582:57.06

MISCELLANEOUS PAPERS 19 (1980)
LANDBOUWHOGESCHOOL, WAGENINGEN
THE NETHERLANDS

LIBER GRATULATORIUS

IN HONOREM

H. C. D. DE WIT

Hoogleraar in de algemene plantensystematiek en -geografie
en in het bijzonder die van de tropen en de subtropen
aan de Landbouwhogeschool te Wageningen

ter gelegenheid van zijn emeritaat aangeboden
door de Vakgroep Plantensystematiek en -geografie

Redactie
J. C. Arends
G. Boelema
C. T. de Groot
A. J. M. Leeuwenberg

Publikatiedatum 1 oktober 1980

H. VEENMAN & ZONEN B.V. – WAGENINGEN – 1980

The Board of the Agricultural University gave generous financial support. It provided the necessary material basis for the successful completion of this volume of the Miscellaneous Papers.

Prof. Dr. J. DOORENBOS, Chairman of the Editorial Committee of the Communications and Miscellaneous Papers of the Agricultural University guided and followed the development of the volume with keen interest.

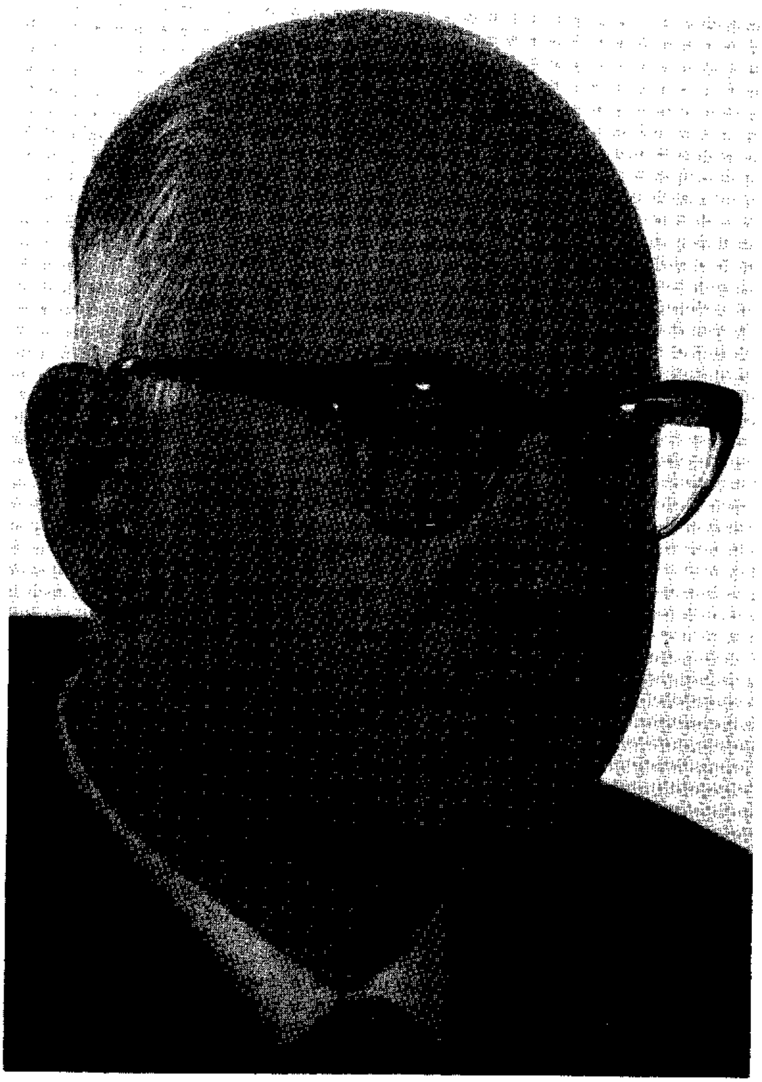
Mr. A. BOOMSMA (Veenman Printers, Wageningen) contributed by his efficient cooperation with the editorial committee.

Miss IKE ZEWALD made the drawing of the cover. Inspiration for this design was found in the small 'secret garden' near the Laboratory of Plant Taxonomy and Plant Geography.

LIBER GRATULATORIUS

in honorem

H. C. D. DE WIT



CONTENTS

PREFACE

At a departmental meeting in 1978, the idea arose to offer Professor DE WIT a valedictory book on his retirement from the appointments of ordinary Professor of the University of Agriculture in Wageningen, and of Director of the Laboratory of Plant Taxonomy and Plant Geography. An editorial commission was set up to organize this project.

Spontaneous and enthusiastic reactions were received in response to requests for contributions. Colleagues, staff, pupils and friends from past and present sent manuscripts. We should like to extend our grateful acknowledgements to all these who have collaborated. Excellent support has been received from the University of Agriculture, as already mentioned.

HENDRIK CORNELIS DIRK DE WIT was born on 24th October 1909 in Purmerend. His interest in biology was stimulated from an early age. In an inaugural speech he tells that his susceptibility and love for Nature were inspired and conveyed by his father.

On leaving gymnasium school in 1931, he went up to the University of Amsterdam. In 1937 he obtained his 'doctoraal' degree in Biology, and left for Pretoria, where he received his master's degree in 1938. In 1941, also in Pretoria, he was awarded his doctor's degree on the thesis: 'Contributions to the knowledge of the genus Setaria Beauv. in South Africa'.

From 1938 to 1940, he worked as an Agricultural Research Officer at the Department of Agriculture, Pretoria. There he did research on possible grazing uses of the natural 'veld' besides teaching students.

In 1941, he was appointed as a botanist by the National Herbarium of the Botanical Gardens, Buitenzorg. Here his research was on plant taxonomy and he was given the task of taxonomic revision of the living plants in the Gardens at Buitenzorg and Tjibodas.

In 1946, he returned to the Netherlands, where he became a botanist of the Flora Malesiana Foundation, and worked for them until 1953. From 1951 to 1953 he also taught biology at grammar schools in Bussum and Amsterdam. On 20th September 1953 he was appointed Lector at the University of Leiden. He taught taxonomy and morphology of Angiospermae.

On lst November 1953, he became Lector at the Agricultural University, Wageningen, with the teaching assignment: the Plant taxonomy and plant geography of the tropics and subtropics. This lectorate was changed to an ordinary professorship on 1 st March 1959, a date on which he also ended his duties as a Lector in Leiden.

On 15th September 1969 he became Director of the Laboratory of Plant taxonomy and Plant geography, and his teaching assignment was enlarged to: the General plant taxonomy and plant geography, with special emphasis to those of the tropics and subtropics. On 1st September 1980, he will retire from these appointments.

In several of the articles included in this selection of works, the various activities of Professor De Wit are described and appraised.

Concluding, one can say his intense fascination in the world of plants was in itself fascinating.

With vision and determination he has stood at the forefront fighting throughout for the needs of his Laboratory, and thereby for his discipline in general. His career in Wageningen was not always without its struggles: he had a straightforward manner of giving his opinions when he found opposition to his work, whether it was on an official or personal level. He always parried openly and honestly, knowing that he could count on the support of his staff. The changes brought about by the structural democratization of the University were – though not without initial resistance – graciously accepted.

Professor De Wit has as a born didactician transmitted his vision of the wonderful world of plants to many students. He has tried to show them how to see and to reflect about what has been seen.

As a classicist, he has continued to work in the traditions set by many generations of biologists, of keen observation and worthy achievement. His lectures on the history of biology also have been greatly appreciated by many over the years. It is therefore with much pleasure that we look forward to the appearance of the first part of the Dutch version of his book on the history of biology, which will be published shortly. It was written over several years, primarily with biology students in mind.

As the title of this valedictory book – this selection of works in his honour – intimates, this work is an expression of thanks and appreciation for all the things that Professor De Wit has done for our department over a period of more than 25 years.

The common wish of all his staff – each of whom has helped in his own way to make up this Liber gratulatorius – is that he may enjoy many years of health and productivity, years in which he may look back with satisfaction over his career in Wageningen, and may see a new generation – each in his own manner – following the path he has laid down, stimulating anew, teaching how to see and to reflect on that which has been seen.

For 'mortal gods' the future is still brightening: Biology goes beyond the bounds of time.

G. Boelema
15th August 1980

TAXONOMICAL STUDIES IN THE FLORA OF EGYPT[1]

VII. Contributions to the Second Edition of Täckholm's Students' Flora of Egypt

MOUSTAFA S. ABDALLAH and FATIMA M. SA'AD

Flora and Phytotaxonomy Researches, Agricultural Research Centre,
Ministry of Agriculture, Dokki, Cairo, A. R. Egypt.

INTRODUCTION

The second edition of TÄCKHOLM's Students' Flora of Egypt, 1974, Beirut, provides at the present time the most complete enumeration of the taxa of the natural Flora of Egypt and their distribution in it. Two supplements were issued in 1974 and 1977 by TÄCKHOLM and BOULOS (31, 32) to bring the data of this reference up to date. The data of the 1974's supplement were already incorporated in the second edition of TÄCKHOLM's Students' Flora of Egypt. The Supplement of 1977 includes numerous additions and corrections to TÄCKHOLM's above mentioned Flora. As far as these additions are concerned, they represent 8 genera, 45 species and one variety entirely new to the Flora of Egypt and 57 species, one subspecies and one variety new to the phytogeographic regions of the country. These additions were based on the contributions of ABDALLAH and SA'AD (2), BARKOUDAH (6), DANIN (11), LACK (15–17) and TÄCKHOLM and BOULOS (32).

On continuing their studies on the Flora of Egypt, the present authors found among the specimens and the publications preserved in the Herbarium of their Institution, i.e. CAIM Herbarium, many specimens and published data of particular interest to the natural Flora of Egypt. The specimens represent in part, taxa entirely new to the Flora or to the phytogeographic regions of the country. The other part of the specimens and the data relate to taxa previously published by some authors but not reported in either the second edition of TÄCKHOLM's Students' Flora of Egypt or the two publications supplementing it. These specimens and data represent many taxa that probably escaped the attention of TÄCKHOLM (30) and TÄCKHOLM and BOULOS (31, 32), either as belonging to the Egyptian Flora, or as occurring in more phytogeographic regions than indicated by them. In other instances they confirm the occurrence of some taxa in certain regions whose presence had been reported uncertain.

The present paper deals with 3 genera, 5 species and 5 varieties (one species and one variety reported for the first time) new to TÄCKHOLM's second edition of the Students'

---

[1] Continued from: Notes Agric. Research Centre Herb. Egypt. 3: 1. 1976.

Flora of Egypt and its two supplements. It also reports on the occurrence of 33 species (2 of them reported for the first time), one subspecies and 3 varieties in phytogeographic (sub)regions other than those reported before, and on the confirmation of the occurrence of 4 species in certain (sub)regions in which their occurrence was considered doubtful.

MATERIALS

The specimens relating to the present investigations were subjected to the normal technique of preserving herbarium specimens. They were either identified or checked and compared by authentic materials kept in CAIM and CAI Herbaria. Some specimens were checked or identified by the Staff of Kew Herbarium. These specimens, as well as the duplicates of the others offered to Kew or any other herbarium are followed by the symbol of the herbarium to which the duplicate specimens were presented. All specimens, except otherwise mentioned, are preserved in CAIM Herbarium.

The abbreviations used for the phytogeographic regions and subregions of Egypt are as follow:

Da. mer.	The Southern part of the Arabian desert from Qenna-Qosseir road to the Sudan boundary.
Da. sept.	The Northern part of the Arabian desert from Wadi Tumilat to Qenna-Qosseir road.
Di.	The Isthmic desert, i.e. El-Tih and the region north of Wadi Tumilat.
GE.	Gebel Elba and the surrounding mountains, situated in the south-east corner of Egypt at the Sudan frontier.
M.	The Mediterranean coastal strip from El-Sallum to Rafah.
Mma.	The Western part of the Mediterranean region, including Rosetta.
Mp.	The Eastern part of the Mediterranean region from Rosetta to Rafah.
Nd.	The Nile Delta, including Cairo but not further south.
Nf.	The Faiyum region.
Nv.	The Northern part of the Nile Valley from Cairo to Aswan.
Nv. mer.	The Southern part of the Nile Valley, including Aswan to Wadi Halfa.
O.	The Oases of the Libyan desert.
R.	The Red Sea coastal strip.
S.	Sinai proper, i.e. south of El-Tih desert.

RESULTS AND DISCUSSIONS

A. Taxa Reported New for the First Time to the Flora or to Phytogeographic Regions.

1. **Euphorbia erinacea** Boiss. et Kotschy (New record to Mma.).

No published data on the occurrence of this taxon in Egypt seem to exist before the year 1956, when TÄCKHOLM (28) reported it from the Isthmic phytogeographic region (Di.). In 1974 EL-HADIDI (13) declared the same taxon growing on rocky slopes in the same region. Two gatherings of *E. erinacea*, collected by SHABETAI from the Western Mediterranean coast (Mma.) are preserved in CAIM Herbarium. They represent a new record to the distribution of the taxon in Egypt. In the meantime, SHABETAI's gathering no. *z 1671*, collected from sandy soil (see below), adds a new record to the habitats in which the taxon may occur. The sheet of this gathering carries a note reads 'Kew conf., A. R. H. 7. XII. 1932, New Record to Egypt'.

Specimens seen: *Shabetai z 1671*, between Matruh and Barrani, 11. IV. 1932, sandy soil; fl., fr.; (conf. K). *Id. z 3091*, Wady El-Ramlah, 14.IV.1934, calcareous sandy ground; fl., fr.

2. **Plantago albicans** L. (New record to Da. sept.).

In 1879 BOISSIER (8) reported the occurrence of this taxon in 'Egyptus inferior ad Alexandriam', i.e. Mma. Few years later, ASCHERSON and SCHWEINFURTH (4) declared its occurrence in the Western (Mma.) and Eastern (Mp.) parts of the Mediterranean region (M.). On the other hand, MUSCHLER (21) and RAMIS (22) confirmed the data of ASCHERSON and SCHWEINFURTH (l.c.), by reporting the occurrence of the taxon in the Western and Eastern parts of the Mediterranean region and 'im Küstengebiet'. In 1956 and 1974 TÄCKHOLM (28, 30) added to the distribution of the taxon mentioned above the Isthmic desert (Di.) and Sinai (S.) regions.

Specimens of a *Plantago* species, preserved in CAIM Herbarium, collected from Wadi El-Digla east of El-Ma'adi in 1972, were recently sent to Kew Herbarium for determination. They proved to belong, according to C. C. TOWNSEND, to *Plantago albicans* L.

The locality from which these specimens were collected belongs to the Northern part of the Arabian desert (Da. sept.). Therefore, the record represents a new addition to the distribution of the taxon in Egypt. In the meantime, this new locality seems to express the most Southern limits of the distribution of the taxon in North Africa and may be looked upon as a step towards filling the existing gap of its distribution between the Mediterranean region and Tropical Africa; cf. BACKER (5).

Specimens seen: *Sa'ad et al. 20*, Wadi El-Digla, east of El-Ma'adi, 10.X.1972; fl., fr.; (K, det. C. C. TOWNSEND 6.VIII.1976).

3. **Sageretia thea** (Osbeck.) M. C. Johnston var. **spiciflora** (Rich.) M. C. Johnston (New species and variety to Flora).

The earliest record denoting the occurrence of any *Sageretia* species in Egypt dates back to the year 1956, when TÄCKHOLM (28) reported *S. brandrethiana* Aitch. from Sinai. In 1969 and 1974 TÄCKHOLM (29, 30) ascertained the occurrence of this species in the same region. The preceding records were based on the gatherings of ALFRED

KAISER, i.e. *Kaiser 19*, Umm Erwen, Farsh Sheikh el-'Arab, Aug. 1926 (ster.) and *Kaiser 106*, Zreqije, 12 Aug. 1926 (ster.); cf. TÄCKHOLM (29).

Another two flowering gatherings belonging to the genus *Sageretia* Brongn., originating from Sinai, are preserved in CAIM Herbarium. The first one, represented by one sheet, is *Kaiser 638*, with neither locality nor collecting date, determined by TÄCKHOLM in 1930 as *Sageretia brandrethiana* Aitch. The second gathering, composed of two sheets, is *Shabetai z 4168*, Mt. St. Catherine, 16.IV.1937, determined by him as *Rhamnus* sp.; cf. SHABETAI (26) sub *Rhamnus* sp. SHABETAIS' sheets have the annotation 'Dupl. cheq. at Kew 1938 by A. R. B.'.

In 1976 one sheet of *Shabetai z 4168* was rechecked at Kew Herbarium, and annotated '*Sageretia thea* (Osbeck.) M. C. Johnston var. *spiciflora* (Rich.) M. C. Johnston – NEW RECORD! DET. L. L. FORMAN 1976'. The specimen of *Kaiser 638* proves to be identical with SHABETAI's specimens *z 4168*, redetermined at Kew. Accordingly, the taxon *Sageretia thea* (Osbeck.) M. C. Johnston var. *spiciflora* (Rich.) M. C. Johnston represents a new record to the Flora of Egypt, both on the specific and varietal levels.

Sageretia thea (Osbeck.) M. C. Johnston (= *Rhamnus thea* Osbeck., *Sageretia theezans* Brongn.) differs from *S. brandrethiana* Aitch. by having often spinescent slender branchlets, with glabrous or pubescent young parts; glabrous, ovate or elliptic, 2–5 cm long leaves, with minutely serrate margins and shining surface (pale beneath); globular, irregularly rugose and dark brown ripe fruits; and by grey or brown bark of older branches, with small white lenticels and shallow longitudinal furrows. On the other hand, *S. brandrethiana* is distinguished from *S. thea* by its numerous, spinescent stiff branches and the dense white woolly tomentum covering the lower surface of leaves, young branchlets and ramifications of the inflorescences; the glabrous upper surface of the elliptic, $1^1/_4$–$2^1/_2$ cm long leaves with entire or minutely dentate margins; the obtuse, 3-lobed and black ripe fruits, with raised longitudinal lines; and by the glabrate bark of older branches with thin, white and shining epiderms exfoliating when young; cf. BOISSIER (7), BRANDIS (9), COLLET (10), LAWSON (18) and TÄCKHOLM (30).

Specimens seen: *Kaiser 638*, Plantes du Sinai, 'D 1432'; fl. *Shabetai z 4168*, Mt. St. Catherine, Sinai, 16.IV.1937, rocky mountain; fl., (K, det. L. L. FORMAN 1976).

B. Other Additions to TÄCKHOLM's Second Edition of Students' Flora of Egypt and its Supplements.

The following data, published during the years 1930–1972, represent further additions and corrections to the taxa of the natural Flora of Egypt and their distribution, reported by TÄCKHOLM (30) and TÄCKHOLM and BOULOS (31, 32). The data are arranged according to the pagination and sequence of the taxa given by TÄCKHOLM in her second edition of the Students' Flora mentioned above. New genera to the Flora and species belonging to them, are inserted in between the genera already reported by her and in accordance with their sequence given in A. ENGLER's Syllabus der Pflanzenfamilien, ed. 12, by H. MELCHIOR, 1964. The distribution of the taxa is reported in terms of phytogeographic regions (see Materials), followed by the locality from which the taxon was collected (if mentioned) and by its authority. Herbaria to which duplicate specimens were offered are also quoted.

P. 51. *Salix acmophylla* Boiss.: S. (Wady Mey'ar); SHABETAI (26); K. New species to Flora.

P. 61. *Emex spinosa* (L.) Campd.: S. (Wady El-Humur; SHABETAI (l.c.).

P. 76. *Portulaca oleracea* L.: GE.; DRAR (12).

P. 95. *Spergularia marina* (L.) Griseb.: O. (Dakhla Oasis); IMAM & KOSINOVÁ (14).

P. 100. *Paronychia arabica* (L.) DC. var. *breviseta* Asch.: GE. (Wadi Kansisrob); SIMPSON (27) sub *P. arabica* var. *brevi-mucronata* Hausskn. et Bornm.

P. 107. *Chenopodium glaucum* L.: Di. (Nifisha), ABDALLAH & SA'AD (1); det. Kew.

P. 119. *Arthrocnemum glaucum* (Del.) Ung.-Sternb.: Nf.; IMAM & KOSINOVÁ (14).

P. 131. *Amaranthus chlorostachys* Willd.: Nf.; IMAM & KOSINOVÁ (l.c.).

P. 133. *Amaranthus ascendens* Lois.: Nf., O. (Siwa Oasis); IMAM & KOSINOVÁ (l.c.).

P. 137. *Alternanthera sessilis* (L.) R. Br. ex Roem. & Sch.: Nf., O. (Dakhla Oasis); IMAM & KOSINOVÁ (l.c.).

P. 190. *Brassica arabica* (Fisch. et Mey.) Fiori: Nd. (Bashteel); ABDALLAH, SA'AD & ABBAS (3); K, det. J. B. GILLET, 23. VI. 1962.

P. 231. *Trigonella polycerata* L.: Nv. (Desert margin, east of El-Ma'adi); SIMPSON (27). TÄCKHOLM (30) considers the occurrence of this taxon in Nv. doubtful, because the species 'is a West-Mediterranean species'. El-Ma'adi, which belongs to Nv. lies few kilometers south of Cairo, i.e. Nd., and borders the very Northern part of the Arabian desert (Da. sept.). Considering the actual occurrence of the taxon in the Nd., accepted by TÄCKHOLM (l.c.), SIMPSON's record seems to represent a natural extension of the taxon in Nv. rather than accepting its occurrence in Da. sept.

P. 252. *Hippocrepis constricta* Kunze: GE. (W. Idaib); DRAR (12).

P. 258. *Tephrosia purpurea* (L.) Pers. var. *pubescens* (Bak.) Brummitt: Da. mer. (W. Mitikwan; G. Is district); ABDALLAH, SA'AD & ABBAS (3); det. K.; K, MO, U, WAG. New variety to Flora.

P. 263. *Astragalus asterias* Stev. ex Ledeb.: S. (Mount St. Catherine; Wady El-Sheikh); SHABETAI (26) sub *A. cruciatus* Link.

P. 272. *Cicer cuneatum* Hochst. ex Rich.: GE. (W. Akaw; Gebel Akwal; Wady Darawein); DRAR (12), VAN DER MAESEN (19). New genus and species to Flora. To be added before the genus *Vicia* L. since both genera, i.e. *Cicer* and *Vicia* belong to the Tribe *Fabeae (Vicieae)*; cf. SCHULZE-MENS (25).

P. 290. *Acacia nubica* Benth.: Da. mer. (W. 'Allaqi, G. Is district); ABDALLAH, SA'AD & ABBAS (3); U, WAG.

P. 303. *Fagonia schimperi* Presl: Da. mer. (W. Mitikwan); ABDALLAH, SA'AD & ABBAS (3) sub *F. myriacantha* Boiss.

P. 304. *Fagonia indica* Burm. f.: Nv. mer. (Khour El-'Allaqi; south of El-'Allaqi village; Aswan; 'Ineiba; etc.); ABDALLAH, SA'AD & ABBAS (l.c.); K, MO, U, WAG.

P. 313. *Tribulus longipetalus* Viv.: Nv. mer. (El-Dakka); ABDALLAH, SA'AD & ABBAS (l.c.).

P. 313. *Tribulus pentandrus* Forssk.: Nv. mer. (El-'Allaqi village; El-Dakka; Adindan; etc.); ABDALLAH, SA'AD & ABBAS (l.c.).

P. 318. *Ricinus communis* L. var. *africana* Muëll. Arg.: Da. mer. (between Bir Nisht and Mitikwan; between Darahib and Mitikwan); ABDALLAH, SA'AD & ABBAS (l.c.); K, MO, U, WAG. New genus, species and variety to Flora. To be added after the genus *Mercurialis* L. since the two genera belong to the Tribe *Acalypheae*; cf. SCHOLZ (24).

P. 358. *Waltheria indica* L.: GE.; Drar (12) sub *W. americana* L. TÄCKHOLM (30) considers the occurrence of this taxon in GE doubtful. Specimens of the taxon, collected by DRAR from Gebel Elba in 1932 (*no. 362*) and in 1933 (*no. 194*, W. Haikwal) are preserved in CAIM Herbarium. They ascertain the occurrence of this species in GE.

P. 371. *Bergia capensis* L.: Nf., O.; IMAM & KOSINOVÁ (14) sub *B. aquatica* Roxb. Occurrence of the taxon in the Oases (O) was reported by TÄCKHOLM (l.c.) uncertain.

P. 371. *Bergia ammannioides* Heyne ex Roth var. *glaber* Abdallah et Sa'ad: Nv. mer. (Tushka); ABDALLAH, SA'AD & ABBAS (3). New variety to Flora.

P. 377. *Ammannia auriculata* Willd.: Nf.; IMAM & KOSINOVÁ (14).

P. 378. *Ammannia attenuata* Hochst. ex A. Rich.: Nf.; IMAM & KOSINOVÁ (l.c.).

P. 426. *Convolvulus hystrix* Vahl: Nv. mer. (Aswan); ABDALLAH, SA'AD & ABBAS (3).

P. 430. *Convolvulus glomeratus* Choisy var. *gymnospermus* Sa'ad: Da. mer. (W. Is); SA'AD (23). New variety to Flora.

P. 441. *Heliotropium zeylanicum* Lam.: Da. mer. (W. Ararat), R. (Mersa Halaieb); DRAR (12), ABDALLAH, SA'AD & ABBAS (3).

P. 446. *Hormuzakia aggregata* (Lehm.) Guzul.: Nv. mer. (Tushka); ABDALLAH, SA'AD & ABBAS (l.c.).

P. 454. *Premna resinosa* (Hochst.) Shaw.: GE. (W. Idaib; W. Aideib; Gebel Hashban); DRAR (12); det. K. New genus and species to Flora. To be added after the genus *Clerodendrum* L., both genera belong to the Subfamily *Viticoideae*. The other genera of *Verbenaceae* occurring in Egypt belong to Subfamily *Verbenoideae*; cf. MELCHIOR (20), TÄCKHOLM (30).

P. 459. *Micromeria sinaica* Benth.: Da. mer. (Gebel Hamata); SIMPSON (27). Occurrence of the taxon was declared uncertain in this region by TÄCKHOLM (30).

P. 491. *Kickxia nubica* (Skan.) Dandy: Da. mer. (W. Selilo), GE.; DRAR (12) sub *Linaria nubica* Skan.

P. 552. *Conyza bovei* DC.: Da. mer. (G. Is district); ABDALLAH, SA'AD & ABBAS (3) sub *Blumea bovei* (DC.) Vatke; K, MO, U, WAG.

P. 583. *Calendula aegyptiaca* Tin. & Guss., as treated as a synonym of *Calendula arvensis* L., s. lat.; cf. TÄCKHOLM & BOULOS (32): Nv. mer. (El-Dakka); ABDALLAH, SA'AD & ABBAS (l.c.) sub *C. aegyptiaca* Desf.; U, WAG. TÄCKHOLM (30, p. 585) considers the occurrence of *C. arvensis* L., s. str., in Egypt uncertain. In the meantime, she (l.c., p. 583) reported *C. aegyptiaca*, as a distinct species, from Nd., Nf., O., M., Di., Da. sept. S. Specimens of *C. arvensis* L., s. str., collected from Mma. by SHABETAI (Abu Sir, near Bahig, 10.III.1921) and by SA'AD (*no. 369*, Abu Sir, 16.IV.1959); both determined at Kew by C. JEFFREY in August 1976; and from Da. sept. by SHABETAI (*no. z 3627*, W. Askhar, south Galala) are preserved in CAIM Herbarium. Therefore, *C. arvensis* L., s. str., occurs as well in Egypt in the Mma. and Da. sept. regions.

P. 587. *Hedypnois cretica* (L.) Dum.-Cours. ssp. *rhagadioloides* (L.) Täckh. et Boulos: Nv. mer. (Aswan); ABDALLAH, SA'AD & ABBAS (l.c.) sub *H. rhagadioloides* (L.) F. W. Schmidt.

P. 602. *Launaea tenuiloba* (Boiss.) Kuntze: Da. mer. (Rod El-Kharouf, near Abraq); ABDALLAH, SA'AD & ABBAS (l.c.).

P. 611. *Alisma plantago-aquatica* L.: Nv. (Bedrasheyn); SIMPSON (27) sub *A. plantago* L.

P. 688. *Sphenopus divaricatus* (Gouan) Rchb.: Nv. mer. (Aswan); ABDALLAH, SA'AD & ABBAS (3).

P. 691. *Eragrostis ciliaris* (L.) R. Br.: Da. mer. (W. Abraq); ABDALLAH, SA'AD & ABBAS (l.c.) sub *E. ciliaris* (L.) R. Br. var. *ciliaris*.

P. 707. *Lolium temulentum* L.: Nv. mer. (Abu Simbil); ABDALLAH, SA'AD & ABBAS (l.c.) sub *L. temulentum* L. var. *temulentum*.

P. 727. *Stipagrostis plumosa* (L.) Munro ex T. Anders. var. *plumosa:* Da. mer. (north-east Umm Qareiyat Mine); ABDALLAH, SA'AD & ABBAS (l.c.) sub *Aristida plumosa* L. var. *plumosa*.

P. 744. *Paspalum paspaloides* (Michx.) Scribn.: O. (Wadi Natrun Oasis); IMAM & KOSINOVÁ (14) sub *P. distichum* L.

P. 786. *Cyperus maculatus* Boeck.: O. (Kharga Oasis); IMAM & KOSINOVÁ (l.c.).

SUMMARY

Numerous additions to TÄCKHOLM's second edition of Students' Flora of Egypt and its two Supplements of 1974 and 1977, based on the specimens and published articles on the Flora of Egypt preserved in CAIM Herbarium, are reported.

The additions represent, in part, 3 genera, 5 species and 5 varieties (one species and one variety

reported for the first time) new to TÄCKHOLM's Students' Flora. The second part reports on occurrence of 33 species, (occurrence of two of them declared for the first time), one subspecies and 3 varieties in phytogeographic (sub)regions other than those reported before. It reports as well on the confirmation of occurrence of 4 species in certain regions in which their occurrence was considered uncertain.

The documentary data related to the taxa included in the present investigations are also provided.

REFERENCES

1. ABDALLAH, M. S. & SA'AD, F. M. 1974. Taxonomical Studies in the Flora of Egypt. IV. On the Occurrence of *Chenopodium glaucum* L. in Egypt. Notes Agric. Research Centre Herb. Egypt. **1**: 1–11, 2 figures.
2. ABDALLAH, M. S. & SA'AD, F. M. 1975. Taxonomical Studies in the Flora of Egypt. V. New Additions to the Flora of Egypt. Ibid. **2**: 1–9, 5 figures.
3. ABDALLAH, M. S., SA'AD, F. M. & ABBAS, A. 1972. Taxonomical Studies in the Flora of Egypt. II. Natural Flora of Egyptian Nubia before the Construction of Aswan High Dam. Min. Agric. Egypt, Techn. Bull. **4**: 1–83, 15 figures.
4. ASCHERSON, P. & SCHWEINFURTH, G. 1887. Illustration de la Flore d'Egypte. Mém. Inst. Egypte. **2**: 123–125.
5. BAKER, J. G. 1900. *Plantaginaceae.* In: W. T. THISELTON-DYER, Flora of Tropical Africa. **5**: 502–505. Ashfort, Kent.
6. BARKOUDAH, Y. I. 1962. A Revision of *Gypsophila, Bolanthus, Ankyropetalum* and *Phryna:* 1–203, 19 plates. Amsterdam.
7. BOISSIER, E. 1872. Flora Orientalis. **2**: 11–12. Genevae et Basileae.
8. BOISSIER, E. 1879. Flora Orientalis. **4**: 876–893. Genevae et Basileae.
9. BRANDIS, D. 1911. Indian Trees: 167–175. London.
10. COLLET, H. 1921. Flora Simlensis: 89–93, fig. 30. Calcutta & Simla.
11. DANIN, A. 1973. Contributions to the Flora of Sinai. Israel Journ. Bot. **22**: 18–32.
12. DRAR, M. 1936. Enumeration of the Plants Collected at Gebel Elba during Two Expeditions. Min. Agric. Egypt, Techn. Sci. Serv. Bull. **149**: 1–123, 29 figures.
13. EL-HADIDI, M. N. 1974. *Euphorbiaceae.* In: V. TÄCKHOLM, Students' Flora of Egypt. ed. **2**: 319–334, pl. 104–111. Beirut.
14. IMAM, M. & KOSINOVÁ, J. 1972. Studies on the Weed Flora of Cultivated Lands in Egypt. 2. Weeds of Rice. Bot. Jahrb. Syst. **92**(1): 90–107.
15. LACK, H.-W. 1974. Die Gattung *Picris* L., sensu lato, im Ostmediterranischen-Westasiatischen Raum. Dissertation Universität Wien 116.
16. LACK, H.-W. 1975. A Note on *Helminthotheca* Zinn. (*Compositae*). Taxon **24**: 111–112.
17. LACK, H.-W. 1975. Type Specimens of the Linnean Species of *Picris* L. (*Compositae*). Taxon **24**: 113–116.
18. LAWSON, M. A. 1875. *Rhamnaceae.* In: J. D. HOOKER, Flora of British India. **1**: 629–644. Ashfort, Kent.
19. MAESEN, L. J. VAN DER. 1972. *Cicer* L. A Monograph of the Genus, with Special Reference to the Chickpea (*Cicer arietinum* L.), its Ecology and Cultivation. Meded. Landbouwhogesch. Wageningen **72**(10): 46–49, fig. 8.
20. MELCHIOR, H. 1964. *Verbenaceae.* In: H. MELCHIOR, A. ENGLER's Syllabus der Pflanzenfamilien. ed. 12, **2**: 435–438, fig. 184. Berlin–Nikolausse.
21. MUSCHLER, R. 1912. A Manual Flora of Egypt **2**: 904–914. Berlin.
22. RAMIS, A. I. 1929. Bestimmungstabellen zur Flora von Aegypten: 175–177. Jena.

23. SA'AD, F. M. 1967. The *Convolvulus* Species of the Canary Isles, the Mediterranean Region and the Near and Middle East. Meded. Bot. Mus. Utrecht. **281**: 1–288, 19 plates.
24. SCHOLZ, H. 1964. *Euphorbiacea.* In: H. MELCHIOR, A. ENGLER's Syllabus der Pflanzenfamilien. ed. 12, **2**: 255–261, fig. 103, 104. Berlin – Nikolausse.
25. SCHULZE-MENS, G. K. 1964. *Leguminosae.* In: H. MELCHIOR, A. ENGLER's Syllabus der Pflanzenfamilien. ed. 12, **2**: 221–240, fig. 90–93. Berlin – Nikolausse.
26. SHABETAI, J. R. 1940. Contribution to the Flora of Egypt. Plants Collected from Southern Sinai in April 1937. Min. Agric. Egypt, Techn. Sci. Serv. Bull. **234**: 160, fig. 61–84.
27. SIMPSON, N. D. 1930. Some Supplementary Records to MUSCHLER's Manual Flora of Egypt. Min. Agric. Egypt, Techn. Sci. Serv. Bull. **93**: 1–59.
28. TÄCKHOLM, V. 1956. Students' Flora of Egypt: 106–111, 235–236, pl. 11, 37. Cairo.
29. TÄCKHOLM, V. 1969. ALFRED KAISER's Sinai-Herbarium. Publ. Cairo Univ. Herb. **2**: 114–115.
30. TÄCKHOLM, V. 1974. Students' Flora of Egypt. ed. **2**: 1–888, 292 plates, Beirut.
31. TÄCKHOLM, V. & BOULOS, L. 1974. Supplementary Notes to Students' Flora of Egypt Second Edition. Publ. Cairo Univ. Herb. **5**: 1–135, 16 plates (1972).
32. TÄCKHOLM, V. & BOULOS, L. 1977. Additions and Corrections to Second Edition of Students' Flora of Egypt. Ibid. **7–8**: 211–218.

LES PLANTES ET LA THERAPIE DE LA STERILITE DES FEMMES EN COTE D'IVOIRE

LAURENT AKÉ ASSI

Centre National de Floristique (Conservatoire et Jardin Botaniques) Abidjan – Côte d'Ivoire*

En Côte d'Ivoire, et peut être ailleurs aussi, la stérilité est souvent l'une des causes de la polygamie; elle est encore le prétexte de nombreuses mésententes conjugales qui conduisent parfois au divorce. La stérilité est presque toujours imputée aux femmes. "C'est un signe de malédiction!", disent les féticheurs.

Dans les villages, pour éviter les méfaits de l'infécondité, les femmes concernées ont recours aux soins des guérisseurs. Souvent, ceux-ci, par l'efficacité de leurs remèdes, parviennent à règler des différends de longue date qui opposaient les deux époux.

Les villageoises ne sont pas la seule clientèle des guérisseurs. Les femmes des grandes villes, pourtant bien équipées en dispensaires et hôpitaux, désespérées de l'efficience de la médecine moderne et souvent lasses des comprimés et des injections d'antibiotiques ou d'hormones, ont recours aux recettes de la médecine traditionnelle.

Les hommes n'étant généralement pas incriminés, seules les épouses sont astreintes à suivre les traitements et à se soumettre à tous les interdits notifiés par les praticiens de la médecine naturelle.

Les espèces végétales et les recettes varient d'une région à l'autre. Le nombre d'espèces de plantes constituant un remède diffère également, allant d'une seule à plusieurs, avec ou sans excipients (piment, poivre, maniguettes, etc.).

Les modes d'utilisations changent aussi suivant les régions. Les remèdes sont administrès soit par instillations oculaires ou nasales, par voie orale, par injections vaginales ou par voie rectale (lavement), ou encore un simple bain de décoction de feuilles ou d'écorces.

Les interdits durant les traitements sont eux aussi multiples et variables suivant les zones; par exemple: s'abstenir de consommer piments et tomates mûrs, ayant une couleur rouge rappelant la menstruation (les règles).

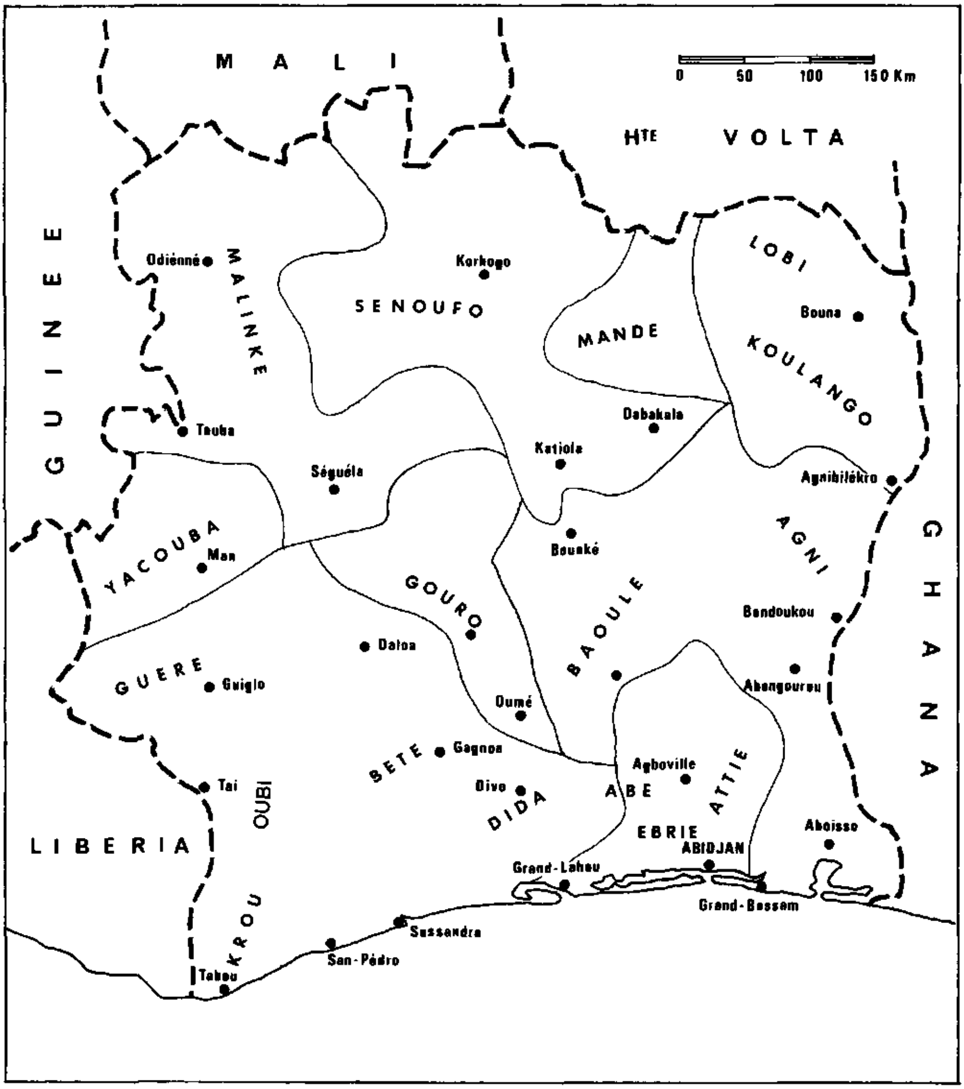
La liste des espèces végétales utilisées en Côte d'Ivoire par les guérisseurs contre la stérilité féminine est longue; nous nous contenterons ici de n'en citer que quelques unes.

Annona senegalensis Persoon var. **oulotricha** Le Thomas (Annonacées)

Description: Arbuste de 1 à 5 m de haut, généralement polymorphe; rameaux jeunes tomentelleux à glabrescents, fauves ou ferrugineux. Feuilles coriaces, poly-

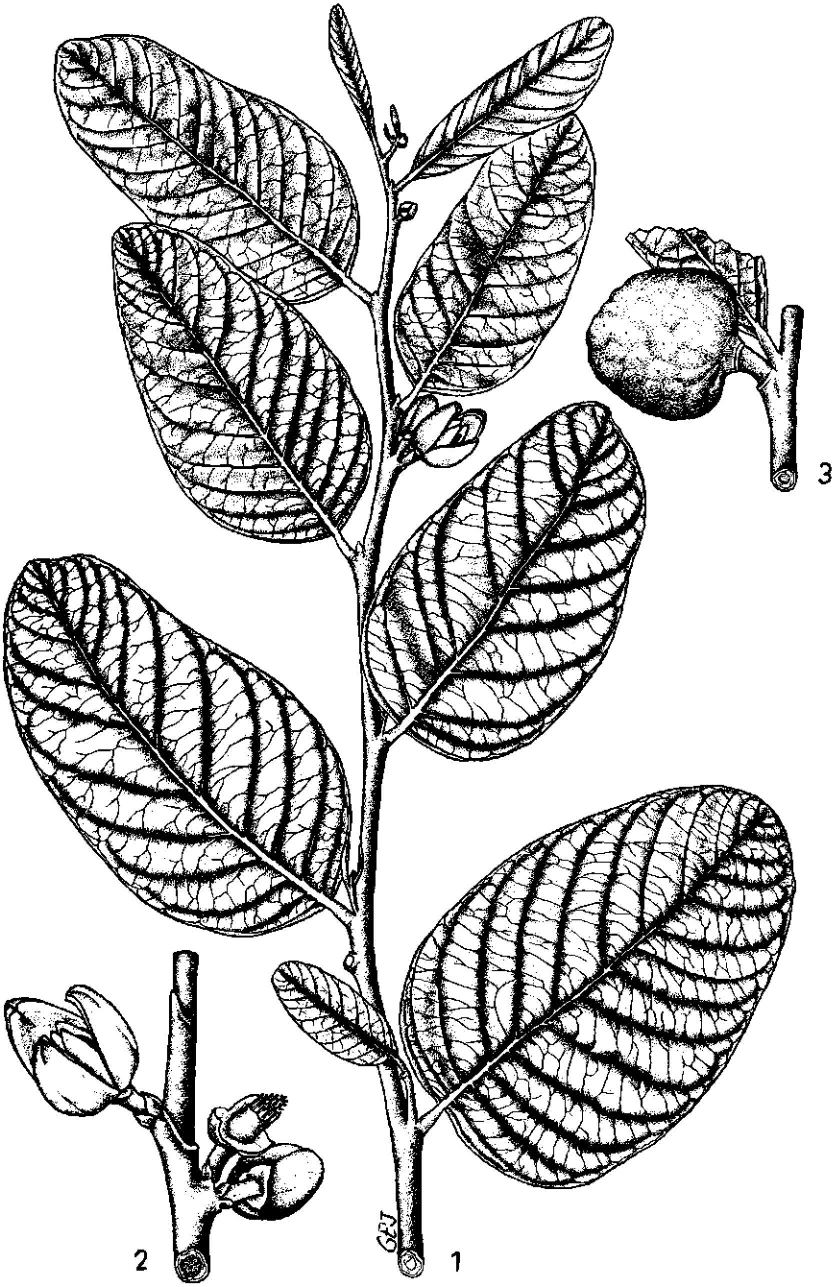
---

*04-B.P.322 ABIDJAN-04



PRINCIPAUX GROUPES ETHNIQUES DE LA CÔTE D'IVOIRE

morphes, orbiculaires, largement ovales, oblongues-obovales à elliptiques, de 6 à 16 cm de long et de 3 à 9 cm de large, arrondies, subcordées à cordées à la base, obtuses, arrondies ou légèrement émarginées au sommet, pubérulentes à glabres au-dessus, tomentelleuses, grisâtres à fauves en dessous; nervures secondaires de 8 à 15 paires. Fleurs solitaires ou géminées, jaune verdâtre ou jaunes; 3 sépales; 6 pétales (3 externes, 3 internes); étamines nombreuses, linéaires, à filet court. Fruits ovoïdes ou globuleux, jaunes à maturité, de 4 à 6 cm de diamètre, légèrement bosselés, glabrescents, à pulpe comestible. Graines nombreuses, beiges ou noirâtres.

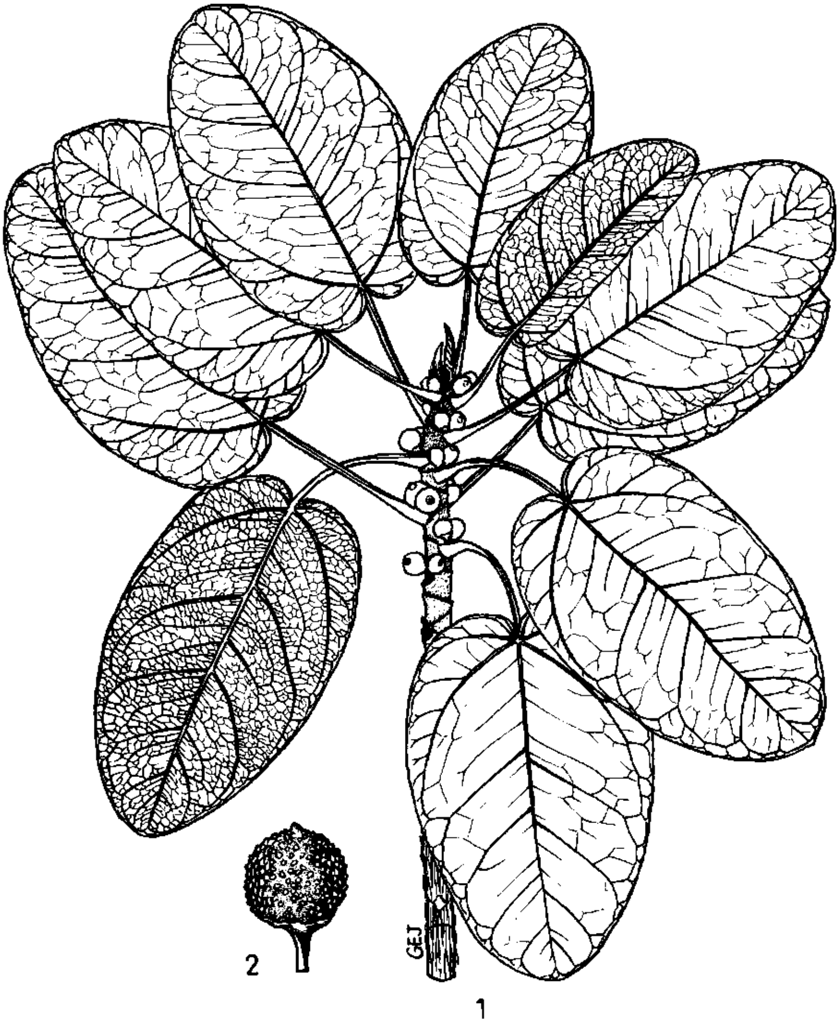


Annona senegalensis Pers. – 1. Rameau feuillé avec boutons et fleur; 2. fleurs; 3. fruit.

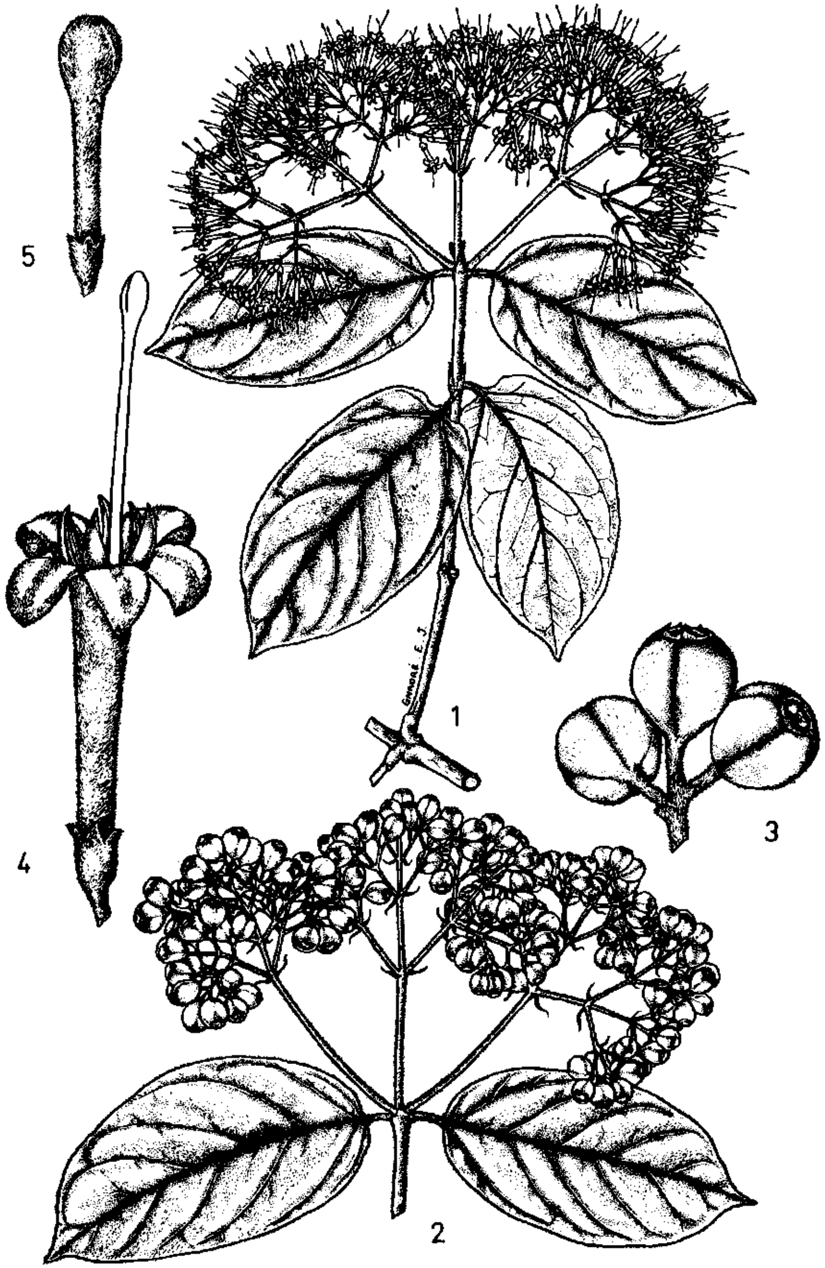
Espèce soudano-guinéenne, elle se rencontre dans tous les types de savanes, depuis le Sénégal jusqu'au Nigeria et en République Centrafricaine.

Usages: Chez les Guimini de la région de Dabakala, le traitement consiste en l'absorption durant plusieurs semaines d'une mixture à base d'écorces de racines de cette plante.

Les écorces des racines ou seulement les petites racines sont lavées, séchées et pulvérisées au pilon dans un mortier. Avec la poudre ainsi obtenue mélangée avec du poisson, on prépare une sauce. Cette mixtion, assaisonnée avec du piment et du sel doit être ingurgitée chaude, deux fois par jour (matin et soir).



Ficus glumosa Del. – 1. Rameau fructifère; 2. réceptacle ('fruit').



Crossopteryx febrifuga (Afzel. ex G. Don) Benth. – 1. Rameau florifère; 2. rameau fructifère; 3. fruits; 4. fleur; 5. bouton floral.

Chaque séance de traitement doit être complétée par un bain plus ou moins chaud de décoction des feuilles de la plante.

Ficus glumosa Del. (Moracées)

Noms vernaculaires: *Loko* (Koulango); *Sèrègbè* (Malinké).

Description: Arbre ou arbuste; jeunes rameaux pubescents; stipules elliptiques, carénées, jusqu'à 4 cm de long, membraneuses. Feuilles ovales à ovales-oblongues, entières, arrondies ou courtement acuminées au sommet, cordées à la base, de 4 à 15 cm de long et de 3 à 7 cm de large, papyracées à coriaces, plus ou moins pubescentes; nervures secondaires de 6 à 7 paires. Réceptacles axillaires, géminés, sessiles à subsessiles, globuleux, glabrescents, de 6 à 8 mm de diamètre. Fleurs mâles à une seule étamine.

Espèce de savane, répandue du Sénégal au Nigeria.

Usages: Chez les Koulango de la région de Bouna, le traitement de la stérilité féminine consiste en un breuvage d'un décocté des racines de cette plante.

Ce sont les racines affleurantes traversant un sentier qui sont employées. Il faut tronçonner celles-ci d'un seul coup de coupe-coupe, de chaque côté du sentier (à droite et à gauche) et par racine.

Les racines ainsi extirpées sont lavées et rangées dans un canari, de l'eau est ajoutée et le tout est porté à ébullition. La cuisson est indiquée par la coloration plus ou moins foncée du liquide.

Le traitement est conseillé une fois par jour, dès les premières lueurs du matin, pendant plusieurs semaines. Le décocté doit être bu tiède ou froid, dans le creux de chacune des mains, deux fois dans la droite et deux fois dans la gauche.

Si nécessaire, le contenu du canari peut être renouvelé en utilisant la même méthode.

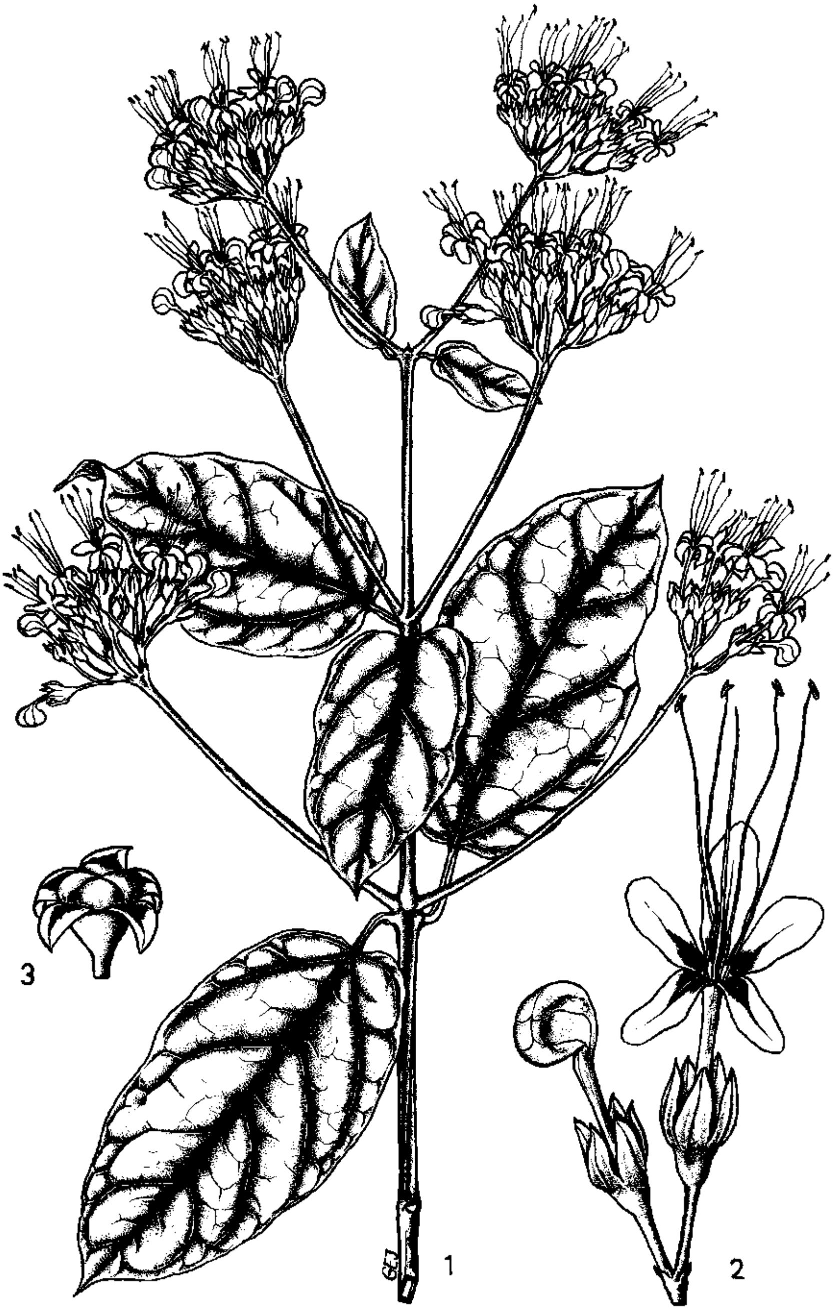
Crossopteryx febrifuga (Afz. ex G. Don) Benth. (Rubiacées)

Noms vernaculaires: *Kinguéhoun* (Malinké); *Krokro* (Baoulé).

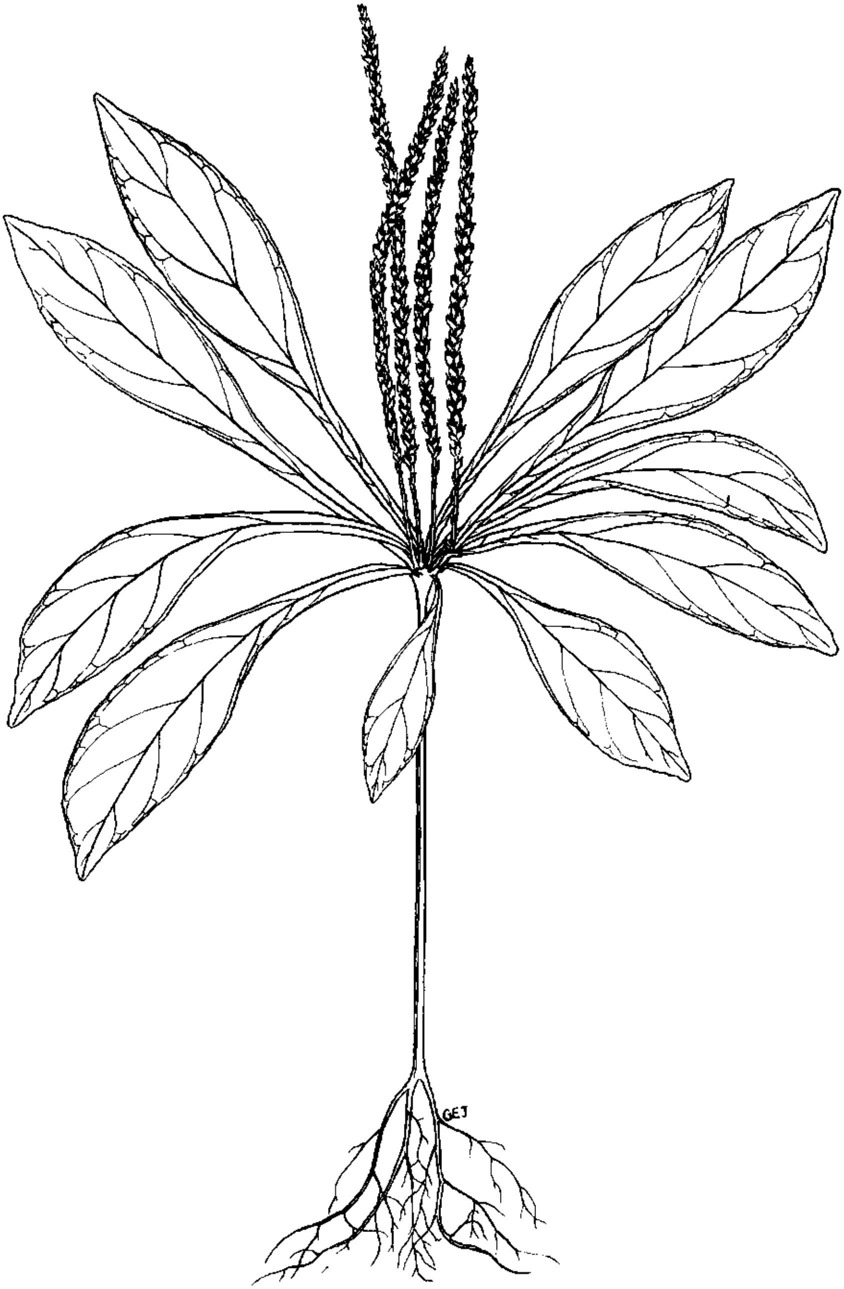
Description: Arbuste de 3 à 8 m de haut. Rameaux grisâtres, pubescents à glabres. Feuilles ovées-elliptiques, obovales, arrondies ou cunéiformes à la base, arrondies ou courtement acuminées au sommet, de 6 à 9 cm de long et de 3 à 6 cm de large, pubescentes à glabrescentes; nervures latérales de 5 à 6 paires. Fleurs nombreuses, blanchâtres, formant une inflorescence corymbiforme dense, terminale ou subterminale; calice petit; corolle tomenteuse, mesurant jusqu'à 8 mm de long; étamines courtement exsertes; style longuement exsert, glabre. Fruits subglobuleux, contenant de nombreuses petites graines plates et légèrement ailées.

Espèce soudano-guinéenne, elle est largement répandue dans toute l'Afrique intertropicale.

Usages: Pour guérir la stérilité, les Malinké de la région de Séguélon prescrivent la décoction des feuilles de cette plante en boisson.



Clerodendrum umbellatum Poir. – 1. Rameau florifère; 2. bouton et fleur; 3. jeune fruit.



Elytraria marginata Vahl – Plante entière.

On place dans un canari quatre bottes de feuilles complètées par de l'eau; le tout doit être mis à bouillir de façon à obtenir un liquide plus ou moins foncé.

Tiède ou refroidi, le décocté doit être bu dans le creux des deux mains (trois fois dans la droite, quatre fois dans la gauche), deux fois par jour, pendant plusieurs semaines.

Le traitement doit être complété chaque fois par un bain de la même décoction.

Clerodendrum umbellatum Poir. (Verbenacées)

Noms vernaculaires: *Appié-so* (Attié); *Irkpiking* (Adioukrou).

Description: Plante érigée ou grimpante, jusqu'à 4 m de haut. Feuilles pétiolées, ovales ou elliptiques, de 6 à 20 cm de long et de 3 à 10 cm de large, arrondies ou légèrement cordées à la base, glabres. Fleurs blanches, étamines exsertes.

Espèce africaine, répandue du Sénégal au Cameroun.

Elytraria marginata Vahl (Acanthacées)

Nom vernaculaire: *Nohotou* (Oubi).

Description: Plante herbacée à tige dressée et courte. Feuilles subsessiles à pétiolées, subverticillées, elliptiques-lancéolées, atteignant 10 cm de long et 3 cm de large, pubescentes ou glabres. Inflorescences spiciformes. Fleurs blanchâtres.

Espèce répandue depuis le Sénégal jusqu'au Zaïre.

Geophila obvallata (Schum.) F. Didr. (Rubiacées)

Description: Plante rampante, à tiges grêles s'enracinant aux noeuds. Feuilles opposées, ovales deltoïdes, cordées à la base, glabres; pétiole assez long. Inflorescences capituliformes, longuement pédonculées. Fleurs blanches. Fruits bleus à maturité.

Espèce sciaphile, répandue depuis la république de Guinée jusqu'au Congo.

Microdesmis puberula Hook. f. ex Planch. (Euphorbiacées)

Noms vernaculaires: *Kpeundzun* (Attié); *Kpekpel* (Adioukrou); *Dèho* (Guéré); *Klatoué* (Oubi); *Kokoï* (Abbey).

Description: Arbuste de 5 à 10 m de haut. Rameaux glabrescents. Feuilles plus ou moins oblongues, cunées et dissymétriques à la base, acuminées, dentées sur les bords. Inflorescences fasciculées. Fleurs petites et jaunes. Fruits petits, jaunes ou rouges à maturité.

Espèce de sous-bois de forêt, répandue de la Guinée au Cameroun et en Angola.

Usages: Pour traiter la stérilité, les Bété de la région de Guéyo utilisent les feuilles de ces quatre espèces et des nids de guêpes maçonnes. Les feuilles et les nids sont triturés et pétris. La pâte ainsi obtenue est délayée dans de l'eau tiède; cette solution acqueuse est administrée en lavement, deux fois par jour, matin et soir, pendant plusieurs semaines.

BIBLIOGRAPHIE

ADJANOHOUN E. et AKÉ ASSI L., 1973. Les Plantes Pharmaceutiques de Côte d'Ivoire.

AKÉ ASSI L., 1977. Les Vertus Antiménorragiques de *Desmodium adscendens* (Sw.) DC. (Papilionacées) chez les Bété de la région de Gagnoa en Côte d'Ivoire. Actes du 2ème Colloque du C.A.M.E.S., p. 17.

AKÉ ASSI L., 1978. Contribution à l'identification et au recensement des plantes utilisées dans la médecine traditionnelle et la pharmacopée en Empire Centrafricain. Ed. Agence de Coopération Culturelle et Technique, Programme de Coopération Scientifique et Technique. Paris, 139 pages, 5 fig., 90 planches.

AUBRÉVILLE A., 1950. Flore forestière soudano-guinéenne.

DALZIEL J. M., 1937. The Useful Plants of West Tropical Africa.

KEAY R. W. J. et HEPPER F. N., 1954–1972, in HUTCHINSON et DALZIEL: Flora of West Tropical Africa, vol. I, II, III.

KERHARO J. et ADAM J. G., 1974. La Pharmacopée Sénégalaise Traditionnelle.

KERHARO J. et BOUQUET A., 1950. Plantes Médicinales et Toxiques de la Côte d'Ivoire – Haute Volta.

LOROUGNON J. G. et AKÉ ASSI L., 1978. Un anticholérique efficace: *Paullinia pinnata* Linn. (Sapindacées) utilisé chez les bété de la région de Daloa, en Côte d'Ivoire. Actes de la 11ème Conférence biennale de l'ASOA-W.A.S.A., Lomé (Togo), vol. 3, p. 102.

VISSER, LEONTIEN E., 1975. Plantes médicinales de la Côte d'Ivoire. Mededelingen Landbouwhogeschool Wageningen 75–15.

NOTES ON AFRICAN ORCHIDS

J. C. Arends[1], W. J. van der Burg[2] and F. M. van der Laan[1]

[1] Department of Plant Taxonomy and Plant Geography, Agricultural University, Wageningen, The Netherlands
[2] Government Seed Testing Station, Wageningen, The Netherlands

Summary

Next to the description of two species of *Polystachya* and *Angraecum* respectively, chromosome numbers of various African orchids are presented. Most of these stray numbers do not shed new light on taxonomic relationships. The observations on the species of the African monopodial orchids, however, show that correlations between basic chromosome numbers and some morphological characters as used in the description of the subtribes *Aerangidinae* and *Angraecinae* can not be maintained.

1. Introduction

This publication deals with a karyological analysis of a number of African orchids. The majority of the plants which have been analysed were collected in Ivory Coast by the second author.

During the identification of the various specimens, it appeared that two taxa should be described as new species. The second author is responsible for the chapter dealing with the description; the remainder of the publication is the result of a joint effort. Dr. G. J. H. Amshoff kindly assisted with the translation of the latin diagnosis.

2. Two new West African Orchidaceae

2.1. **Polystachya bancoensis** Van der Burg, *sp. nov.*; affinis *P. affini* Lindley, a qua statura minori, inflorescentiis plerumque simplicibus, sepalis ± rectis; labelli ± sine venis rubescentibus, cum crista elevata mediana in lobum apicalem mergenti differt.

P. affinis Lindl. var. *nana* J. B. Hall, Kew Bull. 29(2), 428 (1974).

Herba epiphytica prostrata, usque ad 8.5 cm longa, inflorescentiis et radicibus exceptis omnino glabra, radices emergentes subtus ex pseudobulbo, pilosae. *Caules* (pseudobulbi) ad substratum appressi, succulenti, complanati, elliptici vel circulares, 1—2.5 cm longi, 0.7–1.5 cm lati, usque 0.7 cm crassi, emergentes subtus ex pseudobulbo praecedenti. *Folia* 1–2, elliptica, 2–6 cm longa, 0.7–1.5 cm lata, subtus saepe purpurascentia. *Inflorescentia* simplex, interdum ramosa, ramis lateralibus 1–2, brevissimis, 1.5–7 cm longa, pendula, rachi fractiflexa, usque 13-flora; bracteae ovatae usque late ovatae, usque ad 4 mm longae, 3 mm latae, acuminatae, extus pilosae. *Flores* resupinati, excepta basi antherae rubra et basi columnae rubra et interdum venis rubescentibus paginae interioris labelli exceptis flavo-virentes. *Sepala* omnia extus pilosa, pilis hyalinis, usque 0.5 mm longis. Sepalum intermedium oblongo-ellipticum, 5–6.7 mm longum, 3–4 mm latum; sepala lateralia cum pede columnae connata mentum conicum obtusum 5.5–8 mm longum formantia, triangularia-ovata. *Petala* obovata vel spathulata, 4.3–5.7 mm longa, sepalis flaviora, glabra. *Labellum* obscure 3-lobatum, 6.5–7.3 mm longum, paululum deflexum, lobus intermedius semi-ellipticus, retusus vel rotundatus, 2.5–3 mm longus; lobi laterales patentes, transverse semi-elliptici, ± 1 mm longi, pagina superior labelli prope marginem papillosa, interdum venis rubescentibus colorata cum crista glabra elevata margine dense papillosa, currenti ex basi labelli usque ad basim loborum intermediorum. *Columna* 2.7 mm longa, 2.1 mm lata, laete viridis, basi transverse rubro-zonata; anthera 1.7 mm longa, alba, basi puncto unico rubro, pollinarium formatum viscidio unico transverse anguste elliptico, albo, hyalino, 0.2 mm lato, 0.75 mm longo, stipite triangulari valde depresso,

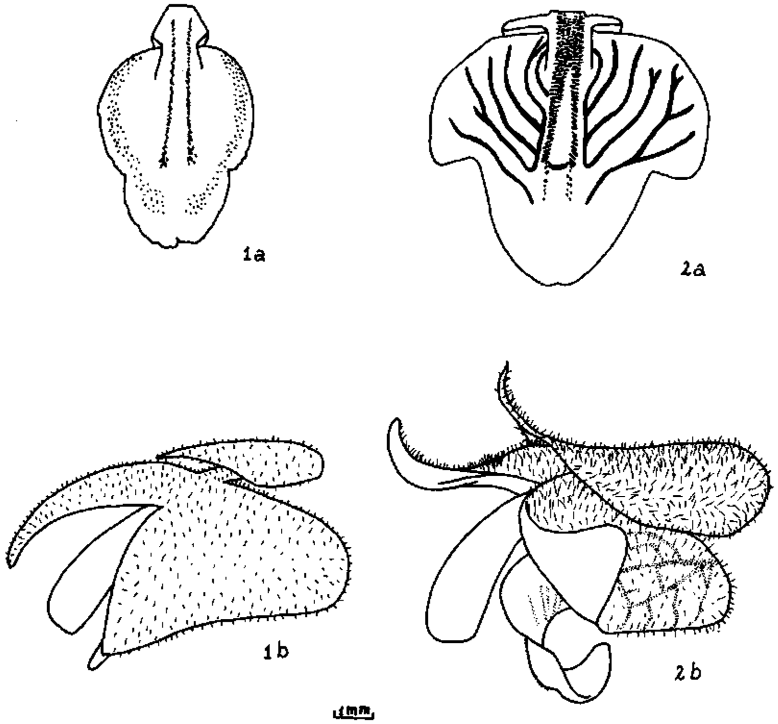


FIG. 1. 1: *Polystachya bancoensis (De Koning 6102)*; 2: *P. affinis (Van der Burg 361)*. a: labellum (spread out) seen from above; b: side view of flower.

hyalino luteo, 0.16 mm longo, et duabus polliniis ellipsoideis, pallide luteis, 0.7 mm longis, 0.5 mm crassis. *Ovarium* tenue, 3–4 mm longum, laete viride, pilosum, pilis albidis.

Ivory Coast: *Van der Burg 1245, 1269: De Koning 5005, 6102, 6107, 6115, 6116* (WAG).

Ghana: *Bowling GC 38171* (holotype: K, isotype: GC).

When J. B. HALL (1974) described *P. affinis* Lindl. var. *nana* he noted that these plants appeared to be a depauperate form of *P. affinis* Lindl., but that the difference in size between the two taxa remained during several years of cultivation.

That the two taxa are much related is beyond any doubt. After having seen more material in situ as well as in cultivation, there appear to be more differences in morphology, ecology and phenology than HALL indicated. In my opinion all these differences justify the conclusion that we are dealing with two species.

Morphology. The most striking difference is found in the flowers, which do not open as much in *P. bancoensis* as in *P. affinis* (figure 1). The sepals and the labellum of the former are almost straight, whereas those of *P. affinis* are markedly curved backwards in the upper part. The main flower colour of *P. bancoensis* is yellowish green; that of the other species brownish yellow. The labellum of *P. affinis* has conspicuous deep red veins, while the labellum of *P. bancoensis* occasionally has some faint reddish lines. The median elevated ridge on the lip of *P. bancoensis* gradually merges with the lip, while the ridge of *P. affinis* finishes abruptly. The first species also has short hairs near the margins on the upper side of the lip, while the hairs of *P. affinis* are confined to the median zone. Apart from its size, the new species is also vegetatively distinguishable by its leaves and pseudobulbs that are dull blueish green and sometimes tinged purplish. *P. affinis* has leaves and pseudobulbs that are glossy medium green. The pseudobulbs of *P. bancoensis* are usually elliptic whereas those of *P. affinis* are mostly circular to almost transversely elliptic.

Ecology. *P. affinis* is found in very damp areas, such as mountain slopes, and growing on mossy branches. The climate is relatively cool and has a high relative humidity throughout the year with reduced solar radiation because of mist and clouds. *P. bancoensis* on the other hand lives on the bare bark of fully exposed branches of the evergreen forest at lower altitudes, in a climate with a marked dry (sunny) season.

Phenology. *P. affinis* probably flowers one to two months after *P. bancoensis*. The latter in contrast with *P. affinis* can be deciduous: during the dry season it may drop its leaves. In cultivation this phenomenon does not occur when the plants are watered during the dry season. This shedding does not surprise since the leaves of *P. bancoensis* are rather fragile and not at all succulent; this in contrast with most of the other epiphytic orchids of the same habitat (e.g. *Bulbophyllum calamarium* Lindl., *Bolusiella iridifolia* (Rolfe) Schltr., *B. talbotii* (Rendle) Summerh., *Listrostachys pertusa* (Lindl.) Rchb. f.).

2.2. **Angraecum bancoense** VAN DER BURG, *sp. nov.*; affine *A. disticho* Lindl., a quo floribus minoribus, floribus foliisque aequilongis, apice calcaris obtusiori, labello recto differt, a *A. aporoidi* Summerh. floribus foliis minoribus, sepalis lateralibus rotundatis, bracteis multo brevioribus differt.

Herba epiphytica, omnino glabra. *Caules* simplices vel pauciramosi, adscendentes vel dependentes, per totam longitudinem foliati, usque ad 20 cm longi vel ultra, 2 mm diametro, vaginis foliorum omnino obtecti. *Folia* disticha, vaginis imbricatis, verticaliter compressa, equitantia, oblique et curvatim ovata, apice rotundata, vel obtusa, carnosa, usque 2 mm crassa, margine superiori anguste V-canaliculata, 4–7 mm longa, 2.5–5 mm lata, vaginis oblique articulatis. *Flores* ex axillis foliorum exorientes, singuli, non resupinati, fere sessiles, albi, carnulosi, pedicellus brevissimus, basi vaginis duabus instructus, ex apice calcaris usque ad apicem labelli 3.7–6 mm longus. *Sepalum* intermedium oblongo-ellipticum, 1.5–2 mm longum, circiter 1 mm latum; sepala lateralia oblique elliptica vel obovata, rotundata, 1.5–2 mm longa, 1 mm lata. *Petala* ± anguste elliptica, 1.5 mm longa, 0.5 mm lata. *Labellum* rectum, basi columnam amplectens, antice trilobatum, totum ± 1 mm longum, lobo intermedio recto, triangulari acuto, lobis lateralibus rotundatis; calcar ± rectum, ex ore usque ad medium vel usque ad duo tertias longitudinis cylindricum, versus apicem obtusum sensim angustatum, 2.5–5 mm longum. *Columna* brevis, crassa, apice truncata, 0.4–0.8 mm longa; rostellum brevissimum, lobis duobus rotundatis terminatum; anthera hemisphaerica, alba, antice truncata, nervo mediano elevato viridi per cursa; polliniis globosis, luteis, circiter 0.1 mm diametro, caudiculo elastico, brevissimo, viscidiis duobus distinctis oblongo-ellipticis; fovea stigmatica transverse quadrata. *Ovarium* tenue, 4–6 mm longum, 0.5 mm diametro, viride. *Capsula* anguste obovoidea vel anguste ellipsoidea, 5–6 mm longa, 1.5–2 mm diametro.

Ivory Coast: *Van der Burg 304* (holotype: WAG), *1260; De Koning 1535, 2901, 3387* (WAG).

Cameroon: *Bos 3922* (WAG).

It is remarkable that the difference between this new species and *A. distichum* Lindl. has not been described before. Both species have the same and very characteristic foliage, and therefore can not be distinguished vegetatively. Apparently it was never noticed that the difference between the flowers is more than a matter of size alone. Analysis of much plant material, living as well as conserved, shows that two species are to be recognized. No intermediate forms have been observed. SUMMERHAYES (1964) described another closely related species, *A. aporoides*, which apart from the flowers is readily distinguished by its much larger leaves (figures 2 and 3). PIERS (1968) apparently has noticed the difference between the present new species and *A. distichum*. As far as can be judged from the photographs in his publication the depicted plants are not specimens of *A. aporoides* but of *A. bancoense*.

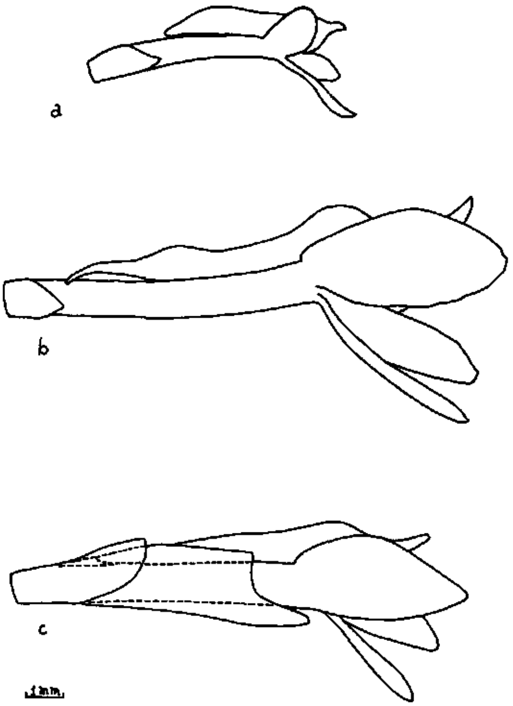


FIG. 2. Side view of flowers. a: *Angraecum bancoense (Van der Burg 1260)*; b: *A. distichum (Van der Burg 838)*; c: *A. aporoides (J. J. de Wilde 8231)*.

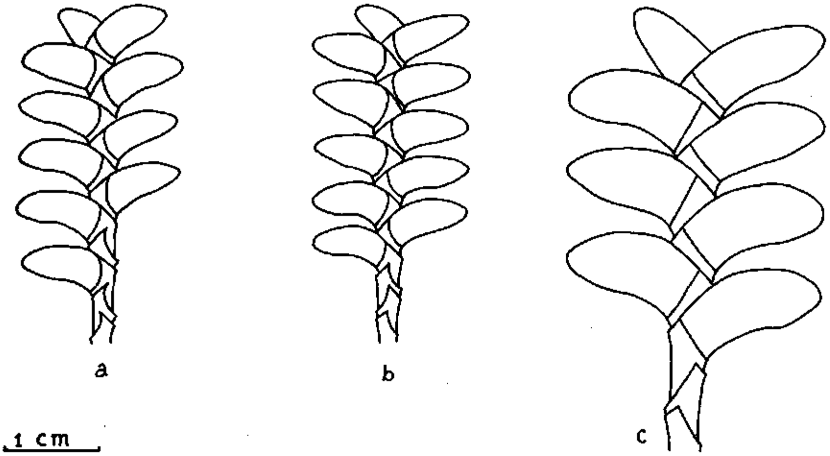


FIG. 3. Branches with leaves. a: *Angraecum bancoense (Van der Burg 1260)*; b: *A. distichum (Leeuwenberg 2555)*; c: *A. aporoides (J. J. de Wilde 8231)*.

A. distichum seems to be more common than *A. bancoense* and is easily distinguished from the latter by its larger flowers that are longer than the leaves, its recurved lip and its slender apex of the spur. Both species show the same variation in leaf-shape. It is likely that the new species is included in many collections under the name *A. distichum* Lindl.

Key to the species

1. Leaves 14–25 mm long, groove on upper margin broad, almost extending to the apex, flowers shorter than the leaves, bracts enclosing a large part of the ovary . . . . **A. aporoides**

1* Leaves 5–11 mm long, groove on upper margin narrow, only extending half way to the apex, flowers equalling or surpassing the leaves in length, bracts enclosing basal part of the ovary only 2

2. Apex of spur suddenly narrowed, slender, flowers 7.5–10.5 mm long from apex of spur to apex of lip, longer than the leaves . . . . **A. distichum**

2* Apical part of spur gradually tapering to a blunt apex, flowers 3.7–6 mm long from apex of spur to apex of lip, about as long as the leaves . . . . . **A. bancoense**

Both species are named after the Banco Forest Reserve near Abidjan, the capital of the Ivory Coast. They both belong to the epiphytic flora of this magnificent but endangered forest.

3. MATERIALS AND METHODS

The plants which have been analysed for their chromosome number are presented alphabetically in table 1. Some species are represented by several specimens. Next to the number of the living plant collection those of voucher materials (both WAG) are given also. Squash preparations of root tips (pretreated in hydroxyquinoline) and of pollinia respectively were made by the usual methods in 2% aceto-orcein. The chromosome numbers have been indicated in the second column as '2n'. When the number was determined at pollen mitoses the result is indicated explicitly as 'n='. All slides were made permanent by freezing and subsequent embedding in DPX. In some cases freezing reversed the spreading of the chromosomes, so some slides had to be discarded. Permanent slide numbers are indicated in column 5.

4. OBSERVATIONS AND COMMENTS

The observed chromosome numbers are presented in the second column of table 1. Information concerning the approximate size of the chromosomes are given in the following paragraphs. These paragraphs are arranged arbitrarily, but discussions on apparently related taxa (following SCHLECHTER, 1915) are presented within one paragraph. When the chromosome numbers are compared with earlier reports, these may be cited without reference. In that case the references can be found in the list of chromosome numbers by TANAKA & KAMEMOTO in WITHNER (1974).

4.1. *Maniella gustavii (Cryptostylidinae)*

Details about this monotypic genus are given by HALLÉ (1965). For the specimen collected in Cameroon 2n = 84 chromosomes (sizes appr. 1.0 µm) were counted. Other taxa of the *Cryptostylidinae* have apparently never been investigated karyologically, hence no comparisons can be made.

4.2. *Phaius mannii (Phaiinae)*

The haploid chromosome number is n = 28, the chromosomes have a size of appr.

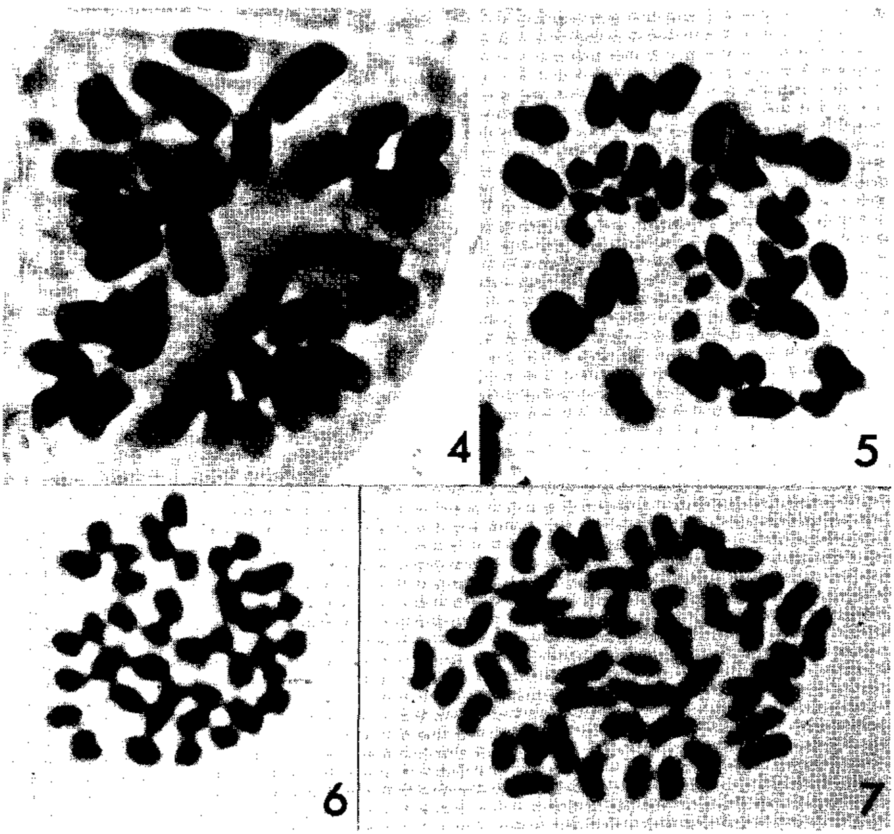


FIG. 4–7. Chromosomes of several species of orchids, appr. 3000 ×. Figure 4: *Phaius mannii;* n = 28 (pollen mitosis). Figure 5: *Liparis epiphytica;* 2n = 42. Figure 6: *Bulbophyllum flavidum;* 2n = 38. Figure 7: *Cyrtorchis hamata;* 2n = 46. Figures 5–7 root tip cells.

