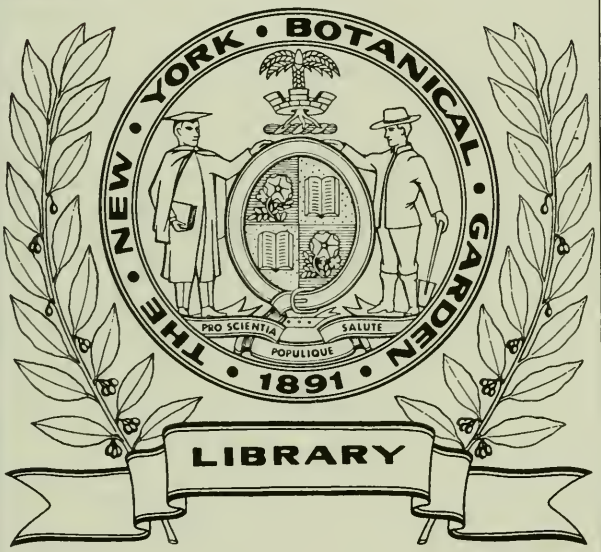
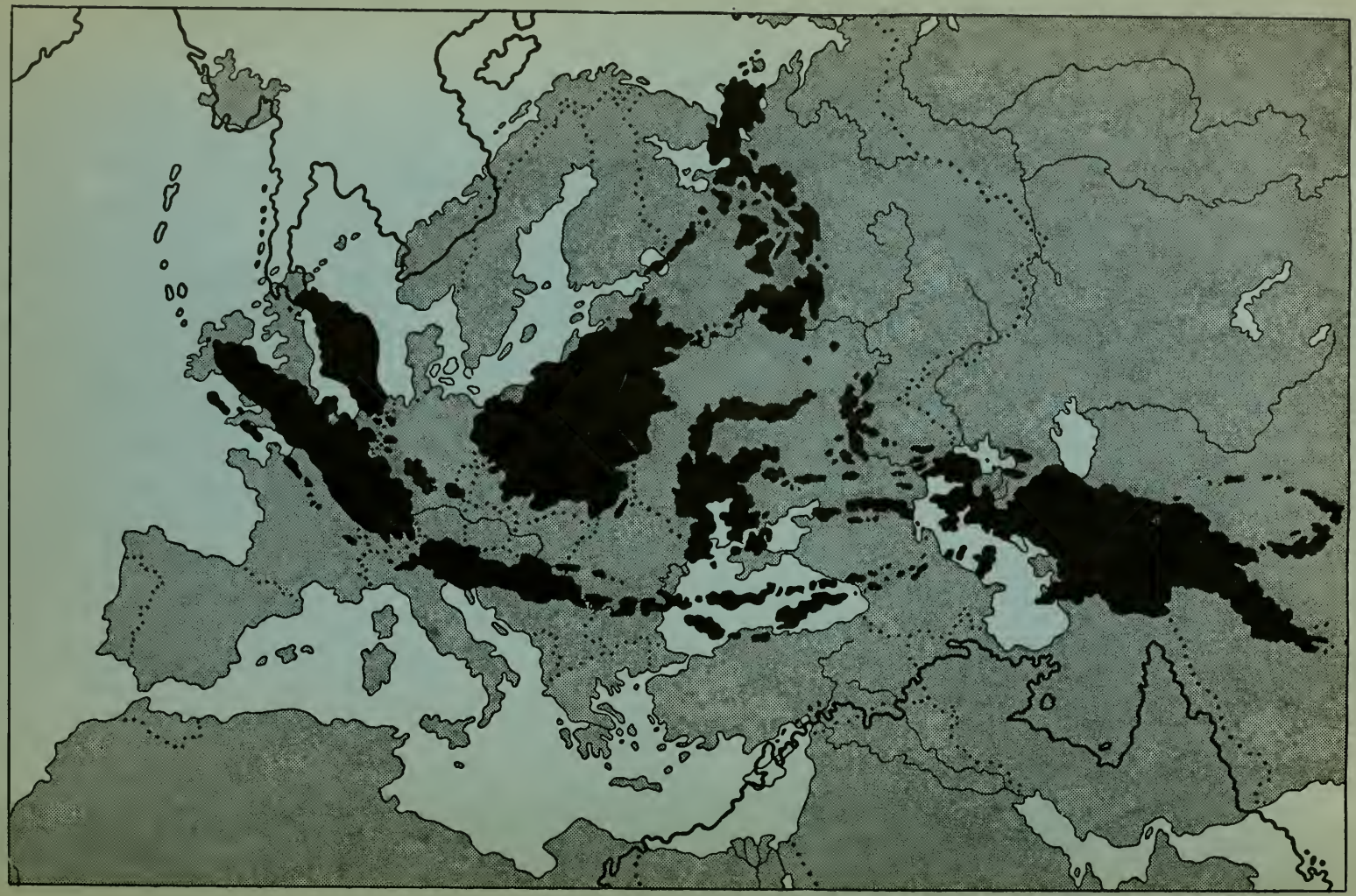
Flora Malesiana



# FLORA MALESIANA



'S LANDS PLANTENTUIN / BOTANIC GARDENS
BUITENZORG / JAVA / INDONESIA

# FLORA MALESIANA

*BEING*

*AN ILLUSTRATED SYSTEMATIC ACCOUNT OF THE MALAYSIAN FLORA, INCLUDING KEYS FOR DETERMINATION, DIAGNOSTIC DESCRIPTIONS, REFERENCES TO THE LITERATURE, SYNONYMY, AND DISTRIBUTION, AND NOTES ON THE ECOLOGY OF ITS WILD AND COMMONLY CULTIVATED PLANTS*

PUBLISHED
UNDER THE AUSPICES OF THE BOTANIC GARDENS, BUITENZORG, AND THE AUTHORITY OF THE CENTRAL GOVERNMENT OF INDONESIA, DEPARTMENT OF AGRICULTURE & FISHERIES

PREPARED
ON AN INTERNATIONAL CO-OPERATIVE BASIS UNDER THE SUPERVISION OF SEVERAL DIRECTORS OF BOTANIC GARDENS, KEEPERS OF HERBARIA AND VARIOUS PROMINENT BOTANISTS

FOR THE PROMOTION OF
BOTANICAL SCIENCE AND THE CULTURAL ADVANCEMENT OF THE PEOPLES OF SOUTH-EASTERN ASIA TO THE SOUTHWEST PACIFIC REGION

SERIES I
*SPERMATOPHYTA*


VOLUME 4
*PART 1*

GENERAL EDITOR:
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SENIOR BOTANIST / BOTANIC GARDENS / BUITENZORG

FOR SALE ONLY / NOT FOR EXCHANGE

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1948

# NOTICE

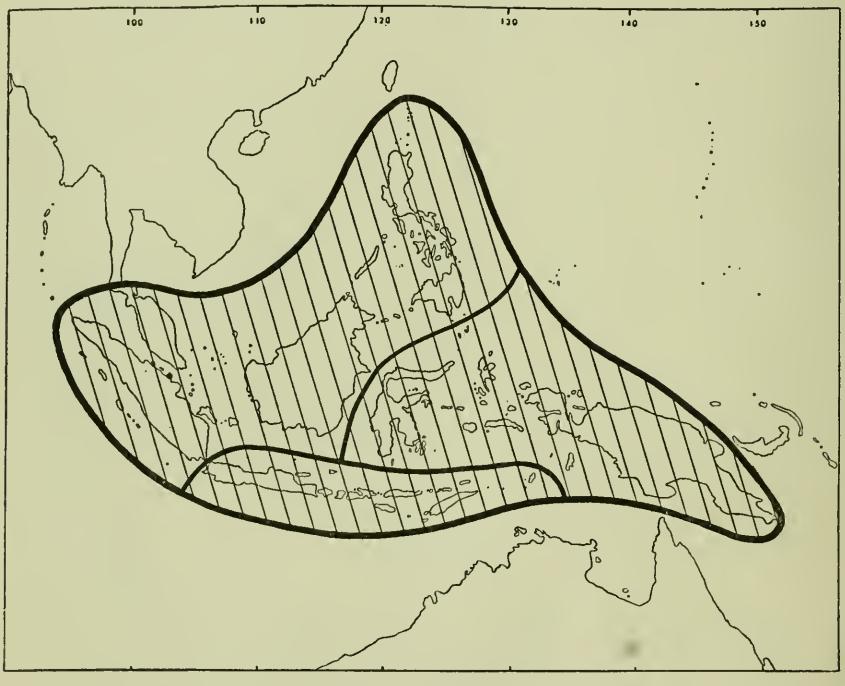


Flora Malesiana is designed to represent a concise flora of the Malaysian region.

The present part is the first published. It contains the 1st instalment of vol. 4 of series I.

The following independent series are planned:

| | | |
|---|---|---|
| Series I. | Spermatophyta (*flowering plants*) . . . . . | *ca* 15 volumes |
| Series II. | Pteridophyta (*ferns and fern allies*) . . . . . | *ca* 3 volumes |
| Series III. | Bryophyta (*mosses and hepatics*) . . . . . | *ca* 5 volumes |
| Series IV. | Fungi & Lichenes (*fungi and lichens*) . . . . . | *ca* 3 volumes |
| Series V. | Algae (*algae*) . . . . . | *ca* 3 volumes |




At the present moment preparations have been made necessary for the start of series I only. As soon as possible the other series will be commenced and directed by special general editors.—The area covered by Flora Malesiana is indicated on the accompanying map by the hatched area.

## PLAN FOR THE PUBLICATION OF SERIES I SPERMATOPHYTA

Volume 1. **Cyclopaedia of Malaysian botanical collectors and collections,** by Mrs M. J. VAN STEENIS-KRUSEMAN.

This is a cyclopaedia of Malaysian collections of Phanerogams and Pteridophytes. It contains over 3000 names of collectors, with short biographies, carefully excerpted itineraries, and literature pertaining to the collections.

Indispensable when localizing herbarium sheets of Malaysian plants and interpreting the scant notes on the labels of older collections. Contains also chapters on methods of collecting in the tropics, hints for travellers, notes on erroneously localized Malaysian collections, &c. — Ready for the press, probably available by the end of 1949. Appr. 600 printed pages. *Sample treatment at the end of this copy.*

Volume 2. **Malaysian plant life,** by Dr C. G. G. J. VAN STEENIS.

This is a second edition, much enlarged, of 'Maleische Vegetatieschetsen' (1935) by the same author. It deals with all vegetation types known in Malaysia, as far as described in literature and reports, or known to the author by personally acquired field knowledge, their status and interpretation, their relations, origin, distribution within Malaysia, and importance to mankind. Biological phenomena, both explained or yet unexplained will be briefly touched on. This book will be copiously illustrated. The MS. can be expected to be finished in 1950. Appr. 500 printed pages. *Sample treatment at the end of this copy.*

Volume 3. **Malaysian plant geography,** by Dr C. G. G. J. VAN STEENIS.

This volume consists of two parts. Part one deals with floristic plant geography and contains tables showing the distribution of the *ca* 2200 recognized indigenous genera of Malaysian phanerogams, compiled from literature and from the Herbarium. Further there are chapters on the history of phytogeographical theories and discussions, a provisional list of the genera with their synonymy, an attempt to divide the Archipelago into phytogeographical districts based on the hitherto known facts of generic distribution, and a discussion of the phytogeographical character of the islands or island groups separately. The MS. is far advanced but not yet ready for the press. *Sample treatment at the end of this copy.*

Part two will deal with the historical plant geography of the Malaysian region. This is only in the initial stage.

Volume 4. **Flora Malesiana proper.** Onwards of vol. 4 the revisions of the families will be printed in the sequence in which they are finished, irrespective of the alliance of the groups concerned. Vol. 4 will be opened by an introductory essay containing chapters on the importance of variability in Malaysian plants, special aberrations with which the Malaysian botanist is confronted in the field and with which he must be acquainted to judge their importance in the often scanty specimens available in the herbaria. A chapter is added on the history of Malaysian phytography. An annotated list of existing revisions concludes the introduction.

## PROPOSED CONTENTS OF VOLUME 4

1. Preface.
2. Introduction.
3. General considerations.
4. History of descriptive Malaysian botany (by Dr H. C. D. DE WIT).
5. General plan of revisions and hints to collaborators.
6. Keys for identifying Malaysian plants.
7. Annotated list of former revisions.
8. Photographs of principal botanical contributors to Malaysian botany.
9. Systematic revisions of families of Phanerogams, incl. Bignoniaceae, Podostemonaceae, Droseraceae, Umbelliferae, Convolvulaceae, Dioscoreaceae, Plumbaginaceae, *etc. etc.*

# MANAGEMENT OF FLORA MALESIANA

Flora Malesiana will *not* be available for purposes of exchange; it is for sale only.
*Co-operating and collaborating institutions* can obtain this flora at a reduced price.
*For subscribers to a complete series* the price will be reduced.
*For substantial collaborators* a special reduction will be fixed individually.
*General volumes* 1—3 *will also be sold separately* to a limited extent.

## APPLICATIONS TO BE DIRECTED TO

N.V. Erven P. Noordhoff,
P.O. Box 39,
Groningen, Holland.

N.V. Noordhoff-Kolff,
P.O. Box 103,
Batavia-C., Java.

and in the Americas to:

The Chronica Botanica Co.,
Book Department
Waltham, 54, Massachusetts, U.S.A.

## SCIENTIFIC COMMUNICATIONS

concerning Flora Malesiana should be addressed to Dr C. G. G. J. van Steenis, c/o Rijksherbarium, Nonnensteeg 1, Leiden, Holland.

## INDEX



PRINTED IN THE NETHERLANDS BY JOH. ENSCHEDÉ EN ZONEN / HAARLEM


F. HOLLEMAN.

MEMORIAE

EORUM QUI SE FLORAE MALESIANAE PERSCRUTANDAE DEDERUNT

ET NOBIS DUCES ET EXEMPLA FUERUNT

GRATO ANIMO

HOC OPUS DEDICANT

AUCTORES

# PREFACE

There are only a few things left in common to the displaced and disjointed inhabitants of this Earth; they are the things spiritual.

Among those treasures of the mind natural science has come to the fore only in the last three centuries, as a lofty and impartial principle that tends to join people instead of disrupting them. Through war, famine and pestilence the undying fire of science has remained a steady beacon.

At the inception of a great work, which shall be the demonstration of the united effort of many workers, it seems meet to remember the function of Science, apart from its benificial or detrimental applications. In these days the adjectives 'pure' and 'applied' have lost much of their meaning, and the Masters amongst us were the least concerned with this classification. Nevertheless, as long as sentiment, politics, greed and bigotry rule this world, a purely scientific endeavour may become a binding force between individual groups, and maybe, even between nations. At the beginning of this great project we therefore see already a dark shadow cast by this unfortunate era, but rather than to dwell on darker thought let us invoke the light that is cast by those that lived and worked in these regions before us, and let us consider this work as an apotheosis of the ideals formulated by Melchior Treub who, half a century ago, became the initiator of co-ordinated scientific effort in the tropics.

His ideals are still ours.

To the General Editor, Dr C. G. G. J. van Steenis, we all want to express our gratitude for his initiative, for his boundless energy and, especially, for his faith in this project.

To discuss the project of the Flora Malesiana from the technical side would be simply borrowing materials from the scientific collaborators.

Rather than to plagiarize it seems fit to leave these matters to the specialist. But as Director of the Scientific Institutes, called "s-Lands Plantentuin' I may express the satisfaction that our Government, almost a century after the foundation of our Herbarium, after 130 years of effort of these institutes, after the publication of innumerable, chiefly disjointed contributions, has decided to further a unified effort. Amongst the many accusations that our workers have suffered in the last years, some at least have some foundation. We have plowed too deep, we were too few, we did not seek enough contact. But the greatest blight of tropical science has been the lack of continuity. Now we may plow deep, but with many to help. Now we may proceed together and, let us hope, with continuity guaranteed.

The great 'Horn of Plenty', the cornucopia of our Malaysian Flora, which was opened by van Rheede and by Rumphius shall still flow for a long time. I wish great joy to those that shall have the privilege to examine its contents.

(L. G. M. BAAS BECKING)

Director of 's-Lands Plantentuin

1. *Systematice* plantas suas disponit verus Botanicus;
   Nec absque ordine easdem enumerat.
2. *Fructificationis* principium in theoretica dispositione agnoscit;
   Nec dispositionem secundum Herbam immutat.
3. *Genera* naturalia assumit;
   Nec Erronea ob speciei notam aberrantem conficit.
4. *Species* distinctas tradit;
   Nec e Varietatibus falsas fingit.
5. *Varietates* ad species reducit;
   Nec eas, pari passu, cum speciebus obambulare sinit.
6. *Synonyma* praestantissima indagat et seligit;
   Nec acquiescit in quacunque obvia nomenclatura.
7. *Differentias* characteristicas inquirit;
   Nec inania nomina specifica praeponit veris.
8. *Plantas* vagas ad Genera amandare studet;
   Nec rariores obvias fugitivis oculis adspicit.
9. *Descriptiones* complectentes differentias essentiales, compendiose sistit;
   Nec naturalissimam structuram oratorio sermone ebuccinat.
10. *Minimas* partes attente scrutatur;
    Nec ea, quae maxime illustrant, flocci facit.
11. *Observationibus* ubique plantas illustrat;
    Nec in vago nomine acquiescit.
12. *Oculis* propriis quae singularia sunt observat;
    Nec sua solum, ex Auctoribus, compilat.

LINNAEUS, *Philosophia botanica*

# INTRODUCTION

After the appearance of RUMPHIUS's *Herbarium Amboinense*, the result of lifelong research into the botanical treasures of the Malaysian Archipelago, the first comprehensive work on the flora of these islands was begun by C. L. BLUME, the second Director of the Botanic Gardens at Buitenzorg. His *Bijdragen tot de Flora van Nederlandsch Indië* (Contributions to the Flora of the Netherlands Indies) consisted of numerous brief botanical diagnoses mostly, however, of Javan species. Shortly after followed his *Flora Javae* and later *Rumphia*. None of these books represent a 'flora'; neither completeness was aimed at nor keys were given.

The first design for a flora of the whole of Malaysia seems to have been drafted by the Swiss botanists H. ZOLLINGER and his teacher, A. MORITZI.[1] I have not succeeded in tracing any further results of their plans.

Since the publication[2] of the *Flora van Nederlandsch Indië* or *Flora Indiae Batavae* by F. A. W. MIQUEL (5 vols, 1854–'60)—which was no 'flora' in the present meaning of the word, keys being almost absent—no work has been conceived with the object of covering the Malaysian region. MIQUEL's work[3] may be considered as a more or less critical compilation of descriptions, mostly copied or extracted.[4]

MIQUEL must have realized that by his Flora the proper work was only started. This may be concluded from the series of revisions which MIQUEL, together with some specialists, published in 4 volumes *Annales musei botanici lugduno batavi* (1863–'69),[5] *Choix des plantes rares ou nouvelles* (1863), to which was added his posthumous *Illustrations de la Flore de l'Archipel Indien* (1870–'71) by his successor at Leyden University, W. F. R. SURINGAR.

Unfortunately, MIQUEL had few pupils[6] which caused a serious shortage of well-trained systematists during half a century of botanical endeavour in the East Indies. The only Dutch scientists studying the Malaysian flora were:

P. DE BOER, who wrote his doctor's thesis on the subject *De Coniferis archipelagi indici* (1866), and later became a professor of Pharmacology at Groningen University, and

R. H. C. C. SCHEFFER, an extremely able botanist whose thesis was entitled *De Myrsinaceis archipelagi indici* (1867).

SCHEFFER was subsequently appointed as the (fourth) Director of the Botanic Gardens, Buitenzorg, and ardently promoted the study of the Malaysian Flora, notwithstanding his feeble health. In his term of office he published several important papers, most on *Annonaceae*[7] and *Palmae*.[8]

DE BOER had one pupil in systematic botany, TH. VALETON, who obtained his doctor's degree on a monographic study of the *Olacineae*.[9] He eventually was employed as a bacteriologist in the Sugar Experiment Station in Java but, soon after, joined the staff of the Botanic Gardens, Buitenzorg (1892).

After the appointment of Dr M. TREUB as the fifth Director of the Gardens in 1880, interest in the promotion of knowledge of the Malaysian flora revived, but TREUB was badly handicapped by the absence of trained Dutch systematists. TREUB—a contemporary of HOOKER, EICHLER, BENTHAM, and HARVEY & SONDER, the editors of respectively the *Flora of British India*, the *Flora Brasiliensis*, the *Flora Australiensis*, and the *Flora of tropical Africa*—was well aware that systematic botany in the Netherlands Empire was on the verge of falling behind that in other tropical countries. He judged the advancement of systematics of preeminent importance.

He engaged W. BURCK, a pupil of SURINGAR's at Leyden, later a teacher of botany at Buitenzorg, as a subdirector of the Gardens (1883) and charged him with critical research into *Sapotaceae* (getahpertja family),[10] *Mucuna*,[11] the *Erythroxylaceae* (cocafamily),[12] and *Dipterocarpaceae*,[13] mostly families of economic importance.

TREUB, who tried continuously to raise a worldwide interest in the Gardens and its botanical institutes, considered the compilation of a new Malaysian Flora to be premature. Collections were inadequate and of the vegetation of the surrounding regions little was known.

He advanced, therefore, the idea of composing a local flora of the surroundings of Buitenzorg, covering the region from the mangrove of Tandjong Priok to the summit of Mt Gedeh at 3000 m. All altitudinal zones would thus be represented.

This *Flore de Buitenzorg* would serve as a guide to botanically interested visitors of the Gardens and be equally acceptable to residents of Java. Dr J. G. BOERLAGE, then conservator of Leyden Herbarium, during a visit to Buitenzorg as a stipendiate of the Dutch Buitenzorg Fund, had already made collections for the new flora (1889) and published an article on the grasses.[14]

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(1) ZOLLINGER, Observationes phytographicae *etc.* Natuur- & Geneesk. Arch. 1 (1845) 375; *cf.* also J. K. HASSKARL, Flora 30 (1847) 299.

(2) Made possible by a grant of the Ministry for the Colonies.

(3) Dates of publication of the several parts in Bull. Jard. Bot. Btzg III, 13 (1934) 284.

(4) Compare ZOLLINGER, Natuurk. Tijdschr. Ned. Ind. 13 (1857) 292–322; *id.* (in German), Vierteljahrschr. Naturf. Ges. Zürich 2 (1857) 318–349.

(5) Dates of publication of the several parts *cf.* NAKAI, Journ. Arn. Arbor. 6 (1925) 211–213.

(6) *Cf.* the article in honour of Dr A. A. PULLE, who resumed MIQUEL's work at Utrecht University, Bull. Jard. Bot. Btzg III, 16 (1939) 103–105.

(7) Ann. Jard. Bot. Btzg 2 (1885) 1–31.

(8) *Ibid.* vol. 1 (1876) 103–164; O. BECCARI, Reliq. SCHEFF. *ibid.* 2 (1885) 77–171.

(9) Critisch overzicht der *Olacineae* (1886).

(10) Ann. Jard. Bot. Btzg 5 (1886) 1–85.

(11) *Ibid.* 11 (1893) 183–190.

(12) *Ibid.* 11 (1893) 190–194.

(13) *Ibid.* 6 (1887) 145–249.

(14) Ann. Jard. Bot. Btzg 8 (1890) 47–78.

TREUB, however, found it difficult to rally workers to this local flora and so most of it was assigned to foreign visitors who sometimes were temporarily employed at the Gardens. Six volumes appeared *viz* the *Myxomycetes* by O. PENZIG (1898), *Ferns* and *Fern Allies* by M. RACIBORSKI (1898), *Hepatics* by V. SCHIFFNER (1900), *Algae* by E. DE WILDEMAN (1900), and *Mosses* by M. FLEISCHER (1900–'22, 4 vols). The 6th and only volume on Phanerogams was written by J. J. SMITH (*Orchidaceae* 1905, atlas 1908–'14).

None of the volumes of the *Flore de Buitenzorg* bears the character of a local flora; the majority deal with the whole of Java. FLEISCHER's *Musci* even expanded to a standard work on the world's mosses.

Of the flowering plants apart from the *Orchidaceae*, much material was collected by BURCK and H. HALLIER who planned to elaborate a 7th volume of the *Flore de Buitenzorg*. A list of the species to be included is kept at Buitenzorg, but nothing ever appeared in print.

During this period important revisions of families were published abroad by O. BECCARI in his 3-volume *Malesia*. Several monographs appeared in the 4[0] tomes of the *Annals of the Royal Botanic Gardens, Calcutta*, on the genus *Ficus*, the *oaks* and *chestnuts*, the *bamboos*, *etc.*

Local floras of other parts of Malaysia were the 3rd edition of BLANCO's *Flora de Filipinas* (1877–'83)[1] by NAVES & F.-VILLAR, SCHUMANN & HOLLRUNG's *Flora von Kaiser Wilhelmsland* (1889), and SCHUMANN & LAUTERBACH's *Flora der Deutschen Schutzgebiete in der Südsee* (1901) with the *Nachträge* (1905). These eastern floras resembled enumerations and were mainly indices of materials collected on expeditions.

In 1890 BOERLAGE previously having published two critical studies of Malaysian plants, *viz* the genus *Achyranthes*[2] and the genera of *Araliaceae*,[3] started a work of quite another nature in the compilation *Handleiding tot de kennis der flora van Nederlandsch Indië*.[4] This comprised a description of the families and genera of Malaysian phanerogams. The species were—especially in the last parts—only briefly enumerated. He added to a few families keys to the genera. The generic descriptions were mostly critically copied from BENTHAM & HOOKER's *Genera Plantarum*, and occasionally emended. Phytographically BOERLAGE's *Handleiding* brought hardly anything new, but now a comprehensive review in the Dutch language of families and genera came within reach of interested persons in the colonies. However, as will be demonstrated later, this interest was and is still more directed towards *species* than *genera*.

(1) On the dates of publication see MERRILL, Philip. J. Sc. 12 (1917) Bot. 113–117.

(2) Ned. Kruidk. Archief II, 5 (1889) 420–430.

(3) Ann. Jard. Bot. Btzg 6 (1887) 97.

(4) In total 5 parts appeared, the last posthumously (1890–1903, 3 vols). The publication was made possible by a grant of the Ministry for the Colonies.

BOERLAGE's work was more intended as a prelude to a general flora than as a final work.

He accepted (1896) the post of subdirector of the Botanic Gardens and Head of its first Division (Herbarium and Botanical Museum), as a successor to BURCK and began a monograph of the *Annonaceae*[5]. Unfortunately he soon (1900) fell a victim to a tropical disease while on a tour in the Moluccas attempting to re-collect the plants mentioned by RUMPHIUS in his Herbarium Amboinense.

Another flora was started, at TREUB's instigation, of trees growing in the island of Java. This was to be based mainly on the collections made by Forest officer S. H. KOORDERS who gathered in the field notes on each species (occurrence, value, uses, etc.). Scientific descriptions and keys were by TH. VALETON. This work is *Bijdragen tot de kennis der Boomsoorten van Java* (*Additamenta ad cognitionem Florae Javanicae*, *pars* I, *Arbores*). Thirteen volmes compose this standard work, the 12th volume is by J. J. SMITH, the concluding 13th by SMITH and VALETON. The work was begun in 1894, and finished in 1913. Later illustrations were edited by KOORDERS in his unfinished *Atlas der Baumarten von Java* (4 vols, 1913–'18). The *Bijdragen* is an excellent work with critical descriptions and notes, and still very useful though, of course, now antiquated. The descriptions of the species and genera are both in Dutch and Latin.

During TREUB's directorate many collections, specially of the Outer Provinces,[6] were brought together. HALLIER made an important one in West Borneo, KOORDERS in Java and North Celebes, the SARASINS collected in Celebes, FORBES and KOORDERS in Sumatra, FORBES in Timor, while WARBURG's, SCHLECHTER's, and BECCARI's great collections equalled those of TEYSMANN's and extended over the whole archipelago. These collections were partly inaccessible though together they could have served to a large measure as a reliable basis for a Flora Malesiana.

Lack of trained taxonomists induced TREUB to engage J. J. SMITH, formerly an assistant curator of the Gardens, for taxonomic work. His revisions of Javan *Euphorbiaceae*, *Ulmaceae*, *Urticaceae*, and *Orchidaceae* proved his ability, and SMITH spent his life in describing Malaysian *Orchids*, *Ericaceae*, and *Epacridaceae*. Unfortunately, he did hardly any monographical work.

For the same reasons TREUB selected C. A. BACKER, a teacher in a primary school at Batavia who possessed already a thorough and critical knowledge of the local flora. BACKER intended to fill the still existing *lacunae* in the phanerogamic part of the Flore de Buitenzorg, which resulted in the publication of one volume of a *Flora van Batavia* (1907). This was followed by a preliminary schoolflora[7] and later by the *Schoolflora* (1911).

(5) Icon. Bogor. 1 (1899) 79–208, t. 26–75.

(6) That was: Netherlands Indian territory outside the islands of Java and Madoera.

(7) *Voorlooper eener Schoolflora van Java* (Precursory Schoolflora of Java). Batavia (1908).

The latter excellent work contained only ± 25 % of the Javan flora (*Choripetalae*). He later devoted all his time to the Javan flora, wrote (together with VAN SLOOTEN) a weed flora of tea plantations (1924), 3 instalments of a *Handboek voor de Flora van Java* (1924–'28), a weed flora of sugar plantations (1928–'34; vol. II (atlas) not yet completed), and is now engaged in completing the Flora of Java.[1]

An ill-advised enterprise was a flora of Java by S. H. KOORDERS who, when charged by the N.I. Government to write a flora of the Javan mountains, abandoned this concept and hurriedly compiled an *Exkursionsflora von Java* (Jena, 1911–'12, 3 vols) which did more harm than good and is scarcely of any value to a student of the Javan flora.

The flora of the Malay Peninsula was originally included in the Flora of British India, but as the account remained very incomplete KING & GAMBLE, and RIDLEY, started to work on it, publishing a true model of a critical local flora.[2] This was later followed by RIDLEY's decidedly uncritical *Flora of the Malay Peninsula* (5 vols, 1922–'25).

On the Flora of Borneo a most helpful *Bibliographic enumeration of Bornean plants* was prepared by Dr E. D. MERRILL.[3]

In the Philippines MERRILL, after 1902, energetically undertook the research of the Philippine flora, this first resulting in an excellent local *Flora of Manila* (1912), in a large number of papers dealing with several aspects of the Philippine flora, and crowned by his *Enumeration of Philippine flowering plants* (1923–'26).

The results of frequent expeditions into the Dutch and German territories of New Guinea were published by Dr A. A. PULLE and others in the serial *Nova Guinea* (vols, 8, 12, 14, and 18), and by C. LAUTERBACH and others,[4] and in recent years those of Dutch and British parts by MERRILL and other collaborators.[5]

**The undesirability of compiling, at this stage, local floras in Malaysia.** The studies of the materials of various separate regions persuaded some leading Dutch botanists in the first quarter of our century—for some reasons they doubted the feasibility of a Malaysian flora as a whole—to propose several local floras *e.g.* one of Java, of Borneo, Sumatra, Celebes, *etc.* This caused the appointment of HALLIER at Leyden to write a Flora of Borneo resulting in a small preliminary paper.[6]

It is clear that this was a wrong policy, born from either ignorance of the taxonomic position and the technique of writing revisions, or from the wish for dodging obstacles; the difficulties should be faced directly. Only temporary profit may be gained from making local floras, and both valuable time and money are wasted by the enormous duplication which is unavoidable when the goal of a flora of a plant-geographical unit is to be reached along this tortuous road.

The natural sequence is to start with the large flora, eventually followed later by local floras, a procedure followed in the great floras of South America, tropical Africa, India, and Australia. The unnatural sequence of starting with the local flora has led, both in North America and Europe, to a most regrettable state of affairs.

The absence of a general flora is also one of the causes that the flora of Java which BACKER has studied close on forty years is only now more or less to be completed. It contains several families which cannot be critically treated (*Lauraceae*, *Araceae*, *Zingiberaceae*, *etc.*) lacking revisions of these families in the whole Malaysian region.

**General Flora.** A general flora was and is needed and prospects at the end of the first World War seemed favourable. The Forest Research Institute and the Museum for Economic Botany[7] at Buitenzorg requested much service and urged the Herbarium of the Botanic Gardens to produce speedy results. This induced the Goverment to add to the staff of the Herbarium R. C. BAKHUIZEN VAN DEN BRINK (1917)—he was originally a plantation assistant—Dr D. F. VAN SLOOTEN and Dr H. J. LAM, the first pupils of PULLE at Utrecht (1919). In 1921 Dr H. C. CAMMERLOHER, a German biologist, was appointed, and a professional collector engaged, H. A. B. BÜNNEMEIJER.

At the same time a scheme was made for critical revisions. These were to be published in the Bulletin du Jardin Botanique, Buitenzorg[8] under the heading: *Contributions à l'étude de la Flore des Indes Néerlandaises*. Economically important families had priority. The method of treatment stood below that of KING & GAMBLE's *Materials* in so far that descriptions were only admitted if species were new or critical. This was believed to save time. On the other hand extensive lists of herbarium numbers had to be compiled. If the latter had been left out and instead a concise characteristic of the occurrence of the species given, besides a good diagnostic description of each species, the *Contributions* would have made a most satisfactory foundation. Though the later *Contributions* are far more complete than the earlier, the manner of treatment and publication is so laborious and slow that at this rate the Flora Malesiana will never be completed. Till the present 34 *Contributions* have appeared, comprising 2000 species.

Due to the post-war economic depression of 1921–'22 the Staff of the Buitenzorg Herbarium

(1) Seven parts of a mimeographed emergency edition were issued up till now through the care of the Rijksherbarium, Leiden (1940–'48), 9 vols.

(2) The contributions of the former appeared under the title *Materials towards a Flora of the Malay Peninsula* in various numbers of the Journ. Asiat. Soc. Bengal, vol. 58 onwards (18891–915).

(3) Journ. Str. Br. Roy. Asiat. Soc. Special number (1921).

(4) Under the title *Beiträge zur Flora Papuasiens* in many volumes of the Botanische Jahrbücher (1912 onwards).

(5) Journ. Arn. Arb. 9 (1928) *et seq.*

(6) Beih. Bot. Centralbl. 2. Abt. 34 (1916) 19–53.

(7) Head of this Museum was the late K. HEYNE, author of the standard work on useful plants of Indonesia (1927).

(8) Bull. Jard. Bot. Btzg III, 5 (1923) 294 *seq.*

were reduced, and though towards 1930 there were a few constructive moments, a protracted slump set in after that year and the Staff at Buitenzorg were reduced to the barest minimum. Shortly before the Pacific War the Staff again increased but the circumstances limited advancement of the Flora to planning.

I have always felt it as a shortcoming, and not in accordance with the standing of the great work at hand, that the contributions appeared in a periodical as scattered articles and not as a separate publication.

The work was undertaken on full official authority but being printed in an irregularly interrupted series of articles in many volumes of a technical journal, it was practically inaccessible to a wider non-professional public. A standard work of this scope and weight meant to be used by future generations and worthy of the wonders of nature in this great land ought to have commanded considerable interest in and beyond the tropics, specially so in neighbouring countries. It would not have made a difference in expenditure to issue this work as a separate publication thus materially augmenting its practical importance, its intrinsic value remaining, of course, the same.

This seemingly trivial technical-editorial point had very undesirable consequences. If the Government had once for all decided to order a standard work on the Malaysian flora to be written with all possible expediency and to be used many years afterwards, the halting and haphazard progress in the decade preceding the Pacific War would never have occurred.

It is a gratifying thought that the turbulent times of the present could not prevent the Government now to put the Flora Malesiana in an advantageous and satisfactory position both as regards effective publication, and national and international collaboration of systematists. Co-operation with foreign colleagues, whose help is invited and whose help is needed in order to finish the work within a reasonable time, will now, presumably, more easily be obtained. Evidently, it is far more attractive and stimulating to be entrusted with an individual part of a standard work than with writing an article in a journal.

**Prospect and scope of the Flora Malesiana.** A general flora of Malaysia must result from a careful study of all previous publications, blending them into a harmonious whole, and so founding Malaysian botany on a secure base of historical fact, observation, and accurate description. This is, however, the labour of a lifetime, and although I may be privileged in witnessing the laying of the foundations and the issue of a number of volumes, I cannot hope to bring it to a conclusion; progress, moreover, will depend entirely upon circumstances at present beyond control. I have no doubt that when I will be called to abandon this endeavour the historical necessity for the completion of this work will compel someone to continue this task and, eventually, to finish it.

It would, however, be wrong were I to convey the impression that this arduous undertaking had entirely originated with myself: on the contrary during many years the conviction has grown among plant taxonomists that the ample collections accumulating in this country warranted the preparation and publication of a Flora Malesiana. The collections are undeniably extensive having been gathered over a wide extent of country.[1]

As I am anxious to render each portion of the work in itself as complete as possible, and desirous of enlisting those of our fellow-botanists as may be willing to take care of those families or groups they are most familiar with, the Flora Malesiana, when terminated will probably consist of a series of local-monographs. For these reasons it seems inadvisable and most inconvenient to arrange the families in the mode of sequence usually adopted in systematic works.

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

**The use of the Flora Malesiana.** In the preceding pages I have mentioned several times the public and the government. Both have a right to a clear understanding of the use of a flora of the scope and character of that now contemplated.

Although it is difficult to explain theoretically the 'use', *i.e.* the material benefit of purely scientific standard works, many anecdotes and instances concerning scientists entirely possessed by their inventions, instruments, and desire for research, told in biographies and popular literature, exemplify the eminently practical results based on seemingly impractical and abstract study.

The same can be said about this Flora. Botany is not a cherished source of pleasure and interest to naturalists only; and I have but vague ideas of

(1) Collections have increased enormously. From 1917 on, the Forest Research Station at Buitenzorg accumulated materials of arboreous plants from the islands outside Java (more than 30.000 numbers): The Museum for Economic Botany furnished by its own collectors another 6000 numbers of those islands. The collectors of the Buitenzorg Herbarium in the past 30 years added to the collections more than 125.000 numbers. A similar increase of Malaysian collections in these last decades is due to the activities at Manila and Singapore; besides, private collectors substantially augmented the collections of New Guinea. A conservative estimate of the collections at Buitenzorg alone runs to about 400.000 numbers of Malaysian plants.

possible advantage and ultimate gain for the community and practice by means of this registration of the Malaysian flora.

I could refer, of course, to the fact that all other civilized nations have already made considerable progress in the task of making common knowledge of their vegetable resources.

Actually the disentangling of confused species, the description of new or the rehabilitation of obsolete genera, the dissection of dried flowers and, in general, the establishment of law and order in 'the hay loft', and the publication of the results have less appeal to the lay public than the segregation of a new promising variety of rice or sugarcane, or devising a method to suppress a pest of coffee or of coconut plantations.

The Flora of Malaysia contains besides highly interesting and even unique plant forms, instructive vegetation types, and peculiar ecological and phytogeographical problems, numerous important industrial plants and economic products which, in their manifold kinds, add to human comfort and social prosperity, while, in their ranks, many treasures still await discovery, the latest accessions being pectin and mannan producing plants. Their value has come as a surprise both to taxonomists and economists.

Nearly a century ago, one of the foremost of British botanists, Sir Joseph Dalton Hooker[1] wrote an introductory essay to the Flora of British India, one of the most instructive general essays ever written on tropical botany. This nearly one century old exposition of facts and thought meets the present state of knowledge of the Malaysian flora admirably. Its excellence induced me to copy the following from it:—

"With regard to economic botany, it is obviously impossible to do more than briefly enumerate, under their respective species, the various products which have been used in the arts: for detailed accounts of their value, we must refer our readers to the many excellent works on those subjects, which have been published by Indian botanists."

"Our work is intended to facilitate the progress of economists, by supplying their great desideratum, a critical description of the plants which yield the products they seek. We have had a considerable experience both in medical and economic botany and we announce boldly our conviction, that, so far as India is concerned, these departments are at a standstill, for want of an accurate scientific guide to the flora of that country. Hundreds of valuable products are quite unknown to science, while of most of the others the plants are known only to the professed botanists. The mass must indeed always remain so: just as the refinements of the laboratory and the calculations of the mathematician must ever be mysteries to the majority of manufacturers and navigators, whose operations are based on the sciences in question. It is a mistake to suppose that it can be otherwise; or that those who are engaged in forwarding a science so extensive and abstruse as philosophical botany, can command the time to become so familiar with the details of the commercial value of vegetable products, as to be safe referees on these subjects. On the other hand, it is equally a mistake to suppose that those who devote themselves to the collection of economic products, can possess the experience and botanical knowledge necessary to render their identifications of tropical plants trustworthy in the eyes of men of science. It is therefore as a strictly scientific work that we offer this commencement of the Flora Indica to the public, but though the advancement of abstract science is indeed its primary object, yet as we yield to none in our estimate of the value of economic botany, we confidently trust that . . . our labours will be found of material service."

"Had it been possible to take up the economic plants of India by themselves, and to present a history of them to the English reader, we should at once have devoted ourselves to the task, with the certainty of obtaining an amount of encouragement which a so-called paying work is sure to command, but which one of a more scientific nature is not thought worthy of receiving. We should, however, only be deceiving the public, were we to propose a scheme which, in the present deplorably backward state of scientific Indian botany on the one hand, and the confusion of Indian economic botany on the other, is literally impracticable: the difficulties have increased fourfold, from scientific botany not having advanced *pari passu* with the economic branch; and so long as plants themselves remain undescribed, it is obviously impossible to recognize what are useful, or so to define them that they shall be known by characters that contrast with those of the useless. Our principal aim, however, being purely botanical, the most insignificant and useless weed is as much the object of our attention as the Teak, Sal, and tea: in the vegetable kingdom, and in the great scheme of nature, all have equal claims on our notice, and no one can predicate of any, its uselessness in an economic point of view."

"Every one who has studied Indian plants, whether for economic purposes or for those of abstract science, must have felt the want of a general work which should include the labours of all Indian botanists, to be a very serious inconvenience. Our own experience in India has convinced us of this; for we found it often impossible to determine the names of many of the most ordinary, and, in an economic point of view, often most valuable forms; and every day's additional experience in the preparation of this volume has served to show more and more clearly, that whilst such a work is wanting satisfactory progress is impossible. At present the student has to search in general systematic works, for the descriptions of species; and as all of these are imperfect, a multitude of scattered papers must be consulted for the additions which have from time to time been made. These too have unfortunately so often been published without reference to preceding works of a similar nature, that the same plant has been described as new by

(1) Hooker & Thomson, *Flora Indica* (1855) 1–280, specially p. 3 *et seq.*

many successive botanists, ignorant or neglectful of the labours of their predecessors." So far HOOKER.

To emphasize our inability to foresee practical results of taxonomic work I intend to mention a few recent instances in Malaysia showing that plants which seem useless at the present may stand in the focus of attention at a future date.

Twenty years ago it would have seemed the whim of a botanist to work on the species of a genus of foetid aroids, scientifically known as *Amorphophallus*. Few years later, however, the tubers of some species of this genus were found to be important commercially and industrially. The basic work on the distinction of the species, the notes on their distribution, their habit and structure proved to be most useful for agricultural purposes.

The same holds for a genus of leguminous plants, *Derris*. The roots were found to contain a very valuable resin-like substance, rotenon, poison to fish and numerous insects but harmless to larger animals, also to man. As soon as its commercial value was recognized a sudden large demand for *Derris* rose. It soon appeared that not every species was valuable and so the original studies of *Derris* offered hold for a first segregation of promising material whereas the systematist was questioned about the characters by which the species could be recognized.

The absence of any reliable taxonomic information of the genus *Metroxylon* prevents at present well-founded research on the economic possibilities of the sago-producing species which supply a basic food to the whole population of East Malaysia and Melanesia.

Invariably it is the duty of the taxonomic botanist to supply *basic data* to research in directed (= applied) botany.

In all cases the *name of the species*, and eventually its varieties, *is the alpha of knowledge*, as it represents the key to existing literature embodying earlier work on habits, life-history, on distribution geographical and altitudinal, ecology and growth habit, current native names if any, *etc.* and Flora Malesiana must serve for this purpose.

In the past *e.g.* tropical plant-breeding in some cases followed a wrong direction and might have achieved better results more rapidly when the aid of taxonomists had been available or requested.

From the discussion of some selected topics above it will be clear that the taxonomic botanist in composing the Flora Malesiana will be able to offer critical knowledge of numerous *forest products*, plants containing *vegetable oils*, *fats*, and *resins*, *rattan*, *timber*, *gums*, *fruits*, *spices*, *insecticides*, *fibres*, *dyes*, and *medicines*, or species which may serve for *afforestation*, for *ornamental use*, as new *green manures*, *fodder plants*, or possibly, *species withstanding drought* or being *resistant to fire or inundation*, suitable for *combating erosion*, and other economic aspects.

In addition to taxonomical information, the Flora Malesiana will contain ecological data. In anthropogenic areas and eroded lands biological control of necessity will seek guidance in its comprehensive survey of facts. Large amounts of money and energy have been wasted in the absence of professional planning, through negligence of fundamentals. I remember attempts, as expensive as they were fruitless, of planting mangroves to protect the coastal area of a tropical harbour, a waste which would have been avoided when the ecological potentialities of mangrove forest had been duly considered.[1]

In (re-)afforestation, the choice of trees has to rely partly on previous experience, but directions can be given by field-taxonomists and by means of general rules of tolerance capacities. Native trees occupy in our forest-types fitting ecological niches, but it should not be assumed that they grow always under optimal conditions. An example is probably found in swamp forest trees which have roots tolerant of a very low aeration of the soil, a virtue not practically utilized, as far as I know, when planting on very poorly aerated soils.

The ecological misunderstanding that all plants grow in nature under optimal conditions for their growth led to 'forest plantations' of quinine by JUNGHUHN. The *Cinchona*-crop was saved thanks to TEYSMANN who maintained that the plant should be grown in the open. Much trouble and still much more money could have been saved if this ecological principle had been better known.

The Flora Malesiana is, therefore, of first interest to practice and may direct new research: it must give data as to where the plant occurs, in what quantity, under what life-conditions, and with what life-cycle. It ought to contain ecological and biological data, and a critical extract of the notes made by the collectors. None of us can predict the industrial future of a neglected plant species, but we should be prepared for any coming rush on the botanical wealth of this vast archipelago, linking the Asiatic and Australian continents.

The aim of the Flora Malesiana is to compile a critical knowledge and a botanical standardization of the Malaysian flora of basic importance both to pure and to economic botany.

**How much of the flora is known?** Often it is assumed—the majority of botanists being acquainted with the state of knowledge in Europe or North America—that the flora of these islands is sufficiently known, and the actual facts cause astonishment.

For instance, not even the number of species is known otherwise than by very approximate calculation; 25.000 to 30.000 species of flowering plants is a conservative estimate. The *Orchidaceae* alone claim about 5000 species. Java possesses more than 500 species of ferns. The number of different species of trees in Malaysia is about 3000. The total number of genera is near 2400. The largest genera are found among the Orchids, *Dendrobium* with *ca* 1110 and *Bulbophyllum* with about 933 recognized species.

This is indeed astonishing if compared with the flora of Holland where the whole native flora

(1) Kustaanwas en mangrove (Natuurwet. Tijdschr. Ned. Ind. 101 (1941) 82–85).

amounts to little more than 1000 flowering plants.

Counting all trustworthy and up to date revisions together, about 5000 out of a total of 25.000–30.000 species are now more or less critically known. It appears that the bulk of the work remains still to be done.

**The area covered by the Flora Malesiana** will besides Indonesia also include the Malay Peninsula, Sarawak, Brunei & British North Borneo, the Philippines, Christmas Island, Portuguese Timor, and the whole of New Guinea (fig. 1).

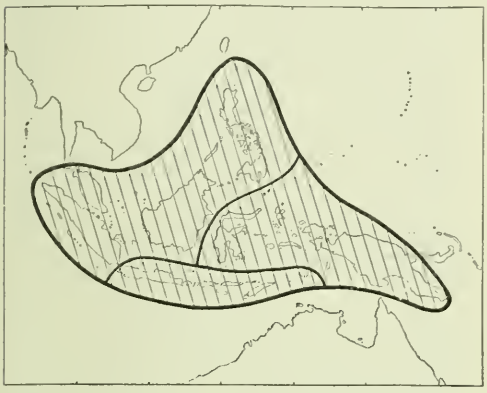

Fig. 1. Delimitation and main divisions of the flora of Malaysia.

It may be asked whether this is not an unnecessary extension of the task to include foreign border countries. To explain this it ought to be realized that the demarcation lines of natural units seldom coincide with political boundaries.

As much as possible, however, the demarcation of a Flora should be based on scientific, that is, plant geographical limits.

Plant geographically the natural demarcation lines of the Malaysian flora pass through the isthmus of Kra, between the Philippines and Formosa, and through Torres Straits, and include the Louisiades and the Bismarck Archipelago. An extensive geographical survey of the distribution of the Malaysian flora will be published in the 3rd volume of this work. The outcome[1] is wholly in confirmation with the suggested demarcation lines which were drawn first, as I have mentioned, about a century ago by Zollinger.[2]

In the NW quite a number of typical Malaysian genera of forest plants fail to occur any further in the Indochinese Peninsula, *e.g. Rafflesia*, *Rhizanthes*, *camphorwood* (*Dryobalanops*), *benzoin* (*Styrax benzoin*), *kauri* or *copal* (*Agathis*), *true ironwood* (*Eusideroxylon*), *menggaris* (*Koompassia*), *etc.*

The Philippines possess an essentially Malaysian flora, in contrast to Formosa's Japano-Chinese floral character which was definitely demonstrated by Merrill.[3]

The flora of New Guinea was formerly assumed to be essentially Australian in character. This interpretation was mostly based on zoological arguments and on the occurrence of few but very striking examples of plants which later appeared to be also spread westwards in the Moluccas and Celebes. O. Warburg, in 1891,[4] on account of important statistics, already showed the essential Malaysian character of the Papuan flora.

Technically the botanist must in *each* case —whether the Flora Malesiana is limited to a political or to a natural demarcation—study and compare critically all species of the natural phytogeographical unit. Plants described hitherto only from East New Guinea almost certainly occur also in West New Guinea, numerous species originally described from the Philippines occur in Celebes, the Moluccas and New Guinea, and the same holds for the Malay Peninsula, where the flora is intimately allied to that of Sumatra and Borneo. In identifying plants of Malaysia in the narrow sense, that is, limited to the Netherlands Indian boundaries, the botanist is always obliged to revise or critically to take into consideration the species described from the border areas. This will cost him about the same time and labour as when admitting them into the final work.

If these species are omitted, the Flora Malesiana will doubtless be out of date early and unnecessarily.

**Bibliographic advantage of the Flora Malesiana.** The absence of any definitely indicated centre of publication for Malaysian plants has led to a rather chaotic taxonomic literature. At the present moment revisions of Malaysian plants are published more or less frequently in about 10 important periodicals scattered all over the world, and occasional publications are found in some 50 others. An annotated list of former revisions will be presented in this volume to facilitate future study. No single individual can be supposed to own these journals and it is thus more or less private knowledge to those, who have access to a well-stocked library. In Malaysia there are only two libraries where they are nearly all represented, *viz* at Buitenzorg and Singapore.

This is of course a rather unsatisfactory situation to naturalists, foresters, agriculturists, phytochemists, veterinarians, pharmacologists, and interested private persons desirous to study the flora according to the best available data. The Flora Malesiana will put students of systematic botany generally in possession of the essence of literature.

**Sequence of publication.** It is commonly understood that in a flora the sequence of publication ought to be in agreement with the 'natural system'. This has been—I feel sure—a serious obstacle mentally and practically to all those who, previously, have considered the project of this flora.

Arguments against this sequence are in the first

(1) Tijdschr. Kon. Ned. Aardr. Gen. 65 (1948) 193–207, 7 fig.

(2) Natuurk. Tijdschr. Ned. Ind. 13 (1857) 293–322.

(3) Bot. Jahrb. 58 (1923) 599–604.

(4) Bot. Jahrb. 13 (1891) 230–455.

place the existence of several 'natural systems'; it is tacitly agreed that the last word in 'the natural system' will probably never be spoken.

A system now adopted may be obsolete when this flora is finished.

A choice seems, therefore, difficult, as most of the systems are advanced by leading botanists who among themselves, may claim little priority of preference.

It would be possible that the editors of the Flora Malesiana advance a system of their own. However, this falls beyond the scope of this Flora which is solely intended as a practical work.

This technical difficulty, which was already mentioned on p. viii, in connection with the adoption of a system is a serious obstacle to the progress of the work.

Clearly not at every moment a specialist is available for every family of flowering plants. This is more or less a matter of chance. Rapid and regular publication is most desirable and so every opportunity should be made use of. A 'natural system' consequently involves the 'waiting' of some manuscripts for many years because it is not yet their turn to be printed, and several volumes will be set up in one part but can be continued only at a remote period because for the 'following' family no specialist was available. The real disadvantage can be observed in works like the *Flora of North America*, in course of publication, of which, in 1941, were published 2 complete volumes and 55 loose parts belonging to 17 of the remaining 32 planned volumes. The same has been the case with the *Flore Générale de l'Indo-Chine* where most volumes ranged over a period of about 30 years before they were completed and could be bound. In the meantime consultation was very difficult because the indexes appeared naturally in the final instalment. The handling of the loose parts is undesirable both from a bibliographical and a practical standpoint.

In the newly started *Flore de Madagascar* the families are numbered according to the natural system and are separately published and paged. The idea is that after completion the subscribers can arrange them into sequence and bind them accordingly. We must be aware, however, that this will hardly bring any advantage as the number of families in the Malaysian flora is 211, and that among them 70 families are represented by less than about 10 species, so that also in this case one has to handle a large amount of small unbound fascicles.

A long time is needed to complete the *Flora Malesiana*, about 25 years at least.[1] This is certainly not overestimated if compared with floras of similar magnitude as *Flora Brasiliensis* (1840–1906), *Flora of Tropical Africa* (1868–*hodie*), *Flora Capensis* (1894–1933), *Flora of British India* (1855–1897), *Flore générale de l'Indo-Chine* (1907–*hodie*), *Flora Australiensis* (1863–1878).

The exact duration cannot be calculated, this depends largely on opportunity and facilities, and the joining of forces. The editors are fortunate in having received the promise of much co-operation, and they hope to be able to extend their resources still more. Moreover a considerable amount of recent publications exists which may easily be adapted to the flora.

The here adopted scheme of 'opportunity sequence' in the production of family revisions will remove any delay caused by the 'natural system'. The addition of an up to date index to the contents of prior parts on the cover of each new appearing instalment will serve to verify in a moment if a desired group has already been revised.

The size of the families is of course widely different ranging from 1–5000 species.

At least one figure illustrating characteristics will be added to each family and large genus.

The volumes will not exceed 500–600 printed pages. They must be easy in the hand, agreeable to work with, and bound in covers which may not be attacked by tropical insects, as we hope that numerous subscribers will be found in the Old World tropics outside the official institutions.

**Completeness of the Flora.** No perfection can ever be attained in any tropical flora. Always novelties and new localities will have to be recorded. No squadron of botanists can ever comb a tropical area engirdling $^1/_7$ of the equator.

Although completeness is a first aim set for this work, its future value will depend mainly on the amount of critical original study which it contains. The Floras of British India[2] and Australia are now definitely incomplete, but they remain first class sources of information. BACKER's *Schoolflora voor Java*, of 1911, still meets present demands nearly as well as at the time of its appearance. If we can keep our flora to so high a standard it will become the keystone to future Malaysian systematic botany.

The Flora Malesiana will be started with the flowering plants (*Series I*).

*Series II* will comprise the ferns and fern allies and is estimated to occupy 3 volumes.

*Series III* will be devoted to mosses and hepatics. These will take about 5 volumes.

*Series IV* will treat the fungi and lichens. The number of volumes can as yet not be estimated.

*Series V* is intended for the algae and other groups of unicellular cryptogams.

For the series II–V special editors will be appointed. The general method of treatment may possibly deviate somewhat from the first and largest series but the needs of these can hardly be estimated at the moment.

C. G. G. J. VAN STEENIS

Buitenzorg/The Hague, Sept. '44/July '47.

(1) Under the most favourable conditions as regards funds, and co-operation.

(2) Dr K. BISWAS calculated that to the 'Flora of British India' consisting of *ca* 14000 species, *ca* 2000 have been added since its publication, a surprisingly low number in relation to its vast surface and variety of vegetation types (Proc. 30th I.S.C. pt II, sect. V, Bot., Pres. addr. p. 109).

# GENERAL CONSIDERATIONS

*We should endeavour to determine how few, not how many species are comprised in the Malaysian flora.*

In writing the following chapters I have kept in mind the exemplary 'Introductory Essay' of J. D. HOOKER in his 'Flora Indica' (1855), the precursor of the 'Flora of British India'.

For the same reasons that moved HOOKER, I felt obliged to introduce the Flora Malesiana proper by some general considerations especially intended for co-operators less fortunate than I have been in acquiring an experience of long standing in the field. I may add that field experience often is invaluable when studying dried, always fragmentary, materials in the Herbarium.

Some of the subjects HOOKER treated are now too large to be included in one essay and, therefore, the *survey of the Malaysian collections*, the *physiognomy of the vegetation*, and the *genetic and floristic plant geography* occupy the (introductory) volumes 1–3 of this work.

The present essay will be entirely devoted to topics directly bearing on the study of systematic botany. Some of them I have previously discussed, or touched on, in my study of the origin of the Malaysian mountain flora.[1]

As my intention is to further the study of Malaysian botany, I shall discuss only points of which a clear understanding is essential to the Malaysian naturalist. I will try to illustrate each case by reference to plants of this region.

These points are: *individual variation and racial segregation, variation caused by the environment, the problem of speciation and specific centres, hybridization, views on the status of the species and subspecies, migration and adaptation*, and the way to interpret these concepts.

These theoretical points are inseparable from a philosophical study of plants, and I believe it to be essential for systematists to explain the principles which have guided them in the execution and design of their work.

HOOKER's general instructions have guided me in my work, and I am convinced that in the *flux* of botanical conceptions in general aspects the words of the Master still hold their own. I desire to express here my admiration for this classic work by quoting *literatim* some passages of his essay.

"It may seem almost chimerical to look forward to a time when all the species of the vegetable world shall have been classified upon philosophical principles, and accurately defined; and it must be confessed that the present state of descriptive botany does not hold out much prospect of the realization of so very desirable an object. This, we think, is in a great measure due, not to any want of students willing and anxious to take up the subject, but rather to a gradually increasing misapprehension of the true aim and paramount importance of systematic botany, and of the proper mode of pursuing the study of the laws that govern the affinities of plants. We are therefore desirous, at the outset of a work which is devoted to these subjects, of explaining our views on them; and as we trust that our work will fall into the hands of many beginners who are anxious to devote themselves usefully to the furtherance of botanical science, but who have not an opportunity of acquiring in any other way its fundamental principles, we shall make no excuse for dwelling at some length on the subject. We are also anxious to refute the too common opinion (which has been productive of much injury to the progress of botany) that the study of systems presents no difficulties, and that descriptive botany may be undertaken by any one who has acquired a tolerable familiarity with the use of terms."

"There can be no doubt that any observant person may readily acquire such a knowledge of external characters, as will in a short time enable him to refer a considerable number of plants to their natural orders; though even for this first step more knowledge of principles is required, than to make an equal advance in the animal kingdom: but to go beyond this,—to develop the principles of classification, to refer new and obscure forms to their proper places in the system, to define natural groups and even species on philosophical grounds, and to express their relations by characters of real value and with a proper degree of precision, demands a knowledge of morphology and anatomy and often of physiology, which must be completely at command, so as to be brought to bear, when necessary, upon each individual organ of every species in the group under consideration. To follow the laws that regulate the growth of all parts of the plant, especially the structure of stems, the functions of leaves, the development and arrest of floral organs, and the form, position, and minute anatomy of the pollen and ovule, and to trace the whole progress of the ovule and its integuments to their perfect state in the seed, ought all to be familiar processes to the systematic botanist who proceeds upon safe principles; but no progress can be made by him who confines his attention chiefly to the modification of these organs in individual or natural orders."—So far HOOKER.

Variability in characters of minor importance and description of extreme forms have led to a rather confused state of affairs. I believe that among the scores of species described many microspecies should be reduced to a much smaller number of true species, with a normal area of distribution and a normal variability in characters typical for Linnean populations which are intermediate between the species of extreme 'splitters' and extreme 'lumpers'. Much 'splitting' has been caused by describing single extreme forms not exactly agreeing with the type or type-description; for practical purposes it is sometimes required to describe such forms as new species and to recognize them provisionally as new 'entities'; the author's conscience and eagerness to finish his task are thus temporarily satisfied. This method has proved a failure and a serious handicap to the progress of tropical plant knowledge.

(1) Bull. Jard. Bot. Btzg III, 13 (1935) 358–407.

There are three methods of handling new collections, all being equally unsatisfactory. Firstly, provisional rapid identification of the material as to genus, or to species as far as is possible, and its insertion in the herbarium; collectors in general do not favour this method as only few final names can be provided on a cursory examination. Secondly, a collection may be worked through by rough comparisons to named specimens and with standard literature. This second method is rapid but all extreme forms and forms belonging to large genera or to difficult families which cannot be identified rom the available literature, are described as new (*specimen description*). By this method collectors get immediate results but science is burdened with a host of 'endemic' species which, as experience has shown, disappear by the score when a thorough monograph is made. Thirdly, a collection may be thoroughly studied, delaying results, as the identification of extremes means in nearly every genus a preliminary revision.

