaswir* SAN 27466 (BO), *Singh* SAN 27442 (BO, L, SING); Pangi, *Charington* SAN 22203 (SING); Tenom vicinity, *P. Binideh* SAN 55834 (A); Sapong, *Buntar* SAN 27265 (L, SING), *Mikil* SAN 31888 (L, SING); Bish trail above Sapong, *Sadau* SAN 42592 (L, SAN); Tomani, Murut trail, *Sadau* SAN 49465 (L, SAN), SAN 49487 (L); Jalan Ulu Tomani, *Rundi* SAN 43196 (L); Crocker Range South, *Rundi* SAN 43022 (L, SAN). Pantai Barat: Kudat vicinity, *Brand* SAN 30957 (L); Tinangul, Napui Hill, *Ampuria* SAN 41543 (L); Bak Bak, *Brand* SAN 30920 (L); Laya Laya River, *Balajadia* BNBFD 3266 (BO); Langkon, *Cuadra* A 3172 (CANB, L, NY, SING, US); Mt. Kinabalu and vicinity, *Carr* SF 26910 (SING), SF 27225 (SING), *Chew & Corner* RSNB 4681 (L, SING), RSNB 7054 (CANB), *J. & M.S. Clemens* 31106 (A, B, BO, L, NY, SING, UC), *Kinabalu Natl. Park labourer* SAN 61974 (L), *Sario* SAN 28550 (BO, L, SAN, SING). Sandakan: Sungai Paitan Forest Reserve, *Ajik bin Gohol* SAN 23955 (L, SING); Sandakan and vicinity, *Castro* NBFD 4560 (A, BO, L, SING), *Cuadra* A 2184 (A, BO, L), *Evangelista* 723 (A, NY), *Puasa* BNBFD 1733 (A), NBFD 9038 (A, BO, BRI, L, SING, US); Betotan, *Apostal* BNBFD 3455 (A); Sepilok Forest Reserve, *Cockburn* SAN 64985 (L), *Kadir* A 2517 (A, BO, SING), *Meijer & Singh* SAN 24788 (L, SING), *Nicholson* SAN 17281 (A, BO, BRI, L, SING); *Sam & Kapis bin Sisiron* SAN 19220 (BO, L, SING), *Wood & Charington* SAN 16302 (BO, BRI, L), *Zain* SAN 64708 (L, SING); Lamag, Kinabatangan, Tidog Camp, *Ampuria* SAN 33297 (L, SING); Batu Puteh, *Maidin* BNBFD 1738 (A, BO); without precise locality, *D.D. Wood* (leg. Salinos) 2010 (BO, UC) 2026 (UC, W), *D.D. Wood (leg. Puasa)* 2117 (BO, UC, W). Tawau: Oxbow Lake E of Segama Tobacco Estate, *G.H.S. Wood* SAN 16154 (A, BRI, L, SING); Apas road, mile 14, *Aban Gibot* SAN 27220 (L); Tawau, *Elmer* 21061 (A, BISH, GH, L, NY, P, PH, SING, U, UC), 21143 (A, BISH, BO, L, PH, SING, U, UC). **KALIMANTAN**: Barat: Sungai Pinju bij Anjongan, *Polak* 699 (BO, L); Pontianak, Sungai Air Hitam, Wadjo, *Enoh* 349 (BO, L). Tengah: Sampit and vicinity, *Anon* bb 2661 (L), *Buwalda* 7716 (BO, L), *Kostermans* 4712 (A, L, SING). Timur: Pladju,

Amdjah 65 (BO, L, U), 79 (BO, L); Mt. Palimasan, Tabang on Belajan River, *Kostermans* 12947 (CANB, L), 13022 (L); Blajan River near Samarinda, *Nedi* 748 (A, L, LAE, SING); Djembajan, *Pangkeij* bb 25146 (BO, L); Gunung Beratus, *Kostermans* 7498 (A, BO, L, SING), *7687* (A, BO, L, SING). Selatan: Marabahan, Sei Badandan, *Dachlan* 21 (BO); km 14 tusschen Bandjermasin en Martapura, *Polak* 415 (BO), 491 (A, L); Tanahbumbu, *Verhoef* bb 13350 (BO); Laut Island, Sei Paring, *Hildebrand* 1 (L). Kalimantan without precise locality, *Rameli* 2370 (L), *Rasjid* ZOB 2441 (L), *Sauveur* 1155 (L).

As seen in Borneo, *Melicope lunu-ankenda* has leaflet blades that are glabrous or nearly so with the main veins prominulous above. The fruiting carpels are 6-10(-12) mm long with glabrous or nearly glabrous exocarp.

Melicope lunu-ankenda is most nearly related to *M. glabra* and *M. clemensiae*. From the former, it differs mainly in its larger fruiting carpels and the main veins of its leaflet blades, which are prominulous or plane above and diverge from the midrib at an angle of 60-70°. From the latter, it differ mainly in its larger petals and anthers and more densely-flowered inflorescences.

Some of the Bornean plants of *Melicope lunu-ankenda* from montane habitats, for example, *Nooteboom & Chai* 2050, from Gunung Murud, and *J. & M.S. Clemens* 31106, from Mt. Kinabalu, have fruiting carpels that are 9-12 mm long and leaflet blades that are coriaceous with rounded to abruptly and obtusely acuminate apex. In these features, they contrast rather markedly with lowland plants of the species, which usually have smaller fruiting carpels and have thinner-textured leaflet blades which are usually acuminate to caudate at apex. The two variants intergrade, however, and I prefer to treat them as a single taxon.

9. Melicope clemensiae T. Hartley, **sp. nov.**

Frutex vel arbor 1.5-12 m alta, trichomatibus pro parte maxima simplicibus; ramulis novellis ut petiolis glabris usque minute velutinis; gemma terminali fere glabra usque minute velutina; foliis oppositis, trifoliolatis (raro foliis infrequentibus unifoliolatis), 6.5-25 cm longis; petiolo 1.5-8 cm longo; petiolulo in foliolis lateralibus 1.5-10 mm longo, in foliolo terminali 1.5-12 mm longo; foliolorum laminis glabris vel in costa (apprime subtus) sparse et minute puberulis, in foliolo terminali ellipticis vel anguste ellipticis usque obovatis vel oblanceolatis, 5-16 x 2-5.5 cm; inflorescentiis axillaribus, laxe pluri- vel multifloris, 2.5-16 x 2-11 cm, axe et ramis glabris usque minute velutinis, ut pedicellis tenuibus, ramis principalibus plerumque patentibus, pedicellis fere glabris usque minute velutinis, 2-5 mm longis (in fructu 3-6 mm longis); floribus unisexualibus (plantae dioeciae); sepalis glabris vel abaxialiter puberulis, basi vel usque 1/3 longitudine connatis, 0.5-0.8 mm longis; petalis glabris, 1.5-1.6 mm longis, in fructu deciduis; staminibus 4, in floribus masculis 1.5-2 mm longis (in floribus femineis 1-1.5 mm longis), filamento glabro, apice subulato, anthera 0.5 mm longa (in floribus femineis 0.3-0.4 mm longa); gynoecio in floribus femineis 1-1.5 mm longo (in floribus masculis ca. 0.2 mm longo), ovario fere glabro usque sparse pubescenti, stylo glabro, stigmate capitato, inconspicue 4-lobato, ca. 0.5 mm lato; carpellis

fructificatibus basi connatis, ascendentibus vel divaricatis, subglobosis usque late ellipsoideis vel obovoideis, 7-9 mm longis, exocarpio subcarnoso, glabrato, endocarpio glabro, saltem apicem versus adnato; seminibus per Type B affixis, subglobosis usque ovoideis vel late ellipsoideis, aliquantum compressis, 5-7 mm longis.

Typus: Aban Gibot SAN 60767, Borneo, Sabah, Pantai Barat, Kinabalu Natl. Park, mile 35, Ranau (holotypus L; isotypus SAN).

Shrub or tree 1.5-12 m high, trichomes mostly simple. Young branchlets like the petioles glabrous to minutely velutinous, 1.6-3 mm wide in third internode; terminal bud nearly glabrous to minutely velutinous. Leaves opposite, trifoliolate (rarely occasional leaves unifoliolate), 6.5-25 cm long; petiole 1.5-8 cm long, 1-1.5 mm wide at middle; petiolule in lateral leaflets 1.5-10 mm long, in terminal leaflet 1.5-12 mm long; leaflet blades subcoriaceous, glabrous or the midrib (especially below) sparsely and minutely puberulent, in lateral leaflets elliptic or elliptic-obovate, or narrowly so, in terminal leaflet elliptic or narrowly so to obovate or oblanceolate, 5-16 x 2-5.5 cm, the base acute to subattenuate (in lateral leaflets often inequilateral), the margin entire, the apex acuminate, the midrib plane or slightly impressed or rarely prominulous above, the main veins prominulous above, in terminal leaflet 11-18 per side, divergent at angle of 60-70°, the veinlet reticulation obscure above or prominulous. Inflorescences axillary, laxly several- or many-flowered, 2.5-16 x 2-11 cm, the axis and branches glabrous to minutely velutinous, like the pedicels thin, the peduncle 1.5-7 cm long, the main branches usually spreading, the pedicels nearly glabrous to minutely velutinous, 2-5 mm long (3-6 mm long in fruit). Flowers unisexual, plants dioecious; sepals puberulent abaxially or glabrous, connate at base or up to 1/3 their length, suborbicular to ovate or ovate-triangular, 0.5-0.8 mm long, persistent in fruit; petals white, greenish white, or cream, narrowly imbricate, glabrous, ovate to elliptic, 1.5-1.6 mm long, deciduous in fruit; stamens 4, in male flowers 1.5-2 mm long (1-1.5 mm long in female flowers), the filament glabrous, subulate at apex, the anther 0.5 mm long (0.3-0.4 mm long in female flowers); disc nearly glabrous or pubescent; gynoecium in female flowers 1-1.5 mm long (about 0.2 mm long in male flowers), the ovary nearly glabrous to sparsely pubescent, the carpels 2-ovulate, the style glabrous, including stigma 0.6-1 mm long, the stigma capitate, weakly 4-lobed, about 0.5 mm wide. Fruiting carpels connate at base, ascending or divaricate, subglobose to broadly elliptic or obovoid, 7-9 mm long, the exocarp subfleshy, glabrate, the endocarp glabrous, adnate, at least toward apex; seed attachment Type B, the funiculus 1.5-2 mm long, 0.3-0.8 mm wide at middle; seeds subglobose to ovoid or broadly ellipsoid, somewhat compressed, 5-7 mm long.

DISTRIBUTION. Endemic to northern Borneo: primary forest from 800 to 1800 m.