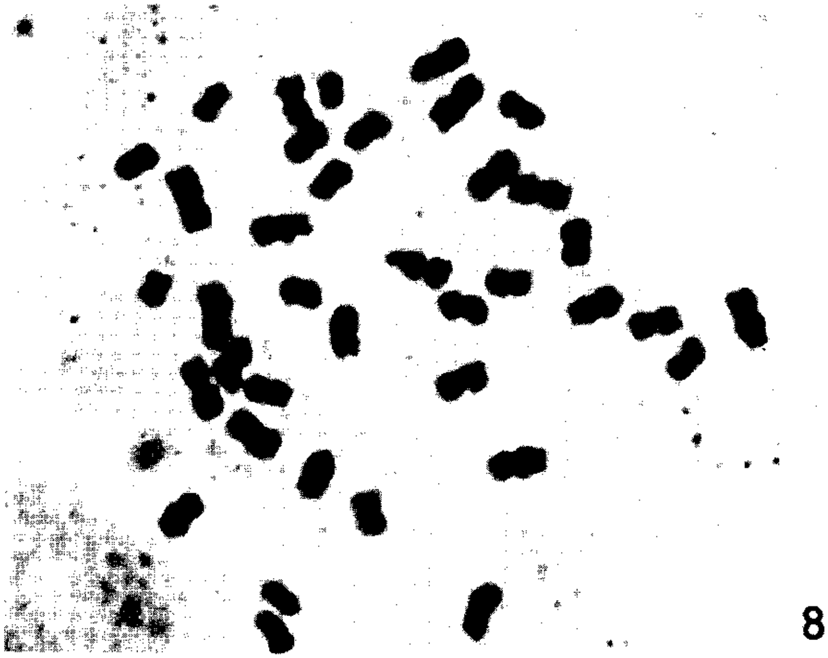


FIG. 8. Chromosomes in root tip cell of *Angraecum birrimense;* 2n = 38; appr. 3000 ×.

3.0–4.0 μm during pollen mitosis (fig. 4). This species is the only representative of the genus in Africa (see also HALLÉ, 1965). Its chromosome number differs from any other number (2n = 38, 42, 44 and 50) recorded so far for various Asiatic species of the genus.

4.3. *Liparis epiphytica* and *L. guineense (Liparidinae)*

Both species have 2n = 42. The first species has a distinct bimodal karyotype (fig. 5), whereas the chromosomes of *L. guineense* vary gradually in size from appr. 1.5–3.0 μm. The same number has been reported for species from Japan and adjacent areas. Other species from the same area have the number of 2n = 30. It remains to be investigated whether the 2n = 42 for the African and some of the Japanese species indicates a particular taxonomic relationship.

4.4. *Eulophia euglossa, E. gracilis* and *E. guineensis (Cyrtopodiinae)*

The three species all have the number of 2n = 44, their chromosomes having a size of appr. 1.0–2.0 μm. The number of 2n = 44 was reported also by AR-RUSHDI (1971) for *E. gracilis,* but for *E. euglossa* and *E. guineensis* he reported 2n = 40 and 2n = 46 respectively. For non-African species numbers of 2n = 32, 38, 54 and 56 have been published.

4.5. *Graphorkis lurida (Cyrtopodiinae)*

Our report of 2n = 52 (chromosome size appr. 1.0 μm) is the first chromosome report on the genus.

4.6. *Eulophidium maculatum* and *E. saundersianum (Eulophidiinae)*

Both species have 2n = 58 chromosomes (sizes appr. 1.0–2.0 μm). AR-RUSHDI (1971) already published 2n = 58 for *E. saundersianum*.

4.7. *Polystachya* species *(Polystachinae)*

The six species which have been investigated all have 2n = 40 chromosomes. Their karyotypes are similar, whereas the chromosomes are small (appr. 0.5–1.0 μm). Our observations corroborate the reports by AR-RUSHDI (1971).

4.8. *Bulbophyllum* species *(Bulbophyllinae)* and *Genyorchis pumila (Genyorchidinae)*

Table 1 shows that some species of *Bulbophyllum* have 2n = 38, whereas other have 2n = 40 chromosomes (sizes appr. 1.5–2.0 μm). Apart from some rare cases of polyploidy the same numbers are found in other publications on the genus. In our experience the genus is particularly cumbersome to deal with cytologically. Some of our observations are in accordance with earlier reports. Other observations, however, such as 2n = 40 for *B. barbigerum* and *B. velutinum* do not agree with reports (2n = 38) by DAKER (1970). Our observation of 2n = 38 (fig. 6) for *B. flavidum* does not agree with the 2n = 40 reported for the species by AR-RUSHDI (1971). A separation of taxa with 2n = 38 on the one hand and those with 2n = 40 on the other does not appear to be supported by any morphological criteria. *Genyorchis pumila* has 2n = 38 chromosomes. The genus is vegetatively similar to *Bulbophyllum*, but its flowers resemble those of *Polystachya*, although the reduction of the petals points to a kinship with *Bulbophyllum* (SCHLECHTER, 1915).On the basis of its karyotype *Genyorchis pumila* cannot be distinguished from the species of *Bulbophyllum* with 2n = 38 chromosomes. The investigated species of *Polystachya* (see 4.7) all have karyotypes made up of chromosomes which are smaller.

4.9. African monopodial orchids

The species can be grouped according to the observed somatic chromosome numbers, which are 2n = 38, 2n = 46 and 2n = 50 respectively. Constrictions within the chromosomes are generally not very distinct. It nevertheless appears that the chromosomes of all species are (sub)metacentric. Next to differences in chromosome size within the various karyotypes, some of the karyotypes are composed of relatively long and others of distinctively short chromosomes. Details in respect to chromosome size are given in the following where the chromosome numbers are presented.

The first group (2n = 38) comprises two species of *Angraecum* and two species of *Calyptrochilum*. The karyotypes of *Angraecum birrimense* (fig. 8) and *A. eichlerianum*

TABLE 1: Chromosome numbers in African Orchids.

	Chrom. number (2n)	Living plant number	Voucher	Slide number	Provenance
Aerangis					
A. biloba (Ldl.) Schltr.	50	00-517		2-31	Cameroon
Angraecum					
A. bancoense Van der Burg	50	00-453	vdB. 1260	1-30	Ivory Coast
A. birrimense Rolfe	38	756	K.S. 457	5-30, 31	Cameroon
A. distichum Ldl.	50	00-432	K.S. 173/K.S. 224	1-24, 27	Ivory Coast
A. distichum Ldl.	50	00-457	vdB. 838	2-41	Ivory Coast
A. distichum Ldl.	50	78-791	Dekker 343	5-28	Ivory Coast
A. eichlerianum Kraenzl.	38	725	Lg. 8208	4-40 5-40	Cameroon
A. podochiloides Schltr.	50	730	vdB. 1271	–	Ivory Coast
A. subulatum Ldl.	50	00-464	vdB. 1146	–	Ivory Coast
Bolusiella					
B. *batesii (Rolfe) Schltr.*	50	00-433	KS. 111/K. *6168*	2-32	Ivory Coast
B. batesii (Rolfe) Schltr.	50	731		5-32	Ivory Coast
Bulbophyllum					
B. barbigerum Ldl.	40 n = 20	00-461	K.S. 358	5-64	Ivory Coast
B. calamarium Ldl.	38	78-475	Dekker 97/Laan 106	2-90 5-27	Ivory Coast
B. falcatum (Ldl.) Rchb. f.	38	00-430	vdB. 1267	5-47	Ivory Coast
B. falcatum (Ldl.) Rchb. f.	38	00-436	vdB. 1264	–	Ivory Coast
B. falcatum (Ldl.) Rchb. f.	38	00-442	vdB. 1262/K.S. 113	5-38	Ivory Coast
B. falcatum (Ldl.) Rchb. f.	38	00-443	vdB. 1261	2-88	Ivory Coast
B. falcatum (Ldl.) Rchb. f.	38	00-447	vdB. 1263	2-54	Ivory Coast
B. falcatum (Ldl.) Rchb. f.	38	00-449	K.S. 112	2-43	Ivory Coast
B. falcatum (Ldl.) Rchb. f.	38	00-456	K.S. 95	2-89	Ivory Coast
B. falcatum (Ldl.) Rchb. f.	38	00-460	K.S. 365	–	Ivory Coast
B. falcatum (Ldl.) Rchb. f.	38	78-785	Dekker 334/K.S. 324	–	Ivory Coast
B. flavidum Ldl.	38	78-416	K.S. 480	5-6	Ivory Coast
B. flavidum Ldl.	38	734	vdB. 1256	5-44	Liberia
B. imbricatum Ldl.	38	00-466	vdB. 1156	5-37	Ivory Coast
B. linderi Summerh.	38	78-751	J.V. 334	5-25	Ivory Coast
B. lupulinum Ldl.	38	78-793	K.S. 308	5-49	Ivory Coast
B. maximum (Ldl.) Rchb. f.	38	00-448		4-96	Ivory Coast
B. pipio Rchb. f.	38	00-451	J.V. 241	5-36	Ivory Coast
B. saltatorium Ldl.	38	00-429		–	Ivory Coast
B. tentaculigerum Rchb. f.	38	78-565	K.S. 230	5-24	Gabon
B. velutinum (Ldl.) Rchb. f.	40	00-454	K.S. 150	3-4	Ivory Coast
B. velutinum (Ldl.) Rchb. f.	40	00-458	K 6112/vdB. 1266	2-42	Ivory Coast
B. velutinum (Ldl.) Rchb. f.	40	00-435	K 6215/ vdB. 1265	–	Ivory Coast
B. velutinum (Ldl.) Rchb. f.	40	78-526	J.V. 338	5-48	Gabon
B. winkleri Schltr.	38	00-446		–	Ivory Coast
B. wrightii Summerh.	38	00-465	vdB. 1259	2-99	Ivory Coast

TABLE 1: Chromosome numbers in African Orchids.

	Chrom. number (2n)	Living plant number	Voucher	Slide number	Provenance
Calyptrochilum					
C. christianum (Rchb. f.) Summerh.	38	78-701		3-3	Cameroon
C. christianum (Rchb. f.) Summerh.	38	78-798	Dekker 329	5-12	Ivory Coast
C. emarginatum (Sw.) Schltr.	38	78-476	K.S. 381	2-63	Ivory Coast
Chamaeangis					
C. odoratissima (Rchb. f.) Schltr.	50	78-800	Dekker 332	–	Ivory Coast
C. odoratissima (Rchb. f.) Schltr.	50	763	K.S. 343	–	Ivory Coast
Cyrtorchis					
C. aschersonii (Kraenzl.) Schltr.	46	00-472	vdB. 754	2-62	Ivory Coast
C. hamata (Rolfe) Schltr.	46	00-471		–	Ivory Coast
Diaphananthe					
D. pellucida (Ldl.) Schltr.	50	740	K.S. 299/Lg. 2962	5-43	Ivory Coast
D. pellucida (Ldl.) Schltr.	50	00-342	K.S. 483	2-40	
D. pellucida (Ldl.) Schltr.	50	753	K.S. 496	–	Cameroon
Eulophia					
E. euglossa Rchb. f.	44	00-495	K.S. 452	4-93	Ivory Coast
E. euglossa Rchb. f.	44	00-485	Bret. 1525/Laan 24	5-39	Cameroon
E. gracilis Ldl.	44	00-502	Bos 1876/Laan 20	–	Liberia
E. guineensis Ldl.	44	78-689	K.S. 451	4-90, 91	Cameroon
Eulophidium					
E. maculatum (Ldl.) Pfitz.	58	00-498	Bret. 7085	5-66	Togo
E. saundersianum (Rchb. f.) Summerh.	58	736	vdB. 1250/Laan 13	4-89	Ivory Coast
Genyorchis					
G. pumila (Sw.) Schltr.	38	78-790	Dekker 342	5-11	Ivory Coast
Graphorkis					
G. lurida (Sw.) Kuntze	52	78-795	Dekker s.n. (alc. mat.)	5-13	Ivory Coast
G. lurida (Sw.) Kuntze	52	00-519	K.S. 295	5-76	Liberia
Liparis					
L. epiphytica Schltr.	42	00-473	K. 7074/K.S. 264	5-9	Ivory Coast
L. epiphytica Schltr.	42	78-703	K.S. 479	5-29	Cameroon
L. guineense Ldl.	42	00-497	K.S. 293	5-77	Ivory Coast
Listrostachys					
L. pertusa (Ldl.) Rchb. f.	46	78-740	Laan 113	–	Ivory Coast
L. pertusa (Ldl.) Rchb. f.	46	78-799	Dekker 331	5-22	Ivory Coast
L. pertusa (Ldl.) Rchb. f.	46	749	De Bruin 1771	4-94	Ivory Coast
Maniella					
M. gustavii Rchb. f.	84	78-699	K.S. 309	5-60	Cameroon
Microcoelia					
M. caespitosa (Rolfe) Summerh.	47		vdB. 755	–	Ivory Coast

TABLE 1: Chromosome numbers in African Orchids.

	Chrom. number (2n)	Living plant number	Voucher	Slide number	Provenance
Phaius					
P. mannii Rchb. f.	n = 28	78-569	B & W 48/Laan 46	4-77, 78	Gabon
Podangis					
P. dactyloceras (Rchb. f.) Schltr.	46	727	Atwell 16	5-5	Cameroon
Polystachya					
P. adansoniae Rchb. f.	40	00-438	vdB. 299	–	Ivory Coast
P. affinis Ldl.	40	00-441	St. 318/vdB. 1254	1-25	Ivory Coast
P. bancoensis Van der Burg	40		vdB. 1269	1-2	Ivory Coast
P. galeata (Sw.) Rchb. f.	40	78-792	Dekker 335	5-34	Ivory Coast
P. laxiflora Ldl.	40	78-801	Dekker 336	–	Ivory Coast
P. laxiflora Ldl.	40	00-427	J.V. 191	–	Ivory Coast
P. laxiflora Ldl.	40	746	K.S. 298	5-33	Liberia
P. polychaete Kraenzl.	40	78-566	K.S. 231	–	Gabon
Rangaeris					
R. rhipsalisocia (Rchb. f.) Summerh.	46	00-470		2-96	Ivory Coast
R. rhipsalisocia (Rchb. f.) Summerh.	46	00-551	vdB. 1270/St. 315	2-91	Ivory Coast
R. rhipsalisocia (Rchb. f.) Summerh.	46	78-702	K.S. 331	–	Gabon
Solenangis					
S. clavata (Rolfe) Schltr.	50	78-753	Laan 5	5-8	Ivory Coast
S. scandens (Schltr.) Schltr.	50	78-786	Dekker 337	5-7	Ivory Coast

are similar, the chromosome sizes vary from appr. 2.0–3.0 μm. Details on the karyotype of *A. eichlerianum* were already presented by TARA & KAMEMOTO (1970). The chromosomes of *Calyptrochilum christianum* and *C. emarginatum* have sizes ranging from 4–5 μm.

The second group (2n = 46) comprises two species of *Cyrtorchis*, *Rangaeris rhipsalisocia*, *Listrostachys pertusa*, *Podangis dactyloceras* and *Microcoelia caespitosa*.

The chromosomes of *Cyrtorchis aschersonii* and *C. hamata* (fig. 7) have sizes ranging from appr. 1.0–2.0 μm. JONES (1967) published the number of 2n = 46 for one unidentified species of *Cyrtorchis*, but also 2n = (ca) 50 for another two unidentified species and 2n = ca 150 for *C. arcuata*. Our observation of 2n = 46 for *Rangaeris rhipsalisocia* (chromosome sizes appr. 1.0–2.0 μm) does not concur with the report by JONES of 2n = 50 and 2n = ca 100 for two other species of *Rangaeris*. Recently AR- RUSHDI (1971) reported 2n = ca 108 for *R. rhipsalisocia*. Hence it appears that there is intraspecific polyploidy. The chromosomes of *Listrostachys pertusa* range from appr. 0.5–1.0 μm in length, those of *Podangis dactyloceras* have a similar size. The observation of 2n = 47 in the only available specimen of *Microcoelia caespitosa* is considered to by an aneuploid cytotype of 2n = 46. The somatic chromosomes of the species are small (0.5–1.0 μm).

The third group (2n = 50), comprises *Aerangis biloba;* four species of *Angraecum* viz. *A. bancoense, A. distichum, A. podochiloides, A. subulatum; Bolusiella batesii; Chamaeangis odoratissima; Diaphananthe pellucida; Solenangis clavata* and *S. scandens.* The number of 2n = 50 (chromosome sizes appr. 1.0–2.5 μm) for *Aerangis biloba* corroborates the record by JONES (1967), who also found 2n = 50 next to 2n = (ca) 50 and 2n = 200 for other, some of them unidentified species. One species, *A. rhodosticta* however has 2n = 42 chromosomes. The numbers of 2n = 50 for the four species of *Angraecum* are presented for the first time. Their karyotypes are similar, with chromosomes having sizes from appr. 1.0–1.5 μm. The number of 2n = 50 for *Bolusiella batesii* (chromosome sizes appr. 1.5–2.0 μm) is presented for the first time as well. *Chamaeangis odoratissima* has according to JONES 2n = 50 chromosomes (sizes appr. 1.5–3.0 μm) also. The 2n = 50 chromosomes (sizes appr. 1.0–2.5 μm) for *Diaphananthe pellucida* have been counted for the first time but the number concurs with 2n = 50 published by JONES for some other species of the genus. The karyotypes of *Solenangis clavata* and *S. scandens* are similar (chromosome length appr. 1.0–2.0 μm). Their numbers are presented for the first time.

The African monopodial orchids designated as the 'angraecoid orchids' by SCHLECHTER (1918) and SUMMERHAYES (1966), were separated by the former on the basis of the shape of the rostellum. The two resulting groups have been recognized as subtribes by SUMMERHAYES (1966). In the diagnosis of the subtribes weight is given to an apparent correlation between the characters of the rostellum and basic chromosome numbers. The subtribe of the *Angraecinae* is in principle characterised by a rostellum which is not elongated and the basic number of x = 19; the *Aerangidinae* on the other hand by an elongated rostellum and the basic number of x = 25. Evidence for these correlations is presented by JONES (1967). He however points to the fact that among his own observations two exceptions occur to the condition that the chromosome number of the *Aerangidinae* should be multiples of the basic number of x = 25: *Aerangis rhodosticta* has 2n = 42 and an unidentified species of *Cyrtorchis* 2n = 46. JONES concludes that these numbers may represent basic numbers of x = 21 and x = 23 respectively. Our observations on the available specimens of *Cyrtorchis, Podangis, Rangaeris* and *Microcoelia* (all 2n = 46) show that there are several species now included in the *Aerangidinae*, which are characterised by the basic number of x = 23. In his discussion of the chromosome number reports of earlier authors JONES suggests that several specimens referred to *Angraecum* and investigated by CHARDARD (1963) might have been incorrectly named. Indeed *Angraecum bilobum,* for which CHARDARD reported 2n = 50, is synonymous with *Aerangis biloba. Angraecum guillauminii* however, which has according to CHARDARD 2n = 50 also, is retained in *Angraecum* by GARAY (1973). Our observations of 2n = 50 chromosomes in four species of *Angraecum,* all having a non-elongated rostellum (the main morphological diagnostic character of the *Angraecinae*) shows that the subtribe and even the type genus as presently conceived, are not necessarily characterised by x = 19. The validity of the character combination as outlined in the diagnosis of the *Aerangidinae* can not be confirmed either. The two species of *Calyptrochilum* investigated here clearly have an elongated rostellum, but contrary to the presupposition of x = 25 their chromosome number is 2n = 38.

In conclusion it is clear that the species of the 'angraecoid orchids' which on the basis of rostellum characters can be separated into either the *Aerangidinae* or *Angraecinae*, do not need to show chromosome numbers based on either x = 25 or x = 19 respectively. Next to x = 19 and x = 25 the basic number of x = 23, as indicated by our observations of 2n = 46 for various taxa within the *Aerangidinae*, appears to be established also. Moreover still other basic chromosome numbers might result from future analysis of other angraecoid taxa. An indication is the report of 2n = 48 (observed as n = 24) for *Ancistrorhynchus clandestinus* by AR-RUSHDI (1971). The monopodial orchids with Asiatic distribution appear to have chromosome numbers exclusively based on x = 19 (TARA & KAMEMOTO, 1970; ARENDS in FAST, 1980). Their African counterparts have evidently evolved partly along other paths of chromosomal evolution. Our observations in respect to differences in chromosome length between the various taxa point to the possibility of obtaining information from karyotype analysis also. It may be expected that a sound taxonomic system of the angraecoid orchids will result when botanical research on the group progresses and eventually will be synthesized. In this connection the authors wish to stress the need for well documented observations. In their opinion the angraecoid orchids are a group worthwile for continued research.

5. LITERATURE

AR-RUSHDI, A. H. 1971. Chromosomes of some West African Orchids. Cytologia **36**: 487–492.

CHARDARD, R. 1963. Contribution à l'étude cytotaxinomique des Orchidées. Rev. Cyt. Biol. Vég. **26**: 1–58.

DAKER, M. G. 1970. The chromosomes of orchids, IV: Bulbophyllinae Schltr. Kew Bull. **24**: 179–184.

FAST, G. 1980. Orchideenkultur. Ulmer, Stuttgart.

GARAY, L. A. 1973. Systematics of the Genus Angraecum (Orchidaceae). Kew Bull. **28**: 495–516.

HALL, J. B. 1974. African Orchids: XXXIV. Kew Bull. **29**: 427–429.

HALLÉ, N. 1965. Deux orchidées Gabonaises présentées d'après des sujets vivants. Adansonia sér. 2, **V**: 415–419.

JONES, K. 1967. The chromosomes of orchids, II: Vandeae Lindl. Kew Bull. **21**: 151–156.

PIERS, F. 1968. Angraecum distichum and A. aporoides. Amer. Orchid Soc. Bull. **37**: 998–999.

SCHLECHTER, R. 1915. Die Orchideen. Parey, Berlin.

SCHLECHTER, R. 1918. Versuch einer natürlichen Neuordnung der afrikanischen angraekoiden Orchidaceen. Beih. Bot. Centralbl. **36, II**: 62–181.

SUMMERHAYES, V. S. 1964. African Orchids: XXIX. Kew Bull. **17**: 511–561.

SUMMERHAYES, V. S. 1966. African Orchids: XXX. Kew Bull. **20**: 165–199.

TANAKA, R. & KAMEMOTO, H. 1974. List of chromosome numbers in species of the Orchidaceae. In: WITHNER, C. L., The Orchids, Scientific Studies. Wiley, New York.

TARA, M. & KAMEMOTO, H. 1970. Karyotype relationships in the Sarcanthinae (Orchidaceae). Am. J. Bot. **57**: 176–182.

LES GROUPEMENTS A *CAREX CURVULA* ALL. DU TOUZAL-COLOME (MASSIF DU CARLITT, PYRENEES-ORIENTALES) ET LEUR INTERET BIOGEOGRAPHIQUE

A. Baudière

Laboratoire de Botanique et Biogéographie – Université Paul Sabatier – TOULOUSE

L. Serve

Laboratoire de Botanique méditerranéenne et pyrénéo-alpine – Université de PERPIGNAN

A un kilomètre à peine du Nord du Pic Carlitt (2921m) le Touzal-Colomé se présente sous forme d'une haute surface plane sommitale de 24 hectares, culminant sur sa bordure ouest à 2804 mètres. Taillée dans un matériau schisteux, cette unité structurale fait partie de la série des 'plas' d'altitude qui constituent incontestablement l'une des originalités morphologiques majeures des Pyrénées Catalanes.

L'existence de vastes surfaces planes à de telles altitudes a retenu depuis longtemps déjà l'attention des géographes. Tout récemment encore, G. Soutadé (1978), dans une magistrale étude consacrée aux 'Modelé et dynamique actuelle des versants supraforestiers des Pyrénées orientales' a brillamment mis en évidence le rôle majeur qui leur était dévolu dans l'ordonnancement des ensembles morphogenétiques que l'on pouvait rencontrer sur les hautes terres catalanes. On saura particulièrement gré à cet auteur de ne pas avoir négligé la végétation et d'avoir notamment révélé le rôle d'indicateurs biologiques que l'on pouvait attribuer à certaines espèces ou certains groupes d'espèces, tant était grand leur assujettissement à certaines contraintes de la géomorphogenèse actuelle.

G. Soutadé a notamment montré que les plas d'altitude fonctionnent de nos jours en 'surfaces de régradation' caractérisées par une évolution lente liée à 'un enlèvement modeste de la matière' (*loc. cit.*, 260).

Il est évident qu'une telle évolution morphologique, si lente soit-elle, implique une réponse biologique au niveau de la couverture végétale. Toutefois, l'action de l'homme sur la montagne catalane s'étant manifestée avec une grande vigueur de part et d'autre de la limite supérieure naturelle de la forêt, il convenait, pour lever le doute que n'aurait pas manqué d'introduire une étude menée dans une tranche altitudinale susceptible d'avoir été affectée par ce phénomène, de s'intéresser à une surface plane située nettement au delà de l'extrême limite supérieure envisageable pour des peuplements forestiers. Malgré son éloignement et la longueur de la marche d'approche, le TOUZAL-COLOMÉ remplissait les conditions recquises.

I. UN COUVERT VÉGÉTAL À LA CHARNIÈRE DE LA PELOUSE CONTINUE ET DE LA FORMATION PONCTUELLE.

Le peuplement végétal du TOUZAL-COLOMÉ se présente sous l'aspect d'une mosaïque extrêmement contrastée où s'imbriquent des lambeaux de pelouse fermée d'étendue variable et des surfaces colonisées par des groupements ouverts physionomiquement dominés par les chaméphytes basses en coussinets compacts, s'ennoyant progressivement dans un faciès minéral d'altérites.

La pelouse compacte est une pelouse à *Carex curvula* subsp. *curvula* qui, dans le contexte général des pelouses oriento-pyrénéennes de cette nature, se singularise par une originalité certaine: l'extrême abondance de *Gentiana alpina.*

En effet, dans un article précédent consacré précisément aux groupements à *Carex curvula* de la partie orientale de la chaîne pyrénéenne (A. BAUDIÈRE et L. SERVE, 1975), nous avions publié un tableau sur lequel étaient réunis 16 relevés de provenances différentes. Parmi ces 16 relevés, un seul était abondamment pourvu en Gentiane alpine. Nous en avions alors discuté la signification, insistant notamment sur le fait que la station correspondante était en situation topographique de croupe.

Or, les relevés effectués sur le TOUZAL-COLOMÉ sont situés dans un contexte microclimatique comparable où la violence des Tramontanes en période enneigée s'accompagne d'un phénomène de déflation nivale accusé.

Six relevés, réunis sur le tableau I, ont été réalisés à l'intérieur d'éléments de pelouse compacte ou encore peu affectée par les agents météorologiques. Le couvert végétal est toujours important, compris entre 70 et 95 %. La pelouse se présente sous l'aspect d'un paillasson physionomiquement dominé au mois d'Août par les feuilles jaunies de *Carex curvula*; toutefois, en Juillet, la floraison de *Gentiana alpina* est alors un excellent réactif de l'abondance que cette plante est localement susceptible d'atteindre.

L'aire minimale du groupement est de l'ordre du mètre carré, mais la plupart des espèces figurant sur nos listes peuvent cohabiter à l'intérieur d'un périmètre parfois plus restreint.

Le nombre spécifique moyen est de 14,2; il est donc relativement élevé si l'on tient compte du fait que 26 espèces seulement au total ont été recensées. 17 d'entre elles, soit 65,4 % sont des hémicryptophytes, les 9 autres étant toutes des chaméphytes, pour la plupart en coussinet *(Minuartia recurva, Silene acaulis, Minuartia sedoides, Armeria alpina, Androsace carnea, Silene ciliata, Saxifraga moschata).*

Néanmoins, le spectre de diversité floristique traduit mal la part prépondérante que prennent les hémicryptophytes à la constitution du tapis végétal. Le rapport moyen de leur coéfficient de recouvrement à celui des chaméphytes est de 55,0 %; dans le détail, c'est précisément pour les relevés dont le degré de recouvrement est le moins élevé (no. 5

et no. 6) que ce rapport est le plus bas.

Ces données illustrent de façon spectaculaire l'idée selon laquelle la densité de chaméphytes en coussinets au sein d'une pelouse traduit l'état de conservation ou de dégradation de celle-ci; l'extraordinaire compacité de la pelouse sur l'emplacement des relevés 1 à 4 n'autorise évidemment pas leur implantation; celle-ci, au contraire, est déjà plus marquée sur l'emplacement des relevés 5 et 6 où le degré de recouvrement de la végétation est moindre et où des écorchures rendent déjà compte de l'agressivité des agents extérieurs.

On note d'ailleurs, parallèlement au renforcement stationnel du type chaméphytique, un développement accru de *Festuca supina* et surtout de *Leontodon pyrenaeus.* Il est, à cet égard, intéressant de constater que ces deux derniers relevés se rapprochent beaucoup, par leur agencement floristique et leur physionomie écorchée, du *Curvulo-Leontidetum pyrenaici* décrit par J. BRAUN-BLANQUET (1948).

Ainsi, par le biais de ces deux relevés, le raccordement du *Curvulo-Leontidetum pyrenaici,* que tous les auteurs oriento-pyrénéens interprètent comme un groupement relictuel, à un hypothétique groupement de pelouse, plus homogène et mieux structuré, évoquant le *Curvuletum* des grands massifs alpiens, se trouve réalisé sur le Pla du TOUZAL-COLOMÉ.

On constatera que, dans le cas présent, la situation topographique, l'altitude et le modelé concourrent à créer des conditions stationnelles autorisant encore le maintien relictuel, par effet de masse, du groupement que l'on peut considérer comme le type primitif, tout en permettant la dégradation vers des états physionomiques et floristiques sectoriels rappelant le 'patron' (pour ne pas dire le modèle) qui prédomine dans ce secteur de la chaîne.

La situation très occidentale du massif du Carlitt dans l'ensemble orographique oriento-pyrénéen permet au TOUZAL-COLOMÉ de bénéficier de précipitations pluviales et nivales accrues par rapport aux autres sommets des Pyrénées catalanes du fait de l'advection, marginale certes mais cependant réelle, de masses d'air océaniques. Une humidité accrue, une altitude plus élevée, une grande planéité sur plusieurs hectares sans la moindre discontinuité autorisèrent sans doute sur le TOUZAL-COLOMÉ l'installation d'une pelouse fermée à *Carex curvula,* contemporaine de l'installation sur les autres plas de la chaîne, mais à altitude moindre, d'une pelouse continue à *Festuca supina* dont les vestiges parsèment de nos jours encore bien des plas, souvent à l'état de lambeaux, voir même d'arabesques.

Deux profils de sols ont été analysés par tranches superposées de cinq centimètres d'épaisseur. Dans chacun des tableaux correspondant (no. 1 et no. 2), la première colonne donne les indications sur la tranche de profondeur analysée; les colonnes 2 et 3 expriment les parts respectives que prennent, en pour cent de la prise d'échantillon, les sommes des fractions granulométriques supérieures et inférieures à 2 mm (respectivement refus et terre fine).

Les 4 colonnes suivantes rendent compte des pourcentages respectifs exprimés en fonction de la prise d'échantillon totale, des différentes fractions constitutives du refus.

Les cinq colonnes qui suivent rendent compte, de la même manière, des pourcentages respectifs des différentes fractions constitutives de la terre fine (sables grossiers, sables fins, limons grossiers, limons fins, argiles); dans chaque colonne figurent, en regard de chaque niveau analysé, deux nombres superposés; la valeur supérieure exprime le pourcentage de la sous-fraction considérée par rapport à la fraction terre fine, la valeur inférieure exprimant ce pourcentage par rapport à la prise totale d'échantillon.

Le pH a été mesuré par voie électrométrique (pH H2 O) à partir de la fraction terre fine et les teneurs en carbone organique ont été établies à partir de cette même fraction; toutefois, tout comme pour les données de l'analyse granulométrique, les résultats obtenus ont été exprimés de deux manières différentes: en pour mille de la fraction terre fine (valeur supérieure) et en pour mille de la prise d'échantillon (valeur inférieure).

Le taux d'azote a été établi seulement en fonction de la terre fine.

On constate que dans les couches superficielles du profil la fraction terre fine est toujours largement prépondérante. Dans ces conditions, argiles et limons sont toujours en proportions importantes, représentant plus du tiers de la masse de cette fraction.

Lorsqu'en profondeur la tendance granulométrique s'inverse et que le refus tend à devenir prépondérant on note parallèlement, dans la fraction terre fine, une régression très nette de l'importance prise jusque là par les limons et les argiles.

Le passage en profondeur a des niveaux plus sableux s'accompagne d'une réduction notable de la teneur en carbone organique, d'autant plus nettement apparente sur le tableau que l'on considère le taux établi par rapport à la masse totale de l'échantillon prélevé.

Le sol résulte donc manifestement d'un important apport organique de surface s'incorporant en profondeur à un horizon sablo-graveleux tenant lieu localement de roche mère, composé essentiellement d'altérites préglaciaires qui ont été conservées sur la haute surface du Pla non soumise au récurage des glaciers. La teneur élevée des niveaux superficiels en carbone organique traduit bien la valeur humigène du groupement colonisateur et la puissance de cet horizon humifère, tout comme l'incorporation de matières humiques en profondeur, rendent compte de l'ancienneté de son installation.

L'installation et l'extension de la pelouse à *Carex curvula* sur le TOUZAL-COLOMÉ confirment donc, aux très hautes altitudes, l'existence d'une phase biostasique ancienne déjà mise en évidence à de plus basses altitudes (L. SERVE, 1972, A. BAUDIÈRE et L. SERVE, 1975 a et b) et que la plupart des auteurs ayant travaillé sur les hautes montagnes catalanes (A. BAUDIÈRE, L. SERVE, G. SOUTADÉ) s'accordent à considérer comme contemporaine de la période 'atlantique' des palynologistes.

II. LA DÉGRADATION DE LA PELOUSE: LE TEMPS DES CHAMÉPHYTES.

Le tableau no. II fait état de 6 relevés (no. 7 à 12) réalisés sur les parties du TOUZAL-COLOMÉ où la pelouse compacte fait place à une pelouse écorchée (au sens étymologique du terme), souvent même rubannée, où les morsures de l'érosion sont fréquemment visibles.

Le relevé no. 7 permet d'assurer la transition avec les relevés du tableau no. I. Il a été réalisé sur une surface de 10 mètres carrés empiétant sur le territoire de deux groupements, l'un constitué de lambeaux de pelouse, l'autre correspondant à une colonisation ponctuelle du milieu. Les relevés 8 à 12, au contraire, ne concernent que des surfaces de trois mètres carrés abritant des peuplements ouverts. Les coéfficients de sociabilité des diverses espèces recensées sont là pour en porter témoignage.

On peut donc considérer que le tableau no. II se rapporte à un groupement alternant, en mosaïque, avec des individus de superficie restreinte de la pelouse précédemment analysée.

28 espèces au total figurent nos listes; le nombre spécifique est encore élevé (15,3); on note toutefois dans la diversité floristique, par rapport au tableau I, une diminution du nombre des hémicryptophytes et une augmentation sensible de celui des chaméphytes.

Mais la différence majeure réside dans la part que prennent désormais ces dernières à la constitution de la couverture végétale. La somme de leurs coefficients de recouvrement, qui ne dépassait jamais 500 dans le tableau I, ne s'abaisse pas au dessous de 2200. Le rapport des coefficients de recouvrement des hémicryptophytes à ceux des chaméphytes, qui dans le tableau 1 demeurait constamment supérieur à 30 (dépassant même 100 en deux circonstances), est, dans le cas présent, cinq fois inférieur à l'Unité; seul le relevé no. 7 fait exception, mais la valeur du rapport (3,73) justifie son rattachement à ce tableau.

La prédominance physionomique des chaméphytes est donc ici le phénomène biologique majeur.

La plupart des espèces sont présentes sous forme d'individus distribués en piqueté, individus dont la durée d'existence est sans aucun doute très limitée dans le temps ainsi qu'en témoignent des cas de déchaussement multiples.

Les chaméphytes qui n'arrivaient qu'exceptionnellement à prendre pied dans la pelouse compacte germent ici en abondance; mais les conditions de maintien durable sont très précaires hors de l'abri de la protection des rhizosphères, sur des formations superficielles où les processus liés aux changements alternatifs et répétitifs de l'état physique de l'eau s'exercent avec une grande intensité en périodes fininivale et prénivale.

La désolidarisation par le gel (pipkrakes notamment) des éléments constitutifs du sol favorise la déflation et l'entrainement au loin des particules fines minérales ou organiques. Peu à peu, par le jeu de cette gélidéflation, les sols s'amenuisent. Les analyses des prélèvements effectués dans ces conditions de milieu (profils no. 3 et 4, tableau no. 3) rendent compte de cette dispersion des éléments fins.

En surface, déjà, les éléments constitutifs du refus représentent plus de 50 % de la masse totale du sédiment alors que sous la pelouse compacte (tableau no. 1 et 2) ils n'en représentaient seulement que 3,5 et 21,8 %).

Cet enrichissement des formations superficielles en cailloux et graviers s'accompagne également d'une augmentation très sensible de la part qui revient à la fraction sableuse entrant dans la composition de la terre fine.

Néanmoins, la teneur en carbone organique des niveaux supérieurs est encore relativement élevée (37‰) et apparemment notablement supérieure à celle qui pourrait résulter de la valeur édificatrice du peuplement végétal colonisateur.

Nul doute donc que, sur l'emplacement du profil no. 3, les 37,3‰ et les 38,1‰ mesurés dans les 10 centimètres supérieurs représentent les vestiges d'horizons humifères que l'on ne peut s'empêcher d'homologuer à ceux que l'on trouve encore à 20 ou 25 cm de profondeur sous la pelouse compacte (tableau no. 1).

Mais, dans le cas présent, une différence majeure retient toute notre attention: les teneurs en carbone organique ne montrent plus comme précédemment, tout au moins dans les niveaux proches de la surface, un abaissement régulier avec la profondeur. Le fait de trouver des teneurs plus élevées entre 5 et 10 cm qu'entre 0 et 5 peut être interprété comme étant le résultat des phénomènes de cryoturbation qui concourrent au remaniement saisonnier des formations superficielles et dont le déchaussement des chaméphytes en coussinet est une conséquence.

Il importe maintenant de se pencher sur le problème des liens pouvant exister entre les deux types de communautés que nous venons d'étudier.

Le tableau no. III reprend, d'une façon condensée, les données des tableaux I et II et a été conçu de manière à mettre en évidence les espèces communes aux deux groupements et celles que l'on peut éventuellement considérer, compte tenu de leur présence-absence ou de leur dominance, comme différentielles de l'un par rapport à l'autre. Le tableau a été simplifié afin de ne tenir compte, sauf rares exceptions, que des végétaux montrant dans l'un ou l'autre de ces groupements une classe de présence élevée.

La première constatation, qui s'impose avec évidence, est l'appartenance de la plupart des espèces ainsi retenues (19 sur 24) aux deux types de communautés, cinq espèces seulement venant dans l'une n'existant pas dans l'autre; elles ne présentent cependant qu'un faible coéfficient de recouvrement.

Peut-on, sur la base de ces seuls critères floristiques, en déduire que nous sommes là en présence de deux associations différentes? Doit-on, au contraire, vu l'importance du fonds floristique commun, penser que nous sommes en présence de deux faciès, l'un à hémicryptophytes, l'autre à chaméphytes, d'une même association?

Le fait que les différentielles absolues (basées sur le principe du diptyque présence-absence) soient deux hémicryptophytes (*Viscaria alpina* et *Carex approximata*) dans le cas du 'groupement initial' et deux chaméphytes (*Arenaria grandiflora*, *Saxifraga bryoides*) et une géophyte (*Galium cometerrhizon*) dans le cas du 'groupement de substitution' nous incite à opter pour la première proposition.

Mais, si l'on s'en réfère maintenant au 'comportement' des espèces rencontrées, à leur dominance respective, on se rend compte alors que la notion d'espèce différentielle peut se concevoir au delà du simple paramètre présence-absence. Plus que les classes de présence, les coéfficients de recouvrement paraissent devoir être tenus comme critère discriminant de première importance; les espèces différentielles de la pelouse compacte sont incontestablement des hémicryptophytes, *Carex curvula* subsp. *curvula* et *Gentiana alpina* tout particulièrement, alors que, *Festuca supina* et *Leucanthemopsis alpina* exceptées, les différentielles du groupement de substitution sont des chaméphytes en coussinet. D'une manière générale d'ailleurs, la plupart des hémicryptophytes sont ici implantées à même les coussinets compacts des chaméphytes et non pas sur un substrat périodiquement remanié par la cryoturbation. A cet égard d'ailleurs la classe de présence élevées (IV) de *Galium cometerrhizon*, que les phytosociologues tiennent pour une caractéristique d'association d'éboulis siliceux non stabilisé, traduit bien, sur des surfaces planes, l'existence d'un remaniement occasionnel des formations superficielles.

Sur cette haute surface plane du TOUZAL-COLOMÉ où les conditions mésoclimatiques sont particulièrement sévères, peu d'espèces sont capables de se maintenir. Celles qui sont susceptibles de s'en accommoder sont, par contre, en mesure de coloniser différents biotopes (pelouses compactes ou coussinets par exemple).

Devant la pauvreté floristique, la notion d'association végétale, basée sur le concept d'espèce caractéristique, s'efface devant la notion de formation, de conception plus physionomique. On touche là aux querelles d'écoles... Néanmoins, s'il nous fallait faire un choix, nous nous rallierions, dans le cas particulier du TOUZAL-COLOMÉ, aux concepts de l'école upsallienne (c'est la raison pour laquelle nous ne proposons pas de désignation à consonnance phytosociologique pour les groupements évoqués).

Il est, en fait, évidemment difficile de proposer des séparations artificielles au sein d'un continuum évolutif. On insistera cependant sur le fait que les éléments de pelouse compacte ne persistent que grâce à un effet de masse qui permet encore leur auto-entretien. Mais à partir du moment où la gélidéflation s'installe elle devient l'agent moteur principal de leur régradation.

LA RÉGRADATION DU 'CURVULETUM' DU TOUZAL-COLOMÉ EST CONFORME AU SENS DE L'ÉVOLUTION GÉNÉRALE DE LA VÉGÉTATION DES PLAS D'ALTITUDE ORIENTO-PYRÉNÉENS.

Les études menées jusqu'à présent (A. BAUDIÈRE, L. SERVE, G. SOUTADÉ *in comm. mult.*) concourrent toutes à démontrer que l'on assiste à l'heure actuelle à une phase de régression des pelouses d'altitude. Certes, les processus en jeu varient beaucoup d'un secteur à un autre, selon la configuration des modelés, selon la nature pétrographique des substrats, selon le type de végétation colonisatrice:

- Substitution d'une pelouse à *Elyna spicata* par une pelouse écorchée à *Helictotrichum montanum* sur le planal occidental du Cambre d'Aze (altérites micaschisteuses),
- destruction de *l'Elynetum* par ostiolisation et extrusion de fines et mise en place de groupements ouverts à *Ranunculus parnassifolius* subsp. *heterocarpus*, *Minuartia verna* et *Festuca glacialis* sur le planal du Pic de Terres (2350 m) ou les hautes surfaces planes du Campcardos calcaire (2700 m),
- dégradation par ostiolisation du *Pumilo-Festucetum supinae* (cryoturbation interne et profonde) et colonisation des plages cryoturbées par un groupement en piqueté à *Ranunculus parnassifolius* subsp. *parnassifolius* et *Minuartia recurva* sur le Pla de

Gorra-Blanc schisteux (2450 m),

- régradation par cryodéflation de la pelouse à *Festuca supina* sur les altérites granodioritiques du Pla du Roc d'Aude (2350 m),
- substitution d'un '*Curvuletum*' fermé par un groupement à chaméphytes en coussinet sur le Pla du Touzal Colomé,
- substitution de la pelouse compacte à *Festuca supina* par un groupement chaméphytique à *Saxifraga retusa*, *S. bryoides*, *Minuartia sedoides*, *Silene acaulis*, sur altérites (arènes) granitiques sur le Pla de la Porteille des Baillettes (2800 m sur la frontière franco-andorranne), etc... partout donc, sur les hautes surfaces planes des Pyrénées orientales, le même phénomène s'inscrit dans la couverture végétale.

Dans tous les cas, un dénominateur commun: le support est constitué d'altérites préglaciaires, conservées localement grâce à une situation topographique les ayant tenues à l'écart du récurage des glaciers. Sur toutes ces hautes surfaces planes une végétation de pelouse fermée paraît s'être autrefois développée au point d'avoir pu les enherber en totalité. Rien, certes, ne permet d'en avoir la certitude absolue mais bien des situations actuelles, bien des héritages conservés permettent d'envisager sereinement cette possibilité.

La multitude d'observations et de mesures réalisées sur ces plas d'altitude montre bien que de nos jours la tendance est inversée et que la dégradation est un phénomène général qui semble se dérouler avec une rigueur inexorable.

Mais si l'observation est chose aisée, l'interprétation s'avère délicate.

On pourrait être tenté de croire, devant l'ampleur du phénomène, à une brutale péjoration des conditions climatiques.

Certes, péjoration il y a eu puisque des pelouses qui ont pu autrefois s'étendre ne sont plus en mesure de se maintenir ou même de cicatriser les écorchures.

Mais, les observations accumulées depuis plusieurs années montrent que la vitesse de dégradation est extrêmement lente et que le résultat identique auquel cette dégradation conduit procède, d'un lieu à l'autre, de causes parfois différentes. Et c'est maintenant qu'il y a lieu de préciser l'orientation évolutive induite lors de la phase incipiente de la dégradation par les héritages d'altération conservés sur les plas:

- sur altérites de texture sableuse la dégradation des pelouses sera surtout un phénomène de régradation frontale par gelidéflation,
- sur altérites de texture limono-argileuse (dans les massifs schisteux) la dégradation des pelouses sera surtout liée à un phénomène de cryoturbation avec comme première manifestation visible, ostiolisation de la pelouse.

Quelle que soit désormais la manière dont le gel agira sur les formations superficielles, l'intégrité des rhizosphères sera progressivement affectée et les processus de régradation seront inexorablement enclanchés.

Dès lors que par le jeu de la destructuration par le gel et l'entrainement par le vent un front de sape apparaîtra dans la pelouse compacte, dès lors que par le jeu de la cryoturbation des phénomènes d'ostiolisation affecteront la pelouse, permettant la remontée en surface d'altérites à forte capacité de rétention en eau amplifiant ainsi le déroulement du processus enclanché, la pelouse sera appelée à évoluer, dans un premier temps vers une pelouse fragmentée à figuration originale, dans un deuxième temps vers une formation de substitution.

C'est la juxtaposition de ces deux étapes que l'on peut observer actuellement sur le Pla du TOUZAL-COLOMÉ comme en bien d'autres secteurs des montagnes-catalanes. Dans tous les cas, trois composantes stationnelles apparaissent d'une façon constante:

- Une composante géomorphologique majeure: de hautes surfaces planes,
- une composante édaphique: un manteau d'altérites,
- une composante climatologique: des vents forts et fréquents.

Les deux premières sont absolument permanentes; la troisième étant seule susceptible de varier dans le temps.

Le déneigement répétitif par les Tramontanes limite l'épaisseur et la durée de protection de la couverture neigeuse; la protection des pelouses contre l'agression et la pénétration du gel n'est donc pas régulièrement assurée sur ces hautes surfaces éventées. Lorsque, par le jeu de la concurrence ou de tout autre facteur extrinsèque (pâturage par exemple), la pelouse présente quelque point de faiblesse, le gel peut facilement s'imposer comme élément catalyseur d'une dynamique difficile à enrayer; quelques répétitions successives d'hivers très froids alternant avec des étés secs ont pu avoir des effets particulièrement néfastes sur le peuplement végétal. La pénétration du gel, et donc les changements d'états physiques de l'eau dans les manteaux d'altérites, peuvent notamment avoir des incidences désastreuses sur les systèmes racinaires. La brièveté de la période de végétation ne permet alors pas au peuplement végétal de colmater les brêches, surtout si les conditions hydriques estivales sont exceptionnellement déficitaires comme cela se produit parfois sur ces franges méditerranéennes.

Pour admettre la possibilité d'installation ancienne de pelouses continues sur ces hautes surfaces planes, force est donc d'admettre également l'existence passée d'une période d'atténuation de l'éventation ou, pour le moins, de compensation des effets de la déflation.

Force est donc également d'avoir recours à l'hypothèse. Ou bien le vent n'a pas été localement un facteur permanent du climat postglaciaire, ou bien les effets de la déflation étaient alors rapidement compensés par de nouvelles précipitations nivales.

Accalmie momentanée de l'activité éolienne contemporaine d'une phase biostasique intense ou réduction, postérieure à cette phase, de la fréquence des précipitations hivernales? Seuls des arguments géomorphologiques permettent de trancher. G. VIERS (1971), se basant sur l'orientation des cirques glaciaires de la partie orientale de la chaîne pyrénéenne pense que déjà, durant les grandes périodes froides du quaternaire, les Tramontanes soufflaient avec la même violence que de nos jours; certes rien ne permet cependant d'affirmer qu'entre temps une période de relative accalmie éolienne n'ait pu se manifester.

L'une des conséquences de l'époussetage éolien des hautes surfaces planes est une redistribution différentielle de l'enneigement qui atteint son maximum sur les versants 'sous le vent', en exposition donc sud à sud-est où, malgré une exposition 'chaude', des congères énormes persistent souvent jusqu'au coeur de l'été. Leur incidence sur la géomorphogenèse des versants est évidente; ces puissantes accumulations neigeuses constituent d'importants réservoirs d'eau à l'état solide dont la restitution progressive à l'état liquide permet une humectation intense des formations superficielles situées en contrebas du front de fusion. Du fait même de l'exposition, la période de fusion se superpose partiellement à la période de l'année ou les gelées nocturnes sont encore très sévères. Cette alternance répétitive gel-dégel est, dans bien des situations, responsable de la physionomie 'en guirlandes' du peuplement végétal. G. SOUTADÉ (1971) a même parlé à ce propos de 'névés agressifs de versant'.

Or, le relèvement progressif de la tranche altitudinale où se manifeste actuellement l'agression du gel sur ces versants a pu être mis en évidence au moyen de différents marqueurs biologiques tels que les gradins de *Festuca eskia* Ram. ou les populations résiduelles de *Senecio leucophyllus* DC. (G. SOUTADÉ et A. BAUDIÈRE, 1973); ce phénomène est la transcription morphologique, avec ses conséquences biologiques, d'un phénomène microclimatique: la fusion plus précoce, à altitude égale, de la neige accumulée dans la congère. Rien ne permettant de penser à un relèvement des températures, on peut donc admettre une diminution de l'alimentation nivale des congères et, par tant, une diminution de la quantité de neige tombée sur les réceptacles que sont les plas qui, au nord-ouest, dominent ces versants.

D'autres preuves, géomorphologiques et biologiques, pourraient encore être avancées qui témoigneraient d'une diminution sensible des précipitations hivernales, postérieure à la phase d'installation des pelouses sur les plas. Ainsi, en bien des secteurs des Pyrénées catalanes, sur bien des versants orientés à l'Est ou au Nord, des systèmes de loupes de solifluxion entravée, dont quelques unes parfois sont encore fonctionnelles, mais dont la majorité présentent des cicatrices transversales dues à l'assèchement, rendent compte du déficit actuel d'alimentation hydrique: la fusion estivale des neiges sommitales n'est désormais plus en mesure d'assurer localement une humectation des versants suffisante pour entretenir la permanence du fonctionnement du modelé.

On le voit fort bien, point n'est besoin d'admettre une brusque préjoration climatique pour expliquer la dégradation des pelouses développées sur les plas: une diminution insensible du rythme des précipitations hivernales postérieurement à l'optimum climatique ayant présidé à leur installation, suffit à déclancher un processus de régradation qui s'entretient, ou même s'amplifie, par autocatalyse.

Les conséquences géomorphologiques apparaissent bien mineures à l'échelle de la montagne: de simples remaniements, sans grande ampleur, des formations superficielles des versants et, sur les surfaces planes, des placages d'altérites.

Les conséquences biologiques et écologiques, par contre, sont d'une toute autre ampleur: la destruction progressive, mais lente, des pelouses alpines avec, pour corollaire, la disparition du manteau des rhizosphères, favorise l'intensification des processus liés aux changements d'état physique de l'eau dans le sol; la cryoturbation prend de plus en plus possession du milieu édaphique; incapables de se maintenir durablement, les végétaux colonisateurs ont une durée d'existence brêve et ne parviennent à donner à la végétation qu'une physionomie en piqueté. Le temps des pelouses est désormais révolu.

Or, de tels phénomènes sont la règle absolue sur la haute montagne méditerranéenne où la sécheresse estivale est un facteur majeur s'opposant à l'édification de pelouses fermées.

La convergence physionomique est, on le voit, évidente. A ce point que sur la foi d'observations réalisées à des niveaux altitudinaux inférieurs à celui du TOUZAL-COLOMÉ (Pla de Gorra-Blanc, 2450 m, A. BAUDIÈRE et L. SERVE, 1975) nous avions pu parler de phénomène d'oroméditerranéisation de la haute montagne catalane. Il est vrai que la sécheresse estivale, plus accusée dans ce secteur de la chaîne, favorise dans leurs rapports concurrentiels avec les autres compétiteurs à l'occupation du sol les espèces à port relativement xéromorphe: ainsi la substitution de pelouses fermées à *Festuca supina* par des groupements ponctualisés à *Festuca durissima*.

Il est néanmoins évident qu'une 'meilleure' spécialisation à supporter la cryoturbation est un facteur d'accomodation de toute première importance. A cet égard le volume du système racinaire est à prendre à considération. Or une constatation est aisée à faire: les Graminées oroméditerranéennes ont un système racinaire bien plus développé que celui de la majorité de leurs congénères de type boréo-alpin: rien d'étonnant donc à ce que les Graminées de type mésogéen soient favorisées lorsque les processus périglaciaires s'intensifient.

Dès lors, sur les bordures méditerranéennes alti-montaines, l'oroméditerranéisation des pelouses alticoles peut être interprétée comme une réponse biologique du tapis végétal à une crise géomorphologique mineure induite par la régradation des pelouses alpines à la suite d'une diminution progressive des précipitations nivales, sans qu'il soit besoin de faire nécessairement appel à un asséchement climatique estival.

A cet égard, le Pla du TOUZAL-COLOMÉ constitue un site d'intérêt biologique majeur: les phénomènes de dégradation de la pelouse initiale sont homologues de ceux que l'on peut observer sur les autres plas oriento-pyrénéens où l'évolution se fait vers des groupements 'ponctualisés'.

Mais ici, en raison de conditions plus rigoureuses encore (altitude bien plus élevée), le peuplement de substitution est surtout constitué de chaméphytes boréo-alpines en coussinet. La ponctualisation végétale du pla ne peut être assimilée à une oroméditerranéisation bien que les processus en jeu soient rigoureusement les mêmes.

On peut donc, grâce aux données comparatives fournies par le TOUZAL-COLOMÉ, en déduire que l'oroméditerranéisation entrevue en d'autres secteurs des Pyrénées catalanes (Massif du Puigmal notamment) apparaît comme une 'mutation' phytogéographique liée davantage à des causes géomorphologiques qu'à des raisons climatiques.

RÉSUMÉ

Les auteurs analysent les causes de la dégradation des pelouses orophiles du Pla du TOUZAL-COLOMÉ (Massif du Carlitt – Pyrénées catalanes). La substitution de pelouses à hémicryptophytes par des groupements ouverts à chaméphytes en coussinet est liée à l'intensification locale de phénomènes périglaciaires. La comparaison avec les phénomènes observés en d'autres points de Pyrénées orientales permet de proposer une explication à un phénomène apparaissant comme général. L'oroméditerranéisation entrevue ailleurs serait davantage le résultat d'une crise géomorphologique de faible intensité que celui d'une modification récente des paramètres climatiques.

SUMMARY

In this article are analysed the main causes of the degradation of orophytic communities on the 'Pla du TOUZAL-COLOMÉ' (Carlitt-Massif-Catalan Pyrenées). The substitution of grasslands with hemicryptophytes by open groupings with chamaephytes, resembling small cushions, are mainly linked with a local intensification of periglacial phenomena. If we compare these results with those observed in other parts of Eastern Pyrenées, it appears that this phenomenon is rather general. The oromediterranisation observed elsewhere seems to be the result of a small geomorphic crisis rather than recent changes in climatic factors.

RESUMEN

Les autores analizan las causas de la degradación de las communidades de *Carex curvula* del Pla del TOZAL-COLOMÉ (Macizo del Carlitt, Pirineos Catalanes). La substitución de communidades con hémicriptofitos por agrupamientos abiertos de camefitos de porte almohadillado esta ligada con la intencificación de fenomenos periglaciarios. Acomparando estos resultados con observaciones realisadas en otros lugares de los Pirineos orientales permite de pensar que esta explicacion es general. La oromediterraneización averiguada en otros lugares parece debida, antes de nada, a una crisis geomorfologica de pequeña intensidad y no a una modificación reciente del clima.

Tableau No. I

Relevé N°	1	2	3	4	5	6	classe de Présence	coefficient de Recouvrement	Type Biologique
Altitude (m.s.m.)	2800	2800	2800	2795	2800	2800			
Exposition	N	N	NNW	–	NNW	NW			
Pente (°)	–5	–5	–5	0	–5	–5			
Superficie (m²)	10	10	10	10	10	10			
Recouvrement (%)	95	95	95	95	70	70			
Carex curvula subsp. curvula	555	555	555	554	543	543	V	7500	Hc
Gentiana alpina	534	544	544	544	533	544	V	5417	Hc
Leontodon pyrenaeus	1+1	1+1	1+1	311	422	522	V	575	Hc
Festuca supina	2+1	1+1	2+1	311	211	321	V	375	Hc
Minuartia recurva	1°+1	1+1	1+1	1+1	311	311	V	133	Ch
Phyteuma hemisphaericum	2+1	1+1	2+1	3+1	2+1	3+1	V	50	Hc
Jasione humilis	2+1	1+1	2+1	1+1	1+1	–	V	42	Hc
Luzula spicata	1+1	1+1	1+1	–	2+1	2+1	V	42	Hc
Leucanthemopsis alpina	1+1	1+1	1+1	–	1+1	–	IV	33	Hc
Agrostis rupestris	1+1	–	–	–	1+1	2+1	III	25	Hc
Silene acaulis	1+1	–	1+1	–	–	1+1	III	25	Ch
Minuartia sedoides	–	–	1+1	–	1+1	2+1	III	25	Ch
Pedicularis pyrenaica	1+1	–	–	1+1	1+1	–	III	25	Hc
Viscaria alpina	1+1	1+1	–	–	1+1	–	III	25	Hc
Carex approximata	–	–	1+3	1+1	–	1+2	III	25	Hc
Armeria alpina	–	1+1	–	–	–	1+1	II	17	Ch
Erigeron aragonensis	1+1	–	1+1	–	–	–	II	17	Hc
Poa alpina	–	1+1	1+1	–	–	–	II	17	Hc
Androsace carnea	–	–	1+1	–	–	1+1	II	17	Ch
Silene ciliata	–	–	2+1	1+1	–	–	II	17	Ch
Gentiana verna	1+1	1+1	–	–	–	–	II	17	Hc
Saxifraga moschata	–	1+1	–	–	–	–	I	8	Ch
Cerastium alpinum var. lanatum	–	–	1+1	–	–	–	I	8	Hc
Thymus nervosus	1+1	–	–	–	–	–	I	8	Ch
Poa violacea	–	2+1	–	–	–	–	I	8	Hc
Sempervivum montanum	–	–	1+1	–	–	–	I	8	Ch
Nombre d'espèces	16	15	18	10	13	13			26
Nombre hémicryptophytes Hc	12	11	12	8	10	8			17
Nombre chaméphytes Ch	4	4	6	2	3	5			9
Coefficient de recouvrement Hc	13050	15500	15500	13300	12750	15700			
Coefficient de recouvrement Ch	150	150	300	100	350	500			
Rapport coefficients rec. Hc/ch	87	103	52	133	34,7	31,4			

TABLEAU No. 1. Profil No. 1 – Sous pelouse compacte

Prof. (cm)	% Refus	% T.F.	Refus (% total)				Terre fine (% Terre fine) / (% total)					pH	C ‰	N ‰	C/N
			20	10–20	5–10	2–5	S.G.	S.F.	L.G.	L.F.	A				
0–5	3,5	96,5	0	0	0,4	3,1	39,6	13,2	5,9	7,7	28,2	4,4	78,0	5,01	15,6
							38,2	12,7	5,7	7,4	27,3		75,3		
5–10	9,8	90,2	0	0	1,9	7,9	43,1	14,6	5,1	7,8	27,4	4,4	72,0	4,69	15,3
							38,9	13,2	4,6	7,0	24,7		64,9		
10–15	13,6	86,4	0	0	2,5	11,1	44,5	13,6	4,4	11,7	27,8	4,4	63,0	3,79	16,6
							38,4	11,8	3,8	10,1	24,0		54,4		
15–20	33,9	66,1	0	3,2	8,0	22,7	47,4	14,2	1,3	13,4	27,6	4,4	40,5	2,97	13,6
							31,3	9,4	0,9	8,9	18,2		26,8		
20–25	59,4	40,6	16,0	7,1	14,0	22,3	53,8	11,5	2,5	1,4	20,4	4,5	53,3	3,05	17,4
							21,8	4,7	1,0	0,6	8,3		21,6		
25–30	71,8	28,2	16,4	15,8	18,6	21,0	64,3	9,5	2,0	9,3	8,1	4,5	52,5	3,21	16,3
							18,1	2,7	0,6	2,6	2,3		14,8		
30–35	67,5	32,5	15,3	14,8	18,4	18,9	71,5	8,7	3,9	3,9	7,2	4,5	32,3	1,44	22,1
							23,2	2,8	1,3	1,3	2,3		10,5		

TABLEAU No. II

Relevé no	7	8	9	10	11	12				
Altitude (m.s.m.)	2800	2800	2800	2800	2800	2800				
Exposition	–	–	–	–	–	–				
Pente (°)	0	0	0	0	0	0				
Superficie (m²)	10	3	3	3	3	3				
Recouvrement (%)	70	60	60	40	20	40				
Minuartia recurva	–	421	421	421	421	531	V	1625	ch	1950
Silene acaulis	321	333	321	321	321	–	V	1625	ch	1650
Carex curvula subsp. curvula	432	222	321	212	–	1+1	V	1158	Hc	640
Saxifraga moschata	311	321	321	321	421	311	V	1033	ch	1220
Festuca supina	2+1	311	321	421	421	311	V	825	Hc	980
Minuartia sedoides	211	–	1+1	1+1	2+1	322	V	300	ch	330
Leucanthemopsis alpina	–	2+1	2+1	2+1	3+1	422	V	283	Hc	340
Jasione humilis	3+1	2+1	2+1	311	2+1	2+1	V	67	Hc	70
Luzula spicata	1+1	3+1	2+1	3+1	3+1	2+1	V	50	Hc	50
Agrostis rupestris	2+1	1+1	1+1	1+1	1+1	–	V	42	Hc	40
Androsace carnea	3+1	1+1	1+1	1+1	1+1	–	V	42	ch	40
Phyteuma hemisphaericum	2+1	3+1	3+1	1+1	–	–	IV	33	Hc	30
Thymus nervosus	2+2	–	1+1	1+1	1+1	–	IV	33	ch	30
Galium cometerrhizon	–	–	(+)	312	1+1	1+1	IV	42	G	50
Gentiana alpina	412	413	–	414	–	–	III	75	Hc	60
Pedicularis pyrenaica	1+1	1+1	1+1	–	–	–	III	25	Hc	20
Armeria alpina	2+1	–	–	1+1	–	–	II	17	ch	10
Silene ciliata	2+1	–	–	–	1+1	–	II	17	ch	10
Arenaria grandiflora	2+1	–	–	1+1	–	–	II	17	ch	10
Leontodon pyrenaeus	533	–	–	–	–	–	I	625	Hc	0
Erigeron aragonensis	–	–	–	–	1+1	–	I	8	Hc	10
Saxifraga bryoides	211	–	–	–	–	–	I	25	ch	0
Luzula lutea	313	–	–	–	–	–	I	25	Hc	0
Poa alpina	1+1	–	–	–	–	–	I	8	Hc	0
Primula integrifolia	2+1	–	–	–	–	–	I	8	Hc	0
Myosotis alpina	1+1	–	–	–	–	–	I	8	Hc	0
Douglasia vitaliana	–	–	–	–	1+1	–	I	8	ch	10
Sedum alpestre	–	–	–	–	–	1+1	I	8	ch	10
Nombre d'espèces	22	13	15	17	15	10			28	
Nombre hémicryptophytes Hc	13	9	8	8	6	5			15	
Nombre chaméphytes xh	9	4	6	8	8	4			12	
Coefficient de recouvrement Hc	8200	2100	3300	2050	1750	1800				
Coefficient de recouvrement Ch	2200	6800	4650	4750	4750	5450				
Rapport coéfficients rec. Hc/Ch	3,73	0,31	0,71	0,43	0,37	0,33				

TABLEAU No. 2. Profil no. 2 – Sous pelouse compacte

Prof. (cm)	% Refus	% T.F.	Refus (% Total)				Terre fine (% Terre fine) / (% total)					pH	$C^{0}/_{00}$	$N^{0}/_{00}$	C/N
			20	10–20	5–10	2–5	S.G.	S.F.	L.G.	L.F.	A				
0–5	21,8	78,2	1,0	1,7	5,3	13,9	47,3 37,0	10,9 8,5	0,4 0,3	20,8 16,3	20,6 16,1	4,4	82,5 64,5	5,16	15,9
5–10	30,3	69,7	0	1,4	8,2	20,7	56,2 39,2	10,4 7,2	0,3 0,2	14,8 10,3	18,1 12,6	4,4	67,5 47,0	3,44	19,6
10–15	42,3	57,7	2,5	5,2	9,8	24,8	54,7 31,6	14,5 8,4	4,3 2,5	10,6 6,1	15,9 9,2	4,5	43,5 25,1	2,75	15,8
15–20	65,4	34,6	17,4	12,0	13,2	22,8	61,6 21,3	12,7 4,4	2,0 0,7	10,5 3,6	13,2 4,6	4,7	41,5 14,4	2,39	17,3

TABLEAU No. III.

Espèces communes aux deux facies et différentielles

1. Espèces communes	1	2	3	4
Hc Jasione humilis	V+	V+	42	67
Hc Luzula spicata	V+	V+	42	50
Hc Phyteuma hemisphaericum	V+	IV+	50	33
Hc Pedicularis pyrenaica	III+	III+	25	25
Hc Agrostis rupestris	III+	V+	25	42
Hc Erigeron aragonensis	II+	II+	17	8
Ch Armeria alpina	II+	II+	17	17
Ch Silene ciliata	II+	II+	17	17
2. Différentielles du groupement initial				
Hc Carex curvula subsp. curvula	V4–5	V2	7500	1625
Hc Gentiana alpina	V4	III^1	5417	75
Hc Leontodon pyrenaeus	V2	I^2	575	625
Hc Viscaria alpina	III$^+$		25	0
Hc Carex approximata	III$^+$		25	0
3. Différentielles du facies dégradé				
Hc Festuca supina	V^1	V^2	375	825
Ch Minuartia recurva	V^1	V^2	133	1625
Ch Silene acaulis	III$^+$	V^2	25	1625
Ch Minuartia sedoides	III$^+$	V^1	25	300
Ch Saxifraga moschata	I$^+$	V^2	8	1033
Hc Leucanthemopsis alpina	IV$^+$	V^1	33	283
Ch Thymus nervosus	I+	IV+	8	33
Ch Androsace carnea	II+	V+	17	42
G Galium cometerrhizon	–	IV+	0	42
Ch Arenaria grandiflora	–	II+	0	17
Ch Saxifraga bryoides	–	I+	0	8

Colonne 1: Expression synthétique simplifiée du tableau no. 1
Colonne 2: Expression synthétique simplifiée du tableau no. 2
Colonne 3: Coefficients de recouvrement établis pour le tableau no. 1
Colonne 4: Coefficients de recouvrement établis pour le tableau no. 2

TABLEAU no. 3. Profils no. 3–4 – Sous pelouse dégradée

Prof. (cm)	% Refus	% T.F.	Refus (% total)				Terrefine (% Terre fine) / (% Total)					pH	$C^{0}/_{00}$	$N^{0}/_{00}$	C/N
			20	10–20	5–10	2–5	S.G.	S.F.	L.G.	L.F.	A.				
0–5	53,8	46,2	10,1	9,6	9,4	24,7	60,3 27,9	9,8 4,5	4,5 2,1	10,3 4,8	11,3 5,2	4,4	37,3	2,88	12,9
5–10	64,9	35,1	14,1	13,4	20,1	17,4	51,3 18,0	8,7 3,1	4,4 1,5	18,9 6,6	13,3 4,7	4,4	38,1	3,17	12,0
10–15	84,6	15,4	13,2	30,3	25,6	15,5	72,8 11,2	6,9 1,1	1,2 0,2	9,2 1,4	9,4 1,5	4,5	19,4	1,44	13,5
15–20	85,1	14,9	10,2	23,5	31,3	20,2	74,6 11,1	7,0 1,0	1,9 0,3	7,3 1,1	7,8 1,2	4,5	13,8	0,90	15,3
0,5	74,3	25,7	16,8	9,6	17,6	30,3	69,4 17,8	6,7 1,7	2,6 0,7	9,7 2,5	10,8 2,7	4,5	16,4	0,98	16,7
5,10	65,1	34,9	20,0	18,3	11,7	15,2	41,4 14,4	11,9 4,2	20,7 7,2	6,1 2,1	17,2 6,0	4,5	25,4	1,03	13,8
10–15	80,5	19,5	20,6	27,4	17,8	14,8	51,9 10,1	10,8 2,1	3,0 0,6	15,5 3,0	14,3 2,8	4,5	18,2	1,61	11,3

BIBLIOGRAPHIE

BAUDIÈRE, A., GESLOT, A., GHIGLIONE, C., NÈGRE, R., 1973. La pelouse à *Festuca eskia* en Pyrénées centrales et orientales. Esquisse taxinomique et écologique. *Acta botanica Acad. Scien. Hung.*, 19(1–4): 23–35.

BAUDIÈRE, A., et SERVE, L., 1971a. Organisation morphologique et rôle des végétaux dans la dynamique des formations superficielles en milieu supraforestier. *Bull. Soc. bot. Fr.*, **118**: 77–94.

BAUDIÈRE, A. et SERVE, L., 1971b. Recherches sur les teneurs en carbone organique des sols de haute montagne dans le bassin méditerranéen occidental. *Coll. interdisc. Mil. nat. supraf. Mont. Bass. Occ. Médit.*: 147–169.

BAUDIÈRE, A. et SERVE, L., 1971 (1975). Les groupements à *Festuca durissima* (Hack). Rouy du Massif du Puigmal et leur signification. *Actes 96° Congr. nat. Soc. Sav.-Sect. Géogr.*: 91–111 TOULOUSE.

BAUDIÈRE, A. et SERVE, L., 1974. Les groupements oroméditerranéens des Pyrénées orientales et leurs relations avec les groupements similaires de la Sierra Nevada. *Coll. intern. C.N.R.S.* **235**.– La Flore du Bassin Méditerranéen, Essai de Systématique synthétique: 457–468.

BAUDIÈRE, A. et SERVE, L., 1975a. Les groupements à *Carex curvula* All. subsp. *curvula* des Pyrénées orientales et leur interprétation phytogéographique. *Doc. phytosociol.*, **9–14**: 1–8.

BAUDIÈRE, A. et SERVE, L., 1975b. Les groupements végétaux du Pla de Gorra-Blanc (Massif du Puigmal-Pyrénées orientales) – Essai d'interprétation phytosociologique et phytogéographique. *Naturalia monspeliensia*, Sér. bot. **25**: 5–21.

BRAUN-BLANQUET J., 1948. La végétation alpine des Pyrénées orientales. Etude de phytosociologie comparée. *Monog. Est. Est. pir. y Instit. esp. Edaf., Ecol. y Fisiol. vég.* 1–306. Barcelona.

BRAUN-BLANQUET J., 1954. La végétation alpine et nivale des Alpes françaises. *Comm. S.I.G.M.A.* **125**: 1–72.

FRODIN J., 1924. Les associations végétales des hauts pâturages pyrénéens. Etudes sur leurs affinités et sur leurs rapports avec les mouvements du sol dans les Pyrénées. *Bull. Soc. Hist. nat. Toulouse*, **52**: 21–51.

FROMARD F., 1978. Recherches sur la dynamique de la végétation des milieux supraforestiers pyrénéens: la Vallée de Soulcem (Haute-Ariège). *Th. Doct. 3ème cycle.* Univers. Toulouse **III**: 159 p.

JALUT G., 1973. Evolution de la végétation et du climat de l'extrêmité orientale des Pyrénées pendant le Tardiglaciaire et le Postglaciaire. *Bull. Ass. fr. Et. Quat.*, **2**: 55–68.

NÈGRE R., 1969. Le *Gentiano-Caricetum curvulae* dans la région luchonaise (Pyrénées centrales). *Vegetatio* **18**(1–6): 167–202.

RIVAS-MARTINEZ S., 1969. La végétation de la alta montana espagnola. *V° simposio Flora europaea. Public Univ. Sevilla:* 53–80. 9 tabl. h.t.

SERVE L., 1972. Recherches comparatives sur quelques groupements végétaux orophiles et leurs relations avec la dynamique périglaciaire dans les Pyrénées-Orientales et la Sierra Nevada. *Th. Doct. Spéc.* Montpellier, 335 p., 16 pl. Ph. h.t.

SOUTADÉ G., 1970a. Formes de 'figuration' de la bordure orientale du Pla Guillem (P.O.). *Actes 94° Congr. nat. Soc. Sav.* Pau 1969: 17–25.

SOUTADÉ G. 1970b. Exhumation de sols polygonaux et dégradation de la pelouse d'altitude sur le Pla de Gorra-Blanc (2450 m), Massif du Puigmal, Pyrénées méditerranéennes. *Bull. Ass. Geogr. fr.*, **384**: 259–276.

SOUTADÉ G., 1971. Modelés supra-forestiers et variations climatiques récentes sur le contrefort occidental du Massif du Puigmal (Pyrénées méditerranéennes). *Coll. interdisc. Mil. nat. suprafor. Mont. Bass. occ. Médit.*: 111–134.

SOUTADÉ G., 1973. Un exemple de surface de régradation lente en milieu de biostasie: le Pla Guillem, 2200–2300 m (Haut-Vallespir, Pyrénées Orientales). *C.R. Ac. Sci. Paris*, **276**: 2137–2138.

SOUTADÉ G., 1975. Effets phytogéographiques et géomorphologiques de l'emprise et de la déprise pastorale à la Costa del Palm (Capcir-Pyrénées-Orientales). *Mélanges offerts à Georges Viers*, **2**: 499–514.

SOUTADÉ G. 1976. Lambeaux de pelouse et dépots sablo-limoneux d'altitude sur les hautes surfaces cristallines (plas) des Pyrénées orientales. *Méditerranée*, **I**: 35–50.

SOUTADÉ G., 1978. Modelé et dynamique actuelle des versants supra-forestiers des Pyrénées orientales. *Th. Univ. Bordeaux* 111, 559 p., 121 fig. h.t., 63 pl. phot. h.t.

SOUTADÉ G. et BAUDIÈRE A., 1970. Vegétation et modelés des hauts versants septentrionaux de la Sierra Névada. *Ann. Géogr.*: 709–736.

SOUTADÉ G. et BAUDIÈRE A., 1973. Mutations phytogéographiques et variations climatiques durant l'Holocène dans les Pyrénées méditerranéennes françaises. Actes IX° Congr. intern. INQUA-Christchurch. *Suppl. Bull. Ass. fr. Et. Quat.*, **36**: 90–93.

VIERS G., 1971. L'englacement quaternaire des Pyrénées orientales et ses problèmes climatiques. *Actes Coll. interdisc. Mil. nat. supraf. Mont. Bass. occ. Médit*: 57–64. Perpignan.

EINE NEUE CULCASIA-ART (ARACEAE) AUS GABON

J. BOGNER

Botanischer Garten, München

SUMMARY

Culcasia rotundifolia Bogner is described as a new species. It is different from all other species of this genus by its roundish and reddish leaf blades as well as the few female flowers, which are mostly arranged in one circle or seldom in two circles, but sometimes the female flowers are reduced to one or a few only.

Sterile Exemplare dieser neuen *Culcasia*-Art wurden bereits 1968 von N. HALLÉ und J. F. VILLIERS in Gabon gesammelt. Im November 1973 konnte ich die gleiche Art ebenfalls in Gabon sammeln, aber es waren keine blühenden Pflanzen zu finden. Die lebend nach München gesandten Exemplare haben inzwischen mehrmals im Botanischen Garten geblüht, so daß es jetzt möglich ist, diese neue Art zu beschreiben.

Culcasia rotundifolia Bogner, sp. nov.

Plantae juveniles internodiis brevibus, erectae; adultae internodiis longis scandentes. Laminae foliorum rubellae, apice subuncinulatae, in plantis juvenilibus late ellipticae, in adultis rotundae basi cordatae vel reniformes. Flores masculini plerumque e duobus rarius e tribus staminibus compositi; flores feminei in verticillis singulis rarius binis interdum imperfectis; ovarium uni- vel biloculare ovulo basali singulo anatropo. Holotypus *Bogner 749* (WAG).

Jugendform aufrecht, mit breit elliptischen Blattspreiten und kurzen Internodien; Altersform kletternd, mit rundlichen Blattspreiten und langen Internodien. Internodien der Altersform 3–7 cm lang und 1–1,5 mm im Durchmesser, leicht rötlich überlaufen, am Stengel mit Haftwurzeln, diese 0,5–1 cm lang, mehr oder weniger rötlich gefärbt. Blattstiel 0,8–1,5 cm lang und 1–1,5 mm im Durchmesser, rötlich, oben abgeflacht und die beiden Ränder etwas erhaben; Scheide 0,7–1 cm lang, rötlich, in eine 1–2 mm lange, freie Spitze endend. Blattspreite der Altersform rundlich bis nierenförmig, 2–6 cm lang und etwa ebenso breit oder etwas breiter als lang, oberseits dunkelolivgrün und rötlich überlaufen, samtartig glänzend, unterseits grünlich bis rötlich; Basis herzförmig, Apex in eine kleine, 1–1,5 mm lange und oft gekrümmte Spitze endend; Nervatur netzförmig, 2 oder 3 Seitennerven 1. Ordnung beiderseits des kräftigen Mittelnervs, Seitennerven 2. Ordnung schwächer; mit punktförmigen Drüsen. Sympodium mit 2–3 Inflores-

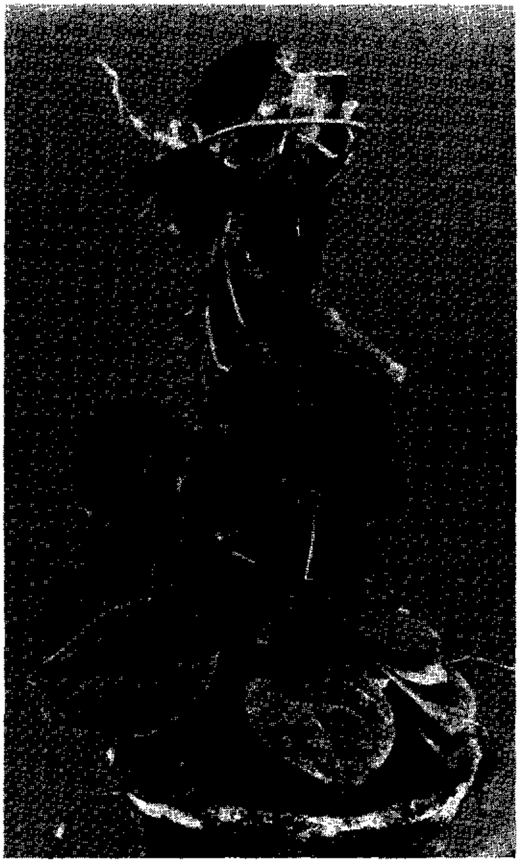


Abb. 1. *Culcasia rotundifolia* Bogner, unten die breit elliptischen Blattspreiten der Jugendform, oben die rundlichen Blattspreiten der Altersform (*Bogner 749*). Foto: J. Bogner.

zen, Niederblätter kurz, 3–5 mm lang, leicht rötlich. Pedunkulus ca. 1,5 cm lang und 1–1,5 mm im Durchmesser, grünlich bis rötlich. Spatha 1,2–1,5 cm lang, innen und außen hellgrün bis leicht rötlich überlaufen, in eine kurze, rötliche Spitze endend, während der Anthese geöffnet, nachher wieder schließend. Spadix 1–1,2 cm lang, gestielt, Stiel 3–4 mm lang und 1–1,5 mm dick, hellgrün; weibliche Blüten meist nur in einem Kreis, seltener in zwei Kreisen übereinander angeordnet, manchmal auch auf eine oder wenige Blüten reduziert; männlicher Abschnitt 5–6 mm lang und 3–3,5 mm im Durchmesser, gelblich, oben gerundet. Männliche Blüten aus meist 2, seltener aus 3 Stamina bestehend; Stamen trunkat, mehr oder weniger rhombisch (in Aufsicht, oft unregelmäßig geformt), ca. 1 mm hoch und 0,7–1,5 mm im Durchmesser, Theken seitlich am dicken Filament sitzend, mit einem breiten Spalt apikal öffnend; Pollenkörner kugelig, 25–30 µ im Durchmesser, inaperturat, Exine warzig. Ovar flachkugelig, 1,2–2 mm im Durchmesser, hellgrün, ein- bis zweifächerig, mit einer Samenanlage je Fach; Samenanlage anatrop, ca. 0,5 mm lang, mit kurzem Funikulus, Plazentation basal; Narbe diskusförmig, sitzend, ca. 1 mm im Durchmesser, gelblich, papillös. Beeren

ABB. 2. *Culcasia rotundifolia* Bogner, blühende Pflanze (*Bogner 749*). Foto: J. BOGNER.

flachkugelig bis kugelig, 0,8–1 cm im Durchmesser; Samen kugelig, ca. 0,6 cm im Durchmesser, Testa glatt. Chromosomen 2n = 42.

Gabon: bei Mbel, ca. 60 m, im Regenwald, 26. Nov. 1973, *Bogner 749* (Holotypus WAG, Isotypen K, M); Monts de Cristal, 15. Febr. 1968, *N. Hallé et J. F. Villiers 5283* (P); Monts de Cristal, Gongolane, plus de 2 m haut, *N. Hallé et J. F. Villiers 4678* (P); Monts de Cristal, route de Kinguélé, 16. Jan. 1968, *N. Hallé et J. F. Villiers 4476* (P); auch bei M'Voum vorkommend (nach BOGNER).

Culcasia rotundifolia unterscheidet sich von allen anderen Arten dieser Gattung durch ihre rundlichen und rötlichen Blätter sowie den wenigen weiblichen Blüten, die meistens in einem Kreis angeordnet sind oder seltener in zwei Kreisen, aber manchmal können die weiblichen Blüten auf eine oder nur ein paar reduziert sein.

ABB. 3. *Culcasia rotundifolia* Bogner, blühende Pflanze, Sympodium mit drei Infloreszenzen und kurzen Niederblättern (*Bogner 749*). Foto: J. BOGNER.

Herrn Dr. W. BARTHLOTT, Heidelberg, möchte ich für die rasterelektronenmikroskopischen Aufnahmen der Pollenkörner vielmals danken, ferner Herrn J. C. ARENDS, Wageningen, für die Zählung der Chromosomen sowie Fräulein H. G. D. ZEWALD für die Anfertigung der Tafel, Herrn Dr. A. KRESS, München, für die Übersetzung der lateinischen Diagnose.

LITERATUR

ENGLER, A. 1905. *Araceae-Pothoideae* in A. ENGLER, Das Pflanzenreich IV. 23 B (Heft 21). Leipzig: Engelmann.

HEPPER, F. N. 1967. *Culcasia scandens* P. Beauv. (*Araceae*) and allied species in West Africa. Kew Bulletin **21**: 315–326.