HOOKER continues (*l.c.*):—"*A knowledge of the relative importance of characters can only be acquired by long study; and without a due appreciation of their value, no natural group can be defined.* Hence many of the new genera which are daily added to our lists rest upon trivial characters, and have no equality with those already in existence. A proneness to imitation leads to a gradual increase in their numbers, without a corresponding increase of sectional groups. Indeed, even when the sectional groups are well defined, and the genera in themselves natural, a too great increase in the number of genera is detrimental, by keeping out of view those higher divisions which are of greater importance. The modern system of elevating every minor group, however trifling the characters by which it is distinguished, to the rank of a genus, evinces, we think, a want of appreciation of the true value of classification. The genus is the group which, in consequence of our system of nomenclature, is kept most prominently before the mind, and which has therefore most importance attached to it."[1]

"The rashness of some botanists is productive of still more detrimental effects to the science in the case of species; for though a beginner may pause before venturing to institute a genus, it rarely enters into his head to hesitate before proposing a new species. Hence the difficulty of determining synonymy is now the greatest obstacle to the progress of systematic botany; and this *incubus* unfortunately increases from day to day, threatening at no very distant period so to encumber the science,[2] that a violent effort will be necessary on the part of those who have its interests at heart, to relieve it of a load which materially retards its advancement. The number of species described is now so very great, and the descriptions are scattered through such a multitude of books, that even after long research it is difficult to avoid overlooking much that is already known; and when botanists with limited libraries and herbaria institute new species, it is almost certain that the latter will be found to have been already characterized. To such an extent is this carried, that we could indicate several works, in which one half and even more of the species are proposed in ignorance of the labours of other botanists. Indian Botany unfortunately, far from forming an honourable exception in this particular, presents a perfect chaos of new names for well-known plants, and inaccurate or incomplete descriptions of new ones".

"It must be remembered too that the Linnean canon, by which twelve words were allowed for a specific character, is now becoming quite inadequate to the requirements of the science; and that the brief descriptions, which are now so generally substituted for definitions, unless prepared with the greatest skill, as well as care, and after an inspection of very numerous specimens, seldom express accurately the essential characters of a plant. It is indeed becoming more and more evident, that in the great majority of instances no definition is sufficient to enable inexperienced botanists to determine with accuracy the species of a plant, even when the whole genus is well known; much more is this the case in genera, many of whose species are yet undiscovered; and most of all, in those where the forms, though sufficiently well known, are liable to much variation. In the last case their determination becomes a special study;

(1) "We may make our meaning more clear by a few examples. The genus *Ficus* is surely more natural than the subgenera *Pogonotrophe*, *Covellia*, *Urostigma*, *&c*, into which it has been subdivided. So with the genera *Anemone*, *Hedyotis*, *Erica*, *Andromeda*, and others which have been split into many by modern systematists." R. BROWN, G. BENTHAM, J. D. HOOKER and others, in all their works, laboured to keep this important principle in view, and to impress it upon others; they have, however, failed to check the prevalent tendency to the multiplication of genera.

I add here other examples of genera occurring in Malaysia which are separated by trifling characters: *Voandzeia* differs from *Vigna* only in fruit biology, *viz* its globular pods ripening subterraneously. In *Urena* and *Pavonia* now only one fruit character remains the decisive distinction, *Dillenia* and *Wormia* are distinguished only in their fruit biology, *Berberis* and *Mahonia* are distinct solely in the foliage, *Kibessia* and *Pternandra* differ only in unimportant characters of the calyx tube, *etc.* The separating characters are far less important than those which, in other genera, serve to divide sections or subgenera.

The more species are described the more differences originally accepted as of generic rank tend to disappear. A redefinition of the generic characters is often delayed, and the attitude in 'local-monographs' is mostly to keep at all costs the old delimitation in order to avoid laborious monographic work. Suggestive casual remarks are often made in local works, but decisions deferred.

(2) In entomology this has led to an intolerable chaos (*cf.* The New Systematics 1940, p. 475–491). The same holds for several large groups of the Fungi.

and when attempted without access to authentic specimens, leads to inextricable confusion, and its evil effects are not confined to specific botany, but extend to all departments."

"The pages of our Indian Flora will supply numerous illustrations of these remarks, and we would direct the attention of those commencing the study to the lesson to be derived from these instructive errors; for where the first botanists of the day have failed, beginners cannot be expected to succeed. It cannot be too strongly impressed upon all students of botany, that it is only after much preliminary study, and with the aids of a complete library, and an herbarium containing authentic specimens of a very large proportion of known species, that descriptive botany can be effectively carried out; and it would be well for science if this were fully understood and acted upon."

"The prevailing tendency on the part of students of all branches of natural history, to exaggerate the number of species, and to separate accidental forms by trifling characters, is, we think, clearly traceable to the want of early training in accurate observation, and of proper instruction in the objects and aim of natural science. Students are not taught to systematize on broad grounds and sound principles, though this is one of the most difficult processes, requiring great judgement and caution; or, what is worse, they are led by the example if not by the precepts of their teachers, to regard generic and specific distinctions as things of little importance, to be fixed by arbitrary characters, or according to accidental circumstances. As a consequence, the study of systematic botany is gradually taking a lower and lower place in our schools; and, being abandoned by many of those who are best qualified to do it justice, it falls into the hands of a class of naturalists, whose ideas seldom rise above species, and who, by what has well been called *hair-splitting*, tend to bring the study of these into disrepute."

"We therefore earnestly recommend to the Indian botanist the detailed study of individuals and their organs with the view of determining their limits of variation."

Wight and Arnott[1] formulated their warning to beginners as follows:—

"We shall perhaps be severely censured for cutting down species. We have all along considered it as trifling with nature to separate species on slight or variable grounds, nor could we ever understand the '*cui bono*' for which so much ingenuity in splitting hairs has been wasted. Before we determined what was a species, we examined with care numerous specimens from the same and different localities; and so far we have had an advantage over many other of the European botanists who have described Indian plants, they having only seen one or two isolated specimens. Numerous observations too were made in the plants in their natural situation, the result of which went to prove, what we have frequently endeavoured to enforce by examples throughout the present volume, that no precise shape of leaf or quantity of pubescence is of any value, although both of these seem in each species to be limited within certain variations. With regard to varieties, we have seldom distinguished any unless well marked and tolerably constant; we are aware, indeed, that these correspond to what some naturalists call species, but our own observations have convinced us, that varieties and forms, as well as species, may be constant in similar situations, and even in widely different situations, for many years, if raised from seeds either obtained from the original locality or from cultivated plants; the cultivated cerealia and garden vegetables ought to lead to such an hypothesis without any additional proof." So far Wight and Arnott.

Hooker continues:—

"In relative size especially, the observer will find immense variation; for, unlike the animal creation, proportional dimensions are of small moment in the vegetable kingdom. This fact, so familiar to the botanist of experience, is always a puzzle to the zoologist, who fancies he perceives a vagueness and want of exactness in all botanical writings (except in those of the too numerous class that make a parade of measuring to lines organs that vary inches), that contrasts unfavourably with descriptive zoology. Symmetry is again only a relative term amongst plants, for even such leaves as grow in pairs are never alike, and often differ much in form, texture, and colour; whilst the various sepals, petals, *etc.* of an individual flower, never so exactly correspond as the relative members of an animal do; and there are still greater differences between these organs, when taken from different flowers."

"It is hardly necessary to allude to the desirability of studying the various forms induced by artificial causes: the browsing of cattle on shrubs, for instance, which is almost invariably followed, by an abnormal state of foliage on the subsequently developed shoots, has been a prolific source of bad species; while there is scarcely an operation of man that does not tend to produce change in the vegetation surrounding him."

"It will generally be found that botanists who confine their attention to the vegetation of a circumscribed area, take a much more contracted view of the limits of species, than those who extend their investigations over the whole surface of the globe. This is partly, no doubt, owing to the force of bad example; and partly to the fact that the student who takes up the study of the flora of his native country, finds that the species are all tolerably well known, and that no novelty is to be discovered. There is therefore a natural tendency to make use of trifling differences, from the scope which they afford for minute observation and critical disquisition; whilst the more close comparison of the few species which come under his investigation, leads the local botanist to attach undue importance to differences which the experienced observer knows may be safely attributed to local circumstances. To this tendency there can be no limit, when the philosophy of system is not understood; the distinctions which appeared trifling to

(1) Prod. Fl. Pen. Ind. Or. I (1834) p. xxxi.

botanists a quarter of a century ago, are at the present day so magnified by this class of observers, that they constantly discover novelties in regions which have been thoroughly well explored; considering as such, forms with which our predecessors were well acquainted, and which they rightly regarded as varieties.[1]

"Another result of the depreciated state of systematic botany is, that intelligent students, being repelled by the puerilities which they everywhere encounter, and which impede their progress, turn their attention to physiology before they have acquired even the rudiments of classification, or an elementary practical acquaintance with the characters of the natural orders of plants. Unfortunately, in botany, as in every other branch of natural science, no progress can be made in the study of the vital phenomena except the observer have a previous accurate acquaintance with the various modifications under which the individual organs of plants appear in the different natural orders, and such an appreciation of the comparative value, structural and morphological of these modifications, as can only be obtained by a careful study of the affinities of their genera and species. Ignorance of these general laws leads to misinterpretation of the phenomena investigated by the physiologist, and to that confusion of ideas which is so conspicuous in the writing of some of the astute physiological observers of the day."

"The modern system of botanical instruction attempts far too much in a very limited space of time, and sends the student forth so insufficiently grounded in any branch of the science, that he is unprepared for the difficulties which he encounters, let his desire to progress be ever so great. The history of botanical discovery, and the philosophy of its advance, form instructive chapters for the student in any department of natural science."

"We owe to LINNAEUS the establishment of the doctrine of the sexuality of plants; and we find by the writings of the same great naturalist, that besides foreseeing many physiological discoveries, he preceded GOETHE in the discovery of morphology, a doctrine which, more than any other, has tended to advance scientific botany. A third great discovery, that of the nature of the ovule, and the relation of the pollentube to the ovary, received its principal illustration at the hands of BROWN, our chief English systematist, and of BRONGNIART, also a practised botanist."

"It should not be forgotten, that the relative importance of physiology is very different in the animal and vegetable kingdoms. In the former, structure and function operate so directly upon one another, that the great groups are, to a certain extent, defined by well-marked external characters, which are at once recognizable by the student, and are familiar, or at least intelligible, to those even who have paid no attention to natural history. In the vegetable kingdom this is by no means the case: the processes of assimilation and secretion present but little of that complication which renders the study of animal physiology so important; they are, on the contrary, uniform almost throughout its whole extent, and moreover so simple in their *modus operandi*, that this very simplicity prevents their being rightly understood. In consequence, even the two great classes of Monocotyledons and Dicotyledons are not distinguishable without considerable practice and study; and were we dependent upon actual inspection of the organs whence the essential characters of these groups are drawn, for the means of recognizing, Systematic Botany would be an impracticable study."

"Herein lies one great obstacle which meets the beginner on the very threshold of his botanical studies: he sees the great divisions of the animal kingdom to be recognizable by mere inspection, and that familiar characters are also natural, and available for purposes of classification: the very names of the groups convey definite information, and to a great extent give exact ideas. Birds, fishes, reptiles, *etc.* are all as natural as they are popular divisions; but what have we in the vegetable kingdom to guide the student through the two hundred and fifty natural orders of flowering-plants? As with a new language, he must begin from the very beginning, and also avail himself of artificial means to procure as much superficial knowledge of structure and affinity as shall enable him to see that there is a way through the maze. Hence the obvious necessity of an artificial system of some sort to the beginner, who has, at the same time, to master a terminology, which, if not so complex as that of zoology, is more difficult at the outset, from the want of standards of comparison between the organs of plants and those he is familiar with in himself as a member of the sister kingdom. Applying these remarks to practice, the botanical student finds that he has much to unlearn at the very outset; in many cases he has misapplied the terms root, stem, leaf, *etc.*, and contracted most erroneous ideas of their structure and functions; while he is startled to find that the popular divisions of plants into trees, shrubs, and herbs, —leafy and leafless, water and land, erect, climbing, or creeping,—are valueless even as guides to the elements of the science."

"It is not however to be supposed, because pure physiology is of secondary importance to the right understanding of the affinities of plants, that botany is therefore a less noble or philosophical study than zoology; since we find anatomy, development, and morphology, occupying a very far higher rank in proportion. Being deprived, as he is in most cases, of all technical aids to the determination even of the commoner exotic natural families, the systematist is compelled to commence with the knife and microscope, and can never relinquish these implements. Systematic Botany is indeed based upon development; and no one can peruse, however carelessly, the most terse diagnosis of a natural order or genus of plants, without being

(1) "Many of the species which have been revived in modern times were indicated by HALLER, RAY, TOURNEFORT, and other ancient botanists, but were reduced to the rank of varieties, when the science was reformed by LINNAEUS."

struck with the variety and extent of knowledge embodied as *essential* to its definition and recognition. Not only are the situation and form, division or multiplication, relative arrest or growth, of the individual organs exactly defined, in strictly scientific and scrupulously accurate language, but the development of each is recorded from an early stage: the vernation and stipulation of the leaves; the aestivation of the young calyx and corolla, and their duration relatively to other organs; the development and cohesion of the stamens; the position and insertion of the anther; its pollen; the cohesion or separation of the carpels, and the stages of their development from the bud to the mature fruit, and from the ovule to the ripe seed, are all essential points; all however minute, must in many cases be actually inspected before the position of a doubtful genus can be ascertained in the Natural System; and this is not the exception, but the rule."

"The necessity for acquiring so extensive and detailed a knowledge indicates a power of variation in those organs from which the natural characters are drawn, that defeats any attempt to render one, or a few of them only, available for the purposes of classification; and hence it is that the study of morphology or the homologies of the organs, becomes indispensable to the systematist; by this he reduces all anomalies to a common type, tests the value of characters, and develops new affinities. The number, form, and relative positions of organs may supply technical characters, by which observers of experience recognize those natural orders under which a great number of plants arrange themselves; but a knowledge of structure and anatomy alone enable the botanist to progress beyond this, and to define rigidly: whilst the study of development affords him safe principles upon which to systematize and detect affinities, and morphology supplies the means of testing the value of the results, and reveals the harmony that reigns throughout the whole vegetable world."

"Physiology, again, is a branch of botany very much apart from these: its aim is the noblest of all, being the elucidation of the laws that regulate the vital functions of plants. The botanical student of the present day, however, is too often taught to think that getting up the obscure and disputed speculative details of physiology, is the most useful elementary information he can obtain during the short period that is given him to devote to botany; and that, if to this he adds the scrutiny of a few of the points under a microscope, he has made real progress as an observer. This, we maintain, is no more botany, than performing chemical experiments is chemistry, or star-gazing astronomy. A sound elementary knowledge of vegetable physiology is essential to the naturalist, and should indeed be a branch of general education, as it requires nothing but fair powers of observation and an ordinary memory to acquire it. For the student to confine his attention to this knowledge of the vegetable world, and to try and improve upon it by crude experiments of his own, undertaken in ignorance of the branches of pure botany we have enumerated, is a very rational amusement, but nothing more."

"The students are indeed, in too many cases, perfectly ignorant of the elements of natural science, and require some practical acquaintance with plants and their organs, before they can appreciate the relations of the different branches of botany to one another, or discriminate between what is essential to understand first, and what is better acquired afterwards. Were the elements of science taught at schools, this would not be so: we should then have the student presenting himself at the botanical lectures fully prepared for the more difficult branches of science, and for making that progress in them for which the professor's aid is indispensable. A sound practical knowledge of system we hold to be an essential preliminary to the study of the physiology of plants—a study which requires also a practical acquaintance with organic chemistry, consummate skill in handling the dissecting knife, and command over the microscope, a good eye, a steady hand, untiring perseverance, and above all, a discriminating judgment to check both eye, hand and instrument. A combination of these rare qualities makes the accomplished vegetable physiologist, and their indispensability gives physiology its pre-eminence in practice."

"It has been with no desire of obtruding our views upon our readers that we have ventured to discuss these obscure subjects with relation to Indian plants, but from a conviction, that in the present unsatisfactory state of systematic botany it is the duty of each systematist to explain the principles upon which he proceeds; and we do it not so much with the intention of arguing the subject, as of pointing out to students the many fundamental questions it involves, and the means of elucidating them."

"To every one who looks at all beneath the surface of descriptive botany, it cannot but be evident that the word *species* must have a totally different signification in the opinion of different naturalists; but what that signification is, seldom appears except inferentially. After having devoted much labour in attempting to unravel the so-called species of some descriptive botanist, we have sometimes been told that the author considers all species as arbitrary creations, that he has limited the forms he has called species by arbitrary characters, and that he considers it of no moment how many or how few he makes. So long as this opinion is founded on conviction, we can urge no reasonable objection against its adoption; but it is absolutely necessary that the principle should be avowed, and that those who think the contrary should not have to waste time in seeking for nature's laws in the works of naturalists who seek to bind nature by arbitrary laws. So again with regard to specific centres; except we are agreed with an author as to whether the same species has been created in one or more localities, and at one or more times, we shall be at cross purposes when discussing points and principles relating to identity of species and geographical distribution."

"Great differences of opinion have from the

earliest days of science always existed on the nature of species. The prevalent opinion has undoubtedly at all times been, that a species is a distinct creation, distinguishable from all others by certain permanent characters. Many eminent philosophers, however, have taken a contrary view; of these the best known have been LAMARCK, and more recently the anonymous author of the 'Vestiges of Creation'." —So far HOOKER.

Modern biological science has progressed rapidly in the last decades through the results of experimental genetics. Though it is far from easy to weld the often contradictory opinions into a satisfactory whole, views relating to matters of variation have much gained. In the following pages I will try to discuss on this new basis the value to be attributed to characters of less than specific importance and a number of considerations which may lead to increased accuracy in judging specific delimitation.

Trifling characters, such as *peloric* and *cleistogamous flowers*, have led to the creation of worthless new genera; *galls*, *insect bites*, *and parasitic fungi* have been mis-interpreted and caused the publication of new species of Phanerogams. *Individual variations*, either intrinsic or extrinsic have, in a similar way, induced systematists working on tropical plants to distinguish more species than Nature intended.

It is not our intention to limit phytography to a merely administrative function in the study of botany, but to treat it as an essential of natural philosophy. The systematist ought to keep pace with cytogenetics, physiology and morphology,[1] phytochemistry, phytogeography, ecology, genetics, *i. e.* experimental taxonomy.

Inadequate material[2] and information are the chief causes which prevent the phyto-systematist from applying the results obtained by these branches of botanical science.

The systematist is seldom favourably regarded by the layman or student of directed botany. They are opposed to changes in nomenclature, being unable to gauge the force of the arguments for a 'new' name for a familiar plant and so rarely accept the judgment of taxonomists. When, on the other hand taxonomic problems are tackled by applied scientists nomenclature and specific distinction become chaotic; entomology, mycology, forestry, agriculture and horticulture supply many examples. A wish for simplification, impatience, or even personal vanity or the desire for pecuniary gain have caused hosts of 'species' to be added to our lists by applied workers. Not long ago a forestry officer made a study of *Agathis*[3] in Malaysia in which 13 species and 2 doubtful ones, that is 15 entities, were distinguished. In the same material the late Dr DANSER, whose judgment and experience cannot be doubted, distinguished only 3 divergent species with a number of local geographic variations. He found it very difficult to define the latter. Additional material showed that the keys and distinctions presented for the 13 species did not hold to the satisfaction of the Forest Research Station, from which this work emanated. In plant families of economic importance particularly in *Gramineae*, *Rutaceae*, and *Leguminosae*, similar work has resulted in multitudes of microspecies provided with binomials; by such a proceeding nothing is gained and much lost.

An example of the difficulties arising between taxonomy and an applied science when a good revision is absent, is the following:—a *Clausena* of unknown origin was cultivated for economic purposes at Buitenzorg. I referred it to *Clausena anisum-olens* (BLCO)MERR. but the phytochemist was dissatisfied, the properties of the oil did not tally with data recorded from the same species in the Philippines. I then sent ample material with full notes to Dr TANAKA, Dr SWINGLE, and to the Kew and Paris Herbaria, for identification. The answers were all different and the phytochemist was, of course, disgusted with the practical results of taxonomy, because now he had the choice among 5 names for his plant. By way of comfort I expressed the hope that a systematist would some day make a satisfactory monograph of the genus.[4] In order not to raise his hopes too high I remarked that even then some research from *him* would be needed to establish the assumed constancy of the oil properties as a specific character. I also informed him that taxonomy has sometimes scored by predicting phytochemical facts, *e.g.* when HALLIER supposed the presence of valerianic acid in *Viburnum*[5] on phylogenetic grounds only.

In the following two chapters general information on variation as a source of superfluous binomials is collected for the benefit of those with no field experience of the Malaysian flora. I distinguish variations induced by the environment from those belonging to the genetic composition of populations, and I have tried to illustrate them by examples in Malaysian phytography.

Often the number of examples is too small, and chapters overlap, but in the course of time every student of Malaysian botany will meet with other equally telling cases. May they stimulate the wish to avoid lapses of this character by conscientious treatment of the revisions in Flora Malesiana.

(1) For the value of wood anatomy in taxonomy, see DEN BERGER, in Handel. 4e N.I. Natuurwet. Congres (1926) 397.

(2) *Cf.* WIGHT, in a letter to GRIFFITH, dated April 15, 1842:—"How people can work on dry plants I cannot imagine. I am daily convinced of the poverty of the study from such materials, unless a man has seen much of living structure." MIQUEL ignored this remark, and on sterile and inadequate material based a host of species from Sumatra which even at present are not wholly elucidated.

(3) Bull. Jard. Bot. Btzg III, 16 (1938) 455–474.

(4) Compare R. WIGHT in a letter to GRIFFITH, dated March 30, 1841:—. . . "as you say Botany is difficult, and increasingly so, but Botanists are to blame for this. No remedy will be so effectual as the publication of Monographs."

(5) Med. Rijksherb. Leiden *no* 14 (1912) 36; *ibid.* 37 (1918) 92. *Cf.* also *V. valerianoides* ELM.

# VARIATIONS MOSTLY INDUCED BY THE ENVIRONMENT

## (*Phenotypic modifications*)

Phenotypic modification is the response to environmental conditions, such as climate, soil, exposure, altitude, temperature, wind, fire and living organisms. The genetic qualities govern the character of the plant, but the environment in which the plant develops determines the actual and final appearance of the individual. The changes or differences from the 'normal plant' are called *modifications*. Such changed characters are not themselves inherited, however, though the manner in which a plant reacts to environmental conditions is. In some cases an external change may be reversed by a change in the environment during the development of the individual but in other cases, when factors act in the seedling stage only, the effects in the individual are irreversible.

It is necessary to agree about the concept 'normal plant'. This is far from easy, as each specimen grows under a different combination of CEB-factors (Climatic, Edaphic, Biotic). We might approach the idea by saying that "the normal plant results from a genetically average individual under average natural environmental conditions", average to be understood in the sense of optimal. This 'normal' individual is never a reality but remains an abstraction.

Though the difference between phenotypic and genotypic variation is clear, the field botanist—and still more the herbarium botanist—is not always able to recognize it. Only experiments may furnish proof. For instance a dwarf shrub in an area subject to fire or browsing animals may assume this stunted form through these CEB-factors but it is also possible that the stunted form is a specialized race adapted to these conditions and thus selected by nature itself from the specific population. Experimental breeding must decide its constancy.

I have arranged the phenotypic modifications under several headings—which partly overlap and interlock—in the following sequence:



### Ontogeno-morphosis

#### 1. *Juvenile forms*

Juvenile forms often differ widely from the mature plant. Seedlings of many *Leguminosae* differ greatly from the adult in foliage and other characters. The youth form of *Cassia javanica* L. possesses large metamorphosed twigs acting as thorns (1). Thorny juvenile specimens are also found in *Alangium*.

In general, flowering twigs have smaller leaves than sterile branches; this often gives rise to difficulty in identifying non-flowering material and s one of the pitfalls if new species are based on sterile material. An example is *Campnosperma acutiauris* Boerl. & Koord. (*Anacardiaceae*) described on sterile juvenile material from Sumatra. The leaves are large and conspicuously auriculate-amplexicaulous. A similar juvenile form was later found in West Java, together with mature trees. These possessed much smaller non-auriculate leaves (fig. 2). The plant appeared to represent a species of *Tristania* (*Myrtaceae*)(2); its specific identity will probably remain obscure, however, as several species produce similar juvenile forms.

Youth forms of *Myrica longifolia* T. & B. differ strongly from mature specimens in possessing distinct stipules and incised larger leaves.

Incised leaves of seedlings occur in a score of arboreous plants, *e.g.* many *Bignoniaceae*, *Proteaceae*, *Gmelina*, *Lonicera*, *Alangium*, *Vitex*, *&c.* Leaves of young trees of *Pangium edule* REINW.


Fig. 2. Large leaf of a juvenile specimen, small leaves of a mature tree of *Tristania sp.* (*Myrt.*) in W. Java, × 1/3.

are 3-lobed whereas the leaves of mature trees are entire.

The growth of different parts of the plant is often very disproportionate. In some *Symplocos* species I found the leaf teeth were mature and large in young leaves but inconspicuous in mature foliage: they possibly have some (?excretive) function during youth only. BACKER (3) found the leaf tip earlier developed than the blade in some species of *Dioscorea*; it disappears also sooner. A peculiar development occurs in the growing leaves of some *Meliaceae*, *e.g. Chisocheton* (fig. 3).

Very peculiar juvenile forms greatly differing from the later normal foliage, have been described in various climbing plants such as some *spp.* of *Adenia*, *Medinilla*, *Macrozanonia*, *Piper*, *Araceae*, *Ficus*, *&c.* Juvenile specimens of these trunk climbers are always sterile. Their foliage is mostly broader than that of mature plants, and is appressed to rocks or tree trunks. The similarity in their appearance may cause considerable confusion as *e.g.* is shown by the type specimen of *Ficus peltata* BL. which was recently proved to represent a juvenile specimen of some climbing species of *Piper*.

In several *Malvaceae*, *Leguminosae*, *Sterculiaceae*, *Tiliaceae*, juvenile leaves are often different from mature ones (fig. 4). *Sterculia polyphylla* R. BR. is a juvenile stage of *St. foetida* L.; young trees often possess leaves having 10–15 narrow leaflets, mature trees have mostly 5–9-foliolate leaves with broader segments. Young *Lasia spinosa* THW. is very different from the mature plant. *Ficus basidentula* MIQ. is merely the juvenile form of *F. callosa* WILLD.; it is quite common in the hedges at Buitenzorg. The polymorphy in the habit and foliage of *Ficus quercifolia* ROXB. and *F. heterophylla* L.*f.* is unbelievable.

In juvenile forms of *Nepenthes* the shape of the pitchers may considerably differ from that in mature plants; as a result juvenile *Nepenthes* cannot with certainty be identified.

In *Carallia lucida* ROXB. leaves of mature trees are oblong to obovate with very shallowly serrate to entire margins; saplings, however, have oblong to lanceolate leaves distinctly serrate (4).

Other cases of old mature plants differing from young ones are found among lianas in which the shape of the stem may change considerably: *Cissus tuberculata* BL. has terete tuberculate stems but they later become flat and, in older stems, up to 60 cm broad looking like gigantic ribbons! The latter were described as a separate species, *Vitis lanceolaria* WALL., but the two forms are merely two stages of one species. The stems of lianas generally change greatly with age, through the development of corky warts and wings, together with secondary wood not present in young flowering twigs. Spines sometimes disappear in lianas and trees with age; in some cases, on the other hand, they enlarge considerably. A peculiar case is represented in two undescribed Cucurbitaceous lianas from the Lesser Sunda Islands, both having a

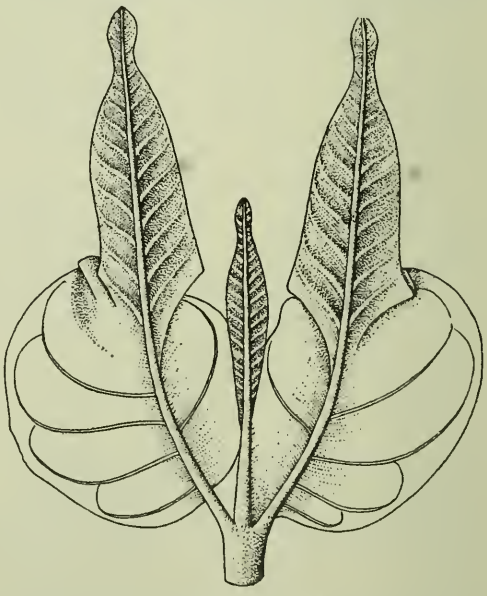

Fig. 3. Growing leaf tip of *Chisocheton sp.* (*Meliac.*) (bb. 23227), × 3.

swollen base; in *Gynostemma sp.* this 'podagric' base is smooth, in *Alsomitra sp.* it is spiny (5).

Habit also sometimes changes with age: *Ancistrocladus* is sometimes a shrub in youth whereas later it becomes distinctly scandent. Climbers which have no support may sometimes grow into semi-erect shrubs; this I once observed in a plant

Fig. 4. *Hibiscus sagittifolius* KURZ (*Malvac.*), leaves from one specimen (Indramajoe, W. Java), × 1/2.

of *Smilax modesta* DC. in a grass field on Mt Diëng.

Spotted leaves often occur only or predominantly in juvenile specimens. *Strobilanthes picta* KOORD. was a new species proposed on account of silvery spots on the leaves. However, it is a juvenile stage of *Str. cernuus* BL. Similar cases are known in *Begonia*, *Cissus*, and other genera where these spots may disappear with age. In greenhouses these juvenile forms are preferred for ornamental purposes.

Juvenile forms of plants with pinnate leaves sometimes have a much larger number of pinnae *e.g.Campsis pandorana* (ANDR.)STEEN. *c.n.* (6).

An example of a new species based on a juvenile plant is found in *Dacrydium*: the type specimens of *Dacrydium junghuhnianum* MIQ. from Sumatra consist of juvenile specimens of *D. elatum* WALL. with long loosely set needles.

In the herbarium flowers sometimes open during drying and create the impression of being mature. This is specially the case with flowers having valvate terete corollas *e.g. Symplocos* § *Cordyloblaste*, *Styrax*, *Polyosma*, *Proteaceae*, *Loranthaceae*, *&c.*

MIQUEL described a new species of *Lonicera* from Sumatra *L. sumatrana* MIQ. In his description short corollas are mentioned; owing to this mistake the species was subsequently placed in the wrong section and described twice again, once from Burma and once from Sumatra (7). The examination of MIQUEL's type specimen revealed that he described immature flowers, in fact buds which had opened in the herbarium. Immature woody capsules or strobili of *Myrtaceae*, *Theaceae*, *Coniferae*, *Casuarina*, *&c.* also tend to open after drying.

There is often a great similarity in the leaves of watersprouts of mature trees with those of saplings: large size, deeper incised teeth, thinner texture, *e.g.* in *Symplocos*, *Ficus*, *Sapotaceae*, *Dipterocarpaceae*, *etc.*

A still unsolved case is that of *Evonymus japonicus* THUNB. of which a sterile slender climbing and rooting form is frequently found in the Javan mountain forests. I originally took it for a juvenile shade form (8). Not until 1941 did I succeed in finding it flowering and fruiting on the open summit of Mt Jang. It is unknown whether the shade conditions in the juvenile stage determine the later morphology.

*Cited literature:* (1) A. J. KOENS, De Trop. Natuur 2 (1913) 174; see also KOORDERS, Bull. Jard. Bot. Btzg. III, 1 (1919) 168. (2) Tectona 22 (1929) 1336–1340. (3) Handboek Flora Java pt 3 (1924) 109. (4) Schoolflora voor Java (1911) 486. (5) Figured in De Trop. Natuur 29 (1940) 6. (6) *Bignonia pandorana* ANDR. (7) Journ. Arnold Arbor. 27 (1946) 441, 445. (8) De Trop. Natuur 22 (1933) 175–176.

### 2. *Precocious flowering (paedogenesis)*

In several Malaysian plants precocious flowering is observed. COSTERUS (1) recorded flowering seedlings in *Melia arguata* DC. (fig. 5). BACKER found them in *Melia azedarach* L. and J. J. SMITH described (2) the same phenomenon in *Murraya paniculata* L. In *Cocos nucifera* L. precocious flowering is often seen. The late Dr A. RANT observed flowering seedlings in *Cinnamomum zeylanicum* THW. (oral comm.). Other plants in Malaysia in which precocious flowering has been observed are *Swietenia mahogani* JACQ., *Coffea robusta*, *Citrus decumana* L., *Nicotiana tabacum* L., *Sesbania sericea* DC., *Vigna sinensis* ENDL., *Teramnus labialis* SPRENG., *Tectona grandis* L.*f.*, *Kalanchoe pinnata* PERS., and *Ailanthus sp.*

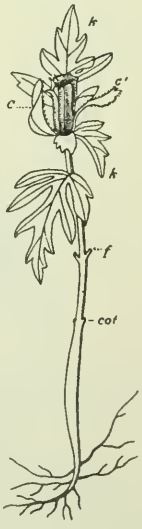


Fig. 5. Precocious flowering (*paedogenesis*) in *Melia arguta* DC. (*Meliac.*). (after COSTERUS)

In plants which flower strictly periodically precocious flowering is sometimes controlled by the date of sowing. If sown too late they flower together with full-grown plants sown earlier. This is a fact well-known to agriculturists (in Java *e.g.* in *Hibiscus spp.*).

Precocious flowering may also be caused by poor soil or some

methods of pruning. An example of the former cause is *Osbeckia pusilla* ZOLL. which is a flowering dwarf of *O. chinensis* L. on poor soils.

Sometimes dwarfed plants flower when very small and represent distinct varieties or strains, *e.g.* the dwarf of *Canangium odoratum* BAILL. *f. pumila* (3) grown in pots in Malaysia (introduced from China), *Aglaia odorata* LOUR. *var. microphyllina* DC., and a dwarf of *Punica granatum* L. The skill of Chinese and Japanese horticulturists in raising dwarfs is due partly to the selection of pygmy varieties but more important is their skill in impoverishing the plant without starving it (4).

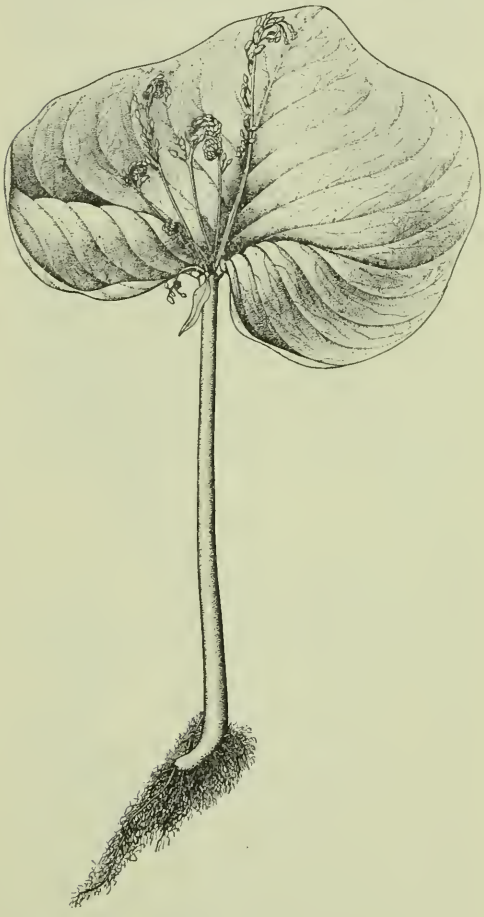

Fig. 6. *Monophyllaea horsfieldii* R.BR. (*Gesn.*), adult plant, one cotyl large and leafy, the other (in front) bract-like, soon disappearing (W. Java, Kalapa Noenggal), × 2/5.

Many dwarfs are found near solfatara, on rocks, and on silicious soils (*cf.* § 15–16).

Flowering juvenile forms are comparable to the neoteny found in the animal kingdom.

*Pteridophytes* generally are apparently more plastic with regard to precocity than Phanerogams, and several species are known to form spores in dwarf or juvenile specimens which have sometimes been described as distinct species. It has been assumed that pygmy species in *Antrophyum* may possibly represent neotenous stages of other species. COPELAND described in 1939 (5) a dwarf fern from Borneo as *Holttumia*, but it is Dr DONK's contention that this fern is a precocious stage of a *Taenites*. In the genera *Teratophyllum*, *Stenochlaena* and *Lomariopsis*, HOLTTUM (6) was able to demonstrate that a great deal of confusion is caused by the description of juvenile stages; being familiar with the living plants in the field he clarified the true status and affinities of a number of obscure species.

DIELS (7) compiled an instructive book on juvenile forms, giving instances where the juvenile foliage persists in the mature flowering plant, a course of development comparable to neotenous forms in zoology. Australian and New Zealand botanists have written a great deal about this phenomenon of heteroblasty which in those floras has apparently an important bearing on speciation (8). I cannot remember a Malaysian plant suspected to represent such a case. Yet such strange plants as *Monophyllaea* (fig. 6) and allied genera of the *Gesneraceae* living on the enlarged cotyledons might be examples.

*Cited literature:* (1) Rec. Trav. Bot. Néerl. 1 (1904) 128. (2) De Trop. Natuur 1936, Jub. uitg. p. 73. (3) Now described as a separate species *Canangium fruticosum* CRAIB (Kew Bull. 1922, p. 166) being cultivated in Siam. (4) Compare F. A. MCCLURE, in Lingn. Sci. Journ. 12 (1933) Suppl. p. 119–149. (5) Philip. Journ. Sci. 74 (1941) 153–156. (6) Gard. Bull. Str. Settlem. 5 (1932) 245 *seq.*; *ibid.* 9 (1937) 139 *seq.* (7) Jugendformen und Blütenreife im Pflanzenreich 1905. (8) cf. COCKAYNE, 13th Meeting Australas. Ass. Adv. Sci. (1912) 217 *seq.*

### 3. *Dimorphous foliage*

It was observed by F. W. WENT (1) that in trees generally *the foliage of the lower branches is larger than that of the upper twigs.* He ascribes this to the amount of water available to different shoots (internal water-conducting capacity); so, in mature trees the upper foliage would be insufficiently provided with water. The leaves of water sprouts, on the other hand, are mostly exceedingly large as their water supply is abundant. Leaves of these shoots are mostly hardly recognizable in the herbarium, as they may reach disproportionate dimensions. Foliage for description in the herbarium ought therefore to be comparable and preferably that of flowering twigs.

The dimorphy of the foliage is mostly linked up with a difference between flowering and non-flowering parts of the plant, similar to that found in *Hedera*. It is conspicuous in several climbing *Ficus*, *Piper*, *Araceae*, and in some *Conifers*. A striking example of plagiotropically flowering twigs is that of *Abroma augusta* L.*f.*

A good illustration is also *Luvunga sarmentosa* (BL.) KURZ (*Rutaceae*). The stem shoots of this

liana possess large straight axillary thorns and 1-foliolate leaves. The climbing shoots, however, possess conspicuously curved thorns and 3-foliolate leaves and the flowering parts of these are often unarmed. *L. eleutherandra* DALZ. was based on a type different from BLUME's but is actually the same species, as was found by KURZ (2).

Fig. 7. Heterophylly in *Ficus deltoidea* JACK (= *F. diversifolia* BL.) (*Morac.*), Mt Gedeh, W. Java, × 2/3.

Putting into practice what he had read of *Hedera helix* in a botanical manual, Mr BOLT made a remarkable application of the dimorphy of *Piper cubeba* L. Near Semarang, instead of cultivating it as a climber he took cuttings of the flowering twigs, and got shrublets which, though small, produced abundantly 'tail pepper'.

Plants with dimorphous foliage are very numerous in Malaysia and species are frequently named after this peculiarity. *Ficus deltoidea* JACK (= *Ficus diversifolia* BL., fig. 7) is one of them; L. VAN DER PIJL (3) could not find any regularity in its heterophylly. In *Faradaya dimorpha* PULLE from New Guinea there are two kinds of twigs, with decussate and with 3-whorled leaves of different shape. *Phytocrene macrophylla* BL. has both entire and 3-lobed leaves on one individual, as have *Broussonetia sumatrana* MIQ., *Knema heterophylla* WARB., several species of *Gmelina* and *Sterculiaceae*, *Tiliaceae*, *Artocarpus varians* MIQ. A good case is also *Uraria picta* DESV. (fig. 8). Heterophylly is common in ferns.

Polymorphy in leaf shape among different individuals of a population is a subject which ought to have a separate heading. It is of universal occurrence in the Malaysian flora, and has (*e.g.* in *Cucurbitaceae*) given rise to a multiplication of names. In *Coccinea*, MIQUEL (4) distinguished two species, one with incised leaves and one with angular entire leaves: according to BACKER they are identical, the incised leaves mostly belong to juve-

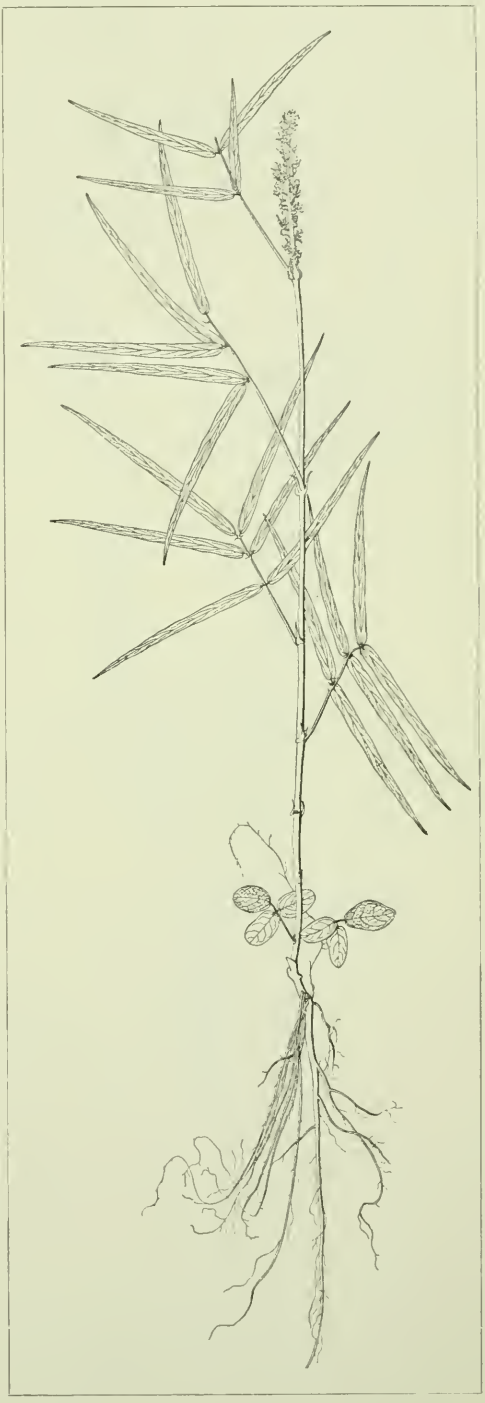

Fig. 8. *Uvaria picta* DESV. (*Legum.*), with heterophyllous foliage, Kangean Island, moist *Imperata* fields at low alt., × 1/2.

nile specimens. In *Gymnopetalum cochinchinense* (LOUR.) KURZ there is even more confusion: specimens with incised leaves have been described as *G. septemlobum* MIQ., *G. quinquelobum* MIQ. and *G. quinquelobatum* COGN., those with angular or entire leaves as *G. piperifolia* MIQ. and *G. horsfieldii* MIQ. There is probably a host of other names

Fig. 9. Macrobiocarpy in *Callistemon speciosus* DC. (*Myrt.*) with 3 sets of fruits below the terminal bud, originating from 3 previous flowering periods, × 1/4.

for this species which is very variable in foliage. In *Trichosanthes* a similar polymorphy of the foliage caused superfluous description of species. *Tr. grandiflora* BL. is, according to BACKER, a form of *Tr. globosa* BL. with lobed leaves. In *Gynostemma* CLARKE and BACKER assume a variability in foliage (3-foliolate to pedately lobed leaves) which will cause a considerable reduction of the number of species. Similarly scores of superfluous names are found in polymorphic species such as *Urena lobata* L. *etc.* In the *Oleaceae*, *Nyctanthes dentata* BL. is only a dentate-leaved form of *N. arbor-tristis* L.

In some Pteridophytes heterophyllous leaves are well known. The most striking examples occur in the genera *Teratophyllum*, *Stenochlaena* and *Lomariopsis* where according to HOLTTUM (5) heterophylly has caused much taxonomic confusion. An other striking case is that of the plant which is mostly cited as *Lindsaya repens* (BORY) BEDD. as demonstrated by W. TROLL (6).

*Cited literature:* (1) Handel. 5e Ned. Ind. Nat. Wet. Congres (1928) 385–392 (1929). (2) Journ. As. Soc. Beng. 39 (1870) 69. (3) De Trop. Natuur 27 (1938) 89. (4) Flora Ind. Batavae 1, 1 (1855) 673. (5) Gard. Bull. Str. Settlem. 5 (1932) 245; *ibid.* 9 (1937) 139. (6) Flora 126 (1932) 408.

### 4. *Dimorphous seeds and fruits*

Of *heterocarpy* (1) only few examples are known in the Malaysian flora. In some *Compositae* the marginal fruits are sometimes strikingly different from those produced by the central tubular flowers, as was described for *Synedrella nodiflora* GAERTN. by A. ERNST (2). It is also known that in *Tragia volubilis* L. normal and 2-hooked one-seeded fruits may occur together.

In *Umbelliferae* normal fruits and fruits with one half reduced may sometimes be observed.

In *Leguminosae* also different types of fruit are sometimes found on one plant. In *Desmodium heterocarpum* DC. the lower pods are 1-seeded, the upper 5–7-seeded.

Dimorphous fruits and seeds are known in *Aeschynomene spp.* and in the genus *Jussieua.*

One of the most curious cases of dimorphous fruits is that detected by BACKER (3) in the common *Acalypha indica* L. in Java where the tip of the male spikelets is crowned by a single female flower developing into a T-shaped fruit with a central fertile and 2 lateral sterile cells; the central cell seems to be sunken in the tip of the axis of the rachis. The normal capsule consists of 3 equal cocci.

A special case is that of *macrobiocarpy* (4) when not all fruits dehisce at the end of the season but a number remain closed on the plant and grow for years larger and woody. Sometimes fruits of 3–4 seasons are found on one twig, which thus keeps a reserve of seeds. Macrobiocarpy seems to be mainly restricted to the semi-arid climates and is of definite advantage in fire-swept areas. It is very common in some genera of capsular *Myrtaceae* (fig. 9), *viz Leptospermum*, *Eucalyptus*, *Melaleuca*, *Agonis*, *Metrosideros*, *Syncarpia.* It possibly also occurs in some *Proteaceae*, *Coniferae*, *Casuarina*, and some *Rubiaceae.*

The woody structure, large size and modified shape of the fruits formed in previous seasons must be allowed for in identifying the species. Inadequate material may cause considerable confusion.

*Cited literature:* (1) DELPINO, Mem. R. Ac. Sc. Inst. Bologna V, 4 (1894). (2) Ber. Deutsch. Bot. Ges. 24 (1906) 450–459. (3) Onkruidflora Jav. Suiker. (1930) 406–407. (4) WINKLER, Ann. Jard. Bot. Btzg 20 (1905) 37–41.

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### 5. *Dimorphous flowers*

A most peculiar case of flower dimorphy occurs in some *Orchidaceae viz* in *Renanthera lowii* RCHB. *f.* (1) and *Grammatophyllum speciosum* BL. (2). The shape and colour of the lower flowers in a raceme are very much different from those of the upper ones. In these Orchids the occurrence of aberrant lower flowers is a normal phenomenon. It seems also to occur in some species of *Arachnis* and less obviously in some species of *Bulbophyllum*.

In *Oberonia imbricata* LINDL. the upper flowers of the spike are abnormal and their gynaecium is reduced.

Dimorphous flowers are also frequently found in dioecious and polygamous plants. Male and female flowers are sometimes very different in shape and size, *e.g.* in *Mangifera*, *Brucea*, *Hevea*, *&c.*

In thyrsoid inflorescences the marginal flowers are often different from the central ones, or sometimes the central ones are reduced or deformed. A conspicuous instance is *Mussaenda* where some flowers of the inflorescences have one calyx lobe large and leafy. Other cases are found in *Hydrangea*, *Sambucus javanica* REINW., some *Umbelliferae*, some *Araliaceae*, *e.g. Boerlagiodendron*, and some *Mimosaceae*.

*Cited literature:* (1) WINKLER, Ann. Jard. Bot. Btzg 20 (1906) 1. (2) COSTERUS, Dodonaea 6 (1894) 24.

### 6. *Cleistogamous flowers*

Cleistogamous flowers occur frequently in the Malaysian flora. A general survey has hitherto not been compiled.

They were described in *Clitoria* by HARMS (1) and RANT (2) where they are sometimes more frequent than normal flowers. The description of specimens with cleistogamous flowers has led here to phytographical confusion: the American genus *Martia* LEAND. SACR. was based on a cleistogamous leguminous plant which is, actually, according to BENTHAM and HARMS (*l.c.*) nothing but the cleistogamous state of *Clitoria*.

Cleistogamy also occurs in Malaysian species of *Viola*. It is stated by BECCARI (3) to occur in several Bornean *Annonaceae*.

A very typical example is described in *Commelina benghalensis* L. by J. VAN WELSEM (4): cleistogamous flowers are present on subterranean shoots.

Another well known case in a common plant is *Ruellia tuberosa* L. mentioned by VAN WELSEM (5) and A. F. G. KERR (6).

Cleistogamous (better: *cleistopetalous*) flowers are common in *Orchidaceae* as J. J. SMITH and R. SCHLECHTER both frequently mentioned. The former gives a list of cases known to him in connection with his experience on autogamy (8); the latter studied the occurrence of cleistogamy especially in New Guinea (7) and found it in several genera, and both in the lowland and in the mountains. Sometimes in several specimens all the flowers are cleistogamous, *e.g.* in *Eria rugosa* LINDL. and *Dendrobium gemellum* LINDL. SMITH even found species which are only known in the cleistogamous state (8, p. 138), or of which normal flowers have only occasionally been found.

SMITH suggests that cleistogamy is more common in the rainy season, and he mentions that R. SCHLECHTER also got the impression that cleistogamy was common in very wet places in Sumatra and in the mossy forests of New Guinea more frequent in the rainy season than in the dry period. The same phenomenon has been observed by C. A. BACKER (9) for cleistogamy in *Dicliptera canescens* NEES (*Acanth.*) in Java; in moist countries or during wet periods in the dry season this plant produces minute white cleistogamous flowers the corollas of which drop in the early morning.

It is certainly noteworthy that a single trivial character like cleistogamy can so upset taxonomical judgment that a new genus has been based on this abnormal state of a plant; this character changes the whole floral development, and suppresses the manifestation of numerous genom tendencies in the mature plant. Physiologically this can only be explained by some break in the physiological chain reactions in an early stage of the development of the flower. The field observations mentioned above may show how this problem may be studied experimentally.

*Cited literature:* (1) Ber. Deutsch. Bot. Ges. 25 (1907) 165–176. (2) Ann. Jard. Bot. Btzg 44 (1935) 239–242; Bull. Jard. Bot. Btzg III, 4 (1922) 241. (3) Wanderings in the great forests of Borneo (1904) 402. (4) De Trop. Natuur 4 (1915) 142; see also BACKER, Handb. Flora Java pt 3 (1924) 25. (5) De Trop. Natuur 2 (1913) 53–58, 68. (6) Journ. Siam Soc. Nat. Hist. Suppl. 10 (1935) 66–67. (7) Die Orchid. Deutsch Neu Guinea, FEDDE, Repert. Beih. 1 (1914) p. I–li. (8) Natuurk. Tijdschr. Ned. Ind. 88 (1928) 122–140, Orch. Rev. 37 (1929) 75, Nova Guinea 14 (1929) 359. (9) Onkruidflora Jav. Suiker (1931) 676, *in nota*.

## Teratologo-morphosis

### 7. *Teratological forms*

Malaysia can boast of a series of good articles by J. J. SMITH & J. C. COSTERUS (1) dealing with teratological phenomena in plants.

Though several of these teratological forms are due to some hereditary factor, others are apparently caused by external factors. Some are possibly the result of a fungus's attack though no fungus has been found.

*Pometia pinnata* FORST. almost always has peculair large brown structures like witches' brooms by which the tree can easily be recognized in the riverine forest: they suggest inflorescences.

*Invirescentia* are quite a common phenomenon in several *Compositae* (fig. 10); the fact that they are often found together in colonies in several different species suggests that they may be due to some virus (?).

*Monstrous flowers* occur rather frequently in *Orchidaceae* and have often confused systematists.

J. J. SMITH (2) has given an interesting account of them. The absence of a rostellum is closely connected with autogamy. As a result the flowers often hardly open, do not develop well, and their colour is paler than normal *e.g.* in *Phajus tankervilliae* BL.

Fig. 10. Invirescence of *Emilia sonchifolia* DC. (*Comp.*) from Mt Abang, Bali, sandy riverbed, *ca* 1000 m, × 1/2.

Sumatran specimens are apparently more normal than Javan. Of quite a number of these abnormal *Orchidaceae* no normal specimen is as yet known.

Another abnormality is a variation in the number of anthers, which, in *Dilochia pentandra* RCHB. *f.*, is five; this 'species' is, however, a mere form of *D. wallichii* LINDL. In other cases the third stigmatic lobe is changed into a rostellum and the rostellum has become a stigmatic lobe.

J. J. SMITH remarks that the phenomenon of peloria occurs in different degrees. Mostly the peculiarities of the labellum disappear, sometimes the tepals show some characteristics of the labellum. As peloria is for the most part inherited these forms are treated in more detail in the following chapter, paragraph 2.

Teratological aberrations frequently cause such large changes in the structure of flowers that they strongly suggest some taxonomic novelty. An additional example is: an interesting 3-seeded *coconut* (3). DE WIT & POSTHUMUS collected at Buitenzorg, Sept. 1944, a specimen of *Cassia mimosoides* L. of which each flower possessed 2 ovaries. This character is considered to be primitive or ancient in the *Leguminosae*; it has been reported to occur in several *Caesalpiniaceae*, *e.g.* in African *Schwartzia* (6) and Indian *Caesalpinia* (7). In *Archidendron*, a genus of *Mimosaceae* centred in New Guinea, it is a generic character.

Monstrous forms occur frequently in *ferns* where the plasticity seems greater than in *Spermatophyta*. Forked, lobed, and crisped leaves occur in many genera. Sometimes these monstrosities seem to be inherited and of racial rank (4). Even precocious spore formation may be partly inherited.

Teratological aberrations merge gradually into *individual variations*. It is questionable whether an individual of *Cassia mimosoides L.* with two ovaries is to be classed as a teratological or individual variation.

I will mention only a few examples of individual variation. MELCHIOR found (5) some flowers in *Aphania masakapu* MELCH. with free anthers. BACKER found individuals of *Alysicarpus rugosus* DC. with 2–3-foliolate leaves. The leaves of *Cissampelos pareira* L. are sometimes both peltate and non-peltate in one plant. Some specimens of *Amaranthus spinosus* L. are unarmed.

There is no end to this kind of individual variation which sometimes affects typically structural characters. Experiments are needed to ascertain whether these aberrant plants are sports of the genom and hereditary or not.

*Cited literature:* (1) Ann. Jard. Bot. Btzg vols 13, 19, 23, 24, 28, 29, 32, 33, 39, 42 (1895–1931). (2) Natuurk. Tijdschr. Ned. Ind. 88 (1928) 122–140. (3) Natuurwet. Tijdschr. Ned. Ind. 101 (1941) 144. (4) O. POSTHUMUS, De Trop. Natuur 25 (1936) 177–178. (5) Notizbl. Berl.-Dahl. 10 (1928) 277. (6) JACQUES-FÉLIX, Bull. Soc. Bot. Fr. 92 (1945) 158. (7) WIGHT & ARNOTT, Prod. Fl. Pen. Ind. Or. (1834) 281.

**Hypselo-morphosis**

8. *Phenotypic effect of altitude*

G. BONNIER, and later F. E. CLEMENTS, experimented on the effect of altitude on plants. BONNIER even assumed that species might change under prolonged exposure to different conditions into other species but it seems that his experiments are untrustworthy (1).

In the Malaysian mountains where collectors are often compelled to follow ridges, plants from exposed situations are frequently brought home. Their foliage is often reduced, the leaves roundish, margins recurved, texture coriaceous, venation prominent, petioles reduced, habit compact. It is

not always certain that these characters are a 'normal feature' of the species. It is, therefore, of the greatest importance to try to collect such species from less exposed habitats (light, wind, poor soil), *i.e.* from the more fertile, sheltered, though less

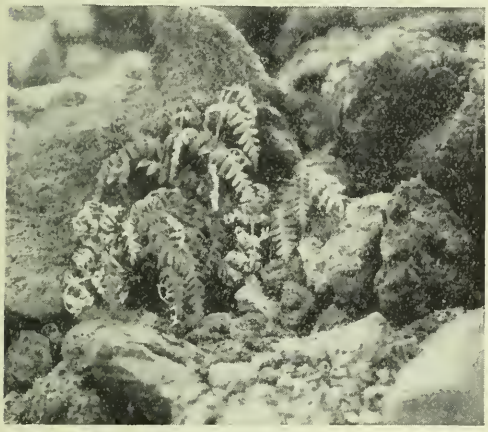

Fig. 12. *Histiopteris alte-alpina* v. A.v.R. (*Polypod.*), an altitudinal form of *H. incisa* J.Sm., in its habitat between 'sterile' rocks on the summit of Mt Kerintji, W. Sumatra, *ca* 3750 m alt. (Frey Wijssling)

accessible slopes. Extensive notes and large collections may show that such variability exists and serve to define the position of transitional specimens. The same species may be a crooked gnarled shrub when growing on a ridge and a moderately tall tree 50 m lower on the slope.

The dwarfing of trees towards the summits of mountains and ridges is chiefly due to the gradual disappearance of the bole with increasing altitude. This is partly a consequence of the development of the young plants under a gradually increasing light intensity which stimulates branching close to the base. I observed a striking example in the field of dwarfing in *Casuarina junghuhniana* Miq. on Mt Soeket, Idjen volcano, E. Java. Herbs too are generally dwarfed at high altitude, *e.g. Erigeron linifolius* Willd.

I studied an instructive case of variation induced by altitude combined with poor rocky soil in the grass *Isachne pangerangensis* Z.M. (fig. 11). A large series of transitions from tall to dwarfed specimens were represented.

An example of a 'hypselo-morphosis' which has been described as a local-endemic species is that of the fern *Histiopteris alte-alpina* v. A. v. R. (fig. 12) from the summit of Mt Kerintji, West-Central Sumatra, which is found at *ca* 3700 m alt., on a barren rocky ridge. This is certainly only a form of the common volcanophile *H. incisa* J. Sm.

It is difficult, however, to single out the various factors associated with increasing altitude *viz* more wind, sudden and large changes of temperature, strong insolation, poorer soils, lower atmospheric


Fig. 11. Variable habit of *Isachne pangerangensis* Z.M. (*Gram.*) in N. Sumatra, Mt Losir, *a.* on burnt ridge in thick humus, 1500 m, *c.* on ridge with ericoid scrub, half-shade, thinner soil, 2000 m, *d-e.* open sandy flats on poor soil, 3000 m, *f.* on rocky windswept summit, soil nearly absent, 3440 m, × 1/4.

pressure, different fluctuations of atmospheric humidity, greater difference between day and night temperatures, &c. In the absence of experiments one can only make some suggestion, in many cases based on observation in the field only.

I know of only few species which are hairier in the mountains than in the lowland, *e.g. Hydrocotyle sibthorpioides* LAMK, of which BLUME described the hairy form as *H. hirsuta* BL. *non al.* However, glabrous forms of this species also occur on the mountains! An other example is that of *Dodonaea viscosa* (L.) JACQ.

KURZ (2) in his 'Sketch of the Vegetation of the Nicobar Islands' has remarked on the apparent absence of any general relation between hairiness and environment.

There is no general rule that flowers are brighter coloured in the mountains. *Ageratum houstonianum* MILL. has larger capitules and brighter blue flowers in the mountains than at low altitude but on Mt Pakiwang, S. Sumatra, I found the reverse (3), *Scutellaria javanica* JUNGH. *var. sumatrana* BACKER having here blue flowers at the base of the peak but white ones towards the summit.

Of *Dendrobium jacobsonii* J. J. S. (*§ Pedilonum*) from the *Casuarina* forests 2400–2900 m alt. in East Java, J. J. SMITH says that at Bandoeng at 700 m alt. cultivated specimens had smaller and paler coloured flowers with a slightly different flower shape: mentum not bent and differences in the labellum; the inflorescences were, moreover, sometimes 2-flowered (4).

Fruiting and flowering are also strongly influenced by altitude, as I demonstrated elsewhere (5).

Experiments on the influence of altitude, the morphological and physiological behaviour of Malaysian plants have been scarcely made. TEYSMANN made some observations in his pioneer work on Mt Gedeh in West Java but did not comment; COSTER (6) wrote a note on the beech specimen planted by the former.

In the Malay Peninsula RIDLEY (7) made some notes on the acclimatization of plants and the ways in which they can be accomodated at low altitude.

*Cited literature:* (1) The New Systematics 1940, p. 55 *seq.* (2) Journ. Asiat. Soc. Beng. new ser. pt II, 45 (1876) 126. (3) Bull. Jard. Bot. Btzg III, 13 (1933) 16. (4) Bull. Jard. Bot. Btzg II, no 26 (1918) 41. (5) Bull. Jard. Bot. Btzg III, 13 (1935) 331–343. (6) Ann. Jard. Bot. Btzg 35 (1926) 105. (7) Agric. Bull. Str. & Fed. Mal. St. volumes 6–7 (1907–08).