OTHER SPECIMENS EXAMINED - BORNEO. SARAWAK: 7th Division: Hose Mts., Bukit Temedu, *Banying ak Nyudong* S.19031 (L, SING). 4th Division: Gunung Leeuakok, upper Baram, *Moulton* SF 6845 (SING); Bukit Mersing, Anap, *Sibat ak Luang* S.22129 (L, SING). 5th Division: Mt. Murud East, Belapan River - Dapo River, *Nooteboom & Chai* 1836 (B, BISH, CANB, L); Pa Lungan, *Nooteboom & Chai* 2095 (B, BISH, CANB, K, L). **SABAH**: Pantai Barat (all from Mt. Kinabalu and vicinity): Tenompok, *Carr* SF 26914 (SING), *J. &*

M.S. Clemens 28590 (A, B, L, NY, SING, UC), 28590A (A, BO, L, NY); Penibukan, *J. & M.S. Clemens* 50317 (NY); Sosopodon, Kundasang, *Taipin* SAN 47960 (L); Liwogo Sosopodon, *Sinanggul* SAN 47971 (L, SAN); Sosopodon Forest Reserve, *Aban Gibot* SAN 64027 (SAN).

Melicope clemensiae is very closely related to *M. subunifoliolata*, differing mainly in its glabrous or nearly glabrous leaflet blades and its smaller, glabrate fruiting carpels. The two differ from other Bornean species of the genus mainly in their combination of somewhat laxly flowered inflorescences, very small, unisexual flowers, and comparatively large fruiting carpels.

The specific epithet commemorates Mary Strong Clemens.

10. Melicope subunifoliolata (Stapf) T. Hartley, **comb. nov.** *Euodia subunifoliolata* Stapf in Trans. Linn. Soc. London, Bot. 4 (1894) 138. Type: *Haviland* 1193, Borneo, Sabah, Pantai Barat, Mt. Kinabalu (holotype K).

Shrub (rarely scrambling) or tree 1.8-12 m high, trichomes mostly simple. Young branchlets like the petioles pubescent to velutinous, 2-3 mm wide in third internode; terminal bud velutinous. Leaves opposite, trifoliolate and/or unifoliolate. Trifoliolate leaves 6-24.5 cm long; petiole 1-9 cm long, 1-2 mm wide at middle; petiolule in lateral leaflets 0.6-8 mm long, in terminal leaflet 1-10 mm long; leaflet blades subcoriaceous, pubescent to velutinous on midrib and sometimes sparsely pubescent on main veins below, glabrous above, in lateral leaflets elliptic or elliptic-obovate, in terminal leaflet elliptic to obovate, 5-15.5 x (1.5-)2.3-5.5 cm, the base acute to subattenuate or in terminal leaflet attenuate, the margin entire, the apex acuminate, the midrib plane or slightly impressed or rarely prominulous above, the main veins prominulous or plane above, in terminal leaflet 10-20 per side, divergent at angle of 60-80°, the veinlet reticulation prominulous or rarely obscure below, prominulous or obscure above. Unifoliolate leaves 5-9.5 cm long; petiole 0.8-1 cm long, 0.7-1 mm wide at middle; petiolule obsolete or up to 1 mm long; leaflet blade elliptic or elliptic-obovate, 4.3-8.5 x 1.5-3.5 cm, the base acute, the main veins 11-14 per side, divergent at angle of about 70°; otherwise similar to trifoliolate leaves. Inflorescences axillary, several- or rather laxly many-flowered, 3-13 x 1-5 cm, the axis and branches pubescent to velutinous, the peduncle 1.5-8 cm long, the main branches ascending, the pedicels sparsely puberulent to short-velutinous, 1-2.5 mm long (2.5-4.5 mm long in fruit). Flowers unisexual, plants dioecious; sepals sparsely puberulent to pubescent abaxially, glabrous adaxially, connate at base, ovate or ovate-triangular, 0.7-1.5 mm long, persistent in fruit; petals white or cream, narrowly imbricate, glabrous, ovate-elliptic or elliptic, 1.3-1.8 mm long, deciduous or rarely subpersistent in fruit; stamens 4, in male flowers 1.5-2.5 mm long (1-2 mm long in female flowers), the filament glabrous, subulate to filiform at apex, the anther about 0.5 mm long (0.2-0.3 mm long in female flowers); disc pubescent on top; gynoecium in female flowers 1-2 mm long (0.5-0.7 mm long in male flowers), the ovary pubescent, the carpels 2-ovulate, the style pilosulose, at least in proximal 1/4, including stigma 0.6-1.5 mm long, the stigma capitate, weakly 4-lobed, 0.5-0.6 mm wide. Fruiting carpels connate at base, divaricate, ellipsoid, 10-10.5 mm long, the exocarp somewhat

dry, hirsutulous, the endocarp glabrous, adnate, at least toward apex; seed attachment Type B, the funiculus 0.5-1.5 mm long, 0.6-0.7 mm wide at middle; seeds subglobose to ovoid, often somewhat compressed, 5-6.3 mm long.

DISTRIBUTION. Endemic to Sabah; primary forest; (180-)1350-2400 m.

OTHER SPECIMENS EXAMINED - BORNEO. SABAH: Pendalaman: Gunung Alab, *Nooteboom* 1029 (B, BISH, CANB, L, SAN). Pantai Barat (all from Mt. Kinabalu and vicinity): Mamut Hill, *Kokawa & Hotta* 5366 (L); Natl. Park Headquarters, *Kanis & Sinanggul* SAN 51487 (SAN); Mesilau River, *Chew & Corner* RSNB 4195 (CANB), RSNB 4354 (SING); Ulu Liwagu and Ulu Mesilau, *Chew et al.* RSNB 2735 (CANB, SING); Mesilau Cave trail, *Meijer* SAN 48079 (SAN); Ulu Langanani, *Chew et al.* RSNB 1271 (CANB); Bembangan River, *Chew & Corner* RSNB 4971 (SING); Lumu trail, *J. & M.S. Clemens* 27845 (NY); 1 mile S of Lumu, *Wood & Wyatt-Smith* SAN A 4487 (A, BRI, L, SING); Tenompok, *Carr* SF 27874 (SING), *J. & M.S. Clemens* 29776 (A, B, BO, NY, SING, UC), 29829 (BO, L); Penibukan, *J. & M.S. Clemens* 40893 (A, NY, L); below Kamborongoh, *Nicholson* SAN 36810 (L); Gurulau Spur, *J. & M.S. Clemens* 50724 (A, L, NY, UC), 51464 (A, NY); without precise locality, *Aban Gibot* SAN 57794 (L, SAN), SAN 60756 (L, SAN), SAN 74122 (L, SAN, SING). *Ampon et al.* SAN 71835 (L, SAN, SING), *Griswold* 94 (A), *Mikil* SAN 36187 (L).

Melicope subunifoliolata is very closely related to *M. clemensiae* (*q.v.*).

11. Melicope accedens (Blume) T. Hartley, **comb. nov.** *Euodia accedens* Blume, Bijdr. (1825) 246. *Zanthoxylon accedens* (Blume) Miq., Fl. Ned. Ind. 1(2)(1859) 671. *Ampacus accedens* (Blume) Kuntze, Revis. Gen. Pl. 1 (1891) 98. Type: *Blume*, Java (Lectotype L, here designated); Blume did not precisely designate a type.

Euodia macrophylla Blume, Bijdr. (1825) 246. *Zanthoxylon macrophyllum* (Blume) Miq., Fl. Ned. Ind. 1(2)(1859) 670. *Ampacus macrophylla* (Blume) Kuntze, Revis. Gen. Pl. 1 (1891) 98. Type: *Blume,* Java (Lectotype L, here designated). Blume's type locality ("*in montanis circa Tjiradjas Provinciae Krawang*") does not appear on any of the sheets examined. The first author to unite *Euodia accedens* and *E. macrophylla* was Miquel (in Ann. Mus. Bot. Lugduno-Batavum 3 (1867) 242), who did so under the name *E. accedens*. The point is relevant only in *Euodia*, however, because the specific epithet *macrophylla* is pre-empted in *Melicope.*

Euodia nervosa Koord. & Val. in Meded. Lands Plantentuin 17 (1896) 208. Type: *Koorders* 6953B, Java, Barat, Preanger, Djampangwetan, Takoka (holotype BO).

Shrub (rarely scandent?) or tree 1-40 m high, trichomes mostly simple. Young branchlets like the petioles glabrous to pubescent or velutinous or rarely tomentose, 3-15 mm wide in third internode; terminal bud puberulent to velutinous or rarely tomentose. Leaves opposite, trifoliolate (occasional leaves unifoliolate), 12-74 cm long; petiole 2.5-33 cm long,

1.5-7 mm wide at middle; petiolule in lateral leaflets obsolete or up to 15(-20) mm long, in terminal leaflet obsolete or up to 35 mm long; leaflet blades chartaceous or subcoriaceous, nearly glabrous to pubescent, or midrib velutinous, below, glabrous to sparsely pubescent, or midrib velutinous, above, elliptic to obovate, or sometimes narrowly so, in terminal leaflet 9.5-46 x 4-21 cm, the base in lateral leaflets rounded to subattenuate, often inequilateral, in terminal leaflet obtuse to attenuate, the margin entire, the apex acuminate or rarely obtuse, acute, or caudate, the midrib prominulous to impressed or rarely prominent above, the main veins plane or impressed or rarely prominulous above, in terminal leaflet 10-24(-26) per side, divergent at angle of (50-)60-75(-80)°, the veinlet reticulation prominulous or plane or rarely obscure. Inflorescences axillary, several- to densely many-flowered, 3-19(-24) x 2-13(-18) cm, the axis and branches glabrous to pubescent or velutinous or rarely tomentose, the peduncle 0.5-7(-10) cm long, the main branches usually spreading, the pedicels nearly glabrous to pubescent or velutinous, 0.5-3.5 mm long (0.6-5 mm long in fruit). Flowers unisexual or sometimes bisexual, plants dioecious or sometimes andromonoecious or monoclinous; sepals nearly glabrous to pubescent or hirsutulous or rarely glabrous abaxially, glabrous adaxially, connate at base or up to 1/3 their length, ovate to narrowly triangular or rarely suborbicular, 0.5-1.5(-2) mm long, persistent in fruit; petals white to green or pale yellow, narrowly imbricate, glabrous to appressed-pubescent or hirsutulous abaxially, sparsely puberulent to pubescent or sparsely pilosulose in proximal 1/4-1/2 or sometimes glabrous adaxially, ovate or broadly so to elliptic-obovate, 1.5-2.8 mm long, deciduous or rarely somewhat persistent in fruit; stamens 4, in male and bisexual flowers (2-)2.5-4 mm long (0.5-2.5 mm long in female flowers), the filament pilosulose, or sparsely so, in proximal 1/6-1/2 adaxially or glabrous, subulate to filiform at apex, the anther 0.7-1.2 mm long (0.4-0.8 mm long in female flowers); disc glabrous to densely pubescent or rarely velutinous; gynoecium in female and bisexual flowers 1.5-3.5 mm long (0.5-1 mm long in male flowers), the ovary glabrous to pubescent or villous or rarely velutinous, the carpels 2-ovulate, the style pilosulose to pubescent or villosulous, at least in proximal 1/4, including stigma 1-3 mm long, the stigma capitate or capitate-peltate, weakly 4-lobed, 0.3-0.5 mm wide. Fruiting carpels connate at base, divergent, subglobose to ellipsoid or obovoid, 3-6(-7) mm long, the exocarp subfleshy, glabrous to pubescent or rarely velutinous, the endocarp glabrous, adnate, at least toward apex; seed attachment Type B, the funiculus 0.3-1.5 mm long, 0.3-1(-1.5) mm wide at middle; seeds subglobose to ovoid or ellipsoid, sometimes compressed and often asymmetrical at chalazal end, 2.5-4.5(-5) mm long.