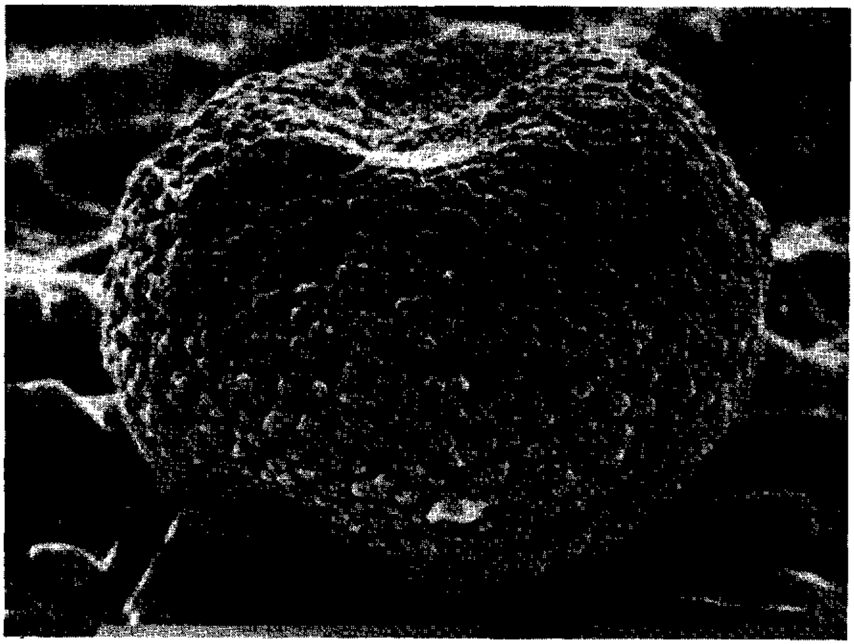


ABB. 4. *Culcasia rotundifolia* Bogner, Pollenkorn, ca. 3000 × (*Bogner 749*). Foto: W. BARTHLOTT.

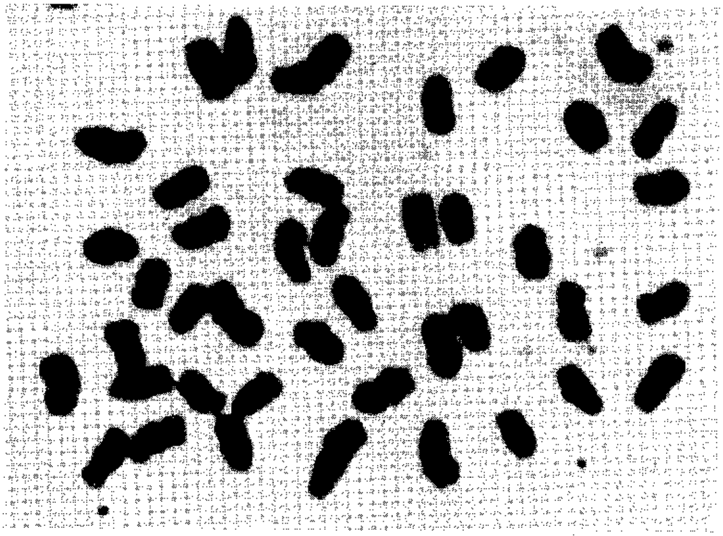


ABB. 5. *Culcasia rotundifolia* Bogner, somatische Chromosomen, 2n = 42, Wurzelspitze, Orceinfärbung, 3000 ×, Dauerpräparat *4–88*, ARENDS, WAG.

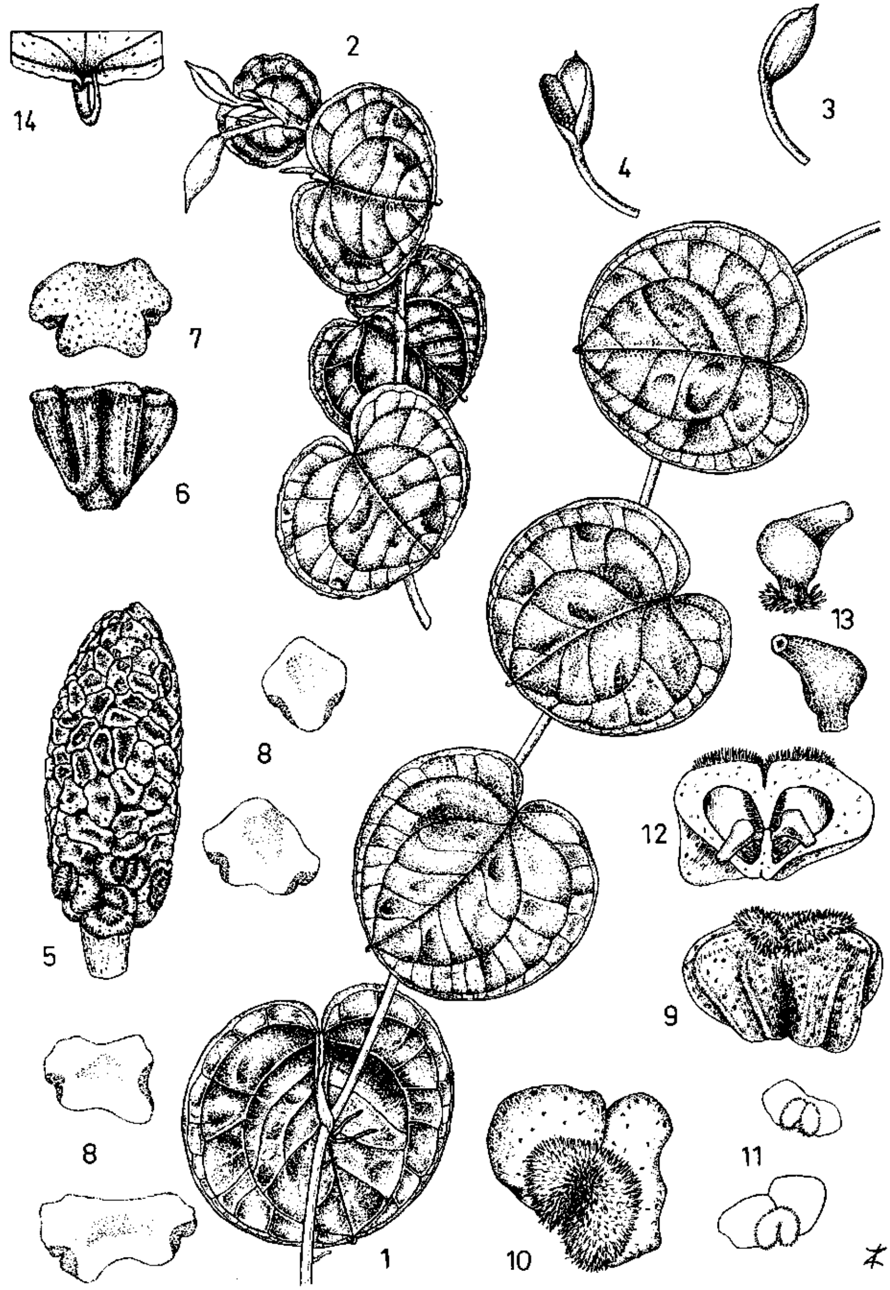

14
2
3
4
7
6
13
5
8
12
9
8
11
1
10

Abb. 6. *Culcasia rotundifolia* Bogner – 1. Sproß mit adulten Blättern (2/3 ×); 2. Sproß mit drei Infloreszenzen (2/3 ×); 3. Infloreszenz mit geschlossener Spatha (2/3 ×); 4. Infloreszenz mit geöffneter Spatha (2/3 ×); 5. Spadix (4 ×); 6. Stamen von der Seite gesehen (12 ×); 7. Stamen von oben gesehen (12 ×); 8. mehrere Stamina (schematisch) von oben gesehen, oft unregelmäßig geformt (12 ×); 9. weibliche Blüte von der Seite gesehen (12 ×); 10. weibliche Blüte von oben gesehen (12 ×); 11. weibliche Blüten (schematisch) von oben gesehen (10 ×); 12. Längsschnitt durch das Ovar (12 ×); 13. Samenanlagen von verschiedenen Seiten gesehen (24 ×); 14. Blattspitze von oben gesehen (4 ×). – 1–14 von *Bogner 749*. Zeichnung: H. G. D. Zewald.

DRACAENA SURCULOSA LINDL.

J. J. Bos

Laboratory of Plant Taxonomy and Plant Geography, Agricultural University, Wageningen
The Netherlands

SUMMARY

This paper is a first issue of a forthcoming monograph on the genus *Dracaena* L. (*Liliaceae*), a subject suggested to me by Prof. dr. H. C. D. DE WIT. A general outline of particular problems in revising *Dracaena* is given and sampled with a treatment of *D. surculosa* Lindl. This species is delimitated from closely resembling species by means of a provisional key, its division into two varieties is critically revised. The delimitation of the varieties is altered and HOOKER F.'s varietal epitheton '*maculata*' is reinstated. Both varieties are described and illustrated, distribution maps are given, and a key to the varieties is added.

From its establishment by LINNAEUS in 1767 (Syst. Nat. ed. 12, II: 246/Mant. Pl. I: 9) the genus *Dracaena* has been invariably mixed up with the genus *Cordyline* Commers. ex Juss. (nom. cons.). When in 1851 PLANCHON endeavoured to revise the highly confused situation, he unfortunately placed a majority of true *Dracaenas* in the genus *Cordyline*, maintaining a few species around *D. draco* (L.) L. in *Dracaena* and referring the true *Cordyline* species to four other genera, viz. *Dracaenopsis* and *Calodracon* of himself, *Charlwoodia* Sweet and *Cohnia* Kunth. Although KOCH and REGEL, and eventually BAKER, have greatly contributed to reassemble the genus *Dracaena* with its proper species, they have not been able to convince the contemporary horticulturists. Horticulture adopted the name *Dracaena* for the combined genera *Dracaena* and *Cordyline*. The tremendous popularity of variegated indoor ornamentals in the last quarter of the last century resulted in the production of thousands of forms of variegated *Cordylines*, of which the commercially more promising clones were usually provided with an often validly published latin binomial in *Dracaena*. Tracing such names is hampered by the fact that they have often been published in rather obscure ephemeral publications like catalogues, horticultural periodicals or even as advertisements in newspapers, usually with full details as to their purchase prize but invariably with an inadequate description in superlatives.

It is remarkable that horticulturists themselves have not separated both genera, as red or reddish variegation so common in *Cordyline* was not yet recorded in true *Dracaenas* in those days, while the usually obvious pinnate character of *Cordyline* nervature does not occur in parallel-nerved *Dracaena*. Essential differences as the pluriovulate ovary cells of *Cordyline* versus the uniovulate cells in *Dracaena* were obviously too technical to be used. This confusion has remained more or less till our days.

When in 1914 BROWN was completing his revision of *Sansevieria* Thg (nom. cons.), he was unable to separate this genus from *Dracaena* in a satisfactory manner. He therefore proposed to divide *Dracaena* into two genera, in order to delimitate *Sansevieria* against each of them. For this purpose he revived *Pleomele* Salisbury, originally based on a species of *Dracaena* and one of *Sansevieria*, and amended this in such a manner as to accomodate the bulk of the *Dracaena* species, leaving only a few close relatives around *D. draco* in *Dracaena*, without reference to PLANCHON's more or less similar view. This division of *Dracaena* has proved to be unsatisfactory and has been rejected almost universally by now.

Dracaena surculosa which is treated here, is rather illustrative for some of the problems briefly outlined above. It is a West-African representative of the *Dracaena* species with more or less elliptic leaves. It may be distinguished from closely resembling species with the following provisional key:

1. Inflorescence branched.
  2. Flowers distributed solitary along the branches of the inflorescence.
    3. Perianth tube about half as long as the free lobes (Asia, ? Madagascar) . . . . **D. elliptica** Thg.
    3. Perianth tube very short, lobes only fused at their very base (Centr. & E. Africa) . . . . **D. laxissima** Engl.
  2. Flowers arranged in glomerules along the branches of the inflorescence (African cont.) . . . . **D. camerooniana** Bak.
1. Inflorescence not branched.
  4. Inflorescence short, contracted, flowers sub-capitate.
    5. Leaves usually less than 15 cm long and 4 cm wide, fruits less than 1 cm in diam. (Centr. Africa) . . . . **D. capitulifera** De Wild. & Th. Dur.
    5. Leaves usually over 15 cm long and 4 cm wide, fruits over 1 cm in diam. (W. Africa). . . . . **D. ovata** Ker-Gawl.
  4. Inflorescence elongate, flowers in one or more clusters.
    6. Inflorescence pendulous; pseudopetioles over 1 cm long, if shorter, then with few pairs of distinctly impressed nerves aside of the midrib on the upper surface of the leaf (W. & Centr. Africa). . . . . **D.** cf. **camerooniana** Bak.
    6. Inflorescence not pendulous; pseudopetioles less than 1 cm long, only the midrib impressed on the upper surface of the leaf (W. Africa, cultivated elsewhere). . . . . **D. surculosa** Lindl.

(Asiatic plants often identified as *D. spicata* Roxb. should possibly be included here, buth their leaf dimensions are generally well beyond the range of those of *D. surculosa*).

As it is treated here, *D. surculosa* comprises two varieties: var. *surculosa* and var. *maculata* Hook. f. The distribution of var. *maculata* covers the entire area of the species, i.e. from western Cameroun to Guinée, while the var. *surculosa* has not been collected in the westernmost part of the area. Specimens of a somewhat intermediary character as reported by HEPPER seem to be confined to localities at the westernmost limit of var. *surculosa*, in Liberia and Sierra Leone. Where both varieties occur together they are so markedly and constantly distinct that, disregarding the Liberian and Sierra Leonean specimens referred to, they could very well be regarded as distinct species. Variegation occurs in both varieties, albeit of a different nature. LINDLEY proposed *D. surculosa* in 1828 on the evidence of cultivated material originating from Sierra Leone. He expressed some doubt as to its proper station in *Dracaena*, but as he was not acquainted with the fruit he declined to give it a separate generic status. Several authors shared this view, but only RAFINESQUE proposed the genus *Nemampsis* for it.

In 1867 a variegated form was described as a new variety by the younger HOOKER, at least partly on the evidence of herbarium material collected by MANN. Although the drawing with the protologue is somewhat misleading as to the nature of the variegation, the preserved original herbarium material is conform the character outlined hereafter.

Although HOOKER F. based his variety solely on the fact that it was variegated, scrutiny of his description of typical *D. surculosa* reveals that this is conform the circumscription of the var. *maculata* as presented hereafter. This indicates in my opinion that HOOKER F. was unaware of the true character of var. *surculosa* at that time. Field observations indicate a much lower rate of occurrence for var. *surculosa* as compared to var. *maculata* and herbarium collections at present contain three to four times as much specimens of the var. *maculata* as of var. *surculosa*.

In 1892 variegated plants of var. *surculosa* were discovered in Nigeria and the horticultural firm of messrs. SANDER of St. Albans acquired live material of it. Cultivated plants from this origin were presented by SANDER at the Ghent Quinquennial Exhibition in April 1893. He had named them *D. godseffiana* in honour of JOSEPH GODSEFF, the manager of his nursery. The plants formed part of a competitive exhibit of 'new plants, not before in cultivation'.

SANDER won this competition, but his victory was contested by his rival LINDEN, who stated that SANDER's *D. godseffiana* was no other plant than *D. surculosa* Lindl. var. *maculata* Hook.f. A vehement dispute ensued with the horticultural world taking sides, well illustrated by a number of articles in Möller's Deutsche Gärtner Zeitung of 1893, where even name-calling was not shunned. The issue was finally decided when BAKER, after studying fertile material, accepted *D. godseffiana* Sand. as a new species apart from *D. surculosa*.

It should be pointed out that BAKER's concept of *D. surculosa* conforms the younger HOOKER's description of it (i.e. *D. surculosa* var. *maculata*) and consequently BAKER retained the name *D. godseffiana* for what rightfully should be *D. surculosa* var. *surculosa*.

Following the view of DURAND and SCHINZ, HUTCHINSON treated *D. godseffiana* as a synonym of *D. surculosa*, without distinguishing infraspecific taxa. HEPPER, however, proposed to place plants with a single terminal glomerule of flowers to the inflorescence in his new variety *capitata*. Unfortunately this character, though often in evidence, is not sufficiently indicative, as is demonstrated hereafter. The fact that the type of HOOKER F.'s var. *maculata* does have a second, biflowered glomerule in the inflorescence, possibly accounts for the new varietal name proposed by HEPPER, but its other characters make it clearly convarietal with HEPPER's taxon.

D. surculosa Lindl.

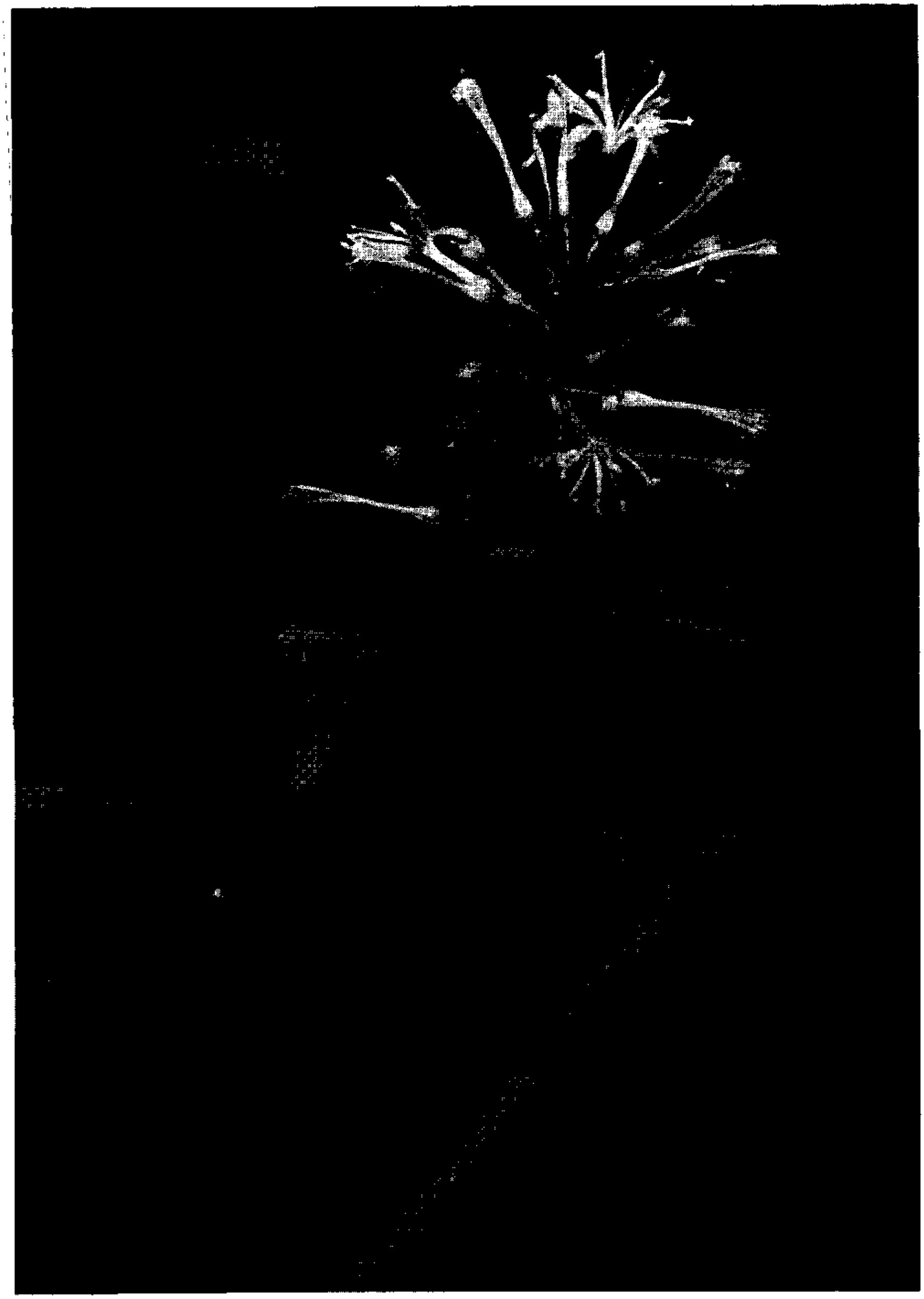
For literature, synonyms and typification see under the varieties.

Diagnostic characters: Glabrous shrubs up to 8 m tall, with more or less tuberous roots producing *Asparagus*-like canes clad in sheathing prophylls and topped by a pseudowhorl of green or variegated elliptic leaves with a short, usually 5–10 mm long pseudopetiole, its base clasping the stem for half its circumference. Inflorescence simple, up to 18 cm long, unbranched, with a terminal glomerule of up to 50 pedicellate flowers and up to 7 few-flowered glomerules in the distal part. Pedicels distinctly jointed. Flowers diaphanous, whitish, fragrant and nocturnal. Perianth fused into a tube for about half its length. Fruit a globular or lobed berry up to 2 cm in diam., bright orange and containing up to 3 seeds.

Description: Glabrous *shrubs* of modest proportions about 1 m high or up to 4(–8) m. *Roots* usually more or less tuberous, about 1 cm in diam., or distinctly so (i.e. 13 × 4 × 3 cm), reddish brown. *Rootcrown* well developed, periodically producing *Asparagus*-like *canes* up to 1 cm or more in diam., proportional to their length. The canes usually overreaching earlier formed aerial parts, the tallest often more or less sarmentose, dark green when young, at length shiny medium brown, densely clothed in greenish-white diaphanous closely sheathing prophylls and topped by a pseudowhorl of a small number of leaves borne in a horizontal plane. Growth may continue monopodially in a similar fashion, but older canes produce lateral branches up to a few mm in diam., which bear fewer-leaved pseudowhorls arranged in one plane with the horizontal branch.

Prophylls on canes and branches are triangular, up to 9 cm long, deciduous or persistent for some time, showing parallel nervature, their bases encircling the stem completely or nearly so, leaving an annular scar. They may produce tiny drops of nectar dorsally on developing canes and inflorescences. Persistent prophylls and more rarely leafbases are in some instances pierced by developing branches or inflorescences from their axillary buds.

Leaves elliptic, the widest part almost exactly in the middle, (1.5–)4–18(–20) × (0.5–)1.5–6(–7) cm, margins smooth to slightly rough, entire, acuminate to more or less cuspidate, tipped by a short subulate mucro (often lost in herbarium); base cuneate- to almost rounded-attenuate into a short pseudopetiole (2–)5–10(–13) mm long and (1–)2–5(–8) mm wide, and abruptly widening to embrace the stem for about half its circumference, fresh leaves coriaceous to thinly so, rather waxy, glossy bright to dark



Dracaena surculosa var. *surculosa* – *Bos 10400*, culta WAG. – Phot. J. W. MUGGE.

green concolourous or variegated with white to yellowish or light green dots, rings or fused patterns, not always distinct on the lower surface, nerves indistinct above, the midrib being indicated by a sharp depression along its length, the midrib prominent but narrow beneath, the parallel nervation visible. In herbarium leaves distinctly thinner, stiff and leathery to rather flimsy-papery, nerves prominent on both faces, about 1 mm apart, the midrib quite similar to the adjacent nerves but distinctly more prominent below. Secondary nerves sometimes also prominent or distinct, traversing the primary nerves in weak wavy lines towards the margin.

Inflorescences produced in the same fashion as the vegetative shoots, monopodial-terminal on canes or branches, but also axillary from leaf or prophyll axils, straight, unbranched, if terminal continuous to the direction of the supporting shoot, 2–18 cm long, 0.5–2 mm in diam., clothed in up to 20 appressed prophylls, 1–22(–55) × 1–4(–16) mm. Flowers arranged in a 5–45-flowered terminal glomerule, 0–7 few(1–5)-flowered lateral glomerules may be present on the distal part of the inflorescence as well. *Bracts* may be present especially on the outside of glomerules, their size and presence diminishes towards their centre, where they may be absent, 3–13 mm long, 1–3 mm wide, of similar nature as the prophylls.

Pedicel jointed, either above or below the middle, basal part (1–)2–4(–7) mm long, (0.2–) ± 0.5(–0.8) mm in diam., in fruit even up to 8 mm long and 1 mm wide, it may bear a flimsy subulate bracteole of 1–2(–3) mm, usually absent in the central flowers of a glomerule; the upper part variable in length, it may continue to increase in length up to the fruiting stage, 1–16 mm long at anthesis, up to 25 mm in fruit.

Flowers 14–26 mm long, subject to accelerated stretching of the buds into anthesis; *perianth* fused into a tube 7–12 mm long with two series of three segments 6–16 mm long, to slightly over 2 mm wide, gracefully curled back in fully expanded flowers, with very delicate diaphanous fleecy margins, flowering nocturnally, anthesis in the late afternoon, withered the next morning, colour greenish- to pure white, fragrant. *Stamens* 6, opposite the perianth lobes. Filaments in the lower part fused with the perianth tube for its entire length, the free upper part subulate, slightly inflated when fresh, up to 0.5 mm wide, usually collapsed and knotty in herbarium, up to 1 mm shorter than the perianth lobes, the filiform tip bend inwards bearing an apparently dorsifixed anther. Anthers pale yellow, 1.5–3 mm long, 0.7–1 mm wide, attached in a versatile manner to the base of the connective between the thecae that have free basal lobes, dehiscence latero-trorse with slits. *Ovary* pale green, cylindrical, ± flat topped, about 2 mm long, about 1 mm wide, 3-celled, each cell completely filled by a single, hemitropic ovule. Style filiform, 0.1–0.3 mm in diam., reaching the tip of the perianth in bud, but after anthesis produced for another 1–3(–5) mm beyond the length of the perianth. Stigma capitate, clubshaped to indistinctly 3-lobed, papillate on top.

Fruit, when ripe, an orange-scarlet berry, globular to distinctly lobed, up to 2 cm in diam., containing up to three globular to semispherical, white to light brown *seeds* with bony endosperm and a short straight germ pointing to the base of the fruit.

In germination plumule and radicle are produced from the seed on the petiole of the cotyledon, the plumule develops into a short cane with prophylls, topped by a small pseudowhorl of initially often ovate leaves, the radicle develops into a small branched rootlet, but is soon pushed aside by a stouter, rather tuberous adventitious root.

Key to the varieties:

1. Leaves not variegated (or this character not available).
   2. Jointed pedicel of open flowers and fruits less than 1 cm long. . . . . **D. surculosa** var. **surculosa**
   2. Jointed pedicel of open flowers and fruits 1–2.5 cm long. . . . . **D. surculosa** var. **maculata**
1. Leaves variegated.
   3. Variegation consisting of pure white, sometimes yellowish white round dots, very sparse to very abundant and fused into one another, clearly distinct on both faces of the leaf. . . . . **D. surculosa** var. **surculosa**
   3. Variegation consisting of sparse to abundant dots, rings, or irregular fused patterns of paler to very pale green, not white, distinct above but often indistinct beneath. . . . . **D. surculosa** var. **maculata**

Dracaena surculosa Lindl. var. **surculosa** **Fig. 1: 4–6 Fig. 2: 8–9 Map 1**

LINDLEY, Bot. Reg. 14 (1828): t. 1189; SCHULTES F. in ROEMER & SCHULTES, Syst. Veg. VII-2 (1830): 1677; LOUDON, Mag. Nat. Hist. IV (1831): 384; ID., Hort. Britt. (1839) suppl.; STEUDEL, Nom. I (1840): 529; KUNTH, En. Plant. V (1850): 14; PLANCHON, Fl. Serres VI (1851): 136; KOCH, Wochenschr. IV (1861): 398; ID., l.c. X (1867): 238; HOOK. F., Bot. Mag. (1867): t. 5662 (name only); REGEL, Gartenflora 16 (1867): 389; ID., l.c. 20 (1871): 142 (name only); ID., Act. Hort. Petrop. I (1871): 143 = ID., Rev. (1871): 43 (name only); ID. ex ANDRÉ, Ill. Hort. 19 (1872): 138; BAKER, J. Bot. XII (1874): 126 (name only); ID., J. Linn. Soc. (1875): 537 (name only); ID. in THISELTON-DYER, Fl. Tr. Afr. VII (1898): 443 (name only); BENTHAM & HOOKER F., Gen. III (1883): 779; DURAND & SCHINZ, Consp. Fl. Afr. (1893): 330 (partly); ID., Et. Fl. Cong. (1896): 266 (partly); VILMORIN's Blumeng. I (1895): 1068 (name only); WATSON, Garden 51 (1897): 299; DE WILDEMAN & DURAND, Contr. Fl. Cong. I-1 (1899): 60; RÄDE, Gartenwelt 12 (1908): 232; DURAND & DURAND, Syll. Fl. Cong. (1909): 566; CHEVALIER, Bot. I (1920): 647 (only n. 19065); HOLLAND, Us. Pl. Nig., Kew Bull. add. ser. IX-4 (1922): 703 (name only); HUTCHINSON, Fl. W. Tr. Afr. ed. 1, II-1 (1936): 386 (partly); DALZIEL, Us. Pl. W. Tr. Afr. (1937): 494 (partly); PAREYS Blumeng. ed. 2, I (1958): 309; AUBRÉVILLE, Fl. For. ed. 2, III (1959): 320; IRVINE, Woody Pl. Ghana (1961): 771 (partly); HEPPER, Kew Bull. 22 (1968): 453 (partly); ID., Fl. W. Tr. Afr. ed. 2, III-1 (1968): 157 (partly); BAILEY & BAILEY, Hortus Third (1976): 398; MOUTON, Adansonia ser. 1, 15-3 (1976): 410.

Provisional type: LINDLEY, Bot. Reg. 14 (1828): t. 1189 (see note).

Homotypic synonyms: *Nemampsis terniflora* RAFINESQUE, Fl. Tellur. IV (1836): 16; *Draco surculosa* (LINDL.) O. KUNTZE, Rev. Gen. Pl. II (1891): 710; *Pleomele surculosa* (LINDL.) N. E. BROWN, Kew Bull. (1914): 278; *Dracaena maculosa* sphalm. in Gard. Chron. (1883-I): 119.

Heterotypic synonym: *Dracaena godseffiana* SANDER ex MASTERS, Gard. Chron. (1893-I): 480; DE BOSCHERE, Rev. Hort. Belg. 19 (1893): 113 (nom. nud.); ID., Ill. Hort. 42 (1895): 188; SARGENT, Gard. & For. 6 (1893): 305; WITTE, Sempervirens 22 (1893): 217; WITTMACK, Gartenflora 42 (1893): 305; LINDEN, Ill. Hort. 40 (1893): 38 (nom. nud.); ID., l.c.: 74 (in syn.); MÖLLER, D. Gärtn. Zeit. VIII (1893): 230, 275, 431; ID., l.c. XII (1897): 190, 195; BAKER, Gard. Chron. (1894-II): 212; ID., in THISELTON-DYER, Fl. Tr. Afr. VII (1898): 444; WATSON, Gard. & For. VII (1894): 363; ID., l.c. VIII (1895): 24; ID., Garden 51-I (1897): 298, t. 1115; THISELTON-DYER, Kew Bull. (1894) app. II: 39; ID., l.c. add. ser. IV (1900): 164; ROBINSON, Garden 47 (1895): 354, 369, 386; DURAND & SCHINZ, Et. Fl. Cong. (1896): 266 (in syn.); SOUTHRON, Garden 50-II (1896): 276; HUMPHRIES, Gard. Chron. (1897-I): 347, 352, 353; HOOK. F., Bot. Mag. (1898): t. 7584; DE WILDEMAN & DURAND, Contr. Fl. Cong. I-1 (1899): 60; RÄDE, Gartenwelt 12 (1908): 231; DURAND & DURAND, Syll. Fl. Cong. (1896): 266 (in syn.): WIEGAND in BAILEY, Stand. Cycl. Hort. I (ed. 1914): 1070; CHEVALIER, Bot. I (1920): 646; HOLLAND, Us. Pl. Nig., Kew Bull. add. ser. IX-4 (1922): 702; HUTCHINSON, Fl. W. Tr. Afr. ed. 1, II-1 (1936): 386 (in syn.); CHITTENDEN, Dict. Gard. II (1951): 710; PAREYS Blumeng. ed. 2, I (1958): 310; HEPPER, Kew Bull. 22 (1968): 454 (in syn.); ID., Fl. W. Tr. Afr. ed. 2, III-1 (1968): 157 (in syn.); BOOM, Fl. Kam. & Kaspl. (1968): 231; BAILEY & BAILEY, Hortus Third (1976): 398 (in syn.).

Type: the protologue, i.e. MASTERS, Gard. Chron. (1893-I): 480.

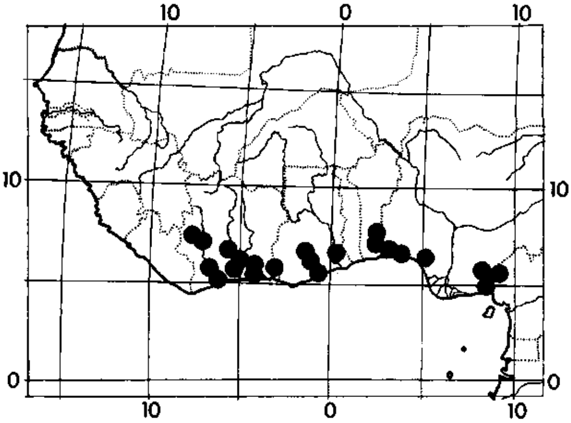
Homotypic synonym: *Pleomele godseffiana* (SAND. ex MASTERS) N. E. BROWN, Kew Bull. (1914): 278; BACKER, Fl. Jav. III (1925): 69.

Shrubs of usually modest proportions, up to 1.5(–2) m tall, roots (sub)tuberous to 1 cm in diam.; prophylls to 3.5(–5) cm long, leaves on the lateral branches often paired or in threes, rather leathery and usually fairly stiff in herbarium, very often at least slightly variegated with pure white to yellow-white dots, distinct on both faces and well preserved in herbarium; the spots entirely devoid of chlorophyll, they may be very densely distributed and fusing in some (especially cultivated) specimens. Inflorescence axis 2–9 cm long, 0.5–2 mm in diam., with 3–7(–8) clusters of flowers, very rarely only a single terminal one; axillary clusters 1–5-flowered, the terminal one (5–)7–9(–13)-flowered; pedicel 1–5(–7) mm long below the joint, 1–4 mm long above the joint, in fruit up to 5 mm long above the joint, the joint usually above the middle and the entire pedicel less than 1 cm long. Flowers usually greenish white. Fruits (7–)10–15(–20) mm long, (8–)10–20(–22) mm in diam., globose to depressed globose, not distinctly lobed when containing more than one seed, exocarp leathery, pulp rather tough, seeds semispherical

DRACAENA SURCULOSA

FIG. 1. *Dracaena surculosa* var. *maculata:* 1. flowering branch, $\frac{2}{3}$ × ; 2. flower, perianth tube slit and opened, 2 × ; 3. stamen, detail, 8 × . – (1. *De Koning 1155*, herb. & *Bos 7354*, living mat.; 2–3. *Bos 7354*, spir. coll.).

Dracaena surculosa var. *surculosa:* 4. inflorescence, $\frac{2}{3}$ × ; 5. flower, perianth slit and opened, ovary in transverse section, 2 × ; 6. style, top, 16 × . – (4–6. *Bos 10397*, herb., living mat. and spir. coll.).



MAP 1. *Dracaena surculosa* var. *surculosa*

to irregular discoid, resembling the cap of a mushroom, 4 × 6 × 8 mm to 8 × 10 × 12(–13) mm.

Distribution: Western Cameroun to Sierra Leone (type loc.), not yet reported from Liberia and Togo, usually in humid conditions in shady forest undergrowth. Variegated forms widely cultivated as ornamental foliage plants.

Notes: The type of this variety has been designated as provisional, as it is not clear at this moment whether original herbarium material from the living plant that served for the drawing has been preserved and is still extant. Such material should preferably be designated as the type, but in its absence the plate must serve as such.

D. godseffiana's protologue was based on living non-flowering specimen-plants of great commercial value exhibited by the firm of SANDER in Ghent in 1893. A year before MILLEN sent live plants from Lagos to Kew Gardens but SANDER apparently imported their stock themselves. Most herbarium specimens from cultivated *D. godseffiana* of that period preserved at Kew, originate from the MILLEN shipment, but one collection is annotated as to originate from SANDER's nursery, it was received in 1910. As these plants are normally propagated by cuttings, it is quite possible that this material is of the same clone as the plants in the Ghent exhibit, but as such it cannot serve as type material. For this reason only the protologue itself is acceptable as the type.

It remains doubtful whether completely concolorous plants of this variety exist. Prolonged scrutiny in apparently non-variegated plants often reveals one or more white dots, although truly concolorous leaves may be distinctly in majority. Herbarium material lacking white dots entirely forms a small minority, but whether this condition prevailed in the entire plant it was collected from, cannot be established.

Selected specimens:

Cameroun: 20 km W. of Mamfé (fr. April), *Letouzey 13701* (K, P, WAG).

Nigeria: Cross R. North F.R. (fr. May), *Van Meer 1691* (WAG); Oban, *Talbot 1421* (BM, K);

Calabar distr., Agoi F.R. (fl. Jan.), *Binuyo FHI45464* (K); Okomu F.R. (fl. Febr.), *Brenan 9027* (B, BR, K, P, WAG); Eluju, Shasha F.R. (fl. Febr.), *Ross 5* (BM); Ogun State, W. of Iro, *Leeuwenberg 13701* (K, P, WAG).

Benin: Pobé (fr. Sept.), *Adjanohoun 74* (K, P): Cercle de Zagnanado, Massé-Ketou (fl. Febr.), *Chevalier 23015* (P).

Ghana: Amedzofe V.R. (fl. b. Jan.), *Veldkamp 6129* (K, WAG); nr. Swedru (fl. b. Febr.), *Dalziel 8292* (K); Kade A.R.S. (fr. April), *Hall & Swaine GC 46552* (K, WAG); W. of Kade, E. of Aiyola F.R. (tubers), *Leeuwenberg 12008* (WAG); Ashanti, Bobiri F.R., E. of Kumassi, *Leeuwenberg 11966* (WAG).

Ivory Coast: Yakassé-Mé, 66 km N. of Abidjan (fr. June), *Bos 10349* (WAG); Teké, 32 km N. of Abidjan (fl. Febr.), *Bernardi 8184* (P); Mt. Mafa, SW. of Bécédi-Mbrignan, *Leeuwenberg 7943* (WAG); rég. Bingerville, Abidjan-Dabou, *Chevalier 15203* (P); Abonabou for. nr. Abidjan (fr. Jan.), *Leeuwenberg 2362* (K, WAG); Amitioro for., *Aké Assi 8381* (K); Kassa for., N'Douci-Ouroumbu Boka (fr. Oct.), *J. de Wilde 672* (WAG); 17 km SE. of Divo, *Leeuwenberg 8111* (WAG); 10 km N. of Sassandra (fr. July) *Bos 10366* (WAG), (fr. May) *W. J. van der Burg 114* (WAG), *264* (WAG), *265* (WAG), *266*,(WAG), *288* (WAG); 16 km NW. of Sassandra (fr. June), *W. de Wilde 202* (WAG); km 24 Sassandra-Lakota, *Breteler 7476* (WAG); Sassandra-Monogaga (fr. April), *De Koning 1403* (WAG); 35 km NNE. of Sassandra, Lakota rd. (fr. May), *W. J. van der Burg 161* (WAG), *162A* (WAG); between Guidéko and Zozro R. (fr. June), *Chevalier 19065* (P); km 20 Daloa-Guiglo (fr. March), *Bernardi 8516* (K, P); Ht. Sassandra, Dioandoagowe-Niangonéplen (fl. b. May), *Chevalier 21523* (P); Sangouiné for. (fl. Jan.), *Bamps 2356* (BR).

Cultivated specimens: *Hort. Brussels dd. 11.XII.1912* (fr.), (BR), *id. 4149 ex Laeken* (fr. May), *Vermoesen s.n.* (BR); *Hort. Kew 11.III.1894 ex Nigeria* (fl.), (K), *id. 18.XII.1895 ex Nigeria* (fl.), (K), *id. 1897* (fl.), (K), *id. 9.II.1898 ex Nigeria*, (K), *id. 31.XII.1910 ex Sander*, (K); *Hort. Laeken 145* (fl. Jan.), (BR), id. (fl. Jan.), *Ledoux & Hughes 643* (P); Hort. WAG (fl., fr. April) *Bos 1530* (WAG), (fl. March) *Bos s.n. 28.III.1969* (WAG), id. ex Ivory Coast (fr. Aug.), *Bos 10265* (WAG), id. ex trade (fr. Aug.) *Bos 10266 & 10267* (WAG), id. ex Ivory Coast (fl. Nov.), *Bos 10397* (WAG, spir. coll.), (fl. March) *Breteler s.n. 18.III.1959*, (WAG), (fl. Sept.), *De Bruijn 1848* (WAG).

Dracaena surculosa Lindl. var. **maculata** Hook.f. **Fig. 1: 1–3 Fig. 2: 1–7 Map 2**

Hook.f., Bot. Mag. (1867): t. 5662*; Regel, Gartenflora 16 (1867): 389; id., l.c. 20 (1871): 142*; id., Act. Hort. Petrop. I (1871): 143 = id., Rev. (1871): 43*; id. ex André, Ill. Hort. 19 (1872): 139; Masters, Gard. Chron. (1868): 236; Lemaire, Ill. Hort. 16 (1869): t. 600; Baker, J. Bot. XII (1874): 166**; id., J. Linn. Soc. (1875): 537**; id. in Thiselton-Dyer, Fl. Tr. Afr. VII (1898): 443**; Nicholson, Ill. Dict. Gard. I (1885): 491; Morren & De Vos, Bull. Féd. Soc. Hort. Belg. 1883–1885 (1887): 83; Möller, D. Gärtn. Zeit. VIII (1893): 432; Vilmorin's Blumeng. I (1895): 1068**; Chevalier, Bot. I (1920): 647 (sub *D. surculosa*, except n. 19065); Holland, Us. Pl. Nig., Kew Bull. add. ser. IX-4 (1922): 703**; Hutchinson, Fl. W. Tr. Afr. ed. 1, II-1 (1936): 386**; Dalziel, Us. Pl. W. Tr. Afr. (1937): 494**; Irvine, Woody Pl. Ghana (1961): 771**; Hepper, Kew Bull. 22 (1968): 453**; id., Fl. W. Tr. Afr. ed. 2, III-1 (1968): 157**.

Type: *Mann 2327*, Old Calabar (K: lecto, P: iso).

---

* Including the description, not the name, of var. *surculosa*.

** Sub *D. surculosa*, partly, regarding the description, not the name.

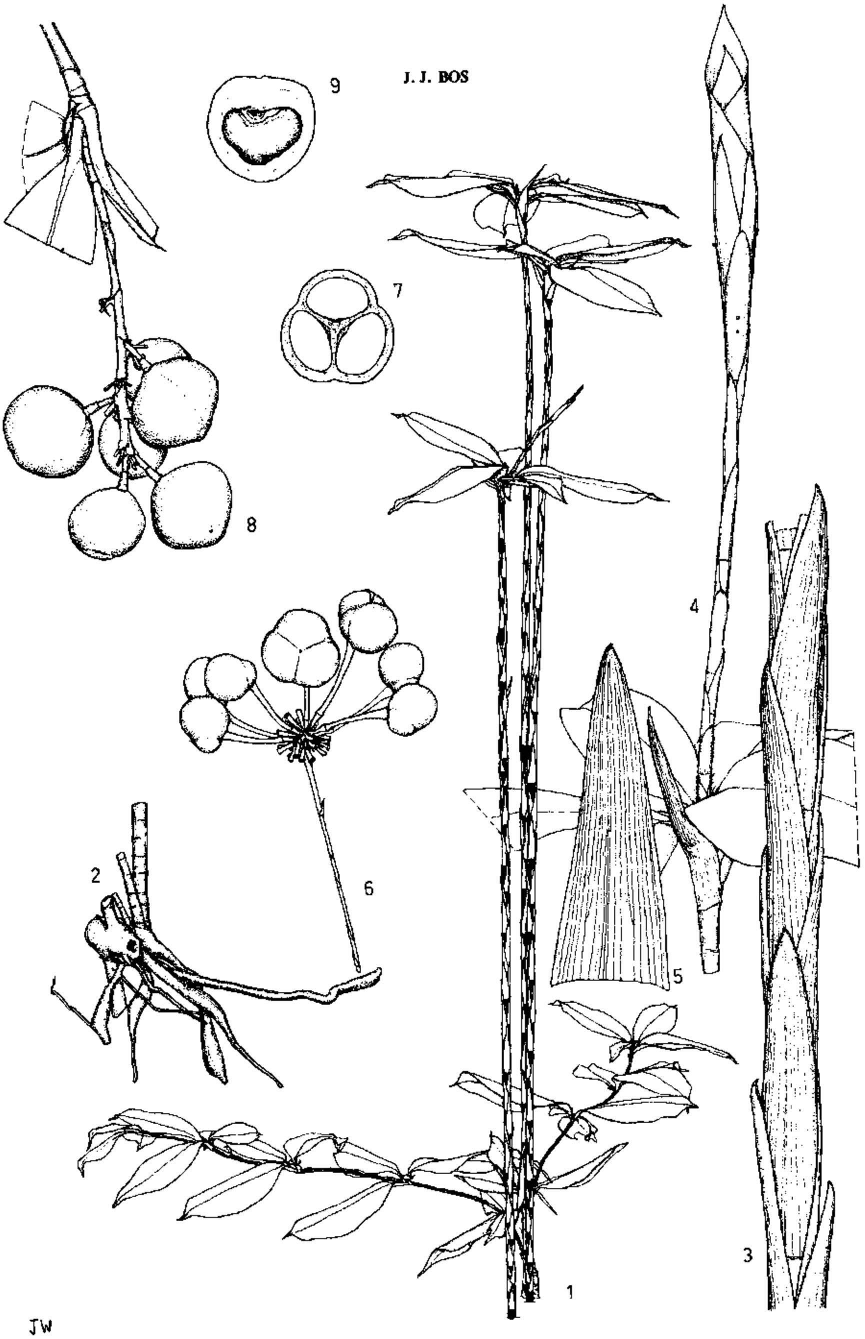


FIG.2. *Dracaena surculosa* var. *maculata:* 1. habit, $\frac{1}{6}\times$; 2. root system, $\frac{1}{3}\times$; 3. cane, detail, $\frac{2}{3}\times$; 4. developing shoot, $\frac{2}{3}\times$; 5. prophyll, $\frac{2}{3}\times$; 6. infructescence, $\frac{2}{3}\times$; 7. three-seeded fruit, in cross section, 1 ×. – (1. *Bos 10354*, living cultiv. plant; 2. *Wit and Daramola 1048*, herb.; 3–5. *Bos 10396*, living mat. and herb.; 6. *Bos 10334 A*, spir. coll. & *Beentje 451*, herb.; 7. *Bos 10334 A*, spir. coll.).

Dracaena surculosa var. *surculosa:* 8. infructescence, $\frac{2}{3}\times$; 9. one-seeded fruit, in cross section, 1 ×. – (8–9. *Bos 10265*, spir. coll.).

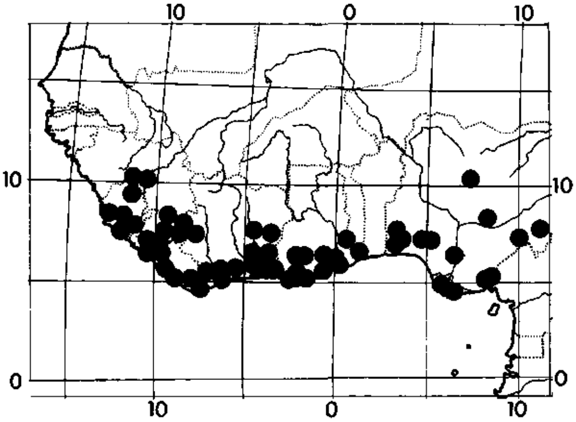
Heterotypic synonym: *Dracaena surculosa* Lindl. var. *capitata* Hepper, Kew Bull. 22 (1968): 453; ID., Fl. W. Tr. Afr. ed. 2, III-1 (1968): 159, fig. 372.
Type: *A. Whyte s.n.*, Sinoe basin (Liberia), 1904 (K: holo).

Shrubs up to 4 m, exceptionally to 8 m tall, roots tuberous, tubers to 4 cm in diam.; prophylls to 9 cm long, lateral (horizontal) branches bearing pseudowhorls of usually 3–4 leaves in a horizontal plane, all facing upwards, the leaf attached to the upper side of the branch pointing distally and consequentially with a 180° twist in the petiole. If present, variegation with dots, rings or irregular fused patterns of distinctly paler shades of green, never pure white, not always distinct in herbarium, and usually not showing on the lower face of the leaf, the variegated zones always containing chlorophyll. Inflorescence axis 3–18 cm long, about 1 mm in diam., usually with a single terminal glomerule of (10–)15–30(–45) flowers, more rarely with up to 5 few-flowered lateral clusters below the terminal one on the distal part of the axis. Pedicels (1–)2–4(–6) mm long below the joint, (4–)8–12(–16) mm long above the joint, the entire length 10–25 mm. Fruit globose, bi- or trilobed according to the number of developed seeds, 6–11(–17) mm long, 6–17 mm in diam., the exocarp fleecy, pulp thin and soft; seeds ± globular, but flattened where pressed against other seeds in more seeded fruits, 5 × 6 × 7 mm to 7 × 8 × 11 mm.

Distribution: Western Cameroun to Guinée, not yet reported from Benin republic. Habitat similar to var. *surculosa*; where they occur simultaneously, var. *maculata* usually far more numerous in individuals. Variegated forms rarely cultivated outside Botanical Gardens.

Notes: The protologue states that MANN collected this variety but that the plate was made after material provided by CLARKE form Glasgow Botanic Garden 'to whom the Royal Botanic Gardens are indebted for a fine living plant'. Some details of the plate however, are strikingly similar to MANN's specimen, i.e. the arrangement of the two miniature leaves and one large prophyll towards the base of the inflorescence axis, the cluster of two flowers away from the top glomerule, while the single fruit is identical to the one on the herbarium sheet. Under these circumstances I think it appropriate to designate the MANN specimen as lectotype.

The yellow spots on the leaves as figured in the Botanical Magazine are suspicious. They resemble the variegation found in var. *surculosa* closely and have never been encountered by me in this form in any of the living or herbarium specimens of var. *maculata*. Moreover the lectotype shows the usual form of variegation of var. *maculata*, viz. shades of paler green and hardly distinct, not contrasting white or yellow. I suspect that either the artist has exaggerated the variegation somewhat, or that the living material from CLARKE consisted at least in part of variegated var. *surculosa*. This latter supposition however, is not supported by the fact that *D. godseffiana*, the variegated var. *surculosa*, was described 26 years later, while this variety is easily cultivated and frequently flowers and fructificates in captivity. If variegated plants of var. *surculosa*



MAP 2. *Dracaena surculosa* var. *maculata*

were available in cultivation as early as 1867, they would certainly have attracted the attention of the horticultural world much sooner than 1893.

HOOKER F. clearly established his variety on the grounds that it was variegated, but according to his description of the type variety he was mistaken in the character of typical *D. surculosa*. His description depicts var. *maculata* as it is delimitated here. Within my concept of var. *maculata* I have not endeavoured to make a distinction between variegated and concolourous forms as this condition seems to vary most gradually and I am not convinced that switches from the one condition to the other never take place in the same individual plant, although I have not observed such a phenomenon.

Selected specimens:

Cameroun: Culta Bot. Gard. Victoria (fl., fr. Oct.), *Winkler 491* (B, WAG).

Nigeria: Old Calabar R. (fl., fr. Febr.), *Mann 2327* (Type: K lecto, P iso); Zaria prov., Jemoa distr., Dogon Kurmi (fr. Dec.), *Olorunfemi FHI 55661* (K); 6 mi. from Kaduna (fl. Dec.), *Meikle 782* (B, K, P, WAG); Ondo prov., Idanre F.R. (fl. Aug.), *Okafor & Daramola FHI 35293* (K); Univ. Ibadan Bot. Gard. (fl., fr. Nov.), *Van Meer 883* (WAG); Ibadan prov., Gambari F.R. (fl. Febr.), *Van Meer 601* (WAG); Ibadan distr., Ijaiye F.R. (fl. Dec.), *Wit & Daramola 1048* (WAG).

Togo: km 58 Lomé-Atakpame (fl. Sept.), *Mahoux 79* (P).

Ghana: Achimota (fl. Sept.), *Irvine 4787* (K); Asuboni R., Kwahu Nteso-Ankoma (fr. Jan.), *Enti & Hall GC 37502* (K); Atewa Range F.R., nr. Boma (fl. b. Jan.), *De Wit & Morton A 2932* (B, WAG); 2 km E. of Ampa junction, Accra-Makessim rd. (fl. Febr.), *Leeuwenberg 11100* (WAG); Ashanti (fr.), *Irvine 489* (K); Tana-Ofin F.R. (fl. b. Jan.), *Lyon 2865* (K).

Ivory Coast: 2–3 km E. of Maféré (fr. June), *Beentje 451* (WAG), (fl. b., y. fr. Sept.), *1089* (WAG); 2 km N. of Maféré (fr. June), *Bos 10352* (WAG); 8 km N. of Maféré (fl. b., y. fr. Sept.), *Beentje 1121* (WAG); 18 km NE of Ayamé (fl. b. June), *Beentje 406* (WAG); Anyama Aouabo, 24 km N. of Abidjan (fl. b., fr. May), *Thijssen 16* (WAG); Agneby R. Valley, Boguie (fl. Jan.), *Chevalier 17056* (P); Teké for. (fl. b. Aug.), *De Wit 8141* (WAG); Amitioro for. (fl. Sept.), *J. de Wilde 279* (WAG); Banco for., NW. of Abidjan (fr. May), *Bos 10334 A* (spir. coll. WAG), (fr. July), *Breteler 5212* (WAG), (fr. Jan.), *De Koning 86* (WAG), (fl. Febr.), *1107, 1152, 1155 & 1166* (WAG), (fr. April), *1557, 1571, 1602 & 1617* (WAG), (fr. May), *1645* (WAG), (fr. June), *1753 & 1776* (WAG), (fl. Sept.), *2220* (WAG), (fr. Nov.), *2595* (WAG), (fr. Dec.), *3034* (WAG), (fl. Febr.), *5394*

& 5395 (WAG), (fr. April), *5683* (WAG), (fl. b. Oct.), *W. de Wilde 1091* (B, BR, K, P, WAG), (fr. Oct.), *1091 B* (WAG), (fl. Febr.), *Leeuwenberg 2678* (WAG), (fr. April), *W. J. van der Burg 418* (WAG), (fl. July), *701* (WAG); Culta Adiopodoumé, ex Banco for. (seedl.), *De Koning 2112, 2256, 2569, 3348, 3547, 3673 & 3788* (WAG); Anguededou For., 26 km W. of Abidjan (fl. b. Febr.), *J. de Wilde & Leeuwenberg 3433* (BR, K, P, WAG), (fl. b. July), *Leeuwenberg 7921* (WAG), (fl. Sept.), *Thijssen 309* (WAG); Bouroukrou (?Dimbokro), Chem. de fer km 92 (fr. Dec.-Jan.), *Chevalier 16824* (P); 17 km SE. of Divo (y. fr. Aug.), *Leeuwenberg 8109* (WAG); km 56 Sassandra-Gagnoa (fl. b. Aug.), *J. de Wilde 335* (WAG); 15 km NW. of Sassandra (fl. b., Oct.), *Breteler 5820* (WAG), (fr. May), *7481* (WAG), (fr. April), *De Koning 1310 & 1319* (WAG); 5 km N. of Sassandra (fr. Dec.), *Leeuwenberg 2262* (WAG); Soubré (fl. b. June), *Chevalier 19142bis* (P); Moy. Sassandra-Moy. Cavally (fl. June), *Chevalier 19275* (P); Tabou, Pata Idié rd. (fr. Oct.), *De Koning 2467* (WAG); 20 km NW of Tabou (fl. Sept.), *Beentje 813* (WAG); Mt. Tonkoui, N. of Man (y. fr. Aug.), *Thijssen 195 & 213* (WAG).

Liberia: Webbo, Cavally R. (fl. April), *Dinklage 2654* (B); Ganta (fl., fr. Febr.), *Harley 906* (B); Zorzor, Loffa County (fl. July), *Bos 2215* (K, P, WAG); 12 mi. inland from R. Cess (fr. March), *Baldwin 11252* (K); Blazie (fr. Nov.), *Adam 16196* (P); 32 km SW. of Suakoko (fl. July), *Leeuwenberg & Voorhoeve 4587* (B, K, WAG); Sinoe basin (fl.), *A. Whyte s.n.* (type of *D. surculosa* Lindl. var. *capitata* Hepper, K holo); Gibi mt. (fl. Jan.), *J. Jansen 1718* (WAG); Firestone Plantation, Harbel (fl., fr. Nov.), *Stoop-van de Kasteele FS 244* (WAG), (fl. Jan.), *FS 310* (WAG), (fr. July) *FS 341* (WAG); Duport, Devilbush, 10 mi. E. of Monrovia (fl. Jan.), *Voorhoeve 776* (WAG); Bomi Hills, Gola F.R. (fl. b. Febr.), *J. Jansen 1529* (WAG), (fl. b. July), *Van Meer 103* (WAG).

Sierra Leone: sin. loc. (fl., fr.) *Afzelius ?37* (BM); Kangahun (fl. Jan.), *Morton & Jarr SL 3355* (K, WAG); Momaligi, Bonthe distr. (fl. b. Sept.), *Morton & Jarr SL 2202* (K, WAG); Guma dam, Penins. (fl. b. Jan.), *Morton SL 1622* (K, WAG); Fourah Bay Coll. Bot. Gard., Freetown (fl., fr. April), *Morton SL 1773* (K, WAG); Freetown (fl. Jan.), *Dalziel 947* (K).

Guinée: foot of mt. Nimba (fl. b. March), *Schnell 837* (P); nr. Nzérékoré (fl. June), *Jacques-Félix 955* (P).

Cultivated: *Hort. Kew* (fl., fr.), *dd. 28 III 1946* (K); Hort. Paris (fl.), *Decaisne 1871* (P); Exp. Gard. Kisanthu, Zaïre (fl. Aug.), *Vanderijst 33468* (BR); *Hort. WAG ex Ivory Coast* (fr. Sept.), *sub n. 669* (spir. coll. WAG), (fl., fr.), *Bos 7354* (spir. coll. WAG), (fl.), *7456* (spir. coll. WAG), (fl. b. Nov.) *10396* (WAG).

ACKNOWLEDGEMENTS

I am greatly indebted to Prof. dr. H. C. D. DE WIT and the staff of his Laboratory, in particular Dr. Ir. F. J. BRETELER, for their stimulating interest, useful criticism and all facilities rendered, to Prof. dr. F. STAFLEU for his advice in nomenclatural matters, and to Miss JULIET WILLIAMSON for her illustrations. The Directors of the herbaria cited, particularly those of B, BM, BR, K, and P are sincerely thanked for their kind hospitality and extensive loan of material. The author received a grant from the Netherlands Organization for the Advancement of Pure Research (Z.W.O.) for his second visit to the herbaria of Kew, London and Paris.

THE AFRICAN DICHAPETALACEAE VI

Three new species from western Central Africa

F. J. BRETELER

Laboratory of Plant Taxonomy and Plant Geography, Agricultural University, Wageningen,
The Netherlands

Western Central Africa, comprising Cameroun, Gabon, Equatorial Guinea, western Zaïre, and northern Angola, has in many instances proved to be the richest part of the tropical African forest area. This is certainly so as regards the genus *Dichapetalum* and is illustrated once more by the species described here for the first time.

In the area covered by the Flora of West Tropical Africa ca 20 species of *Dichapetalum* occur of which 5 are endemic to this area. For Cameroun these figures are 40 species with 2 endemics and for Gabon ca 50 species with 4 endemics. The number of species present decreases from Gabon to the east and south less rapidly as is the case from Cameroun towards the west. Future exploration will certainly reveal that most of the species now endemic to either Cameroun or Gabon occur in a larger area, but most probably not or hardly outside western Central Africa. Of the total number of 80 *Dichapetalum* species for Africa including Madagascar, 55 species occur in western Central Africa while almost 30 of these are endemic to this area.

D. sumbense Bret., *sp. nov.* **Fig. 1**

Frutex parva. Ramuli dense breviter appresse-pubescentes. Stipulae satis diu persistentes, subulatae, 2–8 mm longae. Folia breviter petiolata, coriacea, ovato-elliptica, 8–14 × 2–6 cm, basi late rotundata usque subcordata, apice breviter acuminata et mucronata, costa nervis lateralibus utrinque prominentibus. Inflorescentia axillaris et subterminalis, subsessilis, indistincta ramosa, pauciflora usque multiflora, puberula. Bracteae bracteolaeque 0.5–3 mm longae. Sepala oblonga, extus tomentella. Petala staminaque subaequilonga, basi in tubum 2–3 mm longum connata. Pistillum trimerum, villosum. Fructus 1–2(–3?)-spermus, distincte apiculatus, dense brunneo-velutinus. Endocarpium pergamentaceum, intus appresse-pubescens.

Type: Angola, near lower Zaïre R., Sumba Peco, *Gossweiler 8986* (holotype: K; isotypes: BM, LISJC). From the same locality: *Gossweiler 8528* (paratype: BM).

Shrublet. *Branches* with brown bark, usually with some distinct lenticels. *Branchlets* densely appressedly short-hairy, the same indumentum present on stipules and petioles.

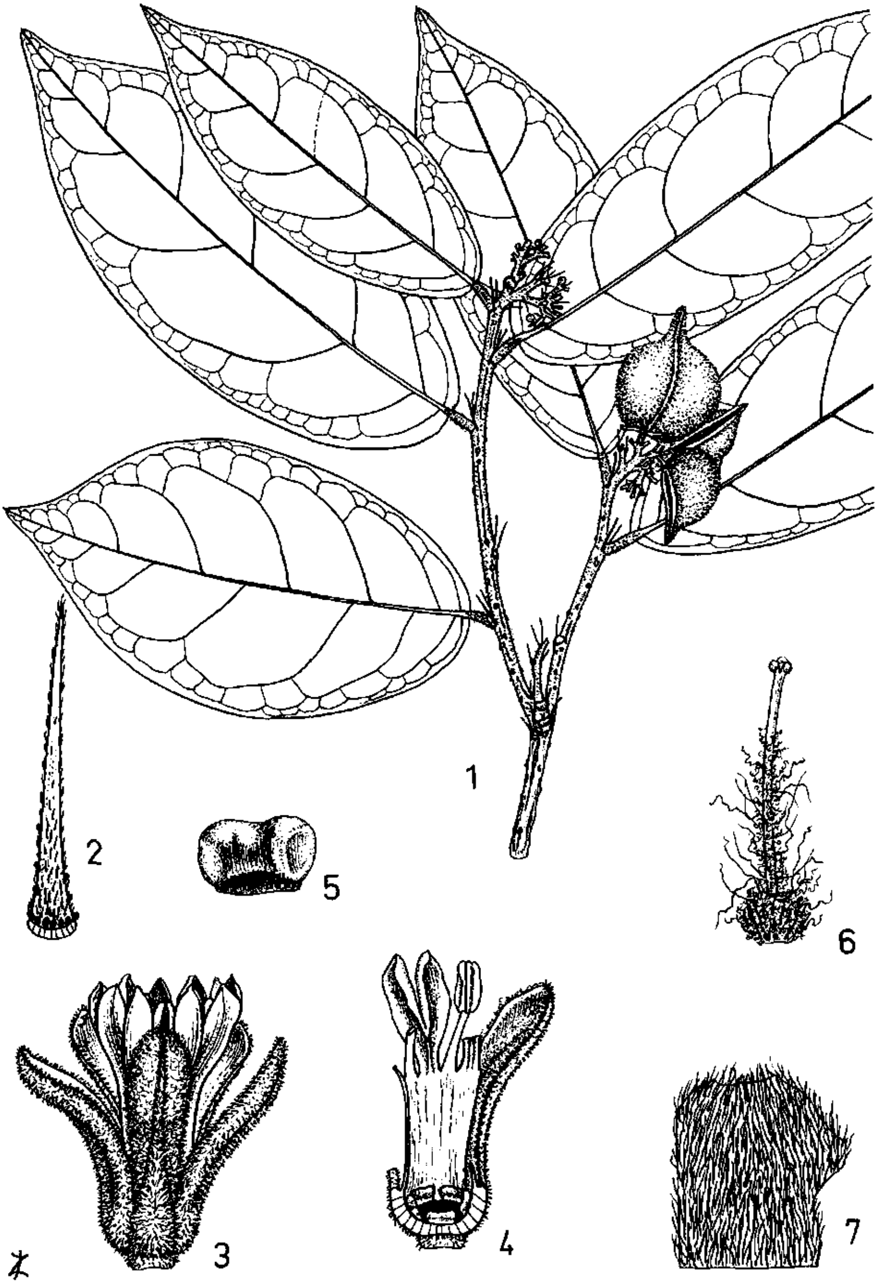


FIG. 1. *D. sumbense:* 1. fruiting branch, $\frac{5}{6}$ × ; 2. stipule inside with pimples, $8\frac{1}{2}$ × ; 3. flower, $8\frac{1}{2}$ × ; 4. flower partly, $8\frac{1}{2}$ × ; 5. staminode, 30 × ; 6. pistil, $8\frac{1}{2}$ × ; 7. fragment of endocarp inside, 5 × . (1–6. *Gossweiler 8986;* 7. *Gossweiler 8528*).

Stipules rather long persistent, narrowly triangular, subulate, 2–8 mm long. *Leaves:* petiole subterete, often grooved above, 3–7 mm long; blade coriaceous, ovate-elliptic, ca 2.5 times as long as wide, 8–14 × 3–6 cm, broadly rounded to subcordate at base, usually gradually and broadly short acuminate, the acumen ca 0.5 cm long, usually distinctly mucronate; midrib and the 6–8 pairs of main lateral nerves prominent both sides, in young leaves sparsely subappressed-hairy also on the margin, usually soon glabrescent; glands rather few, both sides or beneath only, not very distinct. *Inflorescences* axillary and subterminal, rather compact, indistinctly branched at least when flowering, subsessile, the peduncle at most 5 mm long, puberulous, few to many flowered; bracts and bracteoles narrowly triangular, 0.5–3 mm long. *Pedicel* up to 2 mm long, jointed just below calyx, i.e. the upper part 0 or nearly so. *Sepals* erect or slightly spreading, 3.5–4 × ca 1 mm, tomentellous outside, sparsely puberulous inside. *Petals* erect, united at base with stamens into a 2–3 mm long tube, narrowly obovate to spathulate in outline, 5 mm long, ca 1 mm split, glabrous or with a few hairs below split outside, lobes concave. *Stamens* erect, slightly shorter than petals, 4.5 mm long, glabrous; anthers oblong, 0.8 mm long, connective prominent. *Staminodes* transversely oblong, ca 0.5 × 0.2 mm, glabrous. *Pistil* 3-merous, 4.5–5 mm long, villous, on the ovary mixed with some stiff hairs; style glabrous at top, shortly 3-lobed. *Fruits* 1–2(–3?)-seeded, distinctly apiculate, the aborted cells present as a distinct ridge; one-seeded fruit: ovoid-ellipsoid, 1.5–2.5 cm long, 1–1.5 cm diam.; exocarp densely, shortly brown-velutinous, like sandpaper to the touch; mesocarp thin, in mature, dry fruits less than 0.5 mm thick; endocarp pergamentaceous, densely appressed-hairy inside. *Seed* ovoid-ellipsoid, ca 1.5 cm long and 1 cm diam.; seedcoat thin, brown.

Note. The taxonomic position of *D. sumbense* is rather an isolated one. By the fruit characters it shows some relationship with *D. parvifolium* Engl. Its flowers are very much like those of *D. witianum*, a species, however, which by its other characters, stands far apart from *D. sumbense*.

D. trichocephalum Bret., *sp. nov.* **Fig. 2**

Liana (?). Rami ramulique dense brunneo-velutini. Stipulae pinnati-palmiti-divisae in segmenta anguste triangularia usque subulata, lobata vel dentata. Folia obovata, 12–27 × 5–10 cm, basi obtusa usque subcordata, apice acute acuminata, juvenilia utrinque velutina. Inflorescentia capitata, dense pilosa, pedunculata, subglobosa. Bracteae bracteolaeque anguste triangularis 2.5–8 × 0.5–1.5 mm. Flores sessiles vel subsessiles. Petala suberecta, extus praesertim in lobis appresse-pubescentia, intus glabra. Pistillum trimerum, velutinum.

Type: Gabon, south of Lastoursville, Lécala, *Le Testu 8779* (holotype: WAG; isotypes: BM, P).

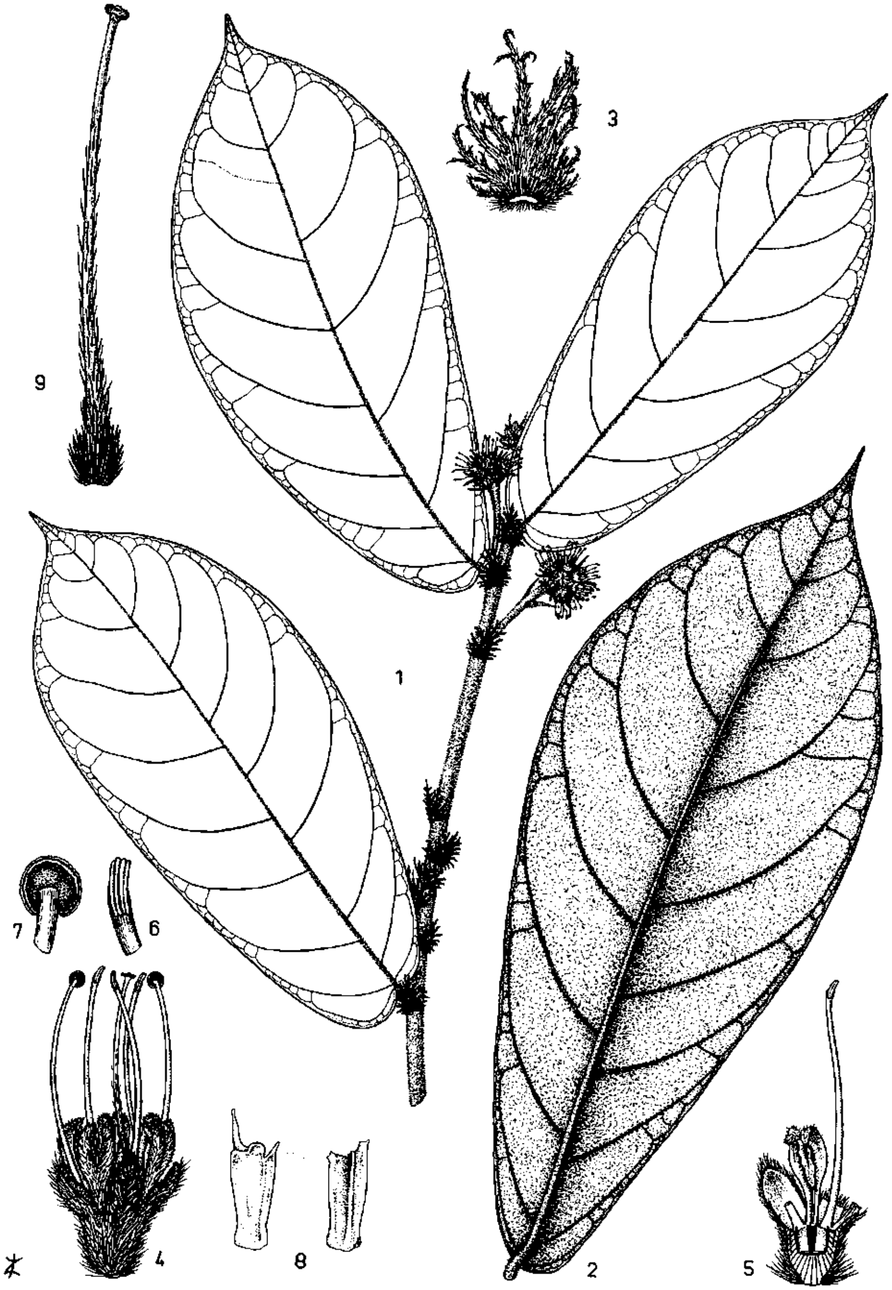


FIG. 2. *D. trichocephalum:* 1. flowering branch, $\frac{1}{2}\times$; 2. leaf beneath, $\frac{1}{2}\times$; 3. stipule inside, 2 ×; 4. flower, 4 ×; 5. flower partly, 4 ×; 6–7. anthers, 15 ×; 8. staminodes outside, 20 ×; 9. pistil, 7 ×. (1–9. *Le Testu 8779*).

Liana (?). *Branches* and *branchlets* densely brown-velutinous. *Stipules* appressed, rather long persistent, pinnately-palmately divided into narrowly triangular to subulate lobed or toothed segments, broadly subovate in outline, 9–16 × 9–14 mm, velutinous outside, strigose inside, glabrescent with age. *Leaves:* petiole subterete, 2–5 mm long, densely velutinous; blade obovate, 12–27 × 5–10 cm, 2–2.5 times as long as wide, obtuse to subcordate and usually unequal sided at base, acutely acuminate at top, the acumen 0.5–1.5 cm long; velutinous both sides when young, more densely so on midrib and main lateral nerves, soon glabrescent above usually except for the slightly impressed midrib, persistent beneath; lateral nerves 7–12 pairs, rather obscure above, prominent beneath; glands beneath only, small, obscure, often numerous, rather well dispersed. *Inflorescence* a densely hairy, stalked, subglobose head, ca 8–15-flowered; peduncle 2–3 cm long, velutinous; bracts and bracteoles usually curved, narrowly triangular, 2.5–8 × 0.5–1.5 mm, velutinous outside, usually less densely so inside, margin often dentate, the lowermost bracts sometimes situated on the peduncle, distinctly below the flowering head (see fig. 2: 1). Flowers sessile or nearly so. *Sepals* suberect, shortly united at base, oblong, 2–3 × 1 mm, densely velutinous outside, sparsely puberulous mainly on upper part inside. *Petals* suberect, at base 1 mm united with filaments into a short tube and this tube adnate to calyx, narrowly obovate in outline, 3–4 mm long, 1–1.5 mm split, appressed-hairy mainly on lobes outside, glabrous inside, the lobes concave and hood-like. *Stamens* suberect, slender, often somewhat bent, ca 6.5–8 mm long, glabrous; anthers reniform, ca 0.5 mm long. *Staminodes* more or less flat, narrowly to broadly oblong, up to ca 0.7 × 0.5 mm, glabrous, with 1–2 teeth at top. *Pistil* 3-merous, slender, ca 6.5–8 mm long; ovary velutinous; style velutinous, glabrous near top; stigma flat, obscurely 3-lobed. *Fruits* unknown.

Note. By its inflorescence and flowers *D. trichocephalum* is related to *D. reticulatum* Engl. and *D. umbellatum* Chod. It differs from these species by its strongly divided stipules, which are entire in *D. reticulatum* and in *D. umbellatum*, and by its bracts and bracteoles which are much smaller in these species.

The joint in the pedicel which is distinct in the two related species could not be observed in *D. trichocephalum*.

D. witianum Bret., *sp. nov.* **Fig. 3**

Liana. Rami sparse puberuli, glabrescentes. Stipulae mox deciduae, anguste ovato-triangulares, 2–5 mm longae. Folia obovato-elliptica, (7)9–15(18) × (3)4–7 cm, basi cuneata, apice acuminata, sparse puberula in costis et in nervis lateralibus primariis, glabrescentia. Inflorescentia pedunculata, distincte ramosa, usque ad 25-flora, puberula; bracteae bracteolaeque minutae. Sepala petala staminaque subaequilonga, ca 5–6 mm longa; pistillum trimerum, 6 mm longum; ovarium lanatum, stylo glabro. Fructus juveniles dense villosi.

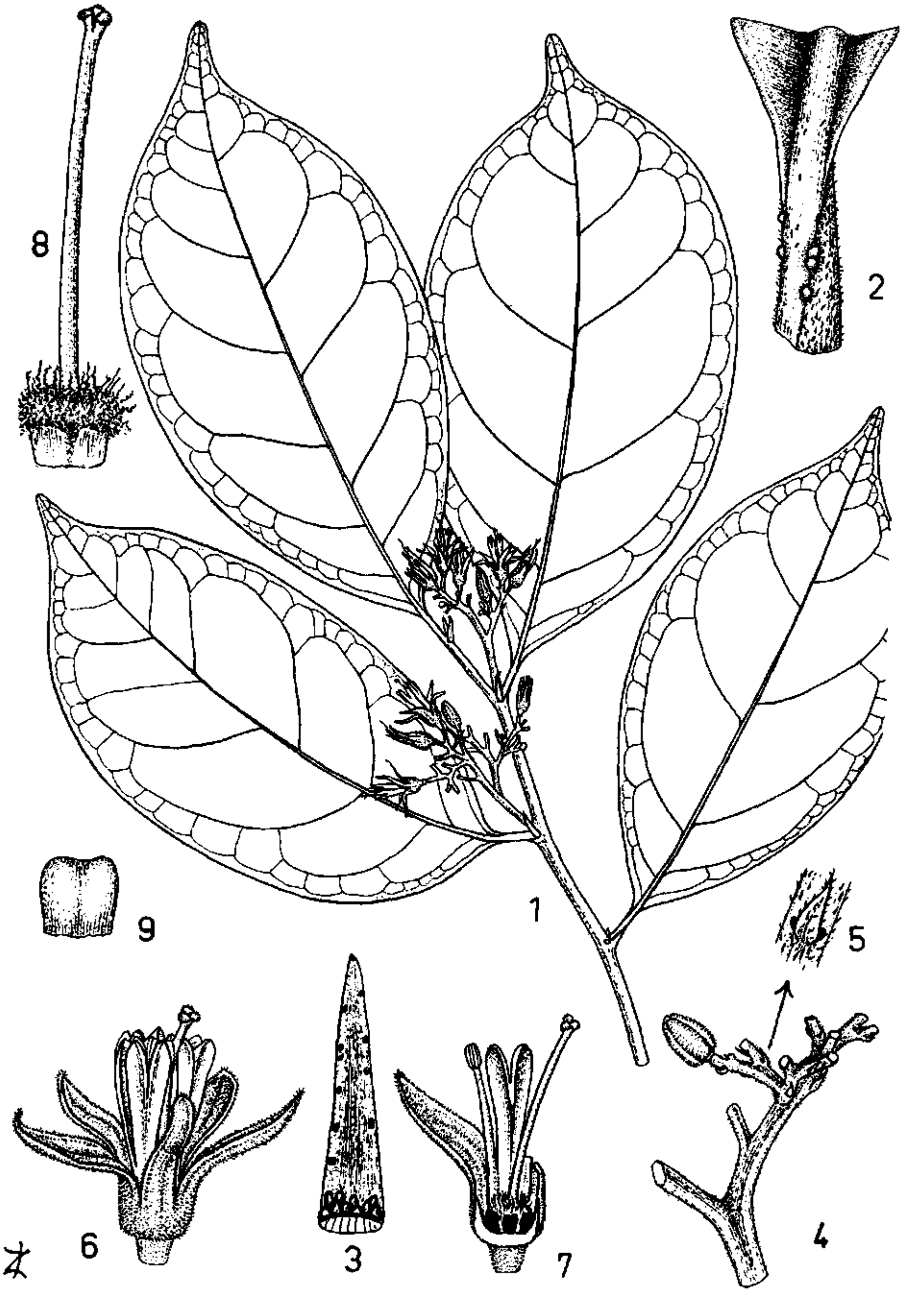


FIG. 3. *D. witianum:* 1. flowering branch, $\frac{5}{6}$ × ; 2. petiole with pimples, 5 × ; 3. stipule inside with pimples, 7 × ; 4. part of inflorescence, $2\frac{1}{2}$ × ; 5. bract with pimples, 15 × ; 6. flower, 5 × ; 7. flower partly, 5 × ; 8. pistil, 10 × ; 9. staminode, 20 × . (1. *J. J. de Wilde 8179;* 2–9. *Breteler & J. J. de Wilde 774*).

Type: Gabon, 36 km S. of Lastoursville, road to Moanda, *Breteler & J. J. de Wilde 774* (holotype: WAG).

Paratypes: Cameroun, 21 km Ebolowa-Kribi Rd., *J. J. de Wilde 8179* (WAG). Gabon, 42 km S.E. of Lambaréné, *Breteler 5712* (WAG); 7 km S.W. of Makokou, *Breteler 7637* (WAG).

Liana. Woodcylinder of main stem 5-lobed. Orthotropic shoots with short, hook-like branchlets. *Branches* glabrous or nearly so, usually sparsely lenticellate. *Branchlets* sparsely puberulous, usually soon glabrescent. *Stipules* soon deciduous, narrowly ovate-oblong to narrowly triangular, 2–5 mm long, sparsely puberulous, at base and at margin inside often with some pimples (see fig. 3: 3). *Leaves:* petiole subterete to semiterete, (2)4–6(9) mm long, puberulous, usually with some pimples on the margin of the flat or grooved upper side (see fig. 3: 2); blade obovate-elliptic, 2–2.5(3) times as long as wide, (7)9–15(18) × (3)4–7 cm, cuneate at base the margin decurrent into petiole, acutely to obtusely sometimes caudately acuminate at top, the acumen 0.5–1.5(2) cm long; midrib and the 5–6(8) pairs of main lateral nerves flat or slightly raised above, prominent beneath, sparsely puberulous both sides, glabrescent, more rapidly so above; glands usually present, beneath only, not very distinct, often mainly alongside the midrib towards base and acumen. *Inflorescence* distinctly pedunculate, distinctly 3–5 times branched, up to ca 25-flowered, puberulous; peduncle (2)5–15 mm long; bracts and bracteoles minute, ovate-triangular, up to 1.5 mm long, very often with two pimples laterally at base (see fig. 3: 5). *Pedicel* up to ca 2 mm long, puberulous, the upper part at most 0.5 mm long. *Sepals* erect to slightly spreading, oblong, 5–6.5 × 1–1.5 mm, tomentellous both sides. *Petals* erect, at base 1.5–2.5 mm united with stamens, oblong in outline, 5–6 × 0.7 mm, up to 1 mm split, glabrous or with a few hairs below split outside, lobes concave. *Stamens* erect, 4–6.5 mm long, glabrous; anthers oblong, 0.5–0.7 mm long, connective prominent. *Staminodes* subquadrate, flat, up to 0.5 × 0.5 mm, glabrous, obtuse to lobulate at top. *Pistil* 3-merous, 6 mm long; ovary lanate; style glabrous, shortly 3-lobed at top. *Fruits* (only young, immature fruits seen) densely villous.

Note. By its flowers with the sepals, petals, and stamens subequal in length, *D. witianum* is related to *D. congoense* Engl. & Ruhl. and to *D. sumbense*. Its leaf base, however, is quite different.

This species is named *D. witianum* to honour Prof. dr. H. C. D. DE WIT, who, for more than a quarter of a century, promoted the taxonomy of tropical African plants at Wageningen.

ACKNOWLEDGEMENTS

The author is grateful to the Directors and Curators of the herbaria cited for their loan of material. Thanks are due to Miss H. G. D. ZEWALD for her fine drawings and to Miss G. J. H. AMSHOFF who helped with the Latin descriptions.

LITERATURE

BRETELER, F. J. 1973. The African *Dichapetalaceae* (III). A taxonomical revision. Species a–b. Meded. Landbouwhogeschool Wag. 73-13.
BRETELER, F. J. 1978. The African *Dichapetalaceae* IV. A. taxonomical revision. Species c–f. Meded. Landbouwhogeschool Wag. 78-10.
BRETELER, F. J. 1979. The African *Dichapetalaceae* V. A taxonomical revision. Species g–l. Meded. Landbouwhogeschool Wag. 79-16.

HERBARIUM VADENSE (WAG) 1955–1980

J. DE BRUIJN

Laboratory of Plant Taxonomy and Plant Geography,
Agricultural University, Wageningen, The Netherlands

INTRODUCTION

This year it will be 25 years ago that the first recent African herbarium collection was brought together for the herbarium in Wageningen. This coincides with the fact that somewhat over 25 years ago Prof. Dr. H. C. D. DE WIT started his activities to initiate the 'Africa project' (of the Herbarium Vadense).

In agreement with the Rijksherbarium of Leyden and the Department of Systematic Botany of the University of Utrecht it was decided that Wageningen would concentrate its activities on Africa. Logical, because Leyden as well as Utrecht were, and had been, active in tropical Asia and tropical America respectively, while Wageningen was in the possession of a more or less general herbarium without a distinct specialisation.

It is the aim of this paper to demonstrate how far Wageningen has succeeded towards this goal; it is a review of the collections now present in the Herbarium Vadense, with emphasis on the African ones.

It will be obvious that the activities of Prof. DE WIT are strongly interwoven with the development of the Herbarium Vadense and that their influence reaches well beyond Wageningen proper.

HISTORY

The herbarium in Wageningen was founded in 1896 as part of the Governmental horticultural college. In 1899 J. VALCKENIER SURINGAR of the Rijksherbarium in Leyden was appointed as a teacher at this college, which, in 1918, becomes part of the Agricultural University. Simultaneously the herbarium became the Laboratory for Plant Taxonomy and Plant Geography with Prof. VALCKENIER SURINGAR as its first director. He initiated the development of the herbarium, but part of the collections brought together have remained his personal property until 1928. In that year VALCKENIER SURINGAR donated his entire personal herbarium to the Agricultural University, including the herbarium of (his father), W. F. R. SURINGAR. An abridged enumeration of the nature of this collection was published by J. JESWIET (1935), while J. G. B. BEUMÉE (1942) deals with this subject in a chapter of the Valckenier Suringar

Memorial Volume. Around 1935 the Herbarium Vadense consists of the following major collections:

1. Herbarium Generale: mainly Dutch plants (a.o. herb. VAN DEN BOSCH, STARING & VALCKENIER SURINGAR).

2. Herbarium Dendrologicum: mainly herb. BAENITZ & VALCKENIER SURINGAR.

3. Herbarium Officinale: 19th century collections from central Europe and the mediterranean area (herb. W. F. R. SURINGAR including several collections, i.e. BILLOT, BOURGEAU, BOISSIER, HAUSSKNECHT, DE HELDREICH, HOHENACKER, HUET DU PAVILLON, KOTSCHY, NOÉ, WILLKOMM etc.).