**Photo-morphosis**

9. *Epiphytes*

It is sometimes wrongly assumed that epiphytism is confined to specific plants which are restricted to this mode of life. The amount of light appears to be the main factor. On the floor of closed forest the shade prevents epiphytes from making use of patches of bare soil, which in primary forest are always present. Exposed places, such as *rocks*, *lava streams*, *landslides*, *poor silicious soils*, *mud streams* and *solfatara*, however, offer conditions suitable for their growth, and are indeed often the places where many epiphytes are assembled, *i.e.* selected from the neighbouring forest. Though epiphytes may withstand dry conditions well, they mostly need a rather high atmospheric humidity which, in these exposed places, becomes a limiting factor. Most astonishingly rich communities of epiphytes I found on the often misty slopes of Mt Tèlong in N. Sumatra which from 1800 m upwards is like a rock garden carpeted with normally epiphytic orchids amidst luxuriant dripping cushions of hepatics and mosses with some isolated dwarf *Rhododendrons*. It is sometimes contended that these terrestrial epiphytes are *epilithes* but I have

Fig. 13. *Vaccinium laurifolium* MIQ. (*Eric.*) as a hemi-epiphyte, height *ca* 5 m, along a road above Trètès, 1500 m, N. slope of Mt Ardjoeno, E. Java.

also found them in deep humic soil between the rocks. I did not succeed in detecting any essential differences in habit between terrestrial and epiphytic specimens.

In other species, though, the terrestrial specimens may differ considerably in habit from epiphytic; they become more rigid and condensed, often fastigiate. *Vaccinium lucidum* (Bl.) Miq., as an epiphyte is a loosely and irregularly branched shrublet with a tuberous woody base. Terrestrial specimens on ridges are mostly cupressus-shaped miniature trees without the woody tuberous base. Similar differences are found in *Ficus deltoidea* Jack of which the epiphytic and terrestrial specimens may differ considerably in habit.

Fig. 14. Habitat variations of *Gentiana quadrifaria* Bl. (*Gent.*) in Java. The condensed pin-cushion shape is found on open dry windswept habitats, the loose habit on marshy or slightly shady soil, × 1/2.

It goes without saying that a proposal by Nakai (2) to distinguish the Ericaceous *Agapetes* and *Vaccinium* by a terrestrial habit in the latter and an epiphytic habit in the former did not meet with the approval of Sleumer.

Some species begin their life as epiphytes but, when their roots subsequently reach the soil, they may grow into trees and sometimes show no sign of their early history. Such is found *e.g.* in *Ficus*, *Fagraea*, *Schefflera*, *Wightia* (1), and I even found it once in *Vaccinium laurifolium* Miq. (fig. 13). Many, however, are equally able to germinate terrestrially and grow normally to trees. This is, in *Wightia*, even more common than the hemi-epiphytic habit. As a small tree it is gregarious on the sunbaked lava streams of Mt Idjen in East Java, but on the forested outer slopes of the same mountain it is a hemi-epiphyte.

*Cited literature:* (1) Revision of *Wightia*, Bull. Jard. Bot. Btzg III, 18 (1948) *in the press*. (2) Japan. Journ. Bot. 12 (1936) 37–38.

### 10. *Shade forms*

Shade forms are found both in the lowland and the mountains. In general they possess larger, thinner leaves, longer internodes, *&c.* Shade and normal leaves may occur in one individual. A very good example is *Gentiana laxicaulis* Z.M. described from Java, which appears to be a shade form of *G. quadrifaria* Bl. Sometimes compact tussocks of the latter bear on one side shoots of 'laxicaulis' in one individual plant (fig. 14).

*Slender modifications* of herbs can be observed in tall grass fields, comparable with those in temperate corn fields. These weeds growing in the damp dark micro-climate between the closely set culms of *Saccharum spontaneum* L., *Andropogon amboinicus* (L.) Merr., *etc.* strive for light. They show reduced leaves and inflorescences in relation to their lank habit. All herbs unable to emerge from the tops of the grasses show a similar habit, a kind of etiolated growth combined with some degree of nanism.

For the effect of light on the habit of forest trees see the paragraph on savannah trees.

## Hygro-morphosis

### 11. *Influence of drought*

Hardly anything is known of the influence of drought, and the changes induced by it in the morphology and physiology of Malaysian plants. In *Gerbera jamesonii* Bolus I observed in the dry year 1945 at Buitenzorg an astonishing reduction in length of the peduncles in relation to leaf length. The size of the leaves was very much reduced during the same period in *Turnera subulata* Sm. (*T. trioniflora* Ait.).

Similar behaviour is mentioned by Backer (1) in *Jatropha gossypifolia* L. *var. elegans* M.A., a plant which is thoroughly naturalized in the dry regions of Java and the Lesser Sunda Islands; during the driest period of the dry season only minute, short-petiolate dark-brown leaves are produced.

Flowering of some trees, *e.g. Dipterocarpaceae*, and probably *bamboos* coincides with unusually dry years. Higher fungi fructify after a dry spell.

*Cited literature:* (1) Onkruidflora Jav. Suiker. (1930) 411.

## Hora-morphosis

### 12. *Seasonal variation*

Seasonal variation as described in Europe (1) I have not found recorded from Malaysia. In the cultivated *Hibiscus sabdariffa* L. I have seen fruiting specimens flowering a second time; these flowers, however, were only half the normal size and, also, paler in colour. Field botanists should search for 'autumn forms' in periodically dry regions.

Seeds of seasonal plants germinating in the wrong season may sometimes grow into dwarfs. I observed such forms also in *Hibiscus sabdariffa* L. at Buitenzorg. These dwarfs were 10–15 cm high and

Fig. 15. Oblique, wind-trimmed *Tamarindus indica* L. (*Leg.*) on a ridge at *ca* 600 m on Noesa Penida, SE of Bali Island (DE VOOGD)

had 2-3 flowers producing good seeds; the flowers were mostly much smaller than those of specimens flowering in the optimal season.

Of leaf-shedding trees flowers are often collected with immature foliage which may deviate considerably from mature leaves. A peculiar case is that


Fig. 16. Compact dwarfing of plants near the fumaroles on the summit of Mt Kembar, Ardjoeno, E. Java, 3100 m alt. Normal specimens left, dwarfed ones right, × 1/3.

of some leguminous trees which produce leaves in flushes; the latter consist of pale or white or even pink-coloured limply hanging leaves which only slowly get their normal texture (*Maniltoa*).

The distinction between annuals, biennials and perennials causes many difficulties in species growing both inside and outside the tropics, specially when the duration of life is used as a character to establish taxonomic limits. I assume *e.g. Centrolepis* to be annual in N. Sumatra, though its perenniality in S. temperate regions is used as a distinctive generic character against allied genera. In some *Gramineae* species may be similarly variable, specially in tropical localities, and thus deviate from temperate representatives of the same species in a character which is, in grasses, generally assumed to be of importance for the delimitation of species if it runs parallel with other morphological differential characters. It is puzzling me how it is possible to interprete from herbarium specimens the duration of life of perennials flowering during their first year and collected in that state. The use of the duration of life as a character in keying out species must be limited to very clear cases based on wide experience.

*Cited literature:* (1) R. v. WETTSTEIN, Unt. ü. d. Saison-Dimorphismus im Pflanzenreiche. Wien 1900. 42 *pp.*

**Anemo-morphosis**

13. *Windforms*

A peculiar aberrant habit in shrubs and trees can be caused by constant winds. I have described this from Noesa Penida and Bali (1) in *Terminalia catappa* L., *Barringtonia asiatica* (L.) KURZ, *Calophyllum inophyllum* L., *Bischofia javanica* BL., *Ficus sp.*, and *Tamarindus indica* L. (fig. 15). Other more recent examples are *Dodonaea viscosa* JACQ. near the Wijnkoops Bay, S. Java, and plants from Padang Bolak in N. Sumatra described by M. VAN DER VOORT (2). These plants possess sometimes a peculiar oblique condensed one-sided habit and always show a decreased leaf size apparently owing to desiccation of the buds. They are found both on seashores and inland.

*Cited literature:* (1) De Trop. Natuur 26 (1937) 69–78, 14 fig. (2) De Trop. Natuur 28 (1939) 201–209.

**Edapho-morphosis**

14. *Fumarole plants*

I have described (1) very aberrant modifications from some mountain summits *viz* Mt Ardjoeno in East Java (2) and Mt Agoeng in Bali (3) at 2900–3000 m alt. Some common lowland weeds, have through chance dispersal by wandering pilgrims and/or by deer established themselves in the immediate neighbourhood of fumaroles. Owing to the heat and moisture emitted by the fumaroles they are able to grow at these high altitudes. They are very much reduced in size and in habit very condensed, and their leaves are very small (fig. 16). Without

flowers their identification would be difficult. They live in what may be called 'open air hothouses' in the subalpine zone, and the altitude, insolation, &c. are doubtless the factors which have induced their

Fig. 17. Dwarf of *Pemphis acidula* Forst. (*Lythr.*) in flower and fruit, seashore of Oedjoeng Koelon, W. Java, × 2/5.

aberrant mode of growth and resulted in what seems to be an 'alpine habit'.

The species concerned were: *Hyptis brevipes* Poir., *Dichrocephala chrysanthemifolia* (Bl.) DC., *Lycopodium cernuum* L., *Emilia sonchifolia* DC., *Bidens pilosus* L., *Oldenlandia herbacea* Roxb., *Fimbristylis capillaris* A. Gray, *Lindernia crustacea* F. v. M.

Fig. 18. Full-grown specimen of *Pemphis acidula* Forst., NE. coast of P. Tioman, Mal. Peninsula. (Corner)

*Cited literature:* (1) The Gard. Bull. Str. Settlem. 9 (1935) 63–69. (2) De Trop. Natuur 23 (1934) 119–120. (3) De Trop. Natuur 25 (1936) 158–159.

15. *Rock plants; calcareous and silicious soils*

Both rocks and silicious soils may bring about rather conspicuous changes of habit in some plants, apparently owing to the small amount of nutrients available. These modifications can occur either at low or high altitude.

Fig. 19. Flowering and fruiting dwarf of *Leptospermum flavescens* J.Sm. (*Myrt.*) on dry sterile sands of Toba highlands, Central Sumatra, in a heath-like vegetation, × 1/2.

Mr C. N. A. de Voogd collected dwarf specimens of *Pemphis acidula* Forst. (fig. 17) on the rocky coast of SW. Java resembling subalpine 'Spaliersträucher'; normally this littoral species is a bush or small tree (fig. 18).

On the so-called 'padangs', the gravelly or sandy flats of various geological history which sometimes occupy large areas in Sumatra and Borneo, many species are dwarfed: *Leptospermum flavescens* Sm. when growing under optimal conditions is a medium sized cedar-like tree (fig. 20); here it is a dwarf, 10–20 cm high, which flowers and fruits abundantly (fig. 19). Many other species behave similarly. If herbarium specimens are not provided with good field notes, a botanist who has never visited the tropics is of course confronted with a puzzle. He may even find some other slight charac-

ter not known to occur in the normal population and may think that they represent a different species: in this way another 'paper species' is created. Residents in the tropics ought to experiment with seeds gathered from dwarf individuals. Abandoned mining grounds in Banka, Billiton and Borneo are rich in dwarf forms of the most diverse species, which flower precociously as very small individuals (1).

Scores of dwarfed species, mostly of shrubs or small trees but also of herbs (*e.g. Dianella nemorosa* LAMK. *f. nana* SCHLITTL. from Camarines and *f. monophylla* SCHLITTL. from New Guinea) occur in the Philippine Islands, and especially in New Guinea on ridges in the mossy forest and the sub-

Fig. 20. Full-grown specimens of *Leptospermum flavescens* J.SM. (*Myrt.*) on the slopes of Mt Bonthain, SW. Celebes. (L. VAN DER PIJL)

On poor unweathered volcanic ash on the slopes of mountains the vegetation as a whole is dwarfed, *e.g.* on the slopes of the easily accessible Mt Lamongan, E. Java. Here the black gravel and sand is continually rejuvenated and gradually runs down. On these ash slopes all the common Javan mid-mountain trees and shrubs are dwarfed but flower and fruit profusely *e.g. Radermachera gigantea* (BL.) MIQ., *Parasponia parviflora* MIQ., and *Weinmannia blumei* (BL.) PLANCH., *&c.* flower and fruit on 1–2 m high shrubs. This observation induces me to suspect that *Radermachera brachybotrys* MERR. from Leyte merely represents a dwarf specimen of some other species; KORTHALS found a similar specimen in the padangs of Borneo.

I have also found dwarfs on wooded limestone cliffs in NW. Bali at 100–200 m mostly of herbaceous species. One of them was so aberrant that I described it as a new variety, *Anisomeles indica* (L.) O.K. *var. biflora* STEEN.; this had solitary flowers, an unusual character in the species (2). Though no experiments have been made it is likely to be an edaphical form only.

alpine zone. No experiments have been done and the 'normal' habit of these plants is thus unknown.

On rock cones, *e.g.* Mt Idjen, E. Java (fig. 21) and Mt Agoeng, Bali, I found *Casuarina* (fig. 22), *Vaccinium*, *Rhododendron* as extremely small shrubs and ascribed this to the very poor soil, though on these cones the influence of climate and soil are not readily separable.

W. TROLL found precocious spore formation in *Gleichenia vulcanica* BL. on Mt Gedeh. This was certainly not caused by altitude but by the locally poor rocky soil. In cracks of rock on the summit Argapoera, of Mt Jang, E. Java, I have collected microphyllous specimens of a *Polygonum* which I originally took for *P. chinense* L. but which DANSER afterwards identified as an aberrant form of *P. runcinatum* DON (fig. 23). On Mt Kerintji were found minute fruiting specimens of *Aralia ferox* BL. which I have distinguished as *f. nana* (3).

*Cited literature:* (1) TEYSMANN, Nat. Tijdschr. Ned. Indië 32 (1873) 84; DUNSELMAN, De Trop. Natuur 27 (1938) 97–104. (2) Bull. Jard. Bot. Btzg III, 17 (1948) 389. (3) Bull. Jard. Bot. Btzg III, 17 (1948) 394.

### 16. *Solfatara plants*

Specimens collected in craters are often of a surprisingly dwarfed habit even when old. SCHRÖTER (1) figured a dwarf plant of *Vaccinium varingifolium* MIQ. of East Java which was probably 50 years old and had the appearance of some alpine 'Spalierstrauch'. At a short distance from these strongly insolated, edaphically dry and often wind-swept barren rocky places on slopes or summits, the same species occurs in hollows or other sheltered places as well-developed shrubs or small trees. The dwarf shrubs of craters are often wholly appressed to the soil (with rooting branches!), with a matted and prostrate habit. Owing to the poisonous gases emitted by the solfatara or effect of the wind on ridges, their surfaces are flat and look as if clipped or pruned (2) (fig. 21, 24). The solfatara may shift its outlet and so release these plants from its influence: I found some partly grown into a fresh bush, proving that the plant had recently escaped from the reach of the gases, the prostrate section being the oldest part. The reverse may also occur; erect shrubs may be affected later by crater gases (3) which makes them one-sided (fig. 25).

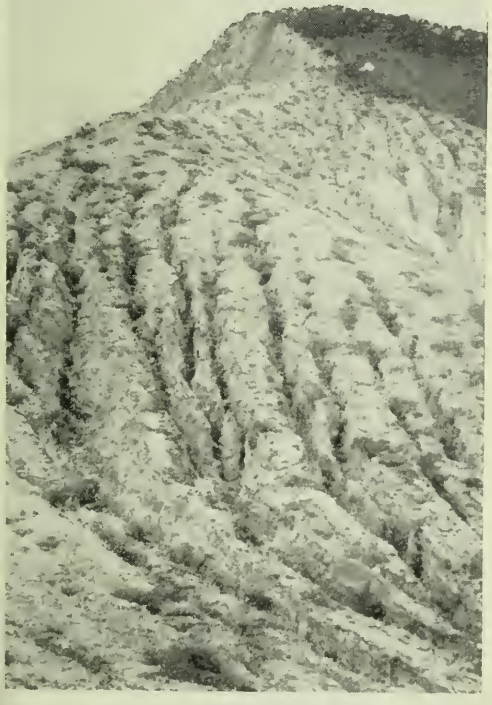

Fig. 21. *Vaccinium varingifolium* MIQ. (*Eric.*) as poor prostrate shrubs ('Spaliersträucher') near Kawah Idjen, E. Java, *ca* 2000 m alt. Exceedingly poor, eroded, very young volcanic soil. This species also grows in the mountain forest on the ridge behind in *ca* 3–6 m tall trees.

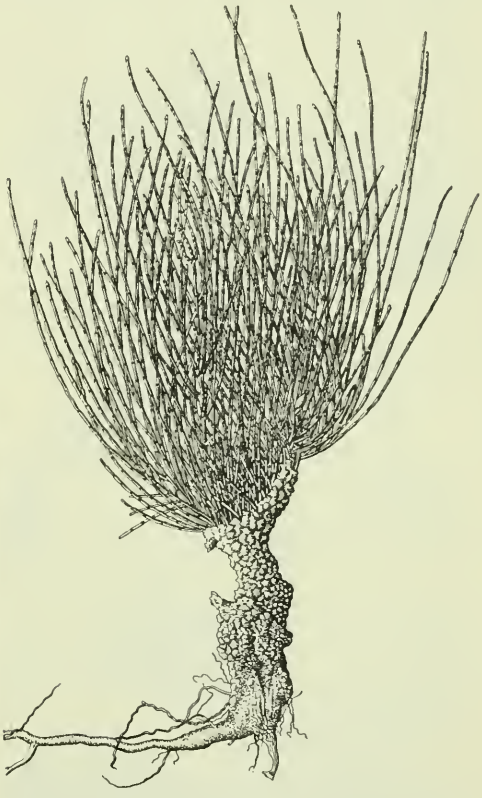

Fig. 22. *Casuarina junghuhniana* MIQ. (*Casuar.*). Old dwarf from the summit of Mt Agoeng, Bali Island, 3100 m, on a rocky windswept cone, × 1/2.

Solfatara plants thus represent forms different in habit, and herbarium botanists must handle these materials cautiously. In a general sense the 'poor soil'-conditions cause nanism.

In Malaysia adaptability to habitat and variability in habit under extreme conditions is far greater than the average herbarium botanist suspects. It is difficult to interpret aberrant specimens from remote regions without a thorough field knowledge. Unfortunately this has led to the description of many 'paper species' which may seem specifically distinct but, when studied under various natural environments appear gradually to merge in the range of modifications existing in many Linnean populations.

*Cited literature:* (1) Vierteljahrschr. Naturf. Ges. Zürich 73 (1928) 584. (2) De Trop. Natuur 24 (1935) 142–144, fig. 2–5. (3) $SO_2$, $H_2S$, $Cl_2$, *&c.*

**Hydro-morphosis**

17. *Water- and swamp plants*

Phenotypic variations comparable to those known in Europe are also known in the Malaysian flora. *Jussieua repens* L., when growing on muddy soil through the lowering of the water level, changes into a conspicuously different land form with minute hairy leaves and very condensed habit; it takes some time to recognize this land form (1). Land forms are also known in *Potamogeton, e.g.* from Sumatra, and in *Utricularia.*

Of *Neptunia plena* BTH. a land form is known. BACKER suggests that the endemic *N. javanica* MIQ., a terrestrial endemic species in Java, is merely a land form of the common *N. oleracea* LOUR. (2).

*Limnophila sessiliflora* BL. and *L. indica* (L.) DRUCE, in shallow water, have deeply divided leaves below the surface with gradual transitions to lobed and toothed upper leaves above the water level. In very deep water pinnatifid leaves predominate, but in marshy grass fields only pinnatisect to dentate leaves are present.

The amount of aerenchyma is closely related to the depth of the water.

Many swamp plants fail to flower in deep water, but come rapidly into bloom when the water recedes (*Lemna, Blyxa, Pistia, Azolla, Salvinia, Marsilea, &c.*).

*Swamp forest trees* are also affected by the amount of water in the soil. A conical base to the trunk, so well known in *Taxodium*, is found frequently in other swamp species *e.g.* in *Gluta renghas* L., *Alstonia spathulata* BL., *&c.* but, in non-inundated soils, the swollen base of the trunk is not or scarcely developed.

The same is true of aerial roots at the base of the trunk. In deep swamps they may resemble the stilt roots of mangrove. Such roots may not develop in the same species when it is growing on dry land *e.g. Acmena* (*Eugenia*) *operculata* (ROXB.) MERR. & PERRY. Root production in these cases is doubtless a direct response to the habitat.

*Cited literature:* (1) De Trop. Natuur 2 (1913) 83, fig. 3. (2) Schoolflora voor Java (1911) 428.

Fig. 23. *Polygonum runcinatum* DON. (*Polygon.*). Below: apex of a normal plant. Above: a very uncommon form of Mt Argapoera (Jang massif, E. Java) from clefts in rocks (ST. 10960), × 2/5.

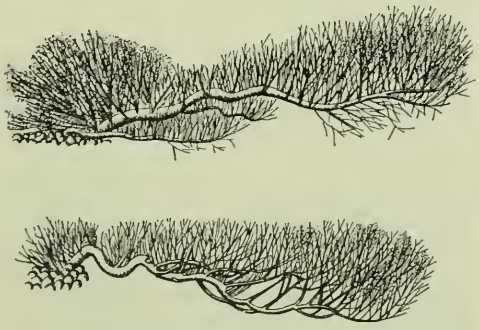

Fig. 24. Sketches of prostrate clipped habit of shrubs in the crater of Mt Papandajan, W. Java, *ca* 2000 m, through the combined action of wind and sulphurous vapours from solfatara. Above: *Vaccinium varingifolium* MIQ., below: *Rhododendron retusum* (BL.) BENN. (*Eric.*) (drawn after photographs).

Fig. 25. Oblique growth of *Vaccinium varingifolium* MIQ. caused by sulphurous gases of the crater of Mt Papandajan, W. Java, *ca* 2000 m alt., *ca* 1 m high.

### Phyto-morphosis

18. *Fungus and bacterial diseases, and symbiosis*

Malformations caused by fungi have led to some errors in identifying Malaysian plants. *Loranthus maculatus* Bl. is, according to Danser, the common *Dendrophthoe pentandra* Miq. with a fungus on the leaves causing black spots (1).

In specimens of *Cassytha filiformis* L. from New Guinea Dr Hatusima found some tetramerous flowers with a central column marked by little pits. The slender inflorescence was glabrous and the rest of the plant hairy. It was evidently a malformation caused by a *Peziza*-like *Ascomycete*.

Fig. 26. Pseudo-flowering of bamboo; galls caused by *Epichloe treubii* (*Fungi*). Bot. Gardens, Buitenzorg, Java.

Root deformities caused by *Cyanophyceae* are found in *Cycas*, *Gunnera*, &c.

Structures like witches' broom are often found in bamboos, and often regarded as immature flowering parts. These pseudo-flowers are galls caused by a fungus (fig. 26).

A curious malformation in *Pilea trinervia* Wight consisting of conspicuous swellings of the internodes was described by Mrs Weber van Bosse (2) and is caused by a parasitic alga: *Phytophysa treubii* W. v. B.

In *Pavetta*, bacteria cause dark often thickened spots in the leaves. According to Bremekamp the symbiosis is mostly restricted to particular species. Similar bacteria are found in species of *Psychotria*, *Ardisia*, the tips of the leaves of *Smilax*, &c. The presence of absence of bacterial nodules is used in the identification of *Rubiaceae*, a rather singular method.

*Cited literature:* (1) Compare Boedijn, Bull. Jard. Bot. Btzg III, 13 (1935) 497–501, fig. 1. (2) Ann. Jard. Bot. Btzg 8 (1890) 165–186.

### Zoo-morphosis

19. *Ant plants (myrmeco-morphosis)*

Several Malaysian plants are inhabited by ants. Treub (1) proved that the cavities in which the ants live in the tubers of *Myrmecodia* and *Hydnophytum* are also formed in the absence of ants.

In other instances, however, ants presumably bite their way into internodes and remove and carry away the pith. This was shown to occur in *Endospermum moluccanum* T. & B. (*E. formicarum* Becc.) by Docters van Leeuwen (2); I am able to confirm this. Docters van Leeuwen also found some specimens *un*inhabited by ants. In *Endospermum*, therefore, whether the internodes are hollow or not is certainly not a good specific distinction, hough used by Pax in his key to the species of

Fig. 27. Above: *Kibessia sessilis* Bl. (*Melast.*) being based on a galled swollen fruit of *K. azurea* Bl. (W. Java). Below: peculiar galls of *Styrax benzoin* Dryand. (*Styrac.*) from Sumatra, × 2/3.

*Endospermum subg. Capellenia* (3). Moreover, as the other character used by PAX, *viz* the number of cocci in the fruit, varies from 3–5, through ignorance of data on points the collector ought to have noted on the label, the whole key breaks down.

In *Wightia borneensis* HOOK. *f.* some individuals are attacked by ants which remove the pith from the upper internodes. The withdrawal of the inner tissue causes the hollow internodes to assume a cigar-like shape.

*Cited literature:* (1) Ann. Jard. Bot. Btzg 3 (1883) 129–153. (2) Treubia 10 (1929) 1–7. (3) Pfl. Reich Heft 52 (1912) 34.

### 20. *Galls deceptive to phytographers (cecidio-morphosis)*

*Cecidia* caused by animals have sometimes deceived botanists when describing plants. An example is *Ceratostachys arborea* BL., a genus based on a galled fruit of *Nyssa javanica* (BL.) WANG.

*Kibessia sessilis* BL. is merely the galled and enlarged fruit of K. *azurea* BL. (fig. 27).

According to RIDLEY (1) *Apteron lanceolatum* KURZ, described as a distinct genus, is identical with *Ventilago kurzii* RIDL.; KURZ mistook some insect galls for the ripe fruit.

MIQUEL described (2) an abnormal tree from Sumatra which was actually a species of *Styrax*, a genus in which most peculiar galls (fig. 27) are very common.

*Otopetalum micranthum* MIQ. is an *Apocynacea* described from Java. According to BOERLAGE (3) the plant was referred to the wrong tribe because MIQUEL erroneously took galled flowers for 1-seeded berries; the former author suspects that it is related to *Micrechites*.

Insects (mostly cicads and larvae of Hemiptera) cause a singular malformation of the flowers in some species of the genus *Sterculia*. H. C. CAMMERLOHER (5) observed that they are attracted to so-called 'sugar hairs' which occur on the inside of the perianth. The insects injure both the hairs and the outer tissue in an early stage of development of the flower. The calyx becomes enlarged, thicker and tough, and opens hardly in anthesis; its lobes remain short and triangular, and the tube is relatively large. These flowers are conspicuously different from the normal 'uninhabited' flowers and, according to ADELBERT (6), ought not to be used when describing or identifying plants.

BACKER (7) described in *Hibiscus schizopetalus* (MAST.) HOOK. *f.* malformations of the vegetative parts and of the flowers caused by plant lice.

The Philippine species *Euphoria malaanonan* was described by BLANCO and by him referred to *Sapindaceae* but MERRILL stated (8) that it is merely based on specimens of the echinate galls of *Shorea guiso* BL. of the *Dipterocarpaceae*.

W. M. DOCTERS VAN LEEUWEN has published (4) an illustrated book on zoocecidia of Indonesia.

*Cited literature:* (1) Flora of the Malay Peninsula 5 (1925) 300. (2) Linnaea 26 (1853) 285. (3) Handleiding Fl. Ned. Ind. 2² (1899) 380. (4) The Zoocecidia of the Netherlands Indies, Batavia 1926; Supplement, Ned. Kruidk. Arch. 51 (1941) 122–251. (5) De Trop. Natuur 22 (1923) 147. (6) In BACKER, Flora van Java, Nooduitg. IVB (1944) fam. 107, p. 18. (7) Flora van Java, Nooduitg. IVC (1943) fam. 109, p. 27. (8) Spec. Blanc. (1918) 33.

### 21. *Influence of browsing animals (pascuo-morphosis)*

In some parts of Malaysia browsing cattle and deer (1) can induce changes in the morphology of plants which might be termed *pascuo-morphosis*. In

Fig. 28. *Casuarina junghuhniana* MIQ. (*Casuar.*) on Mt Jang, E. Java; crown trimmed below by deer.

the deerpark of the Buitenzorg Palace, deer regularly feed on the pendent air roots of *Ficus* and prevent them from reaching the soil. The trees therefore remain single-stemmed and do not form thickets of pillar-like roots.

A similar effect is caused by deer on Mt Jang, in East Java, where deer eat the hanging branches of *Casuarina junghuhniana* MIQ. as high as they can reach (fig. 28). The trees look as if clipped (2) at the underside of the crown like those on the lawns at Buitenzorg. Much the same was observed on Mt Rindjani, Lombok Island (3). The broom-like appearance of the grass *Pogonatherum paniceum* HACK. on Mt Diëng was ascribed to grazing cattle by the late Mr LOOGEN (4), an excellent amateur field botanist.

Browsing of animals has in general the same effect on the vegetation as frequent burning: the plants acquire a low habit and flower at an early age (pseudo-nanism). This occurs very commonly on the closely cropped fields of fine grass of Mt

Jang. It is only in hedges, on steep slopes or somewhere out of reach of deer that plants grow to normal dimensions.

In Central and East Java, and the Lesser Sunda Islands *pascuo-morphosis* is due to browsing of cattle in the dry season; it is known in *Zizyphus jujuba* L., *Streblus asper* L. and other shrubs. These assume a fastigiate habit as high as the browsing animals can reach: above about 2 m the twigs are again spreading and form a globular crown.

A transition to anthropo-morphosis is the clipping and pruning of plants which can sometimes produce an aberrant habit. According to Backer (5) repeated cutting of plants along roadsides produced a peculiar table-shaped densely branched form in *Sida retusa* L. near Batavia. In the Lesser Sunda Islands cattle are sometimes fed in the dry season with leaves of trees, as is done in Africa. For this purpose the people lop the lower branches of trees in order that cattle may reach the foliage. This causes a tendency to umbrella-shaped trees. Deer may cause the same change of habit.

*Cited literature:* (1) Mentioned for India by Hooker & Thomson, Flora Indica (1855) 29. (2) De Trop. Natuur 21 (1932) 27. (3) De Trop. Natuur 30 (1941) 123. (4) De Trop. Natuur 30 (1941) 70. (5) Flora van Batavia (1907) 102.

### Anthropo-morphosis

#### 22. *Influence of fire* (*pyro-morphosis*)

The changes in habit and structural characters induced by fire were named *pyro-morphosis* by Perrier de la Bâthie who made observations in the island of Madagascar. In Malaysia there are few reliable data. One of the changes induced by regular burning of the vegetation is that plants are stunted, and flower when small.

Owing to the damage done to the surface part of the plant the underground parts thicken, and the upper portion of the rootsystem and lower portion of the stem form gradually a thickened half-subterranean 'lignotuber', which sprouts after fires have swept the plains. I made some observations in the Indramajoe plains (W. Java), where species of *Grewia*, *Butea*, *Dillenia*, *Morinda*, *Phyllanthus emblica*, *Zizyphus*, &c. sprouted from these thickened bases (1) (fig. 29).

Some instances of phytographical importance have come to my knowledge. Rant found (2, 3) that *Psidium cujavillus* Burm. *f.* can originate spon-

Fig. 29. Seedling of *Butea monosperma* Taub. (*Leg.*) sprouting in its 3rd year in the fire-swept savannahs of Indramajoe, W. Java, and developing a lignotuber, × 1/3.

Fig. 30. Park-like savannah in SW. Soembawa; trees with short boles and rounded crowns. (de Voogd)

taneously from root shoots of *Ps. guajava* L. It is distinguished from *Ps. guajava* L. mostly by differences of size. *Ps. cujavillus* BURM.*f.* must, therefore, be reduced to a sport of *Ps. guajava*.

Fire-resistant trees are often crippled beyond recognition. Plants described from semi-arid (4) regions where fires occur annually are sometimes known only in this crippled state, *e.g. Fordia fruticosa* CRAIB, from N. Siam, described (5) as a shrublet 40 cm tall. The late A. F. G. KERR, a most able and experienced field botanist, stressed in a note made in the field that the plant was growing in an area subject to fire; this may explain such a habit in this otherwise arboreal genus. The normal plant will, in all probability, prove to be a tree.

*Cited literature:* (1) De Trop. Natuur 25 (1936) Jub. nummer, p. 117–118. (2) Ann. Jard. Bot. Btzg 41 (1930) 27–32. (3) Natuurk. Tijdschr. Ned. Ind. 94 (1934) 112. (4) That is: regions which are periodically wet and dry, and show two distinct seasons coinciding with the monsoons. (5) Kew Bull. 1927, 60; Fl. Siam. En. *1* (1928) 395.

### 23. *Pioneer plants*

In the preceding paragraphs 9, 14–16, and 22, several examples have already been given of pioneer plants. I am decidedly of the opinion that this term should not be restricted to plants peculiar to landslides and other bare soils. Trees settling in savannahs or devastated areas, epiphytes settling on rocks, *&c.* are just as well 'pioneer plants'. They constitute seral vegetation types. In the initial stages of revegetation forest trees may appear as pioneer shrubs, flowering and fruiting early. It is rather baffling to find *Schima noronhae* REINW. flowering and fruiting as a lax shrub 2 m tall, when one is familiar with the gigantic full grown tree in the forest (height sometimes over 50 m, columnar bole over 1 m diam.). BACKER found (1) near Batavia flowering specimens 15 cm tall of *Grewia microcos* L., usually a tree up to 17 m high. The same phenomenon can occur in *Adinandra*, various *Urticaceae*, *Leguminosae*, *Ulmaceae*, *&c.* In New Guinea some endemic species were originally described as tall trees but Mr BRASS has recently found them as gregarious pioneer shrubs in different seral vegetation types.

A promising shade plant, *Albizzia sumatrana* STEEN., described from the Westcoast of Sumatra, was found to be a forest tree. In the plantations it is a weed tree flowering and fruiting at a very early age. In the forest, its native habitat, flowering is apparently suppressed by the deep shade, the seedlings grow into pole trees, slender and tall with a minute crown and real growth only starts when the crownlet emerges from the canopy. The behaviour and appearance of forest trees when growing in the open cannot be predicted. The adaptive capabilities of most Malaysian forest trees are unknown, though data on these points would be of great importance for practical forestry. See also chapt. 2 on precocious flowering, a phenomenon frequently observed in pioneer plants.

*Cited literature:* (1) Flora van Batavia (1907) 196.

### 24. *Savannah trees*

Trees of the savannah generally differ in habit from trees of the closed forest in their short bole and spherical crown (fig. 30). If young forest trees

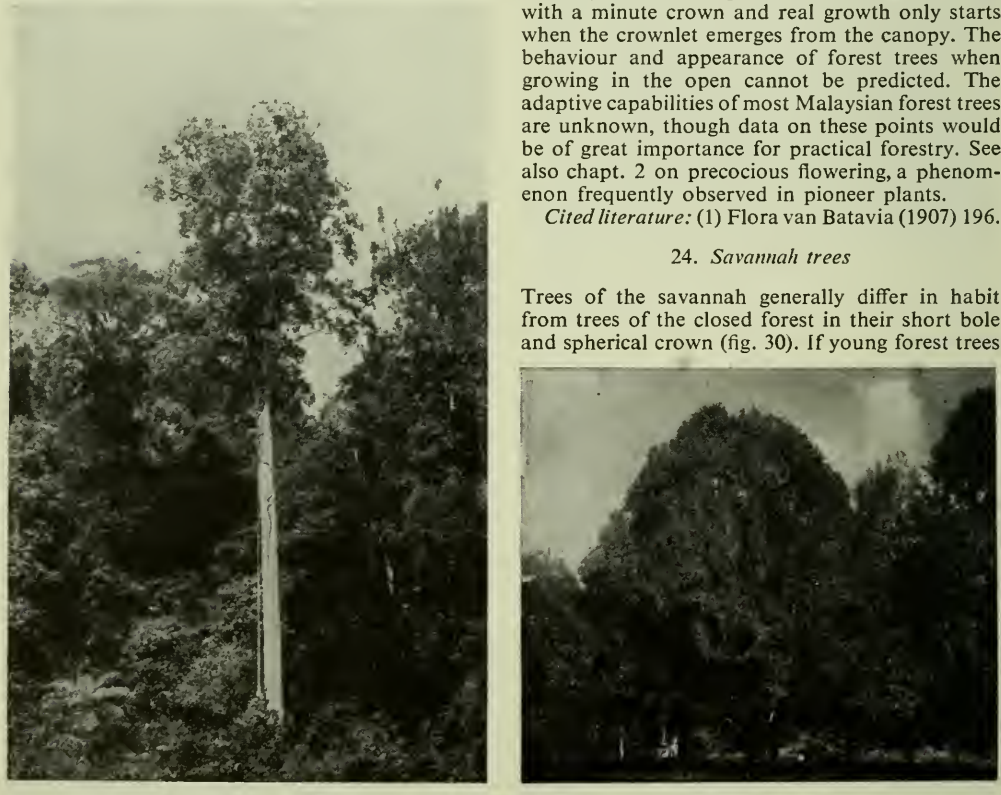

Fig. 31. *Altingia excelsa* NOR. (*Hamam.*) at Tjibodas, W. Java, *ca* 1450 m. Left: forest-grown tree, clear bole *ca* 25 m. Right: planted on the lawns of the mountain garden, at *ca* 200 m distance.

in deforested areas become exposed, or when they are planted as roadside trees, they acquire this shape: a striking example is *Altingia excelsa* NOR., a forest giant of the West Java midmountain forest between 600-1600 m. The clear bole is usually a characteristic feature of the tree; it is columnar, up to 1½ m in diameter, and up to 20–30 m from the ground unbranched (fig. 31). Specimens 50 years old, however, planted on the lawns at Tjibodas mountain garden, have grown into low spreading trees with hardly any bole at all (fig. 31). Descriptions of the habit of trees and shrubs taken from specimens grown in private and botanic gardens, will therefore generally not agree with those taken from specimens in the forest. THORENAAR made similar observations in Javan oaks, and other trees such as *Podocarpus imbricata* BL., *Quercus*, *etc.* The habit of trees grown in open gardens resembles the shape of trees of the savannahs where the rounded crowns on a short bole often characterize the physiognomy of the open savannah forest. Physiologically this tree form is in all probability determined by the high amount of light present during the juvenile stages of growth. The crowns of mature forest giants exposed after deforestation also tend to become rounded.

## VARIATIONS BOUND TO THE GENOTYPE

### (*Genotypic variation*)



Variation bound to the genotype is intimately related to the species concept and to geographical distribution. The ideas advanced by J. D. HOOKER in his introductory essay to the 'Flora Indica' (1855) have gained in 'philosophical' importance through the progress of basic research in experimental taxonomy in the last decades in Europe and the United States, in particular by E. BAUR, F. v. WETTSTEIN, N. H. NILSSON, G. TURESSON, A. MÜNTZING, Ö. WINGE, G. D. KARPECHENKO, B. H. DANSER, W. B. TURRILL, J. CLAUSEN, J. P. LOTSY, H. DE VRIES, N. I. VAVILOV, and many others. This work is summarized in several useful symposia and textbooks such as 'The New Systematics' edited by J. HUXLEY, CAIN's 'Foundations of Plant Geography' and CLAUSEN's *c.s.* 'Experimental Studies on the Nature of Species' (1945).

It lies outside the scope of this essay to consider the various view points on these subjects. Some of them I have already touched on in a study of Malaysian mountain plants.[1]

Now I will try to explain briefly some current views, including my own, and will illustrate them by examples taken from Malaysian botany.

#### 1. *General remarks*

Scientific names of species rest on the 'International Rules of Nomenclature' and depend on the identity of the 'type specimen'. This need not imply that only studies in which all type specimens have been examined, full synonymy is given, in which nomenclature is in accordance with the Rules, and in which new species or other *taxa* have been described by careful Latin descriptions, are sound and durable. I know some excellent works in which nomenclature is neglected and synonymy is obsolete but in which botanical distinction and description are superb, and specific delimination is carefully drawn. Such books give the impression that the author is master of his art.

I become more and more convinced that in the past two decades the care for outward appearance has come to take a too predominant share of the attention of some botanists who wrongly assumed that the examination of type specimens is the last word in real taxonomical research. It is sometimes not realized that *type specimens often are only deficient, poor and miserably dried single plants chosen at random from billions of specimens growing in Nature in the past, the present and the future*, which, together, according to the Linnean principle, compose the specific population. Very often these type specimens by no means represent the 'average' or 'most common type' of the population. The '*α-typica*'-distinction, therefore, has only nomenclatural, *i.e.* administrative but no botanical value.

It needs no comment that an up to date nomenclature is a *conditio sine qua non* for any taxonomic work, and it will be tried to reach a high standard in this Flora. At the same time, however, is is hoped that the contributors will not be satisfied when writing formally correct revisions, but also carefully consider the status of both genera and

(1) Bull. Jard. Bot. Btzg III, 13 (1935) 358-391.

species and the structural differences distinguishing them, not merely limiting themselves to the distinction of *taxa* for reasons of convenience.

Inadequacy of material and lack of field knowledge are both sources for the provisional distinction of 'species of convenience', which mark, in tropical floras, as a rule the initial stage of exploration.

Whilst the inadequacy of material is an immovable obstacle, and not every revisor will have the privilege to acquire field knowledge, a large fund of experience has been collected on the subject of variation in tropical plants.

The following pages contain a discussion, valuation, and illustration of variation in Malaysian plants.

In general the new systematics, based on modern experimental taxonomy holds that a narrow species concept is not in accordance with the structure of nature.

Modern insight offers no support to so-called 'splitters', one of whom declared to me as his 'principle' that he felt obliged to distinguish the smallest distinguishable entities and to assign to these a binomium. On the average the standard of the specific concept proposed by LINNAEUS in his works and rules cannot be questioned and for binomiums the Linnean canon has *priority of conception*. I fail to understand how that conscientious splitter who in matters of nomenclature adheres strictly to priority and applies the binomial system of LINNAEUS can simultaneously call wide-spread polymorphic populations 'collective species'. To do so is intentionally to depreciate the time-honoured and scientifically sound Linnean standards.

The difficulties confronting the systematist are manifold; no clue exists to the causes of polymorphy. Systematists are still far from being able to explain why some species are polymorphic and variable and why others show a narrow amplitude of divergency. This is a fundamental barrier to the methods of 'weighing and measuring', a common basis in the natural sciences generally. Polymorphy is apparently not related to speciation, as monospecific units such as *Homo sapiens*, *Cocos nucifera*, *&c.* are very variable and species of large genera are sometimes not very polymorphic, though it will be observed that in most genera at least one species is widely distributed and rather polymorphic.

Ignorant of the laws underlying his taxonomic distinctions, the systematist should be aware that he deals with *unequal* entities, though we may try to shape them as consistently as possible.

A basic research in this connection is the work of the late E. BAUR, the geneticist, who made unsurpassed long-range efforts in the combined fields of taxonomy, field-work and experiments, to disentangle the genus *Antirrhinum sect. Antirrhinastrum* (1). This section had some dozens of local species described from the West Mediterranean distinguished by characters which were the despair of taxonomists. BAUR proved that the population of the section falls apart in numerous 'colonies' or 'partial populations' which are isolated and cross mutually (*convivia, sensu* DANSER). Each colony has its own type, the larger the colony the wider the local diversity (fig. 33c). All these local types can be freely intercrossed with fertile offspring, and there is no doubt that, if not isolated in nature, they would together merge into a still more diverse population with transitions and intermediates. BAUR, moreover, obtained experimentally many forms *not* realized in nature (*l.c.* p. 289), showing that the potential variability (2) or polymorphy (3), *i.e.* the total number of possible forms (genetic capabilities) is not exhaustively represented. There is a great *reserve* of possible combinations, and the genus manifests itself to us at present under a limited number of combinations.

Hardly any plant species is evenly spread within its area, and many occur in aggregates or colonies. BAUR's findings are thus of the utmost value for the Malaysian archipelago where isolation is a normal factor in specific populations, in the lowland owing to the insular discontinuous nature of this region and in the mountains still more accentuated by the often long distances between the summits. We cannot expect that the whole plant world will be subjected to accurate and thorough experimental research like BAUR's *Antirrhinum*-studies, but, judging from his results, it appears that *geographical distribution is an important argument when determining the status of taxa*. Well-defined allied species possess in general overlapping areas of distribution proving the independence of the populations. If, however, several allied species exclude each other geographically one must be on the alert, and check the differential characters again because the specific population may well be differentiated into a number of races, subspecies, or ecotypes.

Especially along the *frontier*—horizontal and altitudinal—of the area, a species population has a different *facies* from that at its centre. KERNER (4) showed that in *Cytisus sect. Tubocystis* aberrant forms occurred along the border of the area (fig. 33e). Migrating plant individuals (seeds, spores, fruits, root-stocks, *&c.*) carry only a part of the potential polymorphy of the genus, and their offspring will possess a special facies. Hence, along the frontiers, combinations can be expected which are not realized within the centre of the population. According to VAVILOV such pioneer aggregates are found to be recessive homozygotous; this is of great practical importance.

It is worthy of note, as was pointed out by E. C. ANDREWS (5) that BENTHAM realized long ago that the geographical station of a waif or colonist imposes variations upon it almost from the moment of its arrival. ANDREWS adds, that Eucalypts planted in New Zealand, California, *etc.* present marked differences in general appearance from the same species in Australia.

Stimulated apparently by HOOKER (6), HUGO DE VRIES (7), the Master of experimental taxonomic botany, remarked that the initial stages of new species will be found most easily in luxuriant alien vegetations. His classic example, *Oenothera*, showed these 'mutations'—which they indeed are if the

# TAXONOMIC REVISIONS

# ACERACEAE[1] (S. Bloembergen, Buitenzorg)

## 1. ACER

LINNÉ, Sp.Pl. (1753) 1054; PAX, Pfl.R. 8 (1901) 1; K. & V. Bijdr. 9 (1903) 252.

Trees or shrubs, buds with many perules. *Leaves* decussate, petiolate, entire, palmate or pinnate, appearing simultaneously with the flowers or later, exstipulate. Inflorescence racemose, corymbose or spicate, terminal with 2–4 leaves, or rarely terminal or axillary without leaves. Monoecious or dioecious, *flowers* actinomorphic, ♂ and ♀, ovary in the ♂ fls more reduced than stamens in ♀ fls. Calyx and corolla 4–5-merous. Stamens 4–10, mostly 8, hypogynous or perigynous. Disc extra- or intrastaminal. Ovary superior, 2-celled, laterally flattened, each cell with 2 ovules. *Fruit* a samara, splitting into 2, rarely 3, winged usually 1-seeded parts. Seed without endosperm, radicle elongate, cotyledons foliaceous, or thickened, plicate, involute or flat.

Distr. *Ca 200 spp.* in the N. hemisphere, only in Malaysia crossing the equator.

Notes. By BLUME, BENTHAM & HOOKER, MIQUEL, *&c.* this genus was included in the *Sapindaceae.* In Malaysia only one species.

**1. Acer niveum** BL. Rumphia 3 (1847) 193; PAX, Bot. Jahrb. 6 (1885) 293; *ibid.* 7 (1886) 207, *cum var. cassiaefolium;* WESMAEL, Bull. Soc. Bot. Belg. 29 (1890) 41, *cum var. praec.;* SCHWERIN, Gartenfl. 42 (1893) 228, *cum var. laurinum & praec.;* PAX, in E. & P. 3, 5 (1896) 267, 271; Pfl.R. 8 (1901) 4, 31; K. &. V. Bijdr. 9 (1903) 254; BACKER, Schoolfl. (1911) 272; HEYNE, Nutt. Pl. (1927) 987; KOORD. Fl. Tjib. 2 (1923) 153; MERR. En. Philip. 2 (1923) 493; STEEN. Bull. J.B.B. III, 13 (1936) 148.—*A. javanicum* (non BURM. *f.*, 1768) JUNGH. Monatsber. Berl. Geogr. Ges. 1842; JUNGH. & DE VR. Tijd. Nat. Gesch. & Phys. 10 (1843) 138.—*A. laurinum* HASSK. *ib. nomen;* MIQ. Fl. Ind. Bat. 1, 2 (1859) 582, Suppl. (1860) 200, 511; BOERL. Handl. 1 (1890) 281.—*Laurus alba* BL. Rumphia 3 (1847) 193, *in syn.*—*A. cassiaefolium* BL. *l.c.*—*A. philippinum* MERR. Gov. Lab. Publ. 35 (1906) 36.—*A. curranii* MERR. Philip. J. Sc. 4 (1909) Bot. 285.—**Fig. 1.**

Tree up to 48 m, clear bole up to 28 m by 70 cm, buttresses to 2 m high. At the start of the dry season foliate twigs sprout 2–4 together simultaneously from last year's buds; inflor. appearing in the axils of fallen leaves. Both flower and shoot-buds *ca* 4 mm long with 4–9 pairs of decussate *ca* 2 mm long caducous perules. *Leaves* simple entire glabrous, glossy dark green above, glaucous, whitish or light blue-grey below; petiole 1¼–10 cm; blade elliptic to lanceolate, 3- to slightly 5-plinerv-ous at the base, apex acuminate to tailed, tip subacute. Inflor. corymbose, either ♂ or ♀, rarely with few fls of the other sex, glabrous, 2½–10 (in fruit to 19) cm long; peduncle ½–3½ cm, pedicels 4–17 mm. *Flowers* pale yellowish. Sepals and petals (3–)5, free, resp. 2½–3 and 1½–2½ mm long. Stamens (4–)6(–8) in 1 whorl, sometimes isomerous and then alternating with the petals, attached on the disc in pits; filament in ♂ 5 mm, in ♀ 2.2 mm; anther ¾ mm (in ♀ slightly smaller and not dehiscent). Disc flat, glabrous to woolly. Ovary 2 mm broad, densely woolly, in ♂ (with the styles) usually strongly reduced. Styles 2, 1½ mm long. Wings of *fruit* 4–7 by 1–2½ cm, asymmetric and obovate, inside narrowed or straight, hairy; mericarp proper 8–13 mm long, ovate.

Fig. 1. *Acer niveum* BL. × ⅓, flower enlarged.

(1) In Malaysia only one genus.

Distr. *Cf.* fig. 2; in the Malay Peninsula recently collected in the hills near Cameron Highlands (CF. 27181, 27344, 36281, 37745, 45489), in W. Borneo once near Simpang at 27 m (bb 13518) and once in Sarawak (HAVILAND 2092), in the other islands many localities.

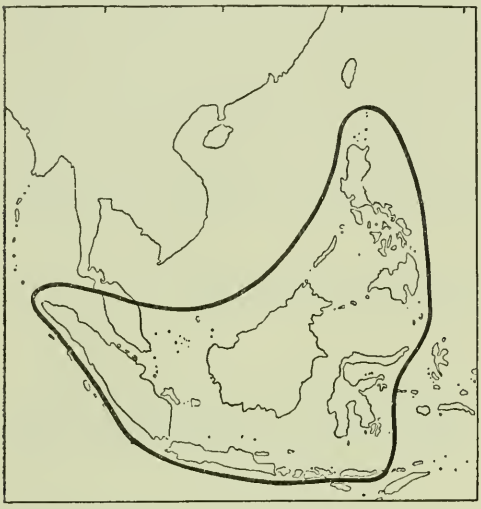

Fig. 2. Distribution of *Acer niveum* BL.; in Borneo and the Malay Peninsula it is very rare.

Ecol. In primary, rarely in secondary or devastated, forests, often common but scattered, 900–2550 m, in Flores descending to 750 m, in Sumatra to 630 m, in Celebes to 450 m, and at only 27 m near Simpang, Borneo. Fls in April–Aug., fr. July–Nov. In *Casuarina* forest saplings have been found. When flowering the leafless crown swarms with *Hymenoptera* collecting honey. Trees are easily located in the forest by the fallen leaves which are glaucous and fine-reticulate-veined underneath.

Vern. Some dozens of native names have been recorded, none of these fixed (HEYNE, *l.c.*).

Uses. Timber unimportant, no distinct heartwood is present; used for building purposes, fit for boxes.

Notes. PAX inserted *A. niveum* in his *sect. Integrifolia* in which the inflor. is terminal on short leafy twigs. I could examine this character in *A. oblongum* WALL. (WALL. 1222 A), *A. laevigatum* WALL. (THOMSON *s.n.*) and '*A. niveum*' (HELFER *s.n.*) from India. *A. niveum* BL. with its axillary leafless inflorescences is, however, possibly related to PAX's *sect. Lithocarpa* and does not belong in *sect. Integrifolia*.

## Excluded

*Acer javanicum* BURM. *f.* Fl. Ind. (1768) 221 = *Actinophora fragrans* R.BR. *sec.* BACKER *in Herb. Bog.;* according to BURRET it is *Colona javanica*, both *Tiliaceae*.

## PHILYDRACEAE (C. Skottsberg, Göteborg)

Erect herbs with a short rhizome. *Leaves* linear radical or crowded at the stem base, distich, equitant, parallel-nerved. *Flowers* zygomorphic, bisexual, solitary in the axil of spathaceous bracts. Perianth corolline, segments 4, 2-seriate. Stamen 1, inserted at the base of the abaxial segments. Filament flattened; anther 2-celled; cells straight or twisted, opening lengthwise by slits. Ovary superior, 3-celled with axile placentas, or 1-celled with parietal placentas. Style simple. Ovules ∞, anatropous. *Capsule* with 3 valves. Seeds ∞.

Distr. Centering in Australia, comprises 4 genera with 5 species.

KEY TO THE GENERA

1. Outer tepals free. Anthers spirally twisted. Ovary 1-locular . . . . . **1. Philydrum**
1. Outer tepals united at the base. Anthers straight. Ovary 3-locular . . . . . **2. Helmholtzia**

### 1. PHILYDRUM

Banks & Sol. *ex* Gaertn. Fruct. 1 (1788) 62; Miq. Fl. Ind. Bat. 3 (1855) 250; Hassk. Bull. Soc. Bot. Fr. 16 (1869) xxiv; Ridl. Fl. Mal. Pen. 4 (1924) 347; Skottsb. Bull. J. B. B. III, 13 (1933) 111.

Outer *tepals* free, inner ones more or less united at the base with the filament. Anther spirally twisted. Pollengrains in tetrads. Ovary 1-locular. *Capsule* loculicid. Testa spirally striate.

Distr. Monotypic, E.–SE. Asia, and Australia, rare in Malaysia.

**1. Philydrum lanuginosum** Banks & Sol. *ex* Gaertn. *l.c.;* Miq. *l.c.;* Hassk. *l.c.;* Banks & Sol. Bot. Cook's Voy. 3 (1905) t. 310; Merr. Philip. J. Sc. 10 (1915) Bot. 88; Ridl. *l.c.;* Skottsb. *l.c.;* Yamamoto, J. Soc. Trop. Agric. 10 (1938) 119; Steen. J. Arn. Arb. 28 (1947) 420.—**Fig. 1.**

Perennial caespitose herb, caudex short. *Leaves* densely rosulate, isolateral monofacial, glabrous, thick and of soft texture, 40–80 cm long incl. the sheath; sheath 14–30 by 1–1½ cm and 2–4 mm thick. Scape 1 m high or more, slender, terete, glabrate below, villous towards the woolly inflor., with few cauline leaves gradually passing into the alternate bracts. Inflor. a terminal spike, simple or paniculate. Bracts ovate, clasping, abruptly acuminate and subulate, 2–7 by ¾–1 cm enclosing the buds, reflexed in anthesis, again embracing the fruit. *Flowers* sessile, yellow. Perianth thin, outer tepals 12–15 by up to 10 mm, acute, ∞-nerved, long-villous outside, margins inflexed, the posterior with 2 stronger veins and bidentate; inner petals united below 1–2 mm with the filaments, 8 by 2 mm 3-nerved, spathulate, base hairy outside. Stamen 8–9 mm, glabrous; anther ± spherical, 1½ mm across. Ovary 6–7 by 2–3 mm, densely long-woolly; style 3–4 mm, glabrous; stigma broad-triangular long-papillose. *Capsule* triangular-oblong, 9–10 by 4–5 mm. Seeds ∞, dark-reddish, bulb-shaped, 0.8–0.9 by 0.3–0.4 mm.

Distr. E. to SE. Asia (Riu Kiu Isl., Formosa, Kwantung, Hongkong, Indo-China, Siam, Burma, Andaman Isl.) and NE. Australia, in *Malaysia:* only in the Malay Peninsula, and in SE. New Guinea, to be expected locally elsewhere.

Ecol. In ponds, marshes, and rice-fields at low altitude, in New Guinea in sedge swamps and moist savannahs.

Notes. According to Merrill (1915) the Cuming specimen credited to the Philippines came from the Malay Peninsula; the Hillebrand specimen is certainly erroneously believed to occur wild in Java.

### 2. HELMHOLTZIA

F. v. M. Fragm. 5 (1866) 202; Skottsb. Bot. Jahrb. 65 (1932) 260; Bull. J. B. B. III, 13 (1933) 112.

*Tepals* united to form a short cupular tube, the inner connate to half their length with the filament. Anther straight. Pollen grains single. Ovary 3-locular. *Berry* leathery, (apparently) indehiscent. Seed with long funicle, outer testa lengthwise striate and not spirally so.

Distr. 2 species, one in Australia, the other in *E. Malaysia*.

Fig. 1. *Philydrum lanuginosum* BANKS, × 2/5 (after BANKS & SOLANDER).

**1. Helmholtzia novoguineensis** (KRAUSE) SKOTTSB. *ll.cc.;* STEEN. J. Arn. Arb. 28 (1947) 419.—'?*Xerotidae sp.*' TEYSM. Nat. Tijd. N.I. 37 (1877) 132–133.—'*Liliacea*' J. J. SMITH, Teysm. 12 (1902) 168, 329.—*Astelia novoguineensis* KRAUSE, Bot. Jahrb. 59 (1924) 559.

Perennial herb. Rhizome stout, ascending to erect, woody, covered with leaf sheaths, up to 35 by 1–1 1/2 cm; roots coarse, shoots flat, fan-shaped. *Leaves* densely rosulate, ensiform, 75–150 by 3–4 1/2 cm; sheath 20–30 cm long, inside with scanty very long thin arachnoideous hairs, linear, acute, glabrous, of firm texture, a bundle veins on each side forms a prominent costa dissolving to the apex, with short oblique transverse veins; blade monofacial arched or horizontal, with secondary upper and lower surface. Scape terminal 25–50 cm, erect, obtuse-angular, upwards covered with a dense light-grey wool, leafless in its lower half, thence carrying 5–10 reduced ensiform leaves or spathes passing into bifacial alternate bracts. Branches of 1st order of the panicle supported by a spathe, the largest 10–40 by 1 1/2–3 cm, 2–3 lowermost with few branchlets of 2nd order 2–8 cm long. Bracts linear subulate 1–2 by 1/4–1/2 cm, 1–3-nerved, base woolly convolute enclosing the bud. *Flowers* sessile, white, glabrous except the 2–2 1/2 mm high tube. Outer tepals narrow-triangular, convolute with filiform apex, posterior one bicarinate-bicuspidate, with inflexed margins, 9–12 1/3 by 4–5 mm, anterior one 8–11 by 2 1/2–3 1/2 mm. Inner tepals and filament adnate to the tube, small, 1-nerved, 4–5 mm long, irregularly 3-dentate, free portion 1 1/2–2 1/2 by 3/4–1 1/2 mm. Free part of the stamen 3 1/4–3 3/4 mm; anther 2–2 1/2 by 1–1 1/2 mm. Ovary 2 by 1 mm densely grey-woolly. Style 3-sulcate, 2 3/4–4 1/2 mm long, stigma small triangular. *Berry* white, slightly 3-sulcate, 7–8 by 6 mm, pericarp tough leathery. Seeds ∞, 2–2 1/4 by 1/2 mm, cylindrical-flattened, often slightly curved, dark-brown with a transparent striate outer testa prolonged at both ends.

Distr. *Malaysia:* Moluccas (Ambon, Boeroe, Ceram) and New Guinea, 600–1500 m.

Ecol. In groups in muddy or moist, humic open spots in rain forests, and along ponds and margins of lakes. *Fl.* & *fr.* throughout the year.

Notes. Closely allied to *H. acorifolia* F. v. M. from E. Australia, which has an almost glabrous scape, a more robust habit, a trifle smaller flowers, outer petals hairy on the back, style 5–6 1/2 mm long, seeds mostly a little less than 2 mm.

## ANCISTROCLADACEAE (C. G. G. J. van Steenis, Buitenzorg)

### ANCISTROCLADUS

(Wall. Cat. (1832) 1052) *ex* Arnott, Nov. Act. 18 (1836) 325; Planch. Ann. Sc. Nat. III, 13 (1849) 316; Scheff. Nat. Tijd. N. I. 32 (1873) 407; Boerl. Handl. 1 (1890) p. XVII, XX; King, J. As. Soc. Beng. 42, II (1893) 137; Massart, Ann. J. B. B. 12 (1895) 121; Gilg, in E. & P. ed. 2, 21 (1925) 589, f. 269-70; Ridl. Fl. Mal. Pen. 1 (1922) 250.—*Bembix* Lour. Fl. Coch. (1790) 282, *nom. rej.*, *cf*. Moore, J. Bot. 65 (1927) 279.—*Wormia* Vahl, Skrift. Nat. Selsk. Kjöbenh. 6 (1810) 104, *non* Rottb.—*Bigamea* Koen. *ex* Endl. Gen. Pl. 1183 (1840).