DISTRIBUTION. Andaman Islands east to Vietnam and south to Java; in Borneo, the species grows in well-drained, primary and secondary forest, swamp forest, heath forest, peat swamp, borders, and open places, from sea level to 1950 m.

OTHER SPECIMENS EXAMINED - BORNEO. SARAWAK: 1st Division: Matang, *Burley & Lee* 325 (CANB); Kuching , *Brooke* 8689 (L, US), 9430 (L, US), *Haviland & Hose* 3401C (CAL), 3401E (L), 3401F (UC); Bau, *Purseglove* 4453 (L); Setapok Forest Reserve, *J.A.R. Anderson* 9082 (L, SING); Stapok, *Brunig* S.17530 (L); Semengoh Forest Reserve, *Hou* 576 (A, L). 3rd Division: Balingian, Bukit Iju, *Jugah ak. Kudi* S.27300 (L). 7th Division: Mt. Majau, *J. & M.S. Clemens* 21817 (A, NY). 4th Division: Tatau, Bukit Buan, *Ashton* S.16499 (A, BO, L, SING). 5th Division: Kalabit Highlands, Batu Lawi, *Nooteboom & Chai*

2284 (L). Sarawak without precise locality, *native collector* 134 (A, BO, L, US), 468 (A, US), 2152 (A). **SABAH**: Pendalaman: Tulid vicinity, *Dewol Sundaling* SAN 80831 (SAN), *Talib et al.* SAN 80394 (SAN). Pantai Barat: Kota Belud, *Wyatt-Smith* KEP 80395 (A, L); Kota Kinabalu - Sunsuran road, mile 28, *Cockburn* SAN 65460 (SING); Mt. Kinabalu and vicinity, *Badak* SAN 32344 (L), *Chew et al.* RSNB 37 (CANB), RSNB 2855 (BO, CANB, SING), *M.S. Clemens* 9868 (A, UC), 10848 (A, UC), *J. & M.S. Clemens* 26759 (A, BO, L, NY, UC), 28161 (A, L, NY, UC), 28161A (A, B, BO, L, NY, UC), 30659 (A, BO, L, NY, UC), 33767 (A, B, BO, L, NY, UC), 50533 (A, L, NY, UC), *Aban Gibot* SAN 57788 (L, SAN), *Hou* 246 (L), *Kadir* A 1647 (A, BO, L), *Kaul & Bogle* 2013 (GH), *Mikil* SAN 56285 (L, SAN), *Sinanggul* SAN 38304 (L), *Sinclair et al.* 9233 (E, L), *Singh* SAN 27484 (L). Sandakan: Mamahat, *Jawanting & Ampuria* SAN 32629 (L, SAN); Bongaya Forest Reserve, *Kodoh & Aban* SAN 82031 (SAN); Gum Gum, *Puasa & Enggoh* NBFD 10679 (A, L, SING); Sandakan and vicinity, *Anthony* A 776 (A, BO, BRI, US), *Elmer* 20100 (A, BISH, BO, CANB, GH, L, NSW, NY, PH, U, UC), *Evangelista* 660 (NY); Kabili-Sepilok Forest Reserve, *Enggoh* BNBFD 7267 (A, BO, BRI, L, US), NBFD 10184 (A, L, SING), *Keith* NBFD 7226 (A, BRI, CANB, L, US), *Meijer* SAN 24858 (SAN), *Onggib* NBFD 10586 (L, SING). Tawau: Lucia Forestry District, Apas road, mile 10, *Kadir* A 2101 (A, BO, CANB); Tawau, *Elmer* 21893 (A, BISH, CANB, GH, L, NY, P, PH, U, UC). Sabah without precise locality, *D.D. Wood* 955 (US), 2664 (A, UC), *Villamil*, Jan.-Mar. 1916 (US). **KALIMANTAN**: Barat: Oelu Kenepai, *Hallier* 1448 (BO); Sungai Kenepai, *Hallier* 1976 (BO, L, U); Liang Gagang, *Hallier* 3031 (BO, L); Bukit Raya, *Nooteboom* 4845 (CANB), *Hans Winkler* 874 (L). Timur: Nunukan Island, N part, *Kostermans* 8705 (BO, L, SING), 9048 (BO, L); Mt. Kemul, *Endert* 4492 (BO, L); West Kutai, Benuwatuwa, *Endert* 1612 (A, BO, L).

As seen in Borneo, *Melicope accedens* has petioles up to 24 cm long, petiolules up to 15 mm long, elliptic to obovate leaflet blades with the main veins usually impressed above, basally obtuse to subattenuate lateral leaflet blades, and fruiting carpels 3-5 mm long.

Among its congeners in Borneo with 4-staminate, usually unisexual flowers, *Melicope accedens* differs mainly in its combination of mostly simple trichomes, comparatively large leaflet blades with main veins usually impressed above, comparatively large inflorescences with main branches usually spreading, and comparatively small, basally connate fruiting carpels.

Two variants of *Melicope accedens* occur in Borneo. Their main characteristics, which intergrade completely, at least in extra-Bornean plants, are summarized below.

Variant A: sepals nearly glabrous or sparsely puberulent abaxially; petals glabrous or nearly so abaxially; fruiting carpels 3-4 mm long, the exocarp glabrous or sparsely puberulent; leaflet blades nearly glabrous to pubescent below, with 13-24 main veins on each side of midrib; throughout the range of the species excepting the Andaman Islands.

Variant B: sepals pubescent or hirsutulous abaxially; petals glabrous to pubescent abaxially; fruiting carpels 4-5 mm long, the exocarp pubescent; leaflet blades sparsely puberulent to pubescent below, with 10-16 main veins on each side of the midrib; Andaman Islands, Malay Peninsula, Sumatra (Atjeh), and Borneo (Sarawak and Sabah).

12. Melicope hookeri T. Hartley, **nom. nov.** *Euodia robusta* Hook. f., Fl. Brit. India 1 (1875) 488. *Ampacus robusta* (Hook. f.) Kuntze, Revis. Gen. Pl. 1 (1891) 98. Syntypes: *Phillips*, Malaya, Penang (not seen); *Herb. Maingay Kew Distrib. No. 278* p.p., Singapore (Lectotype GH, here designated). A Leiden sheet with this Maingay number is *Melicope glabra* (Blume) T. Hartley. The specific epithet *robusta* is pre-empted in *Melicope*.

Tree 9-25 m high, trichomes mostly fasciculate or stellate. Young branchlets like the petioles glabrous to short-velutinous, 3-7.5 mm wide in third internode; terminal bud puberulent to short-velutinous. Leaves opposite, trifoliolate (occasional leaves unifoliolate), 12-33 cm long; petiole 4-13 cm long, 1.3-3 mm wide at middle; petiolule in lateral leaflets 1-8 mm long, in terminal leaflet 2-15 mm long; leaflet blades subcoriaceous, nearly glabrous to puberulent below, glabrous above or sometimes midrib and main veins puberulent or minutely so, in lateral leaflets ovate to elliptic or elliptic-obovate, in terminal leaflet ovate-elliptic to obovate or rarely ovate, 7.5-18 x 4-9.5 cm, the base in lateral leaflets obtuse to acute or rarely rounded or subattenuate, in terminal leaflet acute to subattenuate or rarely obtuse, the margin entire, the apex acuminate or abruptly so, the midrib impressed or sometimes plane above, the main veins plane or impressed above, in terminal leaflet 15-22 per side, divergent at angle of (50-)55-70°, the veinlet reticulation prominulous to plane below and above or impressed above. Inflorescences axillary, many-flowered, 10-26 x 6.5-17 cm, the peduncle glabrous to pubescent, 4.5-13 cm long, the main branches ascending, the distal axis and branches sparsely puberulent to pubescent, the pedicels puberulent or sparsely so, 0.3-1.5 mm long (1-2.5 mm long in fruit). Flowers unisexual or rarely bisexual, plants dioecious or rarely monoclinous; sepals nearly glabrous to puberulent abaxially, glabrous adaxially, connate at base, suborbicular to ovate-triangular, 0.5-0.6 mm long, persistent in fruit; petals white or greenish white, narrowly imbricate, glabrous, ovate to elliptic, 1.5-2 mm long, deciduous in fruit; stamens 4, in male and bisexual flowers 2.5-3.5 mm long (1.5-2 mm long in female flowers), the filament sparsely pilosulose in proximal 1/4 adaxially or glabrous, subulate to filiform at apex, the anther 0.8-1 mm long (0.6-0.7 mm long in female flowers); disc villous or villosulous, at least on top; gynoecium in female and bisexual flowers 1-1.5 mm long (0.5-1 mm long in male flowers), the ovary villous or villosulous, or sparsely so, the carpels 2-ovulate, the style pilosulose in proximal 1/3-3/4, including stigma 0.8-1 mm long, the stigma capitate, weakly 4-lobed, 0.3-0.4 mm wide. Fruiting carpels connate at base, ascending or divaricate, subglobose to obovoid, 3.5-4 mm long, the exocarp subfleshy, glabrous or sparsely puberulent, the endocarp glabrous, adnate, at least toward apex; seed attachment Type B, the funiculus 1-1.2 mm long, 0.2-0.5 mm wide at middle; seeds subglobose to ellipsoid, 2.5-3.5 mm long.

DISTRIBUTION. West Malaysia, Singapore, Sumatra, and Borneo; primary and secondary forest and borders; at lower altitudes throughout the range and ascending to 1600 m in Borneo.