4. Herbarium Tropicum: Asiatic plants from Indonesia (duplicates from the Herbarium Bogoriense, coll. KOORDERS; Forest Research Institute; coll. Jeswiet), tropical American plants from Surinam (coll. VAN HALL, VAN NIEL and GONGGRIJP), and African duplicates from coll. STOLZ and coll. ZENKER.

In the fourth decade of this century the collections of G. H. RUISCH from the Wageningen Botanical gardens especially added to the dendrological collections.

Due to wartime activities in World War II part of the older collections were lost. Some minor collections were added prior to the arrival of Prof. DE WIT in 1953, and the size of the entire herbarium at that time is estimated at some 125000 specimens.

From 1955 a new period of growth of the Herbarium Vadense is initiated. The existing collections are reorganized into one general herbarium collection. Gradually the African collections begin to accumulate, while those of other parts of the world show some increase as well. Of these latter collections a brief review is given here as well, but the main theme of this paper deals with the African collections.

PRESENT SITUATION

The Herbarium Vadense may be considered as a medium large herbarium at present, as was stated by KALKMAN (1979) in his account of the Netherlands contribution to plant systematics. The total amount of preserved specimens numbers about 400000 of which more than half is of African origin. It is useful to provide information on the origin of the African collections, not simply on their size, as an addition to knowledge of the present state of the exploration of Africa.

Simultaneous with the publication of the first map of the botanical exploration of Africa south of the Sahara, LÉONARD (1965), invited plant collectors to review the map critically and amend it where possible. Ten years later LÉONARD (1975) proposes to produce a second edition of the Botanical exploration map of Africa. BRENAN's proposal for the AETFAT meeting of 1978 in Las Palmas enhances the publication of a list of those African territories badly in need of botanical exploration (see HEPPER, 1979).

Such signals demonstrate the need of a lucid inventory of tropical African collections, as well as the fact that there is still much work to be done in the botanical inventarisation of Africa.

As far as the Herbarium Vadense is concerned it can be concluded that over the past 25 years an important foundation for participation in botanical research and the exploration of Africa has been laid. This offers the prospect to continue to participate constructively and on an international level in African botany in the future.

Literature

Beumée, J. G. B. 1942. Autobiographische gegevens van J. Valckenier Suringar. Gedenkboek J. Valckenier Suringar: 35–56.

Beumée, J. G. B. 1942. Het herbarium van Dr. J. Valckenier Suringar. Gedenkboek J. Valckenier Suringar: 57–77.

Hepper, F. N. 1979. Second edition of the map showing the extent of floristic exploration of Africa south of the Sahara, published by A.E.T.F.A.T. *in* G. Kunkel (ed.): Taxonomic aspects of African economic botany: 157–162.

Jeswiet, J. 1935. Laboratory for Systematic Botany and Plant Geography; Arboretum of the State Agricultural College (Landbouwhogeschool). Chronica Botanica **1**: 221–222.

Kalkman, C. 1979. De Nederlandse bijdrage tot de plantensystematiek. Vakblad voor Biologen **59**(**10**): 152–154.

Léonard J. 1965. Carte du degré d'exploration floristique de l'Afrique au sud du Sahara éditée par l'A.E.T.F.A.T. Webbia **19**(2): 907–910.

Léonard, J. 1975. Assemblée générale de l'A.E.T.F.A.T. Rapport du 'Business Meeting'. Bulletin AETFAT **25**: 15–22.

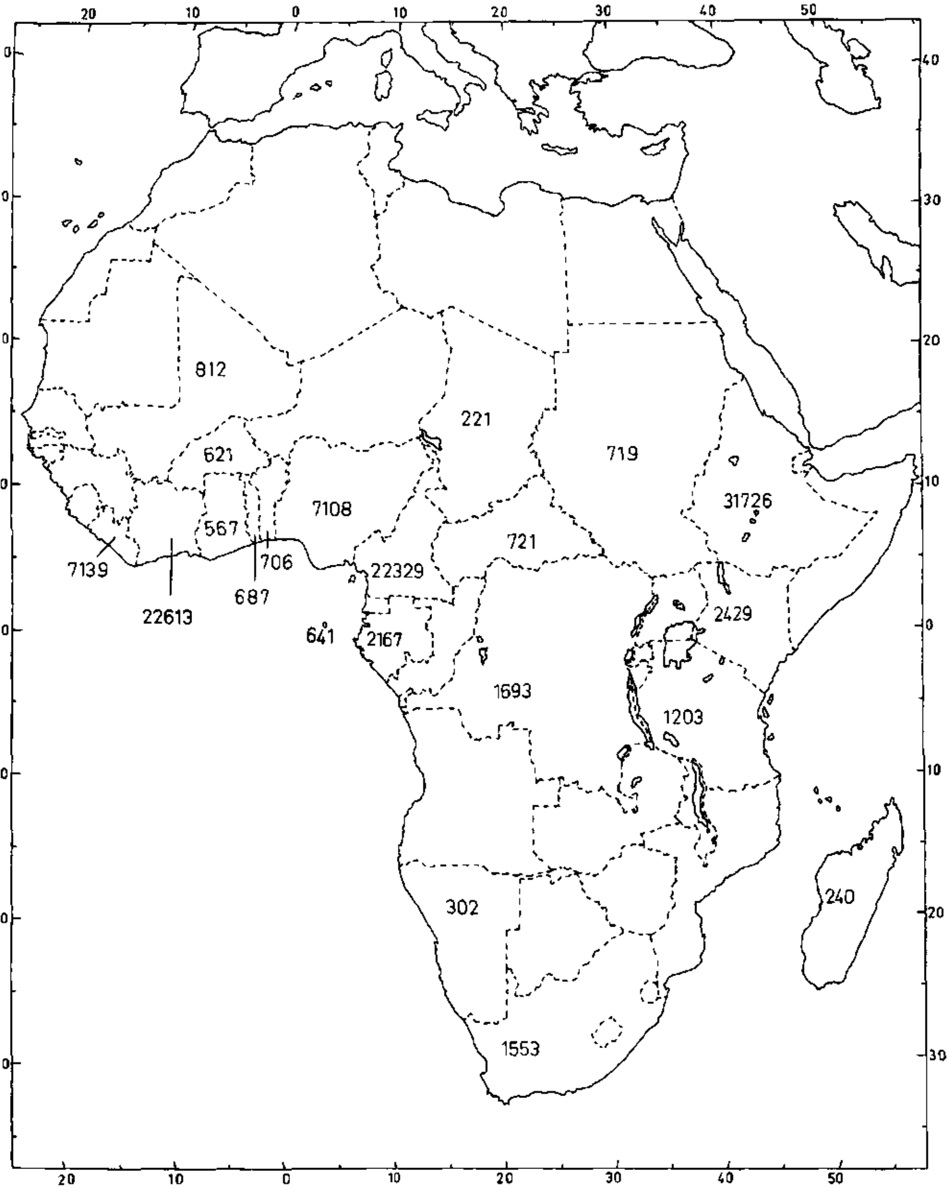
Dutch botanists in Africa 1955–1980

Liberia:

A. G. Voorhoeve	1960–1962	
H. C. D. de Wit	1961	
J. J. F. E. de Wilde & A. G. Voorhoeve	1962	
A. J. M. Leeuwenberg & A. G. Voorhoeve	1962	
A. M. van Harten	1963	
P. P. C. van Meer	1965–1966	
J. J. Bos	1966–1967	
F. J. Breteler, H. C. D. de Wit & J. W. A. Jansen	1968	
J. W. A. Jansen	1968–1971	
Chr. Versteegh & J. W. A. Jansen	1969	
F. S. C. Stoop-v. d. Kasteele	1969–1970	
J. de Koning	1970	
A. de Gier	1977–1978	
		7139 no's

Ivory Coast:

H. C. D. de Wit	*1955, 1957, 1958, 1961*



MAP 1. Numbers of original plant collections made by Dutch botanists in the various countries of Africa in the period 1955–1980 received at Wageningen.

J. J. F. E. de Wilde	1956–1957	
A. J. M. Leeuwenberg	1957–1958	
J. J. F. E. de Wilde & A. J. M. Leeuwenberg	1961–1962	
J. J. F. E. de Wilde	1961–1962	
A. J. M. Leeuwenberg	1962	
W. J. J. O. de Wilde	1963	
R. A. A. Oldeman	1963–1964	
C. Geerling & J. Bokdam	1967–1968	
F. J. Breteler	1968 & 1974	
Chr. Versteegh & R. W. den Outer	1969	
M. Thijssen	1969	
J. van Doorn & H. van Doorn-Hoekman	1972	
J. de Koning	1970, 1972–1976	
L. Smittenberg-Visser	1973	
W. J. v. d. Burg	1975	
H. J. Beentje	1975	
L. Dekker	1978–1979	
A. J. M. Leeuwenberg	1979	
		22613 no's

Upper Volta:

A. J. M. Leeuwenberg	1962	
C. Geerling & J. Bokdam	1967 & 1968	
J. de Koning	1973 & 1976	
		621 no's

Mali:

C. Geerling & J. Bokdam	1968	
H. Breman	1976–1979	
C. Geerling	1978	
L. Dekker	1979	
		812 no's

Ghana:

H. C. D. de Wit	1955	
H. C. D. de Wit & J. K. Morton	1958	
R. A. A. Oldeman	1964	
A. J. M. Leeuwenberg	1977 & 1979	
		567 no's

Togo:

F. J. Breteler	1971	

J. W. A. Jansen	1971–1972	
		687 no's
BENIN:		
C. L. M. van Eijnatten	1967–1968	
A. P. M. van der Zon	1970–1971	
		706 no's
NIGERIA:		
H. C. D. de Wit	1955	
H. C. D. de Wit, R. W. J. Keay & C. F. A. Onochie	1958	
P. N. de Leeuw	1962–1963	
C. L. M. van Eijnatten	1966	
P. P. C. van Meer	1968 & 1971	
C. Geerling	1970–1971	
P. Wit & Z. O. Gbile	1971–1973	
A. J. M. Leeuwenberg	1977	
		7108 no's
CAMEROUN:		
H. C. D. de Wit	1955 & 1957	
F. J. Breteler	1960–1962	
F. J. Breteler, J. J. F. E. de Wilde, A. J. M. Leeuwenberg & R. Letouzey	1962	
W. J. J.O. de Wilde & B. E. E. de Wilde-Duijfjes	1963–1964	
W. J. J. O. de Wilde, J. J. F. E. de Wilde & B. E. E. de Wilde-Duijfjes	1964	
A. J. M. Leeuwenberg	1965–1966	
J. J. Bos	1968–1970	
A. J. M. Leeuwenberg	1971–1972	
P. Wit	1974–1975	
J. J. F. E. de Wilde	1974–1976	
C. Geerling	1973–1977, 1979	
H. C. v. d. Burg	1977–1978	
E. Westphal et J. M. C. Westphal-Stevels	1975–1979	
		22329 no's
SÃO TOMÉ & PRINCIPE:		
L. Groenendijk	1978	
J. J. F. E. de Wilde, J. C. Arends & L. Groenendijk	1980	
		641 no's

GABON:

F. J. Breteler	1968, 1970, 1979	
A. J. M. Leeuwenberg	1977	
F. J. Breteler & J. J. F. E. de Wilde	1978	
		2167 no's

ZAIRE & RWANDA:

H. P. Droogers-Zoutewelle	1968	
J. Bokdam	1970–1974	
		1683 no's

CENTRAL AFRICAN REPUBLIC:

J. W. Minderhoud	1963–1964	
A. J. M. Leeuwenberg	1965, 1966	
		721 no's

CHAD:

W. J. J. O. de Wilde, J. J. F. E. de Wilde & B. E. E. de Wilde-Duijfjes	1964–1965	
		221 no's

SUDAN:

W. A. Blokhuis	1961–1963	
W. J. J. O. de Wilde, J. J. F. E. de Wilde & B. E. E. de Wilde-Duijfjes	1965	
		719 no's

ETHIOPIA:

J. A. Frahm-Lelieveld	1962	
W. J. J. O. de Wilde & B. E. E. de Wilde-Duijfjes	1965–1966	
E. Westphal & J. M. C. Westphal-Stevels	1967–1968	
(culta Wag.)	1968–1973	
J. J. F. E. de Wilde	1968–1970	
J. J. F. E. de Wilde & M. G. Gilbert	1969	
C. J. P. Seegeler	1971–1973	
(culta Wag.)	1974–1977	
J. J. Bos	1974–1975	
P. C. M. Jansen	1975–1977	
		31726 no's

KENYA:

J. A. Frahm-Lelieveld	1962	
R. Harmsen	1966	

W. Bakker	1970–1971	
D. Vuyk	1974–1975	
Chr. Bosch	1976	
A. C. Plaizier	1978	
		2429 no's
TANZANIA:		
J. A. Frahm-Lelieveld	1962	
M. H. Braun	1967	
J. Prins-Lampert	1967–1969	
A. J. M. Leeuwenberg	1975	
		1203 no's
BOTSWANA & S.W. AFRICA:		
R. J. de Hoogh	1968–1969	
		302 no's
SOUTH AFRICA:		
J. J. Bos	1963–1964	
A. J. M. Leeuwenberg	1976	
		1553 no's
MALAGASY:		
R. W. den Outer & W. L. H. van Veenendaal	1978	
		240 no's
	Total:	106197

Duplicates distributed from the collections mentioned above in the period 1960–1979: 118372 specimens. Available for distribution in 1980/81: about 27000 specimens; not yet available about 101000 specimens.

SPECIFICATIONS OF COLLECTIONS OF THE DUTCH BOTANISTS ARRANGED ACCORDING TO COUNTRY OF ORIGIN IN TROPICAL AND SOUTHERN AFRICA.

Liberia

Coll. H. C. D. DE WIT
no. about 45 no's
date: 1961
duplicates: –

1 

2 

 3

1. Prof. Dr. H. C. D. de Wit
2. Ir. J. de Koning
3. Dr. Ir. A. G. Voorhoeve

emphasis of coll. on: –, general collection

Monrovia area, Ganta.

Coll. A. G. VOORHOEVE
no. 1–1325
date: 1960–1962
duplicates distributed to: BR, MO, B, M, EA
emphasis of coll. on: Liberian high forest trees

Monrovia (6.19 N 10.48 W.), Paynesville (6.16 N. 10.42 W.), Devilbush – Duport (6.16 N. 10.40 W.), Careysburg (6.24 N. 10.33 W.); – Bong Range (6.52 N. 10.10 W.), Bomi Hills (6.54 N. 10.50 W.); – Suakoko (6.59 N. 9.35 W.); – Zuole (6.40 N. 8.47 W.); – Tapeta (6.29 N. 8.51 W.) Gbi Nat. Forest; – Tchien (Zwedru) (6.04 N. 8.08 W.); – Nimba Mts. (7.35 N. 8.28 W.); – Loma Nat. Forest (7.42 N, 10.03 W.) (Zorzor – Voinjama).

Coll J. J. F. E. DE WILDE & A. G. VOORHOEVE
no. 3621–3887
date: 1962
duplicates distributed to: K, BR, P, B, A, EA, PRE
emphasis of coll. on: Trichilia (Meliaceae) + general collection

Monrovia, Devilbush (Paynesville – Duport); – Sinoe County, E. of Greenville (4.59 N. 9.02 W.); – Bong Range, Gola Nat. Forest E. of Bomi Hills; – Zuole; – Diala, E. of Tapeta; – Tchien (Zwedru); – Putu Range (5.40 N. 8.10 W.), near Penoken & Kanweake.

Coll. A. J. M. LEEUWENBERG & A. G. VOORHOEVE
no. 4584–4976
date: 1962
duplicates distributed to: BR, P, K, B, MO, PRE, FHI, EA, HBG, UC
emphasis of coll. on: Loganiaceae + general collection.

Devilbush near Paynesville; – Near Yoma (Distr. of the Gola Nat. Forest), N.E. of Bomi Hills; – Bong Range, 32 km N. of Kakata; – N.E. of Ganta (7.14 N. 8.59 W.); – Nimba Mts.

Coll. A. M. VAN HARTEN
no. 1–374
date: 1963
duplicates distributed to: K, HBG, L
emphasis of coll. on: –, general collection

Sinkor near Monrovia, Devilbush near Duport, Careysburg, Porobush near Paynesville; – Bomi Hills, rd. Brewerville – Bopolu; – Tapeta; – Zuole; – rd. Tapeta – Tchien (Zwedru), Krahn Bassa Forest.

Coll. P. P. C. VAN MEER
no. 1–515
date: 1965–1966
duplicates distributed to: BR, MO, FHI
emphasis of coll. on: –, general collection

Monrovia (University New Site), Paynesville, Careysburg; – Bomi Hills, Gola Nat. Forest N.E. of Bomi Hills, Yoma (Distr. of Gola Nat. Forest), Bopolu (7.04 N. 10.29 W.), Gbama (7.00 N. 10.47 W.) near Lofa River; – Gibi Mt. near Bolola (6.35 N. 10.05 W.); – Totota – Gbarnga; – Nimba County (6.45 N. 8.45 W.); – Grand Gedeh County (5.45 N. 8.05 W.); – Nimba Range (7.35 N. 8.28 W.).

Coll. J. J. Bos
no. 1825–2935
date: 1966–1967
duplicates distributed to: LIB, BR, P, K, MO, PRE
emphasis of coll. on: –, general collection

Monrovia (University New Site), Paynesville, Duport, Harbel (6.16 N. 10.21 W.) Firestone Plantation; – Gola National Forest, N.E. of Bomi Hills; – Ganta – Tapeta rd. North Gio Forest, Zuole, Diala, E. of Tapeta (Tapeta – Tchien rd.), rd. Tobli – Tchien (Zwedru), Grand Gedeh County, Tchien, rd. Tchien – Putu Range, rd. Kanweake – Gwebo; – Mt. Nimba; – Loffa County (rd. Gbarnga – Zorzor), Zorzor, Loffa County, rd. Zorzor – Voinjama, surrounding of Viai River and Loffa River.

Coll. W. GOLL
no. 19–118
date: 1967
duplicates: about 150 specimens, not yet available
emphasis of coll. on: –, general collection

Monrovia, University campus, Monrovia – University New Site (18 miles from Monrovia); – Bomi Hills.

Coll. F. J. BRETELER, J. W. A. JANSEN & H. C. D. DE WIT
no. 5414–5487
date: 1968
duplicates: about 200 specimens, not yet available
emphasis of coll. on: Dichapetalaceae + general collection

N. of Monrovia (6.02 N. 10.46 W.), rd. Monrovia – Bomi Hills (6.35 N. 10.47 W.), N. of Bomi Hills (6.54 N. 10.47 W.), near Bendu (6.38 N. 11.11 W.); – Nimba Mts. (7.30 N. 8.30 W.).

Coll. CHR. VERSTEEGH & J. W. A. JANSEN
no. 750–822
date: 1969

duplicates distributed to: U, BR, MO, K, FHI
emphasis of coll. on: forest trees and shrubs

Jenatham; – Bomi Hills; – Tchien.

Coll. F. S. C. Stoop-v/d Kasteele
no. 1–346
date: 1969–1970
duplicates: about 500 specimens, not yet available
emphasis of coll. on: –, general collection.

Harbel, Firestone Plantation; – Gola Nat. Forest N.E. of Bomi Hills; – Loffa County, rd. Voinjama – Zorzor.

Coll. J. W. A. Jansen
no. 770–2579
date: 1968–1971
duplicates: about 3600 specimens, not yet available, 1 set in LIB
emphasis of coll. on –, general collection

Monrovia, Sinkor area (6.19 N. 10.48 W.), University New Site near Monrovia, rd. University New Site – Bensonville, N. of Monrovia, Congotown, 5 miles N. of Monrovia, Paynesville, Duport, N.E. of Monrovia, rd. Monrovia – Kakata, Kakata, rd. Bobola – Kakata, Firestone Div. 33, 10 miles S.E. of Kakata, Robertsfield, plain savanna (6.15 N. 10.22 W.), Harbel, Firestone Plantation, Buchanan (5.56 N. 10.03 W.), rubberplantation 20 miles N. of Buchanan; – Bomi Hills, rd. Bomi Hills – Bopolu, rd. Bomi Hills – Mano River, along Mano River near settlement M.M.A.L. (Sierra Leone boundary), 5 miles N. of Bendu, N. of Robertsport (6.45 N. 11.22 W.); – Gibi Mts., 5–10 miles S.E. of Salala (6.40 N. 10.12 W.), rd. Gbarnga – Ganta, Ganta (Loffa County), rd. Ganta – Tapeta, near Tapeta, Tapeta Gio Nat. Forest, rd. Tapeta – Tchien, Tobli (6.24 N. 8.33 W.), Tchien, Fijnhout Exploitation N.W. of Tchien (Zwedru), Cavalla Forest Reserve, Cavalla River (Iv. Coast boundary), rd. Tchien – Sinoe (Greenville), 10 miles N. of Sinoe, Sinoe (Greenville) airport (4.59 N. 9.02 W.), rd. Tchien – Cap Palmas (Harper), near Cap Palmas (Harper) (4.22 N. 7.43 W.), rd. Harper – Fishtown, Fishtown (4.25 N. 7.50 W.); – near Nimba airport; – Rd. Ganta – Guinea boundary, rd. Zorzor – Voinjama, Voinjama (8.25 N. 9.45 W.), Wologisi rd. (8.00 N. – 10.00 W.), rd. Voinjama – Kolahun, Kolahun (8.17 N. 10.05 W.), rd. Kolahun – Wutivi Mt.

Coll. J. de Koning
no. 401–538
date: 1970
duplicates: about 150 specimens, not yet available
emphasis of coll. on: –, general collection

Monrovia; – Tchien, Fijnhout Explotation N.W. of Tchien (Zwedru).

Coll A. DE GIER & W. GOLL
no. 1–55
101–313
date: 1977–1978
duplicates: about 400 specimens, not yet available, 1 set in LIB
emphasis of coll. on: –, general collection

Gardnersville nr. Monrovia, Duport, rd. Greenville – Sinoe County, rd. Monrovia – Kakata, Old Porobush, 5 miles from Bentol, rd. Schiefflin – Marshall, rd. Bomi Hills – Bopolu, rd. Bopolu – Kpelle Nat. Forest, Kpelle Nat. Forest, 58 miles E. of Bopolu; – Robertsport, 5 miles E. of Robertsport, rd. Robertsport – Mano River.

Ivory Coast

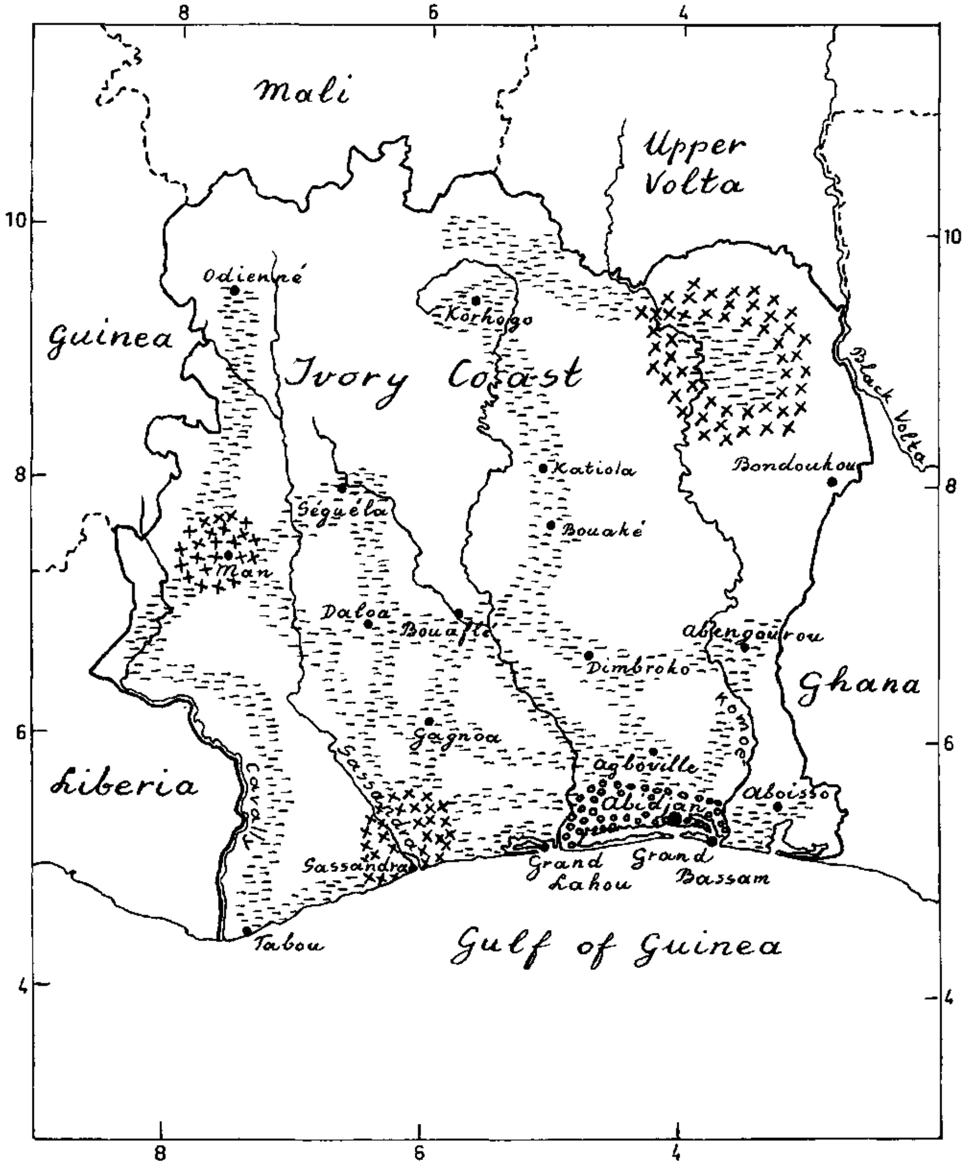
Coll. H. C. D. DE WIT
no. about 570 no's
date: 1955, 1957, 1958, 1961
duplicates: some specimens in K
emphasis of coll. on: –, general collection

Adiopodoumé, ORSTOM, Forêt du Banco, Forêt Adouin, Bingerville, Grand Bassam, Azuretti; – Dabou, Rocher de Brafouédi, Ndouci, Oroumba, Boca, Assakra, Toumodi; – Forêt de Divo, Gagnoa, Duékoué, Mt. Tonkoui.

Coll. J. J. F. E. DE WILDE
no. 1 – 1070
date: 1956–1957
duplicates distributed to: FHO, FHI, GC
emphasis of coll. on: no, general collection

Adiopodoumé, Forêt d'IDERT – ORSTOM, rd. Abidjan-Dabou, Dabou. Forêt du Banco, Forêt de Yapo, Forêt de l'Anguédédou, Port Bouêt, Grand-Bassam, Bingerville-Forêt de N'Zida, Ile Boulay, Lagune d'Ebrié; – rd. Abidjan – Adzopé (Diapé – Adzopé); – Savanne de Moossou, rd. Lakota-Sassandra, Sassandra, rd. Sassandra-Gagnoa, Davo R., rd. Dabou – N'Douci, Bécédi, Rocher de Brafouédi, rd. N'Douci – Oroumba Boka, Assakra, Oroumba Boka; – Tiassalé, Bandama R. (Forêt de l'Amatioro, Forêt de Divo), rd. Gagnoa – Issia, Rocher d'Issia, rd. Issia – Daloa; Man, rd. Man – Danané. Mt. Tonkoui; – Mt. Nimba; – Seguéla, rd. Seguéla – Mankono, Mankono.

Coll. A. J. M. LEEUWENBERG
no. 1700–3350
date: 1957–1958
duplicates distributed to K, P, BR, MO, UC, FHI, GC, B, Z, COI, LISC, FHO, PRE, SRGH
emphasis of coll. on: Loganiaceae + general collection



MAP 2. Ivory Coast: density of exploration by Dutch botanists in collection numbers per km^2.
(o o o: > 1/km^2; x x x: 0.5 – 1/km^2; – – –: < 0.5/km^2)

Adiopodoumé (17 km W. of Abidjan), near Lamé (40 km N.E. of Abidjan), Forêt de Yapo (40 km N. of Abidjan), Forêt de l'Anguédédou (15 km N.W. of Abidjan), Forêt de l'Abouabou (between Abidjan and Grand-Bassam), Port Bouet (E. of Abidjan), Forêt du Banco Agnéby R. (between Grand-Bassam and Abidjan), Near Dabou, near Brafouédi (75 km N.W. of Abidjan), S.E. of Bécédi (70 km N.W. of Abidjan); – N. of Ferkessedougou; – Bouaké and surroundings of Bouaké; – Near Tiassalé; – Sassandra, 18 km N.W. of Sassandra, 49 km N. of Sassandra, near Dakpadou, 62 km N. of Sassandra (rd. Sassandra – Lakota), 64 km N. of Sassandra, 3 km N. of Niapidou, 56 km N. of Sassandra, E. of Béyo (43 km E. of Soubré), 81 km N.N.E. of Sassandra, 55 km E.N.E. of Sassandra, Near Soubré (along Sassandra River); – Mt. Tonkoui, S.W. of Man, Danané, N.W. of Man; – N. & S. of Taï; – Séguéla, Mankono S. of Séguéla.

Coll. J. J. F. E. DE WILDE
no. 3100–3620 (no. 3425–3620 collected by De Wilde & Leeuwenberg)
date: 1961–1962
duplicates distributed to: K, BR, P, B, EA, PRE
emphasis of coll. on: Meliaceae (Trichilia), Loganiaceae + general collection

Forêt d'Anguédédou (25 km W. of Abidjan), Forêt du Banco, Forêt Abouabou (15 km E.S.E. of Abidjan), Rd. Abidjan – Dabou, Adiopodoumé (17 km W. of Abidjan), Moossou (4 km N.N.E. of Grand-Bassam); – Oroumba-Bocca (Assakra) 35 km S.W. of Dimbokro; – Nigbi II, 11 km S.S.W. of Soubré (W. of Sassandra R.), Soubré – Sassandra R.; – S. of Guéyo (between Gagnoa and Sassandra); – Bouna Reserve, 12 km S. of Bavé, 12 km W. of Ouangofétini, 40 km S. of Ouangofétini – Comoé River; – Rd. Taï – Tabou, 7 km N. of crossing rd. with Hana R. Near Taï, Cavally R., 32 km S.S.E. of Taï (village Troya), 50 km N. of Tabou on rd. to Taï.

Coll. A. J. M. LEEUWENBERG
no. 3701–4286
4434–4583
4977–4985
date: 1962
duplicates distributed to: BR, P, K, B, MO, PRE, FHI, EA, HBG, UC
emphasis of coll. on: Loganiaceae + general collection

Adiopodoumé, Forêt de l'Anguédédou (25 km W. of Abidjan), Forêt de l'Abouabou (15 km E.S.E. of Abidjan, Forêt du Bandama, E. of Dabou, N.E. of Dabou, Savanna of Cosrou; – 25–35 km S.W. of Guéyo, 41 km N. of Sassandra, on road to Guéyo, 56 km N. of Sassandra, E. of Béyo, 50 km W. of Sassandra, 72 km N. of Sassandra, along road to Lakota; – Left Bank Sassandra R. near Soubré, 50 km N.W. of Soubré; – N. of Bouaké, Forêt de Bamora; – Tafiré; – Katiola; – Ferkéssédougou; – Mt. Tonkoui, N.W. of Man, N.W. of Duékoué, along road to Man; – Forêt de Bouaflé, 40 km E. of Daloa; – Rocher d'Issia; – Near Oumé; – Bianouan (Ghana boundary); – Krinjabo, S. of Aboisso.

Coll. W. J. J. O. DE WILDE
no. 1–1114
date: 1963
duplicates distributed to: K, BR, P, Z, UC, EA, FHI, IFAN, SRGH
emphasis of coll. on: Adenia (Passifloraceae) + general collection

Adiopodoumé (17 km W. of Abidjan), Forêt de l'Anguédédou (15 km N.W. of Abidjan), Forêt du Banco, Lagune Ebrié (Ile Boulay), Bingerville, Grand Bassam (Bank Comoé R.), Port Bouet (S.E. of Abidjan); – Forêt de Yapo, 8 km S. of Bécédi, near Bécédi (70 km N.W. of Abidjan), Brafouédi (75 km N.W. of Abidjan); – Comoé R. near Mbasso, 50 km N.E. of Adzopé; – Bouaké (nr. I.R.C.T.), 70 km W. of Bouaké, Forêt Classée Matiemba; – W. of Soubré (forest exploitation), 5 km S. of Guéyo, 40 km E. of Soubré; – 40 km from Sassandra near Yadapéla, Sassandra, W. of Sassandra, R., 64 km N. of Sassandra, 4 km W. of Niapidou, 34 km N. of Sassandra, 2 km W. of Kokolo-Pozo; – Tiencoula, 30 km N. of Taï, 25 km S. of Taï, Hana R. (140 km N. of Tabou); – Bouna Reserve, Téhini 40 km E. of Ouangofétini.

Coll. R. A. A. OLDEMAN
no. 1–732, 843–1010
date: 1963–1964
duplicates distributed to: K, BR, P, MO, LD, FHI, Z, IFAN
emphasis of coll. on: –, general collection

Adiopodoumé, Forêt de Yapo, Forêt du Banco (3 km N.W. of Abidjan), Forêt de l'Anguédédou (20 km W. of Abidjan), Forêt d'Abouabou, Grand Bassam, Lagune Ebrié (17 km W. of Abidjan), Savanne de Dabou, Rocher de Brafouédi, 70 km E.S.E. of Tiassalé, near Bécédi, N'Douci, near Tiassalé; – Savanne Néro-Mer, near Béréby, second. forest Sékré, 15 km E. of Béréby, primary forest 26 km N. of Béréby; – Brobo, 25 km E.N.E. & 25 km N. of Bouaké; – Bouna Reserve, Téhini, Ouangofétini, along Comoë R., S. of Ouangofétini; – Mt. Oroumba-Bocca, S.E. of Toumodi; – Mbaso, 50 km E. of Adzopé.

Coll. C. GEERLING & J. BOKDAM
no. 1–1085, 1472–2660, 2712–2942
date: 1967–1968
duplicates distributed to BR, MO, B, FHI, LISC, LD, PRE, K, GC, LG
emphasis of coll. on: Bouna Reserve + general coll. Iv. Coast

Adiopodoumé, Forêt du Banco, Forêt de l'Anguédédou, Lagune Ebrié, S.E. of Abidjan (seashore), Port Bouet, Grand Bassam (Gr. Bassam – Azuretti), Savanna E. & N. of Dabou, Surrounding of Dabou (E. & W.); – Aboisso, Adiaké, Ayamé; – E. of Dakpadou, Dakpadou – Sago (N. of Sassandra), surroundings of Monogaga (W. of Sassandra), 80 km S. of Soubré (N.W. of Sassandra); – Oroumba Bocca, 40 km S. of Toumodi, 50 km S. of Toumodi Lamto Reserve; – Mt. Tonkoui, surroundings of Man, Mt. Nimba, Yéalé near Mt. Nimba, surroundings of Danané; – 30 km N. of Katiola; – Mt. Niangbo, surroundings of Korhogo; – Bouna Reserve: 40 km E. of Ferkessédougou, 40 km N. of Ferkessédougou, 23 km S. of Dabakala, 10–50 km N.E. of Dabakala, Dabakala, Varalé, 60 km N. of Bouna, Doropo (3.21 W. 9.50 N.), 20 km N. of Bavé, Gawi (3.47 W. 9.– N.), 15 km N. of Kong, S. of Kotouba (nr. Bouna Reserve) (3.08 W. 8.30 N.), near Bondoukou (3.5. W. 8.20 N.) 40 km N. of Bondoukou.

Coll. F. J. BRETELER
no. 5200–5413, 5488–5506, 5809–6212, 7309–7503
date: 1968 & 1974
duplicates: not yet distributed, available: ± 2500 specimens
emphasis of coll. on: Dichapetalum + general collection

Adiopodoumé, surroundings of Abidjan, Forêt du Banco, Forêt de Teké, Abidjan – Grand Bassam (rd. Ab. – Gr. B.), Agboville, N. of Abidjan, Rd. Abidjan – Bouaké, near Dabou, Rd. Grand-Bassam – Aboisso, surroundings of Aboisso, Aboisso – Ayamé, barrage Ayam I, rd. Ayamé – Abengourou, rd. Adzopé – Abengourou; – Rd. Tiassalé – Divo. Surroundings of Fresco (between Sassandra and Grand-Lakou); – Surrounding of Duékoué, rd. Guiglo – Toulépleu (direct. Liber. boundary); – Surroundings of Sassandra, ± 30–50 km N. and N.E. of Sassandra, rd. Lakota – Sassandra, rd. Sassandra – Monogaga, rd. Sassandra – Gagnoa, rd. Sassandra – Gagnoa, crossing Davo River, rd. Sassandra – San Pedro; – Km. 58 San Pedro – Tabou, Tabou, rd. Tabou – Grabo, Grabo – Teté, rd. Tabou – Béréby, rd. Tabou – Taï, rd. Taï – Guiglo; – 20 km E. of Yakassé.

Coll. CHR. VERSTEEGH & R. W. DEN OUTER
no. 1–749
date: 1969
duplicates distributed to: U, BR, MO, FHI, MAP
emphasis of coll. on: trees and shrubs

Adiopodoumé, Bot. Garden, O.R.S.T.O.M., 17 km W. of Abidjan, Adièpo–Doumé, Anyama–Aouaba, 25 km N. of Abidjan, E. of Abié, 65 km N. of Abidjan, 35–55 km W. of Dabou, 10 km S.E. of Dabou, 40 km W. of Abidjan, rd. Abobo–Aoué, 15 km N. of Abidjan, rd. Aoué–Alépé, 25 km N.N.E. of Abidjan, Azaguié–Aoua, 45 km N. of Abidjan; – Surrounding of Bonoua, Port Bouet, 8 km W. of Grand Bassam, ferry Grand-Bassam to Bingerville; – Surrounding of Aboisso, surrounding of Abengourou (Ghana boundary); – 10 km S.E. of Ndouci, 10 km S.E. of Divo, Ndouci (N'Doucy); – from 5 to 40 km N. of Sassandra, from 12 to 15 km W. of Sassandra, rd. Sassandra–Lakota, 35 km N. of Sassandra, near Dakpadou, 50 km N. of Sassandra; – Surrounding of Bouaké: 15–25 km N.E. of Bouaké, 30–45 km E. of Bouaké, 15–20 km W. of Bouaké, 20–30 km N. of Bouaké; – Surrounding of Korhogo: 15–20 km N. of Korhogo, 20–30 km N.W. of Korhogo, 20 km N.E. of Korhogo, 20–30 km S.E. & S.W. of Korhogo.

Coll. M. TH. THIJSSEN
no. 1–385
date: 1969
duplicates: not yet distributed, available about 700 specimens
emphasis of coll. on: –, general collection

Near Abidjan, Adiopodoumé, 17 km W. of Abidjan, Forêt du Banco, Forêt d'Anguédédou, Bonoua (Abidjan–Bingerville), rd. Bonoua–Grand Bassam, rd. Aboisso–Bonoua, rd. Aboisso–Grand-Bassam, surroundings of Anyama; – Abengourou (Ghana boundary); – Rd. Séguéla–Bouaké, km 40; – Surroundings of Sassandra (Davo near Sassandra), km 56 Sassandra–Gagnoa; – N. of Man, Mt. Tonkoui.

Coll. J. VAN DOORN & H. VAN DOORN-HOEKMAN
no. 1–391
date: 1972
duplicates: about 500 specimens, not yet available
emphasis of coll. on: –, general collection

Adiopodoumé, Forêt du Banco, Forêt de Yapo, Lagune – Grand Bassam; – Sassandra, San Pedro; – Rd. Tabou–Béréby, rd Grand Divo–Béréby,

Coll. J. DE KONING
no. 1–7243 (no. 401–538 Liberia, no. 796–844 Benin, no, 2904–2925, 7200–7243 U. Volta)
date: 1970, 1972–1976
duplicates: not yet available, about 12000 specimens
emphasis of coll. on: inventory of Forêt du Banco

Adiopodoumé, Forêt du Banco, Forêt d'Anguédédou, Forêt de Yapo, Forêt de Téké, 30 km N. of Abidjan, N. of Abbé, ± 50 km N. of Abidjan, Audouin (Jacqueville), Bingerville, Dabou, Port Bouet–Grand Bassam, Nganda (Nganda Reserve); – Bécédi, Sikensi, Sikensi–Agboville; – Tiassalé, Ndouci–Toumodi, Toumodi, Toumodi–Yamoussoukro, Reserve Marahoué, S.W. of Bouaflé; – Sassandra, Sassandra River, Sassandra–Gagnoa, Sassandra–Monogaga, San Pedro, San Pedro–Grand-Béréby, Grand-Béréby; – Tabou, Taï, Taï–Guiglo; – Rocher Issia, Issia–Daloa, Issia–Duékoué, Toumodi–Duékoué; – Man, Mt. Tonkoui; – Odienné, Odienné–Bako; – Darhala–Toupé (4.08 E. 8.35 N.).

Coll. L. SMITTENBERG-VISSER
no. 1–157
date: 1973
duplicates: no
emphasis of coll. on: medicinal plants

Ahouan–Comouenou (3 W. 7 N.); – Koffi–Akakro (3 W. 7 N.).

Coll. W. J. V. D. BURG
no. 1–1247
date: 1975
duplicates: about 2500 specimens, not yet available
emphasis of coll. on: epiphytic orchids, ferns + general collection

Adiopodoumé, 17 km W. of Abidjan (Centre Néerlandais, culta) O.R.S.T.O.M., Forêt d'Anguédédou, Forêt du Téké, 6 km N. of Anyama (4.03 W. 5.33 N.), Forêt de Yapo, 16 km N.W. of Azaguié-Aoua (4.06 W. 5.43 N.), Lagune near Adiopodoumé, Forêt du Banco; – 15 km on rd. Sassandra–Lakota (5.08 N. 5.50 W.), rd. Kpata–Aidou–Dassiéko, rd. Sassandra–Dassiéko, ± 10 km W. of Kpata-Aidou, W.S.W. & S.W. of Kpata-Aidou, rd. Sassandra–Lakota, on road to Fresco; – Surroundings of Sassandra (6.12 W. 5.02 N.), Lagune W. of Niani, E. of Sassandra (6.04 W. 4.58 N.), 10 km N. of Sassandra, along Sassandra R. (6.07 W. 5.02 N.), 55 km & 81 km N.N.E. of Sassandra, along road to Lakota, 79 km N.N.E. of Sassandra, near Lagako-Tokpeko, E. of Lagako-Tokpeko, 14 km on rd. Lakota–Sassandra; – W. of Yaka, ± 15 km N.W. of Tabou, rd. Yaka–Pata-Idié, 20 km N.E. of Tabou, ± 4 km N.W. of Ménéké (4.32 N. 7.18 W.), Tabou, seashore, ± 2 km N.E. of Tabou, rd. Gliké–Ironia, Ironia, ± 10 km N.E. of Tabou (4.30 N. 7.16 W.), 8 km N. of Tabou (rd. Tabou–Grabo); – Rd. Taï–Guiglo–Taï, 10 km N. of Zagné; – Near Man, rd. to Mt. Tonkoui, Mt. Tonkoui, rd. Man–Danané (25 km W.S.W. of Man), rd. Man–Duékoué, (16 km S. of Man), 40 km N.W. of


1


2


3

1. Dr. A. J. M. LEEUWENBERG
2. Dr. B. E. E. DE WILDE-DUIJFJES
3. Ir. J. J. BOS

Man; – 14 & 15 km W.S.W. of Toulepleu, 3 km S.W. of Klobli (8.32 W. 6.28 N.), 2 km N.E. of Basobli, 15 km W. of Toulepleu (8.32 W. 6.33 N.); – 5 km W. of Dimbokro (6. 40 N. 4.45 W.), 3 km S. of Satama-Sokoro (7.52 N. 4.31 W), 7 km E. of Darhala (8.27 N. 4.18 W.).

Coll. H. J. Beentje
no. 1–1356
date: 1975
duplicates: about 2700 specimens, not yet available
emphasis of coll. on: Callichilia (Apocynac.)
Ferns
Musci + general collection

Adiopodoumé, 17 km W. of Abidjan, Forêt du Banco, N.W. of Abidjan, Forêt du Yapo, 13–16 km N.W. of Azaguié-Ahoua (5.43 N. 4.06 W.), Forêt de l'Anguédédou, Lagune Aghien (5.23 N. 3.51 W.), Forêt de Téké, 12 km N. of Anyama (5.35 N. 4.03 W.), Lagune Abi (5.18 N. 3.10 W.), 5 km N.N.W. of Nganda-Nganda (5.40 N. 3.20 W.), 5 km N. of Assini (5.12 N. 3.27 W.); – 8 & 18 km N. of Ayamé, 13 & 15 km N.E. of Ayamé (5.38 N. 3.07 W.), 33 & 34 km N. of Ayamé (5.47 N. 3.08 W.), 4 km N. of Aboisso (5.30 N. 3.12 W.), 10 & 15 km S.E. of Aboisso, 2 km E. of Maféré (5.24 N. 3.01 W.), 1 km W. of Ehania (5.24 N. 2.56 W.); – 8–20 km N. of Dabou (5.26 N. 4.21 W.), N. of and near Grand-Lahou (5.22 N. 4.48 W.), Bandama River (5.14 N. 4.57 W.), Jacqueville (5.13 N. 4.16 W.), 4–15 km S. of Guitri (5.31 N. 5.14 W.); – Sassandra River, 10 km N. of Sassandra, Sassandra River, W. of Niani, E. of Sassandra (4.58 N. 6.04 W.), rd. Sassandra–Lakota, 35 km N.N.E. of Sassandra (5.05 N. 6.02 W.), 18–20 km N.W. of Sassandra, rd. Sassandra–Lakota, near Lagako (5.25 N. 5.50 W.), Lagako–Tokpeko (5.20 N. 5.50 W.), 15 km on rd. Sassandra–Lakota, along rd. to Fresco (5.08 N. 5.50 W.), 8 km S.W. & 14 km W.S.W. of Kpata-Aidou (5.05 N. 5.50 W., 5.03 N. 5.52 W.); – 1 km N. of Tabou, E. of Tabou, seashore (4.25 N. 7.20 W.), N.N.W. of Tabou, rd. to Pata-Idié (4.27 N. 7.24 W., 4.28 N. 7.25 W., 4.30 N. 7.32 W.), ± 20 km N.E. of Tabou (4.34 N. 7.14 W.), ± 20 km N.W. of Tabou (4.22 N. 7.45 W.), 5 km N.W. of Ironia (4.30 N., 7.16 W.), near Boubélé (4.28 N. 7.15 W.), along rd. Grabo–Taï, along rd. Taï–Guiglo, S. of Vodélobi (6.08 N. 7.30 W.), N. of Zagni (6.14 N. 7.30 W.), 10 km E.S.E. of Taï (5.50 N. 7.22 W.), Taï, along Cavally River; – 14 km W.S.W. of Toulepleu (6.29 N. 8.31 W.), 16 km S.W. of Toulepleu (6.28 N. 8.31 W.), 2 km N.E. of Basobli (6.33 N. 8.32 W.); – Mt. Tonkoui (7.27 N. 7.39 W.), Çascades de Man, Mt. Tonkoui rd. (7.25 N. 7.35 W.), 25 km W.S.W. of Man, rd. to Danané (7.18 N. 7.43 W.), 3 km W. of Blapleu; – 12 km W. of Daloa; – 7 km S.W. of Ndouci (5.49 N. 4.47 W.), 5 km W. of Dimbokro (6.40 N. 4.45 W.), 3 km S. of Satama-Sokoro (7.52 N. 4.31 W.), 7 km E. of Darhala (8.27 N. 4.18 W.), W. of Kong.

Coll. A. J. M. Leeuwenberg
no. 12014–12098
date: 1979
duplicates: about 350 specimens (1 set in ABI)
emphasis of coll. on: Apocynaceae

Cult. ORSTOM, km 17 Abidjan–Dabou (5.19 N. 4.08 W.), Forêt du Banco, N.W. of Abidjan (5.24 N. 4.03 W.), 12 km N.W. of carrière d'Attinguié, rd. Abidjan–Sikensi (5.33 N. 4.19 W.); – Km 17 Grand Bassam–Aboisso (5.24 N. 3.17 W.), along rd. Aboisso–Maféré (5.23 N. 3.08 W., 5.25 N. – 3.15 W., 5.24 N. – 3.10 W.), 1 km of Maféré (5.25 N. 3.01 W.), 3 km E. of Maféré (5.26 N. 3.00 W.); – Sassandra (4.57 N. 6.05 W.), km 24 Sassandra–Gagnoa rd. (5.05 N. 6.04 W.), km

49 Sassandra–Gagnoa rd (5.15 N. 6.04 W.), km 56 Sassandra–Gagnoa rd. 3 km E. of Davo River (5.19 N. 6.01 W.), km 72 Sassandra–Guéyo rd. (5.23 N. 6.01 W.), km 41 Monogaga–Sassandra rd. (4.59 N. 6.19 W.), km 31 Monogaga–Sassandra rd. (4.57 N. 6.20 W.), km 24 Monogaga–Sassandra rd. (4.54 N. 6.22 W.), km 36 Sassandra–San Pedro rd. (5.03 N. 6.20 W.), rd. Sassandra–San Pedro (5.00 N. 6.23 W.), km 9 rd. San Pedro–Soubré (4.49 N. 6.38 W.), km 17 rd. San Pedro–Soubré (4.52 N. 6.36 W.).

Coll. L. Dekker
no. 1–346 (347–419, Mali)
dat: 1978–1979
duplicates about 900 specimens, not yet available
emphasis of coll. on: –, general collection

Yakassé-Mé, 65 km N. of Abidjan (5.47 N. 3.55 W.), Adiopodoumé, 17 km W. of Abidjan (5.20 N. 4.08 W.), Forêt du Banco, 4 km W. of Abidjan (5.23 N. 4.03 W.), ± 5 km N.W. of Jacqueville (5.13 N. 4.27 W.), Grand Lahou, (4.57 N. 5.10 W., 4.59 N. 5.10 W.); – 15 km N.W. of Sassandra, on rd. to San Pedro (5.00 N. 6.11 W.), surrounding of Tabou, 4.29 N. 7.25 W., 4.32 N. 7.15 W.), 20 km S.E. of Taï (5.20 N. 7.22 W.); – Kanangono, ± 23 km N. of Katiolo (8.17 N. 5.04 W.), Tiengala, ± 25 km N. of Katiola (8.19 N. 5.08 W.), Niakaramandougou, along rd. to Tortiya (8.41 N. 5.18 W., 8.42 N. 5.20 W., 8.43 N. 5.26 W., 8.45 N. 5.30 W.), S. of Niakaramandougou (8.38 N. 5.18 W., 8.34 N. 5.16 W., 8.30 N. 5.17 W.), Korhogo, ± 30 km on rd. to Mbingué (9.34 N. 5.52 W.), ± 16 km N.E. of Korhogo (9.35 N. 5.35 W.), Diaouala (10.06 N. 5.29 W.), Diaouala, 6 km on rd. to Kofiplé (10.04 N. 5.30 W.), Diaouala, 5 km on rd. to Niéllé (10.18 N. 5.31 W.), Niéllé, ± 25 km on rd. to Mbingué (10.04 N. 5.48 W.); – Séguéla (9.24 N. 7.09 W.), Séguéla, 15 km on rd. to Tiémé (9.27 N. 7.15 W.), Odienné, ± 10 and ± 15 km on rd. to Tiémé (9.31 N. 7.26 W., 9.31 N. 7.28 W.), ± 10 km W. of Odienné (9.30 N. 7.34 W.).

Upper-Volta

Coll. A. J. M. Leeuwenberg
no. 4287–4433
date: 1962
duplicates distributed to: BR, P, K, B, MO, PRE, FHI, EA, HBG, UC
emphasis of coll. on: Loganiaceae + general collection

Yendéré, along rd. to Banfora, rd. Banfora-Sindou, nr. rock of Sindou, 50 km W. of Banfora, 48 km S. of Banfora, 18 km N. of Banfora, 116 km N.N.E. of Bobo-Dioulasso, on rd. to Dédougou.

Coll. C. Geerling & J. Bokdam
no. 1086–1471
2689–2711
date: 1967 & 1968
duplicates distributed to: BR, MO, B, GHI, LISC, LD, PRE, K, GC, LG
emphasis of coll. on: –, general collection

Sindou, W. of Banfora, surroundings of Bobo-Dioulasso, Koumi, along rd. Bobo-Dioulasso–Orodara, Ouagadougou, Arly, Parc National du W.

Coll. J. DE KONING
no. 2904–2925
7200–7243
date: 1973 & 1976
duplicates: some specimens
emphasis of coll. on: –, general collection

Banfora, rd. Bobo-Dioulasso–Ouagadougou, Feré–Ouagadougou, Ouagadougou.

Mali

Coll. C. GEERLING & J. BOKDAM
no. 2661–2672
date: 1968
duplicates distributed to: BR, MO, K, UCJ
emphasis of coll. on: –, general collection

Surroundings of Gao (16.15 N. 0.03 W.).

Coll. H. BREMAN
no. 1–215, 300–378a, 503–760
date: 1976–1979
duplicates: about 350 specimens, not yet available
emphasis of coll. on: savanna plants

Ranch de Niono (14.19 N. 5.51 W.), N'Diella (14.19 N. 5.52 W.), Ngodila (14.14 N. 6.12 W.); – Niger delta area: surroundings of Ké-Macina, Ténenkou (Diaka River), Djénné and Tominan; – Near Koulikoro, along rd. Koulikoro–Banamba, near Banamba, along rd. Banamba–Nara, along rd. Nara–Banamba, near Kaloumba, along rd. Nara–Banamba, between Nara and Goumbou, N.E. of Nara, 49 km W. of Famabougou, along rd. Sokolo–Nara, Sokolo (14.44 N. 6.08 W.), Alatona (14.48 N. 5.56 W.), E. of Diaba (14.14 N. 6.01 W.), N.W. of Sokolo, 5 km N. of Bourlé (15.08 N. 6.28 W.), along rd. Sokolo–Niono, 18 km S. of Kogoni, along rd. Sokolo–Niono, Fala River, near Kandiourou (14.35 N. 6.07 W.), along rd. Sokolo–Niono, along Fala River, 96 km N. of Niono, along rd. Sokolo–Nampala, N.E. of Sokolo, along rd. Nampala–Sokolo, up to 26 km S. of Nampala, Nampala (15.17 N. 5.33 W.), 3,20 and 25 km N. of Nampala, on rd. to Norhani, Norhani,Mabroûk (15.27 N. 6.48 W.), halfaway on rd. Léré–Lerneb, surrounding of Lerneb (16.20 N. 4.58 W.), along rd. Léré–Ras-el-Má, near Ras-el-Má (16.37 N. 4.28 W.), E. of Ag. Ariassene (16.25 N. 4.46 W.), N. of Ras-el-Má.

Coll. C. GEERLING
no. 5800–5976
date: 1978

duplicates: some duplicates, not yet available
emphasis of coll. on: savanna plants, mainly trees and shrubs

Parc National de la Boucle de Baoulé: Lac Wenia (13.18 N. 8.08 W.), Benbougou (13.33 N. 8.27 W.), Sebekoro (13.42 N. 8.23 W.), Missira (13.43 N. 8.27 W.), along road Missira–Baoulé; – Surrounding around Kolokani (13.35 N. 8.02 W.), 10 km N. to 50 km S. of Kolokani.

Coll. L. DEKKER
no. 347–419
date: 1979
duplicates: about 200 specimens, not yet available
emphasis of coll. on: –, general collection

Parc National de la Boucle de Baoulé, surrounding of Missira (13.43 N. 8.27 W.), surrounding of Dyontégéda (13.53 N. 9.03 W.), Réserve de Kongosanbougou, Siguimidji (13.46 N. 8.35 W.).

Ghana

Coll. H. C. D. DE WIT (1955)
H. C. D. DE WIT & J. K. MORTON (1958)
no. ± 200 no's
date: 1955 & 1958
duplicates: –
emphasis of coll. on: –, general collection

Legon (5.39 N. 0.11 W.), Aburi (5.51 N. 0.11 W.), Winneba (5.20 N. 0.37 W.), Amedzofe (6.51 N. 0.26 W.), N.E. of Ejura (7.23 N. 1.22 W.), Boma Atwa Forest Reserve.

Coll. R. A. A. OLDEMAN
no. 733–842
date: 1964
duplicates distributed to: K, BR, P, MO, LD, FHI, Z, IFAN
emphasis of coll. on: –, general collection

Kwapon (6.37 N. 2.29 W.), between Kwapon and Tano River, about 85 km W. of Kumasi, near Tano River, 75 km W. of Kumasi.

Coll. A. J. M. LEEUWENBERG
no. 11042–11208, 11903–11923, 11944–12013
date: 1977, 1979
duplicates: about 950 specimens (1 set in GC)
emphasis of coll. on: Apocynaceae & Loganiaceae

Accra (5.33 N. 013 W.), Winneba junction to Accra, E. of Ochreku (5.25 N. 0.37 W.), Mankessim–Swedru rd., S. of Ochisu (5.29 N. 0.56 W.), Eisam, rd. to Mankessim (5.17 N. 0.57 W.), Accra–Mankessim rd., 1 km E. of Mankessim (5.16 N. 1.01 W.), surrounding of Takoradi

(4.53 N. 1.49 W., 4.50 N. 1.57 W.), Nsuaen, rd. to Takoradi (4.59 N. 2.01 W.), along rd. to Nkroful (4.59 N. 2.17 W.), along rd. Nkwanta–Prestea (5.29 N. 2.06 W., 5.25 N. 2.12 W.), E. of Nkwanta, (5.24 N. 2.18 W,), W. of Nkwanta (5.25 N. 2.22 W.); – S. of Aburi, rd. to Accra (5.50 N. 0.11 W.), Madina, N. of Accra (5.41 N. 0.11 W.), S. of Medie, Nswawam–Accra rd. (5.46 N. 0.19 W.), 10 km W. of Nswawam (5.48 N. 0.25 W.), W. of Sukrong, along Nsawam–Asamankese rd. (5.48 N. 0.37 W.), 5 km N. of Nsawam (5.50 N. 0.22 W.), between Amarahia and Katamanso, on Accra–Dodowa rd. (5.45 N. 0.07 W.), N.E. of Dodowa (5.55 N. 0.05 W., 5.56 N. 0.03 W.); – E. Region, W. of Apedwa (6.07 N. 0.29 W.), E. Region, S. of Nsutan (6.18 N. 0.28 W.), Atewa range (6.11 N. 0.34 W.), W. of Kadé, E. of Aiyola F.R. (6.08 N. 0.57 W.), Adawsoasi, N. of Anyniam (6.24 N. 0.31 W.), near Anyniam (6.33 N. 0.33 W.), W. of Dadiasi, along rd. Accra–Kumasi (6.35 N. 0.49 W.), 2 km E. of Juaso (6.35 N. 1.07 W.), Bobiri F.R., E. of Kumasi (6.41 N. 1.19 W., 6.41 N. 1,21 W.); – S. of Esumeja, along Kuntanasi–Bekwai rd. (6.29 N. 1.33 W.), km 3 Kuntanasi–Abonu rd. (6.32 N. 1.28 W.), N. of Kwaso, along rd. to Kuntanasi (6.39 N. 1.27 W.), km 20 Kumasi–Bekwai rd. (6.33 N. 1.40 W.), 8 km S.W. of Kumasi (6.38 N. 1.33 W.), E. of Ampabame, along Kumasi–Kubeasi rd. (6.42 N. 1.25 W.); – 9, 11, 12, 14 km E. of Obuasi (6.13 N. 1.34 W. – 6.14 N. 1.32 W.), 1 km N. of Asokwa, along rd. to Dompoasi (6.15 N. 1.31 W.), S. of Obuasi, junction in Kumasi–Dunkwa rd. (6.08 N. 1.44 W.); – S. of Mampong (7.03 N. 1.24 W.), N. of Mampong, Awura R. (7.11 N. 1.24 W.), 2 km S.W. of Ejura, Awura F.R. (7.22 N. 1.23 W.), nr. Kokote, 10 km N. of Wiamoasi (7.07 N. 1.32 W.).

Togo

Coll. F. J. BRETELER
no. 7015–7300
date: 1971
duplicates: 1 set in B, still available about 600 specimens
emphasis of coll. on: –, general collection

Equipe F. J. BRETELER
no. 1–309
date: 1971
duplicates: 1 set in B, still some specimens available
emphasis of coll. on: phytosociological studies in teak-plantations

Lomé, rd. Lomé–Anecho, rd. Lomé–Nuatja, Lilikopé, Tsévié, Avadjé N. of Tsévié, Ouatchidomé, Blévié, Agbatopé, rd. Tsévié–Gapé; – Amégnan near Tabligbo, Essé, W. of Tabligbo, rd. Tabligbo–Essé-Ana, rd. Lomé–Palimé, rd. Lomé–Avétonou, Avétonou S. of Palimé, Palimé, rd. Palimé–Missahohé, Missahohé; – Kra (Chra) N. of Nuatja, Tététou, along rd. Nuatja–Tohoun; – Atakpamé, N.E. of Atakpamé; – Blitta; – Tchamba, E. of Sokodé, on rd. Sokodé–Lama-Kara.

Coll. J. W. A. JANSEN
no. 2585a–2666
date: 1971–1972
duplicates: about 300 specimens, not yet available
emphasis of coll. on: –, general collection

Surrounding of Lomé, N. and S. of Tsévié, rd. Lomé–Palimé, near Amoussoukopé, Avétonou, S. of Avétonou, near Palimé; – Amakpavé, 20 km S. of Nuatja, E. of Nuatja, Lilikopé, 15 km N. of Nuatja.

Benin

Coll. C. L. M. van Eijnatten
no. 2155–2301
date: 1967–1968
duplicates: some specimens
emphasis of coll on: trop. crops and weeds

Porto-Novo, Bopa, Djassin, Affamé, Afbodjédou.

Coll. A. P. M. van der Zon
no. 1–559
date: 1970–1971
duplicates: about 1000 specimens, not yet available
emphasis of coll. on: trop. crops and weeds

Porto Novo, surrounding of Porto Novo: Ouando, Puenta, Podji, Sémi, Hozin, Louhou, Djigbé along lagoon near Porto Novo; – E. of Porto Novo (boundary Benin–Nigeria): Houngbo-Nagot, Kpédjlé-Agada, Djrigoé, Gbékon; – Ita-Djébou, Houeda N. of Porto Novo, Azaourissé between Porto Novo and Adjohon, Abpêchi, 16 km S. of Pobé; – Sakété, S. of Ketou; – 10 km S. of Zou R. (S. of Paouignan), 10 km S. of Paouignan, near Savé, Ouémé R., 12 km W. of Savé, Atao 13km S.S.E. of Savé, Moka 23 km E. of Savé, Okpara R. E. of Savé (boundary Benin–Nigeria); – Biguina, 10 km S.W. of Abomey, 10 km N. of Lokossa; – Porga; – 5 km S. of Quidah, N. of Bopa.

Nigeria

Coll. H. C. D. de Wit (1955)
H. C. D. de Wit, R. W. J. Keay & C. F. A. Onochie (1958)
no.: about 300 no's
date: 1955 & 1958
duplicates: –, coll. 1958 duplicates in FHI and K
emphasis of coll. on: –, general collection

Abeokuta, Ogun River delta, Gambari Forest Reserve, Lagos area, Oyo.

Coll. P. N. de Leeuw
no.: ± 150 no's
date: 1962–1963
duplicates: –
emphasis of coll. on: savanna plants

Jos Plateau, Kano, Zaria, Samaru (11.10 N. 7.38 E.).

Coll. C. L. M. VAN EIJNATTEN
no.: ± 1000–2100
date: 1966
Duplicates: –
emphasis of coll. on: cultivated plants + general collection

Western Province, Gambari (8.16 N. 4.20 E.) 20 miles S. of Ibadan, Ibadan, Moor Plantation; – Ikeja (6.57 N. 3.14 E.), Inisha (7.59 N. 4.39 E.).

Coll. P. P. C. VAN MEER
no. 516–1875
date: 1966 & 1971
duplicates: about 1500 specimens, not yet available
emphasis of coll. on: trees and shrubs

Western State, Ibadan Province: 5 miles N. of Ibadan, 6,5 mile N. of Ibadan, rd. Moniya–Ijaiye, 2–13 km N.W. of Moniya (7.32 N. 3.55 E.); – rd. Ijaiye–Oyo (7.51 N. 3.56 E.), 3–7 km N.W. of Ijaiye, Ijaiye Forest Reserve (7.40 N. 3.45 E.), 10 miles W. of Ijaiye; – Gambari Forest Reserve (7.08 N. 3.50 E.), 18 miles S. of Ibadan; – rd. Ikire–Gbongan, 9 km N.E. of Ikire (7.21 N. 4.11 E), rd. Ilugun (7.23 N. 3.40 E.) – Olokomeji (7.59 N. 4.24 E.), border of Ogun River. Western State, Oyo Province: Rd. Oyo–Ilorin (8.30 N. 4.33 E.), 12 miles N.E. of Ogbomosho (8.08 N. 4.16 E.), 18,5 & 30 km N.E. of Oyo, 3 km S.W. of Awe (7.49 N. 3.58 E.), rd. Awe to Akinmorin, rd. Oyo (7.51 N. 3.56 E.) – Iseyin (7.58 N. 3.36 E.), 22 km W. of Oyo, 5 km S.E. of Iseyin; – near Shabe Heights (8.23 N. 3.24 E.), along road Shaki–Iseyin, 20 miles S.S.E. of Shaki (8.40 N. 3.23 E.); – 5 miles N.W. of Ife (7.28 N. 4.34 E.), Shasha Forest Reserve (7.05 N. 4.30 E.), 35 km E.N.E. of Ondo (7.06 N. 4.50 E.).
Western State, Abeokuta Province: Olokomeji Forest Reserve (7.25 N. 3.32 E.), ± 13 km W. of Ilugun (7.23 N. 3.40 E.), Ilaro Forest Reserve (6.47 N. 3.04 E.), 12 km S.E. of Ilaro (6.53 N. 3.01 E.), rd. Ilaro–Badagri, 5, 22 & 35 km S. of Ilaro, rd. Ilaro–Abeokuta, 2 km N. of Ilaro, Edun Stream Forest Reserve, ± 1,5 km N. of Ilaro, rd. Ibadan–Lanlate (7.36 N. 3.27 E.), 25 km W. of Orile Ilugun (7.23 N. 3.40 E.).
Western State, Ondo Province: Akure Forest Reserve (7.19 N. 5.02 E.), 12 & 16 km W. of Akure, Idanre Hills, 0,5 m. S. of Idanre (7.06 N. 5.06 E.), rd. Akure (7.15 N. 5.12 E.) – Ondo (7.06 N. 4.50 E.), ± 4 km – 11 km W. of Akure, 10 & 16 km S.W. of Akure, rd. Akure–Ondo, 24 km W.S.W. of Akure, rd. Owo (7.11 N. – 5.33 E.) – Benin (6.20 N. 5.38 E.), 19 miles S.E. of Owo.
Western State, Ijebu Province: About 10 km N. of Ijebu Igbo (6.58 N. 4.00 E.), Omo Sawmills, about 32 miles E.N.E. of Ijebu Ode (6.49 N. 3.56 E.).
South-Eastern State: Stubbs Creek Forest Reserve (4.34 N. 7.59 E.), Ekinta River Forest Reserve (4.58 N. 8.35 E.), Lower Enyong Forest Reserve (5.20 N. 7.50 E.), about 35 km N.N.W. of Uyo, Calabar Plywood and Veneer logging area, S. of Mbarakom (5.16 N. 8.19 E.), Cross River North Forest Reserve (5.52 N. 8.46 E.), about 15 km S.E. of Ikom (5.58 N. 8.42 E.). Oban Group Forest Reserve (5.13 N. 8.20 E.).
East Block: 5.08 N. 8.34 E., 5.16 N. 8.37 E., 5.31 N. 8.41 E.
West Block: 5.08 N. 8.19 E., 5.09 N. 8.28 E., 5.13 N. 8.22 E., 5.19 N. 8.25 E., 5.25 N. 8.37 E.

Coll. P. Wit & Z. O. Gbile
no.: 1–3021 (coll. partly in WAG (± 1300 no.'s) partly in FHI)
date: 1971–1973
duplicates: –
emphasis of coll. on: Cyperaceae + Gramineae, general collection

Western State: Oba–Abeokuta rd., Fagbemi (6.55 N. 3.25 E.), Ibadan, surroundings of Ibadan (7.14–7.46 N. 3.28 E.–3.05 E.), Ibadan (Jericho, Forestry School) (7.20 N. 3.50 E.), Elesjo village (21 km Ibadan-West) (7.15 N. 3.45 E.), Ogun River (7.25 N. 3.30 E.), Ijaiye Forest Reserve (7.40 N. 3.45 E.), Ado Rock (7.50 N. 3.25 E.), Ago Owu Forest Reserve (7.15 N. 4.10 E.), mile 20 Ibadan–Ife, W. of Apomu (7.20 N. 4.10 E.), Oba Hills Forest Reserve (7.45 N. 4.10 E.); – Erin, Ijesha waterfalls (7.35 N. 4.50 E.), Ifon, N. of Benin (7.00 N. 5.45 E.).
Midwestern State: Ughoton (6.10 N. 5.22 E.), 24 miles from Benin, surroundings of Benin (6.20 N. 5.38 E.), Sopo Plains (6.28 N. 5.15 E.), Sapoba (6.06 N. 5.53 E.), Usomgbe (5.59 N. 6.11 E.).
Kwara State: Lokoja (7.48 N. 6.44 E.), Niger River, surroundings of Lokoja.
Western State: Old Oyo Game Reserve (8.30 N. 4.10 E.), 15 km from Igboko, Sobi hill near Ilorin (8.30 N. 4.33 E.), surroundings of Ilorin, Igbetti (8.45 N. 4.10 E.) N.W. of Ilorin, Upper Ogun Forest Reserve (8.35 N. 3.45 E.).
Northwestern State: 5 miles S. of Jebba (9.00 N. 4.50 E.), 35 miles S. of Kaiama (9.15 N. 3.50 E.), 3 miles to Kaiama (9.40 N. 4.05 E.), Wawa–Kaiama rd., ± 30 miles S. of Wawa (9.45 N. 4.05 E.), Zuguma Game Reserve, 20 km from Kainji (9.50 N. 4.40 E.), Wawa along rd. to New Bussa (9.55 N. 4.30 E.), New Bussa (10.15 N. 4.30 E.), Borgu Game Reserve (10.20 N. 4.00 E.).
Benue Plateau State: rd. Kaffi–Akwanga (8.50 N. 7.55 E.), Jos Plateau, ± 30 km S. of Jos (9.45 N. 8.50 E.), 32 miles S. of Jos (9.30 N. 8.40 E.), Vom, S. of Jos (9.40 N. 8.50 E.), W. of Vom (9.40 N. 8.40 E.), Shere Mts. (9.55 N. 9.05 E.), Jos Plateau (10.25 N. 8.40 E.), 5 miles N. of Jos (10.00 N. 8.55 E.), 18 miles from Jos (10.05 N. 9.05 E.), Zaria (11.50 N. 7.40 E.).
North-Eastern State: Gembu Valley (6.40 N. 11.10 E.) (Mambilla Plateau), Nguroje Hill (7.00 N. 11.10 E.), Mambilla Plateau (Escarpment), 3 miles of Mayo Selbe (7.15 N. 11.10 E., 7.20 N. 11.10 E.), Beli (7.50 N. 11.00 E.), Zip (8.44 N. 10.39 E.), Yola (9.10 N. 12.30 E.), Mubi (10.20 N. 13.15 E.), Togola (10.15 N. 13.15 E.), Bazza (10.40 N. 13.25 E.), Dadin Kowa, along Gongola River (10.15 N. 11.25 E.), Hong (10.15 N. 12.55 E.), Zalanga (10.45 N. 10.10 E.), rd. Zalanga–Bauchi; – Biu, rd. Biu–Numan (10.35 N. 12.10 E.), Waka near Biu (10.38 N. 12.12 E.), 10 miles from Biu (10.43 N. 1201 E.), rd. Maiduguru–Biu (11.45 N. 12.50 E.), Baga, Lake Chad (13.05 N. 13.55 E.).

Coll. C. Geerling
no. 2950–4430
date: 1970–1971
duplicates: about 3000 specimens, not yet available
emphasis of coll. on: –, general collection

Western State: Oyo Province; – Old Oyo Game Reserve (8.30 N. 4.10 E.), 15 km from Igboko, Upper Ogen Forest Reserve (8.30 N. 3.50 E.).
North-Western State: Borgu Game Reserve (10.15 N. 4.10 E.), Kainji Lake (10.30 N. 4.35 E.).
North-Eastern State: Yankari Game Reserve (9.50 N. 10.30 E.).

Coll. A. J. M. Leeuwenberg
no. 11209–11350

date: 1977
duplicates: about 400 specimens, not yet available
emphasis of coll. on: Apocynaceae & Loganiaceae

Western State: Lagos (6.27 N. 3.23 E.).
Mid-Western State: Warri (5.31 N. 5.45 E.), Benin City (6.20 N. 5.38 E.).

Cameroun

Coll. H. C. D. DE WIT
no. A. 200–709
B. 1–408
date: 1955 & 1957
duplicates: –
emphasis of coll. on: –, general collection

Douala, Yaoundé, Ebolowa, Sanaga, Ayos, Mbam, Nkongsamba, Bafoussam, Mbalmayo, Garoua, Maroua, Ngaoundéré.

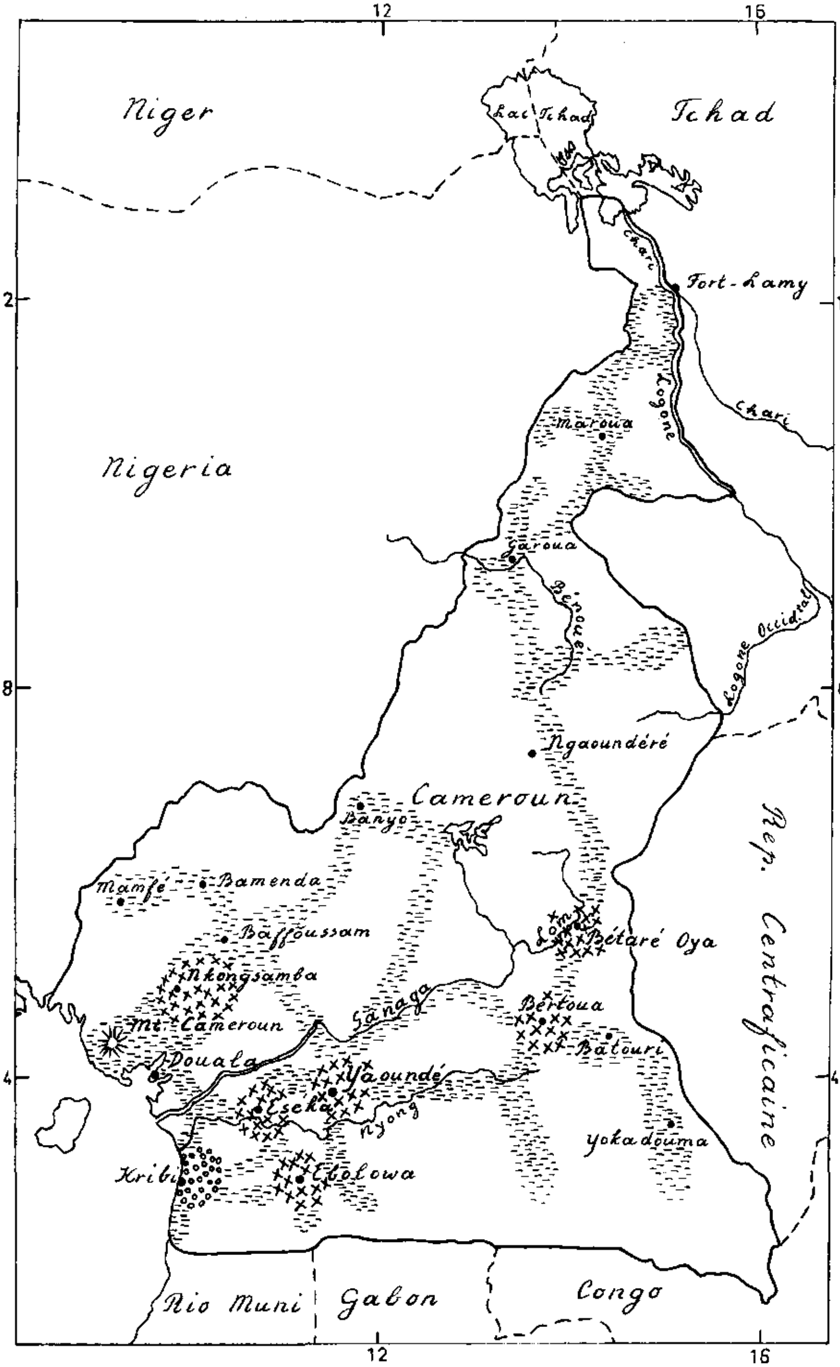
Coll. F. J. BRETELER
no. 182–3006 (no. 2256–2612 together with A. J. M. LEEUWENBERG & J. J. F. E. DE WILDE)
date: 1960–1962
duplicates distributed to: YA, P, K, BR, M, LISC, FI, A, PRE, Z, UC
emphasis of coll. on: forest vegetation, liana's, especially Dichapetalum.

Yaoundé, Nkolbisson, Nyong River S.E. of Yaoundé, Oveng N. of Sangmélima, Nguélémendouka, surrounding of Bertoua, along rd. Bertoua–Dimako–Doumé, Lomié, surrounding of Batouri, rd. Mban–Ebaka, Yokadouma; – rd. Bertoua–Bétaré Oya, surrounding of Bétaré Oya, Ngaoundéré (Adamaoua Plateau).

Mt. Cameroun Expedition: Coll. F. J. BRETELER, A. J. M. LEEUWENBERG, R. LETOUZEY & J. J. F. E. DE WILDE
no. 1–306
date: 1962
duplicates distributed to: P, K, YA, LISC, FHI, FHO, UPS, Z, G, BM, PRE, U (ferns)
emphasis of coll. on: –, general collection

Mount Cameroun.

Coll. W. J. J. O. DE WILDE & B. E. E. DE WILDE-DUIJFJES
no. 1115–3700
date: 1963–1964
duplicates distributed to: YA, P, BR, K, MO, B, PRE, Z, EA, FHI, NLI, SRGH
emphasis of coll. on: Adenia (Passifloraceae) & general collection



MAP 3. Cameroun: density of exploration by Dutch botanists in collection numbers per km^2. (o o o: > 1/km^2; x x x: 0.5–1/km^2; – – –: < 0.5/km^2)

Yaoundé, Eséka, Mbalmayo, Ebolowa, Ambam, Kribi, Bafia, Banganté, Bambouto Mts., Bertoua, Ngaoundéré, Garoua, Maroua, Fort Foureau.

Coll. W. J. J. O. DE WILDE, J. J. F. E. DE WILDE & B. E. E. DE WILDE-DUIJFJES
no. 3701–5112
date: 1964
duplicates distributed to: YA, BR, P, MO, K, HBG, FHI
emphasis of coll. on: –, general collection

Yaoundé, Eséka, Meiganga, Ngaoundéré, Garoua, Maroua, Waza, Fort Foureau.

Coll. A. J. M. LEEUWENBERG
no. 4997–7810 (no. 6242–6262 & no. 7039–7317 collected in Centr. Afric. Republic)
date: 1965–1966
duplicates distributed to: YA, P, BR, K, MO, PRE, LISC, EA, C, B, FHI, GC, SRGH, UC, LUAI, HBG
emphasis of coll. on: Loganiaceae, general collection

Kumba, Buea, Victoria, Douala, Kribi, Edéa, Eséka, Yaoundé, Mbalmayo, Lomié, Nanga, Eboko, Bertoua, Batouri, Yokadouma, Bétaré Oya, Meiganga, Ngaoundéré, Garoua, Mokolo, Mora.

Coll. J. J. BOS
no. 2952–7353
date: 1968–1970
duplicates not yet distributed (1 set in YA), about 20000 specimens available
emphasis of coll. on: Dracaena (Liliaceae) & general collection

Kribi area: ± 60 km around Kribi, between Lobé and Lokoundjo River; coastal area Kribi–Eboké, Campo; – Yaoundé.

Coll. A. J. M. LEEUWENBERG
no. 8125–10707
date: 1971–1972
duplicates not yet available (1 set in YA), about 10000 specimens
emphasis of coll. on: Apocynaceae & Loganiaceae, general collection

Nkongsamba, Banyo, Dschang, Yingui, Loum, Yabassi, Kumba, Mogodé, Foumban.

Coll. P. WIT
no. 2900–3170
date: 1974–1975
duplicates about 800 specimens, not yet available
emphasis of coll. on: savanna grasses and general collection

1



2

3



4

1. Ir. C. Geerling
2. Dr. W. J. J. O. de Wilde
3. Dr. Ir. J. J. F. E. de Wilde
4. Dr. Ir. F. J. Breteler

Garoua (9.18 N. 13.22 E.), E. of Waza (11.17 N. 14.28E.), S.E. of Waza (11.20 N. 14.35 E.), Parc Nat. de la Benoué (8.05 N. 13.47 E.), surrounding of Buffle Noir (8.03 N. 13.43 E., 8.07 N. 13.49 E., 13.50 N. 13.52 E.).

Coll. J. J. F. E. DE WILDE
no. 7412–8751
date: 1974–1976
duplicates about 6700 specimens, not yet available (1 set in YA)
emphasis of coll. on: Begonia (Begoniaceae), forest vegetation

Surroundings of Ebolowa, area between Kribi and Campo, surrounding of Kribi, Foumbot and Mbepit area, surrounding of Bamendam Bafut and Dschang.
Northern Cameroons: Garoua, Waza, Mora, Ngaoundéré.

Coll. C. GEERLING
no. 4431–5780
5977–6080
date: 1973–1977, 1979
duplicates about 1000 specimens, not yet available (1 set in YA and Garoua)
emphasis of coll. on: savanna plants, mainly trees and shrubs

Northern Cameroons: Surrounding of Ngaoundéré, Buffle Noir (8.08 N. 13.50 E.), Parc. Nat. de la Benoué (8.08 N. 13.50 E.), W. of Poli (8.30 N. 13.06 E.); – Campement du Rhinoceros (8.20 N. 14.31 E.), W. of Koum (8.24 N. 14.31 E.); – Tchéboa (9.01 N. 13.11 E.), Lagdo (9.03 N. 13.44 E.), Surrounding of Garoua, Tinguélin (9.26 N. 13.26 E.), surrounding of Maroua, Mogodé – Rhumsiki (10.35 N. 13. 35 E.), Mogodé (10.37 N. 13.33 E.), W. of Mokolo (10.24 N. 13.33 E.), Parc Nat. de Mozogo–Gokoro (10.58 N. 13.56 E.), 10–30 km N. of Mora (11.03 N. 14.09 E.), Reserve de Waza (11.20 N. 14.40 E.), Kalamaloué (12.08 N. 14.54 E.).

Coll. H. C. V. D. BURG
no. 1–120
date: 1977–1978
duplicates about 300 specimens, not yet available
emphasis of coll. on: –, general collection

Rd. Bertoua–Deng Deng (± 20 km), road Bertoua–Nanga Ebobo (± 35 km).

Coll. E. WESTPHAL et J. M. C. WESTPHAL-STEVELS
no. 8733–10230
date: 1975–1979
duplicates about 4000 specimens, not yet available (1 set in YA)
emphasis of coll. on: tropical crops

Plants, seeds etc. collected on markets, fields and in experimental gardens: *markets:* Markets in Yaoundé: Central market, Messa market, Mvog Mbi market, Nkol Eton market, Madagascar market, Melen market, Njong-Melen market; – Obala market, Ebolowa market, Bertoua

market; – Bafia market, Douala New Bell market, Buea market, Tiko market, Victoria market, Mamfé market, Bamenda market, Wum market, Kumba market, Nkongsamba market, Dschang market, Bafou market, Bandjoum market, Bafoussam market, Mbouda market, Foumbat market, Foumban market. – Markets of: Ngaoundéré, Garoua, Pitoa, Kaélé, Yagoua, Mindif, Maroua, Bogo, Mora, Mokolo, Boukoula.
Experimental gardens in Yaoundé, Nkolbisson (ENSA), fields around Nkolbisson, coffee plantation near Nkolbisson, Akondoué Hill, Nkolbisson, secondary forest near Nkolbisson; – 48 km S. of Yaoundé, on Mbalmayo rd., Soo village, 26 km S. of Mbalmayo, on Ebolowa rd., surroundings of Nkolendom; – surroundings of Mandoumba, forest area around Akonolinga; – in fields, coffeeplantation, 35–40 km from Bafoussam (on Banganté rd.), in fields and gardens around Bafou, in forest ca. 5 km W. of Dschang, region of Bayangam; – near Badjouma, 33 km N. of Garoua, on Maroua road, 6 km S. of Neri, Mora in garden, in field 15 km for Mokolo.

Rep. Democr. de São Tomé e Principe

Coll. L. GROENENDIJK
no. 1–138
date: 1978
duplicates: about 350 specimens
emphasis of coll. on: Begoniaceae & Trop. trees.