Scandent shrubs (often erect in youth), without resin; branches sympodial with a series of circinate woody hooks in one plane. *Leaves* spread, simple, entire, often rosette-crowded, cuneiform, penninervous, reticulate-veined, glabrous, both surfaces minutely pitted, each pit with a peltate small hair secreting a wax-like substance; petiole articulated, scar on the twigs often saddle-shaped; stipules absent. *Flowers* ☿, actinomorphic small. Inflor. few or several times dichotomous or spike-like, often provided with said hooks and single reduced bract-like leaves, branches often recurved. Pedicels articulated. Bracts with a glandular-thickened base, margin fimbriate-membranous. Calyx tube short, at length adnate to the base of the ovary; lobes 5 inequal imbricate, enlarged and wing-like in fruit. Petals 5, united at the base, slightly contorted in bud. Stamens mostly 10, rarely 5, the episepalous slightly longer. Filaments with broadened base; anthers basifixed, ± introrse to ± latrorse, 2-celled, opening lengthwise. Ovary for the greater part inferior, consisting of 3 carpels, 1-celled, protruding into a nipple-shaped elongation bearing 3 articulated erect styles with a punctiform or horse-shoe-shaped stigmatic apex; nipple enlarging in fruit. Ovule 1, basal, ascending, with 2 integuments. *Nut* not dehiscent, crowned by the enlarged calyx. Seed roundish with testa intruding between the cerebral-like folds of the endosperm. Exocarp leathery. Embryo straight, erect, obliquely placed; cotyledons diverging; hypocotyl rather thick.

Distr. Disjunct, *ca 3 spp.* in trop. W. Africa, and 9 in SE. Asia, from the Deccan to Burma, Indochina, Hainan, S. China, the Malay Peninsula, Borneo and Sumatra (*cf.* fig. 2).

Uses. Except for some local information nothing is known (*cf.* Burkill).

Ecol. In mixed rain forests, but most common on silicious soil in so-called 'padang-scrub', from the lowland to the hills. Kerr noted of *A. wallichii* (his *no* 7006) that all specimens grew erect, and it is reported by Gagnepain to be erect in youth. Ridley also found it on the ground as a bush, or ascending trees, and this is also observed in specimens from Sumatra and Borneo. In the open padang-scrub it is either erect or trailing.

Notes. This monogeneric family has been subsequently been referred to several families; it is now mostly placed next to the *Dipterocarpaceae* but differs by the 1-celled ovary, basal ovule, peculiar endosperm, climbing habit, sympodial structure, absence of stipules, and presence of hooks. Hallier *f.* brought it to the *Linaceae-Hugoniaceae*, suggested already by Miquel. The bark of the twigs shows a peculiar cracking *viz* lengthwise superficial splitting of the thin grey corky outer bark and further by deeper transverse cracks. In *A. extensus* I found peculiar rather large crateriform glands on the base of the bracts of the inflor. Similar glands I found on 2–3 or all 5 sepals, distinctly elevated, 1–3 together. I have not found any stipules, neither in *A. extensus* nor in abundant living material of *A. hamatus* (Vahl)Gilg; there are rather large bracts leaving scars amidst the leaf-tufts but these belong apparently to the leaf-spiral. Gagnepain (Fl. Gén. I. C. 1 (1910) 393) mentions 3–5 styles, but I found only 3. Hutchinson (Fam. Fl. Pl. 1 (1926) 178) apparently assumes the style to be represented by the nipple-shaped extension of the ovary above the calyx on tip of which 3 free stigmas are articulated, but the tip of the latter I found distinctly 'stigmatic papillose' so that I assume the styles to be articulated with the ovary. The stigmatic surface is punctiform or horse-shoe-shaped. The nipple enlarges in fruit and forms a distinct part of it. All authors assume the presence of a ruminate endosperm, but Hutchinson

denies its presence and assumes the embryo to be constituted of remarkably 'folded cotyledons'. I had no seedlings at my disposal but an examination of the seeds did not confirm HUTCHINSON's statement. The embryo is lying loose in the endosperm.

The flowers are mostly deficient or absent in our rather rich material and when drying shrink to poor and brittle remnants. However, in *A. extensus* I found laterally slit anthers and not introrse cells, contrary to GAGNEPAIN's statements. BOERLAGE mentions slits which are turned somewhat towards the inner surface.

The size of the leaves varies much both in shape and dimensions in one specimen, specially between sterile and fertile twigs. In cultivated *A. hamatus* I found leaves of flowering twigs 6–9 by 2–2½ cm, and those of sterile twigs 35–40 by 4½–5½ cm. Notwithstanding the scanty flowering material I am perfectly satisfied that only one species occurs in Malaysia.

**1. Ancistrocladus tectorius** (LOUR.) MERR. Lingn. Sc. J. 6 (1930) 329; Comm. Lour. (1935) 275.—*Bembix tectoria* LOUR. Fl. Coch. (1790) 282.—*A. extensus* (WALL. Cat. 1052, *nomen*) PLANCH. Ann.

Fig. 1. *Ancistrocladus tectorius* (LOUR.) MERR., from Borneo, × 2/5.

Sc. Nat. III, 13 (1849) 318; KING, J. As. Soc. Beng. 42, II (1893) 137; BOERL. Cat. pl. phan. Hort. Bot. Bog. pt 2 (1901) 114; BURK. Dict. (1935) 155.—*A. pinangianus* (WALL. Cat. 1054, *nomen*) PLANCH. *l.c.*; MIQ. Fl. Ind. Bat. 1, 2 (1859) 587; SCHEFF. Nat. Tijd. N.I. 31 (1870) 348; 32 (1873) 407; DYER, in HOOK. *f.* Fl. Br. Ind. 1 (1874) 300; RIDL. Fl. Mal. Pen. 1 (1922) 251, f. 25.—*A. extensus var. pinangianus* KING, J. As. Soc. Beng. 42, II (1893) 137; GAGN. *l.c.*; CRAIB, *l.c.*—*A. hainanensis* HAYATA, Ic. Pl. Form. 3 (1913) 46.—**Fig. 1—2.**

Liana, in the youth and in open scrub often a shrub, later often trailing; main shoots provided with scattered ± erect small leaves, between and near which arise spreading non-foliate tendril-like shoots provided with 3–6 curved hooks, lower 2 rarely 3 hooks getting woody, hooks mostly unilateral, rarely 1–2 alternate; these 'tendrils' later woody, becoming branches, upper part vanishing. *Leaves* crowded mostly immediately above the 2nd hook, variable in size and shape, sessile, mostly obovate-oblong, tapering towards the base, apex obtuse, rounded, acute or even acuminate, blade 9–30 by 3–10 cm; nerves 4–8 on either side, spreading, connected by a slightly looped intramarginal vein and a 2nd feebler outer one, rather straight, numerous secondary veins often becoming as strong as the main nerves and parallel. Inflor. between the crowded leaves, very rarely lateral in the place of a 'tendril' on the main shoot, repeatedly dichotomous, branches divaricate, 8–15 cm long. *Flowers* rather crowded at their tips. Calyx lobes inequal, oval, thin-margined, glabrous except the

Fig. 2. Localities of *Ancistrocladus tectorius* MERR.

short ciliate rounded apex, some or all lobes provided with 1–3 conspicuous crateriform prominent glands, mostly shorter than the corolla, 1¾–2½ mm long, soon enlarging. Petals oblique-oval, one margin often involute, acute, 3–3½ by 1¾ mm. Styles erect, nearly as long as the nipple-shaped ovary-

top, both 1/2 mm high, stigma punctiform. Stamens alternately inequal; filament broadened at the base; cells free, acute, more or less latrorse. *Fruit* with spreading calyx wings slightly decurrent on the obconical sub-5-angular smooth tube, oblong-cuneate to spathulate, inequal, often oblique, apex blunt to rounded, with 3 larger nerves and numerous smaller densely reticulate ones, overlapping at the base, smallest mature ones measured 2 1/2 by 1/2 cm, largest 5 by 1 3/4 cm; nipple broad-obcampanulate, ± 3 mm high protruding, solid, not filled with part of the seed. Seed obconical with flat apex, ca 5 mm high, mostly consisting of a ruminate endosperm; germ ca 2–2 1/2 mm high, erect, straight, obliquely inserted.

Distr. Burma, Siam, the Andamans, and Indochina to S. China and Hainan, in *Malaysia:* Malay Peninsula, Riouw & Lingga Arch., Anambas Isl., W. Dutch Borneo, Karimata, Banka, Billiton, once collected in S. Sumatra (fig. 2).

Ecol. Low altitude, often near the sea, sometimes on the margin of the beach, mostly on silicious soils, both in mixed forest and padang scrub fr. fl. March-Aug.

Vern. *akar (be)boeloes, beloeloes, meloeloes* (Banka), *mendjoeloeng* (Lepar), *troeng boeloes* (Billiton).

Notes. I agree with BURKILL that no differences of importance can be found between *A. extensus* and *A. pinangianus.* I have tentatively accepted MERRILL's name, though MOORE stated that the type in the Br. Mus. is inadequate for specific identification. It was collected in the classical locality but I am not satisfied that no other species grows there; in tropical regions the identification 'by exclusion' is a somewhat dangerous procedure.

## Excluded

*Ancistrocladus pentagynus* WARB. Bot. Jahrb. 13 (1891) 385 = *Durandea* (*Linac.*) acc. to HALLIER *f.* (B.B.C. 39, II (1921) 68–78).

*Ancistrocladus sagittatus* WALL. = *Tetramerista glabra* MIQ. (*Theac.*).

## APONOGETONACEAE (C. G. G. J. van Steenis, Buitenzorg)

### 1. APONOGETON

Linné *f.* Suppl. (1781) 32; Engl. & Krause, Pfl. R. 24 (1906).

Perennial lactiferous freshwater herbs, rhizome short tuberous with fibrous roots. *Leaves* radical, submerged or floating, base sheathing, oblong to linear, entire or crisped, often long-petiolate; nerves lengthwise parallel, connected by numerous oblique transverse veins. Spike emerging from the water, simple or 2–8-forked, without bracts, subtended by a mostly caducous basal sheath (spathe). *Flowers* bisexual (rarely by abortion unisexual), small, spicate-scapose, white, rose, purple, yellow or yellowish-green. Perianth segments 2 (1–3, or absent), equal or unequal, usually persistent. Stamens in 2 rows, 6 (or more), free, hypogynous, persistent; filament filiform; anthers extrorse, small, 2-celled. Pollen subglobose or ellipsoid. *Gynaecium* superior, apocarpous; carpels 3–6, sessile, each with a simple style. Ovules 1–8 (or more), anatropous. Mature carpels inflated, opening along the back. Seeds without endosperm; outer testa often loose; embryo straight, elongate.

Distr. About 40 *spp.* described, Africa, Madagascar, Ceylon, SE. Asia, through Malaysia (very rare) to N. Australia, centering in Africa and Madagascar.

Ecol. The few Malaysian specimens were collected in lowland stony streams both on calcareous and other rock. The testa contains in some *spp.* air between the two coats and float on the water; it soon decays and the embryo sinks to the bottom.

Uses. The starchy tuberous rootstock is said to be edible in some *spp.*

Notes. Monogeneric family. Next to the single indigenous species, *A. fenestralis* with its unique fenestral-leaved foliage is cultivated in the Bot. Gard. Buitenzorg, and may be found in private gardens as a curiosity.

**1. Aponogeton loriae** Martelli, Nuovo Giorn. Bot. Ital. II, 3 (1897) 472, t. 8; Engl. & Krause, Pfl. R. 24 (1906) 12; Domin, Bibl. Bot. 20 (1915) 254; Camus, Bull. Soc. Bot. Fr. 70 (1923) 672–3; Rendle, J. Bot. (1923) Suppl. 58; Steen. Journ. Arn. Arb. 28 (1947) 419.—*A. crispus* (*non* Thunb.) F. v. M. Descr. Not. Pap. Pl. 8 (1886) 51; Ridl. J. Bot. 24 (1886) 359.—*A. monostachyum* (*non* L. *f.*) Hemsl. Kew Bull. (1899) 113.—**Fig. 1.**

*Submerged;* rootstock roundish 1/2–1 1/2 cm. *Leaves* green or brown, distinctly petiolate (2–15 cm), blade linear-spathulate, 10–35 by 1–4 cm, mostly *gradually tapering into the petiole*, base narrow-cuneate, apex rather broadly cuneate and ± blunt, primary nerves 2 on both sides and a marginal vein; parenchyma opaque dotted brown-punctate; margin slightly undulate-crisped to ± flat. Scape 5–40 cm. *Spathe* 1/2–1 1/2 cm long, ovate-acute, lengthwise nerved, *persistent, decaying gradually from the apex towards the base*, green, concave, subamplexicaulous, apex mucronulate. *Flowers greenish-yellow*, the lower ones over 2–3 cm densely set and

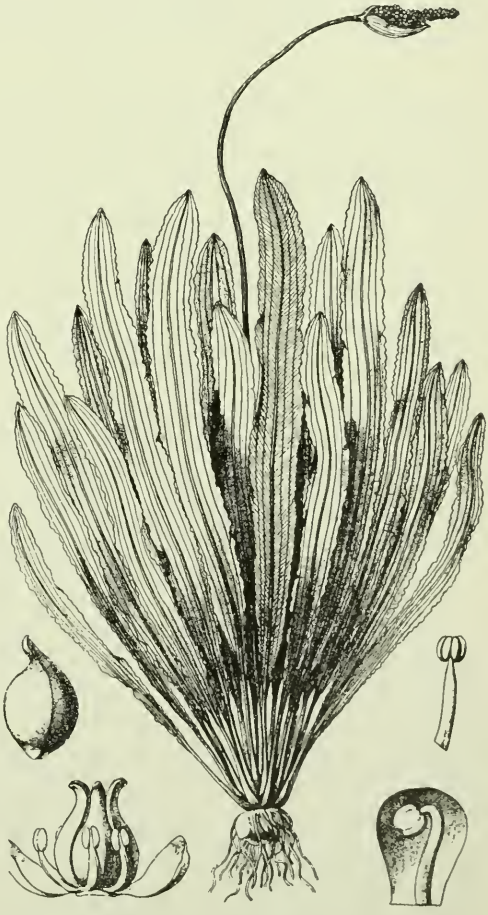

Fig. 1. *Aponogeton loriae* Martelli. Plant × 1/2, flower, tepal with stamen, stamen, and fruit enlarged (after Martelli).

with developing fruits, stamens about equalling the tepals on 2 mm long filaments, the upper ones rather abruptly as it seems male with 3 mm long stamens, very small ovaries and flowers set laxly to remote. Spikes 1 1/2–7 elongating in flower up to 18–20 cm. Tepals obovate *ca* 1 1/2–1 3/4 by 1–1 1/4 mm, concave, apex broadly rounded. Stamens 6; anthers roundish oval, no dehisced ones observed by me. *Carpels* 3, *ca* 2 1/2 mm long, ovate, ± bluntly trigonous, rather abruptly beaked by a distinct recurved rostrate style about 1/2 mm long. Seeds (in TEYSMANN 12792) 1–6 with a delicate loose outer coat 6-winged or -ribbed, transparently brown-reticulate-netted-celled, 2 by 2/3 mm. Inner testal coat oblong, opaque, darkbrown, smooth, 1 1/4 by 1/2 mm, closely enveloping the straight embryo, easily splitting on slight pressure, rounded at both sides.

Distr. Queensland (DIELS 8397, *n.v.*), in *Malaysia:* New Guinea, and SW. Celebes in the calcareous Maros-Pangkadjene distr. (TEYSMANN 11901, 12792).

Ecol. In shallow stony streams in forests and savannahs, 100–600 m.

Notes. There is a remarkable yet unexplained dimorphy in the flowers of the spike, the lower ones setting fruit only and differing in length of anthers.

## BURMANNIACEAE (F. P. Jonker, Utrecht)

Annual or perennial, saprophytic or autotrophic herbs; the saprophytic species often colourless. *Leaves* usually spread or alternate, entire, simple, without stipules; non-saprophytic species with a radical rosette of linear leaves; stem leaves often reduced to small scales; sometimes the basal part of the stem provided with many decurrent, grass-like leaves. *Flowers* ☿, usually actinomorphic, solitary or in capitate or cymose inflorescences. Perianth corolline; limb consisting of 2 whorls; tube sometimes 3-winged. Anthers 3, subsessile in the perianth throat and dehiscing laterally with horizontal slits,or 6, hanging down in the perianth tube and dehiscing with longitudinal slits. Connective large, often appendiculate. Style filiform or shortly cylindrical or conical. Stigmas 3, sometimes connate. Ovary inferior, 1-celled with parietal placentation, or 3-celled with axile placentation. Ovules ∞, anatropous, with 2 integuments; funicles often rather long. *Fruit* usually capsular, sometimes fleshy, crowned by the persistent perianth tube and the style, or by a thickened persistent basal ring of the perianth tube, dehiscing irregularly or with transverse slits at the top. Seeds ∞, small, subglobose to linear, sometimes with loose, reticulate testa, with endosperm.

Distr. About 125 species, widely distributed in the tropics of both hemispheres, also in subtropical America, Chicago area, Moçambique, Southern China, Japan, Southern Australia, New Zealand and Tasmania. As many species are rare, it is possible that only a part of their area is known. Most of them are found in moist regions. Among the autotrophic Malaysian *Burmanniaceae* there are 3 rather common species which are widely spread, *viz Burmannia coelestis*, *B. disticha* and *B. longifolia*. The latter two are absent from Java and the Lesser Sunda Islands, the former occurs in Java proper only in its western part. Of the saprophytic Malaysian species only 3 have been often collected, *viz Burmannia championii*, *B. lutescens*, and *Gymnosiphon affinis*.

Ecol. The autotrophic species provided with green leaves occur in grass-fields, along road sides and river-banks, among brush-wood and in forests or on moist swampy soil, up to about 3000 m alt. The saprophytic species usually occur in dense primary or secondary forests on soils rich in humic matter by decaying wood and leaves, up to *ca* 1500 m alt. They are also found sometimes in bamboo bushes and parks.

Notes. Treatment mostly after Jonker, A monograph of the Burmanniaceae, Thesis, Utrecht, 1938; also in: Meded. Bot. Mus. & Herb. Utrecht *no* 51; slightly revised.

In collecting *Burmanniaceae* it is necessary to collect plants with complete flowers, as the limb with the stigmas and stamens is often caducous. The fruits are also important. The colour of the flowers, stems and leaves must be noted. Preservation of collections in 60 % spirits is recommended.

In the field the saprophytic species are often found in colonies together with other saprophytic plants belonging to the *Orchidaceae*, *Triuridaceae*, and *Gentianaceae*. From the extreme rarity of a number of species it may be assumed that by further collecting these tiny plants several novelties will be found.

### KEY TO THE GENERA

1. Perianth tube cylindrical or trigonous, persistent on the capsule. Style of equal length as the tube. Anthers 3, subsessile in the perianth throat. Thecae dehiscing laterally with transverse slits
   Tribe *Burmannieae* Miers
2. Ovary and capsule 3-celled with axile placentation. Perianth as a whole persistent on the capsule. Ovary and perianth often prominently 3-winged, sometimes 3-costate or wingless. Ovary without glands. Capsule mostly dehiscing irregularly . . . . . **1. Burmannia**
2. Ovary and capsule 1-celled with parietal placentation. Perianth limb with the stamens and stigmas deciduous. Ovary and perianth wingless. Both sides of the top of each placenta inside the ovary provided with a gland. Capsule reticulate-perforated . . . . . **2. Gymnosiphon**
1. Perianth tube urceolate, circumscissile, only a small basal ring persistent on the fruit. Style very short, cylindrical or conical. Anthers 6, hanging down in the tube. Thecae dehiscing introrsely with longitudinal slits . . . . . Tribe *Thismieae* Miers
3. Inner perianth lobes free, or converging at their tops or connate to a mitre with 3 holes, the latter without appendages at the apex . . . . . **3. Thismia**
3. Inner perianth lobes connate to a mitre with 3 holes, crowned by 1 or 3 appendages.
4. Mitre crowned by 3 erect, thick, filiform appendages, clavately swollen at their tops . **4. Geomitra**
4. Mitre crowned by 1 erect thick column, bearing at its apex 3, more or less connate, glandular lobes . . . . . **5. Scaphiophora**


Fig. 1–8. Burmanniaceae. 1. *Burmannia bifaria* J. J. S., × 1/1, 2. *Scaphiophora gigantea* JONK., × 1/3, 3. *Thismia aseroe* BECC., × 8/5, 4. *Th. episcopalis* (BECC.) F. v. M., × 2/3, 5. *Burmannia coelestis* DON, × 3/2, 6. *Burmannia championii* THW., × 1/1, 7. *Gymnosiphon aphyllus* BL., × 2/3, 8. *Burmannia longifolia* BECC., × 2/5.

## 1. BURMANNIA

LINNÉ, Sp. Pl. ed. 1 (1753) 287; JONKER, Monogr. (1938) 18, 57.

Annual or perennial, saprophytic and colourless or chlorophyllose. Flowers often 3-winged. *Perianth* limb usually consisting of 6 lobes; the outer ones being much larger; inner 3 often minute, sometimes lacking. Perianth tube cylindrical to trigonous. Anthers 3; connective sometimes with 2 apical crests and/or a hanging, median, basal spur. Style filiform, branching into 3 short branches, each bearing a stigma, or 3 sessile stigmas at the apex of the style. Ovary trigonous. *Fruit* capsular, mostly dehiscing irregularly. Seeds many, oblong or ellipsoid.

Distr. 57 species, tropics of both hemispheres, also in the S. United States, S. part of S. America Moçambique, S. China, Japan and S. Australia.

### KEY TO THE SPECIES

1. Perennial, leafy green herbs. Greater part of the stem beset with grass-like, linear or ensiform, decurrent, imbricate leaves. Inflorescence usually many-flowered. Flowers hanging, very narrowly 3-winged in the basal part . . . . . (SECT. *Foliosa* JONK.). **1. B. longifolia**
1. Annual or perennial, saprophytic or green herbs. Stem leaves reduced to small scales. The non-saprophytic species with a radical rosette of linear leaves. Stem usually 1- to few-flowered. Flowers erect . . . . . (SECT. *Euburmannia* MALME)
2. Non-saprophytic, chlorophyllose herbs with a rosette of green leaves at the base; rosette often consisting of only 1–3 leaves.
3. Flower wings narrower than the perianth tube or reduced to ribs.
4. Basal rosulate leaves few. Stem bearing 1–2 flowers at its apex. Connective with 2 apical crests, basal spur lacking. Ovary as long as the perianth or longer . . . . . **2. B. geelvinkiana**
4. Basal rosette well developed. Stem bearing at its apex a usually bifid inflorescence. Connective provided with 2 apical crests and a basal, hanging spur. Ovary shorter than the perianth **3. B. bancana**
3. Flower wings as wide as the perianth tube or wider.
5. Margin of the perianth lobes double. Connective with a basal hanging spur and 2 apical crests. Thecae separated.
6. Robust herbs with a well developed rosette of grass-like, up to 15 cm long leaves. Inflorescence usually a bifid, many-flowered cyme . . . . . **4. B. disticha**
6. Slender herbs. Basal rosulate leaves about 1 cm. Stem bearing at its apex a single flower or a cluster of few flowers . . . . . **5. B. coelestis**
5. Perianth lobes with single margin. Connective with 2 apical crests; basal spur lacking. Thecae connate below the basal connective margin . . . . . **6. B. connata**
2. Saprophytic herbs without chlorophyll. Radical rosette absent.
7. Flowers wingless, 3- or 6-costate.
8. Stem scales many, imbricate in the lower part of the stem. Ovary as long as the perianth or longer . . . . . **7. B. sphagnoides**
8. Stem scales not imbricate. Ovary shorter than the perianth.
9. Flowers 6-costate. Perianth limb thick, fleshy, more or less succulent . . . **8. B. bifaria**
9. Flowers 3-costate to narrowly 3-winged. Limb not fleshy.
10. Inflorescence usually capitate. Inner perianth lobes spathulate, sometimes slightly papillose. Connective mucronate at the apex, obtuse at the base . . . . . **9. B. championii**
10. Flowers usually pedicellate. Inner perianth lobes broadly obovate, distinctly papillose. Connective not mucronate, acute at the base . . . . . **10. B. micropetala**
7. Flowers 3-winged.
11. Inner perianth lobes absent.
12. Perianth lobes simple. Connective with an apical, papillose crest and a basal, hanging, obtuse spur . . . . . **11. B. tridentata**
12. Perianth lobes bifid. Connective without crest and spur . . . . . **12. B. oblonga**
11 Inner perianth lobes not lacking, sometimes very small.
13. Very delicate plants. Connective with a basal, hanging spur . . . . . **13. B. steenisii**
13. Plants not very delicate. Connective without basal, hanging spur.
14. Stem rather robust, often many-flowered. Inner perianth lobes minute, orbicular. Flower wings variable, linear to half cuneate or quadrangular . . . . . **14. B. lutescens**
14. Slender herbs, usually 1-flowered. Inner perianth lobes lanceolate. Flower wings elliptical **15. B. malasica**

**1. Burmannia longifolia** BECC. Malesia 1 (1877) 244; JONKER, Monogr. (1938) 20, 59.—*B. leucantha* SCHLTR. Bot. Jahrb. 49 (1913) 107.—**Fig. 8.**

Perennial, 12–50 cm. Stem usually simple, forked at the top into the bifid inflorescence or bearing a simple cincinnus. *Leaves* linear, sometimes keeled, decurrent, stem-clasping, acute, sometimes subulate, parallel-veined but midrib more prominent, growing smaller towards the top, 4–20 cm by 2–9 mm. Upper part of stem beset with appressed, scattered, lanceolate, acute scales, 5–33 mm. Basal part of stem with brownish, dried leaves. Inflorescence 32–1-flowered, branches up to 4 cm. Bracts scale-like, linear-lanceolate, 5–10 mm. *Flowers* subsessile, hanging, white, often with pale-violet or bluish limb, 8–16 mm. Outer perianth lobes deltoid, acute, 2–4[1]/2 mm; margin fleshy at the base. Inner ones broad-obovate to orbiculate, entire and rounded, or retuse, or bilobate, 1[1]/2–2 mm. Perianth tube cylindrical, sometimes swollen in the upper part, 3–5 mm; lower part of tube and ovary very narrowly 3-winged. Stamens inserted just below the inner perianth lobes. Connective broad, oblong, crowned by two, rather wide crests. Filaments short, broad. Style thick, branching into 3 very short branches, each bearing a curved funnel-shaped stigma. Ovary obovoid, 4–7 mm. *Capsule* obovoid, dehiscing transversally, irregularly. Seeds oblong to scobiform, appendaged at both sides; testa loose, reticulate.

Distr. All over *Malaysia*, except Java and the Lesser Sunda Islands.

Ecol. In mountain forests, brush-wood, along mossy trails, often on ridges, scattered, ascending to 2800 m alt.

**2. Burmannia geelvinkiana** BECC. Malesia 1 (1877) 244; JONKER, Monogr. (1938) 111.

Annual, 7–12 cm. Stem filiform, simple, bearing 1 or, sometimes, 2 flowers. Rosulate *leaves* 2–5, linear, subulate, 3-nerved, 3–5 mm by 1 mm. Stem leaves scale-like, appressed, linear-lanceolate, acuminate to subulate, up to 3 mm. Bracts ovate-lanceolate, long-acuminate, 3-nerved, 1[1]/2 mm. *Flowers* bluish, very narrowly 3-winged, 7 mm. Outer perianth lobes triangular to broad-ovate, apiculate, about 1[1]/2 mm. Inner ones linear, obtuse, [1]/2–1 mm. Connective thick, triangular, obtuse at the base, bearing two divergent, slightly papillose crests at the apex. Style rather short and thick, bearing 3 sessile, funnel-shaped stigmas; style with stigmas about 1[1]/2 mm. Ovary ellipsoid to narrowly obovoid, about 4 mm. Flower wings linear, about 5[1]/2 mm by [1]/4 mm. *Capsule* obovoid, dehiscing with transverse slits. Seeds ovoid, bright yellow.

Distr. *Malaysia:* West New Guinea (Wandammen Peninsula, Geelvink Bay), once collected.

**3. Burmannia bancana** MIQ. Fl. Ind. Bat. Suppl. 1 (1860) 617; JONKER, Monogr. (1938) 24, 113.—*B. graminifolia* WARB. in FEDDE, Rep. 18 (1922) 330.

Annual, 20–37 cm. Stem simple, terete, forked into the inflorescence. Rosette distinct; *leaves* many, linear to lanceolate, subulate, parallel-veined, 2[1]/2–7 cm by 6 mm. Stem leaves few, scale-like, appressed, lanceolate, subulate, 1–3 cm. One rosette sometimes bearing 2 or 3 stems. Inflorescence a double cincinnus, 3- to 5-flowered; branches up to 3 cm. *Flowers* blue or purplish, narrowly winged, 6–13 mm. Outer perianth lobes lanceolate-triangular, acute, with 3 prominent, fleshy nerves inside, up to 3 mm. Inner ones linear-lanceolate, obtuse, up to 2[1]/2 mm; midrib prominent, fleshy. Perianth tube cylindrical-trigonous, up to 4[1]/2 mm. Connective oblong, provided with a basal, hanging, obtuse spur and 2 apical, divergent obtuse crests. Style filiform, branching into 3 short branches, each bearing a slightly curved, funnel-shaped stigma. Ovary truncate-ellipsoid, 3–7 mm. Flower wings linear, 11 by [1]/2–1 mm. *Capsule* ellipsoid to obovoid. Testa of the seeds elongate.

Distr. *Malaysia:* Sumatra, Banka, Billiton, Borneo.

Ecol. Wet places, along streams, *&c.*

Vern. *Roempoet taroem, oemboet oemboet* (Billiton).

**4. Burmannia disticha** LINNÉ, Spec. Plant. 1 (1753) 287; JONKER, Monogr. (1938) 115.—*B. distachya* R. BR. Prod. Fl. Nov. Holl. 1 (1810) 265.—*B. sumatrana* MIQ. Fl. Ind. Bat. Suppl. 1 (1860) 616.—*B. disticha* var. *sumatrana* HOOK. *f.* Fl. Br. Ind. 5 (1888) 664.

Robust annual, up to 75 cm. Stem usually simple, forked into the inflorescence. Rosette distinct; *leaves* linear or lanceolate, acute, up to 15 cm by 13 mm. Stem leaves reduced to appressed, lanceolate, acute or acuminate scales, up to 7 cm by 7 mm, imbricate in the lower part of stem; upper part of stem often leafless. Inflorescence branches up to 8 cm. Bracts lanceolate, acute, about 5–12 mm. *Flowers* sessile or shortly pedicellate, blue or purplish, often with yellow-tipped, greenish lobes, rarely yellow, 10–20 mm. Outer perianth lobes triangular, acute, 2[1]/2 mm; margin thick, double in the basal part. Inner lobes linear-lanceolate, fleshy, obtuse, 1–1[1]/2 mm. Perianth tube cylindrical-trigonous, 3–4[1]/2 mm. Connective broad, provided with 2 distinct, acute apical crests and a broad, obtuse to almost truncate, basal, hanging spur. Style thick-filiform, bearing 3 sessile, funnel-shaped stigmas; style with stigmas about 3 mm. Ovary ellipsoid to obovoid, truncate, attenuate towards the base, up to 1 cm. Flower wings elliptical, 10–18 by 1[1]/2–2[1]/2 mm, continuing as crests on the back of the outer perianth lobes, decurrent along the short pedicel. *Capsule* obovoid, truncate, irregularly dehiscing with transverse slits.

Distr. Widely distributed in the tropics of Asia and Australia: Ceylon, India, Siam, Indo-China, China, through Malaysia to Australia, in *Malaysia* hitherto not found in Java, the Lesser Sunda Islands, Moluccas, and Philippines.

Ecol. A species with a large ecological amplitude. It has been collected in brush-wood, swamps and bogs among *Sphagna*, moist hollows, open grasslands, mountain meadows, marshy plateaus, on bare rocks, and has even been recorded as growing in water; ascending to *ca* 3500 m alt.

Vern. *Si goeroe goeroe* (Sumatra).

**5. Burmannia coelestis** DON, Prod. Fl. Nep. (1825) 44; JONKER, Monogr. (1938) 120.—*B. javanica* BL. Enum. Fl. Jav. 1 (1827) 28.—*B. triflora* ROXB. Fl. Ind. 2 (1832) 117.—*B. azurea* GRIFF. Not. 3 (1851) 326.—*B. selebica* BECC. Malesia 1 (1877) 243.—*B. borneensis*, *B. chinensis*, *B. malaccensis* & *B. rigida* GANDOG. Bull. Soc. Bot. Fr. 66 (1919) 290.—**Fig. 5.**

Autotrophic annual, up to 30 cm. Stem simple or, sometimes, branched, bearing a single flower or a cluster of few flowers. Rosulate *leaves* linear or lanceolate, acute or acuminate, 3-nerved, about 1 cm by 1 1/2–3 mm. Stem leaves appressed, imbricate in the basal part, linear-lanceolate, subulate, rather long, up to 2 cm. Bracts lanceolate, acute, 4 by 1 mm. *Flowers* prominently 3-winged, blue, purplish or white, often with yellow lobes, about 11 1/2 mm. Outer perianth lobes ovate, apiculate, with double margin, about 1 1/2 mm. Inner ones lanceolate, apiculate, with double margin, about 1/2 mm. Tube cylindrical-trigonous, about 5 mm. Connective provided with 2 apical, divergent, obtuse to truncate crests and a basal hanging, rather long, obtuse spur. Style thick-filiform, bearing 3 sessile, funnel-shaped stigmas with swollen margin. Style with stigmas about 4 mm. Ovary ellipsoid to obovoid, truncate, attenuate towards the base, about 5 mm. Flower wings half elliptical to half obovate, about 10 by 2 1/2 mm. *Capsule* obovoid, truncate, transversely dehiscing.

Distr. Widely spread in tropical Asia: India, Siam, Indo-China, S. China, and the Caroline Islands, in *Malaysia* throughout the Archipelago, in Java only in the W. part, once collected in the S. part of Madoera Island, and once in Bali, otherwise absent from the Lesser Sunda Islands.

Ecol. Grass-fields, among alang-alang (*Imperata*), in mountain meadows, parks and plantations, ascending to *ca* 1700 m alt.

**6. Burmannia connata** JONKER, Monogr. (1938) 128.

Autotrophic annual, 15–30 cm. Stem simple, bearing 1–3, shortly pedicellate flowers. Rosulate *leaves* few, linear, acute or acuminate, 1-nerved, 4–8 by 1 mm. Stem leaves scale-like, appressed, linear, acute, 2–5 mm. Bracts linear-lanceolate, acute, 1 1/2 mm. *Flowers* prominently 3-winged, 6–8 mm. Outer perianth lobes acute, with involute margin, 1 mm. Inner ones broadly ovate, obtuse, nearly 1/2 mm long. Perianth tube cylindrical, 3 mm. Connective rather broad, provided with 2 apical, divergent, obtuse crests. Thecae bright yellow, appressed against the connective and connate below the basal connective margin. Basal hanging spur lacking. Style as long as the tube, branching into 3 short branches, each bearing a peltate, disk-shaped stigma. Ovary ellipsoid to obconical, 2 1/2–4 mm. Flower wings half oblanceolate, decurrent along the pedicel, 8 by 2 mm. *Capsule* ellipsoid, dehiscing with transverse slits, 4–6 mm. Seeds scobiform, yellow.

Distr. *Malaysia:* Sumatra, Eastcoast Residency (Kota Pinang, Soengei Kana).

**7. Burmannia sphagnoides** BECC. Malesia 1 (1877) 246; JONKER, Monogr. (1938) 135.

Saprophyte, 4 1/2–12 cm. Stem simple, thick, beset with many lanceolate, acute, in the lower part imbricate, 3–6 mm long, scale-like *leaves* and bearing 2–5 subsessile flowers at the apex. Bracts broad-lanceolate to ovate, acute, 3–6 mm. *Flowers* 6-costate, white, about 8 1/2 mm. Outer perianth lobes broadly triangular, with swollen margin, about 8 1/2 mm. Inner ones fleshy, obtuse to rounded, papillose, almost 1 mm. Perianth tube cylindrical, about 2 mm. Connective oblong, acute at the base crowned by 2 divergent, obtuse crests. Style thick-filiform, bearing 3 sessile, obconical stigmas. Ovary large, broadly ellipsoid to subglobose, 4–5 mm.

Distr. *Malaysia:* Malay Peninsula, Sumatra (Eastcoast Res.), and Borneo (Sarawak).

Ecol. A rare species, occurring in decaying matter in forests.

**8. Burmannia bifaria** J.J.S. Icon. Bogor. 4 (1914) 379; JONKER, Monogr. (1938) 136.—*B. engganensis* JONKER, Blumea 3 (1938) 108; Monogr. (1938) 137. —**Fig. 1.**

Saprophyte, 5–13 cm. Stem simple or branched, beset with scale-like, ovate to lanceolate, 1-nerved, sometimes distichous, up to 5 mm long *leaves* and bearing 1 flower or branching into a bifid, up to 9-flowered cyme. *Flowers* shortly pedicellate, 6-costate, white or somewhat purplish, 9–13 mm. Limb fleshy. Outer perianth lobes triangular, obtuse, with involute, crenate margin, 1 1/2–2 mm. Inner ones ovate to orbicular, 1/4–1 1/2 mm. Perianth tube cylindrical-trigonous, 2 1/2–5 mm. Connective obtriangular, crowned by 2 divergent, papillose crests. Style thick-filiform, branching into 3 short branches, each bearing a somewhat funnel-shaped stigma with a broad, rotundate, membranous, hanging appendage. Style with stigmas 4–4 1/2 mm. Ovary ellipsoid, 3–6 mm. *Seeds* ovoid, brown. Flower wings reduced to narrow, linear ribs.

Distr. *Malaysia:* West Java (vicinity of Buitenzorg) and Enggano Island (off SW. Sumatra).

Ecol. Among decaying leaves in forests, ascending to 1000 m alt.

**9. Burmannia championii** THW. Enum. Pl. Zeyl. (1864) 325; JONKER, Monogr. (1938) 138.—*B. tuberosa* BECC. Malesia 1 (1877) 245.—*B. capitata* (*non* MART.) MAKINO, Bot. Mag. Tok. 4 (1890) 23. —*B. japonica* MAXIM. *ex* MAK. Ill. Fl. Jap. 1, *no* 7 (1891) 4.—*B. dalzieli* RENDLE, Journ. Bot. 40 (1902) 311.—*B. chionantha* SCHLTR. Bot. Jahrb. 49 (1913) 107.—**Fig. 6.**

Saprophyte, 2–18 cm. Rhizome tuberous or elongate, covered with hair-like roots, producing small, adventitious tubers. Stem simple, beset with lanceolate, acute, appressed, scale-like, 1 1/2–4 mm long *leaves*. Bracts lanceolate, acute, about 3 mm. *Flowers* subsessile in a capitate inflorescence at the top of the stem, 3-costate, white, 5–12 mm. Outer perianth lobes triangular, acute, with involute margin in the upper part, 1–2 1/2 mm. Inner ones spathulate, rounded, slightly papillose at the margin, about 3/4 mm. Connective broadly oblong, obtuse at the base, crowned by 2 indistinct, divergent, obtuse crests and provided with a median small

point at the apex, usually directed inwards and then hardly perceptible. Style thick-filiform, bearing 3 subsessile funnel-shaped stigmas; style with stigmas 3 mm. Ovary ellipsoid to obovoid, 2–3 mm.

Fig. 9. *Burmannia lutescens* BECC., with broad wings (Mt Gedeh, W. Java), × 1/1.

Distr. Ceylon, S. China, Japan and *Malaysia:* Batoe Islands (off W. Sumatra), Banka, W. Java, Borneo, and New Guinea.

Ecol. A species with a large ecological amplitude, occurring in humus of moist forests and also in parks, plantations, bamboo bush, on rocks in streams.

**10. Burmannia micropetala** RIDL. Trans. Linn. Soc. II, 9 (1916) 228; JONKER, Monogr. (1938) 140.

Saprophyte, 7½–15 cm. Stem simple, beset with acute or acuminate, 1-nerved, often keeled, 2–5 mm long, scale-like *leaves*. Bracts linear-lanceolate, acute, 1-nerved, about 4 mm. Pedicels up to 5 mm. *Flowers* shortly pedicellate, in contracted 3–8-flowered bifid or, sometimes, pseudo-umbellate cymes, very narrowly 3-winged to 3-costate, 7–9 mm. Outer perianth lobes triangular, acute, about 2 mm, in the upper part provided with small, rounded, crenate lateral lobes. Inner ones broadly obovate, rounded, papillose at the margin, ½ mm. Perianth tube cylindrical, about 3 mm. Connective oblong, acute at the base, crowned by 2 divergent, acute crests. Style thick-filiform, branching at the apex into 3 very short branches, each bearing a funnel-shaped stigma with 2 small, apical points. Style with stigmas about 3 mm. Ovary ellipsoid, truncate, about 2½ mm.

Distr. *Malaysia:* New Guinea only.

**11. Burmannia tridentata** BECC. Malesia 1 (1877) 246; JONKER, Monogr. (1938) 141.

Saprophyte, 6–14 cm. Stem simple or branched, beset with appressed, lanceolate, acute, 1-veined, slighly keeled, scale-like, 1½–2 mm long *leaves*. Bracts ovate-lanceolate, acuminate, 1-veined, about 1½ mm. Stem or branches bearing 1–3, prominently winged, 2–7 mm long *flowers*. Outer perianth lobes triangular to ovate, obtuse, swollen at the margin, 1–1½ mm. Inner lobes absent. Perianth tube cylindrical, about 2 mm. Connective quadrangular with a broad, swollen, obtuse, hanging, basal spur, and an apical, erect, papillose, obtuse crest. Style as long as the tube, bearing 3 subsessile, funnel-shaped stigmas. Ovary subglobose, about 2 mm. Flower wings half elliptical to half-orbiculate, about 4 by 2 mm. *Capsule* subglobose, about 2½ mm. Seeds scobiform.

Distr. *Malaysia:* Borneo, Sarawak (Mt Mattang), once collected.

**12. Burmannia oblonga** RIDL. J. Str. Br. R. As. Soc. 41 (1904) 33; JONKER, Monogr. (1938) 25, 142.— *B. bifida* GAGNEP. Bull. Soc. Bot. Fr. 54 (1907) 462.

Saprophyte, 7–15 cm. Stem simple or branched, bearing 1–2 flowers, beset with appressed, ovate to lanceolate, obtuse, scale-like, about 1½ mm long *leaves*. Below the flower 2 lanceolate, scale-like bracts, 2½ mm. *Flowers* white, sometimes with yellow limb, 8–10 mm. Outer perianth lobes bifid, obtuse, about 1½ mm, papillose in the upper half at the margin, in the lower half with 2 yellow bags inside, provided with 2 involute, narrow triangular lateral lobes. Inner ones absent. Tube conical, 4–4½ mm long. Connective oblong, yellow, without crests or spur. Style thick-filiform, bearing at the apex 3 sessile, funnel-shaped curved stigmas. Style with stigmas about 4½ mm. Ovary subglobose, 2½–4 mm. Flower wings obovate, truncate, white, 5–7½ by 3–4 mm.

Distr. Hainan, Indo-China and *Malaysia:* Malay Peninsula, N. Sumatra (Atjeh and Eastcoast Res.).

Ecol. On forested rocks or loamy soil in dense jungle or forest, ascending to 1300 m.

**13. Burmannia steenisii** JONKER, Monogr. (1938) 158.

Delicate saprophyte, 2–6 cm. Stem simple or branched, bearing 1–2 flowers, beset with lanceolate, acute, scale-like, ½–1½ mm long *leaves*. Below each flower 1 or 2 lanceolate, 1-veined, acute bracts, about 1½ mm. *Flowers* pure white with yellow

limb, prominently 3-winged, 3–7 mm. Outer perianth lobes triangular, subobtuse, with swollen margin, about 1 mm. Inner ones orbiculate, minute. Perianth tube cylindrical-trigonous to conical-trigonous, about 2½ mm. Connective quadrangular, with a broad, obtuse, basal hanging spur and crowned by 2 short, thick, straight, obtuse, divergent crests. Style thick-filiform, bearing 3 sessile, slightly curved, bilabiate, funnel-shaped stigmas. Ovary subglobose, about 2 mm. Flower wings half elliptical to half-quadrangular, pure white, about 4½ by 1½ mm. *Capsule* subglobose, dehiscing with transverse slits. Seeds scobiform.

Distr. *Malaysia:* E. Java, Pasoeroean Residency (Mt Lamongan).

Ecol. Collected on the SW. slope of Mt Lamongan on coarse, volcanic sandy soil in brushwood, *ca* 600 m alt. It is the only species of the family hitherto reported from East Java.

**14. Burmannia lutescens** BECC. Malesia 1 (1877) 246; JONKER, Monogr. (1938) 24, 148.—*Gonianthes candida* BLUME, Cat. Gew. Buitenzorg (1823) 20.—*Gonyanthes candida* BLUME, Flora 8 (1825) 123.—*B. candida* (BL.) ENGL. Nat. Pfl. Fam. 2,6 (1889) 50, *not B. candida* GRIFF. *ex* HOOK. *f.*—*B. gracilis* RIDL. J. Str. Br. R. As. Soc. 22 (1890) 335.—*B. papillosa* STAPF, Trans. Linn. Soc. II, 4 (1894) 232.—*B. novae-hiberniae* SCHLTR. in K. SCH. & LAUT. Nachtr. Fl. D. Sch. Geb. (1905) 73.—*B. gjellerupii* J.J.S. in FEDDE, Rep. 10(1912) 487.—*B. gonyantha* HOCHR. Candollea 2 (1925) 325.—**Fig. 9–10.**

Saprophyte, up to 23 cm. Stem thickly filiform to robust, simple or branched, 1-flowered or forked into the inflorescence. *Leaves* lanceolate to ovate, acute, 1–3½ mm. Bracts lanceolate to ovate, often keeled and carinate. Cincinni bifid, up to 11-flowered; branches up to 3 cm. *Flowers* pedicellate, white, sometimes with yellow limb, seldom bluish, about 8½ mm. Outer perianth lobes ovate or triangular, apiculate, about 1½ mm; margin fleshy. Inner lobes minute, fleshy, orbiculate. Perianth tube trigonous, 2½–5 mm. Connective truncate, rounded at the base, slightly 2-lobed at the apex into 2 very short, papillose crests. Basal spur absent. Style thick, bearing 3 subsessile, funnel-shaped to bowl-shaped stigmas. Style with stigmas as long as the tube. Ovary subglobose to truncate-globose, 3–5 mm. Flower wings various, linear, or elliptical, or rather broad, half-cuneate or quadrangular, running from the base of the limb to the middle or the base of the ovary. *Capsule* subglobose, dehiscing with large horizontal slits.

Distr. *Malaysia:* Sumatra, Malay Peninsula, Borneo, Java, New Guinea, and New Ireland.

Ecol. Usually in the humus of shady moist forests, up to 1500 m.

Notes. Specimens with narrow perianth wings have been described as *B. lutescens*, *B. novae-hiberniae*, *B. gjellerupii*, with elliptical ones as *Gonianthes candida*, and rather broad-winged specimens as *B. gracilis*. They all belong to one species variable in that respect. In Java the species was often called *B. candida* (BL.) ENGL. but this is a later homonym; *B. candida* GRIFF. *ex* HOOK. *f.* is an allied species, occurring in Burma, Siam and the Langkawi Islands.

Fig. 10. *Burmannia lutescens* BECC., Mt Salak, W. Java. Form with narrow perianth wings, × 2/3.

**15. Burmannia malasica** JONKER, Monogr. (1938) 152.—*Burmannia lutescens* (*non* BECC.) WINKLER, Bot. Jahrb. 48 (1913) 96.

Saprophyte, 5½–8 cm. Stem simple, 1-flowered, seldom 2-flowered, beset with few appressed, lanceolate, subacute, 1-veined, slightly keeled, 1½–2 mm long, scale-like *leaves*. Bracts elliptical, acuminate, 1-veined, 1½ mm. *Flowers* purple or white with yellow limb, prominently winged, about 5 mm. Outer perianth lobes triangular with swollen margin, acuminate to apiculate, about 1 mm. Inner lobes erect, lanceolate-ovate, obtuse, about ½ mm. Perianth tube cylindrical, 1½ mm. Connective obtriangular, obtuse at the base, provided with 2 short, divergent crests at the apex. Style cylindrical, bearing 3 sessile, funnel-shaped stigmas. Ovary subglobose to ellipsoid, 2½ by 2 mm. Flower wings half-orbiculate to half-elliptical, about 4 by 2 mm. *Capsule* ellipsoid to obovoid, dehiscing with a transverse slit. Seeds scobiform to fusiform.

Distr. S. Siam and *Malaysia:* SE. Borneo.

## 2. GYMNOSIPHON

BLUME, Enum. Pl. Jav. I (1827) 29; JONKER, Monogr. (1938) 27, 168.

Saprophytic annuals, without chlorophyll. *Leaves* scale-like. *Perianth* limb consisting of 6 lobes, the 3 outer being much larger and slightly 3-lobed. Anthers 3, sessile in the throat. Thecae bursting horizontally. Ovary ovoid to globose, 1-celled with 3 parietal placentas, each placenta provided with a large, globose gland at both sides of the top. Style filiform, branching into 3 short branches, each bearing a stigma. Perianth limb, stamens and the upper part of style with the stigmas caducous after flowering. *Capsule* crowned by the persistent perianth tube. Seeds ovoid to globose, reticulate.

Distr. 29 species, tropics of both hemispheres, not in Australia.

Notes. In Asia, and Malaysia, this genus is represented by the section *Eugymnosiphon* URBAN only, characterized by the reticulate-perforated capsule dehiscing at the top.

### KEY TO THE SPECIES

1. Anthers inserted above the middle of the perianth.
 2. Flowers pedicellate, in loose, many-flowered cincinni or bifid cincinni . . . . **1. G. aphyllus**
 2. Flowers ± sessile in a 1- or sparsely flowered inflorescence.
  3. Capsule ± globose. Margin lobes of the outer perianth lobes crenate . . . **2. G. oliganthus**
  3. Capsule conical-ovoid. Margin lobes of the outer perianth lobes entire . . **3. G. minahassae**
1. Anthers inserted in or below the middle of the perianth.
 4. Anthers inserted below the middle of the perianth. Connective apiculate at the top. Ovary elongate-conical, tapering to the pedicel . . . . . **4. G. affinis**
 4. Anthers inserted in the middle of the perianth. Connective not apiculate. Ovary marked from the pedicel.
  5. Flowers sessile or subsessile in loose cincinni or bifid cincinni . . . . . **5. G. papuanus**
  5. Stem 1–2-flowered, or many sessile flowers in a capitate inflorescence at the top of the stem.
   6. Outer perianth lobes acuminate, a third of the length of the whole perianth. Connective narrow. Stigmas with dorsal crest. Inflorescence 2- to many-flowered . . . . . **6. G. neglectus**
   6. Outer perianth lobes deltoid, short, a fifth of the whole perianth. Stigmas without crest. Inflorescence 1–3-flowered . . . . . **7. G. pauciflorus**

**1. Gymnosiphon aphyllus** BLUME, Enum. Pl. Jav. 1 (1827) 29; JONKER, Monogr. (1938) 30, 170.—*G. borneense* BECC. Malesia 1 (1877) 241.—*G. pedicellatum* SCHLTR. Bot. Jahrb. 49 (1913) 105.—**Fig. 7.**

Stem up to 17 cm, forked into a bifid cincinnus or bearing a simple cincinnus. *Leaves* acute, often keeled, appressed, 1–2½ mm. Bracts ovate, obtuse, scale-like. Pedicels 1–5 mm. Inflorescence often loose and many-flowered. *Perianth* white or lilac; tubular part up to 4 mm; limb about 2½ mm. Outer perianth lobes ovate, obtuse, provided with a narrow, crenate lateral lobe at both sides. Inner ones linear-lanceolate, minute. Stigmas curved, funnel-shaped, inappendiculate. *Capsule* about 3 mm.

Distr. S. Siam, throughout *Malaysia.*

Ecol. On humus or decaying wood or leaves in the shade of moist forests, below 1500 m alt.

**2. Gymnosiphon oliganthus** SCHLTR. Bot. Jahrb. 49 (1913) 101; JONKER, Monogr. (1938) 172.

Stem tender, simple or branched, 4–9½ cm, 1- or 2-flowered. *Leaves* and bracts minute, to 1 mm, keeled and appressed. Pedicels up to 3 mm. *Flowers* white to bluish lilac, up to 5 mm. Outer perianth lobes triangular, subobtuse, provided with crenate lateral lobes. Inner ones small, cuneate, obtuse to truncate. Stigmas auriculate, soup-plate-shaped.

Distr. *Malaysia:* NE. Brit. New Guinea, once collected.

Ecol. In forests, 450 m alt.

**3. Gymnosiphon minahassae** SCHLTR. Bot. Jahrb. 49 (1913) 104; JONKER, Monogr. (1938) 172.

Stem usually simple, 2–5-flowered, 7–12 cm. *Leaves* acute, appressed, up to 1 mm. Bracts more or less obtuse, keeled. Pedicels 1–3 mm. *Perianth* white with bluish limb. Outer perianth lobes obtuse; lateral lobes entire. Inner ones lanceolate. Perianth limb deciduous above the anthers. Stigmas quadrangular, truncate at the apex, apiculate at the base.

Distr. *Malaysia:* N. Celebes (Minahasa), once collected.

Ecol. In humic soil, 800 m alt.

**4. Gymnosiphon affinis** J.J.S. Nova Guinea 8 (1909) 194; JONKER, Monogr. (1938) 31.—*G. torricellense* SCHLTR. Bot. Jahrb. 49 (1913) 101.

Stem 7–13 cm, simple or branched, white, lilac or rose-coloured, forked into a bifid cincinnus or bearing a simple cincinnus of 1–3 flowers. *Leaves* ovate, acuminate, 1–2 mm. Bracts to 3 mm. Pedicels 1–4 mm. *Perianth* white, limb 2½ mm, tube 1½ mm. Outer perianth lobes ovate, obtuse; lateral lobes crenate. Inner ones small, rather broad,

obovate, obtuse. Tube swollen at the insertion of the stamens. Connective quadrangular, acute-apiculate at the apex. Stigmas rather large, soup-plate-shaped. Ovary obconical, swollen in the upper part, about 1½ mm. *Capsule* thick-ellipsoid, about 3–3½ mm, crowned by the short, cylindrical to conical, 2 mm long, persistent part of the tube. Seeds brownish, fusiform, reticulate.

Distr. *Malaysia:* New Guinea.

Ecol. In forests, in humic soil, ascending to *ca* 700 m alt.

**5. Gymnosiphon papuanus** BECC. Malesia 1 (1877) 241; JONKER, Monogr. (1938) 174.—*G. celebicum* SCHLTR. Bot. Jahrb. 49 (1913) 104.

Stem simple or branched, 4–14 cm, colourless, bearing rather loose simple or bifid cymes of 3-many subsessile flowers. *Leaves* acuminate, up to 2½ mm. Bracts up to 3½ mm. *Perianth* whitish-purplish; limb about 1½ mm; tube up to 4½ mm. Outer perianth lobes ovate, triangular, obtuse; lateral lobes entire, involute. Inner ones small, linear. Connective deltoid, at the top 3-lobed, provided with a forked thickening. Stigmas rather large, soup-plate-shaped, obtuse, cordate, auriculate at the base. Ovary ovoid, about 1½ mm. *Capsule* obovoid to truncate-subglobose, 2½–5 mm long; crowned by the 2–2½ mm long, cylindrical persistent part of the tube.

Distr. Micronesia (Palau Islands), in *Malaysia:* Celebes and New Guinea.

Ecol. Moist forests, in humic soil, ascending to *ca* 500 m alt.

**6. Gymnosiphon neglectus** JONKER, Monogr. (1938) 175.

Stem simple or branched, 7½–11 cm, bearing 1 or few flowers or a capitate inflorescence, consisting of contracted cymes. *Leaves* lanceolate-ovate, acuminate, keeled, 1–2½ mm. Bracts to 5 mm. *Flowers* subsessile. Perianth dirty white; tube about 2 mm; limb about 2 mm. Outer perianth lobes ovate, acuminate; lateral lobes crenate. Inner ones small, linear, acute. Stigmas funnel-shaped, curved, dorsally cristate. Ovary ovoid, about 2 mm. *Capsule* nearly globose, crowned by the 2 mm long persistent part of the tube.

Distr. *Malaysia:* Java (Preanger Regencies and Semarang).

Ecol. Moist forests, ascending to 1000 m alt.

**7. Gymnosiphon pauciflorus** SCHLTR. Bot. Jahrb. 49 (1913) 102; JONKER, Monogr. (1938) 176.

Stem simple, colourless, 2½–9½ cm, bearing 1–3 sessile or subsessile flowers. *Leaves* ovate, acuminate, 1–1½ mm. Bracts to 3 mm. *Perianth* whitish to purplish; tube about 4 mm; limb very short. Outer perianth lobes ovate, acute, about 1–1½ mm; lateral lobes entire. Inner ones minute. Connective not apiculate, forked at the top. Style branches rather long, each bearing an ovoid, in transverse section somewhat triangular, stigma. Ovary obovoid, about 2 mm. *Capsule* ovoid, to 3½ mm; persistent part of the tube 1½–2½ mm.

Distr. *Malaysia:* New Guinea (Kani Mts), once collected.

## 3. THISMIA

GRIFFITH, Proc. Linn. Soc. 1 (1844) 221; JONKER, Monogr. (1938) 42, 227.

Saprophytic, fleshy herbs. Underground part in the Malaysian species coralliform or vermiform and creeping. Stems usually short, seldom branched. *Leaves* small, scale-like. Below the flowers 1 or more bracts, sometimes forming an involucre. Flowers actinomorphic or, sometimes, zygomorphic, urceolate to campanulate. *Perianth* lobes 6, occasionally free and of equal length and size, or inner ones larger, sometimes inner lobes connivent at the apex or connate in the apical part, then forming an erect mitre with 3 holes, in that case outer lobes very small. Stamens 3, free or, usually, stuck together to an anther tube, hanging at an annulus in the perianth throat. Filaments short, ribbon-shaped. Style thick, short, cylindrical or conical, persistent, bearing at its apex 3 simple or bilabiate stigmas. Ovary obconical or obovoid; the 3 placentas inserted at the bottom or parietally in the basal part of the ovary. *Fruit* fleshy, cup-shaped, crowned by the persistent, fleshy, basal ring of the perianth tube and the style with the stigmas.

Distr. 24 species, in tropical America (*Sect. Myostoma* and *Ophiomeris*), tropical Asia (*Sect. Euthismia* and *Sarcosiphon*), Chicago area, New Zealand and Tasmania (*Sect. Rodwaya*).

KEY TO THE SPECIES

1. Inner perianth lobes free, spreading or erect. Underground part vermiform, creeping (SECT. *Euthismia* SCHLTR.)
2. Perianth lobes equal in length and size . . . . . (SUBSECT. *Odoardoa* SCHLTR.)
3. Flowers zygomorphic, geniculate . . . . . **1. T. chrysops**
3. Flowers actinomorphic.
4. Stems several, flowers 4–6 in a raceme . . . . . **2. T. racemosa**
4. Stem simple; flowers usually 1–3, terminal.
5. Leaves and bracts beset with distinct, prominent, blunt processes . . . . **3. T. grandiflora**
5. Leaves and bracts without processes.
6. Perianth lobes lanceolate, acute to acuminate, flat . . . . . **4. T. fumida**
6. Perianth lobes triangular at the base, tapering into long, filiform tentacles.
7. Perianth tube with horizontal bars inside. Stigmas lanceolate.
8. Anthers provided with 3 thick-filiform appendages at the free apical margin. Perianth yellowish in the basal part, bright orange-yellow in the upper part and limb. Tentacles bright orange-red at the base. Perianth lobes with tentacles up to 10 mm . . . **5. T. aseroe**
8. Anthers with 1 thick-filiform, median appendage and 2 lateral, short teeth at the free apical margin. Perianth white with 6 ochre-brown streaks; lobes with tentacles *c.* 20 mm **6. T. alba**
7. Perianth tube without bars. Apical margin of the anthers with 2 teeth, each bearing a globose body at the top. Stigmas funnel-shaped with prominent margin . . . . **7. T. ophiuris**
2. Inner perianth lobes larger . . . . . (SUBSECT. *Brunonithismia* JONK.)
9. Perianth very zygomorphic, bilabiate. Upper lip fleshy, bent over the opening of the tube **8. T. labiata**
9. Flowers actinomorphic.
10. Inner perianth lobes simple. Tube with prominent horizontal bars inside.
11. Anthers with 3 distinct teeth at the free apical margin, each tooth bearing a stiff hair. Outer perianth lobes broadly ovate, obtuse, erect . . . . . **9. T. javanica**
11. Anthers slightly dentate apically. Outer perianth lobes short, ear-shaped . . **10. T. arachnites**
10. Inner perianth lobes consisting of 3 parts. Basal part erect, short, bearing the transverse part, hamate at the base and broadened at the apex. Third part awl-shaped, inserted on the broad apex of the second part. Perianth tube without bars . . . . . **11. T. neptunis**
1. Inner perianth lobes connected at the apex to an erect mitre with 3 holes. Underground part coralliform . . . . . (SECT. *Sarcosiphon* (BL.)JONK.)
12. Inner perianth lobes linear, connate at the tips, forming a mitre with large holes. Anthers ciliate in the basal part, toothed at the apex.
13. Apical margin of the anthers provided with 2 teeth, each bearing a stiff hair. Anthers slightly constricted in the middle, below the thecae . . . . . **12. T. clandestina**
13. Apical margin of the anthers provided with 3 teeth, each bearing a stiff hair. Anthers constricted at the base, just above the thecae . . . . . **13. T. episcopalis**
12. Inner perianth lobes spathulate, connate to a mitre with rather small holes. Anthers not ciliate, truncate at the apex . . . . . 14. **T. crocea**

**1. Thismia chrysops** RIDL. Ann. Bot. 9 (1895) 323; JONKER, Monogr. (1938) 237.

Stem usually simple and 1-flowered, about 15 cm. *Leaves* and bracts linear-lanceolate, acute more or less imbricate, up to 4 mm. *Perianth* tube geniculate; part below knee *c.* 3 mm, pink with longitudinal striae; the *c.* 5 mm long, upper part and limb chocolate-brown; perianth mouth yellow. Perianth lobes lanceolate, about 7 mm, tapering to filiform tentacles. Annulus prominent, slightly 6-lobed. Anthers quadrangular, provided with a thick hair on both sides of the free, apical margin and a broad, wing-like appendage, inserted on the midline of the connective. Stigmas oblong, bifid. *Fruit* stalk elongate.