OTHER SPECIMENS EXAMINED - BORNEO. BRUNEI: Kuala Abang road, *Ashton* BRUN 5094 (BO, BRI, L, SING). **SABAH**: Pendalaman: Gunung Alab, *Nooteboom* 1021 (L, SAN); Beaufort Hill, *Madius* SAN 50052 (L, SAN); Kepong Tulid, *Leopold & Aloysius* SAN 74404 (L, SAN), *Leopold & Saikeh* SAN 74459 (L, SAN); Ulu Sipitang 5 miles E of

Sipitang, *G.H.S. Wood* SAN 16919 (A, BRI, L, SING). Pantai Barat: Kota Belud, Kelawat Forest Reserve, *Ampuria* SAN 40377 (L, SAN); Mt. Kinabalu, Bungal, *J. & M.S. Clemens* 30014 (A, BO, L, NY); Penampang, Sunsuran trail, *Mikil* SAN 37764 (L, SAN, SING). **SARAWAK**: 1st Division, Kampong Sadir, *Mamit* S.33409 (L). **KALIMANTAN**: Barat: Sanggau, *Hallier* 790a (BO, L), *Anon.*, bb 17218 (A, L), bb 18642 (A, L); Lebang Hara, *Hans Winkler* 386 (L). Tengah: Sungai Kahayan 5 km NW of Haruwn, *Burley et al.* 368 (CANB); Puruktjau, Ma Tupuh, *Atmoesoewarno* bb 10605 (BO). Timur: near Mt. Kemui, *Endert* 4301 (BO, L); Longbangun, Camp Tikah, *Wiriadinata* 648 (CANB); Djembajan, *Samioedin* bb 24675 (A, BO, L, NY, SING); peak of Balikpapan (Gunung Beratus), *Kostermans* 7627 (A, BO, BRI, L, SING); Balikpapan, Sepaku, *Anon.* bb 13929 (L). Borneo without precise locality, *Beccari* 2762 (P).

Melicope hookeri is very closely related to *M. incana* (*q.v.*). The specific epithet commemorates Joseph Dalton Hooker.

13. Melicope incana T. Hartley, **nom. nov.** *Euodia alba* Hook. f. in Trans. Linn. Soc. London 23 (1862) 166. *Ampacus alba* (Hook. f.) Kuntze, Revis. Gen. Pl. 1 (1891) 98. Type: *Lobb*, Borneo, *in ora septentrionalis*, 1857 (holotype K). The specific epithet *alba* is pre-empted in *Melicope*.

Tree 4-18(-33) m high, trichomes mostly stellate. Young branchlets like the petioles and inflorescences puberulent to short-velutinous, 4-8.5 mm wide in third internode; terminal bud velutinous. Leaves opposite, trifoliolate, 12-45 cm long; petiole 3-20 cm long, 2-4 mm wide at middle; petiolule in lateral leaflets obsolete or up to 2 mm long, in terminal leaflet obsolete or up to 3 mm long; leaflet blades subcoriaceous, densely whitish-tomentose below, nearly glabrous to sparsely and minutely puberulent, or midrib densely puberulent, above, in lateral leaflets ovate to elliptic, or broadly so, in terminal leaflet elliptic to obovate, or broadly so, 9-25 x 5-16 cm, the base in lateral leaflets rounded or obtuse, in terminal leaflet obtuse to cuneate, the margin entire, the apex somewhat abruptly acuminate, the midrib and main veins impressed above, the main veins in terminal leaflet 20-25 per side, divergent at angle of 60-70°, the veinlet reticulation prominulous below or obscure. Inflorescences axillary, many-flowered, 9-23 x 4-17 cm, the peduncle 4.5-12 cm long, the main branches ascending, the pedicels 0.3-1 mm long (1-1.5 mm long in fruit). Flowers unisexual or rarely bisexual, plants dioecious or rarely monoclinous; sepals puberulent to densely pubescent abaxially, glabrous adaxially, connate in proximal 1/4-1/3, suborbicular to ovate-triangular, 0.5-0.7 mm long, persistent in fruit; petals white, narrowly imbricate, sparsely puberulent in longitudinal median line abaxially or glabrous, ovate-elliptic or elliptic, 1.7-2 mm long, deciduous in fruit; stamens 4, in male and bisexual flowers 2.5-3.5 mm long (1.5-2 mm long in female flowers), the filament glabrous, subulate to filiform at apex, the anther about 1 mm long (0.7-1 mm long in female flowers); disc sericeous-pubescent; gynoecium in female and bisexual flowers 1.5-2 mm long (0.6-1 mm long in male flowers), the ovary sericeous-pubescent, the carpels 2-ovulate, the style puberulent in proximal 2/3-3/4, including stigma 1-1.5 mm long, the stigma capitate, weakly 4-lobed, about 0.3 mm wide. Fruiting carpels connate at base, ascending, ellipsoid to obovoid, 3-4 mm long, the exocarp somewhat dry, nearly glabrous or sparsely

puberulent, the endocarp glabrous, adnate, at least toward apex; seed attachment Type B, the funiculus about 1 mm long, about 0.3 mm wide at middle; seeds subglobose, about 2 mm long.

DISTRIBUTION. East-central Sumatra, Borneo, and northern Celebes; well-drained, primary and secondary forest, alluvial forest, and freshwater swamp forest; sea level to 800 m.

OTHER SPECIMENS EXAMINED - BORNEO. SARAWAK: 1st Division: Stabut, Padawan, *Mamit* S.29816 (L). 7th Division: Kapit, *J. & M.S. Clemens* 21054 (NY); Ulu Kapit, Sungai Paku near Rumah Rapek, *Chai et al.* S.33228 (L). **SABAH**: Pendalaman: Ingaran, between Tambunan and Mt. Trusmadi, *Nooteboom 1335* (B, BISH, CANB, SAN), *1353* (B, L, SAN), *Cuadra* A 1339 (BO, CANB, SING); Weston, Bukit Suhai Mengalong, *Suleiman* BNBFD 2177 (A, BO). Pantai Barat: Mt. Kinabalu, Kibayo to Keung, *M.S. Clemens* 9884 (A, UC); Mt. Kinabalu, Dallas, *J. & M.S. Clemens* 26017 (A, L, NY), 26805 (A, L, NY); Kilimu, *N. Binideh* SAN 65107 (L); Kimanis, *Bayak* BNBFD 2122 (A). Sandakan: Telupid, mile 81, *Leopold & Amin* SAN 75352 (A, L, SAN, SING). Tawau: Lahad Datu, Kretam, *G.H.S. Wood* A 3485 (L, SING). **KALIMANTAN**: Natuna Islands: Bunguran, Gunung Ranai, *van Steenis* 1353 (L). Barat: Mempawah, Andjongan, *Schuitemaker* bb 15588 (BO, L). Timur: West Kutai, Kiham Batu Beng, *Endert* 2250 (A,L); Balikpapan Bay, Muan, near Sungai Riho, *Kostermans* 4104 (A, BO, L). Selatan: Sungai Tabelong, Kayup, *Hub. Winkler* 2203 (BO, L), 2259 (L). Borneo without precise locality, *de Vriese*, 1859-60 (L, U).

Among the western Malesian species of the genus, *Melicope incana* is immediately recognizable by its densely whitish-tomentose leaflet blades. It is very closely related to *M. hookeri*, which differs mainly in its glabrous to puberulent leaflet blades. From their congeners in Borneo, the two species differ mainly in their combination of mostly fasciculate or stellate trichomes, pubescent disc, usually unisexual flowers, and petals that are deciduous in fruit.

The specific epithet refers to the whitish-tomentose leaflet blades.

14. Melicope latifolia (DC) T. Hartley, **comb. nov.** [*Ampacus latifolius* Rumph., Herb. Amboin. 2 (1741) 186, *tab.* 61.] *Euodia latifolia* DC, Prodr. 1 (1824) 724. *Zanthoxylum rumphianum* Cham. in Linnaea 5 (1830) 58, *nom. illeg. Zanthoxylum latifolium* (DC) G. Don, Gen. Hist. 1 (1831) 804. Type: *Doleschall* 335, Moluccas, Ambon (Neotype W, here designated). De Candolle based this species on Rumphius' protologue, but no type is designated in that account and the illustration is not sufficiently diagnostic to serve as the type.

Shrub or tree 2-27 m high, trichomes simple. Young branchlets like the petioles and inflorescences glabrous to softly hirsute, 2.5-10 mm wide in third internode; terminal bud sparsely puberulent to softly hirsute or rarely glabrous. Leaves opposite, trifoliolate (rarely

occasional leaves unifoliolate), 13-63 cm long; petiole 4-29 cm long, (1-)2-4 mm wide at middle; petiolule in lateral leaflets obsolete or up to 8 mm long, in terminal leaflet obsolete or up to 10 mm long; leaflet blades chartaceous, glabrous to softly hirsute below, glabrous to hirsutulous, or midrib softly hirsute, above, in lateral leaflets ovate to elliptic, in terminal leaflet elliptic to obovate or rarely ovate-elliptic, 8-37 x 3-19 cm, the base in lateral leaflets cordate or rounded to cuneate or rarely subattenuate, equi- or inequilateral, in terminal leaflet narrowly cordate or obtuse to cuneate or rarely subattenuate, the margin entire, the apex acuminate to caudate, the midrib plane or impressed above, the main veins prominulous to slightly impressed above, in terminal leaflet 14-31 per side, divergent at angle of 60-70°, the veinlet reticulation prominulous to obscure below and above or sometimes slightly impressed above. Inflorescences axillary, many-flowered (often densely so), 5-24 x 2-16 cm, the peduncle 0.5-7.5 cm long, the main branches spreading, the pedicels obsolete or up to 2(-3) mm long (0.5-3.5 mm long in fruit). Flowers unisexual or sometimes bisexual, plants dioecious or sometimes monoclinous; sepals glabrous to softly hirsute abaxially, glabrous adaxially, connate at base or up to 2/3 their length, 0.6-1.5 mm long, the free portion ovate to triangular or rounded, persistent in fruit; petals green to yellow or white, narrowly imbricate, glabrous to puberulent abaxially, glabrous adaxially, ovate to elliptic-obovate, 2-3(-4) mm long, deciduous in fruit; stamens 4, 2-4(-5) mm long, the filament glabrous, obtuse or narrowly so or sometimes acute at apex, the anther in male and bisexual flowers 0.6-1 mm long (0.3-0.5 mm long in female flowers); disc glabrous or nearly so; gynoecium in female and bisexual flowers 2.5-4 mm long (obsolete or up to 0.4 mm long in male flowers), the ovary glabrous to hispidulous or pubescent, the carpels 2-ovulate, the style pilosulose at base or up to 1/2 its length or glabrous, including stigma 2-3.5 mm long, the stigma capitate to peltate, 4-lobed or -undulate, 0.5-1 mm wide. Fruiting carpels connate in proximal 1/4 or up to their full length, divaricate after dehiscence, the capsule before dehiscence transversely elliptic in outline, 3-5 mm high, weakly lobed, impressed at apex, the exocarp somewhat dry, glabrous to sparsely pubescent, the endocarp glabrous, adnate, at least toward apex or dorsally; seed attachment Type B, the funiculus 0.5-1.5 mm long, 0.2-0.5 mm wide at middle; seeds subglobose to broadly ellipsoid or hemispherical, 2-3 mm long.