São Tomé:
Milagrosa, Roça Milagrosa 5 km from Trindade, Cruzeiro between Trindade and Milagrosa, Roça Monte Café, S. Nicolau, 6 km from Monte Café, Monte Café, trail Lagoa Amélia to Pico Calvano, surrounding of Lagoa Amélia; along rd. to Zampalma; – Boa Entrada, Roça Boa Entrada, Potó, Rio de Ouro, dependencia Canavial, Praia das Conchas; – Between Diogo Vaz and Esprainha, between Diogo Vaz and Santa Catarina, between Bindá and Juliana de Sousa; – Ribeira Peixe, dependencia Vila Clotilde, Praia Grande, 5 km W. of Ribeira Peixe, Roça S. Cécilia, Porto Alegre Roça.

Principe: Roça Sundy.

Coll. J. J. F. E. DE WILDE, J. C. ARENDS & L. GROENENDIJK
No. 1–503
date: 1980
duplicates: about 2000 specimens, not yet available
emphasis of coll. on: Begoniaceae, Orchidaceae, Pteridophytae + general collection

Further particulars still unknown.

Gabon

Coll. F. J. BRETELER
no. 5507–5808
6235–7001, no. 7578–7663
date: 1968 & 1970, 1979
duplicates: about 3500 specimens, not yet available

emphasis of coll. on: Dichapetalaceae + general collection

Port Gentil, Surrounding of Libreville; – Gamba; – 50 km S.E. of Lambaréné; – Surrounding of Lastoursville, km 48 on rd. Lastoursville–Moanda, 3, 6, 11, 23 km on rd. Moanda–Franceville, 15, 23 km on rd. Moanda–Mbinda, 6, 15, 23, 30, 33 km on rd. Moanda–Bakoumba, 60, 70 km S.S.W. of Moanda; – near Makokou.

Coll. A. J. M. LEEUWENBERG
no. 11375–11569
date: 1977
duplicates: about 700 specimens, not yet available
emphasis of coll. on: Apocynaceae + general collection

Libreville, km 5 on rd. Libreville–Kango, along rd. Libreville–Cap Esterias, 7–10 km S.S.W. of Makokou, Ivindo River 11 km S.W. of Makokou, 7, 14 km on rd. Makokou–Mekambo, 7 km N. of km 49 Makokou–Mekambo rd.

Coll. F. J. BRETELER & J. J. F. E. DE WILDE
no. 1–823
date: 1978
duplicates: about 3300 specimens, not yet available
emphasis of coll. on: Begoniaceae & Dichapetalaceae + general collection

Libreville, Mondah forest 22 and 25 km on rd. Libreville–Cap Estérias, Cap Estérias; – Cristal Mountains: 3, 5, 11, 13 km along rd. Asok–Hydroelectric power station in Tchimbélé R. at Kinglé, waterfalls in Tchimbélé R., 12, 15, 22, 25 km N.E. of Asok, 9, 10 km W. of Asok, about 6 and 8 km along rd. Asok–Nkan, Mount Méla, N.N.W. of Méla, 7, 8, km S.W. of Asok, left bank Mbé River, near – and 8 km S.S.W. of Hydroelectric p.s. at Kinglé; – about 10 km N.E. of Lalara, 10 and 40 km along rd. Lalara–Makokou, 7 km along rd. Lalara–Ndjolé; – Bélinga, Iron mine exploitation, lower slopes and summit of Babiel Nord, Mayibout I, on Ivindo River, between Mayibout I and II, near Mayibout II, about 14, 20, 24, 49 km on rd. Bélinga–Makokou; – Achouka, 45 km on rd. Achouka–Lastoursville, 8, 16, 36 km on rd. Lastoursville–Moanda, about 10 km on rd. Lastoursville–Mékouyi.

Zaire & Rwanda

Coll. H. P. DROOGERS-ZOUTEWELLE
no. 1–147
date: 1968
duplicates about 150 specimens, not yet available
emphasis of coll. on:–, general collection

Yangambi (0.47 N. 24.28 E.), Kisangani (0.30 N. 25.12 E.), surrounding of Kisangani; – Mangobo (0.20 S. 28.07 E.).

Coll. J. Bokdam
no. 3001–4546
date: 1970–1974
duplicates: about 2000 specimens, not yet available
emphasis of coll. on: Sapotaceae + general collection

Kisangani (0.30 N. 25.12 E.), surroundings of Kisangani: Wagenia (0.29 N. 25.11 E.), 76 km on rd. Ituri–Jegu (0.33 N. 25.48 E.), 27 km N. of Kisangani (0.46 N. 25.11 E.), 20, 23 km from Bengamisa (0.57 N. 25.10 E.), Yangambi (0.47 N. 24.28 E.), Ruwenzori area, km 100 on rd. to Bunia; – Virunga Nat. Park (1.00 S. 29.50 E.), Rutshuru (1.11 S. 29.27 E.), Mt. Visoke (volcan) (1.27 S. 29.29 E.), Nyiragongo volcan (1.31 S. 29.15 E.), Goma (1.41 S. 29.14 E.), Mt. Goma (2.36 S. 28.13 E.).

Central African Republic

Coll. J. W. Minderhoud
no. 1–422
date: 1963–1964
duplicates: –
emphasis of coll. on: savanna grasses

Mbaiki (3.53 N. 18.00 E.), Valley of Topia R. (4.20 N. 17.05 E.), Bangui (4.22 N. 18.35 E.), Alindao (4.59 N. 20.02 E.), Bossembélé (5.16 N. 17.39 E.), Bakolobo (5.15 N. 22.22 E.), Fort Sibut (5.44 N. 19.05 E.), Bambari (5.45 N. 20.40 E.); – Bouar (5.57 N. 15.36 E.); – Ouham Pendé area (7.00 N. 16.00 E.): Plateau of Boukaya, Boukaya (6.53 N. 15.34 E.), Marigot, Chaudeurge, Badi; – Valley of Batoua River (6.32 N. 16.01 E.), Bobani (6.37 N. 18.16 E.), Bokambay (7.17 N. 18.29 E.), Batangafo (7.18 N. 18.18 E.).
(Fort Archambault, along Chari River – Rep. Chad)

Coll. A. J. M. Leeuwenberg
no. 6242–6262, 7039–7317
date: 1965, 1966
duplicates distributed to: YA, P, BR, K, MO, PRE, LISC, EA, C, B, FHI, GC
emphasis of coll. on: Loganiaceae + general collection

Km 41, 49, 52 on rd. Garégoumo–Soso, Nakonmbo (3.42 N. 15.50 E.), 55 km E. of Garégouma; – Nola (3.32 N. 16.04 E.) (Mambéré River), 5 km S. of Nola (Sangha River), 6, 11, 13, 15 and 27 km S. of Nola along rd. to Salo; – Mambéré River near Bania (4.00 N. 16.07 E.), 4 km N. of Bania, along rd. to Berbérati, 22 km N. of Berbérati along rd. to Carnot, 2 km S. of Carnot (Mambéré R.), 2 km N. of Carnot, along rd. to Bouar; – 4 km N. of Gamboula along rd. Berbérati–Batouri (Cameroun).

Rep. Chad

Coll. W. J. J. O. de Wilde, J. J. F. E. de Wilde & B. E. E. de Wilde-Duijfjes
no. 5113–5333

date: 1964–1965
duplicates distributed to: BR, P, MO, K
emphasis of coll. on: –, general collection

Fort Lamy (12.07 N. 15.03 E.), Lake Chad near Hadjer el Hamis (12.51 N. 14.50 E.), Bokoro (12.23 N. 17.03 E.), Mongo (12.11 N. 18.42 E.), Abéché (13.49 N. 20.49 E.).

Rep. Sudan

Coll. W. A. BLOKHUIS
no. 1–190
date: 1961–1963
duplicates: –
emphasis of coll. on: –, general collection

Jebel Marra area, Kordofan Province, Et Tibbun (11.20 N. 27.20 E.), Kassala Province, Jebel Queri (14.30 N. 33. 47 E.), Wad el Huri, Ghadambaliya; – Khashm el Girba area (13.55 N. 35.05 E. – 15.10 N. 35.55 E.), near Jebel el Qatar (15.05 N. 35.40 E.), Khashm el Girba area (15.07 N. 35.43 E.).

Coll. W. J. J. O. DE WILDE, J. J. F. E. DE WILDE & B. E. E. DE WILDE-DUIJFJES
no. 5334–5862
date: 1965
duplicates distributed to: BR, MO, K, P, FHI
emphasis of coll. on: –, general collection

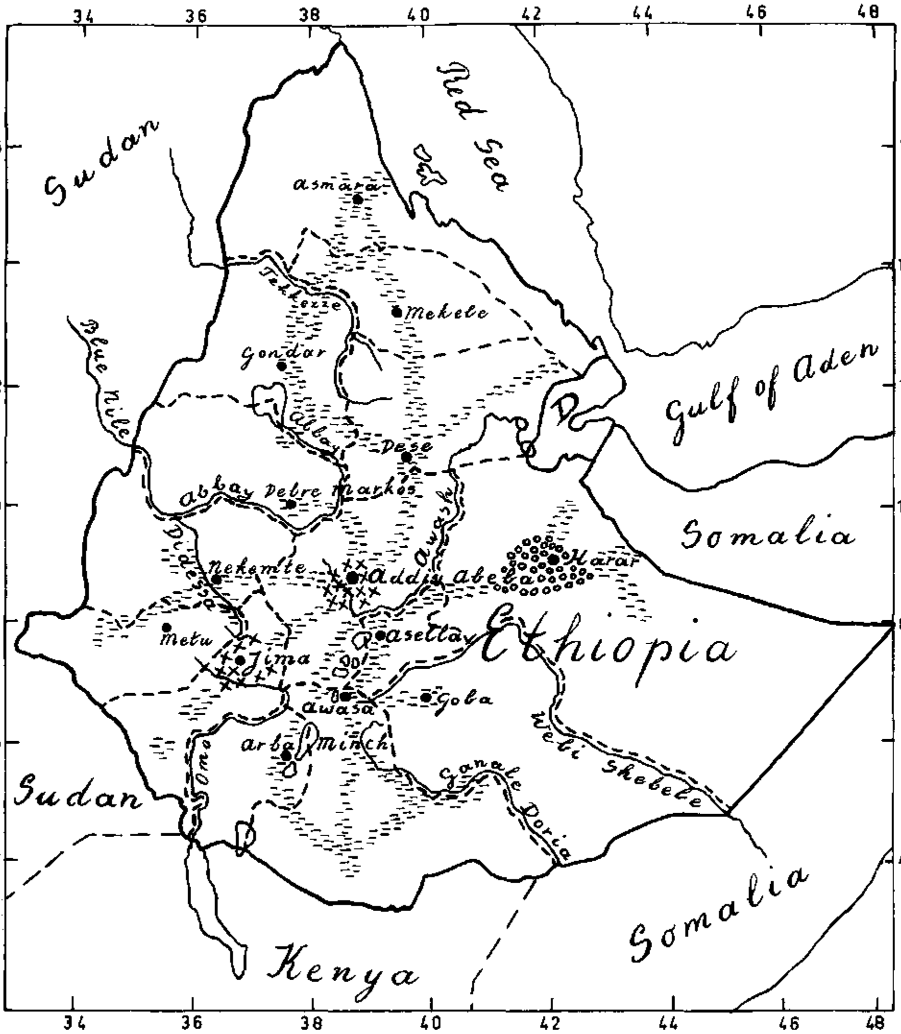
Zalingei, Jebel Marra Mts., Nyala, Jebel Aulia, Wad-Medani – Gezira Scheme, Khartoum.

Ethiopia

Coll. J. A. FRAHM-LELIEVELD
no. 62314–62376
date: 1962
duplicates in K
emphasis of coll. on: Papilionaceae (cytological studies)

Shoa Province: Menegesha Forest Reserve W. of Addis Ababa, Mt. Entotto, N. of Addis Ababa, Awash River, E. of Addis Ababa, Awara Melka N. of Awash Exp. Station, Wonji. Kefa Province: Surrounding of Jima, rd. Jima–Bosa, rd. Jima–Agaro.

Coll. W. J. J. O. DE WILDE & B. E. E. DE WILDE-DUIJFJES
no. 5863–11054
date: 1965–1966
duplicates distributed to: ETH, BR, MO, K, C, B, P, UPS, H, EA, FHI, PRE
emphasis of coll. on: Adenia (Passiflorac.) + general collection



MAP 4. Ethiopia: density of exploration by Dutch botanists in collection numbers per km².
(o o o: > 1/km²; x x x: 0,5–1/km²; – – –: < 0.5/km²)

Wollo Province: Kembolcha, E. of Kembolcha, E. of Bati, rd. Kembolcha–Assab, 200 km S.W. of Assab, surroundings of Assab, Assab–Red Sea coast.
Shoa Province: Addis Ababa, surrounding of Addis Ababa, Mt. Entotto, Mt. Uociacia, Mt. Zuquala, 60 km S. of Addis Ababa; – rd. Addis Ababa–Kembolcha, 30 & 50 km N. of Addis Ababa, Debre Libanos, 'Portuguese Bridge', 100 km N. of Addis Ababa, Mussolini Pass between Debre Berhan and Debre Sina, surrounding of Debre Berhan; – Surrounding of Awash Exp. Station, 15 & 25 km N. of Awash, 50 km W. of Awash, 30–60 km S.W. of Awash, Awash River between Awash Station and Nazret, 35 & 70 km E. of Nazret, 15, 20 & 30 km S. of Nazret; – rd. Addis Ababa–Ghion–Jima, 60, 140 & 200 km S.W. of Addis Ababa; – rd. Addis Ababa–Ambo (Agere Hiwot), surrounding of Ambo, rd. Ambo–Nekemt, 5 & 15 km W. of Ambo, surrounding of Guder, 70 km W. of Ambo, nr. Gedo (Gheddo), 10 km W. of Gedo.
Wellega Province: 10 & 15 km E. of Sire, rd. Nekemt–Ambo, 5 & 20 km E. Nekemt, rd. Nekemt–Gimbi, 20 & 35 km W. of Nekemt, 55 km W. of Nekemt near Didessa river, rd. Nekemt to Angar River, 20, 30, 40 & 50 km N. of Nekemt.
Kefa Province: rd. Jima–Addis Ababa, 100 km N.E. of Jima, crossing Omo River, surrounding of Jima, rd. Jima–Bonga, 10., 30, 40 & 65 km on rd. to Bonga, 67 km S.W. of Jima near Gogeb River, 25 km N.W. of Jima, on rd. Jima–Agaro; – Bonga, surrounding of Bonga.
Sidamo Province: 60 km N. of Shashamane, S.W. of Lake Langano, rd. Shashamane–Awasa, 10, 15, 20, 30 km S. of Shashamane, Awasa, surrounding of Awasa, along rd. Wondo–Agere Selam, S.E. of Agere Selam.
Arussi Province: Asella, 25, 30, 50 km S.E. of Asella (Mt. Boruluccu, Mt. Cilalo), Lake Ziway (Zwai), 10 km W. of Asella, 15 km W. of Asella, 10 km S. of Asella.
Hararge Province: Harar, surrounding of Harar, 50 km S.E. of Harar; – surrounding of Dire Dawa, surrounding of Alemaya, Gara Mulatta Mts. 20 km W. of Alemaya, 60 km S.W. of Alemaya along rd. Harar–Asbe Teferi.

Coll. E. WESTPHAL & J. M. C. WESTPHAL-STEVELS
no. 1–5565 (A)
5566–8686 (B)
date: 1967–1968 (A – collected in Ethiopia)
1968–1973 (B – collected in Exp. Garden at Wageningen. Cultivated from seeds out of Ethiopia)
duplicates distributed to: BR, MO, NA, K, C, DES, BAS, CAIM, LD, PRE
emphasis of coll. on: trop. crops, seed collection (pulses, cereals, condiments, oilseeds), general collection

Begemdir Province: rd. Gondar–Axum.
Wollo Province: Alamata.
Shoa Province: rd. Mieso–Awash, Awash Exp. Station, rd. Awash–Nazret, rd. Nazret–Asella (Metahara), rd. Nazret–Shashamane, rd. Shashamane–Adaba (Koffale, Dodolla), rd. Shasmane–Wondo (Awasa), rd. Mojo–Debre, Zeit, Debre Zeit Exp. Station, rd. Debre Zeit–Addis Ababa.
Wellega Province: rd. Nekemt–Gimbi, near Didessa River, rd. Nekemt–Ambo (Agere Hiwot).
Kefa Province; rd. Ghion–Jima, Jima, rd. Jima–Suntu, rd. Jima–Serbo, rd. Jima–Bonga, Bonga near R.C. Mission, rd. Bonga–Wush Wush.
Gamu Gofa Province: rd. Arba Mintch–Soddo, rd. Arba Mintch–Gidole, rd. Gidole–Konso, rd. Gidole–Giarso.
Sidamo Province: rd. Wondo–Agere Selam, rd. Agere Selam–Kebre Mengist, rd. Neghelli–

Wadera, rd. Wondo–Dila, rd. Dila–Agere Mariam (Wenago, Yirga Chaffe), rd. Soddo–Kolito–Shashamane, rd. Soddo–Arba Mintch.
Arussi Province: rd. Asella–Bekoji, surroundings of Asella, rd. Asella–Nazret.
Hararge Province: Alemaya, experimental gardens in and around Agric. College Alemaya, fields along rd. Agric. College–Kombolcha, Dire Dawa, rd. Dire Dawa–Alemaya, rd. Dire Dawa–Djibouti, rd. Dire Dawa–Harar, Harar, around Harar, rd. Harar–Jijiga (Errer Valley), rd. Jijiga–Degahbur; – rd. Alemaya–Asbe Teferi (Langhe, Bedeno, Harwacha-Gegertu, Kulubi, Deder, K'obo), Asbe Teferi, rd. Asbe Teferi–Machara (Gelemso, Bedessa), rd. Asbe Teferi–Mieso, Rd. Mieso–Dire Dawa (Erergota, Ourso).

Coll. Westphal, markets

Tigre Province: Axum, Mekele, Adua.
Begemdir Province: Gondar.
Wollo Province; Bati, Dese, Woldya.
Gojam Province: Bahar Dar.
Shoa Province: Debre Birhan, Addis Ababa, Debre Zeit, Ghion, Nazret, Wonji, Butajira, Langano, Shashamane, Kolito.
Wollega Province: Nekemt, Shankalla, Gimbi.
Illubabor Province; Dembi, Bedelle, Yamba.
Kefa Province: Assendabo, Serbo, Jima, Agaro, Shebe, Bonga, Woshi.
Gamu Gofa Province: Gidole, Giarso, Konso.
Sidamo Province: Awasa, Yirga Alem, Wondo, Teferi K'ele, Buditi, Soddo, market 20 km S. of Soddo, Neghelli, Dila.
Arussi Province: Asella.
Hararge Province: Mieso, Asbe Teferi, Bedessa, Gelemso, Hirna, Gergertu, K'obo, Kulubi, Wotter, Bedeno, Dire Dawa, Alemaya, Harar, Feddis, Jijiga.

Coll. J. J. F. E. DE WILDE
no. 4072–7386
date: 1968–1970
duplicates distributed to: ALEM, BR, MO, B, C, M, K, LG, PRE, LD, MAP (LMU), MOG, EA, DSM, HBG
emphasis of coll. on: –, general collection

Tigre Province: rd. Asmara–Massawa (15.20 N. 39.02 E., 15.20 N. 39.03 E., 15.19 N. 39.03 E., 15.20 N. 39.05 E., 15.26 N. 39.07 E., 15.32 N. 39.12 E., 15.33 N. 39.13 E., 15.33 N. 39.15 E., 15.36 N. 39.18 E.); – rd. Adua–Asmara (14.14 N. 38.54 E., 14.17 N. 38.53 E., 14.19 N. 38.52 E.), Adua (14.09 N. 38.54 E.); – rd. Adi Abun–Axum (14.09 N. 3851 E., 14.09 N. 38.49 E.), rd. Adua–Adigrat (14.07 N. 39.07 E., 14.21 N. 39.11 E.), rd. Adigrat–Quiha (14.01 N. 39.36 E., 13.55 N. 39.36 E.), rd. Enda Selassie–Gondar (13.57 N. 38.12 E., 13.54 N. 38.11 E.), N.W. of Makalle (13.31 N. 39.27 E., 13.35 N. 39.30 E.), rd. Quiha–Maichew (13.17 N. 39.31 E., 13.06 N. 39.30 E., 13.04 N. 39.31 E., 13.02 N. 39.32 E., 12.55 N. 39.31 E., 12.52 N. 39.34 E.), rd. Maichew–Dessie (12.40 N. 39.32 E.).
Begemdir Province: rd. Axum–Gondar (13,43 N. 38.12 E., 13.40 N. 38.20 E.), Western Semyen Mts. (13.12 N. 37.53 E.), rd. Gondar–Axum (12.46 N. 37.36 E., 12.42 N. 37.27 E.), rd. Gondar–Bahar Dar (12.24 N., 37.32 E., 12.25 N. 37.38 E., 12.07 N. 37.40 E., 11.50 N. 37.33 E.), near Bahar Dar (11.33 N. 37.27 E.), Tisisat Blue Nile Falls (11.30 N. 37.35 E.).
Wollo Province: rd. Kembolcha–Assab (11.11 N. 39.58 E., 11.11. N. 40.14 E.) 11.17 N. 40.24 E., 11.17 N. 40.28 E.).

Gojam Province: E. of Bahar Dar (11.33 N. 37.23 E., 11.30 N. 37.29 E.), W.S.W. of Bahar Dar (11.33 N. 37.21 E.).

Shoa Province: rd. Addis Ababa–Debre Markos, nr. Blue Nile Gorge (11.00 N. 38.09 E.), 10 km S.E. of Dejen (10.05 N. 38.12 E.); – Awash Exp. Station, Awash Nat. Park (9.02 N. 39.53 E., 9.00 N. 39.55 E., 8.57 N. 40.03 E., 8.50 N. 40.02 E.), rd. Asbe Teferi–Addis Ababa (8.50 N. 40.02 E.), rd. Awash–Nazret (8.57 N. 39.39 E., 8.55 N. 39.55 E. (W. of Metahara), 8.50 N. 39.43 E., 8.43 N. 39.34 E.); – rd. Addis Ababa–Ghion–Jima (8.35 N. 38.01 E., 8.34 N. 38.00 E., 8.32 N. 37.58 E. (Ghion), 8.22 N. 37.52 E., 8. 15 N. 37.37 E., 7.56 N. 37.26 E.); – rd. Ambo (Agere Hiwot)–Nekemt (8.59 N. 37.42 E.); – rd. Mojo–Shashamane, Lake Abiyata (7.41 N. 38.38 W.), Lake Langano (7.33 N. 38.41 E.), Lake Shala (7.28 N. 38.38 E.).

Illubabor Province: rd. Gore–Bure (8.09 N. 35.29 E., 8.16 N. 35.08 E.), track Bure–Gambela (8.16 N. 35.01 E.).

Kefa Province: rd. Jima–Addis Ababa (7.40 N. 36. 53 E., 7.42 N. 37.00 E., 8.10 N. 37.35 E., 8.13 N. 37.33 E., 8.13 N. 37.34 E.), rd. Jima–Agaro–Dembi (7.47 N. 36.45 E., 7./7N. 36.42 E., 7.52 N. 36.36 E.), rd. Jima–Bonga (7.37 N. 36.45 E., 7.32 N. 36.33 E., 7.30 N. 36.30 E., 7.27 N. 36.28 E., 7.25 N. 36.27 E., 7.24 N. 36.24 E.,7.24 N. 36.21 E., 7.18 N. 36.14 E.), Bonga (7.15 N. 36.16 E., 7.15 N. 36.15 E.), rd. Bonga–Mizan Tefari (7.18 N. 36.05 E.,7.16 N. 36.12 E., 7.16 N. 36.11 E., 7.16 N. 36.09 E., 7.16 N. 36.08 E., 7.12 N. 36.06 E.), Maji (6.11 N. 35.35 E., 6.12 N. 35.34 E.), Gobe (6.13 N. 35.33 E.), trail Maji-Adicas (6.09 N. 35.36 E., 6.03 N. 35.34 E.).

Gamu Gofa Province: rd. Soddo–Arba Mintch, Lake Abaya (6.16 N. 37.49 E.), E. of Arba Mintch (6.02 N. 37.37 E.), Lake Chamo nr. Arba Mintch (5.57 N. 37.36 E.), S. of Gidole (5.36 N. 37.30 E.).

Sidamo Province: rd. Soddo–Arba Mintch (6.50 N. 37.44 E. (3 km S.W. of Soddo), 6.49 N. 37.53 E., 6.42 N. 37.53 E.), rd. Soddo–Gofa (6.47 N. 37.41 E., 6.50 N. 37.40 E., 6.49 N. 37.32 E. (W.S.W. of Soddo), 7.09 N. 37.37 E. (W. of Soddo), rd. Soddo–Shashamane (6.53 N. 37.47 E.), rd. Agere Selam–Kebre Mengist (6.27 N. 38.33 E., 6.14 N. 38.42 E., 6.13 N. 38.43 E., 6.11 N. 38.45 E., 6.07 N. 38.50 E., 6.06 N. 38.52 E., 6.00 N. 38.57 E.), rd. Kebre Mengist–Neghelli (5.52 N. 39.10 E., 5.50 N. 39.14 E., 5.48 N. 39.18 E., 5.45 N. 39.16 E., 5.45 N. 39.20 E., 5.43 N. 39.21 E., 5.29 N. 39.30 E., 5.23 N. 39.33 E.), Genale Doria River (5.35 N. 39.40 E.), Neghelli (5.21 N. 39.36 E.), rd. Neghelli–Filtu (5.20 N. 39.37 E., 5.20 N. 39.38 E. 5.19 N. 39.40 E., 5.17 N. 39.42 E., 5.15 N. 40.09 E., 5.13 N. 40.28 E.).

Bale Province: rd. Shashamane–Goba, rd. Adaba–Goba, Dintshu, (7.03 N. 39.33 E., 7.04 N. 39.39 E., 7.05 N. 39.41 E., 7.05 N. 39.44 E., 7.06 N. 39.47 E.), near Sof Omar (6.55 N. 40.47 E.).

Arussi Province: rd. Shashamane–Goba, Dodollo (7.09 N. 38.43 E., 7.08 N. 38.44 E., 7.03 N. 38.49 E., 7.03 N. 38.50 E.).

Hararge Province: Alemaya, Lake Alemaya (9.23 N. 42.01 E., 9.24 N. 42.00 E.), rd. Dire Dawa–Harar (9.34 N. 41.52 E., 9.34 N. 41.51 E., 9.33 N. 41.52 E., 9.31 N. 41.53 E., 9.30 N. 41.54 E., 9.30 N. 41.55 E., 9.29 N. 41.54 E., 9.21 N. 42.04 E.), rd. Dire Dawa–Djibouti (9.39 N. 41.55 E., 9.40 N. 42.00 E., 9.49 N. 42.09 E.), S. of Harar, Gobelli R. valley (8.52 N. 42.08 E., 8.32 N. 42.07 E.), rd. Harar–Jijiga, Mt. Hakim (9.17 N. 42.06 E.), Rock-Valley, Errer River (9.17 N. 42.08 E., 9.16 N. 42.09 E., 9.16 N. 42.10 E., 9.15 N. 42.11 E., 9.14 N. 42.15 E., 9.13 N. 42.17 E., 9.11 N. 42.22-23-24-25-26 E., 9.10 N. 42.25 E., 9.12 N. 42.25-27 E., 9.13 N. 42.29 E., 9.22 N. 42.43 E., 9.21 N. 42.45 E., 9.21 N. 42.47 E.), Mt. Kordudu (9.29 N. 42.16 E., 9.27 N. 42.19 E., 9.27 N. 42.20 E., 9.26 N. 42.21 E.), rd. Harar–Jijiga, S. of road (9.06 N. 42.29 E.), rd. Jijiga–Hargeisa (9.21 N. 42.49 E., 9.22 N. 42.53 E., 9.24 N. 43.00 E.), rd. Jijiga–Degahabur (9.20 N. 42.51 E., 9.12 N. 43.04 E. 9.08 N. 43.09 E., 8.45 N. 43.20 E.); – Ogaden, Kebre Dahar (6.45 N. 44.17 E.), Gode Exp. Station (6.00 N. 43.30 E.); – Gara Mulatta Mts. (9.08 N. 41.39 E., 9.14 N. 41.42 E., 9.15 N. 41.42 E., 9.15 N. 41.44 E., 9.17 N. 41.43 E., 9.12 N. 41.46 E., 9.14 N. 41.47 E., 9.20 N. 41.49 E.), rd. Harar–Asbe Terefi, S.E. and S.S.E. of Kulubi (9.25 N. 41.41 E., 9.24 N. 41.46 E., 9.23 N. 41.47 E.), rd. Harar–Asbe Teferi, Ahmar Mts. (9.10 N. 41.04 E., 9.18 N. 41.13

E.); – rd. Dire Dawa–Erergota (9.36 N. 41.49 E., 9.37 N. 41.47 E., 9.35 N. 41.33 E., 9.34 N. 41.30 E., 9.31 N. 41.25 E.), Erergota (9.31 N. 41.23 E.), N. of Eregota (9.38 N. 41.24 E.).

Coll. J. J. de Wilde, markets:
Begemdir Province: Amussit
Wollo Province: Robit
Kefa Province: Maji
Bale Province: Adaba, Habbe.

Coll. J. J. F. E. DE WILDE & M. G. GILBERT
no. 1–450
date: 1969
duplicates distributed to: ETH, ALEM, K, EA, UPS, LG, MO, MOG
emphasis of coll. on: –, general collection

Begemdir Province: Semyen Mts., rd. Gondar–Bahar Dar, Blue Nile Falls, S.E. of Bahar Dar.
Sidamo Province: rd. Wondo–Kebre Mengist (6.33 N. 38.28 E., 6.20 N. 38.40 E., 6.10 N. 38.45 E., 6.05 N. 38.53 E.) rd. Kebre Mengist–Neghelli (5.52 N. 39.07 E., 5.50 N. 39.12 E., 5.35 N. 39.24 E., 5.23 N. 39.32 E., 5.33 N. 39.40 E.), rd. Neghelli–Filtu (5.16 N. 39.41 E., 5.13 N. 40.22 E.), rd. Neghelli–Wachille (4.47 N. 39.25 E., 4.43 N. 39.12 E., 4.35 N. 39.05 E.), rd. Wachille–Mega (4.30 N. 38.35 E.), rd. Mega–Moyale (4.03 N. 38.19 E., 4.01 N. 38.19 E.), E. of Mega (4.04 N. 38.20 E., 4.05 N. 38.19 E.), rd. Mega–Yabello, rd. Yabello–Agere Mariam, rd. Yabello–Konso.
Gemu Gofa Province: rd. Konso–Hamer Coker, rd. Konso–Gidole–Arba Mintch, Arb Mintch.
Hararge Province: rd. Dire Dawa–Djibouti, rd. Dire Dawa–Erergota.

Coll. C. J. P. SEEGELER
no. 1–1577 A (seedsamples from markets in Ethiopia)
1578–2034 B (herbarium specimens and seedsamples collected in experim. garden at Wageningen, cultivated from seeds out of Ethiopia)
2035–3306 C (general collection Ethiopia)
3307–3947 D (herbarium specimens and seedsamples collected in experim. garden at Wageningen, cultivated from seeds out of Ethiopia)
date: 1971–1973 (A & C)
1974–1977 (B & D)
duplicates: about 6000 specimens, not yet available, 1 set in ALEM
emphasis of coll. on: cultivated plants (trop. crops), seedcollection (oilseeds, cereals, pulses), general collection

Eritrea: rd. Asmara–Massawa.
Tigre Province: Adigrat, Axum, Quiha.
Begemdir Province: Between Axum and Gondar, Gondar, rd. Worata–Debre Tabor.
Wollo Province: Dessie, Kembolcha.
Gojam Province: around Debre Markos.
Shoa Province: Debre Berhan, Akaki near Addis Ababa, Nazret, rd. Nazret–Asella, 12, 22, 32 km S. of Nazret, rd. Nazret–Awash, 30 km E. of Nazret, rd. Awash–Gewane, Shashamane, Metahara Sugar Estate.

Wellega Province: rd. Nekemt–Gimbi, Dembidolo.
Illubabor Province: Metu, rd. Gore–Gambela, Gambela.
Kefa Province: Agaro, Jima, Shebe between Jima and Bonga, Bonga.
Sidamo Province: Awasa, rd. Wondo–Neghelli.
Bale Province: Adaba between Shashamane and Goba, Goba, Sof Omar, N. of Goba near Webi River.
Arussi Province: rd. Dera–Sire.
Hararge Province: Alemaya, surrounding of Alemaya, Dire Dawa, rd. Dire Dawa–Erergota, E. of Dire Dawa, Harar, Feddis near Harar, Besidimo, about 15 km E. of Harar, Babile S.E. of Harar, Dakata Valley between Harar and Jijiga, Jijiga, rd. Jijiga–Degahabur, Kulubi, Wotter S. of Kulubi, rd. Harar–Ashe Teferi Chercher Highlands, Zegeta, Asbe Teferi, rd. Asbe Teferi–Gelemso, rd. Mieso–Awash, Mulu.

Coll. Seegeler, markets:

Eritrea: Adi Caieh
Tigre Province: Axum, Adi-show (90 km S. of Quiha)
Begemdir Province: Infranz, Gondar, Addis Zemen
Wollo Province: Haik, Robit (between Korem and Kobbo), Bati, Dessie, Kembolcha.
Gojam Province: Dejen, Lumane, Elias, Telili.
Shoa Province: Gude Beret (nr. Karakorem), Robi (between Kembolcha and Addis Ababa), Kuyera (nr. Shashamane), Kofale (E. of Shashamane), Shashamane, Alelu (nr. Shashamane-N.).
Wellega Province: Dembidole, Alem Teferi (between D'dolo and Gimbi), Defno (nr. Gimbi), Bekejama (nr. Nekemt).
Illubabor Province: Jemero (between Agaro and Bedelle), Metu, Bure (between Goro and Gambela), Gambela, Atank (45 km W. of Gambela).
Kefa Province: Agaro, Yebu (between Jima and Agaro), Jima, Bonga, Chena (between Bonga and Mizan Tefari).
Sidamo Province; Awasa, Neghelli.
Bale Province: Goba, Robi, Goro.
Arussi Province: Sire.
Hararge Province: Asbe Teferi, Mulu, Assabot, Bedessa, Waichu, Kuni, Gelemso, Chelenko, Deder, Wotter, Langhe, Bedeno, Alemaya, Harar, Feddis, Jijiga.

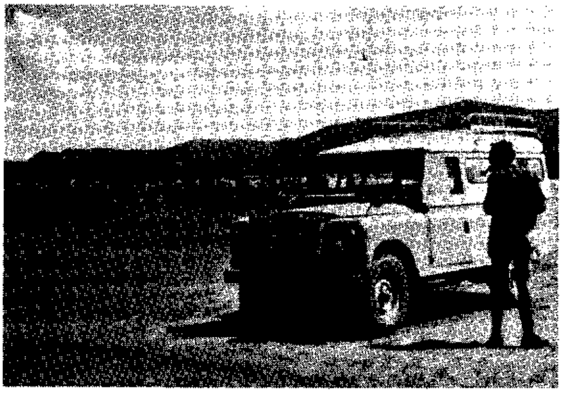
Coll. J. J. Bos
no. 7471–10257
date: 1974–1975
duplicates: about 10.000 specimens, not yet available, 1 set in ALEM
emphasis of coll. on: cultivated plants (about 700 no's Capsicum), general collection

Shoa Province: Awash Exp. Station, rd. Awash–Addis Ababa, between Nazret and Metahara, Addis Ababa, rd. Addis Ababa–Nekemt near Guder and 50 km E. of Bako.
Wellega Province: Gimbi, rd. Nekemt–Addis Ababa 30 and 57 km E. of Nekemt.
Kefa Province: rd. Ghion–Jima-Gibe River, rd. Addis Ababa–Jima, 90 and 208 km from Jima, rd. Jima–Bonga, 8, 10, 24 and 58 km from Bonga, Bonga, surrounding of Bonga.
Sidamo Province: N-shore of Lake Awasa, rd. Awasa–Wondo, 10 and 50 km S. of Awasa, rd. Wondo–Kebre-Mengist, N. and S. of Agere Selam.
Arussi Province: W. side of Lake Langano, E. side of Lake Shala.
Hararge Province: Alemaya, campus Agric. College, Lake Alemaya, rd. Agric.

1


3


2


4


1. Dr. Ir. E. WESTPHAL
2. Ir. J. M. C. WESTPHAL-STEVELS
3. Ir. P. C. M. JANSEN
4. Ir. C. J. P. SEEGELER

College–Kombolcha, Bat, rd. Agric College–Dire Dawa, Awale, Dangago Mt. between Dire Dawa and Alemaya, surrounding of Dire Dawa, rd. Dire Dawa–Djibouti, Shenelle, rd. Dire Dawa–Erergota, Erergota; – rd. Dire Dawa–Harar, S. of Dire Dawa, Dengego, slopes Gara Mulatta Mts. near Curfacelli, Harar, rd. Harar–Jijiga, Rock Valley, Dakata Valley, Chercher Highlands near Carsa, rd. Harar–Asbe Teferi, Huwata 80 km W. of Kulubi, between Hirna and Deder.

Coll. Bos, markets:

Kefa Province: Jima
Hararge Province: Dire Dawa, Alemaya, Bati, Kafira, Harar.

Coll. P. C. M. JANSEN

no. 1–1028 (herbarium specimens and seedsamples collected in experimental garden at Wageningen, cultivated from seeds out of Ethiopia)
1029–7286 (herbarium specimens and seedsamples collected in Ethiopia, cultivated specimens: 1356, wild specimens: 4902)
date: 1975–1977
duplicates: about 20.000 specimens, not yet available, 1 set in ALEM
emphasis of coll. on: medicinal plants, condiments + general collection

Shoa Province: 130 & 225 km on rd. Addis Ababa–Awash, Awash, rd. Awash–Nazret, Nazret, surrounding of Nazret, Nazret Experim. garden, Shashamane; – rd. Addis Ababa–Ambo (Agere Hiwot), Guder.
Wellega Province: Nekemt, surrounding of Nekemt, rd. Nekemt–Gimbi, near Didessa River.
Illubabor Province: Gambela, surrounding of Gambela.
Kefa Province: rd. Ghion–Jima, Jima, surrounding of Jima, Jima in Experim. Garden, rd. Jima–Bonga, near Gogeb River (Godjeb) along rd. Jima–Bonga, Bonga, surrounding of Bonga, rd. Bonga–Wush Wush.
Gamu Gofa Province: rd. Soddo–Arba Mintch, Arba Mintch.
Sidamo Province: Soddo, Awasa.
Bale Province: Goba.
Arussi Province: Asella.
Hararge Province: Alemaya, in Experim. garden near Agric. College, surrounding of Alemaya, rd. Agric. College–Kombolcha, Kombolcha; – Awalle valley, 12 km from Alemaya, rd. Alemaya–Dire Dawa between Alemaya and Dengego, Dengego Mts., Dire Dawa, Shenelle near Dire Dawa, 12 & 18 km on rd. Dire Dawa–Erergota, Erergota; – rd. Alemaya–Kulubi, Harar, surrounding of Harar, rd. Harar–Feddis, rd. Harar–Jijiga, Mt. Kondudu, Dakata Valley, Jijiga; – Gara Mulatta Mts., rd. Gara Mulatta, 14 km from Adele, rd. Kulubi – Asbe Teferi: Chercher Highlands near Chelenko, Gara (Mt.) Ades, Hirna, 65 km from Asbe Teferi, Asbe Teferi.

Coll. Jansen, markets:

Shoa Province: Ambo, Bulbulla, 60 km on rd. Shashamane–Addis Ababa.
Wellega Province: Gimbi, Nekemt, Bako.
Illubabor Province: Gambela.
Kefa Province: Bonga.
Gemu Gofa Province: Adillo, 50 km from Soddo.
Hararge Province: Hirna, Alemaya, Kombolcha, Dire Dawa, Harar, Gursum near rd. Harar–Jijiga, Babile.

Kenya

Coll. J. A. Frahm-Lelieveld
no. 62167–62301
date: 1962
duplicates in K
emphasis of coll on: Papilionaceae (cytological studies)

Molo (0.15 S. 35.44 E.), Kitale Grassland Exp. Station (1.01 N. 35.00 E.), rd. Kiambu–Limuru, Jacaranda Estate Coffee Exp. Station (1.06 S. 36.55 E.), Ruiru, along rd. Ruiri–Thika.

Coll. R. Harmsen
no. KM 1–KM52, KN 1–KN21, KP 1–KP 7
date: 1966
duplicates: –
emphasis of coll on: –, general collection

Mt. Kenya.

Coll. W. Bakker
about 300 no's
date: 1970–1971
duplicates: –
emphasis of coll. on: grasses and small general collection

Kisumu (0.06 S. 34.45 E.), Otongolo (0.05 S. 34.42 E.), Ahero (0.11 S. 34.55 E.), rd. Ahero–Kisii, Paponditi (0.19 S. 34.56 E.), Mwea, Nairobi (1.17 S. 36.40 E.).

Coll. D. Vuyk
no. 1–560
date: 1974–1975
duplicates: about 1500 specimens, 1 set in EA
emphasis of coll. on: –, general collection

S. Nyanza, Kisii District, surrounding of Kisii.

Coll. Chr. Bosch
no. 1–175
date: 1976
duplicates about 600 specimens, not yet available
emphasis of coll. on: Papilionaceae and general collection

Subukia (0.05 S. 36.10 E.), N.W. of Molo (0.11 S. 35.41 E., 0.11 S. 35.42 E.), surrounding of Nakuru, Nakuru Menengai Crater (0.15 S. 36.05 E.), N. of Kericho (0.21 S. 35.17 E.), S.W. of Kericho (0.26 S. 35.10 E.).

Coll. A. C. PLAIZIER
no. 150–1328
date: 1978
duplicates: about 1000 specimens, 1 set in EA
emphasis of coll. on: –, general collection

S. Nyanza, Kisii District, surrounding of Kisii, Masai Mara, Lake Magadi.

Tanzania

Coll. J. A. FRAHM-LELIEVELD
no. 6201–62166
date: 1962
duplicates in K
emphasis of coll. on: Papilionaceae (cytological studies)

Kilimanjaro slopes (3.04 S. 37.22 E.), Marangu (3.17 S. 37.31 E.), Old Moshi (3.19 S. 37.24 E.), Moshi (3.21 S. 37.20 E.), Arusha Pesticides Exp. Station, surrounding of Arusha (3.22 S. 36.41 E.), Rift Wall Estate, bank Lake Manyara (3.55 S. 35.50 E.), Usambara Mts. (4.45 S. 38.30 E.), Lugongo Estate (4.51 S. 38.50 E.), Maramba Estate (Tanga Prov.) (4.52 S. 38.48 E.).

Coll. M. H. BRAUN
no. 1–392
date: 1967
duplicates distributed to: DSM, K, LG, MAP, MOG
emphasis of coll. on: –, general collection

Serengeti National Park.

Coll. J. PRINS-LAMPERT
no. 1–576
date: 1967–1969
some duplicates distributed to: DSM, BR
emphasis of coll. on: Grasses and general collection

Iringa Region, Iringa (7.46 S. 35.42 E.), Mbeya Region, Mbeya (8.50 S. 33.22 E.), Ruvuma Region, Kitulo (10.33 S. 35.36 E.).

Coll. A. J. M. LEEUWENBERG
no. 10810–10880
date: 1975
duplicates: about 200 specimens, 1 set in EA
emphasis of coll. on: Loganiaceae and Apocynaceae

W. Usambara Mts. (4.53 S. 38.17 E.), Handeni (5.26 S. 38.01 E.), Sao Hill (8.20 S. 35.12 E.).

Botswana & S.W. Africa (Namibia)

Coll. R. J. de Hoogh
no. 1–302
date: 1968–1969
duplicates: about 300 specimens, not yet available
emphasis of coll on: –, general collection

Botswana: Ghanzi, Mwakupan along Lake Ngami, about 80 miles S. of Maun, 13 miles N. of Mbelia Pudi along rd. To Maun.
S.W. Africa: along rd. Windhoek–Rehoboth, near Regenstein, Gamma, 28 miles N. of Uhlenhorst, Gamsberg Plateau.

S. Africa

Coll. J. J. Bos
no. 1–1409
date: 1963–1964
duplicates distributed to: PRE, M, K, LISC, B, LD
emphasis of coll. on: Liparia (Papil.) and general collection

S.W. Cape Province: Stellenbosch, Jonkershoek Forest Reserve near Stellenbosch, foothills of Stellenbosch Mt., Durbanville, Hottentotsholland Mts., Simonstown, Paarl Mt., Highlands Forest Reserve, Paardeberg, Brackenfell, Cedar Mts. (Algeria). – Cape Province: near Riverdale, Deepwalls Forest Reserve near Knysna, Baviaanskloof Forest Reserve, Willowmore Div. – Transvaal: Drakensberg Mariepskop, Westfalia Estate near Duiwelskloof.

Coll. A. J. M. Leeuwenberg
no. 10881–11024
date: 1976
duplicates: about 300 specimens, 1 set in PRE
emphasis of coll. on: Apocynaceae, Loganiaceae and general collection

Cape Province: Jonkershoek Forest Reserve, Betty's Bay Kloof, Harold Porter.
Transvaal: Pretoria, Roodeplaatdam N.E. of Pretoria, Pienaars River N.W. of Pretoria, between Nijstroom and Vaalwater.

Malagasy (Madagascar)

Coll. R. W. den Outer & W. L. H. van Veenendaal
no. 988–1228
date: 1978
duplicates: –
emphasis of coll. on: trees and shrubs

Ambalavao, Ranohira, Sakaraha, Tulear, Betioky, Ampanihy, Tsihombe, Fort Dauphin.

OTHER ACQUISITIONS DURING THE PERIOD 1955–1980

Plants from Africa
Received as a gift or otherwise

	Collections	Number of specimens
WEST AFRICA:		
CAP. VERD. ISLANDS	De Pater	129
LIBERIA	W. Goll	± 150
	W. J. Harley	400
	Hunder	147
IVORY COAST	J. A. Frahm-Lelieveld	150
MALI	A. Cissé	± 400
	N'Golo Diarra	± 200
NIGERIA	J. D. Chapman	± 350
	J. A. Emwiogbon	± 325
	Z. O. Gbile et al.	± 500
	A. Kamphorst	200
	M. G. Latilo	± 100
	A. C. Zeven	300
CENTRAL AFRICA		
CAMEROUN	S. N. Ekema	± 100
	A. Meurillon	470
	A. Saxer	463
	Station de Wakwa	52
ZAIRE	INEAC, Yangambi	162
BURUNDI	J. Lewalle	216
NORTH EAST AFRICA:		
EGYPT	E. Sickenberger	72
	Van Vliet	121

ETHIOPIA	G. Aweke	200
	L. Boulos	68
	A. Getahun	165
	H. F. Mooney	376

EAST & CENTRAL AFRICA:

KENYA	E. van Gastel	71
	Van Wissen	200
TANZANIA	R. E. S. Tanner	1333
MALAWI	E. I. Newman & T. C. Whitmore	350
	E. Phillips	1796
ZAMBIA	A. Angus & F. White	214
	'J. Prins-Lampert'	88

SOUTHERN AFRICA:

S. AFRICA	M. C. Olivier	202
	R. D. Stam	140

Total number of specimens: 10970.

Received in exchange

	Number of specimens
TROP. AFRICA, miscellaneous K (Kew Herb.) L (Leiden)	5233
WEST AFRICA Plants received from: (Cambridge USA), IFAN (Dakar), SL (Freetown), G (Genève), LISC (Lisboa), GC (Legon), FHI (Ibadan) Origin: Guinea (Port.), Senegal, Sierra Leone, Liberia, Ivory Coast, Ghana, Nigeria.	10971

Central Africa 26719
Plants received from: BR (Bruxelles), GENT (Gent), LG (Liège), HBG (Hamburg), P (Paris), Z (Zürich), U (Utrecht), IRSC (Congo-Brazzaville)
Origin: Cameroun, Gabon, Rep. Congo, Zaire, Rwanda, Burundi.

North East Africa 2204
Plants received from: CAIM (Cairo), C (Copenhagen), FI (Firenze), GENT (Gent), MOG (Mogadishu), NA (Washington)
Origin: Egypt, Ethiopia, Somalia.

East Africa 15274
Plants received from: BAS (Basel), UC (Berkeley), B (Berlin), C (Copenhagen), DSM (Dar es Salaam), G (Genève), H (Helsinki), MHU (Kampala), LD (Lund), EA (Nairobi), FHO (Oxford), SRGH (Salisbury), UPS (Uppsala), MO (Saint Louis).
Origin: Kenya, Tanzania, Uganda, Malawi, Zambia, Zimbabwe.

Southern Africa 26158
Plants received from: B (Berlin), COI (Coimbra), LISC (Lisboa), MAP (Maputo), LUA (Luanda), PRE (Pretoria), GENT (Gent), MO (Saint Louis).
Origin: Moçambique, Botswana, Angola, S.W. Africa (Namibia), S. Africa.

Malagasy (Madagascar) 775
Plants received from: A (Cambridge USA), P (Paris), L (Leiden).

Total number of specimens: 87333

Plants from North Africa
Received as a gift or otherwise

	Collections	Number of specimens
Algeria	F. M. Muller	91
Morocco	J. J. de Wilde et al.	1534
Tunisia	J. W. A. Jansen	675
	L. J. G. v. d. Maesen	51
	G. Nijland	150

CANARY ISLANDS	G. Kunkel	490
	L. J. G. v. d. Maesen	242
	J. H. Vredebregt	550

Total number of specimens: 3783

Plants from the near East, Asia & Australia
Received as a gift or otherwise

	Collections	Number of specimens
NEAR EAST	M. van Oosten	300
TURKEY	E. Hennipman et al.	1518
	L. J. G. v. d. Maesen	376
	J. J. de Wilde	72
	H. A. de Wit	± 200
ISRAEL	A. Eig & N. Feinbrun	122
	P. Terpstra	83
	M. Risseeuw	160
	J. M. C. Stevels	210
	University of Jerusalem	261
	M. Zohary	400
IRAC	Herb. Baghdad	200
	L. J. G. v. d. Maesen	419
INDIA	L. J. G. v. d. Maesen	1036
MALEISIA	W. H. Diemont & van Wijngaarden	80
INDONESIA	W. Meyer (rice coll.)	200
	J. J. de Wilde	109
AUSTRALIA	H. Doing	150

Received in exchange

	Institute	Number of specimens
INDIA	New Delhi	175
INDONESIA	Leyden (L)	1238
JAPAN	Tokyo (TI)	1048
AUSTRALIA	Hamburg (HBG)	587

Total number of specimens: 8934

Plants from Central and South America received as a gift or otherwise

	Collections	Number of specimens
COSTA RICA	H. A. le Poole	55
CURAÇAO	P. A. W. J. de Wilde	150
COLOMBIA	L. Uribe Uribe	38
PERU	A. J. Hijmans	41
VENEZUELA	F. J. Breteler	2146
	J. de Bruijn	817
	A. R. Camacho Duran	100
	J. W. Meijeraan	59
	G. H. Raets	60
	J. A. Steyermark	260
	Veillon	120
SURINAM	N. W. J. Borsboom	130
	A. Budelman	585
	A. de Gier	±1000
	C. J. Gieteling	136
	E. Groenendijk	235

	R. W. den Outer	138
	J. T. Sterringa	150
FR. GUIANA	Herb. Cayenne	53
	A. J. M. Leeuwenberg	250

Received in Exchange

	Institute	Number of specimens
BRASIL	Curitiba (MBM)	722
	New York (NY)	1731
SURINAM	Utrecht (U)	330
SOUTH AMERICA (different countries)	St. Louis (MO)	945
	Stockholm (S)	475
	Washington (US)	798

Total number of specimens: 11495

Plants from North America
received as a gift or otherwise

	Collections	Number of specimens
CANADA	F. J. Breteler	150
	A. W. H. Damman	43
	R. Harmsen	420
	A. C. Heringa	220
	P. J. van Herwerden	224
	A. J. B. Schalk	170
	H. J. P. Vreeman	300
	J. J. Westra	191
U.S.A.	Herb. Berkely (UC)	92
	P. O. Schallert	300
	J. C. Wilmar	275

Received in exchange

	Institute	Number of specimens
U.S.A.	Berkely (UC)	922
	Philadelphia (PH)	78
	Statesboro (GAS)	141
	Washington (NA)	831

Total number of specimens: 4357

Plants from Europe
received as a gift or otherwise

	Collections	Number of specimens
AUSTRIA	K. J. W. Hensen	125
DANMARK	W. J. Middelhoven	60
FRANCE	G. J. H. Amshoff	113
	E. M. Donker & A. Stevelink	115
	Exc. Biolog. Students, A'dam	198
	Exc. Biolog. Students, Wageningen	1084
	W. Grotenbreg	90
	W. J. Reynders	420
	S. Segal	1300
	J. J. de Wilde	73
GERMANY W.	A. J. M. Leeuwenberg	40
ICELAND	M. Bouman	331
IRELAND	J. Dorgelo	228
	P. A. W. J. de Wilde	300
JUGOSLAVIA	F. Hillenius-Gehrels	220
	H. N. Kooiman	200
	H. Q. Varekamp	84

NETHERLANDS/W. EUROPE	W. Beijerinck	2300
	A. L. Brandhorst	700
	H. Doing	500
	E. Meijer Drees	3000
NETHERLANDS	J. Bakker	114
	W. G. Beeftink	50
	J. de Bruijn	470
	B. Geertsema	120
	E. Groothuis	150
	K. R. Libbenga	203
	W. J. Middelhoven	49
	F. J. Ch. van Prehn Wiese	300
	J. C. Vegelin van Claerbergen	200
PORTUGAL	M. van Oosten	100
PORTUGAL & SPAIN	J. J. de Wilde	150
SPAIN	A. Th. F. Burgers	300
	J. C. Wilmar	150
	H. C. D. de Wit	400
SWEDEN	B. E. E. Duijfjes	226
	S. Segal	280
	P. A. W. J. de Wilde	65
SWITZERLAND	J. de Bruijn	80
	Exc. Biolog. Students, A'dam	541

received in exchange

	Institute	Number of specimens
BELGIUM	Gent (GENT)	900
FINLAND	Helsinki (H)	100
FRANCE	Leyden (L)	148
GREENLAND	Copenhagen (C)	± 500

HUNGARY	Budapest (BP)	309
IRELAND	Dublin (TCD)	138
POLAND	Wroclaw (WRSL)	125
PORTUGAL	Coimbra (COI)	106
RUMANIA	Bukarest (BUC)	100
U.S.S.R.	Leningrad (WIR)	197
EUROPE (misc.)	Kew (K)	150

Total number of specimens: 18462

Cultivated plants collected in the Netherlands

Wageningen, Agricultural University: Department of Plant Taxonomy & Geography,
Botanical Gardens: Arboretum De Dreijen,
Belmonte Arboretum; Tropical collections
in greenhouses.
Department of Tropical Crops,
Department of Horticulture,
Department of Plant Breeding.

Herbarium Staff 1958–1970	6300	
J. J. Bos	400	
J. de Bruijn	900	
K. J. W. Hensen	2000	
N. E. Nannenga-Bremekamp	1200	
F. J. Ch. van Prehn Wiese	1500	
K. van Setten	480	
J. W. van Steenbergen	320	
J. van Veldhuizen	650	
D. O. Wijnands & J. Belder	450	
		14200
Boskoop, Research Station for Arboriculture Coll. F. Schneider & H. J. v. d. Laar		123

Total number of specimens: 14323

STUDIES IN POACEAE

2. A new species of *Digitaria* section *Calvulae*, and a reexamination of *Digitariopsis* and *Digitaria* sections *Flaccidulae* and *Monodactylae*

P. GOETGHEBEUR & P. VAN DER VEKEN

Leerstoel voor Morfologie, Systematiek en Ecologie van de Planten,
Ledeganckstraat 35, B. 9000 Gent, Belgium.

SUMMARY

A new species, *Digitaria fuscopilosa* is described, and keyed out from its relatives in section *Calvulae*. In an ample discussion is concluded that *Digitariopsis* can better be included in *Digitaria*, viz. two species in section *Flaccidulae* and one species in section *Monodactylae*. A full key to all known species of both *Flaccidulae* and *Monodactylae* is given.

After the appearance of our first paper (GOETGHEBEUR & VAN DER VEKEN, 1975) some poorly understood taxa have received a closer reexamination, and some of the results are published here.

It is an honour and a pleasure for us to dedicate this paper to Prof. Dr. H. C. D. DE WIT, as a token of esteem and recognition of his eminent services to the Botanical Community in general and to some botanists from GENT in particular.

We would like to thank the Directors of the undermentioned herbaria for the extended loan of material and for other facilities, and the Belgian National Fund for Scientific Research for the award of a grant. The present study was executed in GENT; other herbaria were visited or material was received on loan from B, BR, COI, LISC, LMA, LUA, LUAI, M, P, SRGH. We would like to express our sincere thanks to Dr. J. BOSSER (Paris), Dr. W. D. CLAYTON (Kew), Dr. P. D. F. KOK (Pretoria) and Prof. Dr. H. SCHOLZ (Berlin) for their various contributions to this study.

1. The section *Calvulae* (Stapf) Henr.

A fine sheet from LISC with plants collected in Mozambique, proved to represent a well defined, formerly clearly overlooked species of the section *Calvulae*, apparently closely related to some Malagasy taxa.

These species, as well as *D. eylesii* and *D. hyalina* are easily recognized by their long creeping, branched or unbranched rootstock; possibly this group could be distinguished as a subsection, although definite affinities with other *Calvulae*-species cannot be denied.

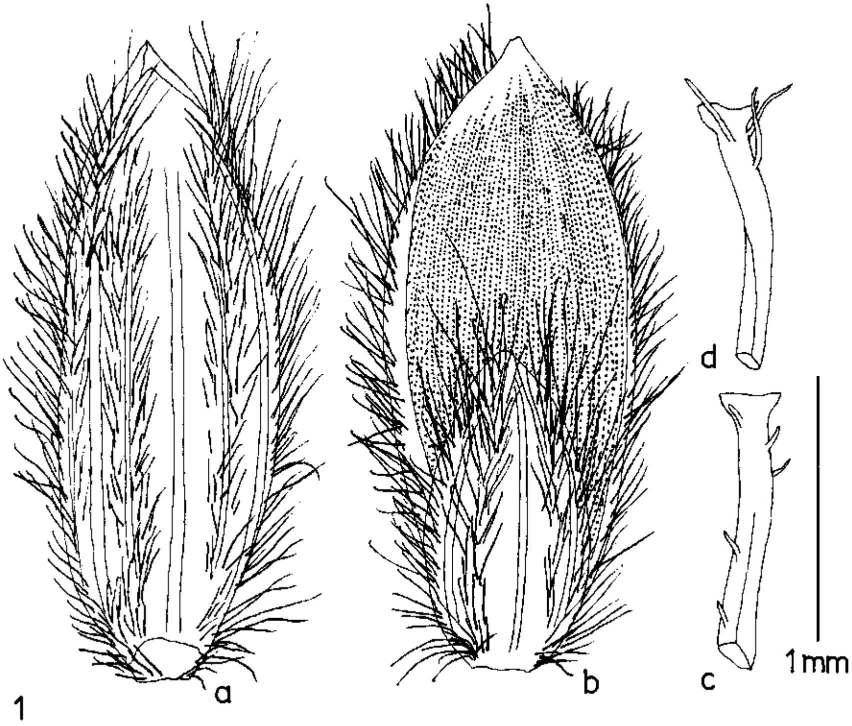


FIG. 1. *Digitaria fuscopilosa* P. Goetghebeur: a: spikelet abaxially; b: spikelet adaxially; c & d: pedicels. – (*Torre & Correia 15642* (LISC)).

Digitaria fuscopilosa P. Goetghebeur, spec. nov. sectionis *Calvulae; D. madagascariensis* Bosser et *D. fulvae* Bosser valde affinis, sed pedicellis subteretibus subglabrisque, gluma secunda breviore atque praesertim spiculis pilis fuscoporphyreis indutis satis distincta. – **Fig. 1.**

Herba perennis, rhizomatosa, laxe caespitosa; culmi erecti, simplices, 40–60 cm alti, teretes; nodi 3–5, glabri. *Foliorum* vaginae striatae, hirsutae; ligulae membranaceae, truncatae, ca. 1 mm longae; laminae lineares, ± involutae, usque ad 10 cm longae, 2–4 mm latae, inferne et superne scaberulae. *Racemi* 3–4, erecti, 4–8 cm longi, sparsi; rhachis triquetra, minime alata, ca. 0.25 mm lata, scaberula; pedicelli 5–3-nati, 0.5–5 mm longae, subtriangulares, subglabri, apice dilatati.

Spiculae oblongae, 2.3–2.5 mm longae; gluma inferior minuta, truncata, enervia, hyalina; gluma superior 1/2 spiculae aequans, triangularis, 3(–5)-nervia, intra nervos pilis apice acuto, leviter undulatis, fuscoporphyreis induta; lemma sterile spiculam aequans, oblongum, 7-nervium, nervis subcentralibus et marginalibus minus evolutis, zonae subcentrales et marginales pilis fuscoporphyreis indutae; lemma fertile spiculam aequans, oblongum, acuminatum, fuscoporphyreum.

Mozambique: Manica e Sofala, Manica, serra Zuira, Tsetserra, 6 km from the 'vacaria', on the way to Vila Pery, 1800 m, in humid mountain grassland near dense *Podocarpus* forests, 3-4-1966, *A. R. Torre & M. F. Correia 15642* (LISC, holotypus!).

Note. – This species and its Malagasy relatives do resemble each other also in their ecology: all three are growing in humid to wet mountain grasslands, 1500–2500 m altitude (BOSSER 1968: 517–518).

Key to *Digitaria fuscopilosa* and its relatives

1 A. Spikelet ⩾ 3.0 mm; pedicel setulose over ± the whole length; racemes (2–)3–4; rootstock with large, unbranched, bent parts . . . . **D. hyalina** Robyns & Van der Veken
B. Spikelet ⩽ 3.0 mm 2
2 A. Spikelet hairs dark purple; pedicel subglabrous; racemes 3–4, 4–8 cm long . . . . **D. fuscopilosa** P. Goetghebeur
B. Spikelet hairs whitish, yellowish or brownish yellow 3
3 A. Spikelet ⩽ 2.5 mm; pedicel setulose over ± the whole length . . . . **D. madagascariensis** Bosser
B. Spikelet ⩾ 2.5 mm; pedicel scabrous, sometimes setulose near the expanded top 4
4 A. Racemes 1–2(–3), (8–)10–20 cm long; spikelets often glabrous . . . . **D. eylesii** C. E. Hubbard
B. Racemes 2–4, 2.5–9 cm long; spikelets densely tawny-hairy . . . . **D. fulva** Bosser

2. The genus *Digitariopsis* C. E. Hubbard

Considering all taxa which have been described or could have been included in *Digitariopsis*, one becomes easily convinced that at least two well defined groups are constituting this taxon. One group is obviously related to the section *Flaccidulae* (Stapf) Henr. of *Digitaria*, the other to the *Monodactylae* (Stapf) Henr. According to CLAYTON (1974: 522): '...to excise and unite the spurred elements from these two sources (sections) is to create an artificial taxon...'; especially the monodactyloid species have but very few characters in common with the type-species of *Digitariopsis*. Quite certainly not all species of *Digitaria* with a spur or callus could be united in one taxon, to make e.g. an extended genus *Digitariopsis*. Moreover, the main characters used by HUBBARD (1940) in creating a genus *Digitariopsis* (spurred, solitary and rhombic spikelets) are not or no more aberrant in *Digitaria* as to keep the 3 species described in *Digitariopsis* outside *Digitaria*.

1. A spur is not as exceptional in *Digitaria* as had been supposed earlier: in several sections true spurs, or poorly developed ones, have been observed, e.g. in *Tricholaenoides* Henr., *Monodactylae*, *Verrucipilae* (Stapf) Henr., *Xanthotrichae* Henr., *Clavipilae* (Stapf) Henr., ...
2. Solitary spikelets can be seen in several subdivisions, e.g. subgenus *Solitaria* (Hack.) Henr., sections *Monodactylae*, *Flaccidulae*, *Trichachne* (Nees) Henr.
3. The rhombic outline and the convex abaxial (!) side of the spikelet are beyond doubt the more exceptional characters; but this striking appearance is well developed only in the type-species, less in *D. major* V. d. Veken, and indiscernible in *D. monobotrys* V. d. Veken.

Our conclusion is that *Digitariopsis* cannot reasonably be maintained and that its species should be included in *Digitaria* sect. *Flaccidulae* and sect. *Monodactylae*.

3. The section *Flaccidulae* (Stapf) Henr.

Already HUBBARD (1940) has pointed to the resemblance of his *Digitariopsis* with *Digitaria* section *Flaccidulae* (upper glume saccate at the base, inflorescence of peduncled racemes), but did not unite them because the members of section *Flaccidulae* were

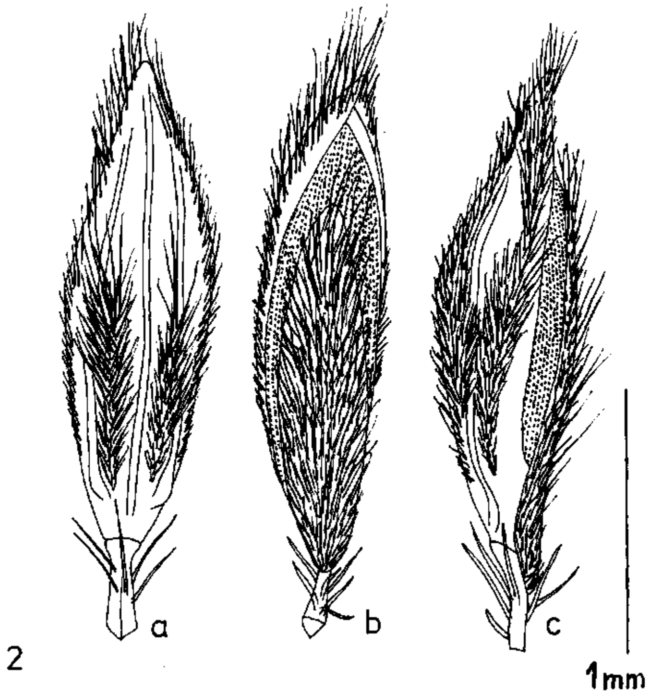


FIG 2. *Digitaria poggeana* Mez: a: spikelet abaxially; b: spikelet adaxially; c: spikelet laterally. – (*Pogge* 5 (B)).

all tightly caespitose perennials, contrary to the slender annual *Digitariopsis redheadii*. Would there be only this species, then a generic distinction was probably appropriate, but as already has been written: '... the gap has since been narrowed ...' (CLAYTON 1974: 522); so *Digitariopsis redheadii* and *Digitariopsis major* clearly and doubtless belong to the section *Flaccidulae* (cf. supra: their different habit poses no problem, if we compare section *Setariopsis* Stapf, *Monodactylae*, *Tricholaenoides*, ...).

A few years ago we had the occasion to study the type-sheet *Pogge 5* (B!) of *Digitaria poggeana* Mez, one of those species of which HENRARD (1950: 578) had not seen the type. Recently, MEZ' full description was published by SCHOLZ (1979: 483). Our observations and MEZ' description leave no doubt that *Digitaria poggeana* and *Digitariopsis major* represent the same taxon, the former being, as rightly supposed by HENRARD (1950: 578) and confirmed by CLAYTON (1974: 522) and SCHOLZ (1979: 483), a member of the section *Flaccidulae*.

Digitaria poggeana Mez, Bot. Jahrb. 57: 191 (1921).
Typus: *Pogge 5*, Zaïre (B!). – **Fig. 2.**
Digitariopsis major Van der Veken, Bull. Jard. Bot. Etat Brux. 25: 330 (1955); *Digitaria major* (Van der Veken) W. D. Clayton, Kew Bull. 29: 523 (1974), **syn. nov.**
Typus: *Quarré 2897*, Zaïre (BR holo!, K iso!).

Key to the species of section *Flaccidulae*

1 A. Annual; pedicel setulose, but glabrous at the top; spikelets often solitary . 2
B. Caespitose perennial; pedicel only hairy, or subglabrous; spikelets rarely solitary 3
2 A. Spikelets all solitary; spur 0.6–0.7 mm long, slender annual . . . . **D. redheadii** (C. E. Hubbard) W. D. Clayton
B. Half of the spikelets solitary; spur 0.1–0.3 mm long, mostly more robust annual . . . . **D. poggeana** Mez
3 A. Stem base surrounded by hairy cataphylls (KOK 1978: 155); pedicels subglabrous, coronula poorly developed . . . . **D. flaccida** Stapf
B. Base of the plant surrounded by woolly cataphylls; pedicels hairy, coronula well developed . . . . **D. nitens** Rendle

4. The section *Monodactylae* (Stapf) Henr.

Concerning the sections *Monodactylae* and *Flaccidulae*, '... within each of which the spurred upper glume has arisen independently from the shared gibbous state...' (CLAYTON 1974: 522), it may be noteworthy that:

1. the spikelet in *Flaccidulae* is not or only very slightly gibbous at the adaxial side (contrary to the situation in *Monodactylae*), but the more so abaxially;

2. the second glume is not the only scale involved in the building of the spur, the most important component being the fertile lemma, but also the sterile lemma has grown out round the spur;
3. the structure of the spur in both sections is clearly different, acute and close to the pedicel in *Flaccidulae* (fig. 2c), more or less obtuse and distant from the pedicel in *Monodactylae* (fig. 3c, 4c); furthermore the spur-building fertile lemma is not or only slightly keeled in *Flaccidulae*, but strongly keeled in at least the spurred species of *Monodactylae*.

Consequently, it seems highly probable indeed that the spur has arisen independently in those two sections, but in our opinion they don't share a common, original, gibbous state and they are not so closely related as has been suggested.

In the *Monodactylae*, two subgroups may be distinguished, one exemplified by *D. monodactyla* (Nees) Stapf, the other by e.g. *D. complanata* P. Goetghebeur. The first subgroup is distinctively characterized by an inflorescence of a single raceme, a broadly and symmetrically winged and ciliated rhachis, and white to rufous, densely hairy spikelets; the other subgroup is easily recognized by its inflorescence composed of 1–2(–3) racemes, and asymmetrically winged and glabrous or only slightly rough rhachis, and white to purplish, densely hairy spikelets. Both have at least partly solitary spikelets, which are gibbous near the base at the adaxial side; in some species this gibbosity is extremely developed to become an obtuse spur. A second common character is shown by the fertile lemma, which can be moderately to sharply keeled.

We have seen but few material of *D. gibbosa* (R. Br.) P. Beauv. It is the only non-African member of the section *Monodactylae*, as conceived by CLAYTON (1974: 522). *D. gibbosa* is furthermore deviating since nearly all its spikelets are 3-nate and its fruit is dark purplish instead of resp. 2-nate or solitary and dark brownish. This morphological difference and the biogeographical isolation give weight to the recognition of a section *Gibbosae* Henr.; the grouping of *D. monodactyla* and *D. ventriosa* with *D. gibbosa* as done by CLAYTON (1974: 522) is somewhat hasty and probably incorrect.

Key to the species of section *Monodactylae*

1 A. Caespitose perennial; sterile lemma ⩾ 2.5 mm long 2
B. Thin, slender annual; sterile lemma ⩽ 2.5 mm long (excepted for *D. sacculata*) 4
2 A. Racemes 2; spikelets 5 mm long, all solitary . **D. monopholis** W. D. Clayton
B. Raceme 1; spikelets < 4 mm, mostly binate 3
3 A. Pedicels with a well developed coronula; spikelets not spurred; upper glume > 1/2 of the spikelet . . . . **D. monodactyla** (Nees) Stapf
B. Pedicels subglabrous; spur of spikelet 0.5 mm long; upper glume < 1/2 of the spikelet . . . . **D. monobotrys** (Van der Veken) W. D. Clayton
4 A. Raceme 1; rhachis symmetrically winged, ciliate; spikelets white to rufous hairy 5

B. Racemes 1–2(–3); rhachis asymmetrically winged, glabrous or only slightly rough; spikelets white to purplish hairy 6

5 A. Winged rhachis ⩽ 0.6 mm wide; spikelet hairs rufous; the prominent subcentral nerves of the sterile lemma are nearly touching each other above the central nerve . . . . **D. spec. nov. A**

B. Winged rhachis up to 1 mm wide; spikelet hairs whitish; the prominent subcentral nerves of the sterile lemma are approaching each other, but far from touching above the central nerve . . . . **D. ventriosa** Van der Veken

6 A. Spikelets spurred, spur ± obtuse, distant from the pedicel; sterile lemma ⩾ 2.5 mm 7

B. Spikelets not spurred, merely gibbous; sterile lemma ⩽ 2.5 mm 8

3

FIG. 3. *Digitaria calcarata* W. D. Clayton: a: spikelet abaxially, showing the scaberulous pedicel (the longer hairs belonging to the spur); b: spikelet adaxially; c: spikelet laterally. – (*Robinson 4411* (M)).

4

FIG. 4. *Digitaria sacculata* W. D. Clayton: a: spikelet abaxially; b: spikelet adaxially; c: spikelet laterally. – (*Robinson 4352* (M)).

7 A. Pedicel only slightly rough; sterile lemma 2.5–2.7 mm long – Fig. 3 . . . . **D. calcarata** W. D. Clayton

B. Pedicel with a coronula; sterile lemma 3.2–3.7 mm long – Fig. 4 . . . . **D. sacculata** W. D. Clayton

8 A. Rhachis up to 0.5 mm broad; spikelets mostly solitary; sterile lemma 2.3–2.5 mm long, hairs exceeding the spikelet for 1 mm . . . . **D. bidactyla** Van der Veken

B. Rhachis up to 0.8 mm broad; spikelets mostly 2-nate, sterile lemma 1.9–2.1 mm long, hairs exceeding the spikelet for 0.5 mm . . . . **D. complanata** P. Goetghebeur

REFERENCES

BOSSER, J. (1968). Note sur les Graminées de Madagascar: VII. Adansonia ser. 2, **8**: 513–522.

CLAYTON, W. D. (1974). Notes on the genus *Digitaria* Haller. Studies in the Gramineae: XXXVI. Kew Bull. **29**(3): 517–525.

GOETGHEBEUR, P. & VAN DER VEKEN, P. (1975). New taxa in the genus *Digitaria* Haller (*Poaceae*) in Africa. Bull. Nat. Plantentuin Belg. **45**(3/4): 397–419, 16 fig.

HENRARD, J. TH. (1950). Monograph of the genus *Digitaria*. Universitaire Pers, Leiden. 999 pp., ill.

HUBBARD, C. E. (1940). *Digitariopsis redheadii* C. E. Hubbard. Hook. Icon. Plant. **5**(1): tab. 3420, 2 p.

KOK, P. D. F. (1978). 'n Hersiening van *Digitaria* Haller (Poaceae) in suidelike Afrika. Ph. D. Thesis, University of Pretoria. 354 pp., ill.

SCHOLZ, H. (1979). Über *Digitaria poggeana* Mez aus der Republik Zaïre. Willdenowia **8**: 481–484, 1 phot.

REVOLUTIONS IN PLANT DESCRIPTION

M. JACOBS

(Rijksherbarium, Leiden)

SUMMARY

Comparisons are made between descriptions of the sugar palm, *Arenga* (Palmae), by **RUMPHIUS** in the 17th century, **BECCARI** & **HOOKER** in the 19th century, and **MILLER** in the 20th century, and the differences pointed out. It is held that they are the result of three revolutions. The first was the rebirth of scientific botany in the years 1530–1550, which was foreshadowed in the works of **DÜRER**. The second revolution was brought about by **LINNAEUS**, in the years 1735–1753; two descriptions of *Hottonia* (Primulaceae) are compared to specify date and meaning. The herbarium technique, which was a product of the first revolution, was by **LINNAEUS** consistently applied, together with an elimination of verbs from descriptions and a reform of botanical terminology. **LINNAEUS** also strove to eliminate consideration of the specific properties of the living plant; this placed taxonomy in an ambiguous position. The third revolution began about 1900; like the first, it was led by artists, namely **MONET**, **GIDE**, **VAN GOGH**, also **CÉZANNE** and **PICASSO**. It is characterized by a renewed acknowledgment of discontinuity and spontaneity as essential elements in human life, and a return of life qualities in the plant description.

For each of the revolutions, the achievements are summed up, together with a few important contemporary landmarks in other fields of human activity; they demonstrate that the development of science takes place in synchronic connections with seemingly unrelated developments, which together form an expression of the meaning of life in the given period.

CONTENTS

BIOHISTORY

The subject of this paper is a biohistorical and metabletic one. The term biohistory received its full significance in the hands of **FRANS VERDOORN**, who from 1958 to 1976 was a professor in this discipline at Utrecht. Biohistory studies the cultural relations between mankind on the one hand, and the world of plants and animals on the other. Biohistory encompasses much more than the history of biology. It is a very large field, which has been re-defined more than once; it roughly coincides with the scope of the fine library which VERDOORN amassed and which has been the nucleus of the Biohistorical institute at Utrecht. An overview of the field which can be said to extend 'From botanical biography towards animal ecology' was given under this same title by VERDOORN in 1966.

The development of biohistory as conceived and realized by VERDOORN has made me very happy. As a plant taxonomomist I found myself in the position of intermediary between two worlds, of plants and of men. I had the good fortune to witness at close range an upsurge of taxonomy, in a series of efforts which gave The Netherlands a worldwide fame. Nevertheless, taxonomy as a scientific discipline is in bad repute, both inside and outside university. This is a sad, but also an intriguing fact, important enough to make it the subject of some reflexion. For this purpose, biohistory has help to offer.

Our subject: plant description, seems well suited for an examination of the relation between taxonomy and society. Plant description is the constant part of plant taxonomy, and can neatly be singled out for closer examination. More important, it is the product of a structured encounter between representatives of human culture and representatives of the plant world. Plant description therefore may reveal features of the relation between men and plants, a relation which throughout has been at the heart of biohistory. The botanist F. A. F. C. WENT made it the subject of a simple equation, which was adopted by VERDOORN (1951). This so-called WENT equation runs thus:

$$\text{Botany} = \text{Plants} + \text{Men}.$$

In this equation, plants make up the constant factor, humans, through history, the variable factor. That there is variability is evident from the differences between descriptions of one and the same species:

Species s, described by botanist A, gives description s_A.

Species s, described by botanist B, gives description s_B.

As we shall see, the differences between s_A and s_B may be considerable, even overwhelming. This may not be particularly interesting, unless the differences are related to the period when the descriptions were made, whatever this may mean. Plant descriptions have been made for an unbroken span of four and a half centuries; if a meaningful change in them can be detected, this can help us understanding the present situation of the science. The meaning of the change – if any – is the subject of metabletics. This is to be discussed below. We first will examine a few descriptions.

RUMPHIUS: A 17TH CENTURY TEXT

The first description which comes up for comparison is of the well-known sugar palm, *Arenga pinnata* (Palmae). It was made by an acknowledged master, GEORG EBERHARD RUMPH(1628–1702). He worked in Ambon, in the Moluccas. Since he began to write in earnest about 1663, and became blind in 1670, the description was probably made in that period, although it was not published before 1741, in the *Herbarium Amboinense* 1: 57. The complete text has over 1500 words. Here is the translation of a typical portion, given by H. C. D. DE WIT, in his '*History of Malaysian Phytography*' (Flora Malesiana i 4: lxxxxvi. 1949).

He grows in the manner of the Coconut Tree, but the trunk is somewhat stouter, also much lower and hardly exceeding the Pinang Tree, smooth near the roots and not at all bulging, being in its black-green foliage wildly and sombrely attired, also easily distinguished from other trees: the trunk is, in addition, slightly transversely ribbed and not only very uneven, and rough with mosses, but also so much overgrown and covered by a variety of Fern and Polypodium that he is scarcely recognisable before being cleaned by the gardeners; which makes him seem a drunken peasant, as he leaps from his sleep in his patched clothes and ruffled hairs; verily, it is the least attractive among all trees. The branches are placed together at the top, like those of the Coconut Tree, but here and there an old one hangs down the trunk: they are fifteen and seventeen feet long, stiffer and rougher than the Coconut branches, not furrowed, but angular, and without any spines on the edges, on both sides bearing broad leaves in the manner of the Coconut Tree, but larger, that is four inches wide and four feet long, to be sure about the middle of a branch; because at both ends they gradually become shorter, the top with a broad blunt end, as though broken or parted in smaller tips, and the foremost is the most smallest, broadest and triangular; their margins are beset with sparse, distant, and minute spinelets, usually on the older leaves, and the majority hang downwards, broken about the middle, and confused, the upper surface being smooth, dark or black-green, the lower surface grey or whitish. See Figure 1.

A 19TH CENTURY TEXT; RESEMBLANCES AND DIFFERENCES

Now we take up a description by ODOARDO BECCARI and J. D. HOOKER in the *Flora of British India* 6: 421 (1892). It deals with the genus *Arenga* as a whole; for the point of the comparison, this does not matter.

Tall stout palms, flowering first from an upper leaf-axil, and successively from lower; trunk densely clothed above with fibrous remains of the leaf-sheaths. *Leaves* terminal, long, pinnatisect; leaflets long, linear, usually praemorse, unicostate, base 1–2-auricled. *Spathes* many, clothing the peduncle of the spadix. *Spadices* interfoliar, large, much-branched, peduncle short decurved, branches slender pendulous; male and fem. flowers usually solitary and in separate spadices, rarely 3-nate a fem. between 2 males. *Male fl.* symmetric; sepals orbicular, imbricate; petals oblong, valvate; stamens numerous, filaments short, anther apiculate; pistillode 0. *Fem. fl.* subglobose; sepals accrescent; petals triangular, valvate; staminodes many or 0; ovary subglobose, 3-celled, stigmas conic. *Fruit* obovoidly globose, 2–3-seeded; stigmas terminal. *Seeds* compressed or plano-convex; albumen equable; embryo dorsal.

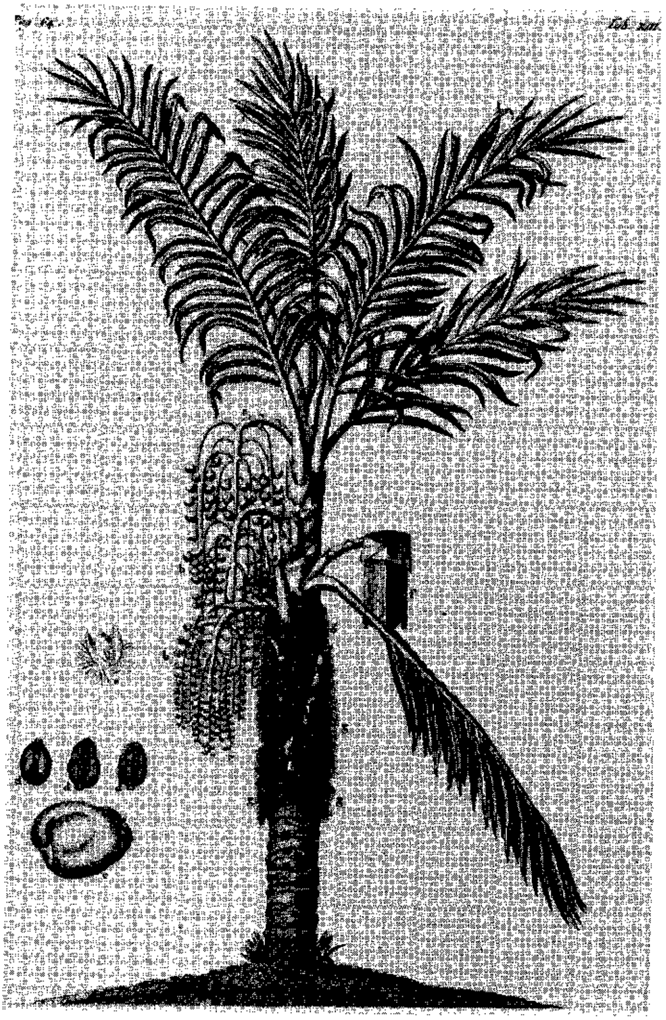


FIG. 1. Palma indica vinaria II (*Arenga pinnata*). G. E. RUMPHIUS. *Herbarium Amboinense* 1, t. 13 (1741).

It is easy to agree with the outstanding quality of either description in its own right. Apparently it is possible to describe plants in very different manners. Before discussing the differences, however, the resemblances between the two descriptions need to be stressed, as they are the criteria of all good description. A good description must:

1. be the result of personal examination,
2. be unambiguous,
3. segregate the important from the unimportant, or omit the unimportant altogether,
4. not contain redundancy,
5. arrange the subject matter in an orderly way.

Since these criteria apply equally to a description of a traffic accident, a disease process, a psychological conflict, a landscape or whatever else, it will be evident that instruction in plant description has a general educational value.

RUMPHIUS satisfies the above criteria as well as do BECCARI & HOOKER. No less than they does RUMPHIUS work methodically: he proceeds from main line to detail, from the basal part of the plant towards its top; he compares *Arenga* with its widely-known relative, the coconut palm, and points out the leaf characters which are indeed significant.

What a world of difference, however! While RUMPHIUS makes bold comparisons to characterize his plant, from the BECCARI-HOOKER description every trace of the drunken peasant has vanished*. It would be out of place amongst the abundance of technical terms of which RUMPHIUS possessed only a few. This instrument was developed during the period in between. Even more striking are the verbs. It is less remarkable that RUMPHIUS used verbs in the everyday form, than that they are wanting with BECCARI-HOOKER. In the latter description, the verbs seem to have been suppressed by force; where one is needed, it has been reduced to a participle. Hence, the BECCARI-HOOKER description leaves us with an impression of dryness and lack of life. RUMPHIUS's plant is as active as a plant can be; moreover, it exists in a relation with humans: "... wild and sad to look at ... with its ugly and savage appearance ... before it has been cleaned by the gardeners". RUMPHIUS, in short, describes a living creature.