Distr. *Malaysia:* Malay Peninsula (Malacca, Mt Ophir), once collected.

**2. Thismia racemosa** RIDL. J. Str. Br. R. As. Soc. 69 (1915) 13; JONKER, Monogr. (1938) 238.

Stems several, occasionally branched. *Leaves* linear, acuminate. *Flowers* 4–6 in a raceme; pedicels 1–1½ cm long. Perianth lobes short, triangular-ovate, blunt. Annulus prominent. Tube cylindrical, about 6 mm long.

Distr. *Malaysia:* Malay Peninsula (Pahang), once collected.

**3. Thismia grandiflora** RIDL. Ann. Bot. 9 (1895) 324; JONKER, Monogr. (1938) 239.

Stem simple, 1-flowered, 3 cm, provided with 2 basal, opposite, scale-like lanceolate *leaves*, about 5 mm, and 2 apical bracts, of the same shape and size as the basal leaves; both leaves and bracts beset with stiff, terete, blunt processes on the back. *Perianth* urceolate; tube pink with longitudinal striae, 8 mm. Lobes patent, ovate-triangular in the basal part, tapering at the apex to filiform tentacles. Annulus prominent. Anthers not or scarcely stuck together, provided with 2 lateral teeth at the free apical margin and a wing-like appendage inserted at the middle of the connective. Stigmas lanceolate, bifid, acute, papillose. Ovary about 4 mm, obovoid, truncate.

Distr. *Malaysia:* Malay Peninsula (Johore), once collected.

**4. Thismia fumida** RIDL. J. Str. Br. R. As. Soc. 22 (1890) 338; JONKER, Monogr. (1938) 240.

Stem slender, conspicuous, unbranched, about 10 cm, bearing 1–2 flowers. *Leaves* very small, appressed, lanceolate, acute. *Flowers* up to 1 cm. Perianth lobes lanceolate, acute, greenish-grey, constricted above the ovary and broadened below the limb, white with pink stripes. Annulus prominent. Ovary obconical. *Capsule* cup-shaped, ribbed and scabrid, crowned by the crenulate, basal ring of the perianth.

Distr. *Malaysia:* Malay Peninsula (Singapore and Selangor).

**5. Thismia aseroe** BECC. Malesia 1 (1877) 252; JONKER, Monogr. (1938) 240.—**Fig. 3.**

Stem simple or, sometimes, branched, 1- or 2-flowered, up to 8 1/2 cm high. *Leaves* few, lanceolate, obtuse, to 4 mm long. At the base of the flowers an involucre, consisting of lanceolate bracts. Perianth obconic-campanulate, dirty-yellow in the basal part, bright orange-yellow in the upper part and in the limb. *Perianth* tube about 11 mm; the basal 5 mm inside with transverse bars. Lobes triangular, 3 mm long, ending in bright orange tentacles, red at the base, 6 mm long. Annulus prominent. Anthers with 3 short thick-filiform appendages at the free apical margin; in the lower part of the anther, inserted at the middle of the connective, a broad, dorsal quadrangular wing, wider than the anther. Thecae oblong, in the basal part of the anther; in the apical part 2 nectaries on the line of junction of one connective with the next. Ovary obovoid, 3 mm. Stigmas narrow-lanceolate, rather long, acute. *Capsule* ribbed, about 5 mm. Fruit stalk lengthening about 5–7 mm above the involucre. Seeds ellipsoid, ribbed.

Distr. *Malaysia:* Malay Peninsula (Singapore and Perak).

Ecol. In humic forests.

**6. Thismia alba** HOLTTUM, *ms.*

A *Th. aseroe* differt antheris singulis munitis una tantum appendice mediana crassi-filiformi, porro margine apicali libera instructa dentibus 2 lateralibus brevibus. Perianthium album signatum striis 6 longitudinalibus ochraceo-brunneis; perianthii lobis tentaculis ± 2 cm longis praeditis.

Stem simple, 1- to 3-flowered, up to 10 cm. *Leaves* few, 3–4 1/2 mm long, lanceolate, acute or acuminate. At the base of the flowers an involucre, consisting of lanceolate, acute bracts. *Perianth* obconic-campanulate, white with 6 thin ochraceous-brown streaks, leading down from each perianth lobe, alternating with 6 thin yellow lines. Perianth tube about 10 mm, the basal part with transverse bars inside. Lobes triangular, 3–4 mm long, pale-yellow at the base, terminated by white, tentacles about 15 mm long. Annulus prominent, bright yellow. Anthers with 1 thick-filiform, median appendage and 2 lateral short teeth at the free apical margin; in the lower part of the anther, inserted at the middle of the connective, a broad, dorsal, quadrangular wing, wider than the anther. Thecae oblong, in the basal part of the anther; in the apical part 2 nectaries on the line of junction of one connective with the next. Ovary semi-globose, about 2 mm. Stigmas lanceolate, retuse, papillose. *Capsule* obconical, about 6 mm.

Distr. *Malaysia:* Malay Peninsula (Pahang).

**7. Thismia ophiuris** BECC. Malesia I (1877) 252; JONKER, Monogr. (1938) 242.

Stem 2–6 mm, simple or branched, 1- or 2-flowered. *Leaves* lanceolate, obtuse, to 4 mm long. Below the flowers an involucre of several, lanceolate, 3–4 mm long and 1 mm wide bracts. *Perianth* urceolate, yellowish brown. Tube about 9 mm; lobes triangular, terminated by long, filiform tentacles, about 13 mm. Annulus broad and thick. Insertion of the stamens broad, then narrowed into a ribbon-shaped filament and again broadened into the quadrangular anthers. Apical free margin of the anthers provided with 2 teeth, each with a globose body at the top. Ovary ovoid, about 5 mm. Style bearing 3 sessile, funnel-shaped, circumvallated stigmas. *Capsule* ribbed; seeds oblong with longitudinal ribs; funicles about the same length as the seeds.

Distr. *Malaysia:* Borneo (Sarawak & Br. N. Borneo).

**8. Thismia labiata** J.J.S. Bull. Jard. Bot. Btzg III, 9 (1927) 220; JONKER, Monogr. (1938) 44, 243.

Stem simple, 22 mm long. *Leaves* ovate, acute, appressed, 1 1/2 mm. Flowers with an involucre of 3 ovate-lanceolate, acute, 5 1/2 mm long bracts. *Perianth* urceolate in the basal part, bilabiate-zygomorphous in the upper part. Outer perianth lobes 2 1/2 mm, broad-ovate at the base, rounded, with a subulate appendage inserted below the top. Inner lobes linear to filiform, subulate, 5 mm. A thick, fleshy upper lip bent over the perianth mouth; on the back of the upper lip 1 inner and 2 outer perianth lobes. The other 2 inner lobes between the 2 lips. The third outer lobe inserted on the middle of the lower lip. Stamens rounded and ciliate at the free, apical margin; thecae elongate; outer side of the stamen provided with scattered hairs. The 3 stigmas connate to a capitate, 3-lobed stigma. Ovary obconical.

Distr. *Malaysia:* Sumatra (Eastcoast Res.) once collected.

**9. Thismia javanica** J.J.S. Ann. Jard. Bot. Btzg 23 (1910) 32; JONKER, Monogr. (1938) 245.—**Fig. 11.**

Stem simple or branched, up to 12 cm, 1- to 5-flowered. *Leaves* ovate or lanceolate-ovate, obtuse, 3 mm. At the base of a flower an involucre of 3 bracts. *Perianth* tube 7 mm, urceolate, whitish with 12 longitudinal, orange stripes, inside with longitudinal bars connected by many transverse bars. Outer perianth lobes obtuse, ovate; inner ones triangular, terminated in up to 3 cm long, filiform tentacles. Anthers 3-toothed at the free apical margin; each tooth terminating in a hair. On the outer side of the anther, inserted in the middle, a qua-

drangular appendage, wider than the stamen. Margin of the appendage strigose. Style orange-coloured; stigmas sessile, ovate, truncate. Ovary obovoid, 3 mm. *Capsule* orange-coloured, about 6 mm. Seeds ellipsoid.

Fig. 11. *Thismia javanica* J. J. S. Doengoes Iwoel, × 3/2. (LIEFTINCK)

Distr. *Malaysia:* Sumatra and W. Java.

Ecol. Shade of forests, on humus, below 1000 m alt.

Vern. *Angkrek rambut* (Java).

Notes. Perhaps conspecific with the following species.

**10. Thismia arachnites** RIDL. Journ. Str. Br. Roy. As. Soc. 44 (1905) 197; JONKER, Monogr. (1938) 247.

Stem simple, 1–7 1/2 cm, bearing 1–3 flowers. *Leaves* few, lanceolate, acute, about 5 mm. At the base of the flowers an involucre, consisting of ovate-lanceolate, acute, 5–7 mm long bracts. *Perianth* urceolate to obconical, about 8 mm long, inside with longitudinal bars, connected by many transverse bars; tube transparent, white with 6, vertical, red streaks in the apical part. Perianth lobes pale red. Outer lobes very short, about ½ mm, ear-shaped; inner ones triangular, about 1 mm, terminating in up to 3 cm long, thin, filiform tentacles. Annulus prominent, yellow. Anthers slightly 3-toothed at the apical free margin, the lateral teeth somewhat larger than the median one, each tooth terminating in an indistinct, very thin, fragile hair. On the outer side of the anther, inserted in the middle, a quadrangular strigose appendage, wider than the stamen. Style thick, conical; stigmas lanceolate, obtuse. Fruit stalk lengthening above the involucre.

Distr. *Malaysia:* Malay Peninsula (Perak & Pahang).

Note. Closely related to the preceding species, perhaps conspecific.

**11. Thismia neptunis** BECC. Malesia I (1877) 251; JONKER, Monogr. (1938) 43, 243.

Stem 4–25 mm, simple, 1-flowered, beset with few, lanceolate, acute, about 3 mm long *leaves*. At the base of the flower an involucre of 3 lanceolate, acute, 4–6 mm long bracts. *Perianth* tube urceolate, with 6 longitudinal stripes, 6 mm. Outer perianth lobes simple, recurved, filiform with triangular base, 4 1/2 mm. Inner ones erect, about 15 mm, consisting of an erect, short, basal part; a transverse part with hamate base and a broadened, rounded apex and, inserted on the apex of the transverse part, an erect, long, awl-shaped part. Annulus prominent. Anther quadrangular, 3-toothed at the free apical margin. Stigmas lanceolate, acute. Ovary obovoid, truncate, 1 1/2 mm.

Distr. *Malaysia:* Borneo (Sarawak, Mt Mattang), once collected.

**12. Thismia clandestina** (BL.) MIQ. Fl. Ind. Bat. 3 (1855) 616; JONKER, Monogr. (1938) 252.—*Sarcosiphon clandestinus* BL. Mus. Bot. Lugd. Bat. 1 (1849) 65.

Stem up to 5 cm, 1–2-flowered. *Leaves* appressed, acuminate, to 5 mm. At the base of the flower 3 bracts. Perianth tube urceolate, about 2 1/2 mm, greenish-grey, with 12 longitudinal, brownish-black stripes. Outer perianth lobes almost absent, inner ones connate to a 2 1/2 mm long, acuminate mitre. Annulus prominent, 6-lobed. Margin of the filaments and upper part of the anthers with short hairs. Thecae oblong, inserted on the margins of the anthers. Free apical margin of the anthers with 2 teeth, tapering to stiff hairs. Inserted on the midline a large, wing-like appendage, provided with bundles of hairs on the angles. Stigmas ovate, bilobate, papillose, whitish. Ovary obovoid, about 3 mm. Funicle about the same length as the ovules. *Capsule* papillose, about 5 mm.

Distr. *Malaysia:* W. Java.

Ecol. In humus of forests, ascending to *ca* 1000 m alt.

**13. Thismia episcopalis** (BECC.) F. v. MUELL. Pap. & Proc. R. Soc. Tasm. for 1890 (1891) 235; JONKER, Monogr. (1938) 46, 253.—*Geomitra episcopalis* BECC. Malesia 1 (1877) 250.—*Bagnisia episcopalis* ENGL. Pfl. Fam. 2, 6 (1889) 48.—*Sarcosiphon episcopalis* SCHTR. Notizbl. 8 (1921) 38.—**Fig. 4.**

Stem simple or branched, 1–8 flowered, up to 19 cm. *Leaves* appressed, ovate, acute, 2–5 mm. *Perianth* tube urceolate, yellow with black stripes, 6–9 mm. Outer perianth lobes almost lacking; inner connate to a slightly acuminate, about 5 mm long mitre. Filaments constricted. Thecae divergent. Margin of the anthers and the winglike appendage hairy, apical part of the anther, below the insertion of the appendage, darker coloured; free apical margin 3-toothed, each tooth terminated by a stiff hair. Stigmas bilobate. Ovary obovoid, 3 mm. Funicles about as long as the ovules. *Capsule* ribbed, about 3 mm. Fruit stalk lengthened.

Distr. *Malaysia:* Borneo (Sarawak, Br. N. Borneo).

Ecol. In humus of forests, ascending to *ca* 1700 m alt.

**14. Thismia crocea** (BECC.) J.J.S. Nova Guinea 8,1 (1909) 193; JONKER, Monogr. (1938) 44, 251. —*Bagnisia crocea* BECC. Malesia 1 (1877) 249.—*Thismia versteegii* J.J.S. Nova Guinea 8,1 (1909) 193.—*Sarcosiphon croceus* SCHLTR. Notizbl. 8 (1921) 38.—*Sarcosiphon versteegii* SCHLTR. Notizbl. 8 (1921) 38.

Stem simple, 1–3-flowered, about 6 cm. *Leaves* appressed in the basal part, lanceolate, acute, to 6 mm. At the base of the flowers 3 ovate lanceolate, acute bracts. *Perianth* tube urceolate, ribbed, reddish-brown in the upper part, yellowish-orange in the middle and white at the base, about 6 mm. Outer *perianth* lobes broad, short, rounded; inner ones connate to a thick, 2 mm long mitre with 3 narrow holes and 3 prominent midribs. Annulus slightly 12-lobed. Anthers quadrangular, not hairy; thecae oblong, parallel; inserted in the apical part of the anther a broad appendage with curled margins. Stigmas ovate, obtuse, papillose. Ovary light reddish-brown, about 2 mm. Funicles as long as the ovules. *Fruit* ribbed, obovoid. Fruit stalk thickened and lengthened after flowering to 16 mm above the bracts.

Distr. *Malaysia:* West New Guinea.

Notes. In Perak (Malay Peninsula), RIDLEY observed a *Thismia*, described by him in Mat. Fl. Mal. Pen. 2 (1907) 75, as *Bagnisia crocea var. brunnea*. This specimen was apparently not preserved; it is highly improbable that it belongs to *T. crocea*.

## 4. GEOMITRA

BECCARI, Malesia 1 (1877) 250; JONKER, Monogr. (1938) 46, 254.

Underground part unknown. Stem beset with scale-like *leaves*. *Flowers* rather large, with an involucre at the base. Tubular part of the perianth urceolate. Outer perianth lobes free, very small. Inner ones connate at the top to an erect mitre with 3 holes, crowned by 3 apical, long, thick-filiform, erect, clavately swollen appendages. Basal ring of the perianth tube thickened, persistent on the fruit. Throat margin of the perianth thickened to a 6-lobed annulus. Stamens 6, hanging at the annulus; anthers stuck together to a tube. Style short, cylindrical, fleshy, bearing 3 erect stigmas. Ovary with 3 stalked placentas; funicles short. *Capsule* cup-shaped, crowned by the persistent, basal perianth ring and the style.

Distr. One species, known only from Borneo (Sarawak).

**1. Geomitra clavigera** BECC. Malesia 1 (1877) 251; JONKER, Monogr. (1938) 46, 255.—*Thismia clavigera* F. v. MUELL. Vict. Nat. (1890) 235.—*Sarcosiphon clavigerus* SCHLTR. Notizbl. 8 (1921) 39.

Stem simple, up to 12 cm, bearing about 3 flowers. *Leaves* lanceolate, acuminate or acute, 2–6 mm. Bracts lanceolate, acuminate, 6–7 mm. *Perianth* tube about 9 mm. Outer perianth lobes erect, broadly triangular, about 1 mm. Mitre about 3–5 mm, hooked at the apex. Filiform appendages 8–12 mm long. Anthers quadrangular; free apical margin with 3 teeth, each bearing a stiff, transparent hair. Anther tube about 4 mm. Stigmas lanceolate, bilobate; lobes acute. Ovary obovoid, truncate, about 3 mm.

Distr. *Malaysia:* Borneo (Sarawak), once collected.

## 5. SCAPHIOPHORA

SCHLTR. Notizbl. 8 (1921) 39; JONKER, Monogr. (1938) 46, 256.

Roots coralliform. Stem provided with scale-like *leaves;* at the base of the flower an involucre. *Perianth* tube urceolate. Outer perianth lobes small; inner ones narrow in the basal part, broadened at the apical part, connate to an erect mitre with 3 holes in the basal part. Mitre crowned by a long, stiff column, bearing at the top 3 lobes. Stamens 6, hanging, inserted at an annulus in the perianth throat. Filaments ribbon-shaped. Anthers stuck together to an anther tube; each anther provided with a wing-like appendage, inserted in the middle and broader than the anther. Placentas stalked; stalks inserted peripherically at the bottom of the ovary. Basal perianth ring and style persistent on the *fruit*

Distr. Two species, one in New Guinea, the other in the Philippines.

KEY TO THE SPECIES

1. Flowers 3–6½ cm long (without column). Column 1½–6 cm long, at the apex broadened to 3 fleshy, connate lobes . . . . . **1. S. gigantea**
1. Flowers 1 cm long (without column). Column 5 mm long, bearing at the apex 3 cup-shaped bodies . . . . . **2. S. appendiculata**

**1. Scaphiophora gigantea** JONKER, Monogr. (1938) 257.—**Fig. 2.**

Stem 4–10½ cm, partly subterranean. *Leaves* lanceolate, acute, 2–4 mm, the lower ones keeled. Bracts ovate, lanceolate, acute, about 18 mm. *Perianth* tube 15–21 mm, pale rose-coloured with yellow veins, reticulate below the inner perianth lobes. Outer perianth lobes ear-shaped. Mitre 5–9 mm long, orange to yolk-yellow. Stamens about 7 mm. Anthers prominently nerved; free apical margin provided with 3 median and 2 lateral teeth; each bearing a stiff, transparent hair. Appendix of the anther greenish-blue; lateral margins bearing 3 bundles of short hairs; apical margin pilose. Thecae divergent, ovate. Style truncate-conical. Stigmas sessile, obovate, 2-lobed, papillose outside and in the upper part inside. *Fruit* cup-shaped. Placentas connate at the apex, stalked; stalks about the same length as the placentas.

Distr. *Malaysia:* Philippines (Luzon), twice collected.

**2. Scaphiophora appendiculata** (SCHLTR.) SCHLTR. Notizbl. 8 (1921) 39; JONKER, Monogr. (1938) 259. —*Thismia appendiculata* SCHLTR. Bot. Jahrb. 55 (1918) 202.

Stem 15–20 mm high, partly subterranean, usually 1-flowered. *Leaves* ovate to lanceolate, 2–3 mm. Bracts lanceolate, acute, about 5 mm. *Perianth* tube 6 mm, yellowish white in the lower part. Outer perianth lobes small, ear-shaped. Mitre 3–6 mm, orange-coloured. At the base of each perianth lobe, on the inner side, a glandular, bowl-shaped body. Column ± broadened towards the apex, bearing 3 thick, fleshy, cup-shaped bodies. Stamens about 3 mm. Appendage of the anther crenulate at the apical margin. Thecae divergent. Style truncate-conical, 1½ mm. Stigmas sessile, obovate, 2-lobed, 1 mm. Ovary 3½ mm. Placentas stalked, above the fertile part suddenly narrowed again into a filiform, apical appendage. Placentas attached to the bottom of the ovary by the stalks and to the roof by the apical appendages.

Distr. *Malaysia:* Northeast New Guinea, once collected.

## SPHENOCLEACEAE (H. K. Airy Shaw, Kew)

Mart. *ex* Lindl. Nat. Syst. ed. 2 (1836) 238; DC. Prod. 8 (1939) 548; Wight, Ill. Ind. bot. 2 (1850) 115; Miq. Fl. Ind. Bat. 2 (1857) 569; Boiss. Fl. Or. 3 (1875) 963.

Annual (?)laticiferous herbs, with the habit of *Phytolacca*. Stem erect, somewhat succulent. *Leaves* spirally arranged, simple, entire, exstipulate. Inflorescences terminal, densely spicate, acropetal. *Flowers* subtended by a bract and two bracteoles, bisexual, actinomorphic. Calyx tube adnate to the ovary; segments 5, united below, imbricate, connivent, persistent. Corolla campanulate-urceolate, perigynous; lobes 5, imbricate. Stamens 5, epipetalous, alternating with the corolla lobes; filaments short; anthers rounded, 2-locular, dehiscing longitudinally. Ovary semi-inferior, 2-locular; style short, stigma capitate; ovules $\infty$, attached to large spongy stipitate axile placentas. *Capsule* cuneate-obconic, 2-locular, membranous, circumscissile; seeds $\infty$, minute, oblong, rugose-costate, albumen very scanty or none (?); embryo axile, straight, subterete.

Distr. Mono-generic, almost pantropical.

Ecol., Uses, Vern., see below under *S. zeylanica*.

Notes. The maintenance of *Sphenocleaceae* as a separate family is abundantly justified; there is no evidence of affinity with *Campanulaceae*, with which it has hitherto been associated. The habit resembles that of *Phytolacca*, and the anatomy shows several significant features occurring in members of the *Phytolaccaceae* and related families. Other characters suggest *Primulaceae*, and provisionally it is suggested that the family represents a 'half-way house' between the families mentioned. From the *Centrospermae* it deviates in the semi-inferior ovary, gamopetalous corolla and straight embryo, and from the *Primulaceae* principally in the alternipetalous stamens. A separate note on the classification will be published in the Kew Bulletin.

### 1. SPHENOCLEA

Gaertn. Fruct. 1 (1788) 113, t. 24, f. 5; Miq. Fl. Ind. Bat. 2 (1857) 569; B. & H. Gen. Pl. 2 (1876) 560; Baill. Hist. Pl. 8 (1886) 327, 362, f. 158–161; Schönland, in E. & P. 4, 5 (1889) 60; Boerl. Handl. 2, 1 (1891) 257. For characters see family description.

Distr. Two species, one pantropical, one endemic in W. Africa.

**1. S. zeylanica** Gaertn. Fruct. *l.c.;* Bl. Bijdr. 16 (1826) 1138; Moritzi, Syst. Verz. (1845–6) 66; Blanco, Fl. Filip. ed. 2 (1845) 62, ed. 3, 1 (1877) 117, t. 143; Miq. *l.c.;* F.-Vill. Nov. App. (1880) 121; K. & G. Mat. Fl. Mal. Pen. *no* 16 (1905) 57; Koord. Exk. Fl. 3 (1912) 301; Merr. Fl. Man. (1912) 462; Sp. Blanc. (1918) 374; En. Philip. 3 (1923) 588; Ridl. Fl. Mal. Pen. 2 (1923) 204; Backer, Onkruidfl. Jav. Suik. (1931) 742; Ochse & Bakh. v. d. Br. Veg. D. E. I. (1931) 93, f. 55, 349.—*Pongatium spongiosum* Blanco, Fl. Filip. (1837) 86.—*Reichelia palustris* Blanco, *l.c.* 220; ed. 2 (1845) 155; ed. 3, 1 (1877) 277, t. 143.—**Fig. 1.**

Roots long, cord-like. Stem hollow, 7–150 cm. *Leaves* oblong to lanceolate-oblong, attenuate at both ends, acute or obtuse, glabrous, 2½–12½ by ½–5 cm; petiole 3–30 mm. Spikes ¾–7½ cm long, cylindric; peduncle 1–8 cm. Bracts and bracteoles ± spatulate, the green apices arched over the calyx before and after anthesis. *Flowers* crowded, rhomboid or hexagonal by compression, sessile, wedge-shaped below, attached longitudinally to the rachis by a linear base. Calyx segments deltoid-semicircular, obtuse, ultimately accrescent and connivent. Corolla whitish, 2½–4 mm long, caducous, segments ovate-triangular, obtuse or acute, united slightly more than half-way, connivent. Stamens inserted half-way up tube of corolla, filaments slightly dilated at base. Ovary obovoid, 2½ mm long, apex broad, free, truncate. *Capsule* 4–5 mm in diam., dehiscing below the calyx segments which fall with the lid, leaving the scarious persistent base. Seeds yellowish-brown, ± ½ mm long.

Distr. Trop. America (introduced), trop. Africa (incl. Madagascar) (indigenous; *cf.* Benth. in Journ. Linn. Soc. Bot. 15 (1875) 13), SW. Persia to Turkestan, India and Formosa (prob. introduced), in *Malaysia* (prob. introduced): Malay Peninsula (scarce, mainly in the prov. Kedah and Wellesley), ?Sumatra, Philippines (Luzon, Biliran, Negros), Java, Bali, SW. Celebes and Timor.

Ecol. A weedy annual occurring in almost any kind of damp ground at low alt. up to 350 m: river banks and dry riverbeds, damp marshy or periodically inundated depressions, seasonal swamps, sides of ponds, ditches, and stagnant water generally, especially rice-fields, both in continuously rainy and in seasonal climates. Almost every flower on

every inflor. sets fruit; only one or two flowers are open at once on any one head. In Malaysia never gregarious, nor growing on mud of tidal creeks, as in Africa.

Uses. In Java young plants and tips of older plants are steamed and eaten with rice; they have a slightly bitter taste; leaves are sold under the name *goenda padi*.

Vern. Java: *goenda*, M, J, Sd, *g. rawah*, *g. lalab*, *g. padi*, *g. sapi*, Sd, *goendha*, Md, *gondo*, J; Bali: *gonda;* Celebes: *gangang karaèng*, Mk., *gonra*, Mk, Bg; Philippines: *mais-mais* (Panay, Bisáya), *silisilihan* (Tagálog); the Javanese names are also applied to the superficially similar Hydrophyllaceous *Hydrolea zeylanica* (L.) VAHL.

Notes. The plant is described as laticiferous but METCALFE reports that 'typical laticiferous canals are absent from the phloem, although occasional elongated cells have been observed in this tissue with granular contents which may represent coagulated latex'. Miss M. C. VREEDE, Anatomist in the Treub Lab., Buitenzorg, Java, reported, July 6, 1948, that in fresh material she could find neither milky juice nor laticiferous elements.

Fig. 1. *Sphenoclea zeylanica* GAERTN. × 1/4. A rich-flowering individual.

# NYSSACEAE[1] (J. Wasscher, Groningen)

## 1. NYSSA

Linné, Sp. Pl. (1753) 1058; Gen. Pl. ed. 5 (1754) 478; Wasscher, Blumea 1 (1935) 343.—*Agathisanthes* & *Ceratostachys* Bl. Bijdr. (1825) 644; Miq. Fl. Ind. Bat. 1, 1 (1856) 838.—*Agathidanthes* Hassk. Cat. Hort. Bog. (1844) 254.—*Daphniphyllopsis* Kurz, J. As. Soc. Beng. 44, II (1875) 201.

Dioecious trees or shrubs. *Leaves* simple, scattered. Stipules 0. *Flowers* unisexual, often in heads, in the axils of a bract and with 2 bracteoles. ♂: in axillary heads or short racemes; calyx entire or 5-toothed; petals 5, imbricate, often small, alternate with the calyx; stamens 8–16 in 2 alternating whorls; anthers small, dorsifixed with lateral lengthwise slits; disk pulvinate; style rudimentary. ♀: solitary, axillary or in 2–10-flowered heads; ovary inferior, 1-locular, connate with the 5-toothed or entire calyx; petals 5–8 often minute; stamens of inner whorl partly sterile, both petals and anthers soon dropping; style with 2 appressed later divergent often torulose branches stigmatose on their inside, brittle, often deficient in the herbarium. Ovule 1, hanging from the apex of the cell, anatropous with 2 integuments. *Fruit* drupaceous ovoid to oblong.

Distr. *Ca* 6 *spp.*, 4 in Atlantic N. America, 1 in China, 1 from India to W. Malaysia.

Ecol. The American *spp.* mostly in swamp forests, the Asiatic one not so.

Notes. The flowers are often deficient in the herbaria. The polymorphy of *N. javanica* suggests that perhaps more than one species is present in Malaysia.

**1. Nyssa javanica** (Bl.) Wang. Pfl. R. 41 (1909) 15; Wasscher, Blumea 1 (1935) 344.—*Ceratostachys arborea* Bl. Bijdr. (1825) 644; Miq. Fl. Ind. Bat. 1, 1 (1856) 839.—*Agathisanthes javanica* Bl. Bijdr. (1825) 645; Miq. Fl. Ind. Bat. 1, 1 (1856) 839.—*Agathidanthes javanica* Hassk. Cat. Hort. Bog. (1844) 254.—*Nyssa sessiliflora* Hook. *f.* & Th. Gen. Pl. 1 (1867) 952.—*Ilex daphniphylloides* Kurz, J. As. Soc. Beng. 39, II (1870) 72.—*Daphniphyllopsis capitata* Kurz, *l.c.* 44, II (1875) 201; For. Fl. Burm. 1 (1877) 240.—*Nyssa arborea* Koord. Exk. Fl. Jav. 2 (1912) 731.—*Nyssa bifida* Craib, Kew Bull. (1913) 69.—**Fig. 1.**

Dioecious tree up to 40 m, 30–100 cm diam., clear bole 13–23 m, buttresses mostly absent. Twigs tomentose, glabrescent. *Leaves* rather densely set, oblong-lanceolate to obovate, rarely subovate, base acute, apex abruptly acuminate, coriaceous, entire, sparsely hairy to tomentose on midrib and nerves beneath, further glabrous, 5–23 by 2½–8 cm; in seedlings the 1st pair of leaves is opposite; nerves 8–11 pairs; petiole 1–3½ cm long, flat or slightly sulcate, hairy or glabrous. *Flowers* pallid, in pedunculate nearly globose axillary heads 12–18 mm diameter; peduncles flattened towards the apex ¾–5 cm long, their apex 2–5 mm broad, glabrous or hairy, *ca* halfway with 1–2 sessile small acute bracts 3–4 by 1 mm. Receptacle globose to ellipsoid, flattened, 2–3 and 4–5 mm. Flowers enveloped by 1 bract and 2 halfway connate bracteoles, all broad-ovate, sericeous-ciliate, 2–2½ by 1½–3 mm, in ♀ persistent.—♂: Flowers 20–40 capitate, ½–4 mm pedicellate; calyx teeth 4–5 rounded, ½–¾ by 1–1½ mm, outside appressed-hairy, ciliate; petals 4–5 free, ovate with broad base, curled back, 3–5 by 1½–3 mm, both sides very short spreading hairy; stamens 8–10, those of outer whorl 3–5 of inner 2–4 mm long; anthers elliptic 1½ by 1 mm, outer loculi often larger than inner ones; disk ½–1 by 1–2 mm, 8–10 lobed.—♀: Flowers usually 3–8 rarely up to 18, sessile; calyx campanulate 2–3 by 1½ mm, densely appressed-sericeous; lobes 4–5 irregular, rounded, ½–1 by 2½ mm or almost absent; petals 4–5 as in ♂ but smaller 3–4 by 2½–3 mm; stamens 8–10, probably of inner whorl at least sterile, smaller than in ♂; style 1½–2 by ½–1 mm, with 2 divergent (in bud one branch longer and incurved over the other), or curled branches 1–2 mm long. *Fruit* ellipsoidal, little flattened, 1½–2¼ by 4–1½ cm, ¾–1½ cm thick, crowned by the disk & calyx limb 1 by 2 mm, immature yellow, ripe purple. Exocarp coriaceous glabrescent, mesocarp spongious-fleshy. Stone flattened obovate, acute 1–2 by ½–1¼ cm, 2–6 mm thick, on one side with 5 length-grooves, the other side with few tubercles above the middle and a length-keel.

Distr. SE. Asia and *Malaysia:* Sumatra, Mal. Peninsula, Borneo, Java, 600–1600 m alt. (in Siam and Sumatra once at 100 m, in the Himalaya ascending to 2400 m acc. to Hook. *f.*).

Ecol. Common or scarce, never gregarious, in mixed evergreen mountain forests both in ever-wet and periodically dry regions (E. Java), not in sec-

(1) The family consists of 3 genera, 2 of which are endemic in Central Asia. *Nyssa* occurs from Malaysia to Asia and N. America. Formerly the family was included in the *Cornaceae sens. ampl.*


Fig. 1. *Nyssa javanica* (BL.) WANG. Twig, × 2/3, *a.* male flower, × 6, *b–d.* female flowers, × 6, *e.* galled fruits, × 2/3, *f.* fruit, × 2/3, *g.* seed, × 2/3.

ondary forest, mostly *fl.* Jan.–May, *fr.* July–Dec. The thick end-bud produces young pale brown-red foliage and flowers in the rainy season. Fruits often deformed into worm-shaped galls.

Vern. Malay names in Sumatra mostly '*medang*' with some additional name (also common for *Laur.*), in Java *hiroeng*, or *kiroeng*, Sd; Javanese names very variable.

Uses: Rather heavy dense wood not highly estimated. Bark grey, smooth, dingy yellow in section. Fruits are said to be edible and have a sweet odour, but a bitter acid taste.

Notes. The fruits are often deformed to a gall on which BLUME based his *Ceratostachys arborea*. The variability in the flowering parts, their early dropping, and the brittleness of the flowers in the herbarium have caused many discrepancies in literature.

Excluded

*Nyssa hollrungii* K. SCH. Nachtr. Fl. D. Schutzgeb Süds. (1905) 334 = *Alangium javanicum* (Bl.) WANG. *var. papuanum* (MANSF. & MELCH.) BLOEMB. Blumea 1 (1935) 284.

# SARCOSPERMACEAE (H. J. Lam, Leyden)

## 1. SARCOSPERMA

Hook. *f.* in B. & H. Gen. Pl. 2 (1876) 655; Ridl. Fl. Mal. Pen. 2 (1923) 260; H. J. Lam, Bull. J. B. B. III, 7 (1925) 248; *l.c.* 8 (1926) 18; Philip. J. Sc. 49 (1932) 143; Blumea 3 (1938) 183; *l.c.* 3 (1939) 261; *l.c.* 4 (1941) 322.—*Bracea* King, J. As. Soc. Beng. 64, II (1896) 101.—*Apoia* Merr. Philip. J. Sc. 17 (1920) 605.

Trees or shrubs, at least two *spp.* laticiferous. *Leaves* simple, entire, subopposite or opposite, rarely subverticillate; often with some alternate ones between, pennineryed; petiole sometimes with auricles at the top; blade often with glandular pits in the axils of the secondary nerves or scattered on the undersurface; tertiary nerves slender but conspicuous, transverse and usually crowded, more or less perpendicular to the midrib. Stipules small, caducous. *Flowers* bisexual, in small fascicles or solitary, placed along racemose or more or less broadly paniculate axillary shoots; bracts minute deltoid. Sepals 5, quincuncially imbricate, two inner ones with scarious margins. Corolla infundibuliform, tube short, slightly thickened; lobes spreading, imbricate in bud. Staminodes 5, alternipetalous, inserted in the throat. Stamens 5, epipetalous; filaments short, connate with the base of the petals; anthers basifix, slightly extrorse, 2-celled, longitudinally dehiscent. Ovary superior, 1–2-celled, glabrous, contracted into a short stout style; cells with 1 apotropous, ascending ovule, attached to the basis of the central axis; stigma truncate, capitate or faintly 2-lobed. *Fruit* drupaceous, 1–(2)-seeded, ovoid to oblong; pericarp thin. Seeds with a thin-crustaceous pale dull testa. Hilum small, round, basal; albumen absent; cotyledons thick; radicle inferior.

Distr. 6 *spp.* of this mono-generic family occur in SE. Asia and Malaysia.

Ecol. Scattered in mixed forests from the lowland up to ± 1100 m.

Uses. The wood of the moderate-sized *S. paniculatum* is rather soft and not durable; in Sumatra it is used as timber (Heyne, Nutt. Pl. (1927)1245); Marco described it in detail anatomically (Trop. Woods 5 (1933) 1).

Notes. The genus is closely allied to the *Sapotaceae;* its wood anatomy is only slightly different. Herbarium specimens are often not recognized and confused with other families.

### KEY TO THE SPECIES

1. Apex of the petiole with distinct auricles. Leaves oblong to elliptic, 6–28, by 3½–10 cm, dark brown *s.s;* glandular pits scattered on undersurface; secondary nerves 6–11. Ovary 2-celled **1. S. paniculatum**

1. Auricles absent. Leaves rather broad, 11–36 by 3–13 cm, slightly pubescent below, light brown *s.s.;* glandular pits absent; secondary nerves 7–16. Ovary 1-celled . . . . . **2. S. uittienii**

**1. Sarcosperma paniculatum** (King) Stapf & King, Ic. Pl. 7 (1901) t. 2690; Lam, *ll.cc.*—*Bracea paniculata* King, *l.c.*—*Discocalyx macrocarpa* Elmer, Leafl. 8 (1915) 2781.—*Apoia macrocarpa* Merr. *l.c.*—*Sarcosperma breviracemosum* H. J. Lam, Bull. J. B. B. III, 8 (1926) 21.

Laticiferous tree, 12–27 m, unbranched bole 6–17 m, 20–50 cm diam., crown spreading. *Leaves* glabrous, opposite or scattered, oblong to elliptic, base acute to ± acuminate, apex gradually bluntly acuminate, 6–28 by 3½–10 cm, auricles acute ½–2 mm long; petiole 1–2½ cm. Stipules subulate, glabrous, *ca* 4 mm long. Inflor. glabrous or slightly tomentose, either paniculate, 1–14 cm long with branches 2–9 cm, or hardly branched 8–16 mm long; bracts glabrous, acute, 1 mm long. *Flowers* thickish, waxy yellow to pale greenish white, fascicled or solitary; pedicels 1–1½ mm. Sepals roundish or broadly acute 2 mm through. Corolla tube 1 mm, lobes ovate 3 by 2 mm. Staminodes acute 1 mm. Stamens ovoid 1 mm through. Ovary 2 by 1 mm; style 1 mm. *Fruit* ovoid, 17–20 by 17–15 mm, 1-(rarely 2-) seeded, 3 mm stalked; hilum 3 by 4 mm.

Distr. *Malaysia:* Mal. Peninsula (Perak), N. Sumatra, Br. N. Borneo, Mindanao, S. Celebes, Ternate, Flores, and E. New Guinea.

Ecol. Scattered in dense or open mixed rainforests, rarely in forest borders, among bamboos, or in secondary jungle, in the Malay Peninsula below 250 m, elsewhere ascending to 1100 m. Fl. and fr. irregularly.


Fig. 1. *Sarcosperma uittienii* H. J. L. *a*. flowering branch, × 1/2, *b*. bud, *c*. flower diagram, *d*. part of the corolla and calyx within, *e*. ovary in longitudinal and cross-section.

Vern. Not constant, few noted.

Notes. It is probable that more specimens are hidden among indeterminates in several families.

**2. Sarcosperma uittienii** H. J. LAM, Bull. J. B. B. III, 8 (1926) 19, f. 1, *&c.*—*S. sumatranum* UITT. *ex* LAM, *l.c.*—**Fig. 1.**

?Tree. Leaves fairly opposite, oblong-elliptic to ovate or obovate, both base and apex acuminate, glabrous above glabrescent below; petiole 12–20 mm. Inflor. densely minutely tomentose, generally broadly and laxly paniculate, sometimes almost unbranched, 3 3/4–13 1/4 cm long, branches 1 1/2–6 3/4 cm long; bracts tomentose, deltoid 1–2 mm long. *Flowers* fascicled or solitary *only known in bud;* pedicals 2–4 mm. Calyx densely tomentose, 2 1/2 by 2 mm. Corolla tube 1/2 mm long, lobes obovate, 2–2 1/2 mm. Staminodes deltoid 1/2 by 1/3 mm. Stamens ovoid, 1 mm through. Ovary glabrous, 2 1/2 by 1 1/2 mm. Style 1 mm. *Fr.* unknown.

Distr. *Malaysia:* only known from Sumatra (Eastcoast Res.).

Ecol. Forests, *ca* 500 m. Fl. June–July.

Vern. Only once noted.

Notes. Inadequately known. Closely related to *S. kachinense* (KING & PRAIN) EXELL from Burma & China, and to *S. arboreum* HOOK. *f.* from India to China.

## Excluded

*Sarcospermum petasites* REINW. ex DE VRIESE, Reinwardt's reize (1858) 576 = *Gunnera macrophylla* BL. (*Halorrh.*).

## STACKHOUSIACEAE (F. I. Brouwer, Groningen)

### STACKHOUSIA

J. Smith, Trans. Linn. Soc. Lond. 4 (1798) 218; Pamp. Bull. Herb. Boiss. II, 5 (1905) 912; Brouwer, Blumea 3 (1938) 173; Mattf., in E. & P. ed. 2, 20b (1942) 240.

Annual, or perennial herbs with a rhizome. *Leaves* scattered, entire. Stipules 0 or very small. Racemes terminal. *Flowers* bisexual, regular, 5-merous, in groups in the axils of bracts. Sepals usually more or less connate, rarely free. Corolla perigynous or almost hypogynous, petals long-clawed, rarely entirely free, usually free at the base, connate in the upper portion of the claws, lobes imbricate spreading. Stamens 5, inserted on the margin of the calyx tube, free, usually unequal (2 shortest), included in the corolla tube. Ovary (2–)3(–5) celled, lobed, each cell with 1 erect ovule. Style with (2–)3(–5) stigmatic lobes, partly sunk in the ovary. *Fruit* with (2–)3(–5) one-seeded cocci and a columella.

Distr. *Ca* 19 *spp.* in Australia, 4 in Tasmania, 1 in New Zealand and 1 in Malaysia, Australia and Micronesia (Palau, Jap).

Notes. The family consists next to the genus *Stackhousia*, the single one by which it is represented in Malaysia, of 2 other monotypic genera, and is practically confined to Australia. It is not directly allied to any other family and has been compared with *e.g. Euphorbiaceae, Celastraceae, Sapindales, &c.*

**1. Stackhousia intermedia** F. M. Bailey, Q. Agric. J. 3, 4 (1898) 174; Q. Fl. (1899) 264; Pamp. *l.c.* 1149, *cum f. philippinensis;* Brouwer, Blumea 3 (1938) 174; Steen. J. Arn. Arb. 28 (1947) 422. —*S. muricata* (*non* Lindl.) *auct. plur. quoad* Philip. —*St. viminea* (*non* J. Sm.) Volkens, Bot.Jahrb. 31 (1902) 467; *id. var. micrantha* Lautb. Nachtr. Fl. Deut. Sch. Geb. Süds. (1905) 305.—*St. tenuissima var. ramosa* Steen. Nova Guinea 14 (1927) 307.— **Fig. 1—2.**

Erect, glabrous annual, 6–50 cm long. Root fusiform, up to 5 cm long, 1 1/2 mm diam. at the base, attenuate, with fibrous ramifications. Stem gradually attenuate to the almost filiform angular apex, little branched and leafy below, terete, striate, internodes 1/2–3 cm long. *Leaves* linear, sessile, base attenuate, 7 1/2–20 by 1/5–2 mm, lower obtuse, upper acute to mucronate, nervation absent or midrib visible. Racemes 1–20 cm long. *Flowers* minute yellow, upper groups 1–3 fls and 2 bracteoles, lower groups with more bracteoles and up to 5 fls. Bracts roundish ovate, strongly acuminate, fimbriate, dentate, 3/4–1 by 1/2 mm, membranous except the midrib. Bracteoles like the bracts but more dentate and less acuminate. Pedicels 3/4–1 1/4 mm. Calyx-tube 1/2 mm high, lobes ovate-acuminate, 1/2 mm long, irregularly fimbriate-dentate, margin membranous. Corolla inserted on the margin of the calyx-tube, sympetalous, hypocraterimorphous, tube cylindrical, 2 by 1/2 mm, divided into 5 petals in the lower portion over 1/4 mm, lobes ovate-oblong, strongly acuminate, *ca* 3/4 mm long. Filaments filiform, 2 shorter ones reaching the middle, 3 longer ones the margin of the corolla-tube; anthers oblong, very obtuse and emarginate at base and apex, 0.6 by 0.3 mm, introrse, dithecic, 4-locular. Ovary subglobose, 0.3–0.4 mm diam. 3-lobate, 3-celled. Style straight, 0.4 mm long, with 3 linear stigmas. *Cocci* 3, roundish ovate, 1 1/2 by 1 mm, reticulate.

Distr. Australia, Micronesia, and *Malaysia:* Sumatra (Toba-Batak Lands), N. Celebes, Philippines (Luzon, Culion, Guimaras), Moluccas (Boeroe, Ambon, Saparoea), New Guinea, 10–100–300–600–1500 m alt.—Fig. 1.

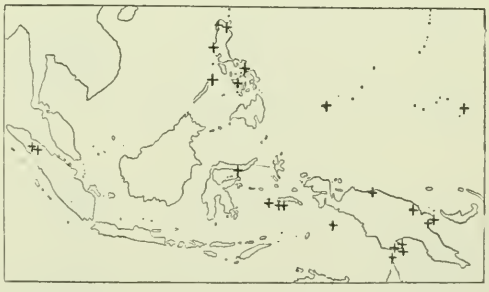

Fig. 1. Localities of *Stackhousia intermedia* Bailey in Malaysia.

Ecol. Lank herb mostly in grassfields, savannahs and abandoned fields, in both wet and dry spots, in Sumatra at 600–1400, but in E. Malaysia & Micronesia below 300 m, in the Philippines ascending to 1500 m. *Fl.* mostly in April–May together with the grasses.

Notes. *St. tenuissima, virgata, aphylla* and *micrantha* Pamp. *l.c.* are most probably all identical with this species.

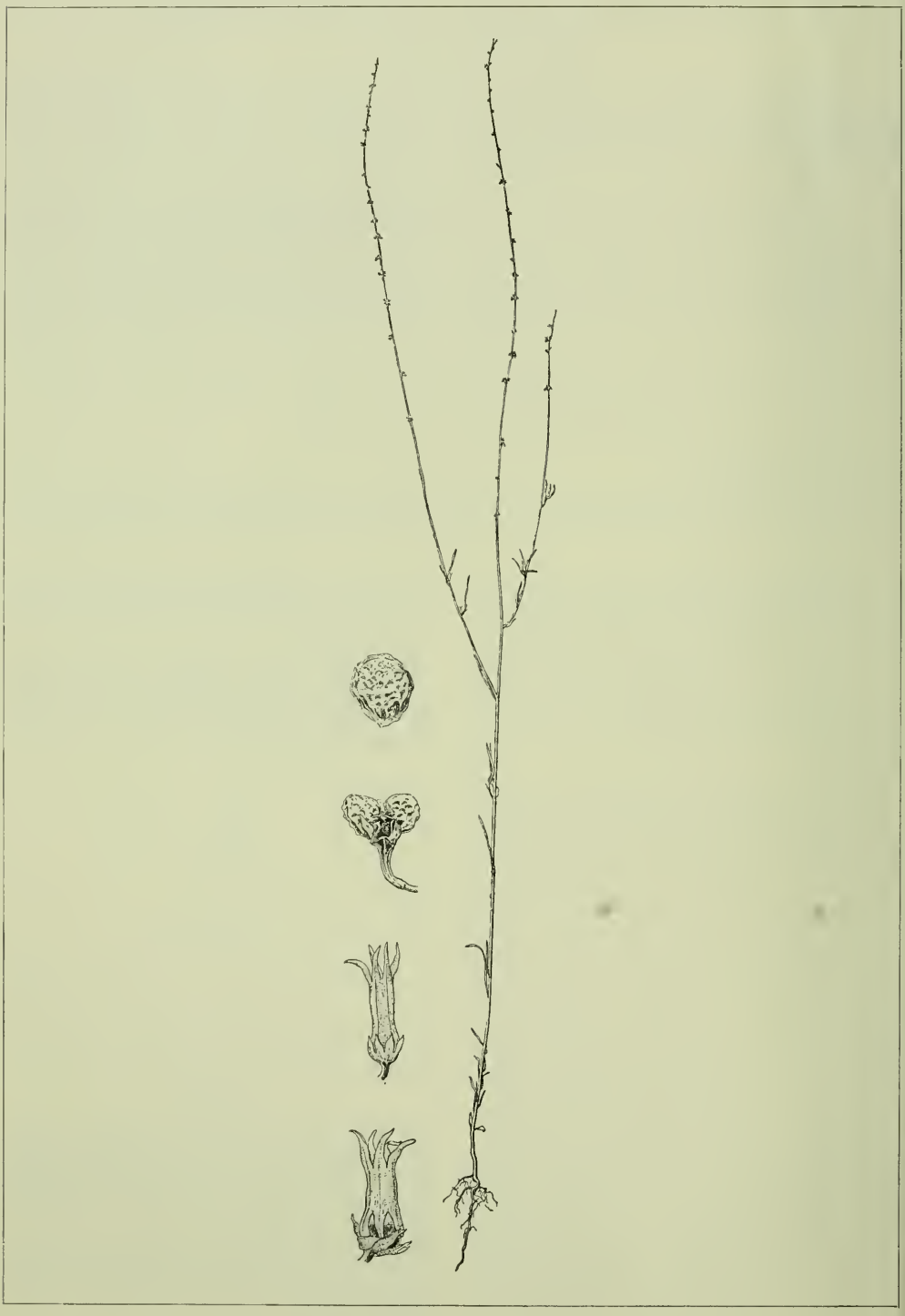

Fig. 2. *Stackhousia intermedia* BAILEY, × 1/2, fruits and flowers enlarged.

# ACTINIDIACEAE (C. G. G. J. van Steenis, Buitenzorg)

## 1. ACTINIDIA

LINDL. Nat. Syst. ed. 2 (1836) 439; B. & H. Gen. Pl. 1 (1862) 177; BENTH. Fl. Hongk. (1861) 26; KING, Ann. R. Bot. Gard. Calc. 5, 2 (1896) 145, t. 176; E. & P. ed. 2, 21 (1925) 36.

Trailing *shrubs or lianas* without special organs for climbing, branches rarely flexuose; stem with wide vessels, raphides in the flowering parts; bark often with short linear lengthwise lenticels. Growth in flushes from terminal and axillary buds. Indumentum of stellate or simple hairs. Stipules minute, obsolete, or absent. *Leaves* simple, scattered, petiolate, serrate or callous-dentate, penninervous, midrib sulcate, veins in cross-bars, veinlets reticulate. Inflor. lateral, often on a common peduncle forked at the apex, cymose, often pseudo-umbellate; bracts 2, at the apex of the peduncle. *Flowers* mostly white, dioecious (or polygamous), 5(–4)–merous. Sepals distinctly imbricate (rarely valvate), free or subconnate at the base, persistent. Stamens (10–) ∞, in ♀ fls with short filaments and small sterile anthers; filaments thin, anthers versatile, base divaricate, attached in the middle, reflexed in bud, dehiscing lengthwise. Disc absent. Ovary free, superior, tomentose (or glabrous), (5–) ∞-celled; ovules attached on the central axis. Styles free, (5–) ∞, persistent, elongating after flowering in ♀, ±clavate, spreading, in ♂ ovary small, with minute styles. *Berry* glabrous (or hairy), often spotted by lenticels, oblong. Seeds ∞, small, biconvex, oblong, immersed in pulp; testa cartilagineous, reticulate-pitted, dark when dry; albumen copious; integuments 1; embryo cylindrical straight, cotyledons short.

Distr. *Ca 30 spp.* from W. Malaysia & Himalaya to Sachalin, Japan and Formosa, centering in China and Japan.

Ecol. Forests and forest borders, in the montane zone mostly.

Notes. Both Malaysian species appear to be strictly dioecious; the number of ♂ and ♀ sheets in *A. callosa* is about equally large; on Mt Kinabalu only ♀ have been found of *A. latifolia*. The total number of specimens examined is inconsiderable; the species are either rare or little collected being inconspicuous. The genus *Actinidia* is often included in *Theaceae*, *Dilleniaceae*, or even *Ericaceae*, and it is closely related to *Saurauiaceae* from which it differs in its trailing or climbing habit, absence of scale-like emergences (except in *A. strigosa*), mostly dioecious fls, ebracteate pedicels, lengthwise dehiscing anthers, numerous styles, and a multilocular ovary. I wish to express my sincere thanks to Mr H. K. AIRY SHAW and to Mr M. R. HENDERSON for verifying the MS. of this contribution with the materials preserved at London and Singapore respectively.

KEY TO THE SPECIES

1. Leaves either glabrous or subglabrous, or provided with simple pluri-celled hairs. Petals glabrous. Inflorescences short . . . . . **1. A. callosa**
2. Leaves glabrous or subglabrous . . . . . *var.* **callosa**
2. Leaves rather distinctly subtomentose beneath . . . . . *var.* **pubescens**
1. Leaves stellate-tomentose beneath. Petals pubescent on the back. Inflorescences often well-developed. Peduncle 1½–8 cm . . . . . **2. A. latifolia**

**1. Actinidia callosa** LINDL. Nat. Syst. ed. 2 (1835) 439, *s.l.*; K. & V. Bijdr. 3 (1896) 280; BACKER, Schoolfl. (1911) 102; DUNN, J. Linn. Soc. 39 (1911) 405; KOORD. Exk. Fl. 2 (1912) 602; Fl. Tjib. 2 (1923) 179; BAKER, J. Bot. (1924) Suppl. 9; STEEN. Bull. J.B.B. III, 13 (1934) 174.—See further under *var. pubescens*.

Rambling or trailing shrub or liana up to 30 m, twig-lenticels distinct, wood and inner bark orange. Petiole red *s.v.*, 1–4 cm, *blade* rather variable in shape ovate-elliptic or obovate, acuminate, midrib red *s.v.*, 5–10½ by 2½–6 cm, sidenerves *ca* 5–6 pairs rather steeply ascending and substraight, insertion decurrent, margin distinctly serrate or dentate, teeth erect at the end of a vein, apex acuminate, base rounded to subcuneate. Indumentum meagre or absent, consisting of short often somewhat crisped pluri-celled simple hairs. Peduncle, pedicels and calyx thin-tomentose. Peduncle ¼–1½ cm, pedicels ½–1¼ cm, all thin. Dioecious, *flowers* white, anthers yellow. Sepals ovate-orbicular, *ca* 6 by 5 mm. Petals oblique-broad-spathulate, sub-

Fig. 1. *Actinidia latifolia* (GARDN. & CHAMP.) MERR., habit × 1/2 (after KING).

fleshy, margin ± irregular, *ca* 10 by 7 mm. Stamens ∞ in *ca* 2 rows, filaments subequal, *ca* 6 mm (in ♀ very short); anthers 1 2/3 by 1 mm, apex subapiculate (in ♀ sterile, hardly dehiscing); ♀ fls unknown to me. Ovary stout cylindric, styles *ca* 2 mm (in ♂ very small, reduced). *Berry* grey-green, spotted grey or brown, entirely syncarp, oboval to broad-elliptic, often oblique, apex often concave, 17–27 by 14–18 mm, base rounded, sepals recurved. Seeds elliptic, 3 by 1 1/2 mm.

Distr. SE. Asia, China, Formosa, in *Malaysia:* Sumatra, Java.

Ecol. Mountain forests, forest borders, 1000–2040 m, rather rare.

Notes. Young shoots edible. Leaves sometimes with raspberry-coloured zoocecidia consisting of crowded-hairy portions. In Java a juvenile shoot was collected with subcordate subglabrous leaves resembling in shape those of *A. latifolia*. A rather variable species; some of the forms distinguished by DUNN are now taken up as species, wrongly it seems. *A. indochinensis* MERR. apparently belongs here.

*var.* **pubescens** DUNN, *l.c.* 406.—*Saurauia tomentosa* KORTH. *nomen ex* K. &. V. Bijdr. 3 (1896) 280.—*Actinidia pubescens* RIDL. J. Fed. Mal. Stat. Mus. 8, 4 (1917) 18.—Leaves 6 1/2–11 1/2 by 4 1/2–6 1/2 cm, thinly tomentose beneath.

Distr. Assam, in *Malaysia:* Malay Peninsula (HENDERSON 23436), Sumatra (KORTHALS, FORBES).

Notes. Apparently rare, may be confused with *A. latifolia*. The Sumatra specimen has glabrous twigs, the others hairy ones. The indumentum seems partly caducous. I assume KORTHALS's specimens came from Sumatra, not from Java.

**2. Actinidia latifolia** (GARDN. & CHAMP.) MERR. J. Str. Br. R. As. Soc. 86 (1922) 330.— *Heptaca latifolia* GARDN. & CHAMP. in HOOK. J. Bot. & Kew Gard. Misc. 1 (1849) 243.—*Kadsura pubescens* MIQ. Fl. Ind. Bat. Suppl. (1860) 620; KURZ, J. As. Soc. Beng. 45, II (1876) 119, *non A. pubescens* RIDL. 1917.—*A. championi* BENTH. Fl. Hongk. (1861) 26; FINET & GAGN. Fl. Gén. I. C. 1 (1907) 28; RIDL. Fl. Mal. Pen. 1 (1922) 206.—*A. miquelii* KING, J. As. Soc. Beng. 59, II (1890) 196, *nomen illeg.;* Ann. R. Bot. Gard. Calc. 5 (1896) 145, t. 176.— **Fig. 1.**

Rambling shrub or liana to 20 m long, twigs dark-coloured *s.s.*, innovations, inflor. and undersurface of the *leaves* thinly cinnamon- (*s.v.* rusty-red-)stellate-tomentose. Petiole 2–4 cm; blade broad-ovate, obovate to suborbicular, 5 1/2–11 by 3-9 cm, base reniform-cordate to rounded or cuneate, apex acuminate, margin subentire with small callous teeth, veins rusty in distinct cross-bars, reticulations below hidden by a pale closed indumentum, upper surface puberulous. Peduncle rather stout, ± remote from the petiole, 1 1/2–8 cm long, apex forked, ± pseudo-umbellate, rich-flowered, pedicels in fr. apparently enlarging. *Flowers* velvety, light-brown, yellow inside, stamens yellow (*ex coll.*). Only seen ♀ buds, these depressed-globose. Sepals tomentose outside. Petals pubescent outside, apex imbricating, basal parts free, blunt, rather roundish, pale green in bud apparently smaller than in *A. callosa*. Anthers numerous ± 1 mm long, on 1/2–3/4 mm long filaments, sterile hardly dehiscing. Ovary depressed-globose, densely pilose, 1 1/2 mm high. Styles ∞, ± 2 mm long, slender-clavate, overtopping flatly the anther clump. *Berry* acorn-shaped, 3–4 by 2 cm, brown, spotted pale. Seeds broad-elliptic, ± 1 3/4–2 by more than 1 mm.

Distr. China, Indochinese Peninsula, Hongkong, ?Formosa, Hainan, in *Malaysia:* Malay Peninsula, Sumatra, Borneo.

Ecol. Hill forests, rather rare, *ca* 900–1500 m, fl. April–July.

Vern. Once noted, S. Sumatra, *wait boerah.*

Notes. There is some variability in the size of the inflor. *A. formosana* HAYATA probably belongs here. Expected to occur in the Philippines.

# MALAYSIAN PLANT COLLECTORS AND COLLECTIONS

## CYCLOPAEDIA OF BOTANICAL EXPLORATION IN MALAYSIA

AND A GUIDE TO THE LITERATURE CONCERNED UP TO THE YEAR 1947

COMPILED BY MRS M. J. VAN STEENIS-KRUSEMAN
WITH AN INTRODUCTION BY C. G. G. J. VAN STEENIS

### GENERAL PART

Chapter 1. *Introductory essay.*
- *a.* History and aim of this Cyclopaedia.
- *b.* The Cyclopaedia as part of Flora Malesiana.
- *c.* Who is a 'collector'?
- *d.* Private collections of Malaysian plants.
- *e.* Why only Phanerogams and Pteridophytes?
- *f.* Collectors and collections of fossil plants excluded.
- *g.* Correction of mistakes and errors.
- *h.* Erroneously localized plants and the sources of errors. How to correct them.
  1. Geography.
  2. Inadequately labelled plants.
  3. Plant-geographical knowledge as a control for some wrongly localized plants.
  4. Interchange of labels or wrongly labelled plants.
  5. Intentional falsifying of labels.
  6. Malaysian botanical collections in which errors occur.
- *i.* List of works principally containing illustrations of Malaysian plants, and of existing collections of drawings and photographs.
- *j.* Annotated list of literature for the use of botanists and explorers in Malaysia.
- *k.* Nomenclature of altitudinal zones.
- *l.* Use of native names.
- *m.* Acknowledgements.