DISTRIBUTION. Java northeast to the Philippines and eastward to New Guinea, New Britain, Solomon Islands, and New Hebrides; also in Samoa; in Borneo, the species grows in primary and secondary forest and open places, from near sea level to 600 m.

OTHER SPECIMENS EXAMINED - BORNEO. SABAH: Pendalaman: Tambunan, *Nooteboom* 1281 (B, L, SAN); Bundu, *Goklin* BNBFD 3217 (A, BO, L); Keningau, *Angian* 7752 (SING). Pantai Barat: Kota Belud, Kelawat Forest Reserve, *Ampuria* SAN 41359 (L, SING); Kudat, Tagaru Forest Reserve, *Mait Battah* SAN 37657 (L); Banggi Island, *Ampuria* SAN 42106 (L), *Castro & Melegrito* 1721 (UC). Tawau: Silam, *Karim* SAN 68241 (SAN), *Muin bin Chai* SAN 29665 (L). Sabah without precise locality, *Agama* 1077 (A, L, US), *Goklin* 845 (A, NY).

As seen in Borneo, *Melicope latifolia* has indumentum on its branchlets, leaves, and inflorescences, the petiolules are obsolete, the lateral leaflet blades are cordate to rounded or obtuse, and usually inequilateral, at base, the terminal leaflet blades are narrowly

cordate or obtuse to cuneate at base, the sepals, which are connate in their proximal 1/3-2/3, are pubescent to softly hirsute abaxially, the style is glabrous or nearly so, and the fruiting carpels are connate in their proximal 1/4-1/2, ellipsoid, 3.5-4.5 mm long.

From its congeners in Borneo, *Melicope latifolia* is distinguishable by the comparatively high degree of connation of its sepals and fruiting carpels and its epetiolulate, basally cordate to rounded or obtuse, usually inequilateral lateral leaflets. Also, among the 4-staminate species, it is distinguishable by its usually obtuse staminal filaments.

Excluded names

Melicope beccarii (Hook. f.) Engl. in Engl. & Prantl, Nat. Pflanzenfam. 3, 4 (1896) 122 = *Tetractomia tetrandrum* (Roxb.) Merr. *fide* Hartley in J. Arnold Arbor. 60 (1979) 133.

Melicope unifoliolata Merr. in Philipp. J. Sci. (Bot.) 13 (1918) 74 = *Maclurodendron porteri* (Hook. f.) T. Hartley in Gard. Bull. Sing. 35 (1982) 8.

ACKNOWLEDGEMENTS

I wish to thank the directors and curators of A, B, BISH, BM, BO, BRI, CAL, CANB, E, GH, K, L, MEL, NSW, NY, P, PH, SAN, SING, U, UC, US, and W for making specimens in their care available to me.

REFERENCES

Hartley, T.G. (1981) A revision of the genus *Tetradium* (Rutaceae). Gardens' Bulletin, Singapore 34: 91-131.

Hartley, T.G. & B.C. Stone (1989) Reduction of *Pelea* with new combinations in *Melicope* (Rutaceae). Taxon 38: 119-123.

Keith, H.G. (1952) A preliminary list of North Borneo plant names. North Borneo Forest Records No. 2, 2nd ed. Govt. of Colony of North Borneo, Sandakan. 528 p.

SANDAKANIA 4 (1994): 75-81

Six new species of *Jasminum* (*Oleaceae*) from Malesia

Ruth Kiew

Department of Biology,
Universiti Pertanian Malaysia,
43400 Serdang,
Selangor, Malaysia

Summary. In revising the jasmines for the Malesian region, six new species are recognised: four from Borneo, one from the Batanes Islands, Philippines, and one from Peninsular Malaysia, which had previously been confused with the Indian *Jasminum adenophyllum*.

Jasminum batanensis *Kiew* **sp. nov.**, *inter congeneribus Jasmino Malesiae foliis parvis et obtusissimis bene distincta; foliis J. yuanjiangenso Bai similis, differt calycis dentibus minutis, floribus minoribus et fructibus globosus. Typus: H.H. Bartlett 15387, Philippines, Batanes Islands, Ibuhos Island, (holotypus PNH; isotypi A, MICH).*

A creeping glabrous bush, stem terete, bark white and minutely fissured. Leaves unifoliolate, lamina elliptic or slightly obovate, 2-2.5 cm long, 0.75-1.25 cm wide, apex obtuse or slightly retuse, base cuneate, sometimes attenuate into the petiole, coriaceous, without domatia, margin strongly recurved, midrib and veins prominent beneath, lateral veins 2 main pairs, strongly ascending. Petiole 3-4 mm long, articulate in upper half. Inflorescence a simple cyme or cymose panicle, usually terminal but also in upper axils, 3- or 9-flowered, total length 3-8 mm, peduncle 3 mm long, bracts foliaceous, sometimes persistent, 14 x 7 mm, bracteoles narrowly elliptic, 1-2 mm long. Pedicel 1.5-3 mm. Calyx tube cupulate, 1.5-2 mm long, 1-1.5 mm wide, sparsely pellucid on outer surface; calyx lobes minute, *c.* 0.5 mm long. Corolla white; tube slender, 5-14 mm long, 1 mm wide, lobes 6-8, 3-5 mm long, 1-2 mm wide, narrowly elliptic, apex acute and sometimes minutely apiculate. Anthers sessile, 2 mm long, linear with short apiculum. Ovary ellipsoid, 1.5 x 1 mm; style 11 mm in long-styled flowers; stigma 1 mm long, lanceolate, apex minutely bilobed. Fruit globose, 6-7 x 6 mm.

DISTRIBUTION. Endemic to the northern Philippines, where it is known only from the Batanes Islands (Ibuhos and Itbayat Islands).

HABITAT. On rocks and slopes at about 150 m altitude.

SPECIMENS EXAMINED - PHILIPPINES: Batanes Islands, Ibuhos Is., *Bartlett* 15387 (holotype PNH, isotypes A, MICH), Itbayat Is., *Quisumbing, del Resario, Gutierres s.n.* 31 March 1961 (PNH).

Jasminum batanensis is unique among Malesian jasmines in its small glabrous leaves, which have an obtuse apex. Several small-leaved species are known from China, Indo-China and Thailand, such as *J. microcalyx* Hance and *J. nintooides* Rehd., but they differ in having ovate leaves with an acuminate apex. *J. yuanjiangense* Bai also has small obovate leaves but it is different from *J. batanensis* in its longer calyx teeth (2-3.5 mm long), larger corolla with a tube 18-23 mm long and lobes 12-15 mm long, and in its fruit, which is ellipsoidal and 10-15 x 8-9 mm.

Detailed field notes are lacking for this species so its habit is not known with certainty, but specimens suggest it to be prostrate. Nor is it known if it is confined to rocky habitats, nor whether it is common where it is found.

Jasminum kostermansii *Kiew* **sp. nov.** *a Jasmino longipetalo King & Gamble foliis angustoribus, petiolis brevioribus et pedunculis longioribus differt. Typus: Fidilis & Sumbing SAN 88453, Sabah, Tawau (holotypus SAN).*

Thin-stemmed, glabrous climber to 14 m long, stem terete, bark smooth. Leaves unifoliolate, lamina narrowly elliptic, 6.5-11.5 cm long, 2.25-4 cm wide, apex cuspidate with acumen *c.* 0.75-1.5 cm long, sometimes apiculate, base shortly attenuate, chartaceous and slightly nitid above, frequently minutely punctate, pubescent with sparsely scattered microscopic hairs on lower leaf surface, without domatia, margin slightly recurved; veins 3-5 pairs, basal pair ascending about midway longitudinal to and *c.* 3-5 mm from margin, slightly impressed above and prominent beneath, tertiary venation obscure. Petiole 5-8 mm long, articulate *c.* midway. Inflorescence axillary, glabrous, a reduced cyme with (1-)2-3 flowers or umbellate with 5 flowers, peduncle 5-35 mm long, bracts ligulate, *c.* 2 mm long, persistent. Pedicel 25 mm long, 1 mm thick in flower, in fruit 25-30 mm long and widened to 2.5 mm below the calyx. Calyx tube narrowly cupulate, 2 mm long, 1.5 mm wide, sometimes 5-ribbed; lobes 5, 0.5-1(-2) mm long, subulate, glabrous. Corolla white, sometimes pinkish outside, intensely fragrant, tube slender, 10-18(-32) mm long, 1 mm wide; lobes 11-12, 24-30 mm long, 1 mm wide, ligulate, apex acute. Anthers 3.5 mm long, linear with a minute apiculum; filament 1 mm long. Ovary globose, 0.75 x 0.75 mm; style in long-styled flowers *c.* 15 mm long; stigma 3 mm long, lanceolate. Fruit globose, 1 x 1 cm.

DISTRIBUTION. Endemic to Borneo (Brunei, E. Kalimantan and Sabah).

HABITAT. On the margins of or in primary or disturbed lowland forest or on ridges and hill tops to 150 m altitude.

SPECIMENS EXAMINED - BORNEO. BRUNEI: Belait, Sg. Rampayoh, *J. Dransfield* JD 7301 (BRUN, K). **SABAH:** Keningau, Sook Dalit, *Cockburn* SAN 73026 (K, SAN); Tawau, Beria, *Fedilis & Sumbing* SAN 88453 (holotype SAN); Sandakan, Telupid, Bukit Tangkunan, *Dewol Sundaling* SAN 92414 (L, SAN), *Abd. Rahim* SAN 92987 (K, SAN); Shang Lian, *Fidilis & Asik* SAN 109998 (SAN). **EAST KALIMANTAN:** Berau, Tdg. Radeb., *Kostermans* 21088 (K, L).

Two Bornean jasmines, this species and *J. melastomifolium* Ridl., have narrowly elliptic leaves where the basal pair of veins runs parallel to the margin and extremely long slender pedicels 1.5-2.5 cm long. *J. melastomifolium* is a distinct species in its four-angled stem, its triplinerved leaves (the basal pair of veins reach almost to the apex) which dry pale grey-green, in its filiform calyx lobes 4-8 mm long and its short corolla lobes (6 mm long).