What BECCARI & HOOKER described is less easy to say. Certainly it is something immovable, something solidified, a genuine object of science. In the two centuries between RUMPHIUS and BECCARI-HOOKER, something must have occurred whereby life as an element was taken out of the plant description. In view of the scientific standing of RUMPHIUS, BECCARI, and HOOKER, all of whom were eminent botanists, the elimination was performed carefully and in a scientific context. Nevertheless, if botanists managed to take nothing less than the element of life away from their observations, and work on so successfully as they have done, the word revolution seems apt. We remember the adequacy of either description, which was the basis of my reasoning. The difference between the two amounts to the presence or absence of the element of life. Between 1670 and 1892 life somehow vanished from the plants to be described. This is the content of the revolution, which was brought about by LINNAEUS, as we shall see presently. It was the second revolution in plant description. The first revolution took place early in the 16th century, when the tradition of scientific botany began which has been continued unbroken to the present day.

---

* In the description by C. A. BACKER & R. C. BAKHUIZEN VAN DEN BRINK, *Flora of Java* 3: 188 (1968) occurs the sentence: 'Stem often showing a ragged appearance', perhaps a faint Rumphian relic.

THE REBIRTH OF BOTANY

Before discussing the First Revolution, some attention must be claimed for the remarkable fact that plants are described at all. Descriptions of plants that answer the five criteria have not always been made, and only, as far as I know, in the civilization of western Europe. In Antiquity, such descriptions were made by Theophrastus (c. 370–285 B.C.), DIOSCORIDES (born c. 50 A.D.), and a few others, Thereafter, no botanical descriptions were made for one and a half thousand years. This period has been called the Dark Ages, a name which prohibits an understanding of what made life meaningful and valuable during those centuries, and perhaps even happy to such an extent that no need for natural sciences was felt. Interest in nature did gradually increase, however, from about the 12th century onwards. But only in the 16th century was the scientific tradition, founded in Antiquity, resumed and perpetuated to our times, the tradition of which RUMPHIUS, BECCARI and HOOKER were such eminent scions. The revival did not come out of the blue. In the course of the half century before, artists took to painting plants with unprecendented accuracy.

One of the famous early examples of such painting is BOTTICELLI's *Primavera* of 1478 (fig. 2). Out of the 40 plant species on it, 30 have been identified*. As plant description is the subject of our inquiry, we may consider the question whether it would be possible to describe those thirty species. They are rather small, and lack much detail. But that is a technicality. There is a more important obstacle. Look at the joyful party, with the Goddess Flora making her appearance. Imagine a botanist there who comes to describe plants! Wouldn't he be the complete stranger? I am pretty sure he wouldn't stay long, as a botanist, that is. So it still is: where people are together having fun, there is scant place for plant description. For botany to succeed, something must happen to change this. Something did happen. Here follow a few events to mark the revolution which gave rise to plant description.

EVENTS CONNECTED WITH THE FIRST REVOLUTION

1478 SANDRO BOTTICELLI, *La Primavera*, painting. People and plants together; part of the plants not recognizeable.

1503 ALBRECHT DÜRER, *Das grosse Rasenstück*, painting. Plants only, perfectly recognizeable, together in a clump.

1525 ALBRECHT DÜRER, *Underweysung der Messung*, textbook on drawing in perspective space, whereby the extension of all objects can be visualized with complete accuracy, from one fixed point.

---

* According to W. BLUNT, *The Art of Botanical Illustration* (1950) p. 28. As for the others, these have been painted largely in geometrical forms, and thus represent rather ideas of plants than actual plants.

FIG. 2. La Primavera. SANDRO BOTTICELLI (1478).

1526 ALBRECHT DÜRER, *Der Akelei*, painting of a columbine, in an isolated position (fig. 3).
1530–1550 LUCA GHINI invented the technique of drying plants for scientific purposes.
1530 OTTO BRUNFELS, *Herbarum Vivae Eicones*, herbal. This book was the first herbal after Antiquity to be based on original observations; it owes its significance mainly to the illustrations, made by a pupil of DÜRER'S, HANS WEIDITZ.
1539 HIERONYMUS TRAGUS, or BOCK, *New Kreütter Buch*, herbal. This was the first herbal with personally made descriptions.
1542 LEONHART FUCHS, *De Historia Stirpium*, herbal. According to AGNES ARBER, *Herbals* (1938), notably superior to the two predecessors.
1543 ANDREAS VESALIUS, *De Humani Corporis Fabrica*, illustrated book on anatomy, one of the landmarks in the history of medicine.
1543 Foundation of the first botanical garden, in Pisa, by LUCA GHINI.
1545 Foundation of the second botanical garden, in Florence, also by LUCA GHINI.

SIGNIFICANCE OF THE FIRST REVOLUTION

Das grosse Rasenstück by ALBRECHT DÜRER is well-known; it was discussed in the book by W. BLUNT, *The Art of Botanical Illustration* (1950), and a colour plate of it given. DÜRER dug out a tuft of plants, and at home prepared one of his famous paintings which

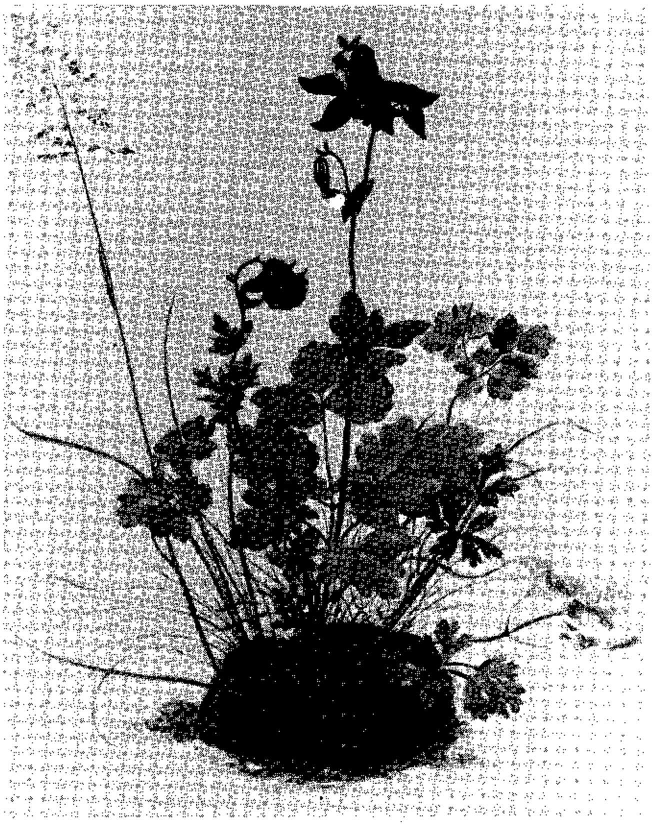


Fig. 3. The Columbine. Albrecht Dürer (1526).

Blunt also calls 'the first ecological study ever made' (p. 25). Could these plants be described? In this case, the question seems appropriate, because there is no disturbing context. An essential difference with Botticelli lies in the absence of humans, whereby a condition for scientific enquiry has been created. For, as is well-known, natural science studies nature without men. If in this case the task seems hard, it is because too many individual plants are crowded together. Description, as we know, succeeds best from an individual which has been isolated.

The columbine of 1526 (fig. 3) satisfies this condition much better. The plant has almost completely been prepared clean, except for one telling stray grass culm. All we need to do is to wash the soil off the roots, and we can start describing.

Just this has been done to the Weissz Seeblum of 1530, by Hans Weiditz, who illustrated the herbal of Otto Brunfels (fig. 4). The plant was taken out of the water, and the roots were cleaned. What therefore we see depicted is a waterlily without water – isn't this a bit paradoxical? All relations between the plant and its habitat have been broken and concealed. And this is yet regarded as the first herbal with illustrations 'true to nature'; Weiditz was a pupil of Dürer's, and no doubt had learnt from the master the

FIG. 4. Weissz Seeblum. HANS WEIDITZ, in O. BRUNNFELSZ, *Contrafayt Kreüterbuch* (1532. This is another edition of the *Herbarum Vivae Eicones*).

motto about nature: 'Wer sie heraus kann reissen, der hat sie' – to tear out nature is to possess her.

DÜRER was born in 1471. A visit to the centennial exhibit in Nuremberg in the summer of 1971, devoted to his life and works, gave me a good opportunity to appreciate his revolutionary qualities. Plants make up a mere sideline in his oeuvre. Common features in it are a wealth of detail, a high degree of exactitude, and the use of measurable space in which he placed his objects.

The method to depict space in central perspective was invented in Italy by BRUNELLESCHI in 1420. DÜRER learnt it in Italy, perfected it, and applied it on a massive scale. From his textbook *Underweysung der Messung* of 1525 an illustration has here been taken. The man on the left places a tight string onto a point of the object to be drawn. The man on the right takes the position in the crossing point of the string down onto the horizontal and vertical coordinates. He thereupon moves the drawing board in place, and marks the point in its proper position. This variant of the method was DÜRER's own invention. It is the most laborious of perspective drawing techniques, but gives the finest results.

All perspective drawing looks from one central point, as if seen through the lens of a camera. The peculiar structure of perspectivic space involves the possibility to precisely indicate the distance of any object from the observer's eye. This is accomplished by transversal lines at regular distances which intersect with the converging longitudinal lines. In practice, this effect is attained, through tiled floors and beamed ceilings on the horizontal planes, and through styles and rows of columns on the vertical ones. The effect is, that the size of each drawn object is proportional to its distance from the eye which, as said, is fixed in one point. Where the one eye is, another eye cannot be; only one person at a time can view the scene properly. Might here be the origin of individualism which so strongly has shaped the traditions of descriptive botany?

Owing to the tiles, the beams, the column rows, the book shelves, in short the calibration in illustrations, it is possible exactly to determine the place of each object in space, along their limits of length, width and height. Perspective space is therefore most appropriate to show *things as objects*, i.e. in their spatial extension. This extension is, according to DESCARTES, one century later, the essential property of all things. In a

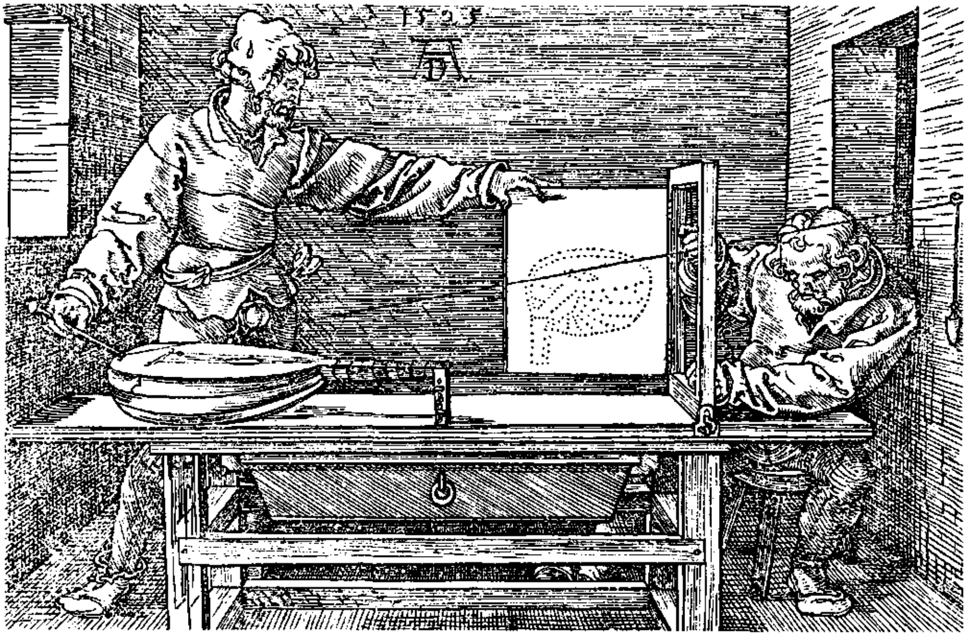


FIG. 5. Perspectivic Drawing. ALBRECHT DÜRER, *Underweysung der Messung* (1525).

perspectivic space are material to a maximum extent, determined, fixed in their position, unable to stir without altering the distance between the points on their surface. In perspectivic space, spontaneity has been taken off things, which have been reduced to their measurable extension, their place in the 3-coordinate system. Such was the new reality of things as DÜRER perceived them, and depicted them, with a vigour and in a profusion which now in hindsight seems much an act of propaganda.

Where is the joyful relation, full of spontaneity and motion, between people and plants? Under DÜRER's pen, it shrivelled, gave way to a relation of severity and order. Objects, it had now been made clear, could fruitfully be examined from one fixed point. The relation of the plant and its habitat got lost, or anyway could be treated with such indifference, that nobody thought much of drawing a water lily without water. In the new relation between subject and object, it did not matter. Thus it became possible, purposeful, to remove plants from their natural place, for examination of their structure. In the process, the plants became open to description and illustration 'true to nature', following systematic and meticulous observation by scientists, who became individualists in the course of their labours.

This is what also happened to the human body and to anatomists through the work by ANDREAS VESALIUS, *De Humani Corporis Fabrica*. Its very accurate plates brought about a transformation of such a movable, elusive structure as the human body into a complex of fixed elements, each with its own extension in 3-dimensional space, of which it is impossible to say whether they are dead or alive. VESALIUS's plates are timeless, like dried plants. Their validity is eternal.

It is less surprising now, to learn that botanical gardens and herbaria were originated in the same time. In botanical gardens, plants are introduced after having been taken out of their own environment. In herbaria, plants are reduced to their structure, the extension of their lasting structure, and this is what matters to the botanist. The artists had shown him how plants looked the new manner, all he had to do is to work out the consequences, for the newly opened field of interest. DÜRER, WEIDITZ, BRUNFELS, FUCHS, GHINI and VESALIUS all were essentially occupied with the same: the initiation of a new way of looking at living things and of dealing with them. People became sharp-eyed, cool-minded, like lynxes, members of the Accademia dei Lincei, which was established in 1603, in Rome. At the same time, the microscope and the telescope were invented.

RESULTS OF THE FIRST REVOLUTION

So much for the First Revolution. Let us summarize what happened:

1. perspectivic, i.e. quantified, space, became reality,
2. things assumed a fixed position in space,
3. their extension became their main visible property,
4. relations between plants and their environment were disrupted,

5. the relation between people and plants became formalized and assumed the character of one between subject and object,
6. in examining his objects from a central point, man became an individualist,
7. plants, as so examined, revealed great detail and could be depicted 'true to nature',
8. personal examination of objects became imperative,
9. plants could be taken from their environment and dried and placed in repositories without loss of any significant property.
10. it became meaningful to depict and describe plants in 'objective', i.e. timeless language.

In 1543, by virtue of the works mentioned, the stage for the First Revolution was set. According to its principles, the world was to be perceived, discovered, described, penetrated and organized. The year 1543, the 'annum mirabile', marks the beginning of the magnificent development of the natural sciences which nowadays increasingly makes us shiver. More botanical gardens were established, more plants preserved in herbaria, more herbals published: DODONAEUS in 1554, LOBELIUS in 1570, with the Herbarium Amboinense by RUMPHIUS, published between 1741 and 1755, the era was brought to a culmination and conclusion. During these two centuries, the tenets of the revolution slowly gained ground. It was not easy to ban humanity from the plant world, or to ignore the relation of plants with their environment. Many botanists of these times, the great JOHN RAY among them, did not think much of plants in a herbarium. DESCARTES's concepts of man as a machine met with stiff resistance ... initially.

THE SECOND REVOLUTION

The First Revolution made RUMPHIUS's work possible; his achievement is that he realized it in the plant world of the tropics, more brilliantly than the few others who had made such efforts. Between his time and BECCARI-HOOKER's another revolution had done its work; the time has now arrived to date it more precisely. To this end, we select a new example of phytography.

The water violet, *Hottonia palustris* (Primulaceae) is not uncommon in shallow stagnant waters in western Europe. It resembles a primrose and indeed belongs to the same family, but has very finely fragmented leaves submerged in the water. From between them there rises a slender scape bearing a few lax whirls of pale lilac flowers with a yellow heart, in early summer. But who am I to embark on a description while one was supplied by the great BOERHAAVE, in the Index Alter Plantarum:

> Radix fibrosa, repentissima. Caulis erectus, nudus. Folia capillacea, pennata, alternê accreta ramis, qui in orbem appositi sunt cauli, atque inde quaquaversum expansi. Eidem cauli adnascuntur verticillatim pedunculi, quorum extrema expanduntur in calicem pentaphyllum, constantem quinque longis, gracilibus, foliosis, in speciem radiantis stellae expansis.

In centro calicis nascitur placenta; ex ambitu ejus flos emergit monopetalus, imâ parte tubulosus, ibi ovarium amplexus, suprâ expansus in quinque segmenta, larga, obtusa, profundê incisa, instar rosae expansa; ubi expandi tubulus florus in amplum incipit pariete interno producit quinque stamina, brevia suis instructa testiculis.

Ovarium, eidem placentae innatum, est ferê sphaericum, emittens ex centro apicis umbilicati tubam longam, gracilem, cujus apex excavatus in formam cymbae; constat uno loculo, in quo erigitur placenta cylindrica, crassa, gerens pileolum ut fungi pileati, cujus convexae superficei accrescunt undique semina plurima sphaerica.

The date is 1727. BOERHAAVE used a fair amount of technical terms, and we note that he did not mention the colour of the flower. He did not record its aquatic habitat, either, but in the synonyms he cited, allusions to this occur, like *Millefolium aquaticum, dictum viola aquatica.*

Now look at the description of *Hottonia* by LINNAEUS, in the *Genera Plantarum.* To do justice to his text, the original Latin has been retained, in both descriptions.

CAL. *Perianthium* monophyllum, quinquepartitum: *laciniis* linearibus, erecto-patulis.
COR. *Petalum* unicum. *Tubus* longitudine calycis. *Limbus* quinquefidus, planus: *laciniis* ovato-oblongis, emarginatis.
STAM. *Filamenta* quinque, subulata, brevia erecta, laciniis corollae opposita. *Antherae* longae.
PIST. *Germen* globoso-acuminatum. *Stylus* filiformis, brevis. *Stigma* globosum.
PER. *Capsula* globosa, acuminata, unilocularis, calyci imposita.
SEM. plurima, globosa. *Receptaculum* globosum, magnum.

The year is 1737. (The above description was copied from the second edition of 1742, but since the editions are largely similar, and LINNAEUS made reference to BOERHAAVE, who established the name *Hottonia*, the difference is presumed to be none.)

If anything, the description is a model of normalization and regimentation. The vegetative parts have been left out altogether. They were not used for classification, and thus we wonder if here a plant has been described in its own right, or for the benefit of taxonomy. Besides, there is no way of guessing what the plant looks like. The free central placenta, character of all *Primulaceae*, so aptly observed by BOERHAAVE, was not accorded a place by LINNAEUS. Most remarkable is the absence of verbs. LINNAEUS banned them from phytography. In case of need, participles are used. These, according to W. T. STEARN in his book *Botanical Latin* are 'parts of verbs with the function of adjectives and are used and declined in the same way'.

Before LINNAEUS, the plants were described through comparison with everyday things under a usage of verbs and not without reference to scent and taste. Owing to such features, a plant in such description comes forward as a creature alive. Through evocation of colour, taste, scent, and environment, we cannot help entering a relationship with the plant which, thus described, is a creature of its own, an incomparable being. This, too, is evident in RUMPHIUS's work, each of his species being the subject of one chapter. In the days just before LINNAEUS, a certain rigidity may already have set in; yet the difference between BOERHAAVE's and his description is telling, and greater, in my opinion, than the difference between LINNAEUS and BECCARI-HOOKER.

LINNAEUS did more than completing the available kit of technical terms: he created a scientific language, the language that he needed and all his successors needed. Essentially, this language was Latin; the idiom consisted of codified words for plant organs. Out of the rather haphazard lot of words in use, LINNAEUS selected the most suitable and fixed them onto short definitions. Syntax was simplified to the utmost. His successors ransacked Greek, baked neologisms, extended the terminology, giving rise to a new language: botanical Latin, our widely acknowledged treasure but no one's property, which unified the science.

The omission of verbs is connected with another of LINNAEUS's achievements. He consistently based his works on dried materials. Contrary to RUMPHIUS and JOHN RAY, the greatest botanists of the 17th century, he early in life took up collecting and preservation of plants, and extended his collection wherever he could. The herbarium technique, two centuries old by then, was by him reformed through a couple of inventions masterful in their simplicity. He introduced* the loose-leaf system in the herbarium, and had only one specimen mounted on a sheet, thus doing away with the herbarium in bound book form. Only in this manner is it possible to rearrange and extend the herbarium, whereby it acquired the potential of becoming a genuine archive of dried plants, a tool for scientific botany, which we nowadays find indispensable.

The reduction of the living plant, for which the First Revolution had set the conditions, was perfected by LINNAEUS through the Second. Botanists took possession of plants, or of what was left of them. LINNAEUS himself led the reduction effort, in the *Philosophia Botanica* of 1751. This is the first textbook of botany, of admirable coverage and brevity, enormously influential. Yet read the chapter on Differentia which gives the criteria of how to distinguish species, and note the negative statements. (The numbers relate to the paragraphs.)

260. Size does not distinguish a species.
264. Provenance makes no specific difference.
265. Time of flowering and of vegetative development is most unreliable as a character.
266. Colour varies within one and the same species, hence is worthless for distinction.
267. Smell never distinguishes a species satisfactorily.
268. Taste is often variable, and should be left out of consideration for delimitation.
269. Value and use are applied in vain for botanical purposes.

For the taxonomic practice, LINNAEUS's advice is eminently sensible, nonetheless we are requested to ignore all that makes the plant a living being. Imagine yourself by a ditch full of *Hottonia* on, perhaps, a summer morning. The place does not matter, exit the shore; the time of flowering does not matter, exit the summer morning. Colour, habit, all

---

* As Dr. W. T. STEARN told me, it is uncertain whether LINNAEUS or GRONOVIUS did. However, through LINNAEUS the method won universal acceptance.

beauty of the plant, all that brings it in relation with us, humans, is rejected for the sake of science.

Now imagine yourself in one of the world's archives of botany, where the many specimens in fine order tell of LINNAEUS's triumph. For interpreting and preparation of botanical descriptions we use the Glossary by B. D. JACKSON, which contains nearly 25,000 items. What we see is botany as the result of these two revolutions. At LINNAEUS's hands, botany became a science in itself, with specialized techniques, methods, and language. Through this discipline, it became possible to deal with the world's flora in a scientifically valid manner, the results are open to verification, and have turned out to be widely useful. Like it or not, taxonomy is the basis of all biology, pure and applied, nevertheless people inside and outside biology treat the *scientia amabilis* mostly with ambiguity, to put it kindly. They are right in doing so, if taxonomy contains an ambiguity in itself. But before approaching this point further, let us summarize the features of the Second Revolution, between 1727 and 1737.

RESULTS OF THE SECOND REVOLUTION:

1. subjugation of plant description to taxonomic purposes,
2. rejection of properties typical of the living plant, as unfit for taxonomic purposes,
3. systematic and wholesale application of technical terms,
4. no allusion allowed to any action on the part of the plant,
5. transformation of the herbarium into a botanical archive, through introduction of the loose-leaf system, which permits rearrangement and expansion,
6. consistent and wholesale application of the herbarium technique,
7. emergence of botany as an organized methodical discipline,
8. alienation of botany from common everyday life.

The other well-known achievements of LINNAEUS, notably the introduction of an effective classification system, the application of binary nomenclature, and publication of his results in books which were both cheap and easy to consult, need not be discussed here and all come under (7). LINNAEUS's first major publication dates of 1735; between this year and 1751, when the *Philosophia Botanica* was published, the Second Revolution was prepared. We see that it brought the completion of the First. Its effect was, that botany became a science of structures of which it mattered little whether they were living or dead. Thus, botany became one exponent of a truly materialistic view on life. As such, it made happy a number of people, but not all; here we broach on the ambiguity again.

CONTEMPORANEOUS EVENTS

Again, the Second Revolution was not something limited to botany. Professor J. H. VAN DEN BERG in his several books has given considerable lists of contemporary events in all sorts of fields of western civilization. We list only the following:

1733 JOHN KAY invented the 'flying shuttle' for automatic weaving; this marked the beginning of the Industrial Revolution. Through this invention, mechanical labour was introduced, whereby man became connected to machine and separated from his craft; it soon led to the division of labour. This made it possible to speed up the process of production, followed by consumption, i.e. economic growth.

1740 (approximately) the beginning of population growth in Europe, through no known cause.

1744 ABRAHAM TREMBLEY published his famous memoir on the fresh water hydra. It contains the discovery that, when cut into pieces, the pieces of this animal regenerate to new animals.

1748 MONTESQUIEU, *L'esprit des lois*. In this treatise, a plea was made for segregation, namely of legislative, judiciary, and executive powers of state.

The 18th century preoccupation with division – didn't later LAVOISIER break down the ancient four elements to supplant them by the elements of chemistry? – which led to widespread doubt about the natural order of things, makes it understandable that an interest in classification emerged, as an answer.

The Third Revolution: a description by André Gide

The third revolution is still ours, and hence it is more difficult than in the two foregoing ones to pinpoint facts and dates. Probably the facts and dates of this revolution are more diffuse by virtue of their nature. The first plant description to show what it is about, was published in 1920. Its author is ANDRÉ GIDE (1869–1951), who in 1947 received the Nobel Prize for Literature. Love for plants was part of his education, and from his governess he received a certain amount of schooling in botany. In winter, she examined flowers under a dissection microscope, and regularly attended the lectures of the botanist E. BUREAU (1830–1918, specialist in Moraceae, anatomy of lianas, and palaeobotany) at the Musée National d'Histoire Naturelle in Paris, and in the spring she used to join excursions led by E. POISSON, his assistant (who studied useful plants in Africa and Brazil, and introduced *Hevea* in some French colonies). Together with her, young GIDE went out to botanize, and kept a herbarium. The following event must have occurred about 1880; it is taken from his autobiography *Si le Grain ne Meurt*, in the English translation (used here to reduce the number of language in this essay) *If It Die...* by DOROTHY BUSSY, chapter 5.

"The palm-trees at Hyères delighted me less than the eucalyptus-trees, which were in flower. The first one I saw sent me into transports; I was alone, but I ran off at once to announce the event to my mother and Anna, and as I had not been able to bring them back the smallest sample, for the flowering branches were out of my reach, I did not rest satisfied till I had dragged Anna to the spot where the tree of wonders grew. She said then:

'It's a eucalyptus – a tree imported from Australia'. And she bade me to observe the hang of the leaves, the way the branches grew, the deciduous bark...

Just then a cart passed by; a small boy, perched up on the top of some sacks, picked and threw us a twig covered with the curious flowers I was longing to examine at close quarters. The buds, which were verdigris colour, were covered with a kind of resinous bloom, and looked like little closed caskets; one might have thought them seeds, but for their look of freshness, and suddenly the lid of one of the caskets would burst open under the tumultuous pressure of the stamens; then, when the lid fell to the ground, the released stamens would stand out in an aureole; from a little way off, among the tangle of the long sickle-shaped, drooping leaves, the white, petal-less flower looked like a sea-anemone."

This is but one of the many passages on plants in GIDE's works. He once wrote in his diary that botany and GOETHE had been his strongest supports in life. Even a monograph has been devoted to *Les images végétales dans l'oeuvre d'André Gide*, by DANIEL MOUTOTE (1970).

SURPRISE, DISCONTINUITY, RELATIONSHIPS

Botanically, GIDE's description is quite satisfactory. Most un-botanical, according to the standards set by the Second Revolution, is its quality of delight, and the human context in which the discovery is made. The presence of ANNA SHACKLETON, the governess, is clearly essential to the event, no less so than, in a totally different manner, the appearance of Flora on the BOTTICELLI painting. And the rapture, the ecstasy, that is: the being-outside-oneself, has nothing to do with the subject-object relation. How the plant comes to life in the description. It opens its flowers before the eyes of a boy who took with him an impression strong enough to write it up forty years later, as one of the highlights remembered from a winter season at the Côte d'Azur. GIDE comes also to life in the description. Wouldn't there have sprung, by way of speaking, also a lid off himself, falling down while, suddenly and to his complete surprise, the stamens unfolded?

I hope that the reader's thoughts will revert to the drunken peasant of RUMPHIUS. His *Arenga* and GIDE's *Eucalyptus* in their description show the human touch, just in this very element of surprise. It is surprise that calls into existence human relations, and what they occasionally need for their continuation.

Surprise, that is a break in the current of predictable events, an element of discontinuity. Such elements were wanting in scientific thinking at the time ANDRÉ GIDE grew up. They had systematically been eliminated by DÜRER and his successors, among them LINNAEUS, who emphatically declared (in the wake of LEIBNIZ): 'natura non facit saltus'. In perspectivic space, where every point is assigned a place, surprise is unwelcome, as it means cutting through the three measurable coordinates of length, width, and height. To the scientist who has learnt to examine objects in such space, eternally the same in a timeless universe, human relations must be a disturbing factor, which is best eliminated.

It seems consistent with this image of the world that biology from its rebirth about 1530 till the end of the 19th century, has largely been a science behind walls. Field work was done, to be sure, but essentially for the purpose of collecting. Plants and animals were reduced to a convenient state of lifelessness, and taken for study inside an artificial space: a botanical garden, a herbarium, museum, or laboratory.

Towards the turn of the century, this began to change. Let me quote the opening sentence of two textbooks of botany, which together so nicely characterize the differences in outlook on the living world. First the one by C. L. WILLDENOW, *Grundriss der Kräuterkunde*, 5. Aufl. (1810), translated: 'A cursory glance which we cast upon this world shows us that all consists of objects' (or bodies, or corpuscles, the German text has Körper). Then the one by C. KALKMAN, *Mossen en Vaatplanten* (1972), in translation: 'The living organisms on earth are interconnected by a meshwork of relations that is beyond overview, and any species or population plays in some or other way a role in the life of other species.' We now will list a few of the events which thrust the relations, and the disconituity, into vision.

CONTEMPORANEOUS EVENTS OF THE THIRD REVOLUTION

1895–1900 PAUL CÉZANNE, *Onions and Bottle*, painting. It shows several distinct deviations from central perspective, i.e. parts have been painted as if looked at from different points.

1895 EUGEN WARMING, *Plantesamfund*, the first book on plant ecology, wherein plants are systematically viewed in relation to their environment. It marks the beginning of ecology as a discipline in its own right.

1898 A. F. W. SCHIMPER, *Pflanzengeographie auf physiologischer Grundlage*, a book in the line of WARMING's, but grand in concept, and still a classic.

1898 HUGO DE VRIES in an address distinguished between continuous and discontinuous variation.

1899 ANDRÉ GIDE, *Le Prométhée mal enchaîné*, novel. First description of the 'acte gratuit', an act without reason, not being the expression of any coherence as an important event; to be viewed as a break with continuity.

1900 MAX PLANCK, *Quantum Theory*, in physics. It proclaims that energy is not absorbed or produced in a continuous stream, but in packages, discontinuously.

1901 HUGO DE VRIES, *Die Mutationstheorie*, in biology. It holds that evolution is achieved by unpredictable changes, and broke with the continuous selection process defended by DARWIN.

1906 PABLO PICASSO, *Les Demoiselles d'Avignon*, painting. No central perspective has been used; it marks the beginning of cubism.

It amounts to an undoing of many previously accepted truths. Discontinuity broke in. Life, as we experience it, is open, never completely subjected to the laws of causality. There is always room for the unexpected, and it can bring about a decisive change. Of course, there is causality, but it is no longer acknowledged as more important in determining life. Life, as we experience it, is given in relations. Discontinuity and relations as something essential in life, are connected. If continuity of time and space prevail, there is no room for relations. Hence an isolated specimen was considered perfectly adequate in the time between DÜRER and GIDE, for instance a waterlily without water, and strikes us now as an unrealistic wretch. A change of such magnitude must have its reflection in scientific botany, as we now will see.

SIGNIFICANCE OF THE THIRD REVOLUTION

By the end of the 19th century, anatomy, morphology, physiology, genetics, taxonomy flourished, all in vacated space. The science of biological relations was not yet

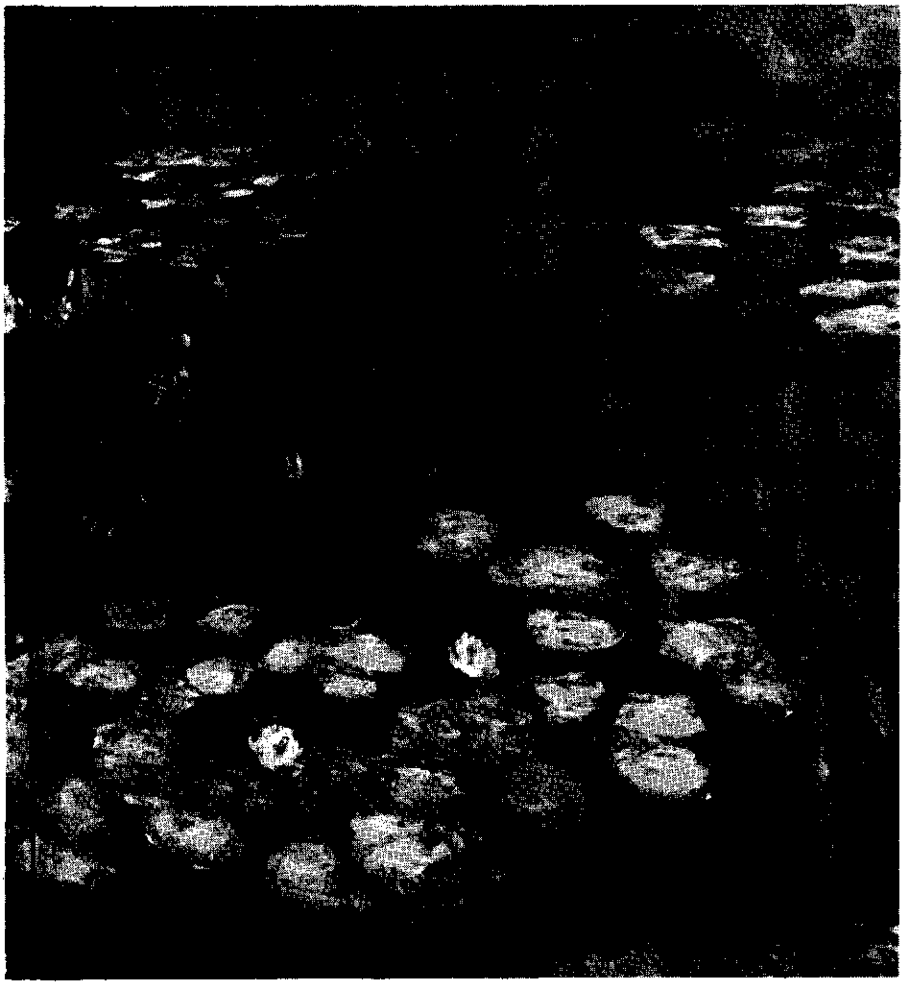


FIG. 6. Les deux étoiles. CLAUDE MONET, after 1920.

born. When E. WARMING had completed his *Plantesamfund* (translated into English as *Oecology of Plants*), he wrote in the preface that he did not know of a work that could have served him as a model. It is indeed the first book on plant ecology, soon to be followed by A. F. W. SCHIMPER's classic *Pflanzengeographie auf physiologischer Grundlage* (1898), translated into English as *Plant-Geography upon a Physiological Basis.* In these works, for the first time the plant world is described and explained consistently in relation with its environment; through them, ecology emerged as a coherent, autonomous discipline, which was to expand so enormously during the 20th century.

Ecology is, by necessity, an outdoor science, and as such is bound to witness interactions between people on the one hand and plants and animals on the other, interactions which for centuries had been ignored. In view of this, GIDE's ecstasy tells of liberation; he discovered not only the eucalypt but also an area of existence. Others joined in the discovery, how did it affect plant illustration and plant description?

The loss of central perspective meant a well-nigh complete break with the past in painting. As J. H. VAN DEN BERG has shown (in *Het Menselijk Lichaam* 2, ch. 4, section 4, 1961) the breakdown was initiated by impressionist painting; the first exhibition was held in 1874. Since CLAUDE MONET was one of these painters of the first hour, one of the greatest, who also occupied himself with waterlilies, his paintings may have to reveal significant things. The one here selected (fig. 6) was also reproduced and discussed in a remarkable book on the relation between science and art in the 20th century, by the geneticist C. H. WADDINGTON, *Behind Appearance* (1969). It was painted 'after 1920', which points to a remarkable parallel, in time, with GIDE, whose inception took place about 1880.

WADDINGTON characterized this painting as "a rather more clear representation than some that he produced. These paintings emerge as all-over modulations of the picture surface, with, in the more extreme examples, no natural focus on interest, and no natural edges – they might extend indefinitely in all directions. And the space they indicate is one which extends into the depths of water, with every further foot of recession indicated, because water is not so trivially transparent as air" (p. 10).

Which waterlily is truer to nature, the waterless one WEIDITZ drew in 1530 which was reduced to an immutable structure, or the one which MONET made float upon a mystery-filled pond? There is obviously no ready answer. The best we can say is that both are adequate in their own right, and in their adequacy are expressions of a period in which something new and fascinating was emerging, different as they were. In either period, the first half of the 16th century and the turn of the 20th, an ancient style of life and of perception was crumbling before another, which enabled man to observe and understand life in a fresh, hitherto undreamt-of manner. The reality of our time was forcibly brought forward by geniuses like GIDE, MONET, PLANCK, DE VRIES, and WARMING. For every period has its own reality, its own ways to truth, and its corresponding style of natural science.

Scientific revolutions differ from political ones in that they lead not to destruction, but to neglect. A few extremely talented, courageous people make discoveries of what turns out to be the newly valid reality of the material world. Others follow suit, methods are worked out, perfected, applied, organizations are established and perpetuate the work. Scientific botany, which grew on the grounds prepared by DÜRER, once was a way towards truth, although in view of the neglect of the factor life in plants which prevailed before the Third Revolution we are now inclined to regard it as a half-truth. GIDE as well as MONET brought back the other half, in their rendering of the qualities of rapture, motion, mystery which appeared to be awaiting rediscovery.

To stress the point, let me refer to one more example of plant illustration: VINCENT VAN GOGH's well-known sun flowers, painted in 1889, and seen through the eyes of a phenomenologist, J. H. VAN DEN BERG, in his book *Gedane Zaken* (1977).

"The beholder of VAN GOGH's sunflowers is struck by the fact of a likeness that is poor on the one hand and apt on the other." They do not resemble the sun flowers as we think (or thought) we know them, since no photographer is able to make a colour picture of such flowers. They keenly resemble the sun flowers which we observe more and more often, since they contain and reflect all that the sun flower has with itself and in itself, the tall growth of the plant with the huge flower, the yellow flames of the petals which blaze around the flower, the bulging bottom of the flower with the orbit of fertility closing in, the heat of a sunny summer, the majesty of the sun itself, the inexhaustible splendour of the earth. It seems to be much more than the flower itself, or rather, it is far more than the mere flower, nonetheless belongs to it, even is the very flower. Subtract the surplus, and what remains is a vegetable, a poor botanical vestige of what the sun flower is. In the two centuries between 1700 and 1900, men learnt, step by step, to be satisfied with the poor remainder, which led people to believe that the properties just described were attached to the sun flowers as ideas, trifles, like rococo-ornaments. VAN GOGH unmasked the falsification. He demonstrated that the ideas are not additions, but the sun flower's authentic properties, belonging to the very thing. His sun flowers show that the world we live in is suspenseful, numinous, magic. ... Things are space, time, colour, splendour, sound, silence, passion, moodiness. In things, creation encounters us, if only we are prepared to do away with our 18th and 19th century ears and eyes, and open up ourselves to see the things as they can be seen in the 20th century. VAN GOGH showed us the way" (p. 77).

RESULTS OF THE THIRD REVOLUTION

The face of descriptive botany now shows the features of four centuries. There always have been made descriptions with high artistic qualities, whereby they don't bear the stamp of one of the revolutions. An example is the descriptions of *Dioscoreaceae* in Flora Malesiana i 4 (1951) by I. H. BURKILL (1870–1965). The Third Revolution only slowly made its way into the realms of taxomomy, and several efforts have been made to do justice to the living plant and its ecology without sacrificing the craftsmanship that the Second Revolution made possible. To many a 'dry' description has now been appended a compilation of field notes. Striking is the addition of chromosome numbers, which emphatically refer to the living plant. The development of chemosystematics has made good the rejection by LINNAEUS of colour, odour, and taste. The other aspects: habitat, time of fertility, and size in response to external factors, are well taken care of by experimental taxonomy. Those botanists who let carry themselves away by such sensitivities as were expressed by GIDE, VAN GOGH, and MONET are no good for their job by which results must be produced in terms of revised genera.

We now come to results in general; to begin with those of the Third Revolution:

1. return of taste, colour, and other typical properties of the living plant as inseparable qualities,
2. relations of the living plant came in view as a subject of scientific enquiry, resulting in a striking development of ecology,
3. renewed appreciation of plants as active beings,
4. appreciation of discontinuity as a valid factor in life and science,
5. abandonment of perspective space,
6. pictorial rendering of plants as less sharply limited objects,
7. plants are approached from various angles of enquiry, *i.e.* a multitude of disciplines became involved,
8. abandonment of excessive terminology, gradual return of verbs in the descriptions,
9. relations between plants and humans are acknowledged and receive scientific attention.

To demonstrate the effect on phytography, it is instructive to quote a modern description of *Arenga*. We take the first portion – to make it about as long as the fragment of the RUMPHIUS description – of the one by ROBERT H. MILLER in his paper *The Versatile Sugar Palm*, Principes 8: 118 (1964). The complete text consists of about 1000 words, two-thirds of what RUMPHIUS needed.

> The bole is solitary, straight, columnar and unarmed, 7–10 m in height, exclusive of leaves, and approximately 40–50 cm in diameter when fully grown. Occasional trees have been reported to reach up to 16 m (leaves excluded) in height and 65 cm in diameter. These tall stout palms are easily recognized by their distinctly large and very long (5–9 m) feather-like, dark green leaves (sometimes appearing almost blackish-green) which ascend stiffly to form a diffuse, dense crown. Each unevenly pinnate (imparipinnate) leaf, spirally arranged on the bole, consists of from 60 to 100 or more pairs of sword-shaped (ensiform), sub-opposite or opposite pinnae. The leaf rachis is devoid of pinnae for some 1.5–2 m above the leaf base. Each pinna, as much as 1.5 m in length and 6–8 cm (or more) in width, has parallel venation, and is a glossy dark green above (adaxially) and somewhat scurfy and whitish or green light below (abaxially). The induplicate pinnae have a single fold at their more or less sessile, auriculate bases, are flatly V-shaped in transection, and possess enlarged midribs. The upper portion of each pinna is dentately serrate, with a more or less oblique and toothed (praemorse) apex. The pinna base usually consists of 1–2 distinctly unequal blunt auricles.
>
> The rachis of each leaf is woody and smooth, light green and slightly concave above. Below, it

FIG. 7. The snake charmer. HENRI ROUSSEAU, 1907.

is somewhat quadrangular or rounded, light-coloured and slightly scurfy, flaring out into a very broad base. The sheath margins become shredded into very long stiff, coarse fibers (bristle-like) that protrude in various directions and become interspersed among a mass of other less coarse horsehair-like fibers, collectively presenting a reticulated and mat-like shaggy profusion.

According to expectation, the verbs are back, and so are the comparisons with well-known things of ordinary life, like horse-hair. Moreover, terminology has been cut down: several terms have been retained for botanists but are explained to laymen. And the rest of the paper is full of interesting facts about the importance of *Arenga* in human society, with a variety of photographs showing palms in action, as well as people.

In view of all this, we wonder about the effects of the Third Revolution on plant illustration, tempting sideline as this is. Before scientific plant observations were made, *i.e.* in BOTTICELLI's time, plants on paintings became increasingly recognizable and identifiable. This trend coincided with a regression of the human presence. Would the opposite also be true? I mean, when humans again enter the plant scene, would the plants cease to the recognizeable?

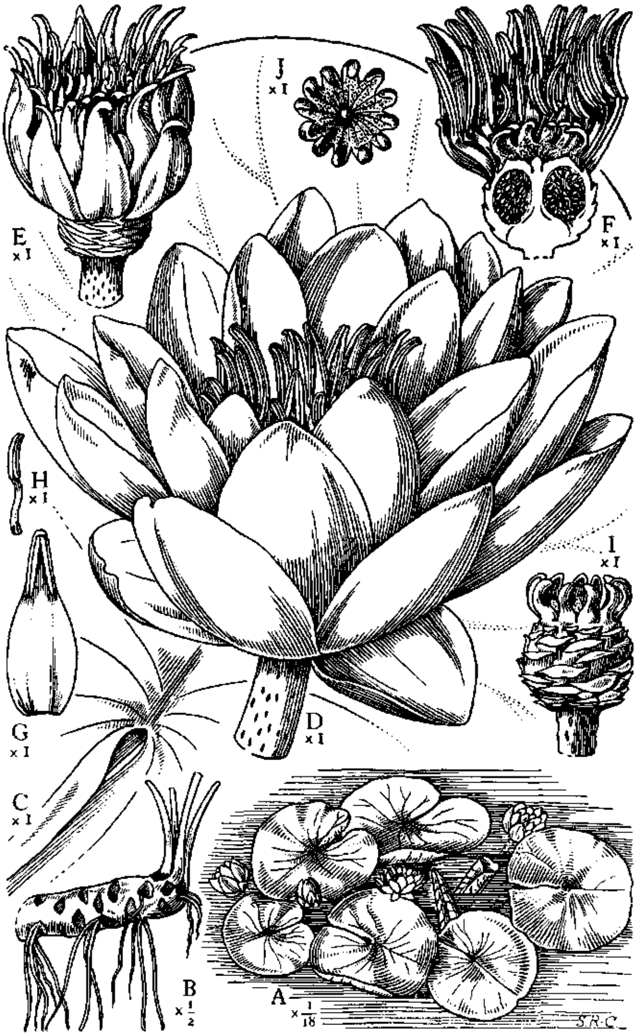
As pre-raphaelitic paintings show, where portraits are surrounded by neatly painted plants, the matter is not simple. Yet there is a difference with these paintings and those by HENRI ROUSSEAU ('le douanier', 1844–1910). In the former the plants serve as ornament, in the latter they act in relation. In many of ROUSSEAU's paintings (from 1886 on), vegetation is overwhelmingly present, and the scene of vehement action, of which *The Snake Charmer* (1907) is a well-known example. Out of the forest fringe, the snakes come, one has already wound itself around the woman's neck, literally tying human to nature. She is, in VAN DEN BERG's words, "more black-tropical-primitive-brooding-magical-feminine than the whole of western anthropology can offer" (*Gedane Zaken*, p. 78. 1977). Likewise, the plants are more manifestly, more symbolically plant-like than anyone could paint them if he kept 'true-to-nature'. Meaning surpasses characters. ROUSSEAU's piece (again VAN DEN BERG)" plant, tree, and human of the 20th century, deprived of their scientific mask, obtained during the period 1700–1900." Here ends our digression, with the remark that ROUSSEAU was quite well able to paint things botanically accurate, witness his *Tropical Fruits* (1908). This painting depicts 17 varieties, of which only 2 remain doubtful; together they make up an abundance of fragrance, colour, and taste.

On scientific plant illustration, the effects of the Third Revolution are less clear. This is partly due to the success of photography, which has replaced too many drawings and watercolours. Drawing as a technique has often been simplified. Yet in the waterlily by STELLA ROSS-CRAIG, from her *Drawings of British Plants* (1948) the habitat is fully present (fig. 8). What strikes the eye foremost is the wealth of details, which almost bury the whole plant, and which come in different magnifications, blurring the beholder's sense of proportion. If we compare this with 19th century plates, where habit and details never interfere, could it be an indication that modern taxonomists have more difficulty in general to single out main lines and leave the details apart? From the current inflation of taxonomic ranks, and the rarity of large revisions, one would almost think so.

Anyhow, the herbarium botanist will find much food for reflection in the three revolutions. He too is a person in relations, a messenger between the world of plants and the world of people. For a very long time, his work carried an aura of ambiguity, because he studied life through dead plants, and because of the intensely private character of the subject-object relation, which entailed much individualism. But there is no doubt that botany, as shaped in two revolutions, sprung from the mainstream of life in western civilization. This stream itself went through two revolutions, which have here been hinted at. The differences between the plant descriptions reflect the enormous alterations.

As the newest description of *Arenga* tells us, a shift in attitude has come which may resolve the ambiguity. The complex and scholarly factory of knowledge that is a Herbarium will remain of fundamental value, the source of facts, but rather as an expression of craftsmanship than as expression of an inflexible eternal truth about plants. Accordingly, work and publications can be geared more freely towards greater usefulness, in scope and contents. And the pleasure RUMPHIUS must have felt in making

FIG. 8. Nymphaea alba. STELLA ROSS-CRAIG, *Drawings of British Plants*, vol. 2, plate 2 (1948).



plant descriptions as he did, comes within reach again, perhaps even outright fun in aptly describing plants. Descriptions of species and genera could be made rather in their own right, than for the sake of classification. Since the advent of the natural system, classification has dominated botany to a disproportionate extent. In all sorts of works, families were arranged according to some or other system, whether it was practical or not, just to rub the system in. So much has classification continued to occupy botanists, that the 20th century has seen the birth of a (more or less) new system of angiosperms about every three years, on average. The subject has been talked dead, and with less gain than one would wish, while in the realm of description of well-defined taxa the progress leaves much to be desired, especially in the large families. Too much solid fact is just waiting in the Herbaria to be unearthed and made available, in elegantly crafted form.

METABLETICS

What I have attempted in this paper is to look at history of science – accidentally represented by revolutions in the plant description – as part of the history of western civilization. However, in the customary way, history of science is conceived as a record of events through time, like pegs on a clothesline. Interesting as the facts may be, they don't assume significance *as such* outside the limits of the discipline, and not much transpires of a meaning they may have had in their particular time and sequence. How is it, for instance, to be *understood* that LINNAEUS so successfully handled terminology, classification, and the herbarium, in that particular period?

Metabletics, or historical psychology, seeks to answer just such questions. It is the study of changes in the meaning of life. The meaning is given in a number of relations between man and his world, like the relation with matter and space, with the body and death, between parents and children, between the sexes, with time, and with God. Man in metabletics is viewed as one counterpart in these relations. A change in the contents of a relation involves a change in the very nature of both counterparts. When a change occurs, new truths come within grasp, while others shrivel. Man himself changes: he is fascinated by new problems, accepts different things as self-evident, and cannot without effort understand the values and fascinations of former times.

For these reasons, such metabletic changes are revolutionary in character. Since events in one relation affect all other relations, we may expect results from an examination of synchronic changes. It is indeed the contents of metabletics, that no landmark in the history of art, science, and spirituality stands alone, but is an expression of a change in the values of life. If this is so, those contemporaneous facts that brought revolution in art, science, or spiritual life can be presumed to have a common significance. This significance is open to a phenomenological investigation, through which it can be explained step by step: each major event has to tell something about all others.

What happened during the years 1733–1753 in botany may cast a light on contemporaneous landmarks in other sectors of society, and conversely. When LINNAEUS introduced the loose-leaf system in herbaria, separation and growth manifested themselves in Europe in a variety of ways. Weren't these phenomena epitomized by ABRAHAM TREMBLEY who cut a hydra to pieces which themselves developed into as many complete animals, to the surprise of all the learned world?

Metabletic ideas occur in a small book by ADOLF MEYER, *Krisenepochen und Wendepunkte des biologischen Denkens* (Jena 1935), the first chapters. As a methodical approach, metabletics was worked out over a broad spectrum by J. H. VAN DEN BERG in a series of books, the first of which dates of 1956 (later published in the United States under the title *The Changing Nature of Man*). Also in the U.S. was published *Divided*

Existence and Complex Society/An Historical Approach (Duquesne University Press 1974). Extensive summarizing accounts in English were given by M. JACOBS in Humanitas/Journal of the Institute of Man. Pittsburgh, vol. 4: 25–73 + 4 pl. (1968) and vol. 7: 291–319, 371–393 (1971), and in Social Research 36: 606–639 (1969). Whether metabletics is a suitable tool for the study of, among others, biohistory, is up to the readers to consider.

ENVOY

Two scholars are to be named for what the above essay owes to their work and personality. First, Dr. J. H. VAN DEN BERG at Utrecht, from 1954 to 1979 Professor at Leiden, and author of many books on phenomenology and historical psychology, in which he developed and brilliantly applied the metabletic method. Second, Dr. H. C. D. DE WIT, whom I learnt to appreciate not only as a fellow reader of the above books, but as a very clever botanist who never lost sight of the life in plants or in people, and whose encouragement in delicate matters has helped me to find my way.

THE CRYPTOCORYNE ALBIDA GROUP OF MAINLAND ASIA (ARACEAE)

NIELS JACOBSEN

Institute of Systematic Botany, University of Copenhagen, Gothersgade 140,
DK-1123 Copenhagen K., Denmark

SUMMARY

Three species of the *Cryptocoryne albida* group are recognized, viz. *C. albida* Parker, *C. crispatula* Engler, and *C. retrospiralis* (Roxburgh) Kunth. The large distribution area of *C. crispatula* is coupled with the occurrence of morphologically and ecologically different races, responding to the topography and the water-bearing in the various rivers in which they grow. The synonymy, distribution, chromosome numbers, and the ecology are treated.

INTRODUCTION

The *Cryptocoryne albida* group is morphologically rather homogenous. It differs from the other species groups by the linear to lanceolate leaves, the long tube of the spathe, the spirally twisted limb of the spathe which lacks a collar, the circular to elongated markings on the limb, and the more or less red speckled inner side of the kettle wall.

The main taxonomic characters for species delimitation in *Cryptocoryne* are the shape and colour of the limb of the spathe, both very difficult to ascertain in herbarium specimens. In the species here dealt with, matters are even more difficult as the question is the exact form of the spirally twisted limb and the differences in the brown, red, and purple colours, features that seem more quantitative than qualitative. However, there are distinctive differences in living material.

The leaves do not present characters useful for delimitation of closely related species, although they differ in the various ecological races of *C. crispatula*. The shape of female flowers, stigmas, and olfactory bodies, the number and shape of male flowers, the colouration of the inner side of the kettle wall, and the colour of the valve closing the opening of the tube vary continuously within the group.

The *Cryptocoryne albida* group has been the subject of several different opinions (ENGLER 1920, DE WIT 1971, RATAJ 1975). Previously (JACOBSEN 1976, 1977), I set forth the view that the species of *Cryptocoryne* were narrow endemics. However, during the course of revision it has been found that this opinion is not tenable for the present species. The next question is: Should the group considered one species with e.g.

three subspecies? The point of view does, to some extent, depend on the taxonomical characters used and the weight they are given.

ENGLER (1920), obviously aware of the difficulties connected with a sectional division of the genus, forwarded a 'dispositio gregum', and placed *C. unilocularis* in § *Unitubulosae* (because of the apparently lacking tube of the spathe), while *C. retrospiralis* and *C. crispatula* were placed in § *Bitubulosae*.

RATAJ (1975) distinguished 8 species (incl. *C. usteriana* Engl.), placed in two sections, viz. Sect. *Retrospiralae* Rataj and Sect. *Costatae* Rataj, a division for which I find no basis (JACOBSEN 1977) considering that *C. retrospiralis* ssp. *albida*, which is con-

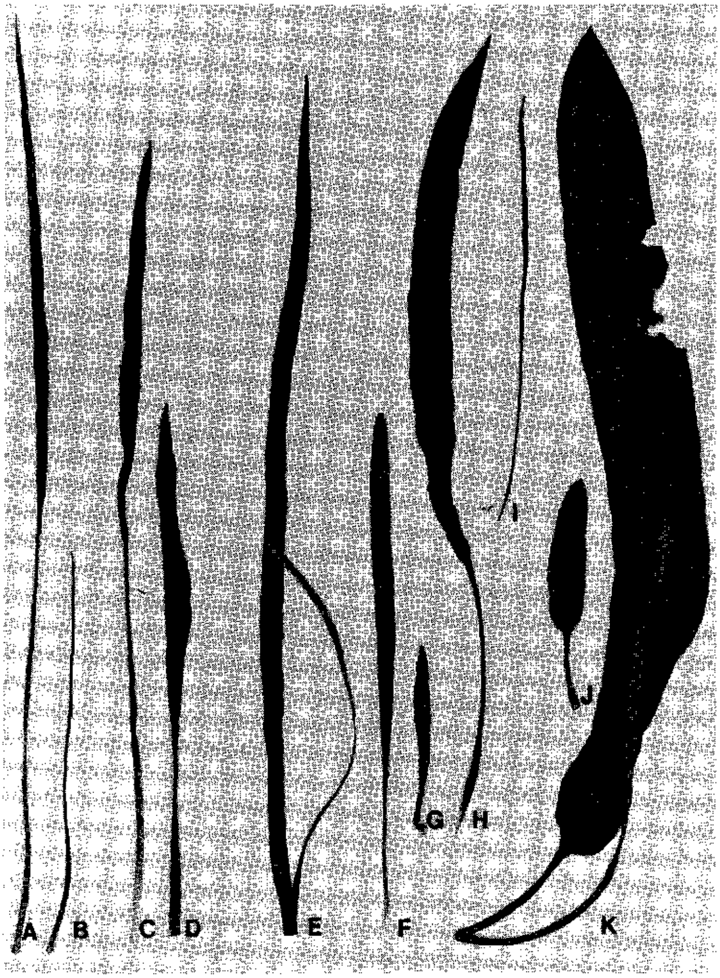


FIG. 1. Leaves of *C. retrospiralis*: A. *NJ 2950*; B. *NJ 2950*, monsoon leaf. – *C. albida*: C. *NJ 77-90*; D. *NJ 2915*. – *C. crispatula*: E. *P 1969/306*; F. *NJ 77-38*; G. *NJ 77-38*, from a plant in full sun; H. *NJ 77-37*; I. *NJ 3025*; J. *NJ 77-16*, emerse leaf; K. *NJ 77-16*, submerse leaf (× c. 0.4).

specific with *C. costata*, and *C. korthausae* were placed in different sections.

Cytological preparations were made from root tips according to JACOBSEN (1977). Voucher specimens are at C under the numbers cited and living plants are cultivated at the Botanical Garden. Photographs of most of the herbarium specimens are also placed at C.

MORPHOLOGY

The taxa in the *C. albida* group are aquatic or amphibious herbs with more or less vertical rhizomes and spirally arranged leaves. Vegetative propagation is obtained by means of subterranean runners. The spathe, appearing lateral, is principally terminal. In this group the cataphylls are lacking or rudimentary. The differences between the genera *Cryptocoryne* and *Lagenandra* in the ramification scheme, as given by ENGLER (1877 & 1920), are due to reductions in the size of the cataphylls and the number of spathes in some *Cryptocoryne*. There are no differences between the ramification schemes of *Lagenandra* and e.g. *C. pontederiifolia* Schott, *C. usteriana* Engl., and continuously flowering specimens of *C. beckettii* Hook. f.

LEAVES

The leaves are linear to lanceolate, green to brown, smooth to bullate (Fig. 1). The length varies from 10 to 70 cm and the width from 0.2 to 4 cm. In the broader leaves there are conspicuous lateral veins parallel to the midrib. In the narrower leaves, the midrib composes the main part of the leaf blade. The margin of the blade is entire to denticulate. In the rainy season, *C. retrospiralis* has short, c. 15 cm long, terete leaves (monsoon leaves, Fig. 1B), a feature otherwise found only in a few collections of *C. crispatula*, viz. *NJ 2984*, where they were 2–4 cm long, and in some collections from Phu Khieo, e.g. *NJ 77–34*, *38* and *39*, where they were 1–2 cm long.

INFLORESCENSE

The spadix (Fig. 12) contains a whorl of female flowers with the stigmas situated vertically to almost horizontally. The olfactory bodies are club-shaped and more or less lobed at the top. The male flowers are more or less spirally arranged at the top of the spadix and their surface is strongly mammillose. The lower part of the spathe constitutes the kettle which is constricted on the inside above the middle. A redspotted valve, emerging into the upper part of the kettle, serves as a trapdoor towards the tube of the spathe. The inside wall of the kettle is redspotted, mostly in the upper part. The inside of the tube is also spotted, often showing a transition between the markings in the kettle and those on the limb of the spathe. The upper part of the inner side of the kettle wall has more or less circular depressions, alveoli. McCANN (1944) considered these alveoli to be 'light windows' which attract the insects. However, as the kettle is often situated far below the ground there seems to be little chance of light reaching them so McCANN's interpretation is somewhat dubious.

The limb of the spathe varies in length from 1 to 6 cm. The limb is more or less spirally twisted, sometimes becoming uncoiled (Figs. 9, 10, 12). In *C. albida*, the unopened spathe is slightly twisted and after anthesis it often becomes recurved, and the short distal part coils backwards several times. The primary colours of the limb are whitish to yellowish to greenish to greyish. The markings on the limb vary in form and colour. Their form varies from small to large spots, from short, thin streaks to long, thick irregular lines. Their density varies from an almost complete coverage of the limb to nearly missing. Their colour varies from brown to red to purple. A margin of the same coulour as the markings on the limb can be present or absent. The form and colour of the markings are characteristic for each species.

SEASON AND DISPERSAL

All three species flower from (October–)December to February, during the dry season. They are inhabitants of small or large rivers where they are submerged part of the year. At falling waters the long tube of the spathe ensures that the opening of the spathe reaches up above the water surface. Later on, many of the plants near and on the river banks are completely emerse. After pollination, the fruit increases in size for the first few months and stays (mostly) hidden beneath the surface of the soil for about 3/4 of a year. At maturity the peduncle elongates 3–10 cm within about a week, the syncarpium rises above the surface of the soil, opens, and disperses the seeds. The seeds are coated with a thin layer of a waxy appearance which makes them float for a short time. Furthermore they have about the same specific gravity as water. The mechanism probably serves to disperse the seeds only at falling waters (December to February) so they do not travel too far, and furthermore ensures that they are distributed below and near 'normal' high water level.

Plants with fruit collected at Phu Khieo and Ban Wangyon (Thailand) in late February 1977 discharged their seeds in November–December the same year under cultivation in Copenhagen.

HABITATS

During a stay in Thailand in February 1977, the author had the opportunity to study different *Cryptocoryne* populations. Three localities will be considered:

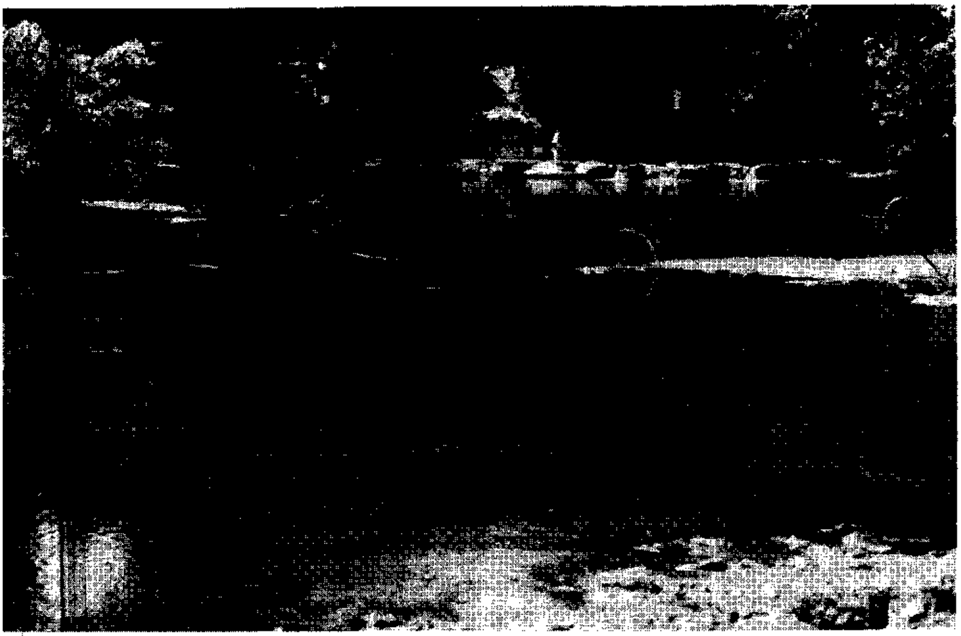


FIG. 2. Mueak Lek. Habitat of the broad-leaved, submersed form of *C. crispatula (NJ 77-16)*.

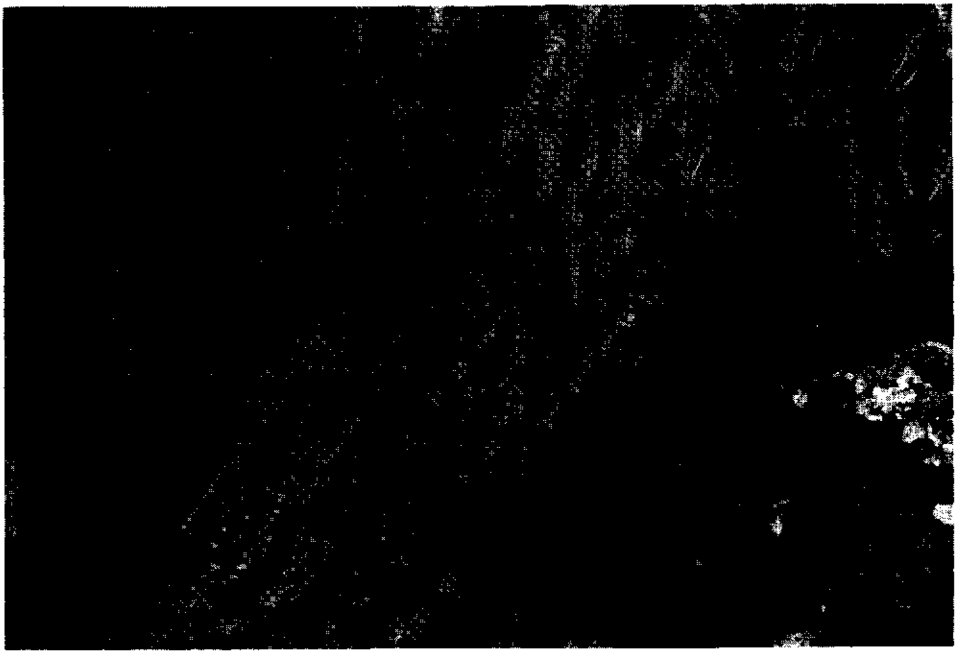


FIG. 3. Mueak Lek. Submerged plants of the broad-leaved form of *C. crispatula (NJ 77-16)*.

1. Mueak Lek (Fig. 2), Distr. Sara Buri. Alt. c. 200 m. The 6–8 m wide river runs through the national park near the main road. The water was rather calcareous, and had a temperature of 24 °C. Calcium carbonate incrustations were found in places with water turbulence, and resulted in the formation of some magnificent travertine dams across the river, creating small waterfalls. In the pools formed, a rich, submerged growth of *Cryptocoryne crispatula (NJ 77-16)* was found. The largest of the plants were 50–70 cm long with 30–50 cm long and 2–4 cm wide, bullate leafblades (Figs. 1K, 3). The plants were incrusted with a layer of calcium carbonate.

Flowering specimens were found at places where the incrustations raised the bottom of the river to the surface of the water (leaves 20–40 cm, spathes 20–30 cm). Emerse, flowering specimens were also found on the banks at the top of the dams. In the emerse specimens, the leaves and the spathes were but 10–15 cm long (Fig. 1J).

2. Phu Khieo Wildlife Sanctuary, Distr. Chaiyaphum. Alt. c. 700 m. The river, Huae Mae Chem, is 8–10 m broad, mostly filled with rather large, round stones and rocks. The river is running quite rapidly and is less than 0.5 deep. The temperature in the water was 21 °C. The *Cryptocoryne* were growing on the banks of the river in large quantities (*NJ 77-34, 38, 39*). The leaves were 10–20 cm long, 0.6–0.8 cm wide, and green and smooth (Figs. 1F–G, 5B). In sheltered places they formed large carpets. Most of the plants were emerged, and most of them had flowered a month or two earlier. (The main course is the type-locality for *C. bertelihansenii* Rataj).

FIG. 4. Phu Khieo Wildlife Sanctuary. Downstream course of the main river with an abundant growth of *C. crispatula (NJ 77-38)* along the banks.

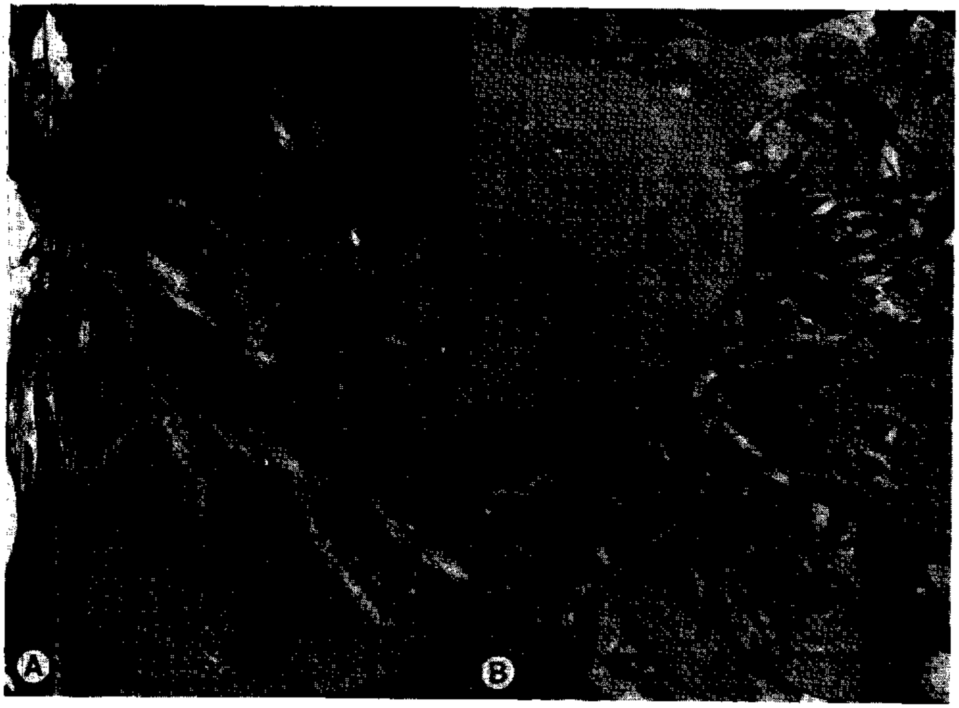


FIG. 5. Phu Khieo Wildlife Sanctuary. *C. crispatula*. A. Submerse plants with copper-brown leaves (*NJ 77-37*). B. Emerse plants of the narrow, greenleaved form along the main course (*NJ 77-38*).

FIG. 6. Phu Khieo Wildlife Sanctuary. Small, shaded tributary just west of the main course of the river with submerged growths of the brown-leaved form of *C. crispatula* (*NJ 77-32*).

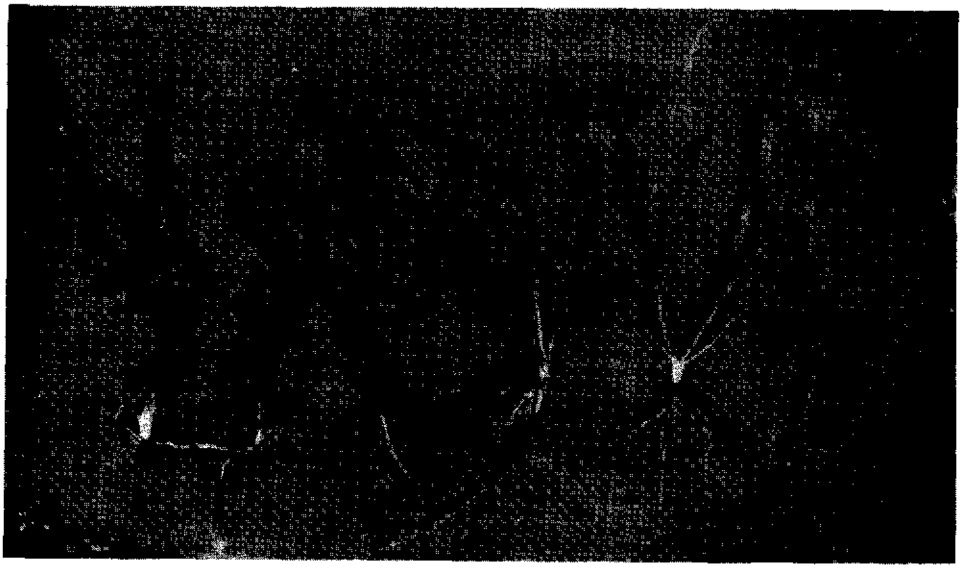


FIG. 7. *C. crispatula* from Phu Khieo Wildlife Sanctuary. A. *NJ 77-37*, submerse; B. *NJ 77-36*, submerse; C. *NJ 77-36*, half submerged; D-E. *NJ 77-38*, emerse (× c. 0.2).

In a quiet, shaded tributary, just east of the main course, plants with a different foliage were found (*NJ 77-37*). The leafblades were almost copper-brown, bullate, 20–30 cm long, and 1–2 cm wide (Figs. 1H, 5A). The limb of the spathe was yellowish with short, purple lines (Fig. 10E). Some plants (*NJ 77-36*) with foliage intermediate between the brown and green-leaved forms, were found only a few meters from the brown-leaved plants. In these intermediate plants the limb of the spathe was greyish, with large, irregular purple lines, resembling those from the main course of the river.

On the west bank of the main course was another small shaded tributary, almost carved into the solid rock (Fig. 6). Here was a pool (4 × 15 m) with a depth of 0.2–0.5 m. The temperature of the water was 16°C. In cracks in the bottom of the pool, plants with brown leaves (*NJ 77-32*), similar to those from the other tributary, were growing. Just above the pool, in full sun, the green-leaved form grew abundantly between the rocks (*NJ 77-35*).

The living material collected at Phu Khieo (Fig. 7) has flowered in cultivation in Copenhagen and they are all *C. crispatula* Engl. All collections were made within 30 meters of each other.

3. In the Malay Peninsula, south of Ranong, several localities with *C. albida* Parker were visited but the population at Ban Wangyon (Fig. 8) is quite representative. Alt. c. 10 m. The river is about 4 m wide and runs rather slowly although there were some small rapids. The temperature of the water was 27°C. The river bed consisted of sand and small stones. Emerse on the banks in the river and on the banks themselves were

FIG. 8. Ban Wagyon. Habitat of *C. albida* on the river-bank showing the very dense growths found in suitable places.

large populations of *C. albida* (*NJ 77-81 a-k*). The plants growing on open soil often had more reddish leaves while those growing close together and in the shade had green leaves. Every transition between green leaves and variegated, red-brown leaves were found. The leaves were more or less upright or flat on the ground, depending on the intensity of the light.

TAXONOMY

Cryptocoryne Fischer ex Wydler

Linnaea 5 p. 428 (1830). – Type: *C. spiralis* (Retz.) Fisch. ex Wydl.; *Cryptocoryne* Fisch. ex Reichenb., Uebersicht des Gewaechs-Reichs I p. 44 (1828). Nom. nud.

Arum L., Spec. Pl. p. 967 (1753). quoad Retz., Observ. I p. 30 (1779).

Ambrosina F. Bassi, Ambrosina Nov. Pl. Gen. p. 1 (1763). quoad Roxb., Pl. Corom. III, 4 p. 90 (1820), *Ambrosinia* ort. mut.; Fl. Ind. III p. 491 (1832).

Myrioblastus Wall. in sched., [C. Muell., Beil. bot. Zeit. IV p. 158 (1846) *Melioblastis* ort. mut.] Griff., Proc. Linn. Soc. I p. 264 (1846). Nom. nud.

KEY TO THE SPECIES OF THE *Cryptocoryne albida* GROUP:

1. Limb rarely exceeding 2.5 cm, more or less recurved (to spirally twisted, with a short appendage). Opening of the limb of the spathe usually distinctly dilatated. Markings on the limb irregular line-like to circular, brownish (to reddish). Leaves green to brown, 10–30 cm long, smooth, neither undulate nor denticulate at the margin. . . . . **C. albida**

1. Limb usually more than 3 cm, more or less regularly spirally twisted. Opening of the limb of the spathe usually not dilatated. Markings on the limb more or less circular, large red spots, or, more or less regular line-like and purple. Leaves 10–70 cm long, smooth to undulate to bullate or with a denticulate margin. 2

2. Limb more or less open-spirally twisted, sometimes uncoiled. Markings on the limb irregular, line-like (to circular), purple. Leaves green to brown, smooth to undulate to bullate, 10–70 cm long. **C. crispatula**

2. Limb of the spathe usually more or less spirally twisted. Markings on the limb large, more or less circular, reddish. Leaves green to brownish, smooth to undulate, 10–40 cm long. . . . . **C. retrospiralis**

Cryptocoryne albida Parker **Figs. 1C–D, 8, 9**

Kew Bull. p. 44 (1931). – *C. retrospiralis* (Roxb.) Kunth ssp. *albida* (Parker) Rataj, Rev. Gen. Cryptocoryne, Studie ČSAV, č. 3 p. 46 (1975). – Type: *Parker 2735*, Yanngwa Klong, 1.3.1927, holotype at K.

C. costata Gagnepain, Not. Syst. 9 p. 131 (1941). – *C. retrospiralis* (Roxb.) Kunth var. *costata* (Gagnep.) De Wit, Aquarienpflanzen p. 184 (1971). – Type: *Kerr 16385*, Jamlieng, 27.12.1928, lectotype (selected by RATAJ, 1975) at K, and isotypes at K and BK.

C. hansenii S. Y. Hu, Dansk Bot. Ark. 23 p. 456 (1968). – Holotype: *Sørensen & al. 813*, Koh Kho Kao, 29.1.1958, at C, isotypes at C, GH, K, and BKF. Paratype: *Sørensen & al. 855*, Ranong, 30.1.1958, at C, GH, and BKF.

C. korthausae Rataj, Rev. Gen. Cryptocoryne, Studie ČSAV, č. 3 p. 55 (1975). – Holotype: *Bogner 452*, cult., 1971 at M.

Rhizome 0.2–0.8 cm thick, occasionally irregularly thickened. Runners 0.1–0.3 cm thick, 5–20 cm long, often with a metallic, blue-grey colour. Root system well developed, sometimes with upright roots. *Leaves* lanceolate, green to brownish marbled, smooth (sometimes slightly undulate), 10–30 cm long and 1–2 cm wide (Fig. 1C, D); lamina with lateral veins; margin entire. *Spathe* 10–20 cm long; kettle 0.8–1.5 cm long; tube 5–15 cm long, limb short, 1–2.5(–4) cm long, at anthesis sometimes more or less

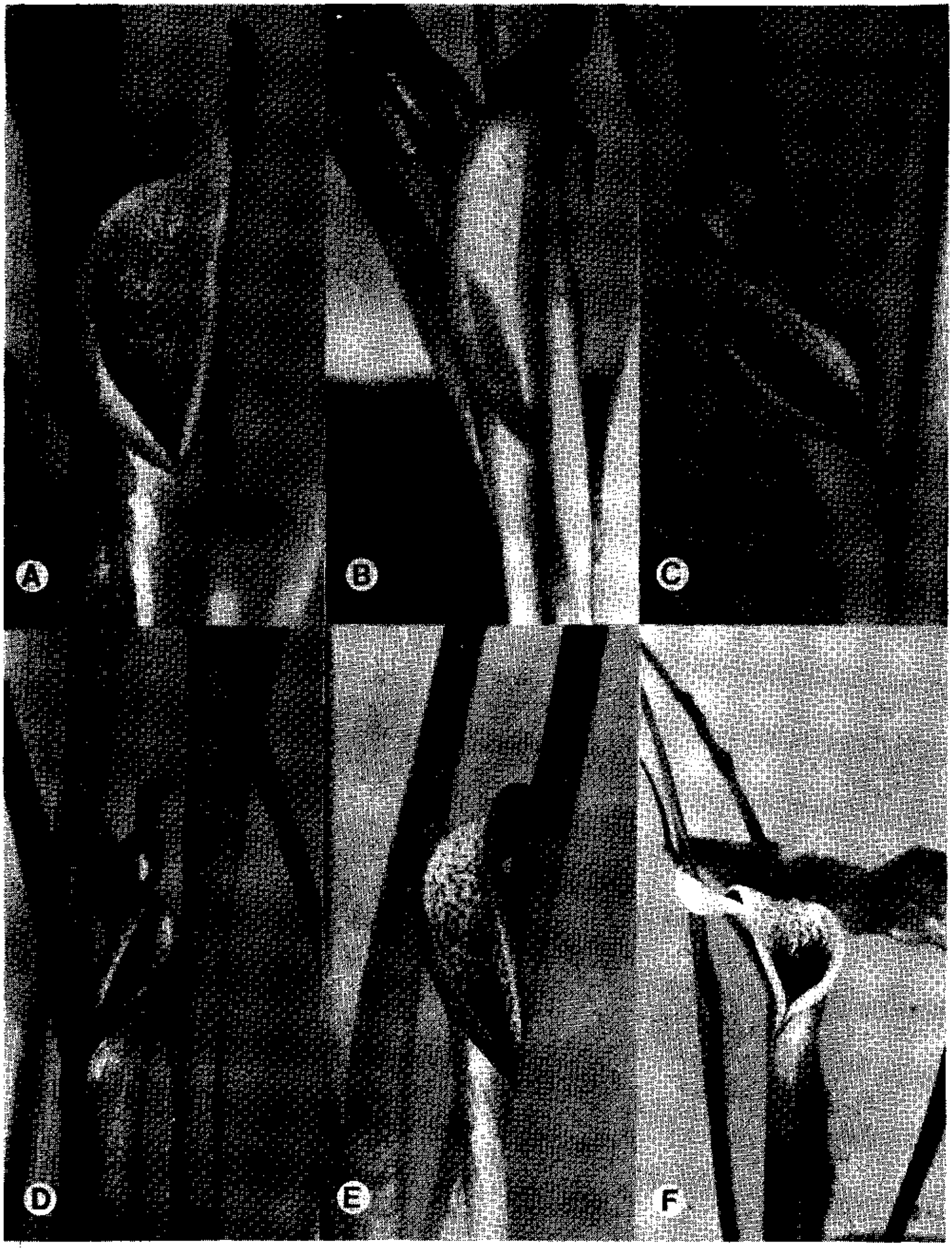


FIG. 9. *C. albida*. Variation in the limb of the spathe. A. *NJ 77-81a;* B. *NJ 77-81b;* C. *NJ 77-81g;* D. *NJ 77-81h;* E. *NJ 77-81i;* F. *NJ 3024* (× c. 2).

upright and spirally twisted, later becoming recurved (Fig. 9); colour greyish to cream, with reddish to brown, irregular to circular, elongate markings which sometimes cover the surface completely. The markings may be missing. *Female* flowers 4–7 with more or less vertical, ovate stigmas. Olfactory bodies more or less rounded, often depressed in the centre, yellowish to greenish, cells mammillose. *Male* flowers 80–120. Pollen globular, 28–45 µm.

Chromosome number 2n=36: *K. E. 102.67; NJ 2979; NJ 3024; NJ 3038; NJ 77–81 a, b, c, e, g, h, i, f, k; NJ 77–82, 83, 90, 91;* and JACOBSEN (1977).

Distribution: Southern Thailand and Burma (Fig. 13).

Habitat: At low elevations on sandy and rocky banks of rivers. Emersed when flowering.

Nomenclatural notes: RATAJ lists *C. albida* Parker as a subspecies of *C. retrospiralis* (Roxb.) KUNTH, but cites a wrong type, namely *Parker 3089*. The form and colour of the spathe do not show such close relationships to *C. retrospiralis* as RATAJ expresses, an opinion which is also agreed upon by RATAJ himself (1975) as, later in the revision, he establishes *C. korthausae*, and maintains *C. costata*, both the same as *C. albida*.

The type of *C. costata* has a rather short, suddenly narrowed limb of the spathe, but can hardly be regarded even as a form of *C. albida*.

Part of the type collection of *C. hansenii* has been cultivated in Copenhagen, and it proved to be inseparable from *C. albida*.

The type material of *C. korthausae* originates from material cultivated at the Botanical Garden at Munich. According to J. BOGNER (pers. comm.) this material was sent to Wageningen and is the same collection as *Zewald no. 40*, 17.3.1969, WAG, which is pictured in DE WIT (1970 and 1971).

Notes: The leaf-form is rather constant. The colour varies from brown to green. The species is distinguished by the short, more or less recurved limb of the spathe with the dilatated opening. The markings on the limb are bownish to reddish and their form varies from dots to elongate, irregular lines. The density of the markings as well as their size also vary. All transitions from no dots at all to markings completely covering the limb occur. Also the length of the limb varies. It may be short, only with a very short cirrhous appendage, or longer and twisted several times (Fig. 9). The total variation of the species does not exceed that found in one locality, e.g. Ban Wangyon, and it is not possible to distinguish between *C. albida* Parker and *C. costata* Gagnep. as done by e.g. DE WIT 1971, RATAJ 1975, and JACOBSEN 1977.

Specimens studied:

Burma: *Gilbert s.n.*, Moulmein, Sept. 1872 (K); *Kurz 2665*, Pegu Yomah, 31.1.1871 (K); *Parker 3089*, Palauk Chaung, 14.1.1930 (B, K).