Chapter 2. *The technique of plant collecting and preservation in the tropics.*

Chapter 3. *Chronology of the collections, being a key to the history of botanical exploration of Malaysia.*
- *a.* Survey of the islands separately.
- *b.* Voyages and expeditions chronologically.
- *c.* Early explorers up to 1840.

Chapter 4. *Desiderata for future exploration.*

Chapter 5. *Sources of information used in compiling the special part.*
- *a.* Survey of sources giving data on collectors, collections, and travels (geographically arranged).
- *b.* Reports, papers, and other information pertaining to herbaria where Malaysian collections are deposited.
- *c.* Select list of originally private collections and their present location.

### SPECIAL PART

Abbreviations, terms, and symbols used.

Alphabetical list of the collectors. (Cyclopaedia proper, containing over 3000 names).

Subject Index.

NB. A geographical map and appr. 160 photographs of collectors will be inserted. The volume will comprise appr. 600 printed pages.

**Aars**, Ch.
Post-Holder in *Roti* (Lesser Sunda Islands), sent some plants from there to *Hort. Bog.* in *1905* and *1917*.

**Aart**, Johannes Hendrikus van
a resident of *Ambon*, in *1885* sent a collection of dried *Sideroxylon* species to *Herb. Bog.* The species were thought identical with those described in the work of RUMPHIUS. Also many living orchids and myrmecophilous plants to *Hort. Bog.* (1885).

**Aarts**, F. W. J.
in *1915* collected at Bodjong Terong Estate, Sidodjaja, in Priangan Residency, *W. Java;* 117 *nos* in *Herb. Bog.*

**Abaca**, Y., *cf. sub* Forestry Bureau, Manila.

**Abar bin Adan**, *cf. sub* Forest Research Institute, Buitenzorg.

**Abas Gelar St. Saidi**, *cf. sub ditto.*

**Abbott**, Dr William Louis
(1860, Philadelphia, U.S.A.; 1936, Northeast, Md, U.S.A.), was educated at the University of Pennsylvania, taking his medical degree in 1884. He continued his medical studies in London. Being financially independent he decided to engage in scientific exploration and field work rather than devote his life to medical science. From 1880 onwards he made collections of birds in America, from 1887–90 zoological collections in East Africa, and subsequently visited the Seychelle Archipelago, Madagascar, and the Himalayas. In 1897 he explored Siam, and in the next 10 years visited Sumatra and Borneo, and cruised the coasts of Siam and the China Sea in his own vessel. He never published any of the results of his explorations.

ITINERARY. *1901. N. Sumatra:* Atjeh, at Loh Sidoh Bay, a few miles S of Acheen Head. From May 26–Aug. 7 *islands E of Singapore*, coast and rivers of *Johore*. From Aug.–Sept. *Centr. Sumatra:* Indragiri river; *Lingga* and *Singkep.—1902. Pag(a)i Islands* (part of the Mentawai Islands, W of Sumatra).—*1903* and *1905. Nias*, W of Sumatra.

COLLECTIONS. Some plants together with C. B. KLOSS (see there) in the *Pag(a)i Islands* in 1902.[1] Living plants from *Sumatra* in *Hort. Sing.* (pres. 1903). Zoological and ethnological collections in the U.S. Nat. Mus. Washington, but no Malaysian botanical collections.

LITERATURE. (1) *cf.* 'Spolia Mentawaiensia' in Kew Bull. 1926, p. 56.

BIOGRAPHICAL DATA. Auk 53, 1936, p. 369–370.

**Abdoelhamid** (= **Abdulhamid**), *cf. sub* Forest Research Institute, Buitenzorg.

**Abdoellah** (= **Abdullah**), *cf. sub ditto.*

**Abdoelmalik** (= **Abdulmalik**), *cf. sub ditto.*

**Abdoelmoein**, *cf. sub ditto.*

**Abdoelwahab**, *cf. sub ditto.*

**Abellanos(a)**, *cf. sub* Forestry Bureau, Manila.

**Abendanon**, Eduard Cornelis
(1878, Pati, Java; x), mining engineer, educated at the Technical College at Delft (Holland) and for an interval of one year at Aix-la-Chapelle (Germany); study tours in Europe for the D. E. Indian Government, 1900–01; in the employ of the D.E.I. Mining Service, 1901–06, from 1903–05 at his own expense making an exploration tour in China and a voyage round the world; from 1907–18 preparation for, execution of, and working out of the results of the Celebes Expedition (see below) of the Royal Dutch Geographic Society;[1] exploration tour to Spitsbergen, 1920; Extraordinary Professor at the Municipal University of Amsterdam, 1921–25; from Nov. 1937–Nov. 1939 travelling in S. Africa, the Dutch East Indies, Australia, New Zealand and Tasmania, and the Dutch East Indies once more; from Febr. 1940–July 1946 staying at Monte Carlo; at present living at Voorburg near The Hague and planning to work out the material for a 3-volume work.

He composed a geological map of the Dutch East Indies and is the author of several geological papers.

*Quercus abendanonii* VAL. is named after him.

ITINERARY. *Celebes Expedition, 1909–10.*[1] *1909. S. Celebes:* arrival at Makassar (March 30); Makassar-Palo(p)po (Apr. 10–13); Palo(p)po (13–15); reconnaissance from the N and E of the Latimodjong Mts (15–26), *e.g.* exploring S. Latoepa, S. Limbong, S. Garoeang, Limpo Batoe, S. Merating; Palo(p)po (Apr. 26–May 7); Ponrang (8) and exploration of the *Latimodjong Mts* till June 12 (top bivouac on Boeloe Palakka, May 16–June 2); ascending the middle-course of the Sa(ä)dang to Rante Pao (June 14–22), also visiting Makale; Rante Pao (22–30); trip to Palo(p)po (July 1–12), *e.g.* visiting S. Loko; trip to the west, S. Masoepoe (8–25); along the S. Mamasa (July 26–Aug. 14), Letta Mts; descending the Lower Sa(ä)dang River (17–22), Enrekang; Makassar (23–24); trip to Malili (25–28); basin of the Malili River (Sept. 28–Nov. 10), visiting the lakes Matana (Oct. 3–11), Towoeti, Mahalona, Wawo toa and Masipi (Oct. 14–Nov. 3); Malili–Makassar (Nov. 10–14) and for some months back to Java.—*2nd Part of the Expedition. 1910. SW. Celebes:* Makassar-Palo(p)po (March 13–21); *Centr. Celebes: via* Lake Po(s)so to Kolone Dale (March 21–Apr. 10), visiting Masamba; stay at Kolone Dale (10–18); exploration of the connecting part with the E. peninsula of Centr. Celebes (19–23); Po(s)so (Apr. 24–May 6); the Po(s)so depression (May 7–25), visiting Tentena; Koro–Lariang trip (May 26–June 17), visiting Gintoe, Gimpoe, Bangkakoro, as far as Saloeponto; beach-bivouac at Saloeponto and by sea to Donggala (20-21); the depression, *fossa Sarasina*, of the SARASINS (July 1–10), Paloe, Koe-

lawi Plain; Donggala (11–18); by sea to Mamoedjoe, Madjene and Pare Pare (arriving 21st); stay at Pare Pare (21–24); ancient beds of the Lower Sa(ä)dang and the bay of Pare Pare (July 25–Aug. 1); back to Makassar and Aug. 7 sailing to Java.

COLLECTIONS. *Herb. Bog.*, valuable but very scanty material, few numbers, *e.g.* from Latimodjong Mts.[2] During the expedition zoological collections were made too. See also under R. M. AMAD and J. J. LEFÈVRE. Also living material for *Hort. Bog.*

LITERATURE. (1) E. C. ABENDANON: 'Onderzoek van Centraal Celebes' (Tijdschr. K.N.A.G. 26, 1909, p. 141–142, 464, 645–654, 800–821, 988–995; 27, 1910, p. 79–106, 506–529, 979–1001, 1219–1232); 'Celebes en Halmaheira' (*l.c.* 1910, p. 1149–1172 and 1303; both with ill., maps, *etc.*); 'Die Expedition der Kgl. Niederl. Geogr. Ges. nach Zentral Celebes 1909 und 1910' (PETERM. Geogr. Mitt. 57, 1911, p. 234–238); 'Midden-Celebes Expeditie. Geologische en geographische doorkruisingen van Midden-Celebes (1909-1910)' (Leiden 1915–18, 4 vols + atlas).

(2) On the flora of the Latimodjong Mts *cf.* 'Midden-Celebes Expeditie *etc.*' *l.c.* vol. 1, p. 102; description of a new species *cf.* Icon. Bogor. 4[1], 1910, p. 81–82; and *l.c.* 4[3], 1912, p. 179–180.

BIOGRAPHICAL DATA. Amsterdamsche Studenten-Almanak for 1926, p. 63–70 + portr.; BACKER, Verkl. Woordenb., 1936.

**Abid,** *cf. sub* Forest Research Institute, Buitenzorg.

**Ablaza,** M., *cf. sub* Forestry Bureau, Manila.

**Aboe Baker,** *cf. sub* Forest Research Institute, Buitenzorg.

**Aboe Hasan,** *cf. sub ditto.*

**Aboe Oemar,** *cf. sub ditto.*

**Aboeseno,** *cf. sub ditto.*

**Abrahamson,** E. E.
in the years 1884–85 sent several *North Borneo* plants to *Hort. Singapore.* Mr HOLTTUM does not think that any records or specimens remain.

**Abram,** *cf. sub* Forest Research Institute, Buitenzorg.

**Abrams, J.**
a sergeant of the Forest Guards, and later Forest Ranger in Penang, *1888–1910*, obtained specimens for CH. CURTIS (see there) in the *Malay Peninsula* (*cf.* BURKILL in Gard. Bull. Str. Settlem. 4, 1927, *nos* 4–5).

**Abu bin Talib**
joined the Forest Department in 1908; now retired.

He collected mainly in Selangor, contributing to the C. F. (see *sub* Conservator of Forests) series of the Forest Service of the *Malay Peninsula*, *e.g* with ABDUL GHANI.

COLLECTIONS. *Herb. Kuala Lump., Sing.*, and *Kew.*

**Abyero,** D., *cf. sub* Forestry Bureau, Manila.

**Achacoso,** *cf. sub ditto.*

**Achmad**
Indonesian collector who collected specimens for K. HEYNE (see there) in *Simaloer* Island W of N. Sumatra, from September *1917*–April *1920*.

COLLECTIONS. *Herb. Bog.:* 1818 *nos; Herb. For. Res. Inst. Buitenzorg* (with original labels); dupl. in *Herb. Utrecht.*

**Achmad,** *cf. sub* Forest Research Institute, Buitenzorg.

**Ackeringa,** *cf.* AKKERINGA.

**Ackert,** C.
from Zürich, presented museum objects from *Sumatra* to *Bot. Mus. Univ. Zürich* in *1913.*

**Acuña,** *cf. sub* Forestry Bureau, Manila.

**Adam,** *cf. sub* Forest Research Institute, Buitenzorg.

**Adams,** Arthur
(1820, ? ; 1878, Honor Oak, Kent, England), Assistant Surgeon on H.M.S. 'Semarang' (itinerary *etc.* see *sub* Capt. E. BELCHER), author of some publications on this voyage,[1] and numerous zoological papers. Evidently some botanical collections were made during the voyage, but the chief object was decidedly zoological. Plants from a certain ADAMS are preserved in *Herb. Imp. Gard. St Petersb.* (= *Leningrad*), no collecting locality known to us;[2] probably not identical.

LITERATURE. (1) A. ADAMS: 'Notes on the Natural History of the islands' (in BELCHER, Narrative *etc.*, vol. 2).

Together with others he published the 'Zoology' of the Voyage (London 1850).

(2) *cf.* A. DECANDOLLE, Phytographie, 1880, p. 391.

**Addison,** George Henry
(1911, England; x), Assistant Curator in the Gardens Department Straits Settlements since 1938; after a short leave in India returned to Singapore in 1946; formerly Student Gardener at Kew.

He collected herbarium specimens and local plants for cultivation in forest in the neighbourhood of Gap, Selangor-Pahang boundary (Aug. *1939*) and at various times in and near *Singapore.*

COLLECTIONS. *Herb. Sing.*

**Adduru,** Marcelo
made his first collection when a student in the University of the Philippines in 1917; he was appointed Assistant of the Bureau of Science at Manila in 1918, being a graduate of the Forest School.

COLLECTING LOCALITIES. *Philippines. 1917. Luzon:* Cagayan Province (May–June).

COLLECTIONS. Collection 1917, 279 *nos*, in *Herb. Manila;* dupl. in *Herb. Arn. Arbor.;* later collections numbered in the F.B. series (*cf.* Forestry Bureau, Manila), in *Herb. Manila.*

In *Herb. Field Mus. Chicago:* 457 *Philippine*

AËT

plants from a series specially collected for the Arnold Arboretum (pres. 1918) (apparently this is the ADDURU collection 1917); in *U. S. Nat. Herb. Wash.:* 127 *Philip.* plants.

**Adèr, J.**

a resident of Garoet, who collected in *1928–30* in *W. Java, e.g.* at Kratjak, Mangoenredja, on G. Papandajan, at Bandjar, Telaga Bodas and on G. Galoenggoen (May 1930).

COLLECTIONS. *Herb. Bog.: Orchidaceae, Balanophoraceae* and *Rafflesiaceae;* also plants in *Hort. Bog.*

**Adèr, J. W. H.**

a surveyor at Garoet, who sent orchids from *W. Java* (G. Tjikorai *etc.*) to *Hort. Bog.* (coll. *1891–97*).

Some specimens, material of which is probably preserved in *Herb. Bog.*, are mentioned in the papers of J. J. SMITH.

**Adjiz, Abd.,** *cf. sub* Forest Research Institute, Buitenzorg.

**Administrateur Lokkibedrijf,** *cf. sub ditto.*

**Aduviso, P.,** *cf. sub* Forestry Bureau, Manila.

**Aerensbergen, A. I. van**

(1874, Nijmegen, Gld, Holland; x), a priest, missionary in Flores (Lesser Sunda Isls), 1908–10; at the seminary at Woloan (N. Celebes), 1910–16; at Manado (N. Celebes), 1917–October 1920; at Batavia, 1920–21; at Bandoeng, 1921–25; at Buitenzorg, 1925–28; at Bandoeng, 1928–32; and at Batavia from 1932 up to the war.

COLLECTING LOCALITIES. *1917. N. Celebes,* Minahassa: Woloan.

COLLECTIONS. *Herb. Bog.:* orchids from there.

**Aët**

(± 1901; x), an Indonesian, in 1919 already in the employ of the Herbarium at Buitenzorg, in later years appointed 'mantri'. He attended several expeditions; during some he independently made plant collections.

ITINERARY. *1937. NE. Borneo.* With Expedition Mrs M. E. WALSH (see there). Environs of Sangkoelirang (Apr. 14–June 28), collecting at the following localities: Kari Orang (= prob. Sg. Kaliorang) (Apr. 14–20); Maloewi, G. Dajak, pinggir laoet (sea coast) and G. Batoe Ampar (22–24) and Kari Orang again; Pelawan besar and ketjil, G. Toda, G. Tembakan, G. Ketapang (low hills only), Babi Djolong, Daga Oenan, Sampajau, Malawai and Mangapoe; in the environs of Samarinda: Tenggarong (July 2–5).—*1938.* Attending BUWALDA (see there) to *Aroe & Tanimber Islands.*—*1939.* With Expedition L. J. VAN DIJK (see there) to *P. Jap(p)en:* Saroerai near Seroei–G. Wawah–Mentemboe (July 22); Seroei (23), Kainoei (25), Samběri (26), Saroerai near Seroei (27), Antam near Seroei (29). kp. Baroe (30), Wamiami (Aug. 1), Semèmi (2), Randomi (3), Fèrèrifi (4), Mariaroti (10), Wasabori (11–16), Sg. Soemboi near Seroei (17), Sg. Arompaul near Seroei (18), Kaunda (19), Wandèsi (21), Kamioraro (22–23), Sg. Papoma (24) Mariadai (26–29), G. Hirong (30), Mariadai (Sept. 1, 8), Seroei (9–11), Sg. Mĕmpĕrawaja (16–17), Soemberbaba (17); VAN DIJK and IDJAN (see there) to Biak, AËT staying behind on account of ill health; Seroei (Sept. 22–26).—*1941.* With E. LUNDQUIST (see there) to *W.* and *S. New Guinea. SW. New Guinea,* near Babo: Tisa (May 8), Moetoeri (11–12), Anakasi (14–16), Jakati (19), Roriès (22), P. Kraka (23); Kaimana (June 3–4); *Dutch S. New Guinea,* near Oeta: Sg. Oemar (12), Sg. Si-èra (Djiera) (16–19), Najaja (20–22), Aria (26–28), Aëndoea (July 1–14), Japakopa (17), Patawai (20–21), Boeroe (23), Tarèra (27–29); *SW. New Guinea:* Kaimana (Aug. 2); near Kaimana: Sg. Bianoga, kp. Aergoeni (9); S of Babo, Sjoga (10), Babo (13–23); near Babo: Agonda (25).

COLLECTIONS. *Herb. Bog.:* from Exp. WALSH *nos* 1–654; from Exp. VAN DIJK *nos* 1–845, 956–1000, for the greater part numbered too in the bb series of the Forest Research Institute; from Exp. LUNDQUIST *nos* 1-731. Dupl. Exp. WALSH in *Herb. Brit. Mus.*

From *New Guinea* Exp. LUNDQUIST he brought home living seeds for *Hort. Bog.*

**Agama**, José
(1889, Manila, Luzon, P. I.; x), a Filipino, at first Ranger of the Bureau of Forestry at Manila, and later Headranger of the Forestry Service in Br. N. Borneo; in 1926 appointed Deputy Asst Conservator of Forests.

Several plants are named after him, especially by MERRILL.

COLLECTIONS. *Herb. Manila: Philip.* plants numbered in the F.B. series (*cf. sub* Forestry Bureau, Manila), and *Br. N. Borneo* plants (coll. *1917–19*); the 2nd set of the *Bornean* plants in *Herb. Sandakan;* 23 dupl. *Philip.* in *U.S. Nat. Herb. Wash.*

BIOGRAPHICAL DATA. BACKER, Verkl. Woordenb., 1936.

**Agati**, J.
collected *Helminthostachys zeylanica* in *Luzon*, P. I., *no* 7799; material in *Herb. Univ. Montreal.*

**Agoo**, *cf. sub* Bureau of Science, Manila.

**Agudo**, *cf. sub ditto.*

**Aguilar**, S., *cf. sub ditto.*

**Agullana**
in 1926 appointed Junior Ranger in the For. Dept Br.N. Borneo, collected at Sandakan (*Br. N. Borneo*) for the Bur. Sci. at Manila.

COLLECTIONS. *Herb. Manila;* dupl. in *Herb. Bog.* (pres. 1929).

**Ahern**, George Patrick
(1859, New York City, U.S.A.; 1942, Washington, D.C., U.S.A.), Lieutenant-Colonel in the U.S. Army, organizer and Chief of the Philippine Bureau of Forestry, 1900–15.[1] Under his direction material of tree species was collected. In 1910 he founded the Forest School in the Philippines. After his return to the U.S.A. on duty at the Army War College, living in Washington.

*Canarium ahernianus* MERR. was named after him.

COLLECTIONS. > 850 *nos* collected under his direction (*not* by himself) in *Luzon*, *Mindanao*, *etc.* in *1901–02* in *Herb. Manila*;[2] dupl. in *Herb. Bog.* (600), *Herb. Leyden*, *U.S. Nat. Herb. Washington* (> 1800 specim.), in *Berl.* (210), *Herb. N.Y. Bot. Garden*. They were probably partly collected by QUADRAS (see there). AHERN's collector (= RAMOS, see there) numbered in the F.B. series (*cf. sub* Forestry Bureau, Manila); material in *Herb. Manila* too.

LITERATURE. (1) G. P. AHERN: 'Compilation of notes on the most important timber tree species of the Philippine Islands' (1901, p. 1–112, pl. 1–43).

(2) E. D. MERRILL: 'Plantae Ahernianae' (Dept of the Interior, Forestry Bur. Bull. 1, 1903, p. 9–55).

J. PERKINS: 'Enumeration of some recently collected plants of AHERN, *etc.*' (Fragm. Fl. Philip. 1904, p. 4–66, 77–202).

BIOGRAPHICAL DATA. BACKER, Verkl. Woordenb., 1936; portr. in Philip. Journ. Forestry 2, 1939, pl. 1; Amer. Forests 48, 1942, p. 276 + portr.

**Ahern's collector**, *cf. sub* AHERN and Forestry Bureau, Manila.

AHERN

**Ahmad**, *cf. sub* Forest Research Institute, Buitenzorg.

**Ahmad bin A. Bakar**
joined the Forest Department of the *Malay Peninsula* in 1910; now retired.

COLLECTIONS. He collected mainly in Pahang East, numbering in the C.F. (see *sub* Conservator of Forests) series; *Herb. Kuala Lump.*

**Ahmad bin Hassan**, *cf.* AHMED BIN HASSAN.

**Ahmed bin Hadji Omar**
plant collector of the Singapore Botanic Gardens, collected in *Singapore Island* (*cf.* BURKILL in Gard. Bull. Str. Settlem. 4, 1927, *nos* 4–5).

COLLECTIONS. *Herb. Sing.*

**Ahmed bin Hassan**
brother of SAPPAN BIN HASSAN and SAPPI BIN HASSAN; employed by the Botanic Gardens, Singapore, 1901 up to the present; 1901–12 plant collector to Mr RIDLEY; then Record Keeper, Botanic Gardens.

COLLECTING LOCALITIES. *Malay Peninsula: e.g.* on Lenggong limestone cliffs;[1] in *Singapore Island* at various times.

COLLECTIONS. Earlier collections numbered along with RIDLEY's, and later in BURKILL's Field Number Series (S.F. *nos*) (*cf.* BURKILL in Gard. Bull. Str. Settlem. 4, 1927, *nos* 4–5); *Herb. Sing.*, also in Herb. of cultivated plants.

LITERATURE. (1) *cf.* Journ. Str. Br. Roy. As. Soc. *no* 57, p. 5.

AJOEB

**Ajat**, F., *cf. sub* Forest Research Institute, Buitenzorg.

**Ajoeb**

(*c.* 1877; x), an Indonesian, employed by the Botanic Gardens at Buitenzorg, finally as assistant 'mantri'. He was attached to several expeditions as a plant collector.

*Dendrobium ajoebii* J.J.S. was named after him.

ITINERARY. *1910-12. Dutch N. New Guinea.* With GJELLERUP (see there).—*1914–15. Dutch N. New Guinea.* With JANOWSKI (see there), and later with FEUILLETAU DE BRUYN (see there).—*1916. S. Sumatra*, Benkoelen. With JACOBSON (see there).—*1920. W. Java.* Garoet and environs, *e.g.* G. Mandalagiri and G. Djaja with LAM.—*1920–21. Dutch N. New Guinea.* With LAM (see there).

COLLECTIONS. *Herb. Bog.*, *e.g.* 550 *nos* Benkoelen Exp.; and especially hundreds of living plants for *Hort. Bog.*[1]

LITERATURE. (1) *cf.* list Exp. GJELLERUP in Versl. Pl. Tuin Buitenzorg for 1912, p. 22.

BIOGRAPHICAL DATA. BACKER, Verkl. Woordenb., 1936.

**Akker**, van den

collected *Alternanthera sessilis* R. BR. at Kesisat, *Bali* (Lesser Sunda Islands) in *1914*; the specimen preserved in *Herb. Bog.*

**Akkeringa**, Johannes Evert

(1829, Delfshaven, Z.H., Holland; 1864, Banka, E of Sumatra), engineer employed in the tinmines in Banka from about 1855; inventor of the so-called Banka drill, and author of a report on the prospects of the Billiton exploration in general and of those of the tin loads in particular.[1]

From 1862–63 stationed in the Office at Buitenzorg; in 1863–64 making an investigation into the occurrence of tin ore in the Riouw-Lingga Archipelago, in charge of the D.E. Indian government. He is said to have died from typhoid fever caught during a Borneo trip.

He is commemorated in some plant names by TEYSMANN & BINNENDIJK.

COLLECTIONS. He sent plants from *Banka* to *Hort. Bog.*; some are described by TEYSMANN & BINNENDIJK in the 'Nat. Tijdschr. N.I.'[2]

LITERATURE. (1) *cf.* 'Billiton 1852–1927' ('s-Gravenhage, M. NIJHOFF) vol. 1, p. 126.

(2) *cf.* also SCHEFFER in 'Observationes phytographicae' (Nat. Tijdschr. N.I. 31, 1870, p. 361, 362).

BIOGRAPHICAL DATA. Nat. Tijdschr. N.I. 27, 1864, p. 31–32; portr. and some particulars in 'Billiton 1852–1927' *l.c.* p. 126–127; BACKER, Verkl. Woordenb., 1936.

**Alambra**, *cf. sub* Forestry Bureau, Manila.

**Alamsjah**, *cf. sub* Forest Research Institute, Buitenzorg.

**Albers**, E.

collected near Deli Langkat in the Butta Mts, *Sumatra East Coast* (*cf.* Pflanzenreich Heft 92, p. 19). Material in *Herb. Berl.*

**Albertis**, Count Luigi Maria d'

(1841, Voltri, W of Genoa, Italy; 1901, Sassari, NW. Corsica), zoologist-ethnographer who accompanied BECCARI (see there) on his first New Guinea trip and who afterwards made further explorations, partly alone, partly with others. In 1875 he settled in Yule Island; he made veritable raids among the natives to enrich his collections. At his arrival in Thursday Island on Jan. 4th, 1878, he was charged with murder on two Chinamen; after acquittal on May 4th he left Sydney, homeward bound.

The genus *Albertisia* BECC. was named after him and several other plant species by F. VON MUELLER and BECCARI.

ITINERARY.[1] *1st Voyage.* Sailing with BECCARI (see there) from Genoa Nov. *1871* and *via Java*

(Batavia, Buitenzorg, Mt Pangrango, Soerabaja), Makassar, *Timor* (Dilly and Koepang) and *Banda* to *Ambon*, where preparations were made for the New Guinea trip. During the stay in Ambon, a visit was paid to *Boeroe* Island and to Wahai in *Ceram*. Sailing from Ambon (March 21, *1872*) *via* Gissar (= Geser), Ceram Laut, Goram (Apr. 1) to *Dutch New Guinea* (8): *P. Karas* (Faor), Kapour (15), *Sorong* (23), the 28th starting for *Salawati* (where fallen ill), Ramoi River (June 13), back to *Sorong* (July 2) and departure from there (15); coast Amberkaki (= Amberbaken) (23); *P. Mansiman* opposite of Doré (Aug. 3); Andai; trip in the Arfak Mts (Sept. 4–Oct. 1)[2] as far as Hatam; taken ill again at Andai (a month); to *P. Mansiman* (Nov. 2); departure to *Sorong* (7), arriving the 15th; *Ambon* (Dec. 7), sailing from there (12) in the 'Vittor Pisani' to Sydney, *via Klein Kai* (= *Noehoerowa*) (Doulan, Dec. 17–20), *Aroe Islands* (Dobo, 21st) and along the S. coast of New Guinea to Port Jackson. At the end of *1873* sailing from Australia *via* Fiji, Honolulu, America, to Europe, arriving in April *1874*.

*2nd Voyage*. Nov. 10, *1874* sailing from Naples *via* Singapore to Somerset in Australia (stay Dec. 27–March 4, *1875*); March 5 sailing for *Papua* (*SE. New Guinea*): Darnley Island (12); Yule Island (arriving the 14th or 16th), which was used as a starting point for several trips:[3] *e.g.* canoe trip to the Hilda and Ethel River, Nikura and Epa (mid-April); visiting Nikura for the 2nd time (May 17) and several other trips by boat to the New Guinea coast; to Naiabui (Aug. 14), exploring the Bioto River and then going back to Naiabui (Sept. 4); march in the mountains (13–17); back in Yule Island (Sept. 22), from where Nov. 7 to Somerset on account of illness (arrival on the 14th).—*1st Exploration of the Fly River*[4] with S. Macfarlane (see there) and H. M. Chester: sailing from Somerset (Nov. 29, *1875*) in the 'Ellengowan'; Fly River (Dec. 6–21); back at Somerset (28).—*2nd Exploration of the Fly River*[5] with Hargrave and Wilcox: sailing from Somerset in the 'Neva'; Katow (May 21, *1876*), mouth of the Fly (22); ascending the river till June 25, travelling on foot upstream for another 5 miles and thereafter return trip during which ascending the Alice River (June 30–July 6); leaving the Fly River mouth on the 18th and *via P. Mibuou* (= *Bristow Island*) (July 18–Aug. 3), *Bampton Island*, Yarrou; Katow River (Aug. 7–Oct. 27, at Moatta = Mawata); *Tawan Island;* back to Somerset (arrival Nov. 21).—*3rd Exploration of the Fly River*:[6] in the 'Neva' sailing from Somerset (May 3, *1877*), reaching the mouth on May 21st. As a result of d'A.'s conduct during the trip they suffered from attacks by the natives; with the Chinese on board difficulties arose too; in consequence they were unable to extend the journey farther inland than in 1876, only the Strickland River was detected. The return voyage was made *via* Moatta (= Mawata near the Katow River; Nov. 23–Dec. 5) to *Thursday Island* (Jan. 4, *1878*).

Collections. His ornithological collection in Mus. Civ. Stor. Nat. Genoa; anthropological coll. in Mus. Florence; botanical collection, at least partly, given to Beccari (= *Florence*). The plants of the trips 1875 and 1876 for the greater part described by F. von Mueller,[7] and probably in *Herb. Melbourne;* those of the last trip by Beccari.[8] According to the latter's account the collection of the last exploration consists of magnificent material thanks to preservation in spirits. The plants originating from the Fly River which are mentioned in d'A.'s book are numbered between 1 and 314.

D'ALBERTIS

Literature. (1) L. M. d'Albertis: 'Alla Nuova Guinea. Ció che ho veduto e ció che ho fatto' (Torino 1880, ill.); English transl. : 'New Guinea, what I did and what I saw' (London 1880, 2 vols); abridged French. transl. Some dates mentioned do not tally with those of Beccari.

(2) *cf.* 'Una mesa fra i Papuani del Monte Arfak' (Boll. Soc. Geogr. Ital. 10, 1873, p. 67–71; 'Viaggio di de Albertis nei monti Arfak e sue collezioni zoologiche' (Cosmos di Guido Cora 1, 1873, p. 218–220).

(3) *cf.* Letter from d'Albertis giving some account of several excursions into Southern New Guinea' (Proc. Zool. Soc. Lond. 1875, p. 530–532).

(4) L. M. d'Albertis: 'Remarks on the natives and products of the Fly River, New Guinea' (Proc. Roy. Geogr. Soc. Lond. 20, 1875–76, 1876, p. 343-353, discuss. p. 353–356; extracts from letters to Dr Bennett of Sydney, publ. in Sydney Morning Herald March 1876).

(5) L. M. d'Albertis: 'Journal of the expedition for the exploration of the Fly River in 1876' (Sydney 1877) w. App. by Baron F. von Mueller (*l.c.*

p. 14). *cf.* Map in PETERM. Mitt. 1878, Taf. 23; and F. ANTOINE in Oesterr. Bot. Zeitschr. 27, 1877, p. 206–208; Tour du Monde 43², 1882, p. 321–336, w. ill.

(6) *cf.* PETERM. Mitt. 1878, p. 198–199 and 423–426; and Boll. Soc. Geogr. Ital. 15, 1878, p.

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105–108; Tour du Monde 43², 1882, p. 321–336, w. ill.

(7) in 'Descr. Not. Pap. Pl. "I, parts 3, 4, 5 and 6.

(8) O. BECCARI: 'Notizie sulle piante raccolte dal sign. L. M. d'ALBERTIS alla Nuova Guinea' (in d'ALBERTIS, Alla nuova Guinea, 1880, p. 571–579); 'Catalogo delle piante del fiume Fly, 1877' (in *l.c.* p. 575–577), also in the Engl. transl.; 'Sulle piante raccolte alla Nuova Guinea dal Sign. L. M. d'ALBERTIS durante l'anno 1877, con descrizione di tre nuove specie di Icacinaceae' (in Malesia vol. 1, fasc. 3, 1878, p. 255–257).

BIOGRAPHICAL DATA. Portr. in Tour du Monde 43², 1882, p. 325; Rivista Geogr. Ital. Roma 7, 1901, p. 628–632 + portr.; Boll. Soc. Geogr. Ital. 38, 1901, p. 849–855; Geogr. Journ. Lond. 18, 1901, p. 629; Deutsche Rundschau f. Geogr. u. Stat. Wien 25, 1902, p. 182–184; BACKER, Verkl. Woordenb., 1936.

**Alberto**

MERRILL cites a *no* 36 collected by ALBERTO, in his 'Enum. Philip. Fl. Pl.'; *no* A 328, *Dioscorea elmeri var. vera* PRAIN & BURK., was collected at Los Baños (*cf.* PRAIN & BURKILL, The genus Dioscorea, 1936, p. 181); and other plants from Los Baños, *Luzon, about 1905.*

FORTUNATE R. ALBERTO coll. for Bur. of Sci. Manila, acc. to BURKILL.

**Alcala,** *cf. sub* Bureau of Science, Manila.

**Alderwerelt van Rosenburgh,** C. R. W. K.

(1863, Kedong Kebo, Poerworedjo, Java; 1936, The Hague, Holland), officer in the D.E.I. Army, 1885–1904; retired on account of deafness; temporary Assistant of the Herbarium at Buitenzorg, 1905–08; Conservator and later Acting Assistant of the said institution, 1910–22.

Author of many systematic publications, principally on ferns.[1]

*Dendrobium alderwereltianus* J. J. S. was named after him.

COLLECTIONS. Principally ferns, also orchids *e.g.* from Soekaboemi (*W. Java*) in *Herb. Bog.;* in *Herb. Berl.:* 310 *nos Selaginella* (pres. 1912–13).

*Hort. Bog.:* ferns from Soekaboemi (pres. 1908).

LITERATURE. (1) *e.g.* 'Malayan Ferns' (1908), 'Malayan Fern Allies' (1915) and following supplements.

BIOGRAPHICAL DATA. Bull. Jard. Bot. Buit. sér. 3, vol. 14, 1936, p. 1–3, w. portr. a. bibliogr.; BACKER, Verkl. Woordenb., 1936; Chron. Bot. 3, 1937, p. 203 + portr.

**Alejandro,** B., *cf. sub* Forestry Bureau, Manila.

**Alfalla,** P., *cf. sub ditto.*

**Alfaro-Cardoza**

Portuguese.

COLLECTIONS. *Herb. N. Y. Bot. Gard.:* 38 *nos* from *Timor*, coll. *1930.*

**Alfiah,** Moh., *cf. sub* Forest Research Institute, Buitenzorg.

**Alga,** A.

collected *c.* 20 *nos* in *Mindanao;* 6 dupl. in *U.S. Nat. Herb. Wash.*

**Ali,** *cf. sub* Forest Research Institute, Buitenzorg.

**Ali,** Moh., *cf. sub ditto.*

**Ali bin Hj. Salleh**

joined the Forest Department in the *Malay Peninsula* in 1903; now retired.

COLLECTIONS. Mainly in Negri Sembilan, numbered in the C.F. (see *sub* Conservator of Forests) series; *Herb. Kuala Lump.*

**Ali Djemar,** *cf. sub* Forest Research Institute, Buitenzorg.

**Ali Silang,** T., *cf. sub ditto.*

**Alimoesa,** *cf. sub ditto.*

**Alkemade,** J. A. van Rijn van, *cf. sub* RIJN VAN ALKEMADE, J. A. VAN.

**Alleizette**, Charles d'

(1884, Paris, France; x), made botanical collections in Madagascar (1904–06), and in Tonkin (Indo-China, 1908). In 1909 he was appointed Underlieutenant of Administration in Oran (Africa), where he was again from 1911–15 and 1917–22. He ended his military career as Chief of Administration at Versailles.

COLLECTIONS. *Herb. Paris*, from Madagascar, Tonkin, *etc.* He collected some ferns, cult. in *Hort. Sing.*, *viz nos* 516 T and 517 T in *1909* (*cf.* BONAPARTE, Notes Ptéridol. fasc. 7, 1918, p. 38–39).

BIOGRAPHICAL DATA. In 'Flore générale de l'Indo-Chine' prelim. vol. 1944, p. 33. *Herb. Leyden* received a set of his collection in 1948.

**Allen**

MERRILL cites the *nos* 168 and 171 in his 'Enum. Philip. Fl. Pl.', *e.g. Nepenthes truncata* from *Mindanao*.

**Allen**, Edgar F.

(born in England; x), Agricultural Officer of the Dept of Agriculture S.S. & F.M.S., stationed at Telok Anson, Perak.

COLLECTIONS. Especially plants of economic interest, *e.g.* keladis (*Araceae*) in *Lower Perak*.[1]

LITERATURE. (1) *cf.* Report Bot. Gard. Sing. for 1939, p. 2; and Gard. Bull. Str. Settlem. 11, 1941, p. 244.

**Allen**, Reverend G. Dexter

COLLECTIONS. *Herb. Sarawak:* a small fern from Lingga Mt., *Sarawak* (pres. 1906).

**Almagro**, *cf. sub* Forestry Bureau, Manila.

**Almeida**, d'

Some *Garcinia* leaves with 6 drawings (*Garcinia hanbury* HOOK. *f.*) in *Hanbury Herb.* (London).

**Almeida**, Pereira, J. d', *cf. sub* PEREIRA.

**Almquist**, Ernst Bernhard

(1852, Skogs-Tibble, Uppland, Sweden; 1946, Stockholm, Sweden), Medical Officer and lichenologist of the Swedish voyage of the 'Vega', 1878–79.[1] He took his M.D. at Uppsala in 1882, and was professor at Stockholm since 1891. The Superintendent of botanical work during the voyage was Dr KJELLMAN, Lecturer in Botany in the University of Uppsala.

ITINERARY. *Voyage in the 'Vega', 1878–79.*[1] Departure from Karlskrone (Sweden) (June 22, 1878), and Gothenburg (July 4); operating in arctic regions, but making the homeward voyage *via* Japan, Hongkong, Canton; *Labuan* (Nov. 17–20, *1879*), part of the expedition (no botanists) making an excursion to the opposite shore of *Borneo;* short stay at *Singapore* (Nov. 28–Dec. 4); Ceylon, and home to Stockholm.

COLLECTIONS. *Herb. Uppsala, Herb. Stockholm.* NYLANDER described 48 lichens from *Singapore*, and 77 from *Labuan*.[2]

In *Labuan* a collection of fossil plants was made by members of the expedition; *cf.* also *sub* TREACHER.

LITERATURE. (1) Baron N. A. E. NORDENSKIÖLD: 'The voyage of the "Vega" round Asia and Europe (1878–79)' (Engl. transl., London 1881).

The official record of the expedition was edited by NORDENSKIÖLD, and consists of 5 octavo volumes.

(2) W. NYLANDER: 'Sertum Lichenaeae tropicae e Labuan et Singapore' (Paris 1891).

BIOGRAPHICAL DATA. WITTROCK, Icon. Bot. Berg., 1903, p. 28; *l.c.* 2, 1905, p. 2, *t.* 110, p. 206; Svenska Linné-Sällsk. Årsskr. 29, 1946, p. 66–67, + portr.

**Aloba**, A., *cf. sub* Forestry Bureau, Manila.

**Alsacid**, Godefredo L.

made a study and collection of natural history specimens, *e.g.* of plants in *Palawan* (March 30–June 18, *1938*); in *1939* he made two joint botanico-zoological expeditions with CAPCO & EDAÑO to Baler and vicinity (March, May–June) in *NE. Luzon*.

COLLECTIONS. In *Herb. Manila*, at least partly with B.S. numbers (*cf. sub* Bureau of Science, Manila).

**Altamirano**, *cf. sub* Forestry Bureau, Manila.

**Altheer**, J. J.

(? ; died in 1863), appointed Pharmaceutical Chemist of the D.E.I. Army in 1852 and as such stationed in Banka in 1858; for some years after 1855, Lecturer in Physics and Chemistry at the Medical School, Batavia.

Author of many chemical papers in Nat. Tijdschr. N.I.

COLLECTIONS. *Herb. Bog.:* principally ferns;[1] also some *Amaryllidaceae* and an orchid from *Banka*, mentioned in TEYSMANN's list of Banka plants;[2] the collection presented in 1860 to the Nat. Ver. N.I. at Batavia, was forwarded to Buitenzorg.[3] Numbering > 42; some plants numbered in the H.B. series of the Buitenzorg Herbarium.

LITERATURE. (1) *cf.* J. AMANN (= S. KURZ) in Nat. Tijdschr. N.I. 23, 1861, p. 399–412.

(2) *cf.* Nat. Tijdschr. N.I. 27, 1864, p. 157–258.

(3) *cf. l.c.* 21, 1860, p. 435.

BIOGRAPHICAL DATA. Tijdschr. v. N.I., N.S. 1, 1863, p. 244-245, w. bibliogr.

**Altmann**, Hendrik

(1896, Serang, Bantam, Java; Sept. 18, 1944, torpedoed in S.S. Junyo Maru when brought from Batavia to Benkoelen by the Japanese), studied tropical agriculture at Wageningen; after 6 years of practice in the Java sugar industry, appointed Group-Adviser of the Java Sugar Experiment Station at Pasoeroean; stationed successively at Koedoes (1925–31), Sidoardjo (1931–32), Pasoeroean (1932–36), Cheribon (1936–41); at the same time acting Director of the subdivision Cheribon in 1937, and Djokja (since Nov. 1941).

COLLECTING LOCALITIES. *1927. Centr. Java:* Koedoes.—*1930. E. Java:* Modjokerto (Patjet).—

*1931. E. Java:* Soerabaja.—*1932. E. Java:* Soerabaja, sf. Boedoeran, Modjokerto (Patjet, Brangkol), Binor, Sido(h)ardjo, G. Baoeng, Gempol, Pasoeroean, Probolinggo, G. Semongkrong, G. Abang, Kepoeh, Pasangrahan Soekolilo, sf. Tawangsari, Tjemorolawang, Ranoe Bedali, (H)Ijang Plateau (Taman (H)Idoep), S. slope G. Smeroe.—*1933. E. Java:* G. Lawoe (Sarangan and crater), S of Malang, sf. Kebonagoeng (Malang Distr.), sf. Alkmaar, Soerabaja, Modjokerto (Patjet, Bongsal), Sido(h)ardjo, Pasoeroean, Probolinggo, Oemboelan, G. Emprit, Tosari, sf. Goenoengsari, Ranoe Pani (G. Smeroe), Bremi, Taman (H)Idoep (Ijang plat.), Djember, Pradjekan, Besoeki, Binor, Sampean ravine, Idjen plateau.—*1934. E. Java:* Soerabaja, Porong, Trawas, sf. Krebet (Malang), Pasoeroean, Kepoeh, Ratji, G. Bentar, (H)Ijang Plateau (Taman (H)Idoep), sf. de Maas, Besoeki, Poeger; *Centr. Java:* Semarang; *W. Java:* Buitenzorg, Bandoeng.—*1935. E. Java:* G. Ardjoeno-Andjasmoro, Djoenggo, Malang Plain, Modjokerto (Patjet), Pasoeroean, G. Smeroe (Ranoe Daroengan), Tosari, sf. Pandji, sf. Pradjekan, Djember, Pasirian Poeger, Watoe-Oeloe, Besoeki, sf. Asembagoes.—*1936. E. Java:* Djoenggo, Soemberbrantas, G. Ardjoeno, Pasoeroean, Kraton, Modjokerto (Patjet), Poeger, Watangan, Besoeki, Garahan, Kendeng road, G. Loeroes, Djember.—*1937. W. Java:* Cheribon.—*1938–41. Centr. Java:* in Indramajoe, Tegal and the Kromong Mts.[1]

COLLECTIONS. *Private herb.* > 500 *nos;* many dupl. in *Herb. Bog.* and in *Herb. Pasoeroean* (453). The *nos* 13–58 not present in *Herb. Bog.*

His *private herbarium* was taken by the Japanese, and was possibly transferred with his office to the Klaten Estate Co. W. A. TERWOGT, at Djokja.

LITERATURE. (1) H. ALTMANN is the author of the botanical section in F. U. M. BUNING: 'Het Kromonggebergte' (Cheribon 1940).

**Alvarez,** Ramon J.

Forester of the Bur. of Forestry at Manila, since 1920 Asst Chief.

COLLECTIONS. *Herb. Manila,* numbered in the F.B. series (see *sub* Forestry Bureau, Manila), *etc.;* 66 dupl. in *U. S. Nat. Herb. Wash.;* also dupl. in *Edinburgh.*

**Alviar,** *cf. sub* Forestry Bureau, Manila.

**Alvins,** M. V.

collector employed in the Forest Dept of the Str. Settlem., from 1884–88 in Malacca.

COLLECTING LOCALITIES. *Malay Peninsula.*[1] *1884.* Reserves of Sg. Udang and Merlimau, around Selandar, Bt Danan, Naning and environs, G. Tampin, State of Sg. Ujong, E. Malacca, Ayer Kuning (from the Malacca side).—*1885.* Sent to Seremban (Negri Sembilan), passing through Rantau; Bt Lasing, Bt Sutu, Beranang, Pantai, G. Beremban; Cape Rachado (probably from Malacca by sea). Unnumbered plants (without date), bear names of Bukit Bruang, *Pulau Nangka, Pulau Dodol,* and other places near Malacca town, and Bt Panchor.

COLLECTIONS. His specimens (*c.* 1000 in 1884, 1840 in 1885 are in *Herb. Sing.* and have been quoted as 'CANTLEY's Collector' or briefly as 'CANTLEY' (see there). He numbered in the field.

LITERATURE. (1) *cf.* BURKILL in Gard. Bull. Str. Settlem. 4, 1927, *nos* 4–5.

**Alwi,** *cf. sub* Forest Research Institute, Buitenzorg.

**Amad,** Raden Mas

surgeon, in *1909* attached to ABENDANON's *Centr. Celebes* Expedition;[1] at the beginning engaged in collecting plants, assisted by sergeant J. J. LEFÈVRE; since May 20th till his departure he had to contend with illness.

ITINERARY. *cf. sub* ABENDANON (also for literature).

COLLECTIONS. *Herb. Bog.:* some waterplants from the lakes Matana and Towoeti about Oct. *1909.* He discovered the new endemic plant *Boottia mesenterium* HALL. *f.*[2]

LITERATURE. (1) *cf.* E. C. ABENDANON: 'Midden-Celebes Expeditie' vol. 1, 1915, p. 101.

(2) *cf.* Meded. 's Rijks Herb. Leiden *no* 26, 1915, p. 7.

**Amand,** J.

resident at Blitar (Kediri), *E. Java,* sent plants to *Hort. Bog.* in *1875.* In the lists of the material preserved in *Herb. Berl.* a collection of mosses from *Banka* is mentioned (presented by J. AMAND *a.* 1858), this is apparently based on a mistake and should be J. AMANN (= S. KURZ, see there); the same holds true for collections in *Herb. Leyden,* and *Utrecht.*

**Amann,** J., (*cf.* Nat. Tijdschr. N.I. 27, 1864, p. 15 *in notam,* p. 403) = S. KURZ (see there).

**Amarillas,** *cf. sub* Forestry Bureau, Manila.

**Amat,** *cf. sub* Forest Research Institute, Buitenzorg.

**Amdjah**

(† 1915), an Indonesian employed by the Herbarium at Buitenzorg, finally as 'mantri'; he was attached to some Borneo Expeditions.

ITINERARY. *1898–99. Borneo* with A. W. NIEUWENHUIS (see there).—*1909. Isl. Noesa Kambangan* (S of Java) (June 9–20).—*1912. NE. Borneo* with Capt. P. VAN GENDEREN STORT (see there for extensive itinerary of the 1st part of the trip, and for literature): arrival at Bandjermasin (May 13), starting June 5th from Pladjoe to Moeara Tagel; after breaking bivouac there, during the return voyage to Labang (Ma Sedalir), the prahu of the Indonesian collectors capsized and as result the collections and collecting necessaries were lost; in order to complete their outfit again, July 5th AMDJAH and some others went to Tg Seilor; after the evacuation of VAN GENDEREN STORT part of the expedition started for Agisan (*via* the Sěboekoe) by land, including AMDJAH who went as far as Djempanga and who was back at Tenampak on

Sept. 27th; by prahu to Kw. Agisan (*via* Kapakoean) (Oct. 4-6). Some larger explorations were made, *e.g.* the Tawanan Expedition (Oct. 17–Nov. 3); to Upper-Seboeda (Nov. 13), Kw. Naoendoeng (17) and back at Tenampak (25); Dec. 7 start of the land expedition to the Simengaris; reconnaisance along the coast (27) and to Tawao. In the Report of the Expedition is not recorded whether the Indonesian collectors participated in these trips. The following collecting localities are mentioned (in list herbarium): B. Oeloe Seboekoe, B.S. Tampilan, Tenampak, B.S. Toelit, G. Djempanga, Soedjau, Tikoeng, Pembliangan and Samenggaris. At the beginning of 1913 back to Tg Seilor and the greater part of the expedition leaving Bandjermasin on Jan. 10th.— *1913. Prinseneiland* (= *P. Panaïtan*) (W of Java) (Oct.) with J. C. Koningsberger; also paying a visit to the lighthouse Oedjoeng Koelon (*W. Java*).

AMDJAH

Collections. *Herb. Bog.: Borneo* (1898–99) 502 *nos*, *Java*, *Noesa Kambangan* 242 *nos*, *Borneo* (1912) 1097 *nos; Herb. Leyden: Borneo* dupl. (1912). Living plants from *Borneo* in *Hort. Bog.* (coll. 1912).

**Amerom**, Willem Frederik Hendrik van
(1899, Soerabaja, Java; 1944, prisoner camp in Kiushu, Japan), Forest Officer, educated at Wageningen Agricultural College, went to Java in 1928. He was successively stationed at numerous places in that island; in 1934 at Garoet, and since 1935 at Madioen. Since 1940 he was attached to the Forest School at Madioen.

Collecting localities. *W. Java:* Garoet (*1934*); *E. Java:* Magetan (*1935*), Ngawi (*1937*), G. Lawoe (*1940–41*).

Collections. In *Hort.* and *Herb. Bog.:* a few numbers. In *Herb. For. Res. Inst. Buitenzorg* some Ja *nos.*

**Amin**, *cf. sub* Forest Research Institute, Buitenzorg.

**Amiroeddin**, *cf. sub ditto.*

**Amorie van der Hoeven**, H. A. des
(1865, Macao, China; x), in 1888 Student Gardener in the Botanic Gardens at Buitenzorg, and in the same year changing his situation for one in the upland cultures. He was employed again by the Botanic Gardens from 1889–91, performing pioneer work in behalf of forest-tree investigation in West Java, first as assistant of Koorders (see there), afterwards working independently. Later he filled several high offices in agriculture. In 1946 he lived at Leyden, Holland.

*Dipterocarpus vanderhoeveni* K. & V. was named after him.

Collecting localities. *W. Java:* principally at Tjibodas (*1890*), at the base of G. Halimoen near Soekaboemi (May 26, *1890*) and at Rongga Estate near Bandoeng.

Collections. *Herb. Bog.*, especially ferns and material of forest trees.

Biographical data. Tijdschr. Ned. Ind. 1897, p. 1003; Backer, Verkl. Woordenb., 1936 (*cf. sub* hoevenianus).

**Anang**
Indonesian, for more than twenty years in the employ of the Botanic Gardens at Buitenzorg, at present 'mantri'. He attended some expeditions (see below).

Collecting localities. *1938. Moluccan expedition* G. A. L. de Haan (see there). Collecting in *Ternate:* Kei Doekoe (Peak of Ternate) (Febr. 26–28); Loboso (March 5); Kabora (7); *Morotai:* Wajaboela (March 11–13); Goegoeti (15); G. Mokoe (16–18); G. Toetoehoe (March 23–Apr. 3); *Halmaheira:* Weda (Apr. 10–11); Tilope (13–17); Weda (May 17–24); Kobe (31).—*1939. Dutch New Guinea Company Expedition* (*cf. sub* A. Schwartz). *Dutch N. New Guinea:* southern part of the subdivision Hollandia (Nimboran), basin of the Korimi River.

Collections. *Herb. Bog.: Ternate nos* 1–147, *Morotai nos* 148–393 and *Halmaheira nos* 394–677 from Exp. de Haan, *New Guinea* duplicates (pres. by the F.R.I.). *Herb. Res. Inst. Buitenzorg: For.* 106 bb *nos New Guinea.* Living plants in *Hort. Bog.*

**Anang Atjil**, *cf. sub* Forest Research Institute, Buitenzorg.

**Anang Kaderi**, *cf. sub ditto.*

**Andel**, W. J. D. van
(1867, Rotterdam, Z.H., Holland; x), came to the D.E.I. in 1891; since 1910 appointed Admini-

strator of the Civil Service, stationed successively in the Lampong Districts (S. Sumatra) 1910–13, in Manado Residency (N. Celebes) 1913–21, in Government Celebes and Dependencies 1922–28, and in Banka and Dependencies 1928–29. After expiry of his European leave, he retired.

COLLECTING LOCALITIES. *1898–1902.* W. *Java:* Soekaboemi and Djampang Tengah.—*1912. S. Sumatra,* Lampong Districts.[1]—*1916. N. Celebes:* Paleleh.

COLLECTIONS. For the greater part living plants in *Hort. Bog.;* also in *Herb. Bog., e.g. Burmannia lutescens* from the Lampong Distr.[2]

LITERATURE. (1) *cf.* Versl. Pl. Tuin Buitenzorg for 1912, p. 18.

(2) *cf.* JONKER, Monogr. Burmanniaceae, 1938, p. 150.

**Anderson,** Captain

visited *Ambon* before *1814* and from there brought seeds for ROXBURGH, *e.g.* of *Wendlandia paniculata.*[1] This might be the Capt. ANDERSON of the Hon. Comp.'s ship Admiral Hughes, which called at Penang in 1790.[2]

LITERATURE. (1) *cf.* COWAN in Bull. Jard. Bot. Buit. sér. 3, vol. 14, 1936, p. 33.

(2) *cf.* TH. FORREST: 'A voyage from Calcutta to the Mergui Archipelago *etc.*' (London 1792) p. 25.

**Anderson,** James Webster

an Assistant Curator in the Gardens Department Straits Settlements, 1910–17; he later became a planter. He is the author of 'Index of plants, Botanic Garden, Singapore' (1912). After return in Britain he became a private gardener.

COLLECTING LOCALITIES. *1910–17. Malay Peninsula:* Taiping Hills, Perak (1911) *etc.*—*1912. NW. Borneo,* Sarawak (at all events in Aug.): visiting Mt Poi and probably ascending Mt Pensaung.[1]

COLLECTIONS. Small collections. In *Herb. Kew:* plants from the *Malay Peninsula* (pres. 1912); *Herb. Sing.* He numbered in the field; the specimens have been named and the duplicates distributed in the last 12 years, but no list has been published (CORNER *in litt.*).

LITERATURE. (1) RIDLEY in Kew Bull. 1933, p. 490 describes *Microcos reticulata* from Mt Pensaung, collected by ANDERSON (without mentioning initials).

BIOGRAPHICAL DATA. BURKILL in Gard. Bull. Str. Settlements 4, 1927, *nos* 4–5.

**Anderson,** Thomas

(1832, Edinburgh, Scotland; 1870, Edinburgh, Scotland), a surgeon under the Government of India and from 1860-68 Superintendent of the Royal Botanic Gardens, Calcutta.[1] He was also the first Conservator of Forests in Bengal. In 1861 he made a journey to Java in connection with *Cinchona* culture. In 1868 he returned to Scotland on account of illness and spent his time in working on *Acanthaceae.*

*Eranthemum andersoni* MASTERS was named after him.

COLLECTING LOCALITIES. *1861. W. Java,* Priangan Res.: G. Goentoer and G. Malabar (Oct. 19), *etc.*; Buitenzorg (Nov. 6); *Malay Peninsula:* Singapore.[2]

COLLECTIONS.[3] *Herb. Calcutta*; probably > 470 *nos* of above-mentioned trip; *Herb. Kew:* India, Suez (pres. 1861–70); *Herb. Brit. Mus.: Singapore* plants; also dupl. in *Herb. Berlin* and *Herb. Leyden.*

LITERATURE. (1) Author of the 'Florula Adenensis' (Journ. Linn. Soc. Lond. Bot. 1860, suppl. 1, 47 pp.).

(2) T. ANDERSON: 'On a new genus of Moraceae from Sumatra and Singapore' (Journ. Linn. Soc. Bot. 8, 1865, p. 167–168).

(3) Plants mentioned by VALCKENIER SURINGAR in 'Het geslacht Cyperus' (Leeuwarden 1898) p. 110; in Pflanzenreich 46, p. 271; in Bull. Jard. Bot. Buit. sér. 2, vol. 9, 1913, p. 38; Ann. Conserv. Jard. Bot. Genève 21, 1920, p. 272.

BIOGRAPHICAL DATA. Journ. Bot. 1870, p. 368 w. bibliogr.; Gard. Chron. 1870, p. 1478; PRITZEL, Thes. Lit. Bot., 1872; Biogr. Index BRITTEN & BOULGER in Journ. Bot. 26, 1888, p. 54 and in 2nd ed. by RENDLE, 1931; CURTIS' Bot. Mag. Dedic. 1827–1927, p. 151–152 + portr.; BACKER, Verkl. Woordenb., 1936.

**Anderson,** William

(died June 3, 1778, off Anderson's Island), Surgeon-Botanist of COOK's 2nd and 3rd voyage (resp. 1772–75 and 1776–80, *cf. sub* COOK). The 2nd voyage can be neglected, the territory treated here not being visited; on the 3rd voyage ANDERSON undertook the botany department together with NELSON (see there), but died in 1778 before arrival in the Malaysian region.

He is commemorated in the genus *Andersonia* R. BR.

COLLECTIONS. In *Herb.* BANKS = *Brit. Mus.,* also MSS; no plants from *Malaysia.*

BIOGRAPHICAL DATA. Biogr. Index BRITTEN & BOULGER in Journ. Bot. 36, 1898, p. 100, and in 2nd ed. by RENDLE, 1931; Journ. Roy. Soc. Tasmania 1909, p. 3; Journ. Bot. 54, 1916, p. 345, and *l.c.* 55, 1917, p. 54; Journ. & Proc. Roy. Soc. N.S.W. 55, 1921, p. 150.

**Anderson,** William

is mentioned by KRÄNZLIN[1] as collector of *New Guinea* plants in *1893;* data on collecting localities are omitted. F. M. BAILEY describes *Dendrobium andersoniana,* named after WILLIAM ANDERSON who collected the specimen in *British New Guinea.*[2]

A certain ANDERSON (initials not mentioned) was a settler and storekeeper at Dedele (Cloudy Bay) († 1899); he was a native of Norway, owned coconut plantations and began to exploit rubber, living 15 years in the colony.[3] He might be identical with the above-mentioned collector.

LITERATURE. (1) 'Orch. Papuan.' in Oesterr. bot. Zeitschr. 44, 1894, p. 161–162.

(2) *cf.* Queensl. Agr. Journ. 1901, p. 411–412.

(3) *cf.* Ann. Rep. Br. N. G. for 1898–99, Victoria 1900, p. 13.

**Andersson**, G. G.
evidently a plant collector of H. O. FORBES (see there).

**Andersson**, John
WICHMANN[1] mentions that a certain JOHN ANDERSSON has pointed to the occurrence of 'peat' in Sumatra already in the year 1794. It seems probable that A. had samples, and possibly also plants from Sumatra.
LITERATURE. (1) *cf.* Versl. gew. verg. Wis- & Natuurk. Afd. Kon. Akad. Wet. Amsterdam 29 Mei, 1909, vol. 18, 1909, p. (5)–(9).