Jasminum kostermansii resembles *J. longipetalum* King & Gamble not only in its elliptic leaves and long slender pedicels but also in its terete stem, leaves which dry brown and which have the basal pair of veins reaching about half-way, short calyx lobes (0.5-2 mm long) and long corolla lobes (18-45 mm long). However, it is distinct from *J. longipetalum* in its narrower leaves and shorter petioles (*J. longipetalum* has leaves 4-6.6 cm wide and petioles 1 cm long) and longer peduncles (those of *J. longipetalum* are 0-31 mm long).

This species is named for "Doc" A.J.G.H. Kostermans, veteran collector of the flora of Indonesia who made extensive collections in Kalimantan, from where he first collected this species.

Jasminum malayanum *Kiew* **sp. nov.** *a Jasmino adenophyllo (Wall.) DC cymis 3-4-floris, foliis brevioribus nervis 4-jugus differt. Typus: King's Coll. 1736, Peninsular Malaysia, Penang (holotypus SING; isotypus CAL).*

J. adenophyllum auct.: King, J. As. Soc. Beng. Extra No. 74(1905) 261; Ridley, Fl. Mal. Pen. 2(1923) 314; Henderson, J. Mal. Br. Roy. As. Soc. 17(1939) 55; Chin, Gard. Bull., Singapore 32(1979) 194 - *non* Wallich, List No. 2876 in DC, Prod. 8(1844) 314; C.B. Cl. in Hook. f., Fl. Brit. India 3(1882) 597.

Slender climber, stem terete, brown. Whole plant glabrous. Leaves unifoliolate, lamina narrowly elliptic, 7.5-8.5 cm long, 2.5-3.75 cm wide, apex obtuse to acuminate, base cuneate, chartaceous, domatia present (at least in axils of lower veins); veins 3-4 pairs, pinnate, in the dried state slightly prominent beneath. Petiole 0.5-0.75 cm. Inflorescence a simple axillary cyme with 3-4 flowers, peduncle 0.75-1.5 cm. Pedicels 30 mm. Calyx tube urceolate, 2 mm long; lobes 5, 12-13 mm long, subulate, glabrous. Corolla white, fragrant; corolla tube 15-18 mm long, 1.5-2 mm wide; corolla lobes 8, as long as or longer than tube, 17-22 mm long, 2-3 mm wide, ligulate, apex apiculate. Anther oblong, mucronate, 3 mm long, connective broad. Ovary cylindric, style slender, stigma clavate. Mature fruit not known.

DISTRIBUTION. Endemic to NE Peninsular Malaysia.

HABITAT. Its habitat in Penang is not recorded. At Gunung Keriang, it was collected from the base of a limestone cliff.

SPECIMENS EXAMINED - PENINSULAR MALAYSIA: Kedah, Gunung Keriang, *Kiah* SFN 35424 (L, SING); Penang, *King's Coll.* 1736 (holotype SING, isotype CAL).

Jasminum malayanum resembles *J. adenophyllum* (Wall.) DC from the Khasia Mts., India, in being a small, wiry, glabrous climber and in having chartaceous leaves with a short petiole and pinnate venation, and flowers with long pedicels and long calyx teeth. It is distinguished from this species by its smaller leaves with fewer pairs of veins and its cymes which have 3-4 flowers. *J. adenophyllum* has leaves 13 cm long with 8 pairs of veins and single-flowered cymes. Because King's *J. adenophyllum* was based on a misidentification, this species requires a new name and is here called *J. malayanum.*

This is an extremely rare species known from just two collections. Both localities are now very disturbed by man's activities. The fact that it has not been recollected for more than fifty years suggests that it is endangered, if not already extinct.

Henderson (1939) reported that this species was cultivated in the Penang Botanic Garden and suggested that it had been introduced by Kunstler (King's Collector), who first collected it in 1881. Unfortunately, by the 1970s this species was no longer in cultivation in the Penang Botanic Garden.

Jasminum multinervosum *Kiew* **sp. nov.** *a Jasmino melastomifolium Ridl. foliorum venatione pinnatae et nervis lateralibus numerosis distincta. Typus: Paul Chai S. 33917, Sarawak, 2nd Division, Lanjak-Entimau (holotypus SAR; isotypi K, KEP, L).*

Thin-stemmed climber *c.* 3.5 m tall. Stem 4-angled, glabrous. Leaves unifoliolate, narrowly elliptic, 16-20 cm long, 3.5-4.5 cm wide, apex obtuse to acuminate, base cuneate, chartaceous, glabrous, drying pale grey-green and minutely punctate above and beneath, domatia absent, margin not recurved; venation pinnate, veins 12-14 pairs, plane above, prominent beneath. Petiole 1.2 cm long, articulation obscure. Inflorescence a simple cyme with a basal pair of opposite flowers, axillary, 5-flowered, 0.75-2 cm long, peduncle 0.5-1 cm long, glabrous. Bracts ligulate, persistent, 2 mm long, glabrous. Pedicel 20 mm long. Calyx cup-shaped, 2 mm long, 2-3 mm wide; lobes 4-5, filiform, 5 mm long, glabrous, minutely punctate outside. Corolla white, tube slender, 13-15 mm long, 2-2.5 mm wide; lobes 5, shorter than tube, 9-10 mm long, 3-4 mm wide, narrowly elliptic, apex apiculate. Anther yellow, linear, 4.5 mm long, apical appendage short; filament *c.* 1 mm long. Ovary globose, 1.5 x 1.5 mm; style in long-styled flowers 12 mm long; stigma lanceolate, 1.5 mm long. Fruit not known.

DISTRIBUTION. Endemic to Borneo (Sarawak).

HABITAT. In primary forest (on slopes) at 930 m altitude.

SPECIMEN EXAMINED - BORNEO. SARAWAK: 2nd Division, Lubok Antu District, Lanjak-Entimau Permanent Forest, Bukit Peninjau, *Paul Chai* S. 33917 (holotype SAR; isotypes K, KEP, L).

This distinctive species resembles *J. melastomifolium* Ridl. in being a slender climber with a square stem, narrowly elliptic leaves which dry pale grey-green, and in having long calyx lobes. However, it would not be confused with this species, which has triplinerved leaves with only 4 pairs of veins. In its pinnate venation and leaves which pucker slightly on drying, *J. multinervosum* resembles *J. oreophilum* from which it can be told apart by its square stem, longer, many-veined leaves and cupular calyx with longer lobes. In fact, in its high number of lateral veins, it is distinct from all other Bornean jasmines, hence its species epithet. At present, it is known from a single collection.

Jasminum oreophilum *Kiew* **sp. nov.** *a Jasmino sarawakensis King & Gamble paniculae paucifloribus, calycibus late campanulatus dentibus minutis et floribus minoribus differt. Typus: Ilias Paie S. 26324, Sarawak, 5th Division, Lawas, Sungai Belaban (holotypus SAR; isotypi K, L, SING).*

Thin-stemmed climber 3-4 m tall, stem terete, glabrous. Leaves unifoliolate, lamina narrowly elliptic, sometimes broadly elliptic, 7.5-13 cm long, 2-4.5(-5.5) cm wide, apex obtuse to acuminate, base rounded to cuneate, chartaceous to subcoriaceous, minutely punctate and sparsely pubescent with widely scattered uniseriate hairs on both surfaces, without domatia, margin recurved; venation pinnate with 5-6 pairs of lateral veins, midrib impressed above and prominent beneath, veins almost plane above and beneath. Petiole 0.75-1 cm, articulate in lower half. Inflorescence glabrous, axillary from 3 distal nodes, lower axils with 5-flowered panicles consisting of an apical 3-flowered cymule with two subopposite flowers below, sometimes upper axils with 3-flowered cymes, 2-4 cm long, with peduncle 0.5-3.5 cm long. Bracts ligulate, persistent, *c.* 1 mm long. Pedicel 6 mm in uppermost flowers, 15 mm in lower. Calyx tube glabrous, pellucid especially on inner surface, broadly cupulate, 1-2 mm long, 2-2.5 mm wide; lobes 5, minute, *c.* 0.25-0.5 mm long. Corolla white or cream, sweetly fragrant; tube slender, 7-11 mm long and 1.5-2 mm wide at base dilating to 4 mm wide; lobes 5-6, broadly elliptic, 4-8 mm long, 2-3(-4.5) mm wide, apex obtuse and minutely apiculate. Anthers sessile, linear, 4 mm long, apiculum short. Ovary globose, 1.5 x 2 mm; style 6 mm in long-styled flowers; stigma lanceolate, 3 mm long. Fruit (immature) globose, 7 x 6 mm.

DISTRIBUTION. Endemic to Borneo (E. Sarawak, Sabah and E. Kalimantan).

HABITAT. Montane forest, including ridges and hill tops, between 1500 and 1900 m.

SPECIMENS EXAMINED - BORNEO. SARAWAK: 4th Division, Bakelalan to G. Murud, *Burtt & Martin* B5234 (E, SAR); 5th division, Lawas, Sg. Belaban, *Ilias Paie* S. 26324 (holotype SAR; isotypes K, L, SING). **SABAH:** G. Kinabalu, Sg. Mamut, *Chew, Corner*

& Stainton 1263 (L, SAN); Tambunan, Sunsuron, *Asik* SAN 127876 (SAN). **KALIMANTAN:** W. Kutei, *Endert* 4223 (BO).

Within Malesia, the majority of jasmines are lowland species, but in Borneo one species, *J. oreophilum*, is confined to montane forest at or above an altitude of 1500 m. Its flowers are unique among Malesian jasmines in having an expanded, almost saucer-shaped calyx, a conspicuously swollen corolla tube and short corolla lobes which have an apiculate apex. In the sterile state, its dried leaves are distinctive in the fine puckering along the veins on both the upper and lower surfaces, a character shared by *J. multinervosum.*

Among the Bornean jasmines with panicles, it most resembles *J. sarawakensis* King & Gamble in being a thin-stemmed climber with elliptic leaves with pinnate venation. It is distinct, however, in its smaller leaves (they are 13-15 cm long and 6-8 cm wide in *J. sarawakensis*), shorter few-flowered inflorescences (panicles of *J. sarawakensis* are 5-16.5 cm long and have 15-21 flowers), the broadly cupulate calyx with minute teeth (the calyx teeth of *J. sarawakensis* are 3 mm long) and its smaller flowers (the corolla tube and lobes of *J. sarawakensis* are 21-25 mm and 13 mm long, respectively).