Thailand: *Beusekom & Phengkhlai 89*, Pompee Village, 25.3.1968 (BKF, C, E, K, P); *Jacobsen 77-81 a-k*, Ban Wangyon, 22.2.1977 (C): *Jacobsen 77-82*, Klong Nang Yon, 22.2.1977

(C); *Jacobsen 77-83, 84,* Klong Naka Game Sanctuary, 22.2.1977 (C); *Jacobsen 77-90,* 33 km SE of Phangnga, 23.2.1977 (C); *Jacobsen 77-91,* 162 to 163 km stone SE of Phangnga, 23.2.1977 (C); *Kerr 11974,* Ban Trang, 17.2.1927 (BK, K); *Marcan 2620,* Ban Pak Twan, 1.4.1931 (BM, K); *Schulze 346,* 80 km S of Ranong, 18.4.1970 (C); *Smitinand 4160,* Thang Nga, 29.1.1958 (BKF).

Cult: *Bogner 469,* 1971 (M); *NJ 2915, 2952, 3024, 3038* (all C); *Zewald no. 40,* 17.3.1969 (WAG).

Cryptocoryne crispatula Engler **Figs. 1E–K, 2, 3, 4, 5, 6, 7, 10, 11**

Pflanzenreich IV, 23 F p. 247 (1920). – *C. retrospiralis* (Roxb.) Kunth var. *crispatula* (Engl.) De Wit, Aquarienpflanzen p. 184 (1971). – Lectotype: *Harmand 65* (*=3355=3356*), Se lam Phao, 1876 at P (selected by RATAJ, 1975), isolectotypes at B, BM, K, and P.

C. sinensis Merr., Sunyatsenia 3 p. 247 (1937). – Type: *Morse 221,* Lungchow, holotype at NY, and drawing and isotypes at K.

C. balansae Gagnep., Not. Syst. 9 p. 131 (1941). – Lectotype (selected by RATAJ, 1975): *Balansa 264* (*=415*), Chan Moi, 21.1.1886, at P, isotype at K. Paratype: *Kerr 5020,* Tan Chum, 7.3.1921 (BK, K, and P).

C. tonkinensis Gagnep., Not. Syst. 9 p. 133 (1941). – *C. retrospiralis* (Roxb.) Kunth var. *tonkinensis* (Gagnep.) De Wit, Aquarienpflanzen p. 184 (1971). – Lectotype (selected by RATAJ, 1975): *Balansa 2045,* Baa Toi, Aug. 1887, at P. Paratypes: *Balansa 2043,* Rivière Noire, 29.11.1887, and *2044,* Baa Toi, 8.2.1887, at L and P.

C. longispatha Merr., Journ. Arn. Arb. 23 p. 156 (1942). – Holotype: *Petelot 2681,* Phan Me, 12.11.1939, at GH.

C. bertelihansenii Rataj, Rev. Gen. Cryptocoryne, Studie ČSAV č. 3 p. 49 (1975). – Type: *Beusekom & al. 4077,* Nam Phrom (= Phu Khieo), 10.12.1971, holotype at L., isotypes at BKF, C, K, and P.

C. yunnanensis H. Li, Acta Phytotax. Sinica 15, 2 p. 108 (1977). – Holotype: *Chiu 60132,* Meng-la, at Bot. Inst. Yunnan. Paratype: *Y. C. Li 2728* at Bot. Inst. Yunnan. Type material not seen.

C. kwangsiensis H. Li, Acta Phytotax. Sinica 15, 2 p. 109 (1977). – Holotype: *R. C. Ching 8505,* Nanning, 2. 12. 28, at Chung-Shan Univ., isotypes at NY and W. Paratype: *Ching 8504,* Chung-Shan Univ. Material from China not seen.

Rhizome 0.2–1.0 cm thick, occasionally irregularly thickened. Runners 0.1–0.3 cm thick, and 5–30 cm long. Root system well developed, sometimes with a few upright roots. *Leaves* very variable, narrowly linear to lanceolate, green to brown, smooth to undulate to bullate, 10–70 cm long, and 0.2–4 cm wide (Figs. 1E–K, 3, 5, 7); broader leaves mostly with conspicuous, lateral veins. Margin entire to finely denticulate. *Spathe* 10–40 cm long, slightly twisted, limb (1.5–)3–8 cm long, more or less spirally twisted (Fig. 10); colour yellowish to greyish to greenish, with short to long, purple markings (before anthesis sometimes reddish). *Female* flowers 4–6, with horizontal to

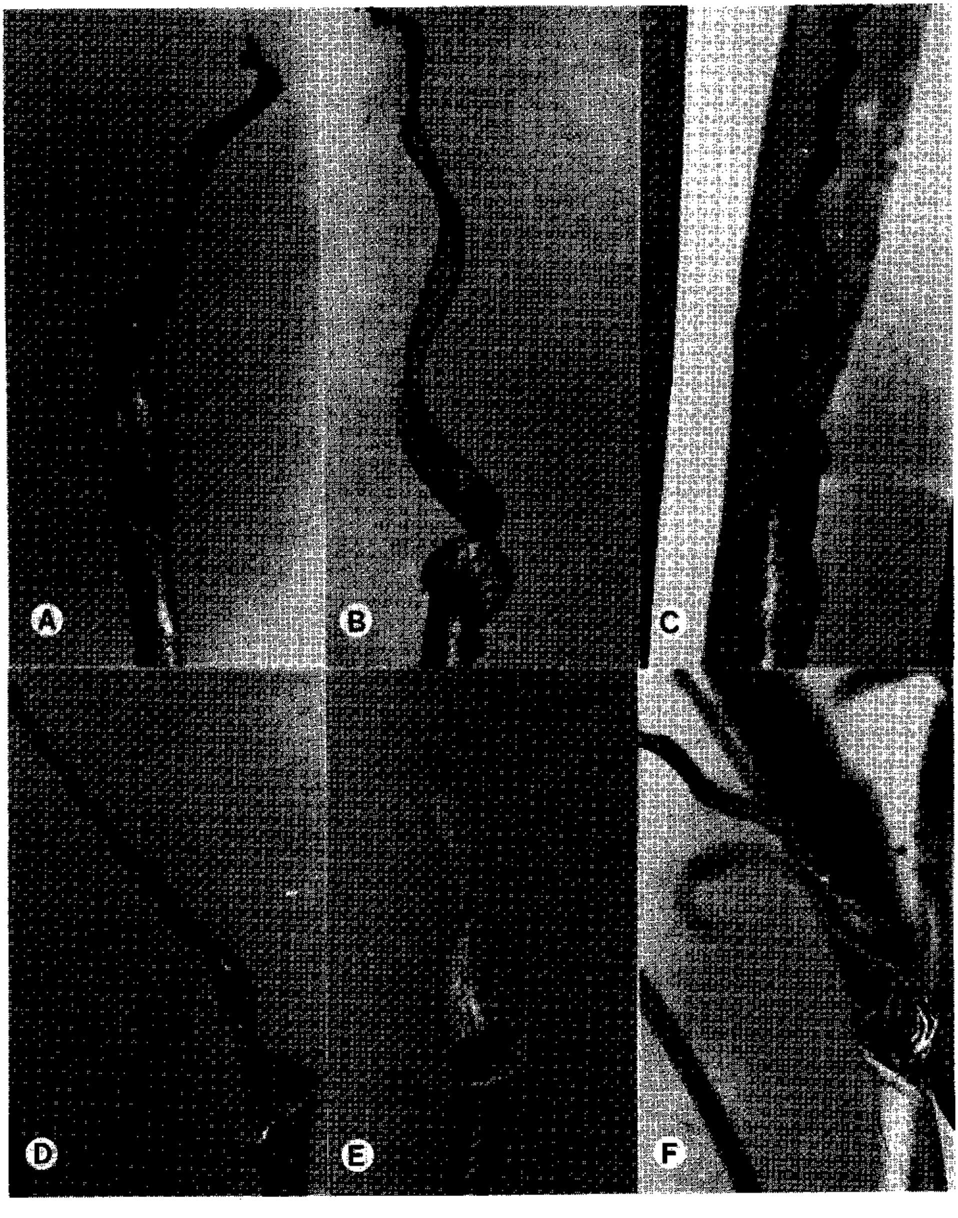


FIG. 10. *C. crispatula.* Variation in the limb of the spathe. A. *NJ 77-38;* B. *NJ 2871;* C. *NJ 2977,* 2n=54; D. *NJ 77-40;* E. *NJ 77-37;* F. *NJ 2981* (× c. 2).

vertical, round to ovate stigmas. Olfactory bodies more or less irregularly lobed. *Male* flowers 90–130. Pollen globular, 28–40 µm.

Chromosome number 2n=36: *P 1964/526; K. E. 305-70.02944; NJ 2871; NJ 2901; NJ 2919; NJ 2981; NJ 2983; NJ 3025; NJ 3076; NJ 3077; NJ 3090; NJ 77-16; NJ 77–35; NJ 77-38; NJ 77-39; NJ 77-40.* 2n=54: *NJ 2977; NJ 2980;* and JACOBSEN (1977).

Distribution: Eastern India, Thailand, Laos, Vietnam, and South China (Fig. 13).

Habitat: The various ecological races are adapted to the varying water-bearing in the rivers in which they grow. Some are submerged all (or almost all) year round while others are completely emerged during flowering (Dec.–Feb.).

Nomenclatural notes: The type of *C. crispatula* Engl. represents the narrow-leaved form with finely denticulate leaves.

The leaves of *C. sinensis* are c. 15 cm long and 1 cm broad. The limb of the spathe is shortly twisted. There is a fine colour-drawing of the spathe at K, showing a greenish colour of the limb and elongate reddish markings.

The type of *C. balansae* is typical in size and shape for emerse specimens of the form with the long, broad, and bullate leaves. The spathe cannot be distinguished from that of *C. crispatula* Engl. RATAJ (1975) designates the lectotype: *Balansa 415*. However, the sheet in P has two labels, viz. *264* and *415*, and, as only the former is mentioned in the protologue, it must be considered the correct citation.

In the protologue of *C. tonkinensis* the three above mentioned collections are cited. *Balansa 2043* has leaves that are smooth, c. 25 cm long, and c. 1 cm broad. The spathe is short, c. 10 cm, and the plant apparently grew emersed. *Balansa 2044* has leaves that are smooth, c. 25 cm long, and c. 0.2–0.3 cm broad. The spathes are c. 25 cm long, and the plants may have grown submerged. *Balansa 2045* has leaves that are slightly undulate at the margins, c. 25 cm long, and the plants may have been growing submerged. RATAJ (1975) refers the first collection to *C. crispatula* Engl., and the two others to *C. tonkinensis* Gagnep. However, all specimens fall within *C. crispatula* Engl.

The type material of *C. longispatha* Merr. represents the form with long, broad, and bullate leaves.

The holotype of *C. bertelihansenii* Rataj has green, smooth leaves, that are 10–20 cm long and 0.4–0.8 cm broad. The markings on the spathe are sometimes a little shorter than the ones generally found in *C. crispatula* Engl. However, these short markings are mostly found in small specimens collected before anthesis. Before the opening of the spathe, the limb is greenish and the markings are also more red, features which change to greyish and purplish, respectively, at the time of anthesis. The paratype, *Beusekom & al. 4486*, has somewhat broader leaves that are brownish. The wide round kettle, mentioned by RATAJ as characteristic for the species, is a feature found in plants that have their growing-points at or above the surface of the soil and it has no taxonomic value whatsoever.

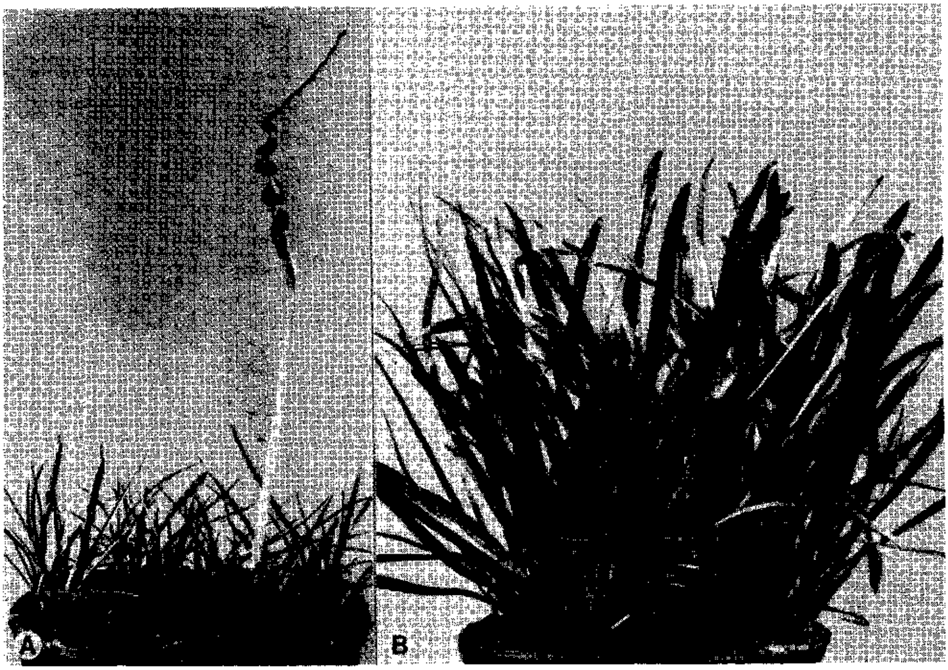


FIG. 11. *C. crispatula* (*NJ 77-38*) cultivated in Copenhagen. A. Earley November. B. Late December.

The drawing of the type of *C. yunnanensis* shows a plant that clearly belongs to *C. crispatula* Engl. The limb is a little shorter than usual (see also plate 39 in LI & AL. 1979).

The type of *C. kwangsiensis* H. Li, is the usually, aquatic form with broad, bullate leaves.

Notes: The foliage is extremely variable, but the species may be recognized by purple, mostly elongate markings on the long, spirally twisted limb of the spathe.

Live material of *C. crispatula* Engl. collected at Phu Khieo showed a more or less continuous variation from the green, narrow-leaved form to the brown, bullate, broad-leaved form. The smallest, measuring 5 by 0.3 cm, being smooth, and the largest, measuring 40 by 2 cm, being bullate. The spathes of the various forms are morphologically identical, there being only minor variation in the form and density of the purple markings of the limb. The markings vary from more or less irregular lines to short, line-like dots (Fig. 10). However, the transition is continuous.

It is important to note, that the leaves can vary in size during the flowering season, and herbarium material should therefore be studied with this in mind. This variability can be illustrated by the specimen *NJ 77-38* from Phu Khieo Wildlife Sanctuary, cultivated in Copenhagen. Fig. 11A shows the specimen flowering in the beginning of November, and Fig. 11B shows the specimen in late December, a few days after the 14th spathe had withered. Thus, the actual polymorphism, of a specimen in question, due to the developmental stage, must be known before the limits of the variation can be drawn.

The author would interprete *C. crispatula* as one species containing different ecological races, i.e. leaf-forms that are adapted to the water supply and the overall topography of the rivers in which they grow. In rivers with a more constant water-bearing, and not too steep a fall, the more aquatic races occur, viz. the long, narrow-leaved forms and the broad-leaved, bullate forms. In rivers with a seasonal variation in the water-bearing, the more amphibious races occur, characterized by having shorter, more or less smooth leaves. There is a continuous transition between the various forms. In cultivation, all forms can grow emerged as well as submerged, but usually each race grows better either submerged or emerged.

The ecological races of *C. crispatula* are widely used as aquarium plants. Their leaf-form is rather constant in cultivation and the races are more or less suited for submerged growth. One could find it desirable that the differences in leaf-forms could receive taxonomic recognition, e.g. be given status of varieties. However, until we have a much better understanding of the relations and e.g. the reproductive mechanisms working in these plants, the author cannot recommend such procedures. Furthermore, if such recognitions should prove possible the author is convinced that the hitherto proposed taxa represent only an arbitrary selection of variants.

Specimens studied:

India: *Bhaskar s.n.*, 29.9.1978, Jharbari (C); *Gamble 814* (= *403 A*), Dulha, 1876 (K); *Gamble 6665 A*, Buxa Reserve, 8.2.1879 (K); *Ludlow & Sherriff 12389*, Rydah, 26.1.1947 (BM); *Parry 1235*, Nongwalbibra, Jan. 8th (K).

Thailand: *Beusekom & al. 4486*, Nam Phrom, 21.12.1971 (BKF, C, K, L, P); *Beusekom & al. 4711*, Phrae, Huae Mae Chem, 17.2.1972 (BKF, C, K, L, P); *Bunchuai 12*, Song Khla, 7.2.1960 (BKF); *Chermisivivathana 1776*, Kanchanaburi, 1.3.1941 (BK); *Hasin 740*, Me Tuno, 20.2.1960 (BK); *Jacobsen 78-16*, Mueak Lek, 18.2.1977 (C); *Jacobsen 77-32, 34 to 39*, Phu Khieo (Nam Phrom), 19.2.1977 (C); *Jacobsen 77-40*, E of Nam Nao National Park, 19.2.1977 (C); *Kerr s.n.*, Ranong Kwang, Pre, 17.2.1921 (K); *Kerr 8788*, Chieng Kan, 1.3.1924 (BK, K, P); *Kerr 17126*, Kapong, 17.2.1919 (BK, K, P); *Kerr 17605*, Dan Chumpon, 12.12.1924 (BK, K); *Larsen 8816*, Sai Yok, 18.12.1961 (C); *Larsen 8592*, Sai Yok, 7.12.1961 (C); *Schulze 343*, Nongkai, 20.4.1970 (C); *Schulze 356*, Ban Nang Yon, 18.4.1970 (C); *Schulze s.n.*, Lom Sak, April 1974 (C); *Smitinand 341* (*5088*), Phukrading, 8.5.1951 (P); *Smitinand 3164*, Klong Pong Namrawn, 15.1.1956 (BKF); *Smitinand & Bunkaet 11441*, Mae Hong Son, 17.2.1971 (BKF, K, L); *Thorel 2741*, Mekong, Ubon (P); *Umpai 33*, Mueak Lek, 11.7.1954 (BK).

Vietnam: *Balansa 265* (*416*), Loch-Nam, 12.1.1886 (P); *Petelot 6679*, Lang Met-Thank Mai, 9.12.1940 (P); *Pierre s.n.*, Cochinchina (P).

Laos: *Micholitc s.n.*, Nain Hou, Nain Moua, 26.10.1905 (BM, SING).

China: *Beauvais s.n.*, 15.2.1897 (P); *Cavalerie 3410*, Lofou, 1909 (E, K, P); *J. Eng.(?) 240 and 329*, Na Frienk(?), Dec. 1909 (E); *Esquirol 2292* (?), Kwei-Tschou, 29.4.1913 (P); *Leville 812*, Kwei-Tschou, 1911 (E, K); *Wang 63492*, Ta Li Hsien, May 1935 (GH).

Cult: *Blass s.n.*, June 1957 (WAG); *Bogner 468* (M); *Bot. Gard. München* (M); *Kress s.n.*, 18.3.1968 (M); *NJ 2871, 2888, 2893, 2919, 2977, 2981, 2982, 2984, 3018, 3025* (all C); *Sadilek s.n.*, 5.6.1978 (C); *Shirley Aquatics* (K); *De Wit 12304*, 29.3.1969 (WAG); *ex Oxford, H 34/62* (K); *P 1969/306* (C).

Cryptocoryne retrospiralis (Roxburgh) Kunth **Figs. 1A–B, 12**

Enum. Pl. 3 p. 12 (1841). – *Ambrosina retrospirale* Roxb., [Hort. Beng. p. 65 (1814), nom. nud.] Fl. Ind. 3 p. 492 (1832). – Lectotype (selected here): Unpublished drawing for 'Plants of the Coast of Coromandel' at K, *No. 1292.*

Ambrosina uniloculare Roxb., [Hort. Beng. p. 103 (1814), nom. nud.] Fl. Ind. 3 p. 493 (1832). – *C. unilocularis* (Roxb.) Kunth, Enum. Pl. 3 p. 13 (1841). – *A. roxburghiana* Voigt, nom. illeg., Hort. Sub. Cal. p. 685 (1845). – *C. roxburghii* Schott, nom. illeg., Prod. Aroid. p. 18 (1860). – Type: *Law ex herb. Hook.*, Bombay (K), drawing at W. In the protologue it is stated that it is the same as *A. uniloculare* Roxb. – *C. roxburghii* Dalz., nom. illeg., Bomb. Fl. p. 257 (1861). – Lectotype (selected here): Unpublished drawing for 'Plants of the Coast of Coromandel' at K, *No. 245* (see taxonomical note under *A. retrospirale* Roxb.). A copy of the drawing was published by WIGHT (1844) t. 774.

C. dalzellii Schott, Bonpl. 5 p. 221 (1857). – *Lagenandra dalzellii* (Schott) Rataj, Rev. Gen. Cryptocoryne, Studie ČSAV č. 3 p. 101 (1975), nom. illeg. (non *L. dalzellii* Schott, Gen. Aroid. 'p.' 2 (1858)). – Lectotype (selected here): *Dalzell s.n.*, Bombay at K, only fruits.

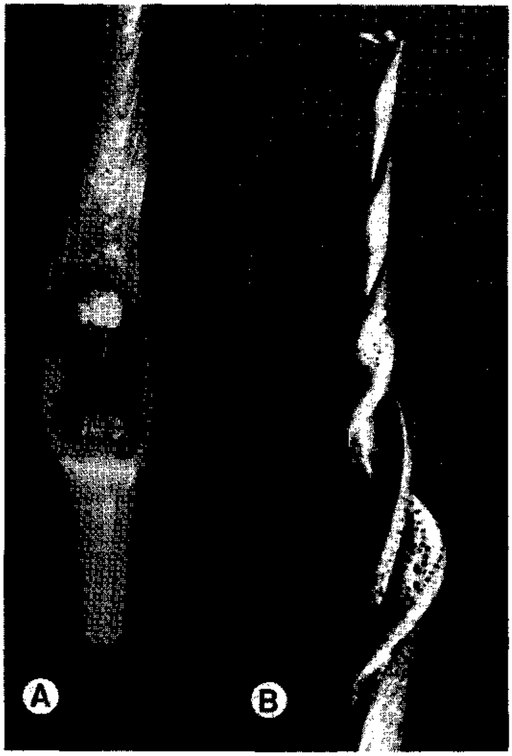


FIG. 12. *C. retrospiralis*. A. Kettle cut open. B. Limb of the spathe. *NJ 2979* (× c. 2).

Rhizome stout, 0.5–1.5 cm thick, sometimes irregularly thickened. Runners stout, c. 0.3 cm thick, 10–30 cm long. Root system strongly developed, also with upright roots that become thickened when they reach above the soil forming a carpet-like growth. *Leaves* linear to lanceolate, green, sometimes brown, 15–40 cm long and 0.3–1.0(–1.5) cm wide (Fig. 1 A–B); lamina smooth or undulate, main rib forming most of the blade, the latter mostly without prominent lateral veins. Margin sometimes denticulate. Monsoon leaves terete, 10–15 cm long. *Spathe* 10–30 cm long, tube 5–20 cm long, slightly twisted; limb of the spathe (1–)3–8 cm long, spirally twisted, occasionally short and more or less open (e.g. *Fischer 856*), yellowish to greenish, with rather large reddish spots (Figs. 12 B, JACOBSEN 1979). *Female* flowers 4–7, with more or less horizontal, oval to round stigmas. Olfactory bodies irregularly lobed in the upper part. *Male* flowers 100–140. Pollen ovoid to globular, 30–40 µm.

Chromosome number 2n = 72 (JACOBSEN 1977).

Distribution: India (Fig. 13).

Habitat: Sandy bottom in and along rivers. More or less emerged during flowering (Oct.–Feb.).

Nomenclatural notes: Besides *Ambrosina ciliata* Roxb. (1820), ROXBURGH had three more drawings prepared for future volumes of the Coromandel Plants, viz. *A.*

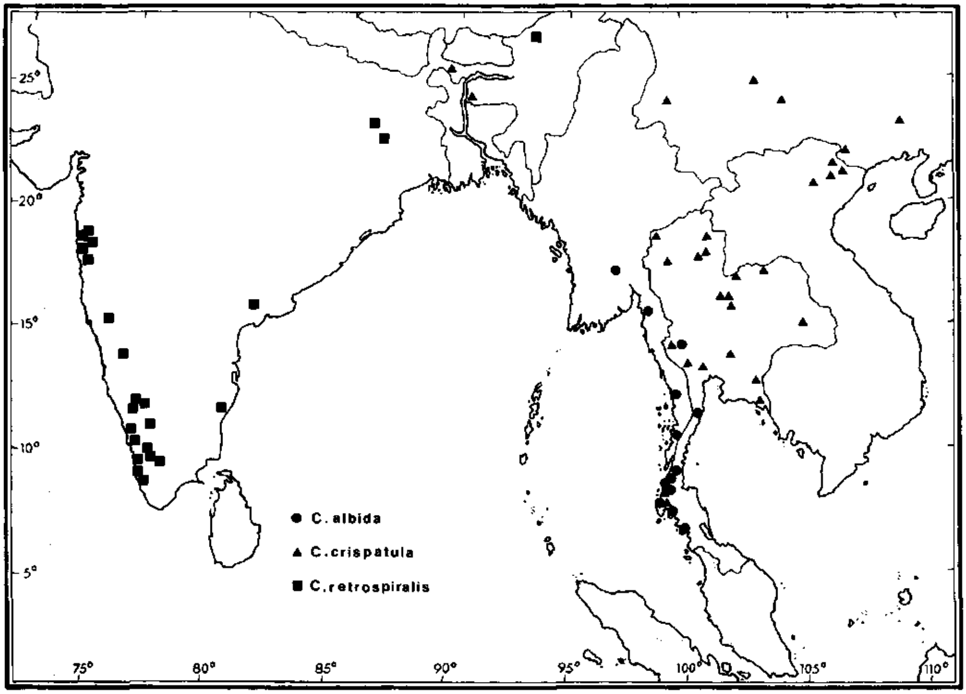


FIG. 13. Distribution of the *Cryptocoryne albida* group.

uniloculare Roxb., *No. 245*, *A. retrospirale* Roxb., *No. 1292*, and *A. spirale* (Retz.) Roxb., *No.1634*. These drawings are deposited at K, and are probably the only material left on which ROXBURGH based his descriptions. This means that drawing *No. 1292* should be chosen as the type. A copy of the drawing was published by WIGHT (1844) t. 772. RATAJ's (1975) choise of lectotype (actually neotype): Concan, Mysore, Herb. Hook. & Thomson, CAL, isotypes at GH and K (here cited as *Thomson s.n.*), therefore, cannot be accepted. When transferring the species to the genus *Cryptocoryne*, Kunth wrote '*Cryptocoryne ? retrospiralis* Roxb.', indicating some doubt as to the correctness of so doing.

In the protologue of *Ambrosina uniloculare* it says 'Spathe ... above the spadix twisted like a screw to a very fine, straight point, ... colour of the outside purplish, that of the inside much deeper, and beautifully spotted with darker spots'. The non denticulate limb shows that it cannot be related to *C. spiralis* (Retz.) Wydl. The unilocular fruit has not been recorded in *Cryptocoryne* since ROXBURGH's drawing and description. It is no doubt due to an incorrect observation by the artist or by ROXBURGH himself. It is difficult to interprete the screwlike limb of the spathe, which apparently begins just above the kettle, due to the rather sketchy drawing. As for the colour of the limb, it seems inconsistent that the outside can be purplish and the inside more purple, with even darker spots. If it is true that the limb is 'beautifully spotted with darker spots', the background must be of a lighter colour or the spots will not show. As for the outside of the spathe, it may very well be purplish but that is not in accordance with the drawing which shows that the outside is of a whitish colour with a purple line where the tube-edges are fused/slit. The author would interprete this inconsistency as a slip of the pen.

The possibility that a plant like *A. uniloculare* exists (save for the unilocular fruit) cannot be ruled out. The author is, however, of the opinion that ROXBURGH's description and drawing is based on a plant that represents *C. retrospiralis* (Roxb.) Kunth.

There has been some uncertainty as to the identity of *C. dalzellii* due to the insufficient type material, which consists of more than 20 separate, mature fruits and one separate leaf, the latter now lost. The fruits are no doubt of a *Cryptocoryne*. As there is no proof of the leaf ever having been attached to the fruits, the author considers it most likely that there has been a misplacement during mounting of the sheet. The fruits are identical to those of *Thomson s.n.*, Carnatic, Madras Cole 21 (BM, CAL, FI, K, L, M, OXF, P, U), and *Lawson s.n.*, Calicut (K), the latter having the fruits attached to the rhizome which also bears the terete, monsoon-leaves so characteristic for *C. retrospiralis* (the above mentioned THOMSON collection with fruits has erroneously been determined as *C. consobrina* Schott and pictured as such by FISCHER (1936)). No species of *Cryptocoryne*, known from India, has leaves like the one that was mounted on the sheet together with the fruits. The author, therefore, finds it most probable that the leaf was something else.

Notes: *C. retrospiralis* is the only species from the western part of India with a long tube of the spathe and a spirally twisted limb. It is characterized by the large, more or less circular, red spots on the limb (Fig. 12).

Only two live 'entry numbers' (probably originating from the same collection) have been available. However, herbarium material is well represented and several well preserved specimens exist at e.g. US, and K, giving a quite distinct picture of the species.

Specimens studied:

India: *Barber 2527*, Beltangadi, S. Canara (CAL); *Barnes 633*, *634*, *636*, Ottakal River, Tenmalai, 24.12.1938 (K); *Barnes 973*, Karapara River, 14.12.1934 (K); *Barnes 982*, Cauvery Mettur, 12.1.1935 (K); *Biswas 1642*, N. Bengal (GH); *Bogner 517*, Nethravathi River (M); *Bole s.n.*, Mahabaleshwar, 13.4.1970 (C, WAG); *Bole 228*, Lingmala Falls, 13.12.1950 (NBG); *Dalzell s.n.*, Bombay (K); *Duninici (?)*, 1816 (GH); *Erlanson 5271*, Vayittary, Wynaard, 25.12.1933 (W); *Fischer 827*, Bhavani, 23.1.1886 (K); *Fischer 856*, Coimbatore (CAL); *Fischer 1765*, Bhacan, 12.2.1910 (K); *Fischer 4023*, Nedungayan, 20.11.1916 (K); *Gamble 9090*, Saranda, Dec. 1880 (CAL, K); *Gamble 10130*, Kechki (?), Jan. 1882 (K); *Gamble 21768*, Luddengy (?), Jan. 1890 (CAL, K); *Gammie 139*, Diking River, Assam (CAL); *Gibson 151*, Mira (K); *Haines '593'*, Karo River, 15.1.1903 (CAL, K); *Haines '593'*, West Duars, Dec. 1895 (E, K); *Kurz 860*, Jonkegeghat River, Aug. 1893 (K); *Law s.n.*, Concan (CAL); *Law 34/36*, Pen River, Nov. 1847 (K); *Lawson s.n.*, Oct. 1888, Calicut (K); *Lawson s.n.*, Dec. 1893, Travancore (CAL); *Perrotet 411*, Nil-Gherries, 1814 (G); *Perrotet 642*, Kanikal (GH, M, P); *Perrotet s.n.*, Poona, 1837 (G); *Perrotet s.n.*, Poona, 1840 (P); *Perrotet s.n.*, Pondichery, 1855 (FI, P); *Ramamoorthy & Gandhi, HFP 2584*, Hemavati, 16.2.1972 (E, K, US); *Renade s.n.* Poona, Nov. 1892 (K); *Ritchie 1485*, Kala Nuddi, 1852 (E, GH); *Rungachari s.n.*, Neriya, Nov. 1907 (K); *Saldanha, HFP 1235*, Vanagur, 10.12.1970 (E, US); *Saldanha 12079*, Kempuhole, 20.12.1969 (US); *Saldanha 15433*, *15434*, Kempuhole, 28.10.1969 (E, US); *Saldanha & Hooper, HFP 2530*, Uppingadi, 25.11.1971 (US); *Saldanha & Ramamoorthy, HFP 1132*, Vanagur, 3.12.1970 (E, US); *Talbot 23*, Arbail (K); *Talbot 1583*, Nugi, N. Kanara (CAL); *Thomson s.n.*, Carnatic, Madras Cole 5, and 21 (BM, CAL, FI, K, L, M, P, U); *Wood*, Chota Nagpur, 1877 (K); *Vicary* (?), Maldat (K); Bombay – *Burmir* (?), (US).

Cult: *Jacobsen 2971* (C).

ACKNOWLEDGEMENTS

During my visit to Thailand in 1977, I received much help from the Royal Forest Dept., from Dr. T. Smitinand and from Dr. T. Santisuk who accompanied me on field trips, which is greatly acknowledged. Prof. J. Schulze and H. Windeløv have kindly supplied me with material. Dr. B. Hansen and Dr. R. von Bothmer have given valuable comments on the manuscript, and Dr. T. Koyama has kindly translated the Chinese texts. The curators of B. BK, BKF, BM, C, CAL, E, FI, G, GH, K, L, M, NBG, P, U, US, and Z have kindly supplied material for my studies.

REFERENCES

ENGLER, A. 1877. Vergleichende Untersuchungen über die morphologischen Verhältnisse der Araceae. II. Theil. Über Blattstellung und Sprossverhältnisse der Araceae. – Nov. Acta Acad. Caes. Leop.-Carol. German. Nat. Cur. **39**(4): 157–232, t. 8–13.

ENGLER, A. 1920. Das Pflanzenreich, **IV. 23.** F. Araceae-Aroideae. Leipzig.

FISCHER, C. E. C. 1936. Cryptocoryne consobrina Schott. – Hook. Ic. Pl., Tab. 3305.

JACOBSEN, N. 1976. Notes on Cryptocoryne of Sri Lanka (Ceylon). – Bot. Notiser **128**: 179–190.

JACOBSEN, N. 1977. Chromosome numbers and taxonomy in Cryptocoryne (Araceae). Bot. Notiser **130**: 71–87.

JACOBSEN, N. 1979. Cryptocoryner. Clausen Bøger, Aschehoug. Copenhagen.

LI, H. & AL. 1979: in Flora Republicae Popularis Sinicae. Delectis Florae Reipublicae Popularis Sinicae Agendae Academiae Sinicae Edita. Tomus **13** (2).

MCCANN, C. 1944. 'Light-Windows' in certain flowers. Journ. Bombay Nat. Hist. Soc. **44**: 182–185.

RATAJ, K. 1975. Revision of the Genus Cryptocoryne Fischer. Studie ČSAV, č. **3.** Praha.

WIGHT, R. 1844. Icones Plantarum Indiae Orientalis **III**(1): 1–7. tab. 737–815.

WIT, H. C. D. DE, 1970. A key to the species of Cryptocoryne Fisch. ex Wydl. (Araceae). Misc. Pap. Landb.hogesch. Wageningen **6**: 257–280.

WIT, H. C. D. DE, 1971. Aquarienpflanzen. Stuttgart.

NOTES ON CEYLONESE PLANTS I

A. J. G. H. KOSTERMANS

Dept. of Botany, University of Peradeniya, Sri Lanka

SUMMARY

Descriptions of new species are presented in: DICHAPETALACEAE: *Dichapetalum zeylanicum;* DIPTEROCARPACEAE: *Stemonoporus angustisepalus, St. bullatus, St. gracilis, St. kanneliyensis, St. latisepalus;* FLACOURTIACEAE: *Homalium dewitii;* LAURACEAE: *Cinnamomum sinharajaense;* MIMOSACEAE: *Entada zeylanica;* MYRTACEAE: *Eugenia sripadaense;* OLACACEAE: *Strombosia nana.* One new name: MYRTACEAE: *Eugenia lankaensis.* Discussion of: DIPTEROCARPACEAE: *Stemonoporus canaliculatus, St. lancifolius, St. revolutus.*

INTRODUCTION

A prolonged stay in Sri Lanka, as a visiting professor of the University of Peradeniya, enabled me to study more intensively the rich flora, than before as a collaborator of the Smithsonian Institution – University of Sri Lanka – Dept. of Agriculture, Sri Lanka – Flora of Ceylon Project.

As had been anticipated, intensive field exploration yielded many novelties and enabled me to solve many problems (cf. HOOKER in TRIMEN, Handb. Fl. Ceylon 4: III. 1898).

Only very few families of the revised edition of the Flora have been published after 11 years of the Project duration, but many manuscripts were available for examination.

Some of the revisions are far from complete and sometimes not even an improvement to TRIMEN's classical Flora. This is usually attributable to hasty work and not enough field work.

The difficulties of producing a revised flora edition have been underestimated. LINNAEUS started his work with the Flora zeylanica, based on the HERMANN collections in the British Museum, the French Academy of Sciences (BURMAN's Thesaurus zeylanicus) and the collections at Leiden and Groningen. His specific concepts have an important bearing on the Flora of Malesia and other parts of the world. Examination of the above mentioned material is hence a must.

I have the intention to try to collect the innumerable species, of which only the few original ones, collected more than a century ago, are known and of which some may have been become extinct.

When enough material will be available, I hope to be able to present complete revisions of the more important tree species.

I am in the lucky position that Dr. and Mrs. Dr. N. GUNATILLEKE are carrying out an intensive ecological survey of the wet, lowland forest in S.W. Ceylon and with their collaboration many new tree species could be marked for intensive collecting.

DICHAPETALACEAE

Dichapetalum zeylanicum Kosterm., *spec. nov.*

Dichapetalum helferianum Auct. (non Pierre) Alston in Trimen, Handb. Fl. Ceylon 6, Suppl. 47. 1931.

Moacurra geloniodes Roxb., var. *b* Thwaites, Enum. Pl. Zeyl. 79. 1859; Trimen, Handb. Fl. Ceylon 1: 254. 1895 (in adnot.). – Typus: *C.P. 1231* (PDA).

Frutex parvis, foliis alternantibus membranaceis oblongis sensim acuminatis basi breve cuneatis, utrinque dense reticulatis opacis, subtus sparse pilosis, petiolis brevis adpresse strigosis, stipulis parvis pilosis persistentibus, inflorescentiis plerumque axillaribus pilosis floribus paucis, adpresse pilosis in racemibus parvis vel masculinis in racemibus glomerulatis, ramulis brevibus impositis, pedicellis brevissimis articulatis, flos femineis non vidi, masculinis sepalis crassiusculis dense adpresse pilosis et (interioribus) lanuginosis, petalis glabris crassiusculis sepalibus vix brevioribus, parte apicalibus incisis, staminibus glabris, ovario dense griseo lanuginosis, stigma deest, fructus griseo pilosis, didymis.

Typus: *Waas 510* (G).

Shrub or treelet, 1.5–2 m high. Apical part of branchlets densely adpressed strigose. Leaves membranaceous, dull, oblong, 2 × 8 – 5 × 19 cm, rarely elliptic, 6.5 × 15 cm, distinctly, gradually acuminate, base shortly cuneate, above glabrous (except on the midrib), rather densely, obscurely reticulate, midrib thin, hardly prominent (at base somewhat impressed); below rather densely pubescent, hairs thin, pubescence denser and more adpressed and strigose on the prominent, thin midrib; lateral nerves erect-patent, strongly arcuate, prominent, 5–7 pairs. Petiole thickish, 3–4 mm long, densely sub-adpressed strigose, narrowly channeled above. Stipules triangular, densely adpressed pilose, acute, 1.5 mm long, persistent. Inflorescences axillary, pubescent, racemiform, either short and few-flowered, or on up to 6 cm long (male ones) axillary branches, bearing remotely placed, clusters of short racemes. Pedicel 1–2 mm long, articulate ca 0.75 mm below the sepals. Hermaphrodite flower not seen. Male flower with 5 imbricate leathery, ovate, obtuse, 2 mm long sepals, the inner ones more densely grey woolly pilose than the adpressed pilose outer ones. Petals glabrous, fleshy, ovate-elliptic, 1.5 mm long, apically divided into two, fingerlike, ca 0.5 mm long parts. Stamens 1 mm long, with broad, 0.5 mm long glabrous filaments and a large anther, opening inward. Ovary reduced, densely grey woolly, no stigma.

Fruit didymous, depressed globose, strongly compressed laterally, densely grey-green pubescent, up to 1.5 cm wide, sometimes only one part developes, which may be up to 2 cm long, pedicel 1–2 mm long, longitudinally ribbed, articulate on 2 mm long stalk, the upper part disk-like flattened and widened.

Distribution: Wet, tropical rain forest in S.W. Ceylon, endemic.

Notes: ALSTON stated that the available specimen (not in Peradeniya, *C.P. 1231*) was identified at Kew, but that it did not fit PIERRE's description of *Dichapetalum helferianum.*

ALSTON keyed out the two species, occurring in Ceylon by the coriaceous leaves of *D. geloniodes* versus the membranaceous ones of *D. helferianum.* This is a mistake, the leaves of *D. geloniodes* are only slightly thicker than those of *D. zeylanicum. D. zeylanicum* can be easily separated from *D. geloniodes* by its thinner, dull leaves of which the base is shortly cuneate and the pilosity of the lower leaf surface.

The leaves of *D. geloniodes* are thicker, very glossy with a very distinct reticulation, the leaves taper from the middle to the base, being sometimes subobovate and are always glabrous on the lower surface. Whether its fruit are smaller than those of *D. zeylanicum* as contended by ALSTON, cannot be confirmed with the scanty material available.

The specimen *C.P. 1245* consists of a mixture of *D. geloniodes* and *D. zeylanicum.*

Sri Lanka (Ceylon): Ambagamuwa, fr. 1855, *C.P. 1245*, p.p. (PDA); fr. 1855, *C.P. 1231* (PDA), type of var. *b* Thwaites; Ratnapura, young fr., *C.P. 1231* (PDA); Galle, *Gardner s.n.*, fl. Dec. 1853, *C.P. 1231* (PDA); Central Province, young fr., *Thwaites s.n.* = *C.P. 1231* (PDA); Ratnapura Distr., Kadamuduna, Bulutota Pass, Apr., fl., *Waas 510* (G, holo-typus), same plant, same date *Sumithraarachchi & Waas 313* (PDA); Kurulugala forest, Bulutota Pass, 900 m, Nov., fr., *Huber 564* (PDA); Handapan Ella, 400 m, July, young fr., *Waas 1404* (PDA); Mannikawatte Forest, 400 m, June, young fr., *Waas 1767 A* (PDA); Hiniduma, Mt. Kaluvitiangama, 800 m, Oct., fr., *Bernardi 15493* (G, PDA); Matara Distr., Diyada-Kale, 150 m, July, fr., *Waas 1371* (PDA); Sinharaja forest, Weddagale entrance, 200 m, Febr., fl., *Kostermans 27305* (L).

DIPTEROCARPACEAE

Stemonoporus Thw.

ASHTON's treatment (in Revised Handb. Fl. Ceylon 2(2), 1977) is not very satisfactory. I intend to present a complete revision in the near future, when all species, as far as possible, will have been recollected and studied in the field.

The distinctive feature of *Stemonoporus* are the anthers, so well described by THWAITES and TRIMEN, but wrongly so by ASHTON, who thought they were end-porus.

The anthers (which are narrowly, elongate triangular and not linear) have a large and a small valve closely adpressed to each other. The part of the large valve above the small valve has its margins incurved (except in *St. revolutus*), although not completely, the margins touch only in the middle part, forming a kind of tube, open at one side, the top looking like an oblique porus from above.

The flowers are not always nodding and not more nodding than those of *Doona* species. The style is, at least in one species visible above the anthers. There are no appendages to the anthers. Germination is epigeal, not hypogeal, the fleshy, dark red cotyledons spread open and become horizontal, they are incised like the fingers of a hand.

They do not flower all the year round, but every species has its own well defined flowering period, usually twice a year after the rains start.

The flowers are visited by many insects: bees, beetles, butterflies, etc., I have never seen them biting the anther tips to get at the pollen.

Stemonoporus angustisepalus Kosterm., *spec. nov.*

Stemonoporus cordifolius Auct. (non Alston) Ashton in Dassanayake (editor), Revised Handb. Fl. Ceylon 2(2): 190. 1977 (quoad *Lewis s.n.*, in adnot.).

Stemonoporus affinis Auct. (non Thw.) cf. Ashton l.c.

Arbor mediocris, ramulis et inflorescentiis sparse minutissime puberulis, foliis glabris rigide coriaceis ellipticis breve obtuse acuminatis basi rotundatis, supra bullatis, nervis majoribus impressis, subtus nervo mediano et costis lateralibus prominentibus, nerviis secundaris sat laxis scalariformibus, petiolis bene evolutis, inflorescentiis paniculatis paucifloris, floribus pedicellatis, sepalibus anguste lanceolatis acutis sparse minutissime puberulis, petalibus oblongis glabris, ovario glabro, staminibus 5, stylo sublongioribus, fructus ignotus.

Typus: *Waas 1608* (PDA).

Tree up to 15 m high with up to 8 m long bole, up to 25 cm diam. Bark smooth, grey, with longitudinal rows of lenticels. Apex of branchlets and end bud with fugaceous, extremely short rather sparse indumentum. Leaves rigidly coriaceous, glabrous, elliptic, 3 × 5 – 8 × 15 (–17) cm, abruptly, bluntly acuminate, acumen slender, 4–10 mm long, base rounded; above bullate to subbullate, midrib, lateral and usually secondary nerves impressed, below paler, midrib strongly prominent, the 8–11 pairs of erect-patent lateral nerves prominent, near the margin arcuate and often (at one side) arcuately connected, forming an intramarginal nerve; secondary nerves prominent, scalariform, perpendicular to the lateral ribs, reticulation of similar pattern, obscure. Petiole slender or thickish, 2–4.5 cm long.

Inflorescences axillary and extra-axillary, paniculate, few-flowered, laxly, extremely minutely puberulous. Pedicels thickish, 2–3 mm long. Sepals narrowly lanceolate, acute, 4 mm long, at base 1.5 mm wide, in sicco rolled up and looking very narrow, outside sparsely puberulous. Petals yellow, oblong, glabrous, 4 mm long. Stamens 5, 2.5 mm long, obscuring the slightly shorter style. Fruit thin skinned, globose, 1.5 cm diam., rusty, roughish because of tiny flat scales. Cotyledons not folded.

Distribution: Ratnapura and Balangoda.

Notes: The leaves resemble those of *St. bullatus*. The number of stamens 5, places this species in subgenus *Monoporandra*. It has an impressed midrib on the upper leaf surface, but can easily be distinguished from *St. canaliculatus*, and *St. bullatus* by the paniculate inflorescence, apart from the number of stamens. Two collections (*Lewis s.n.* and *Waas 1721*) have much smaller leaves (3 × 5–4.5 × 8) than the other two collections (5.5 × 10 – 7 × 17), but otherwise I cannot find any differences.

Balangoda Distr., Medde Kande, Mar., fl., *Lewis s.n.* (PDA); Ratnapura Distr., Walaboda forest, 1800 m, June, fl., *Waas 1721* (PDA); above Balangoda, Tumbegoda road, Tamannawatte to Masenna, Adams Peak Jungle, alt. 600 m, June, fr., *Kostermans 24460* (G, L, PDA, US), distributed as *Aporosa*.

Stemonoporus bullatus Kosterm., *spec. nov.* **Fig. 1**

Stemonoporus canaliculatus Auct. (non Thw.) Ashton in Dassanayake (Editor), Revised Handb. Fl. Ceylon 2(2): 189.1977 (quoad specim. *Ashton 2046* et *Meijer 545*).

Arbor parva, ramulis petiolis juvenilibus inflorescentiis dense minutissime puberulis, foliis coriaceis ellipticis magnis abrupte tenuiter acuminatis basi obtusis, supra bullatis, nervo mediano costisque et nervis secundariis impressis, subtus pallidioribus nervo mediano costisque et nervis secundariis valde prominentibus, petiolis longis, glomerulis floribus paucifloris, pedicellis crassis brevibus, sepalis oblongo-lanceolatis, extus puberulis, petalis oblongis glabris, antheris 15, stylo longioribus, anguste lanceolatis acutis. Fructus non vidi.

Typus: *Balasubramaniam 2147* (G).

Tree, up to 3.5 m tall, up to 3 cm diam. Apical part of branchlets, petioles of young leaves, terminal bud with fugaceous minute puberulous dense indumentum; the same on inflorescences and outside of calyx, but permanent. Leaves coriaceous, elliptic to subovate-elliptic, 7 × 20–12 × 35 cm, with abrupt slender, obtuse, 1–2 cm long acumen, base rounded, above glossy, bullate, midrib strongly impressed, narrow, lateral ribs and secondary nerves impressed; below paler, glossy, midrib strongly prominent, the 16–18 pairs of erect-patent lateral ribs prominent, at margin arcuately connected into a submarginal vein; accessory lateral nerves horizontal, much shorter, straight; secondary nerves scalariformous, perpendicular to the lateral veins, starting where the accesory, horizontal veins stop; other reticulation of the same pattern, obscure; margin slightly incurved. Petioles 2–5 cm long.

Inflorescences glomerulate, axillary and extra-axillary, with one or few flowers; pedicel thick, 1–2 mm long, obconical, at base with tiny bracts broader than long, lightred (fresh). Sepals lanceolate-oblong, acute, 5 mm long, light red. Petals oblong, obtuse, ca 8 mm long, 4 mm diam., glabrous. Anthers 15, narrowly lanceolate, up to 5 mm long, tubular orifice 1–2 mm long, obscuring the style. Flowers erect and facing

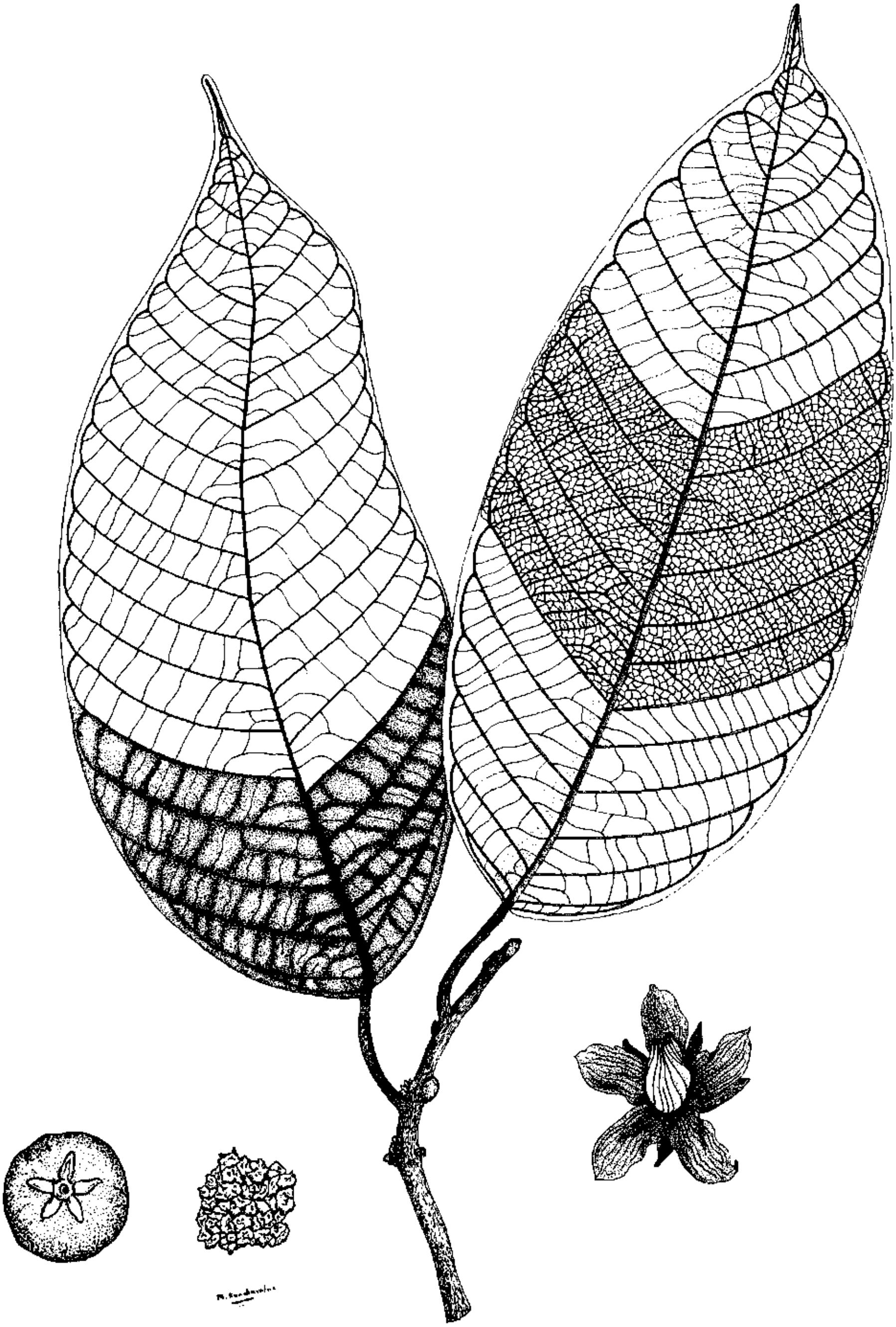


FIG. 1. *Stemonoporus bullatus* Kosterm. – Fruit from below, texture of fruit and flower. – After *Balasubramaniam 2147* (G).

sideways. Fruit globose, up to 3.5 cm diam., slightly depressed, grey, roughish, thin-skinned. The persistent sepals not hardened, flat, adpressed to the base of the fruit.

Distribution: So far only known from the type locality, the Kanneliya forest near Hiniduma wet, low evergreen forest of low altitude.

Notes: By ASHTON confused with *St. canaliculatus*. It has much larger leaves, with considerably more lateral ribs (16–18 pairs versus at most 11 pairs), a strongly bullate upper surface and narrower sepals. The pale grey colour of the mature fruit is unusual in *Stemonoporus* and so is the light red colour of pedicel and sepals. The cotyledons are pale green, strongly folded. The tree is often flopped over as the stems are too thin, quite different from the much thicker, erect boles of *St. canaliculatus*.

S.W. Ceylon, Galle Distr., Hiniduma, Kanneliya forest, alt. ca 150 m, Jan., fl., *Balasubramaniam 2147* (G, L); old logging track opposite bungalow, ster., *Balasubramaniam s.n.* (G,L); ibid., sapling of 1 m, *Meijer 545* (PDA, US); steep hillside, ster., *Ashton 2046* (PDA); old logging road near Bungalow in steep banked, shady rocky small stream, May, fl., *Kostermans 27642* (AARH, G, L); along main forest road, near entrance gate, May, fl., fr., *Kostermans 27654* (AARH, G, L).

Stemonoporus canaliculatus Thw.

Thwaites, Enum. Pl. Zeyl. 38. 1858 and 403. 1864 (as a syn. of *Vateria canaliculata*); Trimen, Handb. Fl. Ceyl. 1: 135. 1893; Ashton in Dassanayake (Editor), Revised Handb. Fl. Ceylon 2(2): 189. 1977 (exclud. specim. *Ashton 2046, 2073* and *Meijer 545*). – Typus: *C.P. 3413* (quoad: *Nellowe and Hinidum Korle* (PDA).

Vateria canaliculata (Thw.) Thwaites, Enum., l.c., Add. 403. 1864; Dyer in Hook. f., Fl. Br. Ind. 1: 315. 1872; Trimen, l.c., Ashton, l.c.

Vatica canaliculata A.DC., Prodr. 16(2): 621. 1868.

The species is here restricted to the original material, enumerated by THWAITES and TRIMEN. Recently it has been rediscovered in the Sinharaja Forest (Weddagalle entrance) at an altitude of 150 m, by Drs. GUNATILLEKE, but all specimens are sterile. *Ashton 2073* has the typical venation of *St. kanneliyensis*, but the midrib is not impressed on the upper leaf surface. I have been unable to place it.

Stemonoporus gracilis Kosterm., *spec. nov.*

Stemonoporus lancifolius Auct. (non Alston) Ashton in Dassanayake (editor), Revised Handb. Fl. Ceylon 1(2): 191. 1977 (p.p., quoad *Ashton 2003* & *Balakrishnan 343*).

Arbor parvis in omnibus partibus glabris, foliis chartaceis vel subcoriaceis subovato-oblongis caudato-acuminatis basi obtusis, supra nitidis laevibus nervo mediano sulcatis, subtus pallidioribus, nitidis nervo mediano prominentibus costis tenuibus prominulis sat patentibus marginem versus arcuatis, nervis caeteribus obscuris laxe reticulatis, petiolis *tenuibus longis supra sulcatis, floribus solitariis, pedunculis tenuibus non ramificatis impositis, pedicellis gracilibus longis, gemmis acutis, sepalis anguste oblongis acutis sat longis, petalis ovato-oblongis acutis, flavis, staminibus 12–13, ovario glabro, stylo longo, stigmate punctatis, fructus subglobosis, sub-acutis, sepalis persistentibus reflexis vix induratis, longis.*

Typus: *Ashton 2003* (G).

Tree, up to 4 m tall, glabrous in all its parts, stem up to 5 cm diam. Bark pale, smooth. Branches pendant. Branchlets slender, glabrous, terminal bud in rest-stage short, globose. Leaves chartaceous to sub-coriaceous, subovate-oblong, 2.5 × 7 – 5 × 15 cm, caudate-acuminate (acumen very slender, 1–3 cm long, obtuse), base rounded; above glossy, smooth, midrib deeply channeled, sometimes lateral nerves faintly visible, below paler, glossy, midrib strongly prominent, lateral nerves thin, prominulous, rather patent, towards the margin arcuate, 10–12 pairs, in between much shorter lateral veins, other veins forming a lax, obscure reticulation. Petiole thin, 1–3 cm long, slitlike channeled above.

Flowers solitary on thin, up to 2 cm long unbranched axillary peduncle, often microscopically adpressed pseudo-scaly. Pedicel thin, up to 8 mm long. Sepals narrowly oblong, rather fleshy, up to 12 mm long; petals yellow, ovate-oblong, acutish, slightly longer. Stamens 12–13 (two flowers dissected), narrowly triangular, acute, 5–6 mm long, ca 1 mm wide at the base, 1–1.5 mm of the apical part a laterally slightly open tube. Ovary glabrous, sub-globose with long, slender style, slightly shorter than the stamens and inconspicuous stigma.

Fruit sub-globose, acutish, 15 mm diam., outside divided into minute, polygonal fields. The persistent sepals not hardened, pointing downward.

Distribution: Only known from an area along a tributary of the Kelani R., ca 0.5 miles S. of Kitulgalle.

Note: The shape (not the size), acumen, and reticulation resembles strongly that of *S. elegans*, but our species differs by the larger leaves, the larger number of stamens, the much broader sepals and the larger fruit.

It is certainly not related to *S. lancifolius*, with which it has been confused by ASHTON and from which, in sterile condition, it can be readily distinguished by the pinnately veined leaves (triplinerved in *S. lancifolius*) and the channeled midrib on the upper surface (midrib prominulous in *S. lancifolius*). The number of stamens, however, brings it nearer to *S. lancifolius*, than to *S. elegans*.

Kegalle Distr., shore and forest along tributary of Kelani R., 0.5 mile S. of Kitulgalle, ca. 80°24′ E 6°59′ N, alt. 70 m, wet, evergreen forest, March, fl., fr., *Bremer 940* (PDA, S, US); ibid., Aug., fl., *Balakrishnan 343* (PDA); ibid., March, fl., *Ashton 2003* (G, PDA, US); ibid., March, fl., fr., *Kostermans s.n.* (L).

Stemonoporus kanneliyensis Kosterm., *spec. nov.* **Fig. 2,3**

Stemonoporus reticulatus Auct. (non Thw.) Ashton in Dassanayake (editor), Revised Handb. Fl. Ceylon 2(2): 192. 1977 (except *C.P. 3414*).

Arbor, ramulis glabris vel dense perobscure minutissime puberulis, foliis glabris rigide coriaceis ellipticis vel subovato-ellipticis, abrupte anguste acuminatis, basi rotundatis, supra laevibus nervo mediano tenuibus impressis, subtus nitidis pallidioribus nervo mediano prominentibus, costis prominentibus sat patentibus marginem versus arcuatis, accessoriis horizontalibus intercalatis, nerviis secundariis prominulis subscalariformibus, reticulatio laxis, petiolis longis, floribus axillaribus vel extra-axillaribus solitariis vel paniculatis paucifloribus, sepalis oblongis acutis brevissime puberulis, petalis subovatis, antheris 15, ovario conico, argenteo sericeis, sulcatis, stylo staminibus longioribus, stigmate punctatis, fructus subglobosis, sepalibus incrassatis conspicuis reflexis.

Typus: *Kostermans 24995* (L).

Tree, up to 15 m tall, flowering when only 4 m tall, 10–35 cm diam., bole up to 8 m long. Bark smooth, hard, grey, very superficially wavily, narrowly fissured, 1 mm thick. Live bark 4 mm, light brown. Wood white, rather hard. Terminal bud small, when developing forming a long bare shoot with apical leaves, both obscurely densely very minutely puberulous, soon glabrous. Leaves spirally arranged, glabrous, rigidly coriaceous, elliptic to subovate-elliptic, 5 × 11 – 8 × 15 – 12 × 23 cm, abruptly acuminate, acumen very slender, sharp, 1–2.5 cm long, base rounded or nearly so; above in adult leaves smooth, the midrib shallowly impressed; below glossy, paler, midrib strongly prominent, the 10–18 pairs of rather patent lateral ribs slender, prominent, near the margin arcuate; in between, especially in the lower half of the leaf conspicuous, almost horizontal, shorter intermediate ones; secondary nerves thin, prominulous towards the margins subscalariform, obliquely to the lateral ribs, reticulation lax. Petioles geniculate, 3–7 cm long. Spikes 3–7 cm or solitary flowers extra axillary, often on old branches, few-flowered, densely, very minutely puberulous. Pedicels thick, 3–4 mm long. Sepals 5 (sometimes more), lanceolate, acute, stiff, patent, 1 cm long, yellowish green inside, brown outside (fresh). Petals ovate, acute, patent, fleshy, yellow, somewhat longer than the sepals. Anthers erect, pressed against the silvery puberulous, pyramidal, ribbed ovary, shorter than the style, lanceolate, acute, 10 outer ones larger than the 5 inner ones, which are opposite 5 outer ones; filaments very short.

Fruit conical, acute, thick skinned, roughish, rusty brown, up to $4^1/_2$ cm long an 4 cm diam. at the base, distinctly broadly ribbed, the hardened, 5–10 mm long sepals persistent, pointing downward. The germinating fruit splits into 3 valves.

The seedling with 4 normal leaves had the cots still included in the fruit, which is attached to a long hypocotyl.

Distribution: Kanneliya forest near Hiniduma, Galle Distr., wet, evergreen forest.

Ecology: mostly along river but also on steep hill sides.

FIG. 2. Seedling of *Stemonoporus kanneliyensis* Kosterm.

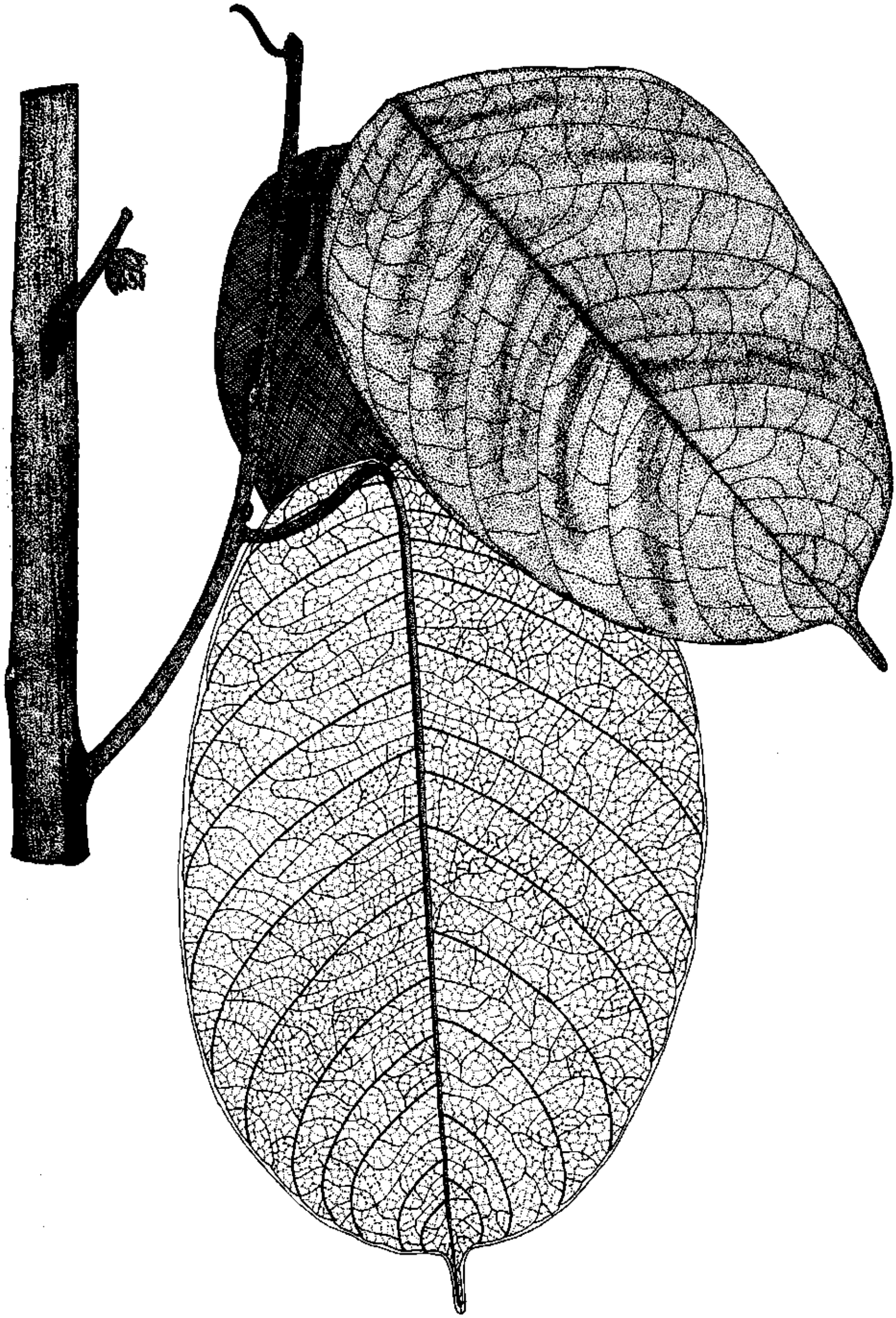


FIG. 3. *Stemonoporus kanneliyensis* Kosterm. – *Kostermans 24995* (PDA).

Notes: By Ashton confused with *St. reticulatus* which, however, is a tall tree according to Thwaites with smaller leaves with an entirely different nervation, without the conspicuous intracostal veins, with smaller flowers. The conical, large, acute fruit is entirely different from the globose one of *S. canaliculatus*. Our species has large downward pointing sepals under the fruit; these are in *St. reticulatus* very small, hardly thickened. Characteristic is also the slender, long acumen. *Ashton 2073*, a sterile, epicormic specimen, enumerated by him under *St. canaliculatus*, has the characteristic venation and the midrib is not impressed (at least not in the greater part of the leaf). I am so far unable to place it.

Galle Distr.: Hiniduma area, Kanneliya forest, alt. 150 m, wet, evergreen forest, June, fl., *Kostermans 24995* (K, L, PDA, US); same tree, *Cramer 3071* (PDA, US); same tree (photograph), near bungalow on river, July, fl., *Jayasuriya & Kostermans 2352* (PDA, US); along main forest road, sapling, *Kostermans 27653* (AARH, G, L); ibid., May, fl., *Kostermans 27655, 27644, 27651, 27650* (AARH, G, L, PDA); seedling, *Kostermans 27655 A* (L); along river, same place, ster., *Balasubramaniam 179*, ster., Jan.; ibid., ster., *Meijer 540* and *990* (PDA, US); ibid., steep hillside, ster., *Ashton 2041, 2048* and *2092* (PDA, US).

Stemonoporus lancifolius (Thw.) Ashton

Ashton in Blumea 20(2): 365. 1972 and in Dassanayake (editor), Revised Handb. Fl. Ceylon 1(2): 191. 1977 (descript. p.p.; exclud. specim. *Ashton 2003 & Balakrishnan 343*). – *Monoporandra lancifolia* Thwaites, Enum. Pl. Ceyl. 39. 1858. – *Vateria lancifolia* (Thw.) Thwaites, l.c. 404. 1864. – *Vateria nitida*, var *lancifolia* Dyer in Hooker f., Fl. Brit. Ind. 1: 316. 1874. – *Stemonoporus nitidus*, var. *lancifolius* Trimen, Handb. Fl. Ceylon 1: 136. 1893. – *Stemonoporus nitidus*, subspec. *lancifolius* Ashton, l.c. (sphalm.) – Hellessee, Pasdun Korale, fl. April 1855, *C.P. 3412* (PDA).

Vateria nervosa Thwaites in Trimen, J. Bot. 23: 206. 1885; Trimen, Handb., l.c. 136. – *Stemonoporus nervosus* Trimen, Handb., l.c. 136.; Ashton, l.c. – Hewesse, Sept. 1865, ster., *C.P. 3885* (PDA).

The reference list above, differs in some respects from that of Ashton, as some mistakes had to be corrected.

Dyer called the species: *Vateria nitida*, var. *lancifolia* and not *Stemonoporus*, as quoted by Ashton, who apparently copied Trimen, without checking Dyer (Trimen quotes in a peculiar way, not in use any more and so did Dyer). Moreover Ashton quoted it wrongly as a subspecies.

Wrongly is also quoted *Vateria nervosa* Thw. as *Stemonoporus nervosus* Thw. It has been correctly quoted by Trimen in his Syst. Catal. (J. Ceylon Br. Roy. As. Soc. for 1885, p. 10), but the combination in *Stemonoporus* is of Trimen in his Handbook.

Stemonoporus nervosus was assumed to be a variety of *St. nitidus* by Trimen (Handb., l.c. 137), but Ashton rightly referred it to *St. lancifolius*; both have the typical subtriplinerved leaves. Trimen mentioned this triplinervy (l.c. 137), but this was overlooked by Ashton.

Stemonoporus latisepalus Kosterm., *spec. nov.* **Fig. 4**

Arbor mediocris, foliis glabris rigide coriaceis, ellipticis, breve late obtuseque acuminatis, basi obtusis, supra laevibus, nervo mediano prominulis, inter costis saepe subbullatis, infra nervo mediano valde prominentibus, costis erecto-patentibus prominentibus marginem versus arcuatis nec conjunctis, nerviis secundariis prope nervo mediano tenuibus horizontalibus, caeteris scalariformibus, caetera laevibus, petiolis sat longis, inflorescentiis extra-axillaribus sat dense minutissime puberulis, sub-paniculatis, brevibus, paucifloris, pedicellis sat crassis bene evolutis, sepalis ellipticis latis, petalibus simulantibus, staminibus 15, filamentis brevissimis, basi connatis, stylo sub-excertis.

Typus: *Waas 1688* (PDA).

Tree 15 m tall, bole 8 m, dbh. 23 cm. Main branches mostly horizontal. Apical part of branchlets, petioles of young leaves, inflorescence and sepals densely, minutely puberulous, the indumentum fugaceous except in inflorescence and sepals. Leaves glabrous, rigidly coriaceous, elliptic, 6 × 11 – 8 × 14 cm, shortly, bluntly, rather broadly acuminate, base rounded; above smooth, midrib slender, prominulous in a shallow depression, lateral nerves sligthly impressed, causing bullateness between the lateral nerves; below paler, midrib strongly prominent, lateral nerves 8–10 pairs, erect-patent, arcuate towards the margin, not connected into a marginal vein; secondary nerves close to the midrib slender, prominulous, horizontal, the others scalariform and ultimately perpendicular to the lateral nerves, reticulation none. Petioles 2–3 cm long, often slightly swollen apically.

Inflorescences extra-axillary, sub-paniculate, 1.5 cm long, flowers and short branches very few. Pedicel thickish, 3 mm. Sepals rather thin, elliptic, concave, 5–6 mm long, 3–3.5 mm wide. Petals yellow, only slightly larger. Stamens 15; filaments short, in groups of three connate at the base. Style slightly exserted.

Distribution: Montane forest, only known from the type locality.

Notes: Resembles *St. kanneliyensis* by the venation, but less lateral nerves, a short, broad, obtuse, acumen and not impressed midrib. The lateral nerves are not forming a marginal vein. Moreover the inflorescence is paniculate and the sepals unusually broad and resemble the petals.

Ratnapura Distr., Mandagala Oya forest, along trail to Maskeliya from Malibode, alt. 700 m, June, fl., *Waas 1688* (PDA).

Stemonoporus revolutus Trimen

ex J. D. Hooker in Trimen, Handb. Fl. Ceylon 5: 384. 1900; Ashton in Dassanayake (editor), Revised Handb. Fl. Ceylon 2(2): 193. 1977, p.p. – Holotype: *F. C. Lewis*, Jan. 1893, Kukul(e) Korale at about 3000 ft. (K).

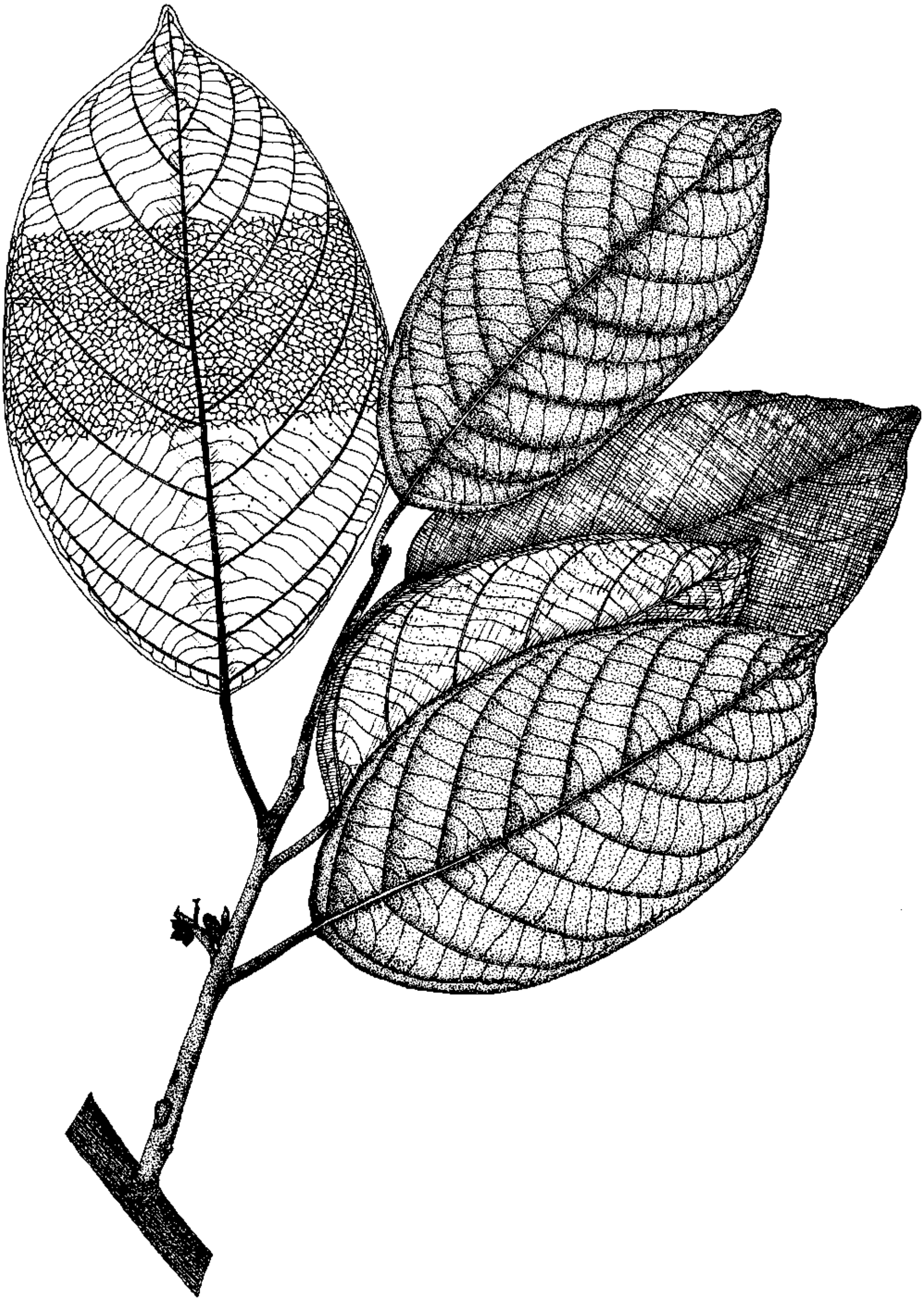


FIG. 4. *Stemonoporus latisepalus* Kosterm. – *Waas 1688* (PDA).

ASHTON's treatment of this species is rather confusing and partly wrong.

The typification is wrong. The holo-type, described by J. D. HOOKER (consisting apparently of more than one sheet, as he says: 'specimens') is sterile (HOOKER) and he included it therefore in *Stemonoporus* with a question mark. HOOKER clearly indicates the holo-type specimen and this is not the one quoted by ASHTON and it is not in Peradeniya.

In Peradeniya is an iso-type sheet (annotated by ASHTON) of which LEWIS's annotation reads: 'Tree 15 feet high, steep ridge of rock facing Sinha Raja about 3000 ft., overlooking Kukul Korale, Jan. 1893, *F. Lewis* '*no. 2*'. It bears also a note (of TRIMEN) 'with one fruit, see drawing'.

Apparently ASHTON failed to examine the plate in the Peradeniya plate collection, which depicts a flowering branch and a fruit (ASHTON says: 'fruit unknown'). The iso type sheet in Peradeniya has one small racemelike inflorescence, without flowers and one dissected flower in a convolute.

I am mystified from what ASHTON described the flowers, as none of the specimens quoted (all from Peradeniya) has a complete inflorescence, whereas the plate gives an inflorescence with 2–3 flowers and not up to 5 as mentioned by ASHTON.

ASHTON also overlooked LEWIS's note that tree was 15 ft. high, as he described it as a moderate tree and his ecological remark, that this is apparently a canopy tree, is incorrect.

I have before me the same material (Peradeniya) which was annotated by ASHTON, but I find the following discrepancies.

The leaves are usually rounded, more rarely retuse or emarginate (as described by HOOKER) and not 'more or less shallowly retuse' (ASHTON). The petioles are up to 20 mm long (ASHTON: 10–12 mm). The lateral nerves are very conspicuous on the lower leaf surface and not 'hardly elevated' (ASHTON).

The most remarkable item (missed by ASHTON), is that the anthers are different from those of other *Stemonoporus* species. The large valve remains flat and hence there is no elongate (open laterally) 'porus' and the pollen escape from an almost flat apical area and from the lateral apertures, where the smaller valve is pressed against the larger one.

Recently the species has been recollected by S. WAAS (S. of Sinharaja, Mannikkawatte forest, Ratnapura Distr., alt. 1300 m, *Waas 1770*, treelet 4 m, flowers yellow, leaf crown at apex in pseudo-whorls).

The flowers of this specimen are badly conserved (as in most material collected under the Smithsonian Flora Project), and only the calyces are extant. The petioles are somewhat shorter, but this is also found in the classical material.

FLACOURTIACEAE

Homalium dewitii Kosterm., *spec. nov.* **Fig. 5**

Arbor mediocris, ramulis glabris griseis, foliis ellipticis vel subovato-ellipticis glabris sat obscure acuminatis, basi in petiolum brevem gracilibus contractus, utrinque nitidis et reticulatis, margine serratis, nervo mediano et nervis lateralibus tenuibus utrinque prominulis, inflorescentiis terminalibus paniculatis, partialibus racemiformibus, floribus numerosis, sessilibus, basi bracteis minutis suffultis, dense griseopilosis, calycibus tubum elongatis basi rotundatis, segmentis angustis acutis, 6, petalis angustis sub-spathulatis, lobis calycibus duplo longioribus, margine longe fimbriatis, 6, filamentis 6 × 3, petalibus oppositis tenuibus, ovario dense pilosis calycibus tubus adnatis, stylis 3 tenuibus longus stigmate inconspicuis.

Typus: *Jayasuriya 2099* (G).

Tree, 10 m tall, diameter breastheight 20 cm, forming several coppice boles together. Bark pale: live bark gritty, hard, ochre. Wood hard, ochre, Branchlets slender, glossy grey, glabrous, smooth. Leaves glabrous, rather thin, elliptic to subovate-elliptic, 3 × 5–3 × 9 cm, rather obscurely acuminate or acute, base contracted into the petiole: margin serrate: both surfaces glossy, reticulate, midrib slender, prominulous on both surfaces; lateral nerves thin, 5–9 pairs, erect-patent, arcuate, prominulous on both surfaces. Petiole slender, ca 1 cm long.

Inflorescences terminal, consisting of a glabrous, rather slender main peduncle and rather widely spaced 5–11 cm long spikes. Flowers numerous, densely packed, greenish, sessile: base surrounded by 2 pairs of decussate minute, suborbicular, rather patent bracts. Calyx tube cylindrical-suburceolate, base obtuse, densely grey sericeous, 1.5–2 mm long; calyx lobes 6, narrow, acute, ca. 1.5 cm long, densely adpressed grey pilose. Petals 6, narrow, rather patent, sub-spathulate, ca 2.5 mm long, densely, long-fimbriate. Stamens 6 × 3, opposite the petals, filaments glabrous, thin, as long as the petals, anthers 2-celled, subglobose. Ovary pilose, almost completely adnate to the calyx. Styles 3, slender, ca 2 mm long, stigma inconspicuous, acute.

Distribution: At the base of Friars Hood, Nuwaragale For. Res., Amparai Distr., low alt. Endemic.

Ecology: Intermediate zone (not very dry).

Notes: This interesting species is based on a specimen, included by Dr. W. MEIJER in *Homalium zeylanicum* (Dr. MEIJER is supposed to revise the *Flacourtiaceae* for the New Flora of Ceylon), but it is entirely different from the latter. In some respects it is intermediate between *Osmelia* and *Homalium* (MEIJER included erroneously a specimen of *Erythrospermum* in *Osmelia gardneri*). It has the terminal inflorescences of *Osmelia gardneri*, the sessile flowers and the bracts (but not fused as in *Osmelia*), but here the likeness ends, as it has petals and the ovary is completely included in the calyx tube. From

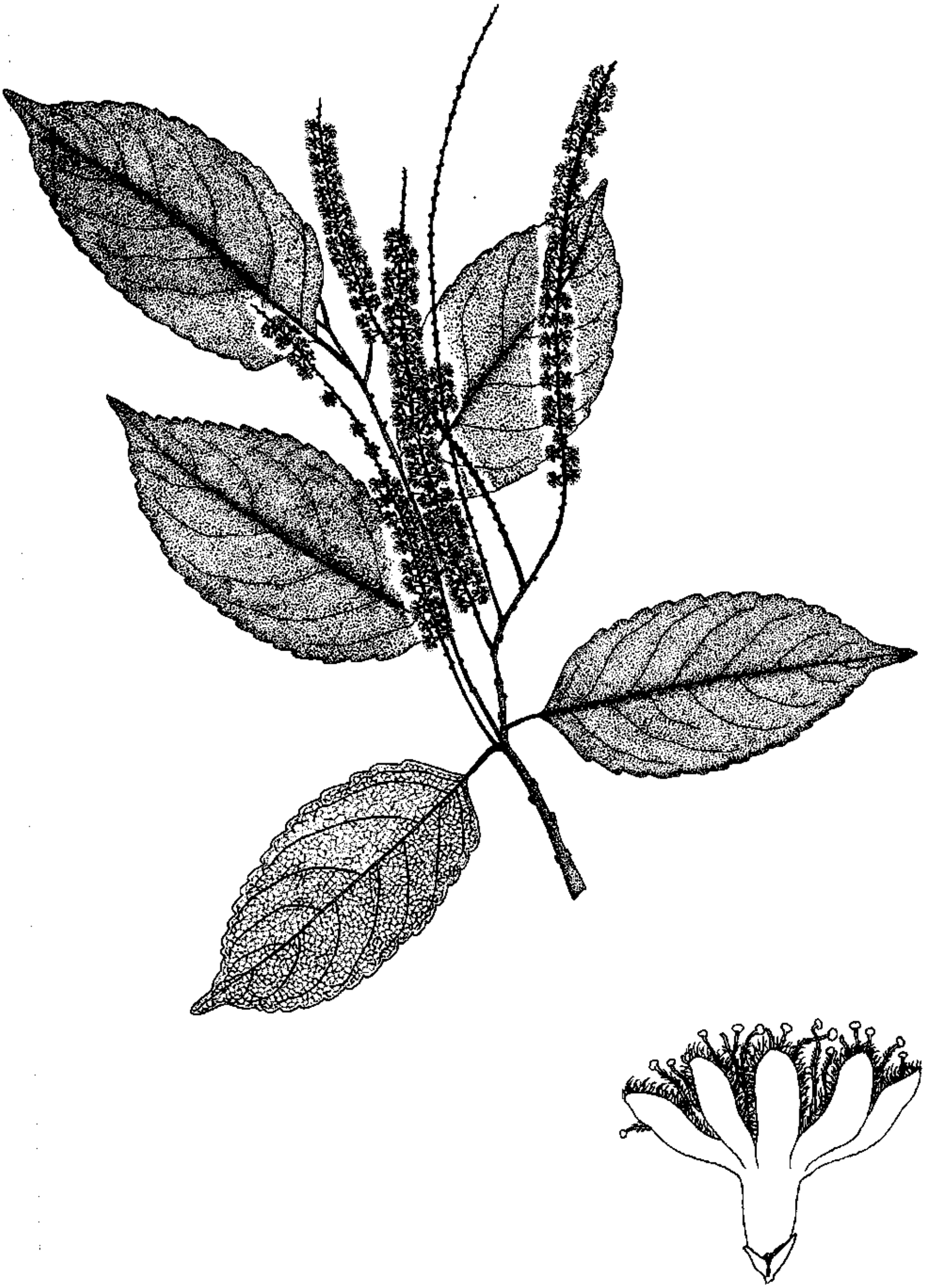


FIG. 5. *Homalium dewitii* Kosterm. – Holo-typus (G).

the common *Homalium zeylanicum* it differs as follows:

H. zeylanicum: Inflorescences reddish, axillary; pedicels long, thin, articulate; no bracts; 4–5 calyx lobes and petals: stamens 4–5; ovary almost entirely included into the calyx tube; styles 4; petals not fimbriate.