**Andersson**, Nils Johan
(1821, Gärdserum, Småland, Sweden; 1880, Stockholm, Sweden), finished his studies at Uppsala, taking his Ph. Dr's degree in 1845; he was a member of a Swedish expedition round the world. In 1852 he was appointed Natural History Lecturer at Stockholm, in 1855 *ditto* at Lund; in 1856 Director of the Bot. Sect. of the Nat. Hist. Museum Stockholm, at the same time Professor.
Author of many systematic papers *e.g.* on *Gramineae* and *Salicaceae*.[1]
ITINERARY. *Voyage in the 'Eugenie', 1851–53.*[2] Departure from Karlskrona (Sept. 30, 1851) and *via* Madeira, Rio de Janeiro, Montevideo, Valparaiso, Callao, Panama, Galapagos Isls, Sandwich Isls, California, Sandwich Isls, Friendship Isls, New Holland (Sydney), Carolines, China; reaching the *Philippines*, *Luzon:* Manila (Jan. 4, *1853*), making trips to Pasig, Laguna, Santa Cruz, Pagsajan, Cavinti, Louisiana, Mahayhay, Lillo, G. Banajao (not reaching the summit), Bay, Los Baños, Lake Socal; Jan. 14th sailing for *Singapore* (arrival on the 25th, sailing on the 30th), where according to the account of the voyage (Dutch transl.) no collecting was done owing to illness; *W. Java:* Batavia (Febr. 4 arrival), where some little trips (Buitenzorg *etc.*) were made in the last few days; sailing for the Cocos Isls on the 13th and *via* Keeling and Cocos Islands and the Cape of Good Hope; back in Sweden in June 1853.
COLLECTIONS. *Herb. Mus. Stockholm;* dupl. in *Herb.* DECANDOLLE (*Geneva*) (500), *St Petersburg* (= *Leningrad*) (1478 *nos*), *Vienna*, *Liege*, *Brit. Mus.* (mosses acquired w. *Herb.* HAMPE), *Kew* (pres. 1856–74), *Berl.* (128 specimens of the Galapagos Isl. and 55 dupl. from Stockholm pres. 1935–36), Herb. LINDEMANN (? U.S.S.R.) (59), *N. Y. Bot. Gard.:* 18 *nos* of the *Philip. Isls*. Evidently the labels are not very trustworthy, especially with regard to collecting localities. KÜKENTHAL mentions *Cyperaceae* collected by A. in *Java* (Batavia), *Malacca*, *Singapore* and *Luzon*.[3] These data do not comply with the statement that in Singapore no collecting was done.
The botany of the voyage was partly published,[4] but no plants of the Malaysian region were dealt with.
LITERATURE. (1) The latter in DECANDOLLE, Prodromus 16[2], 1868, p. 190–331.
(2) C. SKOGMAN: 'Fregatten Eugenies Resa omkring Jorden åren 1851–53 under befäl af C. A. VIRGIN' (Stockholm 1857–61, 4 vols; 1st ed. 1854–55) (*non vidi*); Dutch transl. by J. J. A. GOEVERNEUR: 'Eene reis om de wereld met het Zweedsche oorlogsfregat Eugenie' (Groningen 1864); German transl. by A. VON ETZEL: 'Erdumseglung der Königl. Schwedischen Fregatte Eugenies in den Jahren 1851 bis 1853 *etc.*' (Berlin 1856, 2 vols).
*cf.* also some letters *etc.* from ANDERSSON in Svensk Vetensk. Akad. Öfvers. 10, 1853, p. 58–64, 75–76, 177–191 (in Swedish).
(3) In Pflanzenreich Heft 101, IV, 20, 1936, *cf.* p. 71, 86, 134, 424, 519 *etc.*
(4) Kongliga Svenska Fregatten Eugenies Resa *etc.* Botanik I–III, 1857–1910 by N. J. ANDERSSON and F. W. C. ARESCHOUG.
Mosses by J. ANGSTRÖM in Öfvers. Vet.-Akad. Förh. 29, 1872–73, p. 15–29, 118–139; *l.c.* 33, 1876, p. 50–55; Hedwigia 14, 1875, p. 85–93.
BIOGRAPHICAL DATA. MART. Flor. Bras. vol. 1, *pars* 1 in 'Vitae itiner. collect. *etc.*'; PRITZEL, Thes. Lit. Bot., 1872; WITTROCK, Icon. Bot. Berg., 1903, p. 29, *t.* 11 and in *l.c.* 2, 1905, p. 3.

**Andoetoe**, J. H., *cf. sub* Forest Research Institute, Buitenzorg.

**Andrea**, A. F.
captain in the mercantile marine, presented *Herb. Copenhagen* with a collection of plants from the *Philippines* in *1875*.

**Andreas**
of Menggala, *W. Borneo*, sent orchids to *Hort. Bog.* in *1896*.

**Andreas**, A. C.
District Officer of the Civil Service at Tegal (*Centr. Java*), sent plants to *Hort. Bog.* in *1878*.

**Andreas**, H., *cf. sub* Forest Research Institute, Buitenzorg.

**Andreas**, P. P.
Doctor of Law at Buitenzorg, *W. Java*, presented plants to *Hort. Bog.* in the years *1873–75*; when in *1883* at Bonthain (*SW. Celebes*), he forwarded plants (orchids *etc.*) to the said Gardens.

**Andresen**, A. J.
Lieutenant Colonel in the Western Division of *Borneo*, sent material of the gutta-percha tree to the 'Natuurkundige Vereeniging' at Batavia in *1852*.

**Andrews**, Charles William
(1866, Hampstead, England; 1924, ?), Assistant in the British Museum, Nat. Hist. Dept, who made an expedition to Christmas Island (Indian Ocean).
Some plants were named after him, *e.g. Panicum andrewsi* RENDLE.
ITINERARY. Left England beginning of May 1897, sailing July 23 from Batavia, and staying in *Christmas Island* July 29, *1897*–May *1898*, for 10 months.[1] He may have visited the island again in 1901 (see below).
COLLECTIONS. *Herb. Brit. Mus.:* 278 plants

collected in *Christmas Island*, pres. by Sir J. MURRAY, including types of the novelties described in the monograph of the island;[2] 110 spec. incl. 49 cryptogams from *Christmas Island* (pres. 1910) and crypt. from the same (pres. 1916). In *Herb. Bog.* a few duplicates, *e.g.* of *Strongylodon lucidus* SEEM., according to the label collected 12–10–*1901*.

LITERATURE. (1) C. W. ANDREWS: 'A description of Christmas Island (Indian Ocean)' (Geogr. Journ. 13, 1899, p. 17, w. map); 'A monograph of Christmas Island (Indian Ocean). Physical features and Geology. With descriptions of the Fauna and Flora by numerous contributors' (London 1900).

(2) *cf.* Chapter Botany in Monograph *l.c.* p. 171–200, pl. 17–18.

BIOGRAPHICAL DATA. Who's who 1913.

**Angeles**, *cf. sub* Forestry Bureau, Manila.

**Angremond**, Arend d'

(1883, Amsterdam, Holland; August 1945, Japanese prisonercamp Si Rengo-Rengo near Medan, Sumatra), was educated at the Agricultural School at Wageningen; went to Surinam as Estate Manager in 1905, taking much trouble for the promotion of the culture of bananas. In 1911 he went to Switzerland, where he studied for some years at Zürich under Prof. A. ERNST, taking his Ph. Dr's degree in 1914 on a flowerbiological thesis. Subsequently he departed for Java, where he was Director of the Tobacco Experiment Station at Klaten till 1928, and later of the A.V.R.O.S. Experiment Station at Medan (Sumatra).

COLLECTIONS. Probably a few plants only. In *Herb. Bog.*: *e.g.* material of *Curculigo orchioides* GAERTN. (pres. *1931*).

**Angst**, Ed.

architect, Zürich, presented 28 *nos* of cultivated plants from *Java* to *Herb. Univers. Zürich* in *1906*.

**Anhali**, *cf. sub* Forest Research Institute, Buitenzorg.

**Aniff** = HANIFF (see there).

**Annandale**, Thomas Nelson

(1876, Edinburgh, Scotland; 1924, Calcutta, Br. India), zoologist and anthropologist, Superintendent of the Indian Museum, Calcutta, and Director of the Zoological Survey of India. He came to India in 1904, and is the author of many zoological papers, D. Sc. in Edinburgh 1905. He was attached to the Skeat Expedition (see below) and revisited the Malay Peninsula on more than one occasion.

ITINERARY. *Malay Peninsula. 1899. Skeat Expedition*,[1] *cf. sub* YAPP. ANNANDALE left the expedition after the stay at Kuala Aring towards the end of September.—*1901–03*. On some occasions with H. C. ROBINSON (see there).—*1916*. Accompanied by a collector in the Siamese Malay States (Jan.–Febr.).[2]

COLLECTIONS. *Herb. Sing.*: collection *1916*, numbered in the field with S.F. *nos*.

We do not know whether any botanical collections were made by him during the former expeditions.

LITERATURE. (1) TH. N. ANNANDALE: 'The Siamese Malay States' (Scott. Geogr. Magaz. 16, 1900, p. 505–523).

(2) *cf.* Ann. Rep. Bot. Gard. Str. Settlem. for 1916, p. 4.

BIOGRAPHICAL DATA. Who's who 1913; Rec. Ind. Mus. Calc. 27, 1925, p. 1–28, incl. bibliogr.; Journ. Bomb. Nat. Hist. Soc. 30, 1925, p. 213–214; BURKILL in Gard. Bull. Str. Settlem. 4, 1929, *nos* 4–5.

**Anonymous*** **Indonesia**

The *Dutch East Indian* exhibits at the exhibition at Paris in 1867 and 1900 were presented resp. in 1869 and 1901 to the *Kolon. Mus.* (now *Ind. Inst. Amsterdam*). Those of the exhibition at Amsterdam in 1882–83 are at least partly in *Herb. Leyden*.

**Anonymous** **Sumatra**

12 *Filices* from Acheen (= Atjeh), *N. Sumatra*, with KAMEL's plants in *Herb.* PETIVER in *Brit. Mus.*; also 3 *Algae*. The material must have been collected *about 1700*.

A rather extensive collection from Padang and environs, *Sumatra West Coast*, collected in *1870*, in *Herb. Bog.* The labels are written in a non-German hand; some of the numbers exceed 300; *cf.* also *sub* JODNER.

The District Officer of the Lampong Districts (*S. Sumatra*) sent a lot of orchids to *Hort. Bog.* in *1895*.

The Resident of Pariaman, *Sumatra West Coast*, collected some plants (July 14, *1903*), *e.g. Knema mandaharan;* in *Herb. Bog.*

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(*) **Anonymous collectors** are numerous in the Malaysian collections. Many of them were officials whose names can only be traced with difficulty or not at all, and who, in all probability, often did not collect in the field themselves.

Some large collections were made by native collectors whose names are not noted (*e.g.* from Borneo). Further there are quite a number of totally anonymous collections, of which we have not the faintest idea who made them. The anonymous collections cannot be neglected; some are very large *e.g.* the 'Native Collector(s)' employed by the Bureau of Science in Borneo. Some are very important, and contained a lot of novelties, *e.g.* the grasses collected by veterinary surgeons in Soemba Isl. (L.S.I.). Sometimes duplicates were distributed of well-known collections with totally inadequate labels, specially of the old collections; these duplicates are now often 'anonymous'. The anonymous collections have been annoying for the present compiler. They are here arranged geographically and chronologically.

G. Meyer-Darcis, Wohlen (herbaria dealers), Switzerland, presented 408 *Sumatra* ferns to the *Herb. Univers. Zürich* in 1905. The actual collector(s) is (are) not mentioned. The collection must have been made *before 1905*. There is a possibility that the plants are duplicates of the Sumatra collection of G. Schneider (see there).

The Assistant Resident of Padang Pandjang, *Sumatra West Coast*, sent living orchids to *Hort. Bog.* in *1905*.

The Resident of the Lampong Districts, *S. Sumatra*, forwarded rattans *etc.* to *Hort. Bog.* in *1905*.

In *Herb. Bog.*: weed collection from Bah Biroeng Oeloe, Tea plantation S E of Pematang Siantar in *Sumatra East Coast* (coll. *1924*).

The Government Veterinary Surgeon of Sibolga (Res. Tapanoeli), *N. Sumatra*, sent more than 36 grasses from Padang Lawas to *Herb. Bog.* (pres. July *1926*).

In *Herb. Kol.* (= *Ind.*) *Inst. Amsterdam:* a large amount of cultivated plants, presented in *1927* by the Deli Experiment Station, Medan, *Sumatra East Coast*.

In *Herb. Bog.*: 16 grasses from Tapanoeli, *N. Sumatra* (pres. in *1927* through the intermediary of the Dir. of the Veterinary Inst.).

In *Herb. Kol.* (= *Ind.*) *Inst. Amsterdam:* 11 wood samples + herbarium from the forests of Singkel (= Singkil, S. Atjeh, *N. Sumatra*) (pres. by the N.V. Houthandel Singkel in *1928*).

The District Officer of Takengon in Atjeh, *N. Sumatra*, collected 4 living orchids on the Boerni Telong; in *Herb. Bog.* (*193 .*).

The Forest Officer of Tapanoeli, *N. Sumatra*, collected 11 *nos* herbarium material of plants and shrubs on G. Semponan (Dairi Lands) (Nov. 27, *1929*), without labels; presented to *Herb. Bog.* by the Forest Research Institute (Buitenzorg) towards the end of 1930.

The Estate-Manager of Kotaboemi in the Lampong Districts, *S. Sumatra*, collected at least 9 *nos* of plants (March 22, *1934*); in *Herb. Bog.*

The Assistant Consulting Agriculturist at Wonosarie, Palembang Res., *S. Sumatra*, collected the weeds *nos* A–M; in *Herb. Bog.* (pres. *1940*).

Many times during several years plants were sent for identification to *Herb. Bog.* by:

1. **Deli Experiment Station**, Medan.
2. **General Experiment Station** of the A.V.R. O.S., Medan.
3. The agriculturists in the employ of the **Agricultural Syndicate**, stationed in Sumatra West Coast and S. Sumatra.

**Anonymous** **Islands near Sumatra**

The 'demang' (native government official of the Civil Service) of the *Batoe Islands*, W of Sumatra, sent 2 plants to *Herb. Bog.* in Dec. *1930*. The Civil Administrator of the said islands, *ditto* 1 plant to *Herb. Bog.*

In *1855* the Resident of *Banka* sent species of *Nepenthes* originating from there, to the 'Natuurkundige Vereeniging' at Batavia; the specimens were passed to Teysmann, *Herb. Bog.*, for identification.

The Consulting Agriculturist at Pangkalpinang, *Banka*, collected 4 plants (*1928*); in *Herb. Bog.*

Plants originating from *Billiton* and *P. Mendanau* in *Herb. Leyden*, presented by the Dept of the Colonies between the years *1871–98* (*cf.* Goddijn in Meded. 's Rijks Herb. Leiden *no* 62b, p. 20; Mandanao = Mendanau).

**Anonymous** **Malay Peninsula**

12 *Filices* from *Malacca* with Kamel's plants in *Herb.* Petiver, *Brit. Mus.* The material must have been collected *about 1700*.

A collector employed by Thomas Evans (see there) collected in *P. Penang* in *1808*, *e.g. Begonia evansiana* Andr. (*cf.* Backer, Verkl. Woordenb., 1936).

A Chinese collector in the employ of the Fed. Malay States Museum, made a collection of plants near the summit of G. Benom, Pahang, in the *Malay Peninsula* (July–Aug. *1925*), at an alt. of 6000 feet and upwards. Material in *Herb. Fed. Mal. Stat. Mus.* = permanently on loan in *Herb. Sing.* (*cf.* M. R. Henderson: 'On a collection of plants from Gunong Benom, Pahang' in Journ. Fed. Mal. Stat. Mus. 13, 1926, p. 217–227).

**Anonymous** **Java**

Plants from a Javanese Garden in *Herb.* Plukenet, *Herb.* Sloane 89 in *Brit. Mus.* The material must date from *about 1700*.

Plants by a Dutch Gardener (from Cleyer's garden?) from Batavia in *Herb.* Sloane 286–287, in *Brit. Mus.* The material must date from *about 1700*.

*Java* plants, collected *before 1842*, without the name of the collector (*ex Herb.* Webb), were sold with the Herbarium of Lambert in 1842; they were bought by R. Brown (= *Brit. Museum*).

A native collector of the Botanic Gardens Buitenzorg, discovered *Rafflesia rochussenii* on the Manellawangi (= Mandelawangi, spur of G. Gedeh) on July 29, *1850* (*cf.* Teysmann & Binnendijk in Nat. Tijdschr. N.I. 1, 1850, p. 425–430, 2 pl.; and in *l.c.* 2, 1851, p. 651–655; *cf.* also Hook. Lond. Journ. Bot. & Kew Gard. Misc. 3, 1851, p. 217–220).

*Java* plants of an unknown collector in *Herb. Oxford* (*cf.* HOOK. Journ. Bot. & Kew Gard. Misc. 6, 1854, p. 281).

*Herb. Amsterdam: Plantae Ind. Orient. Javanicae*, beautiful collection of *Piperaceae etc.*, collected in the vicinity of Semarang, *Centr. Java.* Probably very old.

The Assistant Resident of Lebak, Bantam, *W. Java*, sent 6 plants of *Gonystylus miquelianus* to *Hort. Bog.* in *1866*.

The District Officer of Rangkas Bitoeng, Bantam, *W. Java*, sent some orchids to *Hort. Bog.* in *1886*.

From Aug. *1888*–March *1889* plants were collected on behalf of J. G. BOERLAGE (see there) in the environs of Buitenzorg (*cf.* Versl. Pl. Tuin Buitenzorg for 1888, p. 18); in *Herb. Leyden.*

*Herb. Univers. Zürich:* pharmaceutically important material in spirits from *Java* (purch. *1895*).

*Herb. Univers. Zürich:* 100 plants from *Java*, presented by SCHINZ in *1903*. Collector(s) unknown to compiler.

An Overseer of the Forest Service collected 13 *nos* of plants in the mangrove forest near the Kinderzee near Tjilatjap, *Centr. Java;* in *Herb. Bog.* (coll. *19* . .).

The Estate-Manager of Kiara Pajoeng, N of Tjiandjoer in *W. Java*, sent at least 8 *nos* of weeds to *Herb. Bog.* in July *1922*.

In *Herb. Kol.* (= *Ind.*) *Inst. Amsterdam:* material of the cultivated species of coffee from Bangelen, presented by the Malang Experiment Station in *1926*.

In *Herb. Kol.* (= *Ind.*) *Inst. Amsterdam:* samples of 'cubeben' + herbarium, presented by the Central Java Exp. Stat. at Salatiga in *1926* and *1931*.

The Consulting Horticulturist of *E. Java* collected in *1928*, 30 *nos Loranthaceae;* in *Herb. Bog.*

An Overseer of the Forest Service collected *Rubus calycinus* WALL. *var. suffruticosus* in *E. Java*, on the Jang Plateau near Taman Hidoep (Nov. *1929*); in *Herb. Bog.*

The Forest Officer of Djember, *E. Java*, sent 3 *nos* of *Aleurites montana* to *Herb. Bog.* (pres. July *1930*).

The Director of the Normal School at Ambarawa, *Centr. Java*, collected material of *Cuscuta* (Jan. *1930*); in *Herb. Bog.*

The Estate-Manager of Tjikopo, *W. Java*, collected *Dysoxylum macrocarpum* BL. (July *1933*); in *Herb. Bog.*

The Estate-Manager of Moedjoer, Pasoeroean, collected *Omphalopus fallax* (JACK) NAUD. at Moedjoer, *E. Java* (*cf.* BAKHUIZEN V. D. BRINK in Rec. Trav. Bot. néerl. 40, 1943, p. 119); specimen in *Herb. Bog.*

Many times during several years plants were sent for identification to *Herb. Bog.* by:

1. **General Experiment Station for Agriculture** (Algemeen Proefstation voor den Landbouw = A.P.L.) at Buitenzorg; partly collected by HACKENBERG, VAN HEETEREN and HUITEMA (see those) of the division **Agricultural Institute**, partly by others and presented through the intermediary of the said Institute; also by FRANSSEN, VAN DER GOOT and VAN DER VECHT (see those) of the division **Institute for Plant Diseases** (partly by others and presented by the said Institute).

2. The **Private Experiment Stations**, *viz* **W. Java** (a combination of the formerly separate stations for tea, rubber, *etc.*) at Buitenzorg, collected by the staff, principally by HEUBEL and PRILLWITZ (see those), and also a lot of material coming from various estates and presented through the intermediary of the Exp. Station; **Salatiga, Semarang, Klaten, Malang** and **Besoeki** (Djember) *ditto*, presented by the respective directors.

3. **Public Health Service**, Medical Laboratory at Batavia, *e.g.* from the Malaria Department, especially waterplants.

4. The **Opium Factory** at Batavia.

5. The **Commercial Museum** (Handelsmuseum) at Batavia (the former Museum and Inquiry Office for Economic Botany, Buitenzorg).

**Anonymous** **Islands near Java**

The Manager of the Government Caoutchouc Estate in *Noesa Kambangan* (S of Java) sent some plants to *Hort. Bog.* in *1922*.

The Consulting Horticulturist of *Madoera* sent 2 *nos* of plants to *Herb. Bog.* in Aug. *1932*.

The Assistant Consulting Agriculturist at Bangkalan (*Madoera*) sent some plants from experiment fields, *e.g. Tenagocharis latifolia* BUCH. to *Herb. Bog.* in *1933*.

The Agricultural Overseer at Toendjoeng (*Madoera*) collected ± 50 *nos* of weeds from experiment fields in *1934;* in *Herb. Bog.*

The Assistant Consulting Agriculturist at Pamekasan (*Madoera*), sent respectively 21 and 13 *nos* of plants from experiment fields to *Herb. Bog.* in *1934* and *1935*.

The Consulting Agriculturist of *Madoera* sent plants from experiment fields in the years *1934* and *1936;* a number of them preserved in *Herb. Bog.*

**Anonymous** **Lesser Sunda Islands**

The Resident of *Bali* and *Lombok* sent a lot of living orchids to *Hort. Bog.* in *1886* and *1908.*

The Estate-Manager of Poeloekan (*Bali*) collected *Salvia occidentalis* SCHWARZ; in *Herb. Bog.* (pres. Sept. *1933*).

The District Officer of *Lombok* sent a *Cypripedium sp.* to *Hort. Bog.* in *1906.*

The Overseer of the Forestry Service collected *Dysoxylum ramiflorum* MIQ. in *Lombok;* in *Herb. Bog.* (pres. *1933*).

The Veterinary Surgeon of Soembawa besar (*Soembawa*) sent 39 *nos* of grasses for identification to *Herb. Bog.* (*1930*).

The Govt Veterinary Surgeon at Waingapoe (*Soemba*), collected *Coleus scutellarioides* BTH. (April *1930*); in *Herb. Bog.*

In *Herb. Bog.:* 5 *nos* of grasses from *Soemba* (pres. through the Veterinary Institute Buitenzorg).

The Civil Administrator of *Flores* sent plants to *Herb. Bog.* in *1918.*

The Govt Veterinary Surgeon at Roeteng, *Flores* (= ? W. R. KNAAP, see there), sent 20 grasses to *Herb. Bog.* in *1926.*

A forester (in German: Förster) collected in 1932 in behalf of *Herb. Berl.* in *Flores. cf.* FÖRSTER, and Mrs I. RENSCH (coll. *1928*).

The Overseer of the Forestry Service collected prairie plants in *Flores* in Nov. *1934*; 7 *nos* in *Herb. Bog.* (pres. Febr. *1935*).

The Assistant Consulting Agriculturist at Larantoeka collected 3 *nos* from *E. Flores* in May *1935;* in *Herb. Bog.*

The Assistant Agriculturist collected 13 *nos* in *Flores* (Oct. 24, *1936*); in *Herb. Bog.*

The Consulting Agriculturist of Timor and adjacent islands, sent plants from Larantoeka, *E. Flores,* to *Hort. Bog.* in *1938.*

The Civil Administrator of *P. Lomblen* sent a *Myristica sp.* to *Hort. Bog.* in *1915.*

The Consulting Agriculturist of Timor and adjacent islands, sent plants from *P. Adonare* to *Hort. Bog.* in *1938.*

The Forest Architect (=? DE GRIJP, see there) at Koepang, *Timor*, collected plants, *viz* in *1934* a collection of 28 *nos* and in April *1935*: 18 *nos* from Fetin, Lelefoei, Nenas, Fatoe, Amnasi and Bidjeli; in *Herb. Bog.*

The *Herb. N. Y. Bot. Gard.* acquired a small collection from *Timor* in *1935* (*cf.* Bull. N. Y. Bot. Gard. 36, 1935, p. 21).

The Lieutenant of the Chinese in Ambon sent a lot of living orchids from the *Tanimber Islands* to *Hort. Bog.* in *1900.*

**Anonymous** **Borneo**

12 *Filices* from *Borneo* with KAMEL's plants in *Herb.* PETIVER in *Brit. Mus.* The material must date from *about 1700.*

The Resident of *SE. Borneo* sent material of some useful plants to the Nat. Ver. N.I. at Batavia in *1865;* they were forwarded to *Herb. Bog.* (*cf.* Nat. Tijdschr. N.I. 29, 1867, p. 428–429, 436).

The Civil Administrator of the Tidoeng lands, *NE. Borneo*, sent sterile specimens of *Dryobalanops lanceolata* BURCK to *Herb. Bog.* (year unknown).

The Sultan of Sambas, *W. Borneo*, sent some iron-wood (*Eusideroxylon*) plants to *Hort. Bog.* in *1869.*

The Resident of Pontianak, *W. Borneo*, sent living plants to *Hort. Bog.* in *1894* and *1896; cf. sub* S. W. TROMP.

The Sultan of Koetei, *E. Borneo*, forwarded several orchids to *Hort. Bog.* in *1895.*

The Resident of *SE. Borneo* presented fat-yielding plants to *Hort. Bog.* in *1897.*

Mrs A. BONORAND, Küsnacht, Switzerland, presented fruits *etc.* from *Borneo* to *Herb. Univers. Zürich* in *1902.* Probably not collected by herself.

In *Herb. Kol.* (= *Ind.*) *Inst. Amsterdam: Palaquium sp. div.* of the Western Division of *Borneo* (pres. *1909*).

The Civil Administrator of Kotta Waringin, *SW. Borneo*, (= ? C. VAN NOUHUYS, see there), sent living orchids to *Hort. Bog.* in *1912*; *ditto* the Civil Adm. of Tanahgrogoh, *E. Borneo*, in *1912.*

A native collector has been employed by the Philippine Bureau of Science, through the agency of the Sarawak Museum during *1913–14.* The collections were made in Sarawak, *NW. Borneo, e.g.* on Mt Merinjak, Mt Santubong, at Kuching, and Retuh (*cf.* E. B. COPELAND: 'Notes on Bornean ferns' in Philip. Journ. Sci. C. Bot. 10, 1915, p. 145–149, pl. 1). In *Herb. Manila, nos* ranging between 1 and 2700. Duplicates *Herb. Arn. Arb., Herb. Bog., Herb. Kew*, and probably elsewhere.

The District Officer of W. Koetei (= ? W. C.

VAN GELDER, see there), Tenggarong, *E. Borneo*, sent some wild orchids to *Hort. Bog.* in *1919*.

A native collector of the Sarawak Museum collected at Kedurong, *Sarawak* in *1925*.

Native collectors under the supervision of the Sarawak Museum collected great numbers of plants at the instigation and with the assistance, both technical and financial, of E. D. MERRILL, then at Berkeley, California. In *1926–28* large collections were dispatched to the *U.S.A.* It seems probable that a duplicate set is in the *Sarawak Museum*.

The Agricultural Officer at Pontianak, *W. Borneo*, sent specimens of *Shorea* to *Herb. Bog.* in Oct. *1929*.

The Consulting Agriculturist at Pontianak, *W. Borneo*, collected *Crotalaria striata* at the end of *1935*; in *Herb. Bog.*

**Anonymous** **Philippines**

VIDAL in Rev. Pl. Vasc. Filip., 13, speaks of finding at the Museo del Jardin botanico, *Madrid*, 5 packets of *Philippine* plants collected in the years *1830* to *1835*. In 1884 these specimens were evidently still undisturbed in their original packages.

The collector is unknown, but was probably some army or naval officer. According to MERRILL (Bull. Philip. Bur. Agr. *no* 4, 1903 p. 33–34), COLMEIRO credited the collection (400 *nos*) erroneously to BLANCO & LLANOS.

Part of it is collected on Mount Arayat in the Province of Pampanga (*Luzon*), in *1829;* the first collection secured from one of the higher mountains!

**Anonymous** **Celebes**

The Assistant Resident of Pampanoea, *SW. Celebes*, sent material of orchids and *Loranthaceae* (dried and in spirits) to *Herb. Bog.*

The Civil Administrator of Melillik sent a collection of dried plants and material in spirits to *Herb. Bog.* in *1912*.

The Assistant Resident in Boni (= Bone, *SW. Celebes*), sent some orchids (dried and in spirits) to *Herb. Bog.* in *1912*.

The Resident of Boni, Pampanoe(w)a, *SW. Celebes*, sent some orchids to *Hort. Bog.* in *1913*.

The Veterinary Surgeon at Gorontalo, *N. Celebes*, sent plants to *Herb. Bog.* in *1928*.

The Assistant Veterinary Surgeon at Donggala, *Centr. W. Celebes*, collected several plants in the years *1928–29*; *nos* 1–71 originating from Lindoe, Sibalaja, Tobali, Biromaroe, *etc.* and *nos* 75–128 from Koelawi, Sidoa, Dolo and Lake Lindoe; in *Herb. Bog.*

The Assistant Veterinary Surgeon at Gorontalo, *N. Celebes*, collected 74 *nos* of plants in *1928–29;* in *Herb. Bog.*

**Anonymous** **Islands near Celebes**

The Resident of Manado sent material of *Gunnera macrophylla* from G. Awoe, *P. Sangihe* (coll. May *1941*) to *Herb. Bog.*

**Anonymous** **Moluccas**

The Estate-Manager of Tobelo, *Halmaheira*, sent some specimens of plants to *Herb. Bog.* in Nov. *1919*.

The Resident of *Ternate* sent some samples of *Sapotaceae* to *Herb. Bog.* in *1884*.

The Post-Holder at Kairatoe, *Ceram*, collected at Oldenburg, by the orders of the Resident of Ambon, specimens of *Ormocarpum cochinchinense* (LOUR.) MERR. (July 10, *1896*); in *Herb. Bog.* (*Herb. bot. var.* KOORDERS *no* 27).

A Civil Administrator of *Ceram* sent several specimens of sago-palms to *Herb. Bog.* in *1911–12*.

Some medicinal herbs originating from *Ceram* were presented by the Eykman Institute (Batavia) to *Herb. Bog.* in *Dec. 1939*.

Plants from *Ambon*, without mentioning the collector's name, were sold with the *Herb.* LAMBERT in *1842*; they were bought by RICH (*cf.* Advertisement in Athenaeum 1842, p. 44). Probably the plants were presented to LAMBERT by W. ROXBURGH (*cf.* LAMBERT, Descr. of the genus *Pinus*, 2, 1837, *appendix* p. 13–24), and collected by ROXBURGH *Jr* or CHRISTOPH. SMITH (see those) *early in the 19th century*.

The Lieutenant of the Chinese in *Ambon* sent a lot of living orchids from that island to *Hort. Bog.* in *1900*.

The Resident of *Ambon* sent plants to *Hort. Bog.* in *1901*.

In *Herb. Leyden:* 286 Banda Plants, accompanied by a list of vernacular names. Neither collector, nor the year of collecting is mentioned, but probably dates from the first half of the 19th century.

The Roman-Catholic mission in the *Kai Islands* sent some fodder plants to *Herb. Bog.* in *1927*. *Ditto* 27 medicinal plant species to the Medical Laboratory (Batavia) in *1939*, which were forwarded to *Herb. Bog.* too.

**Anonymous** **New Guinea**

The German New Guinea Company sent living plants from *NE. New Guinea* to *Hort. Bog.* in *1894*.

The 'Landeshauptmann' (=? SCHMIELE) in former *German New Guinea* at Friedrich Wilhelmshafen

sent living plants to *Hort. Bog.* (*cf.* Versl. Pl. Tuin Buitenzorg for 1894, p. 138, 144) in *1894*.

*Hort. Bog.*: orchids from Doré, *NW. New Guinea* (pres. *1899*).

The Resident of Ternate presented *Piperaceae* originating from the N. coast of *New Guinea* to *Herb. Bog.* The same in *1900* a lot of orchids from *New Guinea* to *Herb. Bog.*

*Herb. Univers. Zürich*: 8 *New Guinea* plants presented in *1904* by H. Brockmann, student at Winterthur. Probably not collected by himself.

In *1905* the Assistent Resident of Merauke, *S. New Guinea*, sent orchids to *Hort. Bog.*

The Assistent Resident of Merauke (= prob. J. A. W. Coenen, see there), sent material preserved in formalin from *S. New Guinea* to *Herb. Bog.* in *1912*.

The Officer in Command of Ambon and Ternate sent some orchids from Upper Digoel, *Dutch S. New Guinea*, to *Hort. Bog.* in *1913*.

In Febr. *1938*, 2 specimens from *Dutch S. New Guinea* (Upper Digoel) were presented through the intermediary of the Army Surgeon E. M. Elsbach at Soerabaja, to *Herb. Bog.*

**Anonymous** **Bismarck Archipelago**

The Department of Agriculture, Rabaul, *New Britain* (*Bismarck Archipelago*), sent orchids to *Hort. Bog.* in *1935*.

The New Guinea Department of Agriculture collected plants in *New Britain* (*cf.* Journ. Arn. Arbor. 22, 1941, p. 93).

**Ansar**, S. M., *cf. sub* Forest Research Institute, Buitenzorg.

**Anta**

an Indonesian employee of the Herbarium at Buitenzorg, accompanied Bloembergen (see there and *sub* Asdat) on his trip to Celebes and the Soela Islands in 1939, and subsequently attended J. Wentholt (see there) on his 3rd New Guinea expedition in *1940–41* to *Dutch S. New Guinea*.

Collections. *Herb. Bog.*: about 200 *nos* from Merauke River. Through the outbreak of the Pacific War part of the material was retained at Makassar, especially plants collected near the Digoel River. The latter material is probably all lost.

**Antonio, D.**

collected in the *Sulu Islands*, *cf. sub* Forestry Bureau, Manila.

**Apalla**, P., *cf. sub* Forestry Bureau, Manila.

**Apostal**, L.

Forest Ranger, *cf. sub* Forest Department, Br. N. Borneo.

**Appelman**, Frederik Johannes

(1894, The Hague, Holland; x), studied forestry at Wageningen; in 1920 appointed Forest Officer in D. E. Indian Govt service and as such stationed at Madioen 1920–28, in the forest district Cheribon-Tasikmalaja 1929, and since 1933 at the same time charged with the management of Garoet; in Bondowoso end of 1935–38[1], in Malang 1938–40; in 1940 stationed in the Head-Office Buitenzorg for affairs connected with nature and game protection; in 1941 appointed Inspector of the eastern part of the D.E.I., stationed at Makassar. After his internment by the Japanese returning thither about 1946; he retired in 1947. At present attached to the Zoological Garden in Rotterdam, Holland.

Collections. Few, *Herb. Bog.*, *e.g.* from Garoet (*1933*), Madjalengka (*1934*), *Rafflesia patma* Bl. collected in the Penandjoeng Peninsula[2] near Pangandaran on the S coast of *Centr. Java* (March *1934*) and *Rafflesia zollingeriana* in S. Djember (*E. Java*, May 10, *1940*); some Ja. nos in *Herb. For. Res. Inst. Buitenzorg*.

Literature. (1) F. J. Appelman: 'De Baloeran' (Natuur in Indië 1937, p. 49–56, w. ill.); and papers on nature protection *etc.*

(2) F. J. Appelman: 'Het schiereiland Penandjoeng' (Versl. N.I. Ver. t. Nat. Besch. for 1933–34, p. 55–59, fig. 3–5).

Biographical data. Wie is dat? 1935, p. 444.

**Arden**, Stanley

employed in the Agricultural Department of the *Malay Peninsula*, 1900–190 . .

Collections. *Herb. Sing.* (pres. *1902*) (*cf.* Burkill in Gard. Bull. Str. Settlem. 4, 1927, *nos* 4–5).

**Arendsen-Hein**, Mrs

Collections. *Herb. Bog.*: 27 *nos* from Brangkal, G. Ardjoeno (*E. Java*) in *1889*.

**Arens**, Pedro Martin José

(1884, Huancabamba, Peru; x), biologist who took his degree at Bonn (1907); employed by the Central Java Experiment Station at Salatiga 1908–11, by the Malang Experiment Station 1911–21; subsequently Director of the Research Department of the 'Rubber Cultuurmaatschappij Amsterdam' (Galang, Sumatra East Coast).

Collecting localities. *Lesser Soenda Islands*, *Bali:* G. Agoeng (June 2, *1912*).—*E. Java:* G. Ardjoeno, Lalidjiwo (July 1, 1912, *etc.*); teak forest Singosari (Dec. 15, 1912); G. Kawi (Apr. 23 and Dec. 9 and 12, *1916*; Jan. 30, *1917*).—*Sumatra East Coast:* Sg. Poetih and Prapat, *etc.* (*1928–29*); *Sumatra West Coast:* Alahan Pandjang (May *1930*).

Collections. Phanerogams in *Herb. Bog.* and *Herb. Leyden* (*Java* and *Bali*, 150 *nos*); *Java* collections many times made together with Th.

WURTH (see there). Mosses, especially from later years in *Sumatra*, in *private herbarium* and *Herb.* VERDOORN.

**Arifin**, *cf. sub* Forest Research Institute, Buitenzorg.

**Aris**, *cf. sub ditto.*

**Armit, Miss**

collected a living *Dendrobium*, described by BAILEY as *Dendrobium armitae nov. spec.* (*cf.* Queensl. Agric. Journ. 1899, p. 48), near Samarai in *SE. New Guinea.*

**Armit, William Edington de Margrat**

(1848, Liege, Belgium; 1901, New Guinea), Officer of the Queensland mounted Police at Georgetown, commanded the 'Argus Expedition' sent by the Argus and Australasian Melbourne Newspapers to Papua in 1883, to report on the resources and capabilities for settlement. The main object of the expedition was to cross the southeastern peninsula of New Guinea in ENE direction from Port Moresby to Dyke Acland Bay; on account of illness and loss of one of the members they did not succeed. When the expedition was over, he made several other New Guinea trips; acting Govt Agent for Rigo and Mekeo, from July 1894–Jan. 1895 [1]; sub-collector of Customs, *etc.*, at Samarai, 1895–97;. he retired towards the end of 1897; a trader of native rubber; reappointed to the public service in charge of the Northern Division during 1899. Falling ill in 1900, he returned to Australia in August, sailing for New Guinea again in November when not yet recovered; finally Resident Magistrate, Northern Division.

He is the author of a book and many ethnological papers on New Guinea.[2] The former, written over the pseudonym of J. A. LAWSON is, according to WICHMANN, wholly invented.

*Ficus armiti* KING and other plants were named after him.

ITINERARY. *Papua, SE. New Guinea. 1883. Argus Expedition*:[3] Port Moresby (July 10); setting out for Robaduma (14), ascending a spur of the Astrolabe Range; on the way to Laloki Valley (21), Sogeri region, Meroka region at the base of Mt Belford, Aroa River; back at Port Moresby (Sept. 3).—*1884. 2nd trip to E. New Guinea*,[4] visiting the Moresby and Basilisk islands and the Redlick group of the Louisiades, E of New Guinea, and on the mainland: Milne Bay and East Cape. In all staying away 7 months.—*1887.* He is cited to have collected in this year on Mt Astrolabe (*cf. sub lit.* 7, BROTHERUS).—*1894.* Set ashore on the NE. coast together with R. E. GUISE by MAC GREGOR near Fir-tree-Point (Febr. 26), Collingwood Bay for an attempted *ascent of Mt Victory*:[5] going up Dako River (until Febr. 28), continuing by land; reaching the junction of the Tanamgina and the Waia Waima (March 23, above 5200 ft); camping 10 days? near summit Mt Maneao (Mt Dayman); setting out for the return (Apr. 3), reaching the mouth of the Dako on the 12th; back on board of the 'Merrie England' (14) on the way to Port Mor sby (arrival 21st). Shortly after, visit to the *Goodenough Islands* for exploration of the mountains.—*1900.* Leaving Tamata Station (Jan. 26) for *Yodda Valley*[6] for the purpose of discovering a practical road to the new Diggings: Ope River (Jan. 29); *via* Borua Tutu, Tumbare Susu and the watershed of the Ope and the Kumusi; Bogi Angerita (Febr. 4); Segarata (9); the confluence of the Kumusi in the Sena (11); ascending the Kumusi to Korobama, Pidsa, Papangi; Sisureta (22), Twidi (24); Kodo on the Yodda; back at Tamata Station (Apr. 1).

COLLECTIONS. *Herb. Melbourne;* specimens referred to by F. VON MUELLER, and others;[7] 5 dupl. *N. Guinea* grasses in *U.S. Nat. Herb. Wash.*

LITERATURE. (1) *cf.* Ann. Rep. Br. N. G. 1894/95, Brisb. 1896, p. xx.

(2) 'Wanderings in the Interior of New Guinea' (London 1875, over the pseudonym of J. A. LAWSON); 'Notes on the Philology of the Islands adjacent to the South-Eastern Extremity of New Guinea' (Proc. Roy. Soc. Queensl. 2, 1885, Brisb. 1886, p. 2–11; 'The Papuans: Comparative notes on various authors, with original observation' (in *l.c.* p. 78–116).

(3) *cf.* Globus 44, 1883, p. 287; Ausland 56, 1883, p. 717 and *l.c.* 57, 1884, p. 255–256; Proc. Roy. Geogr. Soc. Lond. 6, 1884, p. 37–38; Boll. Soc. Geogr. Ital. 21, 1884, p. 218–225; also in the 'Melbourne Argus' 1883.

(4) *cf.* Ausland 58, 1885, p. 480.

(5) *cf.* Ann. Rep. Br. N. G. for 1893/94, Brisb. 1895, p. 78–87, *App.* 10, AA and II.

(6) *cf. l. c.* 1899/1900, Brisb. 1901, p. 87–95, p. 96–98.

(7) F. VON MUELLER in the Vict. Naturalist 1, 1885, p. 168; 2, 1885, p. 18–20 and 3, 1886, p. 71–72; in 'Descr. Not. Pap. Pl.' pt 6.

A. COGNIAUX in Bull. Ac. Roy. Belg. sér. 5, vol. 14, Bruxelles 1887, p. 363.

F. M. BAILEY in Queensl. Agr. Journ. 7, 1900, p. 349.

BROTHERUS described his collection of mosses in Finska Vet. Soc. Förh. Helsingf. vols 37, 40 and 42, *e.g.* from Astrolabe Range *1887* (no trip known to us) and from Mt Dayman (9000 ft); *cf.* also GEHEEB in Bibl. Bot. Heft 13, 1889.

BIOGRAPHICAL DATA. Ann. Rep. Br. N. G. for 1900/01, Brisb. 1902, p. xlii; MAIDEN in Journ. Austr. Ass. Adv. Sci. Brisbane Meeting 1909, p. 374; BACKER, Verkl. Woordenb., 1936 (1886 or 1887 erroneously stated as year of death); Journ. & Proc. Roy. Soc. N. S. W. 55, 1921, p. 150–151.

**Arnaud Gerkens, D. d'**

COLLECTIONS. *Herb. Bog.: Burmannia lutescens* BECC., *no* D 27 from Sitoehiang, S of Leuwiliang in *W. Java*, collected in *1924* (*cf.* JONKER, Monograph Burmanniaceae, 1938, p. 151).

**Arnold, Joseph**

(1782, Beccles, SE of Norwich, England; July 1818, Padang, Sumatra), sometimes erroneously named ARNOTH or ARNOTT; Surgeon in the British navy, 1808–16; in 1818 appointed Naturalist in the

service of RAFFLES who at that time was Lieutenant-Governor of Benkoelen (= Bencoolen). In his capacity of Naturalist he made several trips in *Sumatra*.

*Rafflesia arnoldi* R. BR. was named after him and RAFFLES.[1]

COLLECTIONS. He left behind collections of plants (acc. to BACKER, Verkl. Woordenb., shells and fossils too; the latter two were bequeathed to the Linnean Society). On his 2nd trip in *S. Sumatra*, he detected the mentioned *Rafflesia* near P. Lebar on the Manna River (2 days upstream) on May 20, *1818*. In *Herb. Bog.* 1 dupl., *viz* H.B. *no* 17315, originating from Siak (*Sumatra East Coast*).

LITERATURE. (1) *cf.* Transact. Linn. Soc. Lond. 13[1], 1822, p. 201–234, *t.* 15–22; Flora 4[2], 1821, p. 637–641.

BIOGRAPHICAL DATA. D. TURNER: 'Memoir' (Ipswich 1849); Biogr. Index BRITTEN & BOULGER in Journ. Bot. 26, 1888, p. 55, and in 2nd ed. by RENDLE, 1931; J. D. MILNER, Catalogue portraits in Kew, London 1906, p. 4; BACKER, Verkl. Woordenb., 1936.

**Arnoldi,** Wladimir Mitrofanowitsch

(1871, Koslow, Russia; 1924, Moscow, U.S.S.R.), botanist, educated at Moscow University, where he was Assistant for several years; from 1899–1900 he made a tour to the south of Italy, Munich and Copenhagen; in 1900 Lecturer in Moscow; in 1901 Professor at the Agricultural Institute in Nowo-Alexandria (Lublin), and in 1903–19 professor in Kharkov; subsequently working in the Kaukasus, and from 1921 in Moscow. At the outset he mainly did morphological work, but since 1909 he devoted most of his time to algological studies.

With his assistant S. L. STRELIN he made a voyage to the Dutch East Indies from Jan. 10–June 5, *1909*. They made a trip to the *Duizend Eilanden* (in the Bay of Batavia) and a voyage to the *Aroe Islands* to make studies on *Algae*.[1] They visited the *Mariri Archipelago*, E of Aroe, too.

COLLECTIONS. They brought together a rich collection of demonstration material on *Algae*. We do not know whether phanerogams were collected too; if so, *probably* preserved in *Kharkov*. In *Herb. Brit. Mus.:* 7 *Algae* from *Aroe Islands* (pres. 1912); *Herb. Leyden: Algae* from the *Malay Archip.*

LITERATURE. (1) *cf.* DAMMERMAN in Ann. Jard. Bot. Buit. 45, 1935, p. 34.

W. ARNOLDI: 'Voyage to the Malay Islands' (Moskau 1911; in Russian) (*non vidi*); 'Zur Morphologie einiger Dasycladaceen' (Flora 104, 1912, p. 85–101, pl. V, 16 fig.); 'Materialien z. Morphologie des Meeressiphoneen II. Bau des Thallus von Dictyosphaeria' (*l.c.* 105. 1913, p. 144–161).

BIOGRAPHICAL DATA. Ber. D. B. G. 42, 1924, p. (98)–(103) incl. bibliogr.; Sci. Mag. Biol. (Ukraine) 1927, p. 1–6 + portr.

**Arnot,** D. B.

(killed in Java in Febr. 1942), joined the Forest Department Malay Peninsula in Sept. 1925; Instructor of the Forest School.

COLLECTING LOCALITIES. *Malay Peninsula:* Kanching Forest Reserve, Selangor (*1927*); Bubu Reserve in Perak (early part of *1933*) with the Forest Botanist (=? SYMINGTON); Bruas Reserve (March *1935*). He collected all over the Peninsula.

COLLECTIONS. *Herb. Kuala Lump.:* 60 *nos* from G. Bubu *etc.*, numbered in the C. F. (see *sub* Conservator of Forests) series.

**Arnoth,** D. Joseph = J. ARNOLD (see there).

**Arnott,** D. J. = J. ARNOLD (see there).

**Arnush,** R.

Andai, *NW. New Guinea*, sent orchids to *Hort. Bog.* in *1932*.

**Arres & Ahn,**

are cited by BITTER in his monograph on *Lycianthes* (Abh. Naturw. Ges. Bremen 24, 1919, p. 506), as collectors of *no* 3 = *Lycianthes parasitica ssp. epiphytica* (MERR.) BITT. from Moeara Teweh in *Borneo;* this specimen in *Herb. Bog. cf.* VAN ASSEN & AHN, the label being misread.

**Arrhenius,** Olof Vilhelm

(1895, Stockholm, Sweden; x), physiologist-ecologist who was educated and took his Ph. D. (1920) at Stockholm University. In Jan. 1921 he arrived at Buitenzorg in *W. Java*, where he worked for some time at the Foreigners' Laboratory.[1] From 1920–26 Assistant at the Central Agricultural Experiment Station at Stockholm; on the staff of the Java Sugar Experiment Station at Pasoeroean, 1926–28; after his return to Sweden he has made researches in agriculture and forestry on his estate Kagghamra near Stockholm.

COLLECTIONS. *Herb. State Mus. Nat. Hist. Stockholm:* material from Buitenzorg.

LITERATURE. (1) *cf.* DAMMERMAN in Ann. Jard. Bot. Buit. 45, 1935, p. 44.

**Arsad,** Mohammed, *cf. sub* Forest Research Institute, Buitenzorg.

**Arsat**

retired native forest guard, *cf. sub* Forest Department, British North Borneo.

**Arshad**

an employee of the Forest Department *Malay Peninsula.*

COLLECTIONS. In *Herb. Kuala Lump.*, numbered in the C. F. (see *sub* Conservator of Forests) series; mainly collected in Perak.

**Arsin**

(† 1913), an Indonesian, since 1868 employed by the Botanic Gardens at Buitenzorg, finally in 1884 appointed 'mantri' at the Herbarium; he was an excellent connoisseur of plants, who *e.g.* classified the fossils of the ELBERT Expedition. In 1902 he was awarded the Silver Star for Loyalty and Merit. He arranged the Buitenzorg Herbarium in accordance with Index Kewensis.

COLLECTING LOCALITIES. *1879. W. Java:* G. Gedeh (Tjibodas, Tjibeureum, Geger Bintang) (end of Aug.—beginning of Sept.); G. Tjisalak near Pasir Tengah and kali Tjiapoes (beginning of Oct.); Pameungpeuk (Oct. 21).—*1883. Sumatra West Coast:* with Dr BURCK (itinerary *etc.* see there) to the

ARSIN

Padang Highlands (Aug.–Nov.).—*1885–86. E. New Guinea:* with H. O. FORBES (itinerary *etc.* see there). —*1905. Krakatau* in Soenda Straits: with TH. VALETON (see there) on the 1st of March.

COLLECTIONS. *Herb. Bog.; Java* plants numbered in the H.B. series. The collections from *Sumatra*, *New Guinea* and *Krakatau* probably respectively under the names of BURCK, FORBES and VALETON.

**Asda(t)**
a Sundanese employed by the Herbarium at Buitenzorg, who attended BLOEMBERGEN (see there) on his trip to the *Soela Islands* in *1939*, and a soil-scientific expedition under the direction of VAN DER VOORT and TÄNZER (see those) of the Soil Science Institute (Buitenzorg), to the environs of Troemon in SW. Atjeh (*N. Sumatra*) (Aug. 17–Sept. 2, *1941*).

COLLECTIONS. *Herb. Bog.:* 207 *nos Sumatra* plants; *Herb. For. Res. Inst. Buitenzorg:* 69 *nos Soela Islands*, numbered in the bb. series, collected by ASDA & ANTA.

**Asgar**, *cf. sub* Forest Research Institute, Buitenzorg.

**Askey**, A. M.
Ranger in the Forest Department (1906–22), collected in the *Malay Peninsula* (*cf.* BURKILL in Gard. Bull. Str. Settlem. 4, 1927, *nos* 4–5).

COLLECTIONS. *Herb. Kuala Lump.*, numbered in the C. F. (see *sub* Conservator of Forests) series.

**Askey**, J. E.
Ranger in the Forest Department (1905–10), collected in the *Malay Peninsula* (*cf.* BURKILL in Gard. Bull. Str. Settlem. 4, 1927, *nos* 4–5).

COLLECTIONS. *Herb. Kuala Lump.*, *e.g.* from Negri Sembilan, the Dindings, and mainly Perak and *Penang;* numbered in the C. F. (see *sub* Conservator of Forests) series.

**Asloeri**
an Indonesian, since 1910 employed by the Experiment Station for the Java Sugar Industry at Pasoeroean, in 1915 appointed 'mandoer' of the selection division and since 1937 Head-mandoer of the gardens. He has a notorious capacity for classifying still undescribed cane clones. He assisted many members of the staff of the said institution during trips in and oudside Java, *e.g.* Prof. Dr J. JESWIET, Dr C. A. BACKER and Dr O. POSTHUMUS (see those).

COLLECTING LOCALITIES. *E. Java:* Pasoeroean and neighbourhood (*1931–33*); G. Kawi *1932*).

COLLECTIONS. *Herb. Pasoer.:* 47 *nos.*

**Asnawigana**, *cf. sub* Forest Research Institute, Buitenzorg.

**Assen**, van & **Ahn**
collected some plants near Moeara Teweh in *SE. Borneo* (June 24, *1894*); specimens in *Herb. Bog.*

**Assu**, Abd., *cf. sub* Conservator of Forests series, Kepong.

**Atang**, *cf. sub* Forest Research Institute, Buitenzorg.

**Atasrip**
(† 1921), an Indonesian, since 1888 employed by the Buitenzorg Herbarium, finally 'mantri'.[1] He assisted during some expeditions outside Java (see below).

*Dryopteris atasripii* ROSENST. was named after him.

ITINERARY. *1899. Moluccas*, with expedition HAM (see there). Collecting in *Banda* (Jan. 27), *Ternate* (Febr. 2); *P. Obi* (March 22–Aug. 12), and in this period visiting *P. Bisa*, *Obi-Latoe* (July), *P. Belang Belang* and *Woi Besar* (July); *Ternate* (Aug. 23).—*1903. Dutch North New Guinea.* With Expedition WICHMANN (see there, and *sub* DJIBJA), near Geelvink Bay, Cyclop Mts, Lake Sentani, Hollandia, *etc.* ATASRIP returned to Java before the fixed date, *viz* when the trip to Lake Sentani and the Cyclop Mts was over.[2]

COLLECTIONS. *Herb. Bog.:* 130 *nos* from the *Moluccas*, *Banda* 3, *Ternate* 43, *Obi Isls* 84; *c.* 250 *nos* from *New Guinea;* dupl. in *Herb. Leyden.* He

brought home living plants from *New Guinea* too.[2] The *New Guinea* plants were provisionally classified by ARSIN and later described by VALETON.[3]

LITERATURE. (1) In the papers published by WICHMANN and LORENTZ on this New Guinea expedition, he is erroneously mentioned as ATJIP or ADJIP. ATASRIP was accompanied by a 2nd assistant, *viz* DJIBJA (see there).

(2) *cf.* Versl. Pl. Tuin Buitenzorg for 1903, p. 102–103; Bull. Mij Bev. Nat. Ond. Ned. Kol. *no* 45, p. 6.

(3) In 'Plantae papuanae' (Bull. Dép. Agr. Ind. néerl. 10, 1907, 72 pp.); *cf.* also in FEDDE Repert. 5, 1908, p. 377–397).

*cf.* also J. J. SMITH in Nova Guinea vol. 8.

BIOGRAPHICAL DATA. BACKER, Verkl. Woordenb., 1936.

**Atin**, *cf. sub* Forest Research Institute, Buitenzorg.

**Atje(h)**

Indonesian, in the employ of the Botanic Garden Buitenzorg.

ITINERARY. *1913–14.* With *Expedition* VAN HULSTIJN (see there) to the *Soela Islands*. According to Versl. Pl. Tuin Buitenzorg for 1913, his departure from Buitenzorg took place on July 18, 1912; this is, apparently, a printer's error and rightly should be *1913*. Collecting was done in the following islands: *Soela besi* (= *Sanana*), Mangoli (*e.g.* on G. Pakao), *Taliaboe*, *P. Masonie*, *P. Seho* and *P. Kano*. During the latter part of the expedition VAN HULSTIJN was assisted by SAÄNAM (see there).

COLLECTIONS. *Herb. Bog.*: 420 *nos Soela Islands* Exp. VAN HULSTIJN. Living plants in *Hort. Bog.*

**Atmoesoewarno**, *cf. sub* Forest Research Institute, Buitenzorg.

**Atmotaroena**, *cf. sub ditto.*

**Augustin**, D., *cf. sub* Forestry Bureau, Manila.

**Augustinovicz**, Thoma Matveyevich

a medical man and zealous botanical collector. From 1871–82 he explored E. Siberia. In *1879*, when on his home voyage in a Russian ship, he gathered some plants in *Singapore* (*cf.* E. BRETSCHNEIDER, History of European discoveries in China, London 1898, p. 1035 (The cited christian name Foma is an error).

COLLECTIONS. In *Herb. Bot. Gard. St Petersburg* (= *Leningrad*).

**Awang Lela** bin Mukin Adam

joined the Forest Department *Malay Peninsula* in 1926.

COLLECTIONS. *Herb. Kuala Lump.*, numbered in the C. F. (see *sub* Conservator of Forests) series; mainly collected in Pahang. Dupl. in *Herb. Sing.*

**Azaola**, Iñigo Gonzales y

a planter in Laguña Prov., Luzon, mentioned by MERRILL as cited in literature as a collector of *Philippine* plants (*cf.* Bull. *no* 4 Bur. of Agr. Manila, 1903, p. 30).

The genus *Azaola* BLANCO and several other plants were named after him.

He collected some *Rafflesia* specimens on Mt

ATJE

Majaijai (*cf.* HIERONYMUS, Ueber Rafflesia schadenbergiana GÖPP. *etc.*' (Breslau 1885, p. 8). He sent his plants to BLANCO, a friend of his, therefore they probably do not exist any more.

**Aziz bin Ahmad**

joined the Forest Department *Malay Peninsula* in 1914 as Forest Ranger; retired now.

COLLECTIONS. *Herb. Kuala Lump.*, numbered in the C. F. (see *sub* Conservator of Forests) series; mainly collected in Pahang West.

**Azurin**, *cf. sub* Forest Research Institute, Buitenzorg.

**bb.** *nos*, *cf. sub* Forestry Research Institute, Buitenzorg.

**Blt.** *nos*, *cf. sub ditto.*

**B.S.** *nos*, *cf. sub* Bureau of Science, Manila.

**Baalen**, J. van

collected some weeds from Tjikantjoeng Rubber Estate near Tasikmalaja (Priangan Res.), *W. Java*,

at an altitude of ± 260 m (June 24, *1922*); plants in *Herb. Bog.*

**Babak,** *cf. sub* Forest Research Institute, Buitenzorg.

**Bacani,** E. S., *cf. sub* Forestry Bureau, Manila.

**Bachmid,** Mohammed, *cf. sub* Forest Research Institute, Buitenzorg.

**Backer,** Cornelis Andries

(1874, Oudenbosch, Holland; x), a schoolmaster who came to the D.E.I. in 1901 and when stationed at Weltevreden (Batavia) at once enthusiastically started collecting and studying Java plants. He came into touch with TREUB, at that time Director of the Botanic Gardens at Buitenzorg, through whose intermediary he was appointed at the Herbarium of the said institution in 1905, since 1914 Botanist for the Java flora. He spent many years in travelling in order to get the required materials for a flora of Java.[1]

He was pensioned off at the end of 1924 and after that was temporarily employed by the Experiment Station for the Java Sugar Industry at Pasoeroean (1925–31) for composing a weed flora of the Java sugar-cane fields.[2] When the latter book was finished he left for Holland, settling at Heemstede (near Haarlem), where he up till now is engaged in continuing his work on the flora of Java which is near its completion.

In 1936 he was awarded a honorary Dr's degree at Utrecht University.

He is the author of a 'Verklarend Woordenboek', 1936, many times cited in this cyclopaedia.

Many plants were named after him including the genus *Backeria* BAKH. *f.* (*Melast.*).

COLLECTING LOCALITIES. *1903–05.* W. *Java:* environs of Batavia, *e.g.* at Pepango, Sentiong, Pesing, Doeri, Kemajoran, Bidara Tjina, Mr Cornelis, Tg Priok, Angké, Antjol, Tanggerang *etc.*; G. Tangkoeban Prahoe (Oct. 2, 1903).—*1905–24* collecting many times in the environs of Buitenzorg, *e.g.* on G. Salak (Tjiapoes, Waroeng Loa), at Dèpok, Sëmplak, Masing, Tjibinoeng, Tjilodong, Tjisëèng, Koeripan, G. Tjibodas, Tjampea, Leuwiliang, Bodjong Gedeh, Klappa Noenggal, Batoetoelis, Tjiogrèk, G. Gedeh (Tjibodas), Tjianten, Bolang, Djasinga.—*1906.* With ERNST & PULLE:[3] *P. Edam* (Bay of Batavia) (Apr. 24), Tg Rata (= Vlakke Hoek) (Lampong Distr., *S. Sumatra*) (25), Java's Eerste Punt (*W. Java*) (25), *Krakatau & Verlaten Eiland* (26).—*1908. Krakatau & Verlaten Eiland* (May 4–5), *Lang Eiland* (6).[4]—*1911–15*, travelling all over *Java.*—*1911. Centr. Java:* Poerwakarta, Maos (Apr. 11); Batoe Raden (12), G. Slamat (upwards of 1000 m) (13); Batoe Raden, S. slope of G. Slamat (16–22); *W. Java:* environs of Buitenzorg; in Bantam (June 9–July 1): Rangkas Bitoeng, Tjilèlès, G. Kentjana, G. Kendeng, Malingping, Panjawoegan, Bajah, G. Madoer, Langkop, Tjitorèk, Moentjang, Pasir Agoena and environs, Rangkas Bitoeng; Dec. 21–30 visiting the south coast: Tjibadak, Wijnkoopsbaai, Tjisolok, Tjilëtoeh, Zandbaai, Tjikëpoeh; Dec. 31–Jan 2, 1912: Pasawahan, Tjiëmas, Palaboehan Ratoe.—*1912. W. Java:* in Priangan Res. (March 1–5): environs of Bandoeng, Lembang, G. Tangkoeban Prahoe, Nagreh (= prob. Nagreg); trip to Djokja (= Jogjakarta) and the south coast of *Centr. & E. Java* (Apr. 6–19): Djokja and environs, Wonosari,

BACKER

Kemadang, south coast, Djepitoe, Kalak, Patjitan, Toelahan, Tegalombo, Slahoeng; *E. Java* (May 27–June 19); Bangil, Malang District near Wonokerto, Soemberwalo, Gondang Legi, Ampel Gading, Kali Glidik, Widodaren (near G. Smeroe), south coast, Soerabaja; *W. Java:* Leuwiliang & Bolang (July 16–19); trip to Bandjar in the SE. part of *W. Java* and *Noesa Kambangan* S of *Centr. Java* (Aug. 27–Sept. 11): Bandjar, Rawah Lakbok (27), G. Babakan, Tjikawoeng, Rawah Apoe, Tjikembo(e)lan, Tjilatjap, *Noesa Kambangan* (Sept. 7–8), Bandjar, Wanaredja (11); *W. Java:* Tjiandjoer and environs & G. Gedeh-Pangrango (Sept. 13–21); trip to environs of Cheribon (Oct. 17–31): Cheribon, Linggadjati, G. Tjeremai (up to 2210 m), Koeningan, G. Tjeremai (3075 m, crater); Priangan Res. (Nov. 12–Dec. 1): Bandoeng, Garoet-Tjipanas, G. Goentoer, Waspada, G. Tjikorai, Tjisoeroepan, G. Papandajan, Taloen, Tjinjiroean; in Krawang District (Dec. 19–Jan. 1, 1913): Tjileungsi, Klappa Noenggal, Si Boentoe, Goea Gadjah and surroundings, G. Handjawang, G. Boetik Boeligir, G. Karang Gantoengan, G. Soenarari. —*1913. Centr. & E. Java* (Jan. 21–Febr. 12): Solo, Karanganjer, Soemberlawang, Goendih, Koe-

# MALAYSIAN PLANT LIFE

## BEING A MUCH ENLARGED SECOND EDITION OF 'MALEISCHE VEGETATIESCHETSEN'

ILLUSTRATED BY NUMEROUS PLANT FIGURES

PHOTOGRAPHS AND MAPS

BY C. G. G. J. VAN STEENIS

Contents:



N.B. The volume will comprise appr. 600 printed pages. The MS. will probably be completed within two years.—ED.