From information on herbarium labels, there appears to be some variation in flower colour, which is described as yellow in bud (*Chew et al.* 1263); cream (*Burtt & Martin* B5234) or white (*Ilias* S. 26324) in the open flower.

Jasminum steenisii *Kiew* **sp. nov.** *a Jasmino crassifolio Blume foliis parvioribus, inflorescentia gracilis et floribus parvioribus corollae lobis multo angustoribus differt. Typus: J. Dransfield 6938, Brunei, Temburong (holotypus K; isotypi BRUN, KEP).*

Thin-stemmed climber. Stem terete, glabrous, drying grey. Leaves unifoliolate, lamina narrowly or broadly ovate, 8-13.5 cm long, 3.5-7.5 cm wide, apex acuminate with acumen to 1.5 cm long or sometimes acute, base rounded, subcoriaceous, dark green, glabrous, without domatia, margin not recurved; veins 5-6 pairs, strongly ascending, lower pair longitudinal and 4-10 mm from margin for more than half the lamina length, prominent beneath, in dried state veins scarcely prominent but distinctly puckered above. Petiole 1-2.5 cm long, articulate towards base. Inflorescences axillary on main branches, with 1-5 inflorescences per axil, 4-10 cm long, glabrous, lower axils with simple cymes (sometimes reduced to a single flower), distal axils with panicles with 4-15 flowers, peduncle slender, 2-6 cm long, the branches 4-9 cm long and spreading at 45°. Bracts linear, persistent, 1 mm long, glabrous. Pedicel slender, 8-22 mm long, widely spreading. Calyx tube cupulate, slightly ribbed, 1-2 mm long, 2-3 mm wide; lobes dentate, 0.3-1 mm long, glabrous. Corolla white with green eye, fragrant, tube slender, 9 mm long, 1.5 mm wide, dilating distally to 3.5 mm wide; lobes 5, shorter than tube, 4-6 mm long, 3-4 mm wide, broadly elliptic, apex apiculate. Anthers narrowly lanceolate, 3 mm long, apex apiculate, filament *c.* 0.5 mm long. Ovary ellipsoid, 1.2 x 1 mm, style in short-styled flowers 2 mm long, stigma lanceolate, 2 mm long, minutely bilobed at apex. Fruit ellipsoid, 11 x 8 mm.

DISTRIBUTION. Borneo, endemic to Brunei.

HABITAT. Lowland mixed dipterocarp forest on steep slopes or valley bottoms or in lower montane forest at 1470 m altitude.

SPECIMENS EXAMINED - BORNEO. BRUNEI: Temburong, Sungai Temburong, *J. Dransfield* 6680 (BRUN, K), Bukit Pagon, *Wong* WKM 1788 (BRUN, K), Selapon, *J. Dransfield* 6938 (holotype K; isotypes BRUN, KEP), Bukit Belitan *J. Dransfield* 6940 (BRUN, K).

This species is named in honour of C.G.G.J. van Steenis (1901-1986), architect of the Flora Malesiana project, who encouraged me to revise the Oleaceae for the Malesian region.

The particularly slender inflorescences with long spreading branches are unique among Malesian jasmines. The leaves of *J. steenisii* are similar to those of *J. crassifolium* Blume in being ovate, in having the basal pair of veins ascending halfway up the lamina and in drying pale green-fawn. *J. crassifolium* is, however, a robust climber with stout inflorescences, larger leaves (9-17 cm long and 4-13 cm wide), larger flowers (corolla tube 11-25 mm long) with broad corolla lobes (10-20 mm long and 6-10 mm wide) with a rounded apex. *J. oreophilum* has equally small flowers with short corolla lobes, but it would not be confused with *J. steenisii* because of its pinnate venation and stouter inflorescences.

Recent intensive collecting for "The Checklist of the Plants of Brunei" project has netted four collections of this new species, all from Temburong. The fact that it has not been collected elsewhere in Borneo suggests that it has a very local distribution.

ACKNOWLEDGEMENTS

Financial support from the Royal Society is gratefully acknowledged. I thank the Universiti Pertanian Malaysia for granting me permission to take sabbatical leave, to the curator of The Herbarium, Department of Plant Sciences, University of Cambridge for accommodating me during my sabbatical leave and to the curators of A, BM, BO, CAL, CGE, E, K, KEP, L, MICH, PNH, SAN, SAR and SING for permission to examine specimens in their care.

SANDAKANIA 4 (1994): 83-86

Pneumatophore root clusters as nuclei of woody plant establishment in a Bornean freshwater swamp forest

K.M. Wong

Forest Research Centre, Sepilok
P.O. Box 1407, 90008 Sandakan
Sabah, Malaysia

Summary. Pneumatophore root clusters, common in some freshwater swamp forest sites in the Mulu National Park in Sarawak, in west Borneo, are the major foci for the development of litter mounds that form the nuclei of woody plant establishment. These microsites may be favourable for woody plant establishment because they are better aerated than the intervening, usually waterlogged parts.

Pneumatophore or "breathing" roots are commonly formed by a number of tree species in both freshwater and peat swamp forests in Southeast Asia. Species in Borneo which form peg-like or loop-like ("knee") pneumatophore roots include *Alstonia pneumatophora* Backer ex Berger (local name *pelai paya*, Apocynaceae), *Dyera polyphylla* (Miq.) Ashton (*jelutong paya*, Apocynaceae), *Lophopetalum multinervium* Ridl. (*perupok paya* or *dual*, Celastraceae), *Madhuca motleyana* (de Vr.) Baehni (*ketiau paya*, Sapotaceae), and *Polyalthia glauca* (Hassk.) Boerl. (*selukai*, Annonaceae). These pneumatophore roots have large air spaces in their tissues and supposedly function to increase oxygen intake for the root system, which otherwise has to function in a comparatively oxygen-poor environment in waterlogged or frequently inundated substrates in swamp forests.

In lowlying stretches of some freshwater swamp forests in northern and western Borneo, such pneumatophore roots can develop along lateral roots growing some distance away from the trees that bear them, and often clusters of peg-like or loop-like pneumatophore roots are common. Around such clusters of pneumatophore roots, as around fallen branches or logs in the forest, litter mounds frequently build up, and appear to be associated with concentrations of woody plant seedlings and saplings (Fig. 1). This paper reports the relative frequency of such root-cluster litter mounds encountered in a patch of freshwater swamp forest in the Mulu National Park, Sarawak, as estimated along a 2-km

trail from the Park Headquarters complex to the Deer Cave, and the possibility that such mounds are nuclei for the establishment of woody plant seedlings.

Fig. 1. Woody plant regeneration establishing on litter mounds forming around pneumatophore root clusters in a freshwater swamp forest site in the Mulu National Park, Sarawak (photo by W.M. Poon).

Methodology

The excellent plank walk leading to the Deer Cave from the Park Headquarters complex was regarded as a transect where it passed through a patch of freshwater swamp forest, as it was constructed with minimal disturbance to the vegetation. The census was carried out along one side of this plank walk, and strips of wood used to hold down a wire-meshing over the surface of the plank walk, placed at 1-yard intervals, were used as markers for including 100 such sections along the plank walk as units in the census.

For each of the 100 sections of the plank walk transect so demarcated, a visual count was made within an area 2m wide, and from one edge of the plank walk, of
(a) pneumatophore root mounds with and without woody plant regeneration;

(b) other types of mound (such as those forming around logs, fallen branches and tree bases) with and without woody plant regeneration; and
(c) woody plant regeneration (number of seedlings or saplings) not associated with any type of mound (usually in the waterlogged lower lying sites among mounds).

The regeneration censussed included any woody plant developing a stem up to about 5 cm diameter at the base. Herbaceous plants, palms and pandans were excluded from the census; these were abundant and generally appear to be more tolerant of waterlogging. Mounds developing around tree bases exceeding 5 cm diameter were excluded from the census.

Results

The number of pneumatophore mounds per section of the transect (N = 100, range = 0-8, median = 2.0) were found to be significantly higher (Mann-Whitney U-test, p = 0.00) than the number of other mounds (N = 100, range = 0-1, median = 0.0).

There were also significantly less seedlings and saplings (Mann-Whitney U-test, p = 0.00) not associated with any mound (N = 100, range = 0-3, median = 0.0) than those establishing on pneumatophore mounds (N = 100, range = 0-8, median = 1.0), assuming there is only one seedling or sapling per pneumatophore mound.

Analysis with the Kruskal-Wallis test also showed significant differences (p = 0.00) among pneumatophore mounds with seedlings or saplings (N = 100, range = 0-8, median = 1.0), other mounds with seedlings or saplings (N = 100, range = 0-1), median = 0.0), and seedlings or saplings not establishing on any mound (N = 100, range = 0-3, median = 0.0). There was no significant difference between the number of non-pneumatophore mounds with regeneration and the number of seedlings or saplings not associated with any mound.

Implications for swamp forest regeneration

The factors that are crucial to the quality of tree regeneration in a swamp forest include the number of mother trees seeding at different times, the degree of canopy opening (which influences the amount and quality of radiation reaching the forest floor and, thus, also the proliferation of ground shrubs and herbs that may shade out tree regeneration), and the availability of sites that favour the successful establishment of woody plants. Our observations indicate that raised mounds are the nuclei of woody plant establishment in such frequently waterlogged freshwater swamp forests, and that the pneumatophore clusters developing are the major foci for such mound development. Such root cluster mounds may be important to woody plant regeneration in the first place because of a general inability of most woody plant seedlings to establish in waterlogged, oxygen-deficient conditions in swamp forest, so that they are more able to survive in better aerated conditions in mounds.

In north and west Borneo, such as in the Sugut-Paitan, Kuala Labuk and Kuala Kinabatangan swamps of Sabah, some areas with freshwater swamp forest rich in *Lophopetalum multinervium* may be good sources of commercially extractable *perupok paya* timber. Foresters have often observed the difficulty with which such logged swamp forests, from where there is a tendency to remove a high stocking of mature stems of commercially desirable species such as *perupok*, can recover, if they recover at all. Much of the ensuing changes in floristic composition is due to a drastic alteration of the forest structure, where more open conditions encourage a weedy growth of herbs and pandans that shade out tree regeneration, which is also much reduced by the vastly lower number of immediately reproductive trees remaining. It also appears, from the present study, that when a large crop of such pneumatophore-forming trees are removed or killed in a swamp forest, the proportion of raised mounds present as nuclei of woody plant establishment will be reduced, as the root clusters, which form the bases for such litter mounds, die and decay.

The destruction of the tree canopy in such a swamp forest not only alters the environmental regime within the stand, but also destroys the living framework of pneumatophore root-clusters and the canopy, which are the major elements of a system that ensures the natural regeneration of the forest itself.

ACKNOWLEDGEMENTS

These observations were made during a walk through the freshwater swamp forest on a visit to the Deer Cave in the Mulu National Park, Sarawak, as a Sabah Society outing organised by C.L. Chan in March, 1994. I wish to thank C.L. Chan, Arthur Y.C. Chung, Robert C. Ong, and Steve Sutton for helpful comments, and W.M. Poon for taking the photograph used in Fig. 1.; Arthur Chung also helped with the analysis of the data used here.

SANDAKANIA 4 (1994): 87-91

A note on root sucker production in the conifer, *Dacrydium xanthandrum* (*Podocarpaceae*) on Mount Kinabalu, Sabah

K.M. Wong

Forest Research Centre, Sepilok
P.O. Box 1407, 90008 Sandakan
Sabah, Malaysia

Summary. Root suckers of the conifer, *Dacrydium xanthandrum* Pilger were observed on Mt Kinabalu, Sabah, in northern Borneo. They may be important in the clonal propagation of individuals where lateral roots extend in the exploration of new substrate and sites suitable for the establishment of new plants are occupied by such root suckers.

Root suckers have been documented for a small number of tropical and temperate plants, although their significance in tropical forests have been little discussed. For example, they are known to be produced by *Fagus grandifolia* Ehrh. (the American beech, Fagaceae) (Horn 1975), *Cinnamomum camphora* (L.) J. Presl (the camphor of China and Japan, Lauraceae) (Barlow, Enoch & Russell 1991), *Millingtonia hortensis* L. (the Indian Cork Tree, Bignoniaceae) (Backer & Bakhuizen 1965, van Steenis 1977, Corner 1988), *Artocarpus incisa* Thunb. (the breadfruit tree of the Indo-Pacific islands, Moraceae), *Cecropia* spp. (pioneer and secondary forest trees of the neotropics, Cecropiaceae), *Eucalyptus globulus* Labill. (the Australian blue gum tree, Myrtaceae), *Musanga cecropioides* R. Br. (the tropical African umbrella tree, Cecropiaceae), *Populus* spp. (the poplars, Salicaceae), *Psidium guineense* Sw. (the guisaro of tropical America, Myrtaceae), *Sequoia sempervirens* (D. Don) Endl. (Californian redwood, Taxodiaceae) (Halle, Oldeman & Tomlinson 1978), *Euclinia longiflora* Salisb. (the African Angel's Trumpets, Rubiaceae), *Ixora coccinea* L. (India to Indo-China and south China, Rubiaceae), *I. finlaysoniana* Don (Thailand, Rubiaceae) (Wong 1989), and *Vitex pinnata* L. (the Malayan *leban*, a common pioneer and secondary forest tree, Verbenaceae) (Wong, unpublished observation).

Up to now, root-sucker production appears to be known only for temperate forests or pioneer, secondary forest or forest-fringe species in the tropics; examples of root suckering in species of primary, undisturbed high tropical forests are lacking; either this is a relatively rare phenomenon or one difficult to observe in high tropical forests. van

Steenis (1956) has noted that root suckers are more frequently encountered among what he called "biological nomads", or sun-loving plants with characteristically short life spans. Wong (1989) observed that whereas root suckers are known in some seasonal-climate species of Rubiaceae, they are not known to be produced by the rain forest species of this large family.

Halle, Oldeman & Tomlinson (1978) point out that the root suckers of several species they have studied reiterate, or reproduce, the growth architectural model of the plant completely, in effect producing potential new plants that are clones of the parent. They distinguish two processes, that of "neo-formation" of meristems in the formation of root suckers, and the activation of latent meristems in the development of stem-base suckers. Kormanik & Brown (1967) suggested that the ability to produce root suckers is determined genetically. van Steenis (1977) concludes that *Millingtonia hortensis* is successful in dry monsoonal areas because it is fire-resistant by its thick corky bark and profuse root sucker production, and Halle *et al.* (1978) consider root suckering one of the most efficient ways for a plant to achieve self-replacement. Horn (1975) found that root suckering was ecologically significant in the case of *Fagus grandifolia*, and that it was not merely an efficient repair mechanism, but also a means of vegetative spread into new territory.

Fig. 1. Root suckers produced along superficial lateral roots of *Dacrydium xanthandrum*.

Root suckers of *Dacrydium xanthandrum*

Root suckers have been observed for a number of trees of the conifer, *Dacrydium xanthandrum* Pilger, in the montane forest at 1800 m elevation on Marai Parai, a spur on the west side of Mt Kinabalu in Sabah, northern Borneo (Fig. 1), where this species was common and grew in dense peaty forest together with species like *Falcatifolium falciforme* (Parl) de Laub., *Leptospermum recurvum* Hk. f. and *Scaevola micrantha* Presl. Root suckers were observed only in trees at the fringe of the forest, where the vegetation was sparse and the substrate much less peaty and even rocky. It was difficult to ascertain if any of the sapling-like individuals within the peaty forest were root suckers or have originated as such, because there the vegetation and root mass on the forest floor were very dense, making excavation difficult. It is also not known if root sucker development by these trees was inhibited by peaty or other conditions within the forest, as apparently they were common only at the forest fringe.

Fig. 2 shows the extent of root sucker production for a selected forest-fringe tree of *D. xanthandrum* which has a stem basal diameter of 34.4 cm. The root suckers farthest from the stem of this tree were about 6 m away, and a number of suckers had developed sizeable stems of their own, the largest measuring 19 cm diameter at the base.

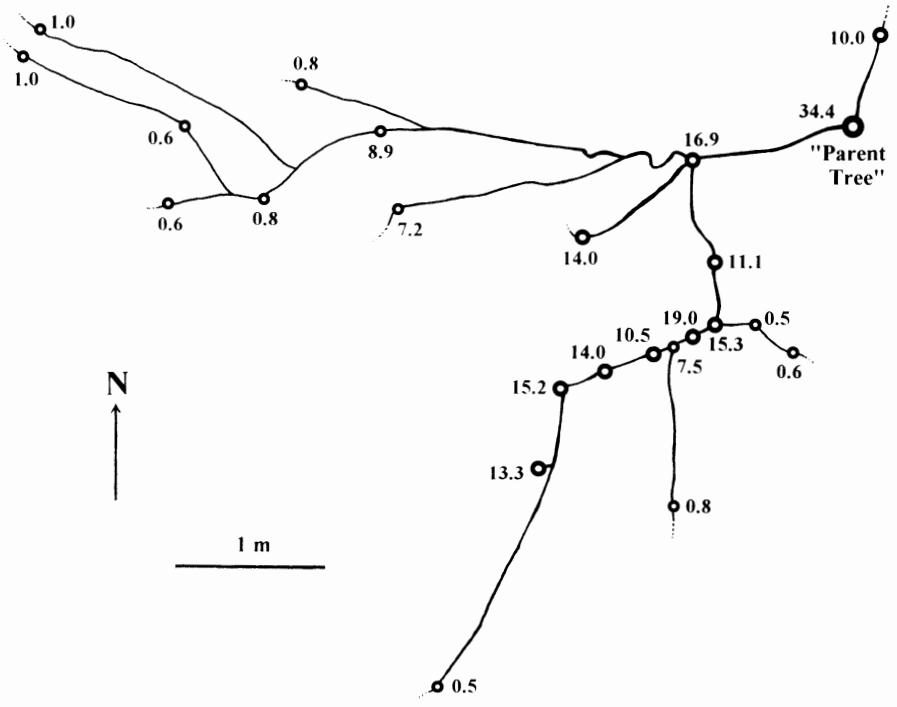


Fig. 2. The distribution of root suckers produced by an individual tree of *Dacrydium xanthandrum* on the Marai Parai spur on Mt Kinabalu.
Numbers are basal stem diameters in centimetres. The dense peaty forest is to the east, and the sparsely wooded, sedge-dominated, rocky open area begins westward.

For the forest-fringe trees observed having root suckers, the greatest extent of development of superficial lateral roots and root suckers was in a direction away from the peaty, dense forest and towards the sparsely wooded, open area dominated by *Machaerina* and *Scleria* sedges. This may indicate that lateral root extension into sites with sparse tree cover and root sucker production in *D. xanthandrum* may serve for the exploration of new substrate by the clone and as a means of vegetative reproduction. The root suckers had the same growth architecture as the parent plant and a number had developed their own root masses at their stem bases, so that conceivably fragmentation of the lateral roots connecting suckers to the parent plant may produce physiologically independent clones. It was not possible, however, to determine if physically separate young plants scattered around root-suckering trees had in fact originated as root suckers. The trees observed having such root suckers did not show signs of damage, so that root sucker production in these trees appear not to be the kind of "repair" response discussed by Halle *et al.* (1978). However, it is not known, without conducting wounding experiments, if root sucker formation was correlated to physical damage to the lateral roots that bear them.

ACKNOWLEDGEMENTS

I thank the Sabah Parks Department and Parks Ecologist Jamili Nais, who organised the expedition to Marai Parai on Mt Kinabalu in September 1993, when these observations were made. A. Berhaman, L. Madani, Sulaiman Talip, Baraham Buhari, Donggop Tokilip, Suin Gambukas, and Gambiyo Loloh of the Forest Research Centre, Sepilok, Sandakan, Sabah, assisted in mapping the distribution of root suckers.

REFERENCES

Backer, C.A. & R.C. Bakhuizen van den Brink (1965) Flora of Java, Vol. 2. N.V.P. Noordhoff: Groningen, the Netherlands.

Barlow, H.S., I. Enoch & R.A. Russell (eds.) (1991) H.F. MacMillan's Tropical Planting and Gardening. 6th edition. Malayan Nature Society: Kuala Lumpur.

Corner, E.J.H. (1988) Wayside Trees of Malaya. 2 vols. 3rd edition. Malayan Nature Society: Kuala Lumpur.

Halle, F., R.A.A. Oldeman & P.B. Tomlinson (1978) Tropical Trees and Forests: an Architectural Analysis. Springer Verlag: Berlin.

Horn, H.S. (1975) Forest Succession. Scientific American 232 (5): 90-98.

Kormanik, P.P. & C.L. Brown (1967) Root buds and the development of root suckers in the sweetgum. Forest Science 13: 338-345.

Steenis, C.G.G.J. van (1956) Rejuvenation as a factor for judging the status of vegetation types: Biological nomad theory. UNESCO, Actes Coll. Kandy, pp. 212-218.

Steenis, C.G.G.J. van (1977) Bignoniaceae. Flora Malesiana 1, 8: 114-186.

Wong, K.M. (1989) Book review: Tropical Woody Rubiaceae, by E. Robbrecht. Gardens' Bulletin, Singapore 42: 75-77.