Fig. 8. Pandan vegetation in the crater of Mt Kaba, SW. Sumatra. (DE VOOGD)

**361. Dolichandrone spathacea** (L. *f.*) K. Sch. (*Bign.*).—*Poko kulo* (Mal. Pen.), *koeda koeda*, m, (*ki*)*djaran*, s, (*kajoe*) *djaran*, j, (*djo*)*djamè* (Molucc.), *Mangrove trumpet tree.*

Small to medium-sized soft-woody tree widely distributed from Malabar throughout Malaysia to New Caledonia (not known from Australia), restricted to the littoral zone, mostly in tidal creeks, estuaries in the back-mangrove. Leaves 1-pinnate, flowers very long, tubular, white, nocturnal, in short racemes, apparently pollinated by long-tongued moths. Pods linear falcate, seeds corky, rectangular. In Perlis, N-most prov. of the Mal. Peninsula, it is a feature of the low country, standing like an upright poplar in the rice-fields, onwards from Kodiang, and flanks the roads which lead to Kangar and Singgora. Nowhere else it is reported gregarious or of physiognomic importance (1).

Literature. (1) Corner, Wayside trees Malaya (1940) 164, Atlas pl. 26.

**139. Antidesma ghaesembilla** Gaertn. (*Euph.*).—*Onjam*, s, *dĕmpoel lĕlĕs*, j, *kĕnjan*, j, *sĕpat*, j, *koetikata goenoeng* (Ambon), *goentjak*, *koentsjoh* (Mal. Pen.).

Rather small often crooked tree 5–13 m by 10–25 cm (1) from trop. Africa and SE. Asia to West Malaysia, fruits edible, both native and planted (2). Crown dense, bushy, first conical then round, or umbrella-shaped, very twiggy (3). In the Philippines this is one of the commonest trees of the mixed monsoon forest and characteristic of open grasslands. Steup found it one of the most common savannah trees in Celebes (4) dominating on the extensive hills and flats of Mamoedjoe (SW. Cel.), near Galoempang, in orchard facies. Steup found also locally dominance in the Masoepoe savannahs; elsewhere it occurs mixed. Bloembergen found it dominating in grass-thickets on terraces in the S of Soela Sanana Isl. at 450 m alt. It decidedly prefers a pronounced dry season.

Literature. (1) Heyne, Nutt. Pl. N.I. (1927) 186. (2) Burkill, Dict. Ec. Pr. (1935) 186. (3) Corner, Wayside trees (1940) 233. (4) De Trop. Natuur 25 (1936) Jub. Nr p. 43–5.

**225. Pandanus** L. (*Pandan.*).—*Pandan*, *screw-palm*, *screw-pine.*

*Pandanus* is an old Old World genus of the *Pandanaceae* distributed from Africa towards SE. Asia, Malaysia, Australia, and the Pacific Islands. Its area includes Tahiti, New Caledonia, E. Australia to 33° SL, Madagascar, trop. Africa, Assam, Tonkin, S. China, Riu Kiu and Bonin Isl. There is no marked centre of specific development. Although monographic treatments have been given by S. Kurz (1), Solms Laubach (2), Warburg (3) and later additions by Martelli (4) identification of species is very difficult, specific discrimination of the more than 300 species described being far from satisfactory. This induced recent students of Papuan specimens [Kanehira and Merrill & Perry (14)] to add to the scores of endemics. This is partly due to the fragmentary collections of these generally bulky dioecious plants. For a proper placing in the subgenera both ♀ and ♂ plants are needed; the ♂ are in many species unknown. Backer in a careful study at Buitenzorg (5) reduced several species described from Java. A new monograph prepared in Malaysia is urgently required. Though not occurring in the temperate parts of the globe (except, possibly, as fossils) pandans grow in the mountains of New Guinea up to over 3200 m. No sandy beach is devoid of pandans, except in dry regions which they avoid. I gave a provisional general treatment of the role pandans play in the Malaysian vegetation in 1935 (6).

Fig. 1. *P. faviger* Backer, on edge of Lake Bratan, Bali, young specimens, ca 1000 m alt.

The general habit of these characteristic woody plants (fig. 1–2) is rather uniform: a terete soft-woody smooth stem is supported below by conspicuous straight stilt or prop roots; a tap-root is absent. Sometimes these roots sprout from all over the stem and a clear bole is nearly absent, and in some cases they are also found on the branches. The upper roots often do not reach the soil and remain aerial (fig. 2, 3). The stem is ringed by the scars of the sheathing amplexicaulous leaves. It is thinnest at its base. The apex is mostly pseudodichotomously branched with densely tufted foliage (fig. 1) as in *Dracaena* (candelabra or palmid habit). The inflorescences are terminal, and cause sympodial branching. Small species are sometimes nearly stemless, *e.g. P. caricosus* Kurz and *P. polycephalus* Lamk. *non* Spr. measuring $^3/_4$–$1^1/_2$ m. Others, *e.g. P. bidur* Jungh. from the beach and *P. brachyphyllus* Merr. & Perry from the Papuan Mts may reach 20–25 m in height, while in *P. jiulianettii* Mart. the average large tree is as much as 30 m tall (fig. 5). A very unusual character is found in *P. aggregatus* Merr. & Perry where stems form clumps of several trees rising from a small compact group of erect prop roots (14, p. 177). The conspicuous stilt roots are mostly straight and unbranched, although when wounded they may branch profusely into much thinner roots. They occur both in specimens growing in dry or inundated soils and bear small prickly warts in longitudinal rows (fig. 3). In large species the root caps are larger than a fist and consist of thin corky sheets.

Sometimes epiphytes and other plants settle in these 'hanging flowerpots'; I illustrated this (7) from Bali (fig. 3). The seeds of these plants were probably mostly dispersed by ants. In greenhouses the roots in the soil sometimes produce very thin short negatively geotropic rootlets, as palms some-

Fig. 2. Large stilt-root and aerial root system of *P. faviger* BACKER, mixed rain-forest, near Lake Bratan, Bali, 1000 m alt.

times do in inundated places. Similar tiny upturned adventitious roots are sometimes found on the stem within the leaf sheaths (similar to palms) (8) and apparently later harden into upturned prickles (14, p. 157, 163, 165). The linear leaves of *Pandanus* are set in 3 spirals accentuating the characteristic stiff habit. The prickles on their margin and those on the underside of the midrib are directed upwards; sometimes additional prickles are found on the upper side of the parallel nerves. Cultigens are sometimes unarmed. The midrib portion of the leaves is shallowly sulcate (fig. 6), and acts as a furrow along which débris assembles on the often long persistent leaf base. There is an axillary bud. The width of the leaf varies between 1 and 20 cm, and in the larger species the leaves may reach a length of 4½ m. Young foliage is mostly pale but in *P. houlletii* CARR. it is coppery-purple. The pine-apple-like fruit consists of the fused fruits of the individual ♀ fls each topped by an indurated style. They vary considerably in size and inner structure in different sections of the genus (fig 6, 9); in *P. leram* KURZ the separate fruits from the spadiceal capitulum may attain 12 by 8 cm; all are more or less obconical. Of *P. simplex* MERR., a medium-sized Philippine species, unbranched stem 6 m, ELMER collected a solitary syncarp 60 by 20 cm weighing *ca* 25 kg, the fruits were gradually shed from the apex to the base of the syncarp (15). In small species the capitulum measures only 2 cm. The pyrenes are surrounded by a pulpy mesocarp full of fibres; in several species the ripe fruit is a beautiful bright red, and the mesocarp is often rich in red fat (carotines) and aleurone (13). They germinate from the base. They are probably partly water- and partly animal-dispersed. The male flowers consist of branched spadices with an abundance of stamens; the spadix is provided mostly with large thin cream-coloured bracts; these infl. are sometimes very fragrant (*e.g.* in *P. tectorius* PARK.), sometimes they are fetid. The method of pollination is unknown, probably by wind or partly by bats. The frequency of flowering in several species is often low, and the number of ♂ and ♀ plants is often very different. Sometimes ♂, in other cases ♀, plants predominate. In many species ♂ plants are as yet unknown impeding taxonomical study. Some cultigens never flower. Most species are terrestrial, a few are epiphytic, *e.g. P. epiphyticus* MART. from Borneo; BECCARI mentions (9) 2 species from Sarawak associated with epiphytic ferns and orchids; in the Malay Peninsula there are also two epiphytic species preferably growing on trees alongside rivers. Epiphytes are sometimes found abundantly on the smooth, pandan stems (VERSTEEG in sago swamps in New Guinea, *cf* SMITH in Nova Guinea 8). Near Buitenzorg *Dendrobium pandaneti* RIDL. is mostly confined to *Metroxylon!* BRASS found *Hymenolepis validinervis* KUNZE, a fern, restricted to pandan crowns at 3225 m at Habbema camp in W. New Guinea. Several Pandans are cultivated in Malaysia, either for ornamental or other purposes. Two forms of unknown origin are cultivated for the fragrance of the drying leaves, *viz P. amaryllidifo-*

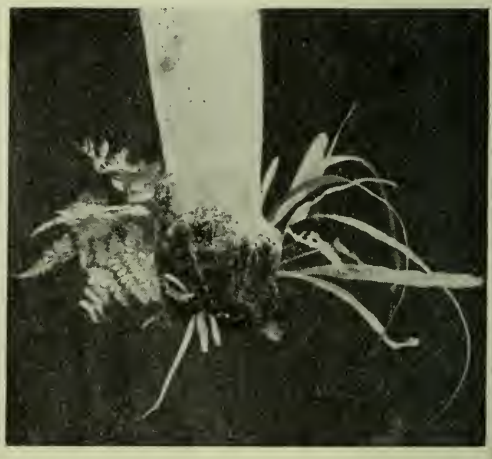

Fig. 3. 'Hanging flower pots' from Bali. Root caps of *P. faviger* BACKER with epiphytic plants, mostly ferns, ca 1000 m alt.

*lius* ROXB. and *P. latifolius* HASSK. (*P. odorum* RIDL.) The latter cultigen is only known to be sterile, the former only as ♂ individuals, both are sparsely armed. An unarmed form of *P. tectorius* PARK., *f. laevis* WARB., is cultivated for the fragrant bracts of the infl. Of the same species a *f. samak* WARB. is a group of prickly pandans cultivated for the tough leaves suitable for matting (5). A variegated form of the same species (*syn. P. variegatus* MIQ.) is always sterile and has when young longitudinal yellowish-banded leaves. The fatty mesocarp of several species is edible or used for flavouring either cooked (necessary for destroying oxalate needles) or raw. In West Malaysia it is used only by certain local tribes but in New Guinea and the Pacific (13) it represents often a substantial part of the native diet; the red fat is rich in provitamins (carotenes). Mountain tribes of Papuans save the wild trees in their clearings (fig. 4, 5) and also plant them in groves. These Papuan species may become industrially important. *P. subumbellatus* SOLMS, *P. jiulianettii* MART., *P. conoideus* LAMK., *P. houlletii* CARR., *P. leram* JONES, *P. krauelianus* K. SCH. & *P. terrestris* WARB. belong to these fat producing species. Leaves of pandans are commonly used for thatching; the leaf-fibres vary in durability and toughness according to species (10, 11). The leaf strips or their fibres are extracted in some species and used for making sails, hats, belts, streamers, tobacco-pouches, etc. The young leaves and tip of the stem of some species are eaten. Some are also used medicinally or for magic purposes. The growth of pandan is mostly rapid; the wood keeps soft and juicy. In the Botanic Gar-

Fig. 4. View up lower valley of Bele river, W. Central New Guinea, from 2140 m on E slope. Old garden lands of Papuans. Newly planted sweet potato gardens on left, and others in distance. Groups of spared and planted *Pandanus prob. brosimos* MERR. & PERRY. Numerous planted (?) *Casuarina* trees on deforested slopes, and relic patches of *Castanopsis* forest. Dec. 1938. (BRASS, 3rd Archbold New Guinean Exp.)

den, Buitenzorg, *P. papuanus* SOLMS was planted in a pot; its stem measures now 19 m height, 40 cm diam.[1] In pandan groves there is little undergrowth and the soil below them is mostly as bare as that under bamboos, though pandan does not give as much shadow as bamboo does. A strongly

Fig. 5. Planted grove of *P. jiulianettii* MART. mixed with an other species of similar appearance, perhaps *P. macgregorii* MART., cultivated for leaves and oily seeds. Nemodi, E. slope of Mt Tafa, Centr. Div., Papua, ca 2400 m alt. (ARCHBOLD)

developed root system in the upper soil may be responsible. One of the reasons for its gregarious occurrence is obviously the large clumps of fruits which are always found in pandan groves. Probably ground animals such as pigs are fond of them and contribute to local dispersal. Contrary to WILLIS's statement (12) that '*Pandanus* grows almost entirely under the uniform conditions of seashores and marshes' the genus displays an almost universal adaptability to a variety of conditions. They are known from the beach, swift streams, swamps, peat forest, mixed dry-lowland forest, limestone cliffs, savannahs, craters, mountain forests, from sea level to 3225 m. Species which grow gregariously always predominate in more or less open places and may form seres in partly devastated or cleared areas.

The backward state of taxonomic knowledge of this most fascinating group of plants prevents me from enumerating predominant species by name, and therefore I have taken them together according to habitat. I have refrained from using native names, as these are local, numerous, and shifting as the sands of the sea.

LITERATURE. (1) KURZ, Journ. Bot. (1867). (2) SOLMS LAUBACH, Linnaea (1878). (3) WARBURG, Pfl. Reich (1900). (4) *Cf.* list in Webbia 4 (1913–'14). (5) BACKER, Handb. Fl. Java pt 1 (1925) 42. (6) T.K.N.A.G. 52 (1935) 367. (7) De Trop. Natuur 26 (1937) 72. (8) BACKER, De Trop. Natuur 9 (1920) 179. (9) Wanderings (1904) 395. (10) HEYNE De Nutt. Pl. Ned. Ind. 1927. (11) BURKILL, Dict. Ec. Prod. Mal. Pen. (1935). (12) The course of evolution (1940) 157. (13) BROWN, Bern. P. Bish. Mus. Bull. 84 (1931) 30; HEDLEY, Austr. Mus. Mem. 3 (1896) 1–71. (14) Journ. Arn. Arb. 20 (1939) 160–186; *ibid.* 21 (1940) 169–175; FAGERLIND, Svensk. Bot. Tidskr. 34 (1940) 1–6. (15) MERRILL, Govt. Lab. Publ. 29 (1905) 6; ELMER, Leafl. 1 (1906) 80.

**226. Littoral pandans.**—Fig. 6.

(*A*) The most common pandan of the sandy or rocky beaches is *P. tectorius* PARK., a rather low, and often considerably branched species (fig. 6). It is very polymorphous, was described under several specific names, and has ∞ varieties from the Mascarenes to the Pacific. (Syn. *P. fascicularis* LAMK., *P. odoratissimus* L. *f.*, *P. samak* HASSK., *P. laevis* KTH., *P. moschatus* MIQ., *P. variegatus* MIQ.). There are a number of fixed races selected by natives, some of which were mentioned above. The plant often forms a rather narrow but dense barrier 3–7 m high, difficult to penetrate behind the *pescaprae*-formation of the beach proper. As such it properly belongs to the *Barringtonia*-beach-forest, and it is often found mixed with *Scaevola*, *Sophora*, *Tournefortia*, in that habitat. If dunes are formed behind the beach it extends into them. This is figured and described by BOOBERG (1) from the older parts of the dunes near Poeger, SE. Java, where it is associated with *Spinifex*, *Hyptis* and *Lantana*. It is probably well-adapted to shifting sands. It is nearly always present on a sandy or rocky coast, and an enumeration of all localities is superfluous (5). LAM (2) mentions it from Mianghas island, I myself found it in narrow fringes many km long on the beaches of S. Preanger (near Oedjoeng Genteng), near Noesa Kambangan, Banjoewangi, and in S. Bali. In P. Enggano (S. Sumatra) RAPPARD found all around the island a pandan fringe partly consisting of this species mostly 20–30 m, sometimes 100 m broad. Acc. to BRASS it is

(1) Unfortunately its age is not known.

a common strand species of the coast of the Gulf of Papua often gregarious in large numbers. It occurs also on coastal cliffs (*cf. No* 229). In the Pacific it seems to extend sometimes from the beach inland and to be able to colonize and form a sere on deforested areas.

Fig. 6. Fruit-head of *P. tectorius* Sol. on the beach of SW. Java, ca × 1/10.

(*B*) *P. polycephalus* Lamk. is a small (2–3 m) branched species with erect spadix, capitulum consisting of 3-8 fruit receptacles. Known from Banka, Borneo, Celebes, Moluccas and New Guinea along sandy or rocky beaches and near non-muddy estuaries (3). According to Warburg (4) it forms small low scrub in the Moluccas and New Guinea (5).

(*C*) *P. bidur* Jungh. (*P. pacificus* Veitch) is one of the tall sparsely branched pandans (8–20 m) of beautiful stature closely allied to *P. dubius* Spreng. According to Backer (3, p. 39, 5, p. 188–189) it is found in extreme SW. Java and on the Thousand Islands (N of Batavia), on sandy or rocky places on or near the beach, sometimes locally abundant (5). According to Backer (6) it also occurs in the Moluccas (Halmaheira) and W. New Guinea (Sorong). Fibre from the roots is used for thread and the leaves for thatching. The large species from P. Enggano is this one or the following.

(*D*) *P. dubius* Spr. (*P. latissimus* Bl.). Large species averaging 12–13 m, but up to 25 m high, allied to *P. bidur* Jungh. from the Moluccas and New Guinea, grows along the beach and is much valued for fibre and thatching; probably the same species as mentioned by Teysmann (7) as occurring by the thousands on and behind the beach in Groot Banda; also in Ceram, Ternate, &c.

(*E*) *P. labyrinthicus* Kurz. Strongly branched, 3–6 m tall, many-stemmed species with numerous roots forming impenetrable tangles of stems and aerial roots (4, fig. 2) and therefore easily forming small dense groves. Known from the sandy and rocky beaches of the Westcoast of Sumatra, Simaloer Island, West Borneo, and prob. SE. Java (3 p. 44, 5, p. 16, 6, p. 132).

Literature. (1) Hand. 5e Ned. Ind. Natuurwet. Congr. Soerabaja (1928) 377, profile and map. (2) Miangas *etc.* (1932) 27. (3) Backer, Handb. Fl. Java pt 1 (1925) 45. (4) Pfl. Reich (1900) 20. (5) Backer, De Trop. Natuur 9 (1920) 178–191; 10 (1921) 12–17. (6) in Heyne, De Nutt. Pl. (1927) 129. (7) Natuurk. Tijdschr. Ned. Ind. 23 (1861) 356.

**227. Littoral mudbank pandans.**

Only one record is known to me of a gregarious species peculiar to tidal mudbanks of the Fly River up to Ellengowan extending to 320 km from the sea (1).

Literature. (1) Brass, Journ. Arn. Arb. 19 (1938) 178.

**228. Coastal forest pandans.**

No species except scattered specimens of the beach species have been recorded from the coastal forests.

**229. Coastal cliff pandans.**

It appears that the coastal cliff pandans have no preference for a special type of rock; they occur both on elevated coral reefs and other limestone, and on andesite.

(*A*) *P. tectorius* Park. Creeps up from the beach onto the rocks. Mentioned *e.g.* by Coert from Popoh, S.Central Java, (1), Kroe, SW. Sumatra.

(*B*) *Pandanus spp.* On a limestone terrace between Waren and Wariap, Miss Gibbs passed through a striking group of old *Pandanus* 30 m tall; Papuans said this was also in the forest in isolated groups. Miss Gibbs wrongly supposes them to represent the original vegetation on the limestone later displaced by more rapidly growing mixed forest trees (2). Lane Poole figures a beautiful stand of *Pandanus* on coastal limestone (3).

Literature. (1) De Trop. Natuur 22 (1933) 80. (2) Flora & Phyt. Arfak Mts (1917) 18. (3) Rep. For. Res. Terr. Pap. Nw G. (1925) fig. 22.

**230. Lowland open swamp pandans.**

There is every transition between wooded swamps (swamp forest) (*No* 231) and open swamps, but for the sake of convenience the open swamps are described separately. Riverine pandans (*No* 235) may sometimes fill cut windings of rivers and resemble swamp pandans. Few gregarious swamp pandans have been named.

(*A*) *P. radula* Warb. Described from Sumatra, but recorded and figured by Hub. Winkler from the Bornean 'danaus' (1).

(*B*) *Pandanus sp. div.* Beccari records from Borneo some pandans which form impenetrable thickets in marshy localities (2). In South Sumatra, de Voogd found in the rawahs of Sekanak, near Palem-

bang, a creek connection with the river Musi filled with pandans (3). In E. Celebes I found, S of Palopo, Bone, marshes locally dominated by a rather tall pandan with beautiful red fruits (STEENIS 10367) locally in rather pure groves in old lowland secondary forest. In the Fly river area BRASS and RAND mention from Gaima pandans in dense stands on mud banks (4).

LITERATURE. (1) Das Leben der Pflanze 6 (1913) Abb. 79, p. 232. (2) Wanderings (1904) 395. (3) Trop. Natuur 21 (1932) 64. (4) Bull. Amer. Mus. Nat. Hist. 77 (1940) 361.

**231. Lowland swamp and peat forest pandans.**

Of this group also few species are sufficiently known. In a swamp forest no real peat layer is present; when peat forest is mentioned layers of more than 1 m peat are present.

(*A*) *P. setistylus* WARB. According to WARBURG (1) a lowland swamp species in NW. Guinea.

(*B*) *P. papuanus* SOLMS LAUBACH. Large species, stems 10–15 m, prop roots developing below the branches; all along the E. coast of New Guinea and adjacent islands; gregarious in locally extensive groves on permanently marshy soils along the coast and along rivers and lakes. Papuans use the fibre from the 7–8 m long prop roots. Cultivated in Halmaheira where the leaves are used for matting; not useful for plaiting (2).

(*C*) *P. atropurpureus* MERR. & PERRY. Large species 14–16 m tall, with branched crown and long stilt roots; fruit head 43 by 20 cm; collected by BRASS, 'plentiful in the more open and swampy parts of floodplain rain-forests' in the Idenburg river region, New Guinea; also collected at 850 m occasionally in rain forest on slopes (3).

(*D*) *P. johorensis* MART. Shrub 4 m tall, from the Mal. Peninsula and East Sumatra, in the lowland swampy forest, gregarious (2, p. 132).

(*E*) *P. exiguus* MERR. & PERRY. A dwarf species, not branched, found by BRASS gregarious in considerable numbers in forest undergrowth round the edges of a swampy depression and extending to the surrounding low ridges, Palmer river, Papua (9).

(*F*) *Pandanus spp.* 'Bengkuang' is in E. Sumatra, Bengkalis Isl. and the opposite inland of Sumatra typical of the acid soils and central parts of the peat forests; together with 'linau redang' (prob. the palm *Cyrtostachys renda* BL.), it is dominant over a vegetation of sedges *Scleria &c.* in a 'fairy forest', according to J. H. DE HAAN, Febr. 1935. ENDERT (8) found the same in the Palembang peat forest where a very large pandan is associated with *Eugenia*, *Tristania* and *Architaea*. In Borneo, BECCARI (4) found along the Sumundjang river a 'terrible *Scleria*' covering large tracts of swampy land with impenetrable thickets in which a *Pandanus* is a conspicuous feature; he found also flooded forests with masses of the sedge *Mapania* and *Pandanus* as a substage (4, p. 349). In Obi Island, Moluccas, G. A. L. DE HAAN took a photograph of a swamp forest at 200 m on serpentine rook, E of lake Telaga, in which *Pandanus* was abundant (5). In New Guinea, LANE POOLE records from the Ramu valley two species of *Pandanus* associated with *Sarcocephalus* and *Saccharum spontaneum* L. This is the community of the true swamps, depth a few in. to 4 ft, underneath mud (6). BRASS & RAND recorded from Sturt Isl. in the Fly river a low species forming a substage layer over considerable areas which are frequently flooded (7).

LITERATURE. (1) Pfl. Reich (1900) 81. (2) HEYNE, De Nutt. Pl. Ned. Ind. (1927) 132. (3) Journ. Arn. Arbor. 21 (1940) 173. (4) Wanderings (1904) 348–349, 395. (5) Tectona 31 (1938) 170, fig. 2. (6) Rep. For. Res. Terr. Pap. Nw G. (1925) 59. (7) Bull. Amer. Mus. Nat. Hist. 77 (1940) 361. (8) Tectona 13 (1920). 125. (9) Journ. Arn. Arb. 20 (1939) 171.

**232. Inland rock and cliff pandans.**

Only records of non-identified species are on my list. On dry tuff-ridges near Sibolangit and on the margin of the limestone sinter terraces of the hot springs *Pandanus* is rather gregarious and conspicuous (1); it is clearly more tolerant than other species of the surrounding forest. F. C. VAN HEURN mentioned the conspicuous occurrence of pandans on the limestone sinter terraces of Tinggi Radja, Sum. Eastcoast (4). WITKAMP found in the inland of Koetei, E. Borneo, *P.* on limestone cliffs (2). WALLACE mentioned in the Key Isl. pandans and *Dracaena* characterizing the vegetation of the more rocky places (3). BRASS found *P. hollrungii* WARB. in Papua, Palmer river, 'apparently restricted to poorly drained soil on flat ridgetops, ca 100 m alt.'; small species 4–5 m tall (5). For rocks and ridges at high altitude see *No* 266–268.

LITERATURE. (1) Natuur in Indië (1937) 13. (2) T.K.N.A.G. 46 (1929) 209. (3) Mal. Archip. ed. II, 2 (1869) 111. (4) Studiën *etc.* (1923) 77–83. (5) Journ. Arn. Arb. 20 (1939) 160.

**233. Pandan in savannahs.**

Pandans are sometimes tolerant of burning practices and resistant to some extent to deforestation. For these reasons pandans are sometimes a striking feature in savannahs. *P. ovatus* KURZ is a dwarf species growing in tufts in open grassy places and on hill-tops in S. Siam and the Mal. Peninsula as far S as Central Johore (6). In Celebes the SARASINS (1) found S of the Topapu Mts burned grassland with stretches of burned young forest; groups of a candelabra-pandan had survived in the charred area. ARCHBOLD & RAND record (2) from Dogwa, 40 m alt., 99 km from Daru, Papua, flat valleys to the W of Dogwa, covered with tall dense grass and scattered low trees, or with extensive stands of pandans. The ridges were also grass-covered, some dotted with low trees, some with stands of *Pandanus*. The clear stands of 6–10 m high might be called 'pandan-forest' and were a striking feature. The stands extended over some of the valleys in which the ground was very wet and also onto the ridges where the soil was dry and where burning of the grass was practised by the natives. W of Merauke, S. Dutch New Guinea, a similar open savannah was found by H. NEVERMANN (3) showing a sparse association of *Pandanus* and *Melaleuca*. J. W. R. KOCH figures the same

from the neighbourhood of Merauke (4); a species with thin tall stems, candelabra-branches and hanging foliage. Father H. GEURTJENS mentions it from about the same area where he found an anthropogenic savannah with termite ('ant') hills, scrub and pandans in extensive flats behind the beach and dunes on hard grey loamy soil (5). In Daru Isl., W. Div., BRASS collected a variety of *P. tectorius* PARK. as abundant in the substage and conspicuous in the savannah forests as a tree 7–8 m high (7). He found the same species in the Wassi Kussa area in poorly drained savannah forests: mature trees were rare, but seedling plants were very abundant in places (7, p. 164). *P. brassii* MART. is recorded by BRASS from Dogwa, Oriomo river, West. Div. Papua, as commonly scattered over open grass-slopes, and also forming patches some acres in extent of almost pure forest of trees 4–5 m tall on seasonally wet hummocky ground in savannahs (7, p. 165).

LITERATURE. (1) Reisen in Celebes 2 (1905) 119. (2) Bull. Amer. Mus. Nat. Hist. 68 (1934) 578. (3) Bei Sumpfmenschen und Kopfjägern, 2. Aufl. prob. 1936, p. 23, 37, fig. p. 48. (4) ZW.N. Guinea Exped. 1904–05 (1908) 503, fig. 106. (5) Op zoek naar oermenschen. Roermond (prob. 1934) 28–30, 53, fig. (6) BURKILL, Dict. Ec. Prod. Mal. Pen. (1935) 1650. (7) Journ. Arn. Arb. 20 (1939) 163.

**234. Dry lowland forest pandans.**

Except in streams, swamps, on ridges and rocks, near solfatara and hot springs, I have no data on gregarious occurrence of pandans; scattered specimens and small colonies of pandan are found in nearly every type of lowland forest on dry soil, specially as substage plants. *P. kaernbachii* WARB. was found in Sturt Isl., Lower Fly, abundant in the substage of the flood-plain rain forests by BRASS (stem 8–10 m long) (1).

LITERATURE. (1) Journ. Arn. Arbor. 20 (1939) 161.

**235. Riverine pandans** (*pandan rasau* or *resau*).— Fig. 7.

Along rivers and swift streams, both freshwater and peatwater, all over the Archipelago special species of *Pandanus* may form a conspicuous fringe on the banks. The stems are mostly submerged. Sometimes rivers are overgrown by them and the passage is obstructed; and isolated river arms are rapidly filled with pandan, specially in the Malay Peninsula, Sumatra and Borneo. This is not known from Java! In the Malay Peninsula RIDLEY (1) mentions *P. helicopus* KURZ, a slender species up to 6 m tall, forming dense thickets often for miles and blocking the waterway in rivers. *P. prainii* MART., a small species, stem $2^1/_2$–$3^1/_2$ m tall, is found in small water holes with the top of the fruit just above the water. *P. immersus* RIDL. with erect leaves forms equally dense thickets in streams, *P. militaris* RIDL. is another riverine species.

In Sumatra TEYSMANN (2) found a gregarious riverine pandan near Sibolga, along the river which debouches near Djagadjaga in Tapanoeli Bay. In the Koeboe regions, in the Lalang river system, N of Palembang *P. helicopus* KURZ, up to 6 m tall, mostly only 2 m emerging from the water, known from the Mal. Pen., Sumatra and Banka, commonly forms a fringe 5–10 m broad along the rivers (3). Acc. to ENDERT (12) the peat water rivers of Palembang are fringed by three different species

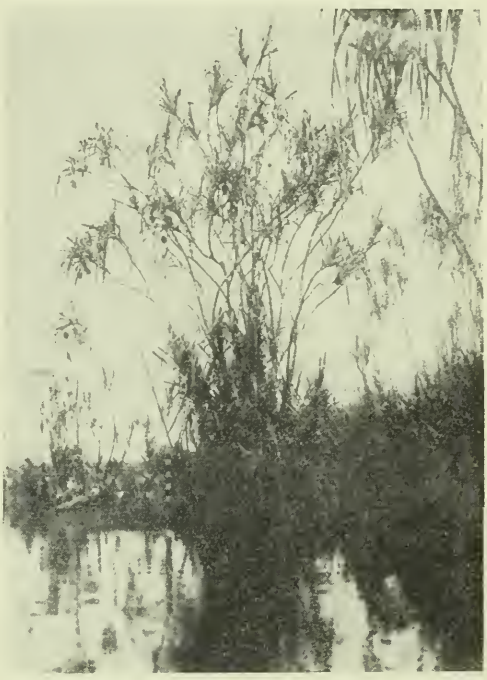

Fig. 7. Riverine *rasau pandan* in fruit, NE. Borneo. (ENDERT)

of *Pandanus*, amongst them *P. helicopus*. In the less swiftly running water a floating fringe of *Susum* is found in front of the pandan zone. Miss E. POLAK (13) also photographed them in SE. Sumatra (fig. 7). In Banka TEYSMANN found a riverine species in the Djeboes flowing into the Kampa estuary, and one in the river Kepo above the brackish water level; natives sometimes cut the vegetation to keep the water open (4). BECCARI peculiarly does not mention the striking riverine pandans which occur in Borneo. V. D. ZWAAN found them in SW. Borneo, in the Sg. Rasau Lemandau, Kota Waringin (5). In E. Borneo ENDERT figured them along the Kombeng stream from the Upper Mahakam system (6) where he found two species, and H. WITKAMP recorded them from the Sg. Koetai-lama there. From SE. Borneo HUB. WINKLER (14) mentions them. From New Guinea there are several records. HELDRING (7) found them in the peatwater of the De Wildeman river, upwards of ca 100 km from its confluence with the Eilanden river; the depth of the thick pandan fringe exceeds 6 m. Also along the Lower Digoel pandan swamps are present. H. WITKAMP found them in some cut off bends of the

Digoel above Tanah-merah (1939). The same was observed by SALVERDA (8); he photographed rows of a large pandan on the bank of the Bloemen river. BRASS & RAND (9) found on the river flats a gregarious pandan at 100 m alt., at Palmer Junction Camp, Central Fly, SE. New Guinea. LAM also mentioned riverine pandans from NW. New Guinea (10) and LORENTZ gave a good figure (11). BRASS found *P. pseudopapuanus* MART. as a tall tree up to 25 m or more near Wuroi, Oriomo river, W. Div., plentiful in riverbank rain-forest (15). *P. leiophyllus* MART. was found by BRASS in the Middle Fly in rain forests; in the Lower Fly region he found it gregarious in extensive, dense, pure stands, 6–8 m high, as undergrowth and substage in tall forest of *Bruguiera sexangula* (LOUR.) POIR. and *Myristica hollrungii* WARB., on mud flats frequently inundated by fresh water backed up by the tides, on Sturt Isl. and vicinity, Papua. In the Upper Wassi Kussa river it was restricted to riverbanks in the rain forests (15, p. 171). *P. aggregatus* MERR. & PERRY forms clumps 12–14 m tall, of several trees rising from a small compact group of erect prop roots, stems branched or not; abundant in the substage layer of riverine forests at 100 m alt. (15, p. 176). A common species in Papua is *P. lauterbachii* K.SCH. & WARB., found by BRASS gregarious in extensive communities forming undergrowth of low substage 4–14 m high, in tall forest of river flood banks, Lower Fly about Sturt island, Upper Fly on river lowlands, and near Bernhard camp, Idenburg river (*in litt.*).

LITERATURE. (1) Flora Mal. Pen. 5 (1925). (2) Natuurk. Tijdschr. Ned. Ind. 14 (1857) 358. (3) HEYNE, De Nutt. Pl. Ned. Ind. (1927) 131. (4) Natuurk. Tijdschr. Ned. Ind. 32 (1873) 40, 77. (5) Report 1938. (6) Midd. Oost Born. Exp. (1927) 220, 221, fig. 80, 257, 239, fig. 90. (7) Jaarb. Mijnw. Ned. O. I. Jg. 40 (1911) Verh. p. 78–79. (8) Rapp. Orient. Expl. ZW. N. G. 1936-7, mimeogr. p. 19, phot. 31, p. 24. (9) Bull. Amer. Mus. Nat. Hist. 77 (1940) 368. (10) Fragm. Pap. IV, 205–208. (11) Zwarte menschen, witte bergen (1913) p. 121 photo. (12) Tect. 13 (1920). 125. (13) Proc. Akad. Wet. A'dam 30 (1933) *no* 3. (14) Bot. Jahrb. 50 (1914) 196. (15) Journ. Arn. Arb. 20 (1939) 165.

**236. Pandans in mountain forests on volcanoes, and near craters.**—Fig. 1–3, 8, 10.

The wide edaphic tolerance of pandans which enables them to grow in acid peat swamps, on brackish seashores, and on limestone cliffs allows some species also to grow gregariously on volcanic slopes and summits and near craters, where they often form a conspicuous feature. The same species are found in all these habitats but they are more gregarious near the craters. VOLZ (1) found pandan a characteristic plant in the Batak Lands, W. Central Sumatra between 1600 and 2000 m. He also mentions it (same species?) to be abundantly planted for plaiting (*l.c.* 82) in the Karo Lands. On Mt Sinaboeng he found towards the summit (*l.c.* p. 5–6) low scrub of *Rhododendron* and *pandans*. According to BACKER this is *P. platycarpus* BACKER *ms.* (*non* WARB.) which is also found gregariously on Mt Sibajak and near Wilhelmina waterfalls. MARTELLI mentions *P. vriensii* MART. from Mt Sibajak. BARTLETT (2) saw a belt of *P. sumatranus* MART. on Mt Sinaboeng between the forest belt and the ericoid scrub, between 1700–2300 m (vern. *toemenang*) (7). KEMMERLING (3) says that the

Fig. 10. *P. furcatus* ROXB. in a mountain swamp, above Buitenzorg (Telaga Saät), *ca* 1400 m alt., *ca* × 1/15.

gradually increasing frequency of pandan indicates the approach to the forest limit on Mt Talamau (= Mt Ophir) (6). On Sorok Merapi pandan is very frequent between 2000 and 2145 m (summit); trees are often covered by volcanic ash. On Mt Tandikat he found (*l.c.* p. 19, 27) ferns and pandan in ash and sand of the 1889-eruption. From the Goudberg, E. Atjeh, VOLZ (4) mentions abundant pandans round the solfataras of Van Heutsz crater at 650 m alt. LEKKERKERKER (5) mentions the same; *Pinus merkusii* is also found there. On Mt Dempo, Bencoolen, FORBES (8) found at 2100 m patches of tall pandans on the sides of a gorge but nowhere else on the mountain. Mt Kaba, also in Bencoolen, a much lower active volcano, however, has a crater very rich in pandans, he says (*l.c.*, p. 228) above 2250 m associated with *Melastoma* and *Lonicera;* these are figured by DE VOOGD (9), (fig. 8), forming impenetrable thickets; elephants feed on the young tufts of foliage and the fruit. In Java gregarious pandans are rare in the mountains: a species occurs gregariously in Central Java, Kedoe, on the Randjak near the summit of Mt Andong acc. to ALTONA (10). On Mt Pandan, Madioen, pandans are frequent in undergrowth, 700–900 m. ZOLLINGER found a large species gregarious on Mt Taroeb, the older part of Mt Lamongan, E. Java (11). This is

# MALAYSIAN PLANT GEOGRAPHY

## BEING A FLORISTIC AND GENETIC PLANT GEOGRAPHY OF THE MALAYSIAN REGION

ILLUSTRATED BY NUMEROUS MAPS

BY C. G. G. J. VAN STEENIS

Contents:



N.B. The preparation of this part of volume 3 is in an advanced stage. The second part which will deal with the genetic plant geography is in the initial stage. The complete volume will comprise appr. 600 printed pages.—ED.

# THE DELIMITATION OF MALAYSIA AND ITS MAIN PLANT GEOGRAPHIC DIVISIONS

## *as based on the distribution of the genera of Phanerogams*

Plant geographical demarcations are sharp for one single genus, one species, &c. but the general picture is far from clear. This is quite natural as the present vegetation represents only the outcome of continuous plant-migration and subsequent floras in past aeons. Everywhere progressive elements thrive together with relics. The localities of the latter are but rarely connected by phyto-palaeontological localities proving their former occurrence and migration and, possibly, elucidating their present disjunct distribution.

*An example from the Malaysian lowland* is *Dryobalanops*, a camphor producing genus of *Dipterocarpaceae* consisting of 7 species and occupying a coherent area in Central Sumatra, the Malay Peninsula and Borneo ( Fl. Mal. I, 4, p. lv, fig. 44). In the Late Tertiary Period it thrived in the adjoining parts of S. Sumatra and W. Java, where now large quantities of silicified timber of unquestioned identity testify of its formerly frequent occurrence where it is at present entirely extinct.

*In N. Sumatra I found on the high mountains* communities of the sedge *Schoenoxiphium kobresioideum* KÜK. with great numbers of *Ericaceae*, the latter so well represented numerically that they strongly suggest a recent development. *Schoenoxiphium* is, however, according to Dr KÜKENTHAL, the 'missing link' between the African *Schoenoxiphium* and the Asiatic *Kobresia;* the N. Sumatran species is the first of its genus to be found outside Africa.

The segregation of the present mixed Malaysian flora could be accomplished by determining in each genus its centre(s) of development in order to evaluate the present distribution in Malaysia in respect to the whole generic area. In combining the figures of the several genera, the laws governing the past and present distribution (*genetic or historical plant geographic method*) of the Malaysian flora might be traced. Small groups are particularly suited to this method.

Another way to analyse and demarcate the Malaysian flora is the *floristic* or *quantitative method* by which the single groups are not valued individually. Its sole purpose is to trace demarcation lines where the botanical 'melting-pot' shows a more or less abrupt change, or, a threshold in its composition.

In following the latter method here *I have adopted the genus as the unit* for distribution or, in some cases, a well-marked subgenus or section. To study the distribution of the species would be impossible, their known synonymy and acknowledged area being generally far less reliable than those of the genera.

Similar attempts have been made formerly for local areas based on special collections, *e.g.* by WARBURG for the Papuan flora (1891), by STAPF for the Kinabalu flora (1894), and by MERRILL for the Philippine flora (1923).

*Biological lines* have been drawn in and around Malaysia by the dozens based on zoological, palaeontological, or botanical arguments. Similar lines have been derived from palaeogeographical, climatological, and geological sources or combinations of these. The lines are partly of a *connecting*, partly of a *dividing* character. Several efforts have been made both by zoologists and botanists to co-ordinate the lines. Striving towards a synthesis, botanists often derived their conclusions from a small or at any rate limited group of related plants and tried to make their results agree with one of the more than two dozens of theories proposed for Malaysian geology. HALLIER's work is both the most daring and the least sustained by facts, MERRILL's the best provided with basic material. Is is striking that though MERRILL's botanical results distinctly show the overwhelming West Malaysian character of the Philippine flora, he prefers to put his results into the frame of a geologic division of the Malaysian Archipelago in two continental shelf-areas separated by an unstable region.

As the various natural sciences mentioned above show different aims and means, it seemed to me that the first object of Malaysian plant geography must be to sift and analyse the botanical facts themselves and to synthesize the major botanical features, without binding them to some geological or otherwise non-botanical theory.

Malaysian botany has its own problems. An example is the different degree of alliance between the floras of different altitude: *the mountain flora of Java* is nearly identical with that of most of Sumatra but very different from the Bornean mountain flora. The *lowland floras of Sumatra and Borneo* are practically identical, however, but widely different from the present Javan flora. The lowland flora of the Philippines is closely allied to that of Borneo, but the upland flora of N. Luzon shows a remarkable set of E. Asiatic genera and species. The lowland flora of New Guinea is essentially Malaysian but the summit flora has produced a unique Australian-Subantarctic element.

The present study is based on several years of research in the Buitenzorg Herbarium, on literature, and on accumulated herbarium material. Many unpublished data have been used, especially those from the numerous large collections made in the years 1930–1940. I am of opinion that, though unexpected, the outcome is both clear and well founded. Some predictions founded on my results have already proved to be correct, which gives them marked support.

The results are based on figures derived from more than 2100 distribution maps of all genera of Phanerogams native in Malaysia.

For each genus I have tried to locate the centre(s) of specific development. This has led to an arrangement of these genera in 5 types which gave the following figures:

| Different types of generic distribution: | Number of genera: | Percentage of total: |
|---|---|---|
| TYPE 1. Occurring in Asia, Australia, and Malaysia; no distinct centre in the paleo-tropics . . . . . | 602 | 27.7 |
| TYPE 2. Centre of specific distribution clearly in Asia; absent or scarcely represented in Australia . . . . . | 574 | 26.3 |
| TYPE 3. Centre of development in Malaysia, and some outposts in surrounding regions . . . . . | 580 | 26.6 |
| TYPE 3a. Genera known only from one island or island group in Malaysia (endemic genera) . . . . . | 296 | 13.8 |
| | 876 | 40.4 |
| TYPE 4. Centre of development in Australia; absent or scarcely represented in Asia . . . . . | 94 | 4.3 |
| TYPE 5. Centre of development in the Pacific-Subantarctic region | 32 | 1.4 |
| Total | 2178 | 100.1 |

Though the census was made in 1945 and, therefore, the ultimate figures will be slightly different, they are so well pronounced that their essential tendency may be seen as final.

A first characteristic is the high percentage of type 1 which could be termed the '*Indo-Australian basic flora stock*'.

Another remarkable feature is the great number of Asiatic genera absent from or only just reaching the Australian continent, which shows that the old opinion of HOOKER & THOMSON, MIQUEL, and ZOLLINGER of the close alliance between the Malaysian and the Asiatic floras holds.

The high percentage of genera entirely confined to Malaysia (type 3a) or centering in Malaysia (type 3) together comprising 40% of the total proves that the Malaysian region is worthy of the rank of a separate plant geographical province on an equal footing with that of SE. Asia.

The endemic genera are far from being equally distributed over the island groups, and certain islands are much richer than others. The grouping of the endemic genera is shown on a map (fig. 1).

The Australian resp. Pacific elements play, measured by figures, a very unimportant role in the general picture. Their number was formerly much overestimated owing to the occurrence of some conspicuous plants such as *Araucaria*, *Eucalyptus*, *Casuarina*, *Banksia*, *Grevillea*, and *Acacia*. This was specially suggested for the New Guinean flora, and has even made a geologist declare that the New Guinean flora possessed essentially an Australian character. Our knowledge of the Papuan flora is still incomplete but there is no reason to assume that it is more incomplete as regards the Australian element than as regards the Asiatic-Malaysian element.

A most important point is the *delimitation of the region* we have defined as the Malaysian region, and accepted as a natural plant geographic unit. It has 4 contacts or 'bridges' with the adjacent floral regions, *viz* with Asia in the Malay Peninsula and in the Philippine Islands, with the Pacific islands in the Bismarcks and Solomons, and with Australia in the island of New Guinea.

Is there any abrupt demarcation in the generic composition or is the change in the flora gradual?

1. *The Malay Peninsula.* Though the NW. frontier of Malaysia is situated on the isthmian land-connection with continental Asia in the Indo-Chinese Peninsula, the Malay Peninsula has up to the north, approximately near the line Alor Star–Singgora (that is a little north of the political border), a typical Malayan flora intimately allied to the floras of Sumatra and Borneo but differing strongly from that of Indo-China. On the other hand, the immediate neighbourhood of the latter has not appreciably enriched the Malay Peninsular flora with continental elements if compared with the

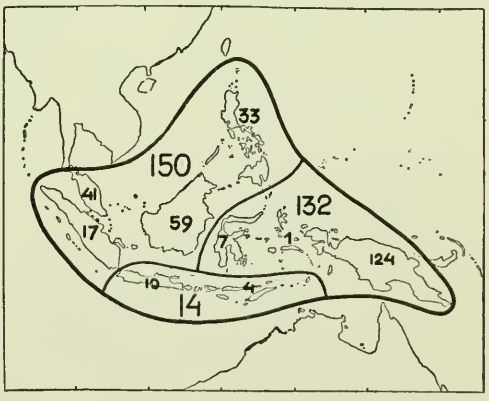


Fig. 1. Number of endemic genera of Phanerogams in the several islands and island groups of Malaysia, according to a census made in 1945.

Sunda Islands. The figures are: the Malay Peninsula has *36* Asiatic genera not found elsewhere in Malaysia, Sumatra *18*, Java *21*, and Borneo *10*. Conversely, the Malay Peninsula shows *196* Malaysian genera which are absent from continental Asia, or have only a stray record in Ceylon, Pegu or Siam. The close connection between the floras of Sumatra and Borneo when matched with the flora of the Malay Peninsula is illustrated by the

fact that the islands together possess only *62* Malaysian genera which have as yet not been found in the Malay Peninsula. To the 'generic pressure' from the Malaysian side towards Asia must be added the endemic genera of Malaysian affinity found in Sumatra (*17*), the Peninsula (*41*), and Borneo (*59*), that is *117* in all.

The total of Malaysian genera on the Malaysian side of the NW. frontier becomes thus 196 + 62 + 117 = *375* genera.

On the continental side of the frontier are about 200 Asiatic genera, recorded from Burma, Siam or Indo-China which have not been found in Malaysia.

The '*demarcation-knot*' Malaysia ←→ SE. Asia amounts therefore to 375 + 200 = *ca 575*. In other words: *575 genera respect the demarcation Alor Star–Singgora.—Cf.* fig. 2.

I employed the same method for the other Malaysian frontiers. The magnitude of the 'demarcation-knots' is a means of measuring quantitatively the borders and 'knots', both of the Malaysian frontiers and the divisions inside the Malaysian flora. *Knots of equal magnitude delimit districts or provinces of equal standing*, and indicate the standing of the enclosed area.

2. *Philippines*. An analysis of the Philippine flora according to this method shows the occurrence of *32* genera of type 2 (Asiatic genera) in the Philippines (among these 23 are found only in Luzon and 21 genera are mountain plants!) which are not recorded from other parts of Malaysia. This is about of the same order as the figures found for Borneo, the Malay Peninsula, and Sumatra. It confirms the essentially Malaysian character of the Philippine

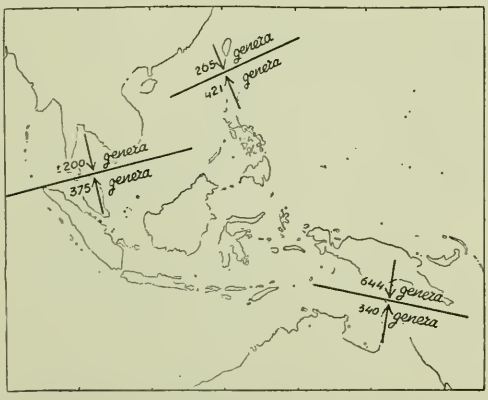


Fig. 2. The 3 principal floristic 'demarcation knots' of the Malaysian flora.

flora. In the Philippines occur *388* Malaysian genera which have never been found in Formosa or the adjacent parts of China. The Philippines possess *33* endemic genera. Of the 1185 genera known from Formosa, *265* are not found in the Philippines. The 'demarcation-knot' Philippines←→Asia is thus 388 + 33 + 265 = *686*. This is slightly larger than in the Malay Peninsula, but still of approximately the same rank.—*Cf.* fig. 2.

3. *New Guinea*. For the island of New Guinea compared with Queensland the figures are as follows. In New Guinea 175 Asiatic genera have their most eastern distribution; further the areas of *345* Malaysian genera[1] end here and, in addition, there are *124* endemic genera which is a total of *644*


Fig. 3. Numbers of eastern-centred genera in the Archipelago; above the hyphen: Australian genera, below it: Pacific-Subantarctic genera.

genera. In Queensland and North Australia about *340* Australian genera, absent in New Guinea or other parts of Malaysia, occur. The total of the 'demarcation-knot' in Torres Straits is thus *984*. This is markedly larger than the figures pertaining to the Malay Peninsula and the Philippines. Here is, apparently, one of the main demarcations of the Palaeotropic plant world.—*Cf.* fig. 2.

The analysis of eastern genera, Australian, Pacific or Subantarctic (types 4 and 5) in Malaysia shows that New Guinea possesses 40 of those not recorded elsewhere in the Archipelago. Of these, 16 are confined to savannahs, 13 to the forest, 10 to the high mountain summits, and 1 to the mangrove swamps.

New Guinea has certainly the largest number of eastern genera in Malaysia but not many more than elsewhere in the Archipelago, as may be concluded from the map reproduced in fig. 3, which shows a rather gradual decrease of eastern genera towards the west. It seems natural that New Guinea with its enormous and varied land surface and geographic situation should harbour most of them.

4. *Bismarcks, Solomons, and New Hebrides*. Here I cannot find figures of the magnitude of the other 'knots'. This is partly due to the backward state of knowledge of these floras (both as regards collecting and literature), but the main cause is that the Micronesian and Melanesian floras are poor,

(1) Of some genera which are, in New Guinea, richly developed, *e.g. Saurauia, Medinilla, Rhododendron, Polyalthia, Cyrtandra, etc.* with dozens of species, a stray species sometimes occurs in N. Queensland.

and without a distinct character in any degree comparable with that of the floras of Asia and Australia. They are mainly derivatives from the Malaysian flora.

The demarcation of Flora Malesiana against these island groups is artificial, and we know it. For practical reasons we have refrained from including these floras in the present one.

These statistics show that Malaysia, as we accept it, is a natural unit, well-demarcated at its frontiers except towards Micronesia and Melanesia. The Indo-Asiatic flora rather abruptly ends in New Guinea. On account of a few facts but with a remarkably clear insight, ZOLLINGER had, already in 1857, come to the same conclusion.

*Inner Divisions of the Malaysian flora.*

In 1845 EARLE propounded his 'bank' or 'shelf' theory; he distinguished the western shallow sea covering the Asiatic continental shelf, or *Sunda shelf*, from a similar shallow submerged extension of the Australian and New Guinean land, or *Sahul shelf;* these were separated by a non-continental central part.

A year later SAL. MÜLLER, apparently quite independently, proposed on zoological arguments a division of the Archipelago into two parts through the Makassar Straits.

In 1857 ZOLLINGER extended this line northwards between Celebes and Mindanao; towards the south he did not extend the line somewhere between the Lesser Sunda Islands, but east of them. He was followed in this by MIQUEL, in 1859.

In 1863 WALLACE proposed the boundary called 'Line of Wallace' by HUXLEY, which line has been so amply discussed up till the present time. WALLACE seems to have founded this line independently of ZOLLINGER; nowhere did I find any mention made of the Swiss's work.

NIERMEIJER,[1] in a historical review of Wallace's Line, has shown that WALLACE himself changed his views on the subject, and finally did not take it too seriously.

Much later, MERRILL & DICKERSON projected a northern continuation of WALLACE's line along the W. side of the Philippines, between Palawan and Mindoro, and recently v. MALM shifted WALLACE's Line in its southern extremity between Bali and Lombok towards the east between Flores and Timor. The different courses of the Line of WALLACE are indicated in the map reproduced in fig. 4.

In using the method of the 'generic demarcation-knots' we may first calculate the importance of Sunda Straits and Java Sea between Java and Sumatra-Borneo. In 1933, I tried[2] to draw a comparison between these floras. The flora of Java appeared to be very poor in relation to that of the other islands: 3 (small) families and 111 genera—several of which show an abundant specific development in Sumatra and Borneo—are absent from Java. On the other hand Java possesses many genera which are absent from Sumatra and Borneo. The climate cannot be held responsible for this difference as West Java does not differ in climate from South Sumatra. The genera occurring in Java but not in Sumatra and Borneo, however, belong most-

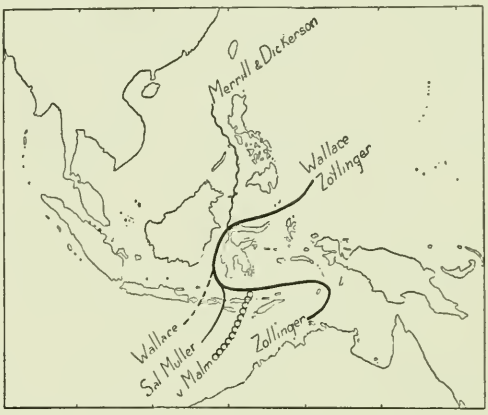


Fig. 4. Various courses of the dividing line between East and West Malaysia: all have Makassar Straits in common, that of MERRILL & DICKERSON is a deviation only in the north, those of SAL. MÜLLER (the oldest line) and v. MALM are deviations in the S. end only. The line accepted here is that of ZOLLINGER.

ly to plants bound to a two-seasoned climate. Most of them belong to type 1 or 2; they occur in the monsoon forests of Burma, Siam, and Indochina, are absent from the wet central part of West Malaysia, but reappear in Java, the Philippines, Celebes, and the Lesser Sunda Islands. This disjunction is doubtless climatic. It remains a telling fact that the monsoon plants are even in Timor mainly Asiatic, without any appreciable or significant admixture of Australian drought plants.

In any case, the generic 'demarcation-knot' of Sunda Straits and Java Sea is at least *200*, which agrees with the importance the zoologist VAN KAMPEN attached to Sunda Straits.

I have not been able to trace a knot of this rank between the other parts of West Malaysia: Sumatra, Mal. Peninsula, Borneo, and the Philippines.

There is, between Java and the Lesser Sunda Islands, very little basic difference: the flora of the latter is characteristically a depauperized Javan flora without appreciable admixture of Australian elements. I had formerly found this for the mountain flora.[3] A characteristic of both Java and the Lesser Sunda Islands is the low percentage of endemic genera (*cf.* fig. 1).

Java and the Lesser Sunda Islands form together a separate province of Malaysia, a view already held a century ago by ZOLLINGER and MIQUEL.

(1) Tijdschr. Kon. Ned. Aardr. Gen. 14 (1897) 758–769.

(2) Bull. Jard. Bot. Btzg. III, 13 (1933) 23–28.

(3) Bull. Jard. Bot. Btzg III, 14 (1936) 56–72.

Turning to other parts of Malaysia, Makassar Straits proves still to be a very important line of demarcation. No less than *297* genera of Phanerogams occur in Borneo but not east of Makassar Straits. The number of eastern genera occurring in Celebes but not in Borneo is much less well marked (*cf.* fig. 3), the total number of eastern genera


Fig. 5. Numbers of Asiatic-centred genera which are known to occur in Malaysia only in 1 island (figure above the hyphen) or 2 islands (figure below the hyphen), illustrating intensity of 'Asiatic influence' in the Malaysian flora.

being much smaller than that of western genera.

For the northern extension of the Makassar Straits demarcation line there is a choice between the line separating Celebes from Mindanao (ZOLLINGER, WALLACE) or the 'corrected line' between Palawan and Mindoro (MERRILL & DICKERSON).

In the first place, the large number of Asiatic genera which occur in only one or two islands in W. Malaysia indicates a remarkably sharp demarcation, and is to some degree a good measure for 'Asiatic influence'; it clearly supports the original course of Wallace's Line. This is demonstrated on the map reproduced in fig. 5.

Secondly, on comparing the number of western and eastern elements according to the scheme reproduced in fig. 6, where A + A′ is opposed to B + B′, it appears that 110 + 71 = 181 genera find their eastern border E of the Philippines, but only 9 + 34 = 43 find their western border W of the Philippines. This is further evidence that the original Line of Wallace is substantially more important than the corrected line.

Thirdly, it must be considered that typical West Malaysian genera and families show a large specific development in the Philippine Islands closely connected with the development in Borneo, as shown by MERRILL in 1923 in his valuable study on the distribution of *Dipterocarpaceae*.

From these arguments it can only be concluded that the 'demarcation-knot' in the N. part of Malaysia agrees with the original Line of Wallace. There are no botanical but only geological arguments for keeping the Philippines apart from West Malaysia.

Having thus established by the quantitative method of 'demarcation-knots' the borders of the Malaysian flora against the adjacent areas of the Indian and Australian floras, and the main divisions within its boundaries (a *West Malaysian*, *East Malaysian*, and *South Malaysian province* (fig. 1, p. xi), it remained to divide the provinces into districts. The tentative result is reproduced in fig. 7 where the thickness of the lines indicates their phytogeographical value.

The interpretation of the floristic divisions involves much discussion and explanation:

1°. When geological maps are examined there is a discrepancy between botanical delimitation and that of the shelves, *viz* in Torres Straits, Sunda Straits and the Java Sea, which are botanically very important demarcations. The Philippines—though situated outside the continental shelf—have a West Malaysian flora.

The great importance of Torres Straits was pointed out already by WARBURG (1891). Accepting geological arguments as decisive, LAM, in 1934 and 1935, has advanced an explanation on the basis of WEGENER's theory, and made the bold speculation that Australia and New Guinea with their originally poor Subantarctic flora, had drifted together from the Subantarctic regions towards the NW and so had come, in the Upper Tertiary, into contact

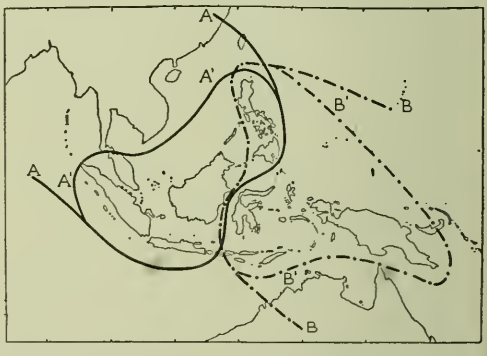


Fig. 6. Comparison of the character of the Philippine flora by contrasting A (Asiatic-centred genera of type 2) and A′ (West Malaysian-centred genera of type 3) against B (Australian and Subantarctic genera of types 4 & 5) and B′ (East Malaysian genera of type 3).

with the Malaysian tropical plant world.[1] The Malaysian vegetation, then, overwhelmed this original Subantarctic flora and its remnants could only survive on the high mountains of New Guinea.

This certainly contradicts the opinion of HOOKER, BENTHAM, and DIELS who in their analyses

(1) Blumea 1 (1934) 115–159; in: KLEIN, Nieuw Guinee 1 (1935) 192–198.


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