H. dewitii: Inflorescences green, terminal; flowers sessile; 2 pairs of decussate, orbicular bracts; 6 calyx lobes and petals; stamens 6 × 3, in groups opposite the petals; ovary completely included into the calyx tube; styles 3; petals very long and densely fimbriate along their margins.

This species is named in honour of Professor H. C. D. DE WIT of the Landbouwhogeschool, Wageningen, Netherlands.

Ceylon (Sri Lanka): Amparai Distr. (Eastern Ceylon), intermediate zone, low altitude, at base of Friars Hood, Nuwaragala For. Res., May, fl., *M. Jayasuriya 2099* (G, PDA, US).

LAURACEAE

Cinnamomum sinharajaense Kosterm., *spec. nov.*

Arbor mediocris, glabris in omnibus partibus, foliis sub-oppositis coriaceis, ellipticis vel late ellipticis magnis acuminatis, basi in petiolum crassum longum contractis, supra obscure dense excavato-punctulatis, nervo mediano et costis sub-basalibus prominulis, subtus pallidioribus nervo mediano prominentibus, costis sub-basilibus prominentibus apice foliorum non attingentibus, nervis secundariis obscuris vel nullis horizontalibus.

Typus: *Kostermans 26840* (G).

Tree, 6 m tall; bole grey, smooth, 30 cm in diam. Live bark 3 mm, pale, the outside bright red, without odour or taste. Branchlets glabrous. Leaves glabrous, sub-opposite, coriaceous, elliptic to broadly elliptic, 6 × 14 – 12 × 20 cm, acuminate (acumen broad, 1.5–2 cm long), base contracted into the petiole, obtuse, the centre very shortly cuneate; above dull, obscurely, minutely pitted to smooth, midrib and sub-basal lateral nerves smoothly prominent, below paler, midrib prominent, the two sub-basal lateral nerves prominent, ending 2–5 cm below the leaf apex; secondary nerves obscure, parallel, horizontal, widely spaced, also present at the outside of the lateral nerves, or invisible, reticulation dense, obscure or invisible. Petioles thick, 1.5–3 cm long.

Distribution: Only known from the type locality, very rare.

Notes: First found as a sapling, along a small stream in the wet, evergreen forest of Sinharaja. At first mistaken for *C. verum*, but the larger leaves and the lack of odour and taste of the bark and leaf petioles (so characteristic for *C. verum*), made me start a search for other trees. Only two more sapling trees were found, but the tree climber discovered a mature tree of 6 m height on another stream, after which it is described. This tree will be regularly visited (although it takes two days to reach the place and a long difficult climb over bolders in a steep rocky stream, where it grows in deeply shaded, moist forest).

In the Peradeniya herbarium, I found years ago a detached leaf, marked: Sinharaja, which was never identified and which represents this very rare species.

S.W. Ceylon, Sinharaja forest, Weddegale entrance, wet, evergreen forest, along rocky stream, alt. 200 m, ster., *Kostermans 26840* (G, L, PDA).

MELASTOMATACEAE

Memecylon hookeri Thw.

The type material of this species has buds only. The *C.P. 2686* specimen in Peradeniya is in a very poor condition, and only one anther was found, which has no appendage.

I believe, that this is a species of *Eugenia*, related to *Eugenia insignis*, which has similar leaves with similar, very distinct marginal vein and similar small, fascicled flowers.

Hence the new name: **Eugenia lankaensis** Kosterm. (basionym: *Memecylon hookeri* Thw.) is proposed.

Eugenia hookeri Steudel, Nomencl., ed. 2, 1: 603. 1842, is a nomen nudum.

MIMOSACEAE

Entada Adanson, nom. conserv.

MERRILL (Philipp. J. Sci. Bot. 5: 32. 1910) commented on the confused nomenclature of the genus *Entada* and of the Malesian species *E. scandens* (L.) Benth.

The generic name and the description were published by ADANSON in 1763, Fam. Pl. 2 in two places: page 318 and in the Index p. 554 with different references, but it was not the earliest proposed name, as he mentioned (p. 318), apart from *Entada* H. (ortus) M. (alabaricus) 9, t. 77 (which is *Entada monostachya* DC.) and *Parrang* Rumph. 5, t. 4 (which is now *E. phaseoloides* Merr.) also *Gigalobium* P. Browne, Hist. Jamaica 362. 1756. The latter makes ADANSON's name superfluous and hence conservation of *Entada* against *Gigalobium*.

In the Index, ADANSON (p. 554) quoted *Entada*, Malab. 318 with the synonym: *Parimkakuvalli* Mal. (perim, Malayanam = large; valli = liana; kaku = ?) (which is now *Entada pusaetha* Alston), *Gigalobium* Browne and *Mimosa* 15 Linn. Spec. 518.

The oldest name of the genus is, however, *Lens* Stickmann Linn., Herb. Amboin. 11 May 1754 (id. in Amoen. Acad. 4: 128. 1759), a name taken up by W. F. WIGHT (Contr. U.S. Nat. Herb. 9: 307, 308, pl. 56. 1905).

STICKMANN reads as follows: '4. *Faba marina* = *Lens phaseoloides, proprii generis.*' It is not clear, whether this name is valid. According to some it is invalid (Art. 41) as there is no reference to a former (infra-) generic description and also invalid (Art. 42, which deals with descript. gen.-specif.) as it does not refer to a new species, but to one already described by RUMPHIUS. However, the latter can also be interpreted in such a way, that as nomenclature of Phanerogams starts with LINNAEUS, there cannot be a species described (nomenclaturlaly) before that time, and as to the first: gen. propr. can and cannot be explained as meaning nov. genus.

Luckily it has become known now, that *Lens* Stickmann is antedated by *Lens* Miller (Gard. Dict., Abridg., ed. 4, 28 Jan. 1754) and hence it is not necessary (cf. Rules) to conserve *Lens* Miller against *Lens* Stickmann, and this name should be deleted from the List of Nom. Gen. conserv.

O. KUNTZE (Rev. Gen. Pl. 204. 1891) who adopted a different starting point for Phanerogams, accepted the generic name *Pusaetha* Linn., Fl. Zeyl. 236. 1747, in which he has been followed by TAUBERT (in ENGL. & PR., Nat. Pfl. fam. 3(3): 122. 1894). This name can now be discarded.

The Rules have conserved *Entada* Adanson (3468) and as type species one has chosen the citation of LINNAEUS, as quoted by ADANSON in his Index (p. 554), a not very satisfactory choice, but acceptable.

Entada pusaetha and *E. monostachya*

The nomenclature of these two species is rather confused. In LINN., Fl. Zeyl. (1748) both species are mentioned: Page 98: '*Mimosa foliis duplicato-pinnatis, cirrho terminantis,*' of which the description refers to a flowering specimen. I assume, that the description was extracted from RHEEDE, Hort. Ind. Malab. 9, p. 15, t. 67 (should be 77), quoted by LINNAEUS (this is now: *E. monostachya* DC). However, LINNAEUS also quoted *Acacia scandens spicata, siliquis amplissimis*, Plumier, Spec. 11, which is a different American *Entada*.

On page 236 under Barbarae Annihilatae (meaning that there was no actual herbarium specimen in HERMANN's herbarium) is quoted: *Pusaetha* Hermann, Mus. Zeyl. 44 (HERMANN calls the seed: fruit); there is no description, but many references are quoted, referring to the American species (BREYN., Prodr. 2: 63; SLOAN, Flor. 68; PLUK., Almag. 295; BAUHIN, Pinax 404) and to the Ceylon species (BURMAN, Thesaur. Zeyl. 139; HERMANN, Lugd. Bat. 494) and to the Indian species (RHEEDE, Malab. 8, p. 59, t. 32–34, *Perim-kaku valli;* RAY, Dendr. 116), which is conspecific with the Ceylonese species and now called *Entada pusaetha* DC. (not *pursaetha*, an unintentional mis-spelling, already corrected by DALZELL & GIBSON, Bombay Fl. 83. 1861 and TALBOT's Bombay Fl.). Moreover LINNAEUS says: Vide supra n. 619.

In Spec. Pl. 1753, p. 518 is quoted: *Mimosa entada* with the descriptive phrase: *Mimosa inermis, foliis bipinnatis, cirrho terminatis*, Fl. Zeyl. 219 (p. 98) and again (like in Fl. Zeyl.): *Entada* Rheede 9, p. 151, t. 67 (should be 77) is quoted, but PLUMIER's quotation of

Fl. Zeyl. is deleted. This makes it perfectly clear that this is the flowering plant, described by RHEEDE p. 151 and depicted on plate 77; which is now called *Entada monostachya* DC.

Pusaetha Hermann is not further mentioned. In the second edition of Spec. Pl. 1(2): 1501. 1762, another *Entada* is added, called: *Mimosa scandens (Mimosa inermis, foliis conjugatis cirrho terminati, foliis bijugis)* described on p. 1502; as habitat is quoted India, the description refers to a fruiting plant. Quoted are the references: BROWNE, Jam. 362; SLOAN, Jam. 68; BAUHIN, Pinax 404, all referring to the American species; RUMPH, Amboin. 5, p. 5, t. 4, the Moluccan species; *Pusaetha*, Fl. Zeyl., the Ceylonese species and *Perim-kaku valli* Rheede 8, p. 59, t. 32, 33, 34, the Indian species. This covers apparently the same as *Pusaetha* Hermann, although other quotations are added and others deleted, but we may safely assume, that this is *Entada pusaetha* which LINNAEUS thought to be identical with the fruiting *Entada* of RHEEDE (which is right) and with the American species (which is different).

Mimosa entada returns in the second edition with the same phrase (added is *foliis partialibus quinquejugis*), but again the thing is muddled up by adding, apart from the quotation: *Entada* Rheede, Mal. 9, p. 151, t. 67 (the flowering plant, which is correct), also PLUMIER Sp. 7, Ic. 12, the American plant, but this time with an interrogation mark and consequently *Mimosa entada* L. of 1762 still covers *Mimosa entada* L. 1753, based on the flowering plant of RHEEDE (*E. monostachya* DC).

Nowhere is RUMPHIUS mentioned, but it is clear that LINNAEUS thought that the Moluccan plant was conspecific with the Ceylonese and fruiting Indian plant, but as the thought that also the American plant was conspecific, and no preference is given to either, we have to follow L. M. JOHNSON (Sargentia 8: 136. 1949) who made the first choice and typified it with RUMPHIUS, quotation and plate.

The oldest name, however, is *Lens phaseoloides* Stickmann and although this name was not taken up by LINNAUS (hence apparently he did not quote RUMPHIUS in his second ed. of Spec. Pl.) for reasons, mentioned above, as the Rules give not absolute evidence that STICKMANN's name is invalid, his epithet stands and the Moluccan species is still: *Entada phaseoloides* (L.) Merrill.

WIGHT says that two species have been confused with the Moluccan (Rumphian) species: one *Entada pusaetha* of Ceylon and S. India (which he quoted solely from DC., Prodr. 2: 425, mid-Nov. 1825, but the name actually dates from DC., Mém. Légum. 12: 422. 29 Oct. 1825; the same holds true for the nomen novum: *Entada monostachya* for *Mimosa entada* L., which dates of 29 Oct. 1825, a mistake also made in the Code).

Of *Entada monostachya* there is a specimen in the Candolle herbarium in Geneva, collected by POITEAU. There is no indication where this flowering specimen was collected, but as POITEAU did not collect in Ceylon, it is almost certain from India.

ROXBURGH (Fl. Ind. 2: 554. 1832) described in detail, what may be *Entada pusaetha* as *Mimosa scandens* Roxb., but this is not proved, as he quoted RHEEDE's flowering plant (*E. monostachya* DC) and specimens from Silhet.

BRENAN (Kew Bull. 1955: 161-65) has satisfactorily settled the identity of the African species.

Conclusion: *Entada pusaetha* DC., typified by the Linnaean quotation and originally based on a vernacular name, quoted by HERMANN is a plant occurring both in S. India and Ceylon, characterised by very long, straight pods. Flowers unknown.

The name *pusaetha* is derived from Pus, (pronounce: poos), the Sinhalese name of the climber, usually called locally pus wael (weal is climber) pus means empty, alluding perhaps to the many empty pods, whereas aetha is a corruption of the Sinhalese etta = seed). Apparently HERMANN did not understand the language and noted down *pusaetha* when he was presented with the *seeds* of this plant.

The identity of *Entada monostachya* cannot be solved at this moment. It is, according to me, likely to be conspecific with *E. pusaetha*, but flowering and fruiting material from the same plant is necessary to make a definite conclusion.

In Ceylon another species of *Entada* occurs, which is already mentioned in MOON's Catalogue as: Heen pus wael (heen = small; pus wael = pus climber).

ALSTON (TRIMEN, Handb. Fl. Ceylon, Add. vol. 6: 95. 1931) saw of this species only seeds. He believed it to be conspecific with the Indian *E. monostachya*, but adds in the quotation of Hin pus wael an interrogation mark. WIGHT & ARNOTT thought it a young form of *E. pusaetha*, RIDLEY (J. Bot. 58: 159) thought it to be distinct.

ALSTON quotes TENNANT, Ceylon I, p. 105 as follows: 'One monstrous creeping plant called by the Kandyans the Maha (= large) pus wael or Great Hollow (empty is better) climber, has pods some of which I have seen fully 5 feet long and six inches broad. The same plant when found in lower situations, where it wants the soil and moisture of the mountains, is so altered in appearance that the natives call it Heen-pus-wael.' One of the drawings in the Peradeniya herbarium shows a twisted pod, which ALSTON was unaware to represent the Heen pus wael.

Apparently this species was already well known, long ago. I discovered it for the first time in the Sinharaja forest in S.W. Ceylon, where *E. pusaetha* does not occur. The species is very common. Then I found it plentiful in the Udawatte forest (at the outskirts of Kandy town), also a common climber. So TENNANT's remarks are partly confirmed, that the Kandyans call it Heen pus wael; in his remarks on the lowland form, he is, however, completely wrong. The complete distribution of *E. pusaetha* and *E. zeylanica* (Heen pus wael) in Ceylon is not known. Both occur in hte lowland and lower hill country, up to 500 m altitude, but their areas do not, or rarely overlap.

I prefer to describe the Heen pus wael as a new species, unless it is proved that *E. monostachya* from India is the same, which I doubt.

Entada zeylanica Kosterm., *spec. nov.*

Liana, usque ad 50 m longa, ramulis glabris, foliis glabris bijugatis, pinnae 8-foliolatis, cirrhus terminalibus glandulis deest, foliolis oppositis tenuibus glabris obliquis oblongis, obtusis vel emarginatis, basi oblique brevissime acutis, nervo mediano medianus prominulis, nervis lateralibus prope margine arcuato-conjunctis, petiolus brevissimis, legumen curvatis, seminibus orbicularibus applanatis biconcavis nitidis laevibus, floribus ignotus.

Typus: *Kostermans 26787* (G).

Woody climber, up to 50 m long, up to 50 cm diam. Bark rough, greyish brown, peeling off; live bark 1 cm thick, red, fibrous, inside yellow, very little red sap. Branchlets glabrous. Leaves spirally arranged, bipinnate, main rachis 8–15 cm long, ending in a 10 and more cm long strong cirrhus, main petiole rather short, glandless; pinnae up to 15 cm long, concave above, glandless. Folioles glabrous, grey underneath (fresh), thin, usually 4 (rarely 5) pairs, opposite, obliquely oblong, 3.5 × 7 – 1.5 × 4 (terminal leaflets) to 1 × 2 – 2 × 5 cm (basal leaflets), obtuse to emarginate, base obliquely, very shortly acute; midrib almost central, curved towards the apex, prominulous on both surfaces; lateral nerves ca 9 pairs, (with accessory in between), near the margin arcuately connected into a marginal vein. Petiolules very short, 2 mm, thickish.

Pods up to 45 cm long, up to 8 cm wide over the seeds, turned into a semi circle or circle or spirally twisted, outside lobed between the seeds, inside entire, thickened. Dehiscent as in all *Entadas*. Seeds flattened, biconcave, glossy brown, orbicular, 2–3.5 cm diam., up to 1.5 cm thick in the centre.

Distribution: Ceylon, up to 500 m altitude.

Notes: The differences in number of petiolules as indicated for *E. monostachya* does not hold true, nether the compound, paniculate inflorescence versus the simple spikes, as given for *E. pusaetha*.

The only difference so far known is in the much smaller, curved or twisted pods, those of *E. pusaetha* are straight and more than a meter long and the seeds which are 1/3–1/2 the size of those of *E. pusaetha*.

There is one flowering specimen available (*Waas 398*), which might belong here, it has slightly longer petals than those of *E. pusaetha*, but flowering and fruiting material of one tree is necessary to find out whether there are any differences in the flowers.

Ratnapura Distr., 1 mile S. of Carney, alt. 400 m, June, fr., *Maxwell & al. 955* (PDA, US); Sinharaja forest, S.W. Ceylon, Weddagale entrance, alt. 300 m, July, fr., *Kostermans 26787* (G, K, L, PDA, US); Udawatte forest above Kandy, fr., *Kostermans s.n.* (G, K, L).

MYRTACEAE

Eugenia sripadaense Kosterm., *spec. nov.*

Arbor parva ramulis et foliis juvenilibus dense minute aureosericeis, foliis glabris rigide coriaceis subtrapeziformibus vel late ellipticis, parvis, late apiculatis vel subobtusis, basi cuneatis sub-decurrentibus, supra opacis laevibus vel obscure minutissime excavato-punctatis, nervo mediano impressis, subtus palidioribus, nervo mediano prominentibus, costis lateralibus perobscuris erecto-patentibus, venis marginalibus obscuris, margine *proximis, petiolis sat crassis, supra canaliculatis, floribus axillaribus solitariis pedunculis longis impositis, sessilis basi bibracteatis, calycinis late obconicis dense minute pilosis, lobis patentibus, late triangularibus acutis, petalis ovato-oblongis acutis margine pilosis sat longe persistentibus, staminibus numerosis, discus magnis applanatis dense pilosis.*

Typus: *Kostermans 27033* (G).

Hardly, apically branched treelet of 3 m, bole smooth, 5 cm diam. The leaves congested in dense masses at the end of the branches. Branchlets and juvenile leaves densely sub-aureous pilose. Leaves (also flush) erect, glabrous, rigidly coriaceous, sub-trapezoid to broadly elliptic, 2 × 3–4.5 × 7 cm, obscurely broadly apiculate or acutish, base cuneate, margins somewhat decurrent into the thickish, 5–8 mm long petiole, which is slit-like channeled above; upper surface smooth, dull, often obscurely, minutely pitted, midrib impressed, lower surface paler, smooth, midrib prominent, lateral nerves very obscure, erect-patent, ca 12 pairs; marginal vein obscure, 1–2 mm from the margin.

Flowers solitary on a slender, axillary, 1–1.5 cm long peduncle, sessile, subtended at the base by two opposite, ovate, acuminate, keeled, 3 mm long puberulous bracts. Sometimes peduncles very short, especially at the apical shoot. Calyx broadly obconical, pilose, ca 4 mm high; lobes broadly triangular, patent, acute, hairy, 3 mm long. Petals ovate-oblong, acute, pale greenish white, up to 8 mm long, margins densely fringed. Stamens numerous, 8 mm long; the disc-like flower bottom conspicuous, flat, very hairy. Style 5 mm long.

Distribution: Only known from the type locality.

Notes: The species is closely related to *Eugenia (Jossinia) cotinifolia*, from which it differs by the denser pilosity of the young parts, the invisible lateral ribs on the upper leaf surface, the much smaller calyx lobes, the smaller petals and the much more and longer haired disc.

Adam's Peak Jungle; flat extensive, slightly peaty rock outcrop at the base of the rocky upper part of Adam's Peak, alt. ca 2000 m, montane low forest of *Myrtaceae* and especially *Calophyllum walkeri*, trail from Moray Estate, Maskeliya Distr., Nov., fl., *Kostermans 27033* (G, L, PDA).

I am not in the position yet to decide, whether the genus *Jossinia* (in which the above species belongs) should be maintained, or fused with *Eugenia*.

OLACACEAE

Strombosia nana Kosterm., *spec. nov.*

Arbor parva in omnibus partibus glabris, foliis tenuiter chartaceis, maturate glabris, subovatis vel subovato-ellipticis parvis acuminatis basi in petiolum contractis, utrinque opacis laevibus, supra minutissime pustulatis, nervo mediano applanatis, subtus obscure *corrugatis, nervo mediano prominulis costis vix conspicuis, petiolis gracilibus, supra subcanaliculatis, inflorescentiis axillaribus vel supra-axillaribus glomerulatis paucifloris, pedicellis cum pedunculis brevissimis, minutissime bracteatis, tubo calycibus obconicis coriaceis parvis supra concavis, lobis distinctis latioribus quam longioribus, obtusis, fimbriatis, petalis oblongo-lanceolatis glabris, discus obscuris, filamentis petalis longe adnatis, ovario discus vix inclusis, stylo bene evolutis, stigmatectruncatis, fructus claviformibus, obtusis, solitariis, ovario sub-inclusis.*

Typus: *Kostermans 24987* (G).

Tree, up to 6 m tall and 20 cm diameter, glabrous in all its parts. Bark smooth, very finely longitudinally fissured, dark to light brown, 0.25–0.5 mm thick. Live bark white to straw, 2–4 mm thick. Branchlets thin, stiff, slightly zig-zag. Leaves spirally arranged, thinly chartaceous, subovate to subovate-elliptic, 3 × 5 – 4 × 6.5 cm, obtusely acuminate (acumen 5–10 mm long), base contracted into the petiole, both sides dull, above smooth, minutely pustular, midrib level with the surface, sometimes with few very thin hairs near the base, below paler, obscurely minutely furrowed, midrib prominulous, lateral nerves hardly visible, ca 4 pairs, erect-patent, arcuate, Petiole slender, 5–10 mm long, superficially channeled above.

Inflorescences axillary and extra-axillary. Flowers 1–5 on short pedunclets, glomerulate on very short tubercles. Pedicel none (merging into the fleshy calyx) or extremely short, base with a tiny bracteole, peduncles less than 0.5 mm long, with basal, tiny bracts. Calyx fleshy, obconical, 0.5 mm high, apically somewhat concave. Calyx lobes 5, obtuse, broader than long, 0.5–1 mm high, margin fringed. Petals lanceolate, 1.5–2 mm long, glabrous. Disc obscure, flat; filaments for the greater part adnate to the tepals. Ovary almost superior, glabrous; stigma 0.5 mm long with truncate stigma.

Fruit club shaped, solitary, 1 × 1.5 cm, the obtuse top with a central aperture through which the top of the ovary and style are extruding.

Distribution: S.W. Ceylon, wet, tropical, low rain forest, locally common.

Notes: Of *Strombosia ceylanica*, of which since THWAITES times only once a flowering specimen has been collected (*Waas 1503*), reexamination of the classical C.P. material revealed discrepancies with TRIMEN's description.

In *C.P. 1237* (PDA) there are next to axillary also extra-axillary inflorescences, the calyx tube can hardly be called campanulate, as the top is very shallowly concave. The petals are only hairy around the anthers and the margin fimbriate near the anthers. The almost completely adnate filament is very clearly discernable. The disc is under the ovary. I have the impression, that both the hypanthium and the disc and not only the disc grows out and surround ultimately the ovary completely, only the style sticking out (in *S. nana* part of the ovary sticks out and the fusion of hypanthium with ovary is less tight.

S. ceylanica as described in BACKER & BAKH. Flora Java 2: 65. 1965, differs by the free filaments, and hence might represent another species.

S. nana is very near to *S. ceylanica*, but is a smallish tree with different (*S. ceylanica* has a smooth, glossy, hammered bark, peeling off in large jig-saw pieces), smaller, differently shaped leaves (in sicco dull, like those of *S. ceylanica*) with very obscure lateral nerves. The flowers are much smaller than those of *S. ceylanica* and the ovary is extruding from the enlarged hypanthium in the fruiting stage. Both species have a different distributional range, growing in different climatic areas.

S.W. Ceylon, Hiniduma Distr., Kanneliya forest, alt. low, June, fr., *Kostermans 24987* (K, L, PDA, US); Sinharaja forest, Weddagale entrance, Shorea forest on ridge, alt. 200 m, common, Febr., fr., *Kostermans 27277* (G, K, L, PDA); fl., *Goonatilleke 3502* (G, L).

OBSERVATIONS SUR *SAXIFRAGA DIAPENSIOIDES* BELLARDI AU VAL DE BAGNES (SUISSE, VALAIS)

André Lawalrée

Jardin botanique national de Belgique, Meise

Herbacé, vivace, *Saxifraga diapensioides* Bellardi forme des pelotes appliquées sur les rochers. Il atteint, lorsqu'il fleurit, tout au plus 12 cm de haut. Sa tige se divise dès la base en rameaux longs de 1,5 à 5 cm. Ces rameaux sont densement couverts de feuilles très étroitement appliquées contre le rameau et les unes contre les autres: chaque rameau feuillé forme une petite rosette ou une courte colonne compacte. Les divers rameaux sont pressés les uns contre les autres. Le coussin formé par une plante a l'aspect d'une colonie dense de rosettes de quelque petit *Sempervivum* (photo).

Les feuilles sont alternes, sessiles, entières, vert gris clair, un peu charnues. Celles des rameaux stériles, densement imbriquées, sont dressées et ne se recourbent pas ou guère au sommet; elles sont longues de 3 à 6 mm et larges de 1 à 1,8 mm, linéaires à oblongues-obovales, rétrécies en coin et souvent rougeâtres dans leur partie inférieure, obtuses au sommet, triangulaires en section transversale et obtusement carénées en-dessous; leurs bords montrent une étroite marge cartilagineuse et portent, sauf au sommet, de courts cils étalés; la face supérieure du limbe s'orne, près de la marge, de 5 à 9 pores que recouvre parfois une excrétion calcaire.

Selon les sites et les années, la floraison a lieu de fin avril à fin juillet. Le rameau qui va porter des fleurs se prolonge d'abord par une partie d'axe dressée, aux entre-noeuds plus allongés, aux feuilles moins rapprochées; cette portion d'axe, longue de 2 à 8 ou 10 cm, porte des poils étalés denses et aussi longs ou même plus longs que son diamètre; ces poils ont une tête glanduleuse rougeâtre; les feuilles de cet axe, longues de 3 à 5 mm et larges de 1,5 à 2 mm, sont linéaires-spathulées et munies de poils glanduleux, sauf à leur sommet; celui-ci est glabre et calcarifère. L'axe florifère reste parfois simple et uniflore; le plus souvent, il porte de 2 à 6 fleurs, parfois jusqu'à 9; ses rameaux, des pédicelles simples, sont densement couverts de poils glanduleux, de même que les bractées et les bractéoles.

Les fleurs sont pentamères ou très rarement tétramères. Leur ovaire est semi-infère. La face externe du réceptacle est densement glanduleuse. Les sépales, appliqués contre la corolle, sont longs de 3 à 3,5 mm et larges de 1,5 à 2 mm, ovales à oblongs-ovales, obtus ou parfois subaigus au sommet, parcourus par trois, quatre ou cinq nervures; ils sont densement poilus-glanduleux sur le dos et sur les bords, et ont parfois des cils non glanduleux. Les pétales, longs de 7 à 9 mm et larges de 4 à 5 mm, sont oblongs-obovales à elliptiques, rétrécis en coin dans le bas, arrondis au sommet, blanc laiteux mais un peu verdâtres à la base; leur nervure se ramifie à plusieurs reprises pour former de 5 à 9 nervilles légèrement rougeâtres. Les étamines portent leurs petites anthères rondes à peu près au niveau des stigmates. L'ovaire est pourvu d'un anneau nectarifère; les deux styles sont dressés, dépassent les sépales et se terminent chacun par un stigmate bien développé. La capsule est longue de 4 à 4,5 mm. Les graines, longues de 0,6 à 0,8 mm, sont fusiformes, aiguës aux deux bouts, chataines et garnies de petites protubérances.

S. diapensioides est protérogyne, mais sa dichogamie n'est pas totale. Ses étamines externes deviennent fonctionnelles alors que les styles le sont encore, ce qui donne à la fleur la possibilité de s'autoféconder. Les étamines internes ne deviennent fonctionnelles qu'après que les styles aient cessé de l'être: elles ne peuvent donc réussir que des fécondations allogames.

En Suisse, *S. diapensioides* n'est connu que du Valais. Il y a été signalé:

1. en divers endroits du Val d'Entremont et surtout des montagnes qui séparent ce Val du Val Ferret;
2. sur le versant est du Catogne, au-dessus d'Orsières, en dessous du Col du Bonhomme;
3. dans le Val de Bagnes, en plusieurs localités: Pierre-Avoi, près de Croix-de-Coeur, Lourtier, entre Bonatchesse et Mauvoisin (Le Tseppi, sentier de Vasevay, Mazeria, Pont de Mauvoisin), à La Liaz et sur les rochers près et au-dessus du glacier de Giétroz;
4. d'une façon peu précise et mise en doute par certains, dans le massif du Cervin et au Monte Rosa, cette dernière montagne constitutant éventuellement la limite orientale de l'aire de la plante.

Hors de Suisse, *S. diapensioides* est connu des Alpes Graies (p. ex. Vallée de Cogne, Mont Cenis, etc.), des Alpes Cottiennes (p. ex. Mont Viso), du Dauphiné (p. ex. Haute-Maurienne, moraine de l'ancien glacier de l'Arc à La Madelaine, entre Bessans et Lans-le-Villard), des Alpes Maritimes (p. ex. vallée du Roja au nord de Tenda) et des Basses Alpes (p. ex. bassin supérieur de l'Ubaye).

Plusieurs Angiospermes ont une aire assez semblable à celle de *S. diapensioides*. C'est le cas entre autres d'*Hugueninia tanacetifolia* (L.) Rchb. var. *tanacetifolia*, d'*Oxytropis foetida* (Vill.) DC. et d'*O. gaudinii* Bunge, qui tous trois existent dans le Val de Bagnes.

Les altitudes auxquelles on a noté *S. diapensioides* vont de 850 m (près de Tenda) à 2820 m (au Col de Tsa-Sèche = Chaz-Sèche).

Cette plante est calcicole. Dans la Vallée de Cogne, on le rencontrerait pourtant sur granit, à Grosjon (vers 1600 m).

En juillet 1978 et en juillet 1979, j'ai observé *S. diapensioides* sur quatorze rochers du Val de Bagnes, groupés en trois ensembles: sept rochers dans le massif de Pierre-Avoi, deux sous Le Tseppi et cinq au-dessus du Tseppi.

A. Les rochers voisins de Pierre-Avoi sont calcaires. Les rochers 1–6 se situent dans le Km^2 107–108/580–581 de la carte nationale de la Suisse (1:25000, feuille 1325, Sembrancher); le rocher 7, dans le Km^2 106–107/580–581 de la même carte, mais tout contre la limite du Km^2 précédent.

ROCHER 1. Vers 2410 m, au-dessus du sentier qui va du Col de La Marlénaz à Pierre-Avoi, un rocher émerge d'une pente à *Carex sempervirens* Vill. et *Sesleria coerulea* (L.) Ard. La face regardant le Sud-Est est inclinée de 80° et porte deux touffes de *Saxifraga diapensioides* ainsi que les espèces suivantes: *Anthyllis vulneraria* L., *Arctostaphylos uva-ursi* (L.) Sprengel, *Asplenium ruta-muraria* L., *Athamanta cretensis* L., *Carex sempervirens* L., *Galium pumilum* Murray, *Globularia cordifolia* L., *Gypsophila repens* L., *Helianthemum ovatum* (Viv.) Dunal, *Hieracium villosum* L., *Juniperus nana* Willd., *Kernera saxatilis* (L.) Rchb., *Rhamnus pumila* Turra, *Saxifraga oppositifolia* L., *Sesleria coerulea* (L.) Ard., *Thymus* § *serpyllum*. Le *Saxifraga* s'y loge avec des mousses dans des creux du rocher, sous de petits surplombs. Ce même rocher porte sur sa face ouest beaucoup de pieds de *Saxifraga moschata* Wulfen subsp. *rhodanensis* Braun-Blanquet.

ROCHER 2. Vers 2380 m, entre Combe Plane et Pierre-Avoi, une paroi rocheuse inclinée à 80°, fissurée, tournée vers l'Est, porte une plante de *Saxifraga diapensioides* ainsi qu'*Athamanta cretensis* L., *Dryas octopetala* L., *Festuca pumila* Chaix, *Galium pumilum* Murray, *Globularia cordifolia* L., *Gypsophila repens* L., *Hieracium villosum* L., *Juniperus nana* Willd., *Kernera saxatilis* (L.) Rchb., *Rhamnus pumila* Turra, *Senecio doronicum* L. et *Sesleria coerulea* (L.) Ard.

ROCHER 3. Vers 2320 m, il y a deux rochers séparés par un 'col' de 20–30 m de large. Le rocher supérieur expose au Sud sa face d'aval presque verticale, qui porte quelque quinze touffes de *Saxifraga diapensioides*, beaucoup d'entre elles situées sous des surplombs. On voit dans les mêmes niches *Arctostaphylos uva-ursi* (L.) Sprengel, *Athamanta cretensis* L., *Carex ornithopoda* Willd., *Festuca pumila* Chaix, *Gypsophila repens* L., *Kernera saxatilis* (L.) Rchb., *Leontopodium alpinum* Cass. et *Sesleria coerulea* (L.) Ard.

ROCHER 4. Au même 'col', vis-à-vis la paroi dont je viens de parler (3), la face exposée au Nord du rocher inférieur porte quelque vingt pieds de *Saxifraga diapensioides*, associés à *Asplenium viride* Huds., *Athamanta cretensis* L., *Carex ornithopoda* Willd., *Festuca pumila* Chaix, *Saxifraga moschata* Wulfen subsp. *rhodanensis* Braun-Blanquet, *S. oppositifolia* L., ainsi qu'au lichen *Caloplaca elegans* Th. Fr.

ROCHER 5. Au bas du groupe de rochers étudiés ici, parmi ceux situés juste au-dessus du petit sentier de promeneurs qui court vers 2260 m d'altitude, le rocher le plus vers l'Est porte sur sa face orientée au Sud, face inclinée à 80°, trois touffes de *Saxifraga diapensioides* associées aux plantes suivantes: *Arctostaphylos uva-ursi* (L.) Sprengel, *Athamanta cretensis* L., *Carex sempervirens* Vill., *Festuca* sp., *Galium pumilum* Murray, *Globularia cordifolia* L., *Gypsophila repens* L., *Helianthemum ovatum* (Viv.) Dunal, *Hieracium* cfr *murorum* L. (un individu), *Hieracium villosum* L., *Hippocrepis comosa* L., *Juniperus nana* Willd., *Kernera saxatilis* (L.) Rchb., *Leontopodium alpinum* Cass., *Polygala chamaebuxus* L., *Rhamnus pumila* Turra.

ROCHER 6. Plus vers l'Ouest, à environ 2280 m d'altitude, du sentier des promeneurs dont il vient d'être question part un sentier qui descend à l'est d'éboulis calcaires où croît entre autres *Valeriana montana* L. Au-dessus du confluent des sentiers, un petit rocher montre sur sa face sud cinq touffes de *Saxifraga diapensioides* associées à *Arctostaphylos uva-ursi* (L.) Sprengel, *Athamanta cretensis* L., *Campanula rotundifolia* L., *Festuca* sp., *Globularia cordifolia* L., *Gypsophila repens* L., *Hieracium villosum* L., *Kernera saxatilis* (L.) Rchb., *Rhamnus pumila* Turra, *Senecio doronicum* L., *Sesleria coerulea* (L.) Ard. et *Thymus* § *serpyllum*.

ROCHER 7. Un peu au-dessus du sentier touristique 4B (Office du Tourisme de Verbier), vers 2230 m d'altitude, un rocher porte sur une face verticale regardant le Sud deux touffes de *Saxifraga diapensioides* qu'accompagnent *Arctostaphylos uva-ursi* (L.) Sprengel et quelques autres plantes qu'il ne m'a pas été possible d'identifier p.c.q. je ne suis pas alpiniste.

B. *S. diapensioides* existe sous Le Tseppi, sur 2 rochers calcaires situés au fond de la vallée de la Drance, en amont de Bonatchesse, dans le coin nord-est du Km^2 95–96/591–592 de la carte nationale de la Suisse (1:25000, feuille 1346, Chanrion), entre la route Fionnay-Mauvoisin et la Drance. Près du point marqué 1653 m sur la carte, une passerelle métallique enjambe l'étroite gorge qui sépare Le Tseppi (rive droite) de La Grand-Tête (rive gauche). De cette passerelle, un sentier descend sur la rive droite et gagne Bonatchesse. A droite du sentier, sous le pylone électrique FMM5, le talus porte un buisson de *Sambucus racemosa* L. ainsi que des colonies d'*Adenostyles alliariae* (Gouan) Kerner et de *Petasites* sp.

ROCHER 8. En face du pylone électrique FMM5, le sentier est bordé par un rocher haut de 3 à 7 m et couronné par des épicéas et des mélèzes, dont les troncs percent un tapis de *Rhytidium rugosum* (Hedw.) Lindb. Au pied du rocher, le bord gauche du sentier est colonisé par *Alchemilla alpina* L., *Arabis alpina* L., *Bellidiastrum michelii* Cass., *Carduus defloratus* L., *Cerastium arvense* L. subsp. *strictum* (Haenke) Gaudin, *Dryas octopetala* L., *Epilobium angustifolium* L., *Erucastrum nasturtiifolium* (Poiret) O.E. Schulz, *Euphorbia cyparissias* L., *Kernera saxatilis* (L.) Rchb., *Phleum alpinum* L., *Polystichum lonchitis* (L.) Roth, *Rubus idaeus* L., *Salix pubescens* Schleicher (= *S. albicans* Bonjean), *Sesleria coerulea* (L.) Ard., *Silene vulgaris* (Moench) Garcke et *Tussilago farfara* L.

La paroi rocheuse légèrement inclinée surplombante qui longe le sentier et qui est orientée au Sud-Est, porte une douzaine d'individus de *Saxifraga diapensioides*, pour la plupart installés dans de petites crevasses ou sur de petites corniches horizontales ou inclinées. *S. diapensioides* s'y trouve seul ou en compagnie d'*Asplenium ruta-muraria* L., de *Festuca pumila* Chaix, de *Saxifraga oppositifolia* L. et du lichen *Caloplaca elegans*

Th. Fr. Sur ses parties plus lisses, la paroi rocheuse porte la mousse *Orthotrichum cupulatum* Brid. et le lichen *Toninia lobulata* (Sommerf.) Lynge. Certaines crevasses et certaines corniches du même rocher ont une végétation plus fournie, avec *Asplenium viride* Huds., *Campanula* cfr *rotundifolia* L., *Carduus defloratus* L., *Euphorbia cyparissias* L., *Festuca pumila* Chaix, *Kernera saxatilis* (L.) Rchb., *Sesleria coerulea* (L.) Ard., *Valeriana tripteris* L., *Viola biflora* L. et des mousses, mais *Saxifraga diapensioides* ne se trouve pas dans un tapis aussi 'luxuriant'. A son extrémité vers l'aval du sentier, le rocher présente à l'Est une face où la végétation comporte *Dryas octopetala* L. et davantage de *Festuca pumila* Chaix. Dans sa partie amont, le rocher est bordé d'une petite pente d'éboulis qui descend jusqu'au sentier. Cette pente porte la souche d'un Epicéa qu'on a coupé, et *Bellidiastrum michelii* Cass., *Carduus defloratus* L., *Chrysanthemum leucanthemum* L., *Daphne mezereum* L. (un individu), *Euphorbia cyparissias* L., *Festuca pumila* Chaix, *F. curvula* Gaudin, *Galium* sp., *Geranium sylvaticum* L., *Hieracium bifidum* Kit. subsp. *cardiobasis* Zahn, *Juniperus* sp., *Lotus corniculatus* L., *Melica nutans* L., *Polygala* sp. et *Valeriana tripteris* L.

ROCHER 9. En aval du rocher dont je viens de parler, il en est un plus petit, détaché du premier, dans le coude du sentier. Ce second rocher, approximativement long de 4 m et haut de 2 m, est couronné de deux avortons d'Epicéas et d'un petit Mélèze. Ses fissures nourrissent une végétation en général un peu plus fournie que celle des fissures du grand rocher. On y trouve *Saxifraga diapensioides* en compagnie des espèces suivantes: *Asplenium ruta-muraria* L., *Carex* cfr *ornithopoda* Willd., *Salix pubescens* Schleicher (un petit individu), *Saxifraga paniculata* Miller, *Sesleria coerulea* (L.) Ard., *Thymus* § *serpyllum* et *Valeriana tripteris* L. S'y joignent les mousses *Encalypta vulgaris* (Hedw.) Hoffm., *Grimmia apocarpa* Hedw. et *Tortella tortuosa* Limpr., ainsi que divers lichens: sur le rocher, *Collema undulatum* Laur.; sur la 'terre', *Rinodina phaeocarpa* (Smrft.) Vain.; sur les mousses, *Cetraria terrestris* (Schaer.) Fink (= *C. tilesii* Ach.) et cfr *Squamarina gypsacea* (Sm.) Poelt.

C. Les rochers à *Saxifraga diapensioides* situés au-dessus du Tseppi, au Plan de la Dzeu, se trouvent dans le nord-ouest du Km^2 95–96/592–593 de la Carte nationale de la Suisse (1:25000, feuille 1346, Chanrion), à proximité d'une ancienne étable marquée à 1815 m d'altitude.

ROCHER 10. Dans le nord-ouest de la clairière, un rocher de quelque 4 m^3 présente au Nord-Nord-Ouest une face verticale où quelques étroites corniches presque horizontales portent huit pieds de *S. diapensioides*. On y trouve aussi *Asplenium ruta-muraria* L., *Campanula cochleariifolia* Lam., *Dryas octopetala* L., *Saxifraga oppositifolia* L., *Sesleria coerulea* (L.) Ard. et *Thymus* § *serpyllum*, les mousses *Bryum algovicum* Sendtn. ex C. Müll. var. *ruthenicum* (Warnst.) Guendw., *Campylopus subulatus* Schimp., *Encalypta streptocarpa* Hedw., *Myurella julacea* (Schwaegr.) B.S.G., *Pseudoleskeella catenulata* (Brid.) Kindb. et *Tortella tortuosa* (Hedw.) Limpr., les lichens *Lecanora epibryon* Ach. et *Squamarina crassa* (Huds.) Poelt, auxquels s'ajoute, dans le bas de la paroi, la fougère *Cystopteris fragilis* (L.) Bernh. Les autres faces du même rocher portent en outre *Alchemilla alpina* L., *Anthyllis vulneraria* L., *Chrysanthemum leucanthemum* L., *Festuca* sp., *Globularia cordifolia* L., *Helianthemum ovatum* (Viv.) Dunal, *Minuartia verna* (L.) Hiern -sensu *M. gerardii* (Willd.) Hayek-, *Sedum dasyphyllum* L. et le lichen *Caloplaca elegans* Th. Fr.

ROCHER 11. Un peu à l'est de l'étable, un rocher à structure stratifiée (phyllades?) porte sur une face verticale exposée au Sud, trois touffes de *Saxifraga diapensioides* avec *Asplenium ruta-muraria* L., *Gypsophila repens* L., *Leontodon hispidus* L., *Sedum dasyphyllum* L., *Sesleria coerulea* (L.) Ard. et les mousses *Encalypta streptocarpa* Hedw., *Pseudoleskeella catenulata* (Brid.) Kindb. et *Schistidium apocarpum* (Hedw.) Brid. var. *confertum* (Funck) C. Müll.

ROCHER 12. Un rocher voisin du précédent mais plus petit, présente sur sa face sud, sous un surplomb, une corniche avec une touffe de *S. diapensioides* (photo) et *Festuca* sp.; les parois obliques surplombantes portent *Tortella tortuosa* (Hedw.) Limpr. La face supérieure du rocher est horizontale; y poussent *Carduus defloratus* L., *Poa alpina* L., *Saxifraga paniculata* Miller et *Sedum dasyphyllum* L.

Suisse: Valais: commune de Bagnes, lieu dit Plan de la Dzeu: fente de rocher sous léger surplomb, abritant une plante de *Saxifraga diapensioides* Bellardi, avec *Festuca* sp.; à l'avant-plan *Tortella tortuosa* (Hedw.) Limpr.; le canif mesure 9 cm de long. – Photo A. LAWALRÉE, juillet 1979.

ROCHER 13. Plus vers l'Est, le long du petit sentier presque horizontal (alt. 1815 m), se trouve du côté de la vallée le seul rocher où j'ai vu *Saxifraga diapensioides* sur une face presque horizontale et sans l'abri d'un surplomb. Ce rocher est légèrement abrité par un *Larix decidua* Miller. La face supérieure est, dans sa partie nord, inclinée d'environ 10° vers le Nord. Elle porte cinq pieds de *S. diapensioides* (inclus. jeunes plantes!) ainsi que *Botrychium lunaria* (L.) Swartz, *Campanula cochleariifolia* Lam., *Euphorbia cyparissias* L., *Euphrasia* sp., *Festuca* sp., *Globularia cordifolia* L., *Gypsophila repens* L., *Kernera saxatilis* (L.) Rchb., *Sedum dasyphyllum* L., *Sesleria coerulea* (L.) Ard. et les mousses *Campylopus subulatus* Schimp., *Distichium* cfr *capillaceum* (Hedw.) B.S.G., *Encalypta streptocarpa* Hedw., *Myurella julacea* (Schwaegr.) B.S.G. et *Tortella tortuosa'*(Hedw.) Limpr.

En outre, la face verticale du même rocher regardant l'Ouest porte un pied de *Saxifraga diapensioides* sous un petit surplomb, avec *Asplenium viride* Huds.

Rocher 14. Le sentier horizontal de l'altitude 1815 m dont il vient d'être question, débouche à son extrémité orientale dans un autre sentier. Celui-ci, sur la rive droite du Torrent de Merdenson, monte de la route Bonatchesse-Mauvoisin (1680 m) en direction de l'Ecurie du Vasevay (2155 m). Non loin du confluent des deux sentiers, le premier est bordé, côté montagne, par un rocher calcaire compact dont la face verticale exposée au Sud montre deux pieds de *Saxifraga diapensioides*, avec *Campanula cochleariifolia* Lam., *Dryas octopetala* L., *Festuca* sp., *Gypsophila repens* L., *Saxifraga oppositifolia* L., *Sesleria coerulea* (L.) Ard. et la mousse *Tortella inclinata* (Hedw. f.) Limpr.

Mes observations sont très limitées. Dans le Val de Bagnes, *Saxifraga diapensioides* a été trouvé ailleurs qu'où je l'ai vu, et il y existe sans doute encore: je n'ai pas visité tous les rochers de Bagnes! Quant aux autres parties de l'aire de cette espèce, on ne peut leur étendre mes résultats.

Ces restrictions faites, il faut reconnaître que *S. diapensioides* est très rare dans le Val de Bagnes. Les quatorze rochers décrits ne sont rien en comparaison des grandes étendues rocheuses prospectées et n'ont montré que nonante individus de notre *Saxifraga*. Pour ces rochers, ce nombre ne pourra guère être augmenté par des recherches ultérieures. *S. diapensioides* mérite donc d'être respecté, d'autant plus qu'il se multiplie apparemment très peu. Comme ses fleurs, très belles, sont généralement fanées dès le début de juillet, il attire peu l'attention des vacanciers. Certains individus de la plante sont d'ailleurs heureusement presqu'inaccessibles.

La grande majorité des individus observés étaient isolés sur des parois calcaires presque verticales et s'y nichaient sous de légers surplombs. *S. diapensioides* ne cohabitait étroitement avec d'autres espèces qu'exceptionnellement. Seul, le rocher 13 nous a montré des individus sur une face presque horizontale; c'était aussi le seul endroit où il y avait des plantes jeunes; c'était aussi le seul site où *S. diapensioides* bénéficiait d'un léger couvert, celui d'un Mélèze.

Partout ailleurs, on ne trouvait que des plantes adultes, – de quel âge, je l'ignore –, et en des sites tout à fait découverts. Le tapis végétal y était formé de plantes souvent largement isolées les unes des autres; son recouvrement ne dépassait pas 5 à 10% des parois rocheuses, du moins pour ce qui était des plantes supérieures.

Les sites en question relèvent du *Potentillion caulescentis* Br.-Bl. dont *Asplenium ruta-muraria* L., *Globularia cordifolia* L., *Kernera saxatilis* (L.) Rchb., *Rhammus pumila* Turra et *Saxifraga paniculata* Miller sont des caractéristiques. Les associations du *Potentillion caulescentis* hébergent souvent des taxons paléoendémiques, parfois très étroitement localisés. *Saxifraga diapensioides* est un de ces taxons.

Les rochers à *S. diapensioides* du massif de Pierre-Avoi, situés à une altitude plus élevée (2230–2410 m), portaient *Arctostaphylos uva-ursi* (L.) Sprengel, *Athamanta cretensis* L., *Carex sempervirens* Vill., *Hieracium villosum* L., *Leontopodium alpinum* Cass., *Rhammus pumila* Turra et *Saxifraga moschata* Wulfen subsp. *rhodanensis* Braun-Blanquet, qui manquaient aux rochers des deux autres groupes. A l'exception d'*Athamanta cretensis* L., ces espèces sont pourtant présentes à proximité des rochers de ces deux autres groupes. Sur les deux rochers du fond de la vallée, sous Le Tseppi, *Globularia cordifolia* L., *Gypsophila repens* L. et *Helianthemum ovatum* (Viv.) Dunal manquaient également. Les rochers de Plan de la Dzeu se singularisaient par la présence de *Campanula cochleariifolia* Lam. et de *Sedum dasyphyllum* L. Ces différences entre les trois groupes de rochers ne marquent sans doute que des variations locales (altitudinales) d'une même association, le *Potentillo-Hieracietum* Br.-Bl.

Sur les parois rocheuses exposées, *Saxifraga diapensioides* résiste à de fortes variations de température et à une sècheresse qui peut être très forte durant de longues périodes. Rien ne le protège du froid en hiver. Cette espèce a les caractères des plantes des nunataks.

Je remercie ceux qui ont déterminé certaines plantes citées: P. AUQUIER (*Festuca*), R. CLARYSSE (*Lichenes*), B. DE RETZ(*Hieracium*), F. DEMARET, G. RAEYMAEKERS et R. WILCZEK (*Bryophyta*).

août 1979

NOTES ON AMERICAN GESNERIACEAE VII

A. J. M. LEEUWENBERG

Laboratory of Plant Taxonomy and Plant Geography, Agricultural University, Wageningen, The Netherlands

INTRODUCTION

Some years ago two new Gesneriaceae species have been collected in French Guiana, which are described here at the request of the discoverer, J. J. DE GRANVILLE. They belong to the genera *Drymonia* and *Episcia.*

Drymonia psila Leeuwenberg, **sp. nov.** **Fig. 1, p. 240**

Herba epiphytica glaberrima. Folia opposita petiolata per paria valde inaequalia, laminis anguste ellipticis vel ovatis, apice longe acuminatis basi obliqua integris. Flores axillares solitarii pedicellati. Sepalorum pallide viridium basi connatorum obtusorum integrorum quattuor oblique ovata et unum dorsale circum calcarem curvatum oblongum. Corolla fere alba oblique tubulosa limbo patente lobis subaequalibus suborbicularibus fimbriatis. Stamina quattuor didynama filamentis basi connatis antheris oblongis. Ovarium ovoideum apice solum appresse pubescens. Stylus glaber apice curvatus. Stigma crassum capitatum. Disci glandula dorsalis magna. Capsula ovoidea.

Typus: French Guiana: near Saul, de Granville 2000 (WAG, holotype; CAY, isotype).

Epiphytic herb 30–50 cm high, entirely glabrous except for some hairs at the apex of the ovary. *Stems* sappy, slightly or not branched, terete, 5–8 mm in diam., thinner when dry. *Leaves* succulent and brittle when fresh, more or less papery when dry, opposite, petiolate, those of a pair strongly unequal; blade medium green above, much paler beneath; larger: petiole 10–30 mm long; blade narrowly elliptic, 3.5–4 × as long as wide, 10–24 × 2.5–6.5 cm, long-acuminate at the apex, obliquely cuneate at the base, entire; smaller 2–10 × shorter; petiole 2–10 mm long; blade obliquely ovate or elliptic, 2–4 × as long as wide, 2–8(–13) × 0.5–3.5(–5.5) cm, acuminate at the apex, obliquely cuneate or rounded at the base. *Flowers* axillary, solitary. Pedicel 5–12 mm long. *Sepals* pale green, connate at the base, obtuse at the apex, entire, brittle when fresh; 2 ventral obliquely ovate, 22–26 × 8 mm, erect, 2 lateral obliquely ovate, 25–27 × 9–10 mm, erect, the fifth (dorsal) oblong, 7–10 × 3–5 mm, curved around the spur. *Corolla* creamy, with a large pale yellow spot ventrally in the tube, 40 mm long, slightly contracted above the spur and there 5 mm wide, at the throat 7 mm; tube slightly curved, 27 mm long; spur approximately globose, 5 mm in diam.; limb 18 mm wide; lobes suborbicular, rounded,

FIG. 1. *Drymonia psila* Leeuwenberg: 1. branch, × 0.5; 2. flower, × 0.8; 3–4. corolla laterally and dorsally, × 0.8; 5. opened corolla, × 0.8; 6. androecium, × 1.6; 7. anther, × 5; 8. pistil with 4 sepals, × 0.5; 9. pistil, × 1.6; 10. stigma, × 5; 11. immature fruit, × 0.8; 12. seed, × 16 (1. Leeuwenberg 11740, flower partly from de Granville 2000; 2–11. de Granville 2000; 12. de Granville 1662).

fimbriate; the ventral 8 × 8 mm, the two lateral 6 × 5 mm, and the two dorsal ones 7 × 7 mm. *Stamens* 4, included, didynamous; filaments inserted on the corolla base, widened and connate at the base, curled after anthesis; anthers oblong, 5 × 1.5 mm, almost sagittate at the base; cells 2, parallel, dehiscent throughout by a longitudinal slit. Staminode minute, 0.5 × 0.1 mm, without anther. *Ovary* obliquely ovoid, laterally compressed, 7 × 3 × 2.5 mm, only at the extreme apex minutely appressed-pubescent; style glabrous, included, 8 × 0.6 mm; stigma large, capitate. Disk gland one, dorsal, large, curved around the base of the ovary, 1.5 × 2.5 × 1 mm, entire. Placentae ovuliferous on the inner side only. *Capsule* obliquely ovoid, laterally compressed, 18 × 10 × 7 mm, acute, minutely pubescent at the extreme apex. *Seed* longitudinally striate.

Distribution: Only known from a few collections made in French Guiana.

Ecology: Epiphytic on trees in forest. Alt. 200–700 m.

Paratypes: French Guiana: Montagnes de Kaw, de Granville 2982 (WAG, duplicate of CAY); Monts Galbao, WSW. of Saul, de Granville 1662 (CAY, WAG); ibid., Leeuwenberg 11740 (CAY, P, US, WAG).

Etymology: *ψιλός*, glabrous. *D. psila* is almost entirely glabrous.

Drymonia psila is closely allied to *D. stenophylla* (Donn. Sm.) H. E. Moore from Central America (cf. Skog 1978) by the entire leaves, entire sepals, and fimbriate corolla lobes.

Both species can be distinguished as follows:

Leaves of a pair nearly equal to strongly unequal, 5–13 × 1.1–4.2 cm, beneath glabrous or strigillose; sepals narrowly oblong to ovate, 8–17 mm long, acute, entire or rarely serrulate . . . . **D. stenophylla**

Leaves of a pair strongly unequal, larger ones of each pair 10–24 × 2.5–6.5 cm, entirely glabrous; 4 sepals ovate, 22–27 × 8–10 mm, obtuse . . . . **D. psila**

None of the other *Drymonia* species occurring in French Guiana is entirely glabrous.

Episcia xantha Leeuwenberg, **sp. nov.** **Fig. 2, p. 243**

Herba repens stolonibus suffulta caulibus tenuibus. Folia petiolata elliptica vel ovata bullata apice obtusa vel acuta basi rotundata vel subcordata, crenato-serrata supra hirto-pilosa subtus sparse hirto-pubescentia. Inflorescentia axillaris pauci vel multiflora pedunculata. Flores aggregati pedicellibus brevibus. Sepalorum viridium liberorum quattuor obovata apice serrata et unum dorsale circum calcarem curvatum anguste oblongum integrum. Corolla pallide flava oblique infundibuliformis limbo patente lobis subaequalibus suborbicularibus integris. Stamina quattuor didynama filamentis basi connatis antheris suborbicularibus. Ovarium ovoideum hirsutum. Stylus glaber apice curvatus. Stigma crassum capitatum. Disci glandula dorsalis magna. Capsula subglobosa.

Typus: French Guiana: Montagnes de Kaw, 4.32 N; 52.06 W., Leeuwenberg 11819 (WAG, holotype; isotypes: CAY, K, MO, P, U, US; U, clonotype in greenhouse).

Stoloniferous herb. *Stems* decumbent, sappy, terete, about 5–7 mm in diam., much thinner when dry, hirto-pilose, with spreading adventitious roots. *Leaves* opposite, petiolate, those of a pair equal or subequal; petiole hirsute, 1–8 cm long; blade bullate, elliptic or ovate, 1.2–2 × as long as wide, 5–20 × 3–15 cm, soft and sappy, membranaceous to papyraceous when dry, obtuse or acute at the apex, rounded, subcordate, or less often cuneate at the base, crenate-serrate, hirto-pilose and with impressed veins above, beneath sparsely hirto-pubescent and with prominent veins. *Inflorescence* axillary, pedunculate, few- to many-flowered, 3 × 3 – 7 × 7 cm. Peduncle brown-purple, sparsely pilose or glabrous, 1.5–5 cm long. Bracts resembling the sepals, but smaller. Pedicels short, 3–12 mm long. *Sepals* pale green, free, sparsely and minutely pubescent on both sides, conspicuously ciliate, 4 subequal, obovate, 10–12 × 5–8 mm, with 2–5 teeth at the obtuse apex, gradually narrowed towards the base, and erect or apically spreading, the fifth (dorsal) much narrower, 9–11 × 2–2.5 mm, acute, entire, curved around the spur. *Corolla* pale yellow with 4–5 red spots ventrally in the throat, oblique in the calyx, obliquely infundibuliform, 26 mm long, at the base 3 mm and at the throat 7–8 mm wide, not contracted, hirsute outside in the upper half, glabrous in the lower, inside partially pubescent with glandular hairs in the tube; tube 16 mm long; limb 20 mm wide; lobes subequal, broadly suborbicular, 5 × 6–7 mm, rounded, entire, spreading. *Stamens* included; filaments glabrous, curled after the pollen is shed, all connate at the base, inserted on the base of the corolla; anthers barely coherent, suborbicular, 1.2 × 1.2 mm, subacute to rounded at the apex, cordate at the base; cells parallel, discrete, dehiscent throughout by a longitudinal slit. Staminode small, glabrous, 0.5 × 0.1–0.2 mm, without anther. *Ovary* hirsute except for the glabrous base, ovoid, laterally compressed, 3–4 × 2–3 × 1.5–2.5 mm; style glabrous, about as long as the stamens, 0.8 mm thick, curved at the apex; stigma large, capitate. Disk gland dorsal, entire, glabrous, 1–1.5 × 1–1.5 × 0.5–1 mm. Placentae ovuliferous on the inner side only. *Capsule* subglobose, laterally compressed, 10 × 8–9 × 6 mm, acute or obtuse, hirto-pubescent, bivalved. *Seed* ellipsoid, obliquely striate, dark brown, 7 × 5 × 4 mm.

Distribution: Only known from some localities in French Guiana.

Ecology: On dead logs or terrestrial in forest. Alt. 200–500 m.

Paratypes: French Guiana: Montagnes de Kaw, de Granville 2931 (WAG, duplicate of CAY), 2965 (WAG, duplicate of CAY), Oldeman B-2376 (CAY): Monts Galbao, SW. of Saul, de Granville 1605 (CAY, WAG), 1659 (CAY, WAG); Carbet Maïs, near Saul, de Granville 3025 (WAG, duplicate of CAY); between Saut Maïs and Pic Matecho, 30 km ENE. of Saul, de Granville 3089 (WAG, duplicate of CAY); Mont Saint Marcel, W. of Trois Sauts, Upper Oyapock R., de Granville T-1198 (CAY, WAG).

Etymology: χανϑός, golden yellow. *E. xantha* is the only species known of *Episcia* section *Episcia* with yellow flowers.

E. xantha belongs to *Episcia* sensu stricto (cf. WIEHLER 1978) or *Episcia* section *Episcia* (cf. LEEUWENBERG 1958). This species is closely allied to *E. cupreata* (Hook.) Hanst. by the habit and the shape and size of the flowers. Both species can easily be distinguished as follows:

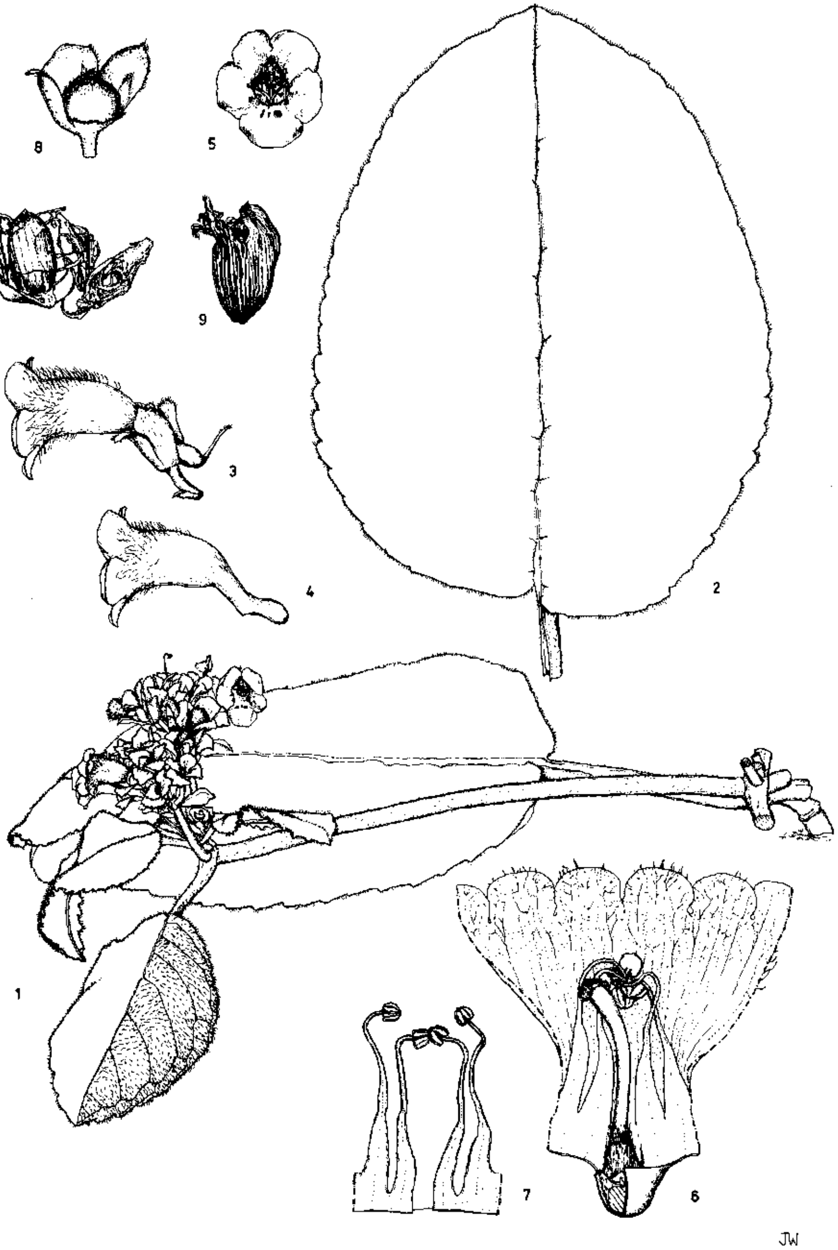


FIG. 2. *Episcia xantha* Leeuwenberg: 1. habit, × 0.5; 2. large leaf, × 0.5; 3. flower, × 1; 4. corolla, × 1; 5. apex of flower, × 1; 6. opened corolla with pistil, × 2; 7. androecium, × 2; 8. fruit, × 1; 9–10. seeds, × 20 (1–10. Leeuwenberg 11819).

Corolla scarlet; lateral and ventral sepals 3–6 × as long as wide; flowers solitary or rarely 2–3 together . . . . **E. cupreata**

Corolla pale yellow; lateral and ventral sepals about twice as long as wide; flowers arranged in distinctly pedunculate inflorescences which are mostly many-flowered . . . . **E. xantha**

ACKNOWLEDGEMENTS

The author is very grateful to Miss J. WILLIAMSON for the fine drawings.

REFERENCES

LEEUWENBERG, A. J. M. 1958. The Gesneriaceae of Guiana. Acta Bot. Neerl. **7**: 291–444.

SKOG, L. E. 1978. Gesneriaceae, Flora of Panama Part IX. Ann. Miss. Bot. Gard. **65**: 783–998.

WIEHLER, H. 1978. The genera Episcia, Alsobia, Nautilocalyx, and Paradrymonia (Gesneriaceae). Selbyana **5**: 11–60.

LES BOTANISTES HOLLANDAIS AU CAMEROUN

R. Letouzey

Laboratoire de Phanérogamie, Paris, France

Ce titre, pour l'historien de l'Afrique, évoquera immédiatement des temps déjà lointains où, de la fin du 16ème à la fin du 18ème siècle, l'activité des Hollandais se manifestait sur toutes les côtes de ce Continent. Parmi les marins, les commerçants, les administrateurs... ayant abordé le Cameroun, y aurait-il eu quelques botanistes? La réponse semble négative... 19ème siècle... 1900... 1920... 1940... 1945... 1950... toujours rien. Le premier à apparaître sur la côte camerounaise: H. C. D. de Wit, en 1955, puis à nouveau en 1957... Mais depuis 25 ans le retard de plusieurs siècles a été comblé, avec quelle fougue et quelle capacité!

L'Herbier National Camerounais de Yaoundé est certes encore un modeste Herbier par rapport à beaucoup d'autres; créé de facto vers 1950 et solidement implanté seulement depuis 1970, il rassemble déjà près de 50000 spécimens, uniquement camerounais, avec anthothèque, palynothèque, carpothèque et xylothèque annexées; sur ce nombre... le tiers environ est constitué d'échantillons recueillis par des botanistes hollandais, au Cameroun, en moins de 20 ans.

La riche flore camerounaise, que renferment mangroves, forêts, marécages, rochers, savanes, steppes, montagnes... groupe semble-t-il quelque 225 familles, 1800 genres et au moins 8000 espèces (et peut-être près de 10000). Le pourcentage de ces 8000 espèces, représenté actuellement en herbier à Yaoundé, ne peut évidemment être déterminé exactement mais, pour près de 80 familles étudiées et recensées en détail, ce pourcentage avoisine 90% (1096 espèces représentées sur 1219 inventoriées), l'échantillonnage pour chaque espèce étant (toujours pour ces 80 familles) composé en moyenne de 7 spécimens.

Un tel résultat aurait-il été atteint en quelques années sans la contribution des botanistes hollandais?... Ceci est fort peu probable. Reprenons la chronologie de l'oeuvre:

Fidèle à la tradition maritime de son pays, H. C. D. de Wit débarque à Douala en juillet 1955; en quelques semaines il reconnaît le pays, par Yaoundé, Nkongsamba, Garoua, Maroua, Ngaoundéré et juge de son intérêt; il approfondira ses connaissances de la forêt camerounaise en décembre 1957, se rendant à Mbalmayo, Ebolowa, Ayos, Obala, Bafoussam, Nkongsamba. Quel agréable compagnon, escaladant les pentes herbeuses du Manengouba, assis sur les banquettes rustiques d'une étroite pirogue sur le Nyong, se glissant dans les sous-bois pour découvrir quelque *Dorstenia* ou quelque *Ardisia*... tout en parlant de ses expériences indonésiennes ou sudafricaines. L'Afrique tropicale... il commence à la découvrir et s'y attache car il entreprend très rapidement d'innombrables voyages (aériens à présent) qui font de lui, jusqu'à maintenant, le véritable 'Hollandais volant' du siècle; volant à la découverte des sites et des territoires où ses élèves, progressivement formés par lui-même, à Wageningen – et avec quelle méthode, quelle conscience et quelle efficacité!, prendront place peu à peu, qui dans une Université, qui dans un Service forestier, qui dans un projet d'un Organisme international, qui comme enseignant dans une école d'Agronomie, qui avec l'assistance d'un accord bilatéral,... Pour établir tout ce réseau il faut des contacts et H. C. D. DE WIT recherche certainement autant les contacts avec les hommes que les contacts avec les plantes.

Le premier 'placé' en Afrique, c'est – au Cameroun – F. BRETELER (15 août 1960 – 8 septembre 1962) puis, pratiquement sans interruption jusqu'à ce jour, un élève ou disciple de H. C. D. DE WIT a été présent dans ce territoire: W. DE WILDE et B. DE WILDE-DUIJFJES (1er novembre 1963 – 31 octobre 1964), A. LEEUWENBERG (2 mars 1965 – 19 février 1966), J. BOS (20 août 1968 – 21 septembre 1970), à nouveau A. LEEUWENBERG (2 juillet 1971 – 30 novembre 1972), J. DE WILDE (27 août 1974 – 12 février 1976), C. GEERLING (11 octobre 1973 – 20 juin 1977), P. WIT (2 octobre 1974 – 3 août 1975), E. WESTPHAL (1er mars 1975 – 8 juillet 1979), sans parler de missions de plus courtes durées effectuées par J. DE WILDE (2 novembre au 31 décembre 1964, 30 septembre au 7 octobre 1978), F. BRETELER (8 au 23 octobre 1968, 18 au 31 août 1970, 5 au 20 décembre 1971, 30 septembre au 7 octobre 1978), A. LEEUWENBERG (20 juin au 15 juillet 1970, 22 septembre au 5 décembre 1977), C. BERG (12 avril au 15 mai 1972), H. VAN DEN BURG (1er novembre 1977 au 25 août 1978), C. GEERLING (12 avril au 10 mai 1979), ou encore des passages de H. C. D. DE WIT venu 'visiter' ses botanistes (17 au 19 septembre 1968, octobre 1971, 13 au 18 août 1975,...).

La carte ci-jointe montre qu'il reste peu de zones où le pied et la main de botanistes hollandais n'aient foulé le sol camerounais, en dehors de zones lointaines ou difficiles d'accès; mais c'est aussi par des récoltes intensives autour de lieux de résidence permanente spécialement choisis que se sont accumulés des matériaux régionaux fort précieux pour l'étude de la flore et de la phytogéographie camerounaises: GEERLING et WIT à Garoua; LEEUWENBERG à Nkongsamba; BRETELER, W. DE WILDE, LEEUWENBERG et WESTPHAL à Yaoundé; BOS à Kribi; J. DE WILDE à Ebolowa.

A titre documentaire, le tableau ci-après mentionne les récoltes effectuées, au Cameroun, par ces différents botanistes, échantillons déposés à Wageningen (WAG) et qui, déduction faite des parts uniques ou non remises à Yaoundé pour diverses raisons, représentent en gros le tiers de l'Herbier National Camerounais (YA). Ces échantillons, habilement récoltés, bien séchés, correctement présentés, sont toujours accompagnés de renseignements morphologiques détaillés, de localisations géographiques précises et de données écologiques intéressantes, souvent aussi de matériel en liquide conservateur ou de bois; récoltés chaque fois que possible en un assez grand nombre de parts, celles-ci ont fait l'objet de distributions importantes dans un grand nombre d'Herbiers mondiaux (en utilisant les sigles internationaux sur le sujet: A, B, BM, BR, C, EA, FHI, FHO, FI, G, GC, HBG, K, LISC, LUAI, M,

Signe cartographique	Nom	Numéros	Total
●	H. C. D. de Wit	200–709 (1955); 1–408 (1957)	918
✚	F. Breteler	182–3006	2825
◆	W. de Wilde et B. de Wilde-Duyfjes	1115–5113	3999
✖	A. Leeuwenberg	4997–6241; 6263–7038; 7318–7810; 7860–7897; 8125–10706; 11570–11593	5158
△	J. Bos	2951–7353	4403
◇	J. de Wilde	7412–8751	1340
▽	C. Geerling	4431–5780; 5977–6080	1453
▬	P. Wit	2900–3170	171
▮	E. Westphal	8695–10230	1536
○	H. van den Burg	1–120	120
		soit au total	21.923

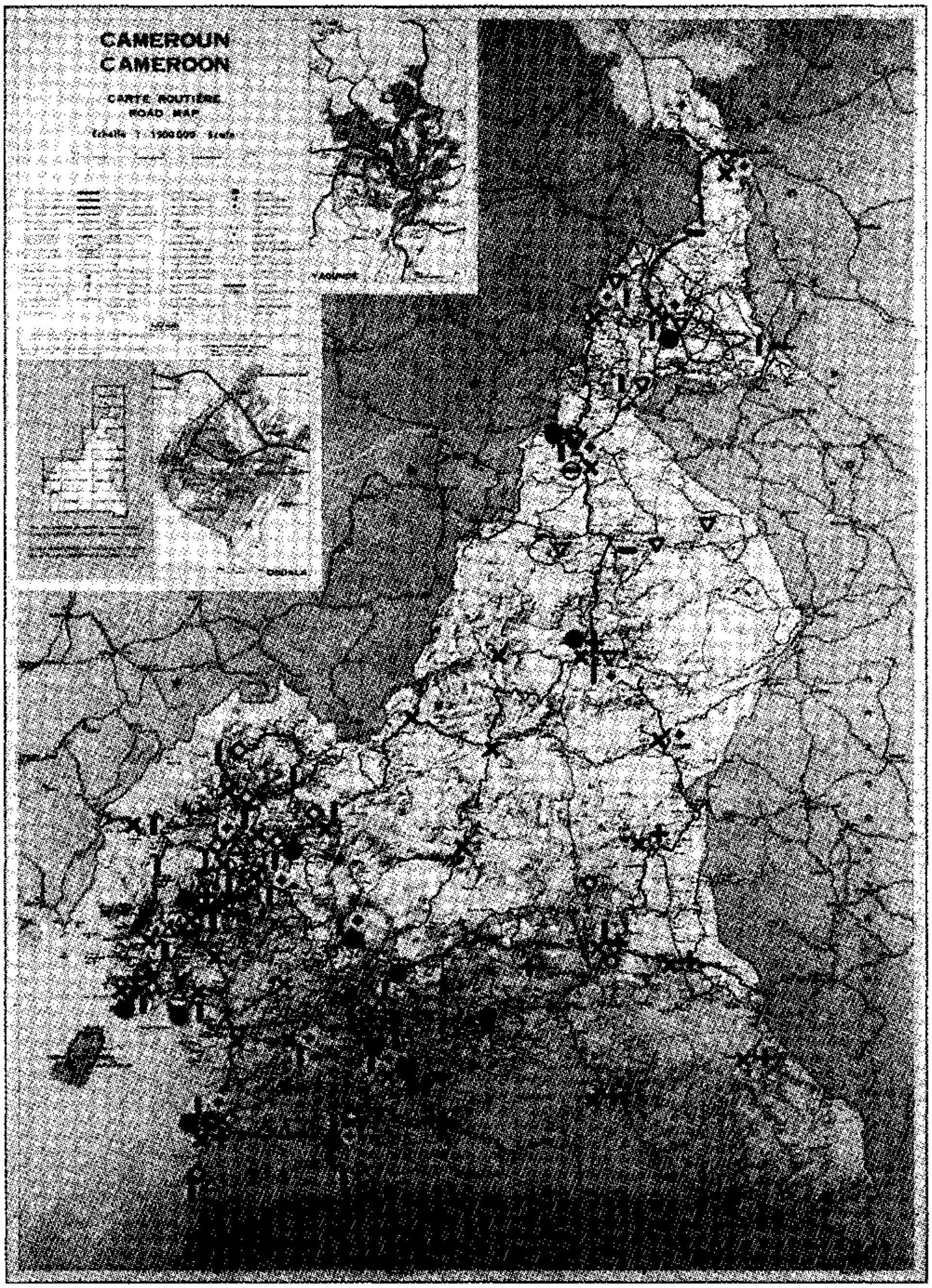
MO, NLI, P, PRE, SRGH, U, UC, UPS, Z, ...).

Au matériel desséché d'herbier proprement dit, il faut ajouter les graines, boutures ou jeunes plants mis en culture dans les Serres de Wageningen et qui ont à leur tour fourni un matériel d'étude intéressant en particulier pour les travaux de J. Arends, cytologiste attaché à l'Herbier de Wageningen.

A diverses reprises, les collecteurs ci-dessus ont travaillé ensemble (Bos et Breteler; Leeuwenberg et Breteler; Breteler, J. de Wilde et Leeuwenberg; W. de Wilde et Leeuwenberg; W. de Wilde et J. de Wilde; J. de Wilde et De Wit; Breteler et J. de Wilde, ...) mais ont aussi fait appel pour les aider aux Assistants de l'Herbier National Camerounais de Yaoundé (MM. Biholong, Dang, Koufani, Mbamba, Mezili, Mpom, Nana, Otthou, ...), les faisant profiter de leurs connaissances scientifiques et bénéficiant en contrepartie de l'expérience permanente de ceux-ci; ailleurs ce sont des personnes de l'Ecole de Faune de Garoua (MM. Bosch, Mayouo, Nene, Ngog, ...) ou de l'Ecole Nationale Supérieure d'Agronomie de Yaoundé (MM. Dehok, Nloga, ...), voire même... des épouses (MMmes B. de Wilde-Duyfjes, J. Westphal-Stevels) qui ont été mises à contribution. Du 31 janvier au 7 février 1962 une équipe ('Mission Camerounaise 1962'), composée de Breteler, J. de Wilde, Leeuwenberg et Letouzey, gravissait le Mont Cameroun et y récoltait quelque 300 échantillons.

L'étude de toutes les 'récoltes hollandaises' au Cameroun est à peine entreprise et déjà des nouveautés ont pu être attribuées en hommage à ces collecteurs:

- *Leeuwenbergia* R. Let. et N. Hallé, Euphorbiaceae; *in* Adansonia, ser. 2, 14 (3): 380 (1974).


CAMEROUN
CAMEROON
CARTE ROUTIÈRE
ROAD MAP
Échelle 1 : 1 500 000 Scale
YAOUNDE
DOUALA

- *Ardisia dewitiana* Taton, Myrsinaceae; *in* Bull. Jard. Bot. Nat. Belg. 49 (1/2): 96 (1979).
- *Culcasia bosii* C. Ntepe, Araceae; inéd. (sous presse).
- *Hymenostegia breteleri* Aubréville, Caesalpiniaceae, d'après Breteler 2232; *in* Flore du Cameroun 9: 104 (1970).
- *Rhaptopetalum breteleri* R. Let., Scytopetalaceae, d'après Breteler 2754; *in* Adansonia, ser. 2, 17 (2): 134 (1977).
- *Memecylon breteleranum* Jac.-Fél., Melastomataceae, d'après Breteler 2932; *in* Adansonia, ser. 2, 18 (4): 420 (1979).
- *Dichapetalum dewildei* Breteler, Dichapetalaceae, d'après J. De Wilde 8493; *in* Mededelingen Landbouwhogeschool Wageningen, 78 (10): 56 (1978).
- *Warneckea wildeana* Jac.-Fél., Melastomataceae, d'après J. De Wilde 8686; *in* Adansonia, ser. 2, 19 (3): 253 (1979).
- *Memecylon amshoffae* Jac.-Fél., Melastomataceae, d'après Leeuwenberg 5142; *in* Adansonia, ser. 2, 18 (4): 410 (1979). Espèce dédiée à J. AMSHOFF, habile déterminatrice expérimentée qui, à Wageningen, a procédé à l'identification de très nombreux échantillons camerounais.

Plusieurs espèces ou variétés camerounaises, nouvelles pour la Science, sont à présent décrites – d'après des échantillons récoltés par les botanistes hollandais au Cameroun – et la liste ci-après, certainement incomplète mais montrant manifestement l'intérêt de ces collections, s'accroîtra certainement de jour en jour; pour s'en tenir à l'échelon spécifique: *Adenia letouzeyi* W. De Wilde, Passifloraceae (W. De Wilde 2285); *Adenia tricostata* W. De Wilde, Passifloraceae (Breteler 1465); *Ardisia ebolowensis* Taton, Myrsinaceae (W. De Wilde 1954); *Ardisia etindensis* Taton, Myrsinaceae (W. De Wilde 1256); *Begonia bonus-henricus* J. De Wilde, Begoniaceae (J. De Wilde 8281-A); *Clerodendrum anomalum* R. Let., Verbenaceae (Leeuwenberg 9540); *Dichapetalum barbatum* Breteler, Dichapetalaceae (Bos 4318); *Diospyros longiflora* R. Let. et F. White, Ebenaceae (W. De Wilde 1735); *Dorstenia involucrata* Hijman et Berg, Moraceae (Bos 3428); *Leeuwenbergia africana* R. Let. et N. Hallé, Euphorbiaceae (Leeuwenberg 9791); *Maranthes sanagensis* F. White, Chrysobalanaceae (Leeuwenberg 5476); *Memecylon amshoffae* Jac.-Fél., Melastomataceae (Leeuwenberg 5142); *Momordica obtusisepala* Keraudren, Cucurbitaceae (Breteler 1838); *Pyrenacantha cordicula* Villiers, Icacinaceae (Leeuwenberg 2084); *Strychnos asterantha* Leeuwenberg, Loganiaceae (Breteler 2963); *Strychnos campicola* Gilg ex Leeuwenberg, Loganiaceae (Leeuwenberg 5447); *Strychnos canthioides* Leeuwenberg, Loganiaceae (Leeuwenberg 7008); *Strychnos chromatoxylon* Leeuwenberg, Loganiaceae (Breteler 2161); *Strychnos elaeocarpa* Gilg ex Leeuwenberg, Loganiaceae (Leeuwenberg 7005); *Strychnos mimfiensis* Gilg ex Leeuwenberg, Loganiaceae (Leeuwenberg 6821); *Strychnos urceolata* Leeuwenberg, Loganiaceae (Breteler 2803); *Trichilia zewaldae* J. De Wilde, Meliaceae (W. De Wilde 2848); ...

Dans cette liste apparaissent déjà les noms mêmes de botanistes hollandais comme noms d'auteur de nouvelles espèces.

D'autres taxons nouveaux ont aussi été décrits par eux, à partir de matériel camerounais de provenances diverses, tel *Strychnos ternata* Gilg ex Leeuwenberg, ... mais il faut mettre ici l'accent sur la ligne de conduite préconisée par H. C. D. DE WIT, visant à faire réaliser par ses élèves et disciples, à l'échelle africaine (voire africaine et malgache, plus rarement mondiale dans le cas des genres *Adenia* et *Dracaena*), des monographies de genres ou de familles: *Loganiaceae* puis *Apocynaceae* par LEEUWENBERG et ses étudiants. *Dichapetalaceae* par BRETELER, *Dracaena* par BOS, *Trichilia* puis *Begoniaceae* par J. DE WILDE, *Adenia* et autres *Passifloraceae* par W. DE WILDE, familles auxquelles il faut ajouter les *Moraceae* étudiées par BERG (et ses élèves M. HIJMAN et J. WEERDENBURG).

Ces études monographiques seront presque directement utilisables pour l'élaboration de la Flore du Cameroun; celle-ci comprend à ce jour 20 fascicules, parus depuis 1963, groupant 79 familles (dont 26 de Ptéridophytes), 396 genres (dont 68 de Ptéridophytes) et 1219 espèces (dont 257 de Ptéridophytes), pour un total de 8970 échantillons cités (dont 1572 pour les Ptéridophytes); elle représente par ailleurs 3485 pages avec 2781 de texte (372 se rapportant aux Ptéridophytes) et 704 planches d'illustration (dont 55 de Ptéridophytes). Parmi ces 20 fascicules, le numéro 11 (paru en 1972), concernant les *Loganiaceae* (51 espèces), est dû à A. LEEUWENBERG; un prochain fascicule traitera des *Moraceae* par C. BERG, un suivant des *Dichapetalaceae* par F. BRETELER, lequel a déjà soutenu une Thèse de Doctorat (1973) sur ce sujet et a déjà publié plusieurs fragments de ses études: The African *Dichapetalaceae;* III (1973), IV (1978), V (1979). W. DE WILDE a, pour sa part, réalisé sous forme de Thèse de Doctorat (1971), une monographie mondiale du genre *Adenia.*

C'est dire aussi que la collaboration entre ces botanistes hollandais s'est traduite sur le terrain, au Cameroun spécialement, par une accumulation remarquable de matériel concernant les huit familles ci-dessus mentionnées et que, à l'heure actuelle, les Herbiers de Wageningen et de Yaoundé sont ainsi spécialement riches en échantillons, espèces et genres camerounais appartenant à ces familles.

'Monographies de genres ou de familles', 'Flores locales'... deux tendances de la systématique; la première répond à un besoin fondamental, quitte à ce qu'il soit satisfait dans un avenir assez lointain; la seconde est motivée par un besoin pratique, souvent immédiat. On peut estimer que les deux voies sont à suivre parallèlement car elles s'épaulent et s'étayent mutuellement; l'exemple donné par H. C. D. DE WIT et son École est là pour attester la valeur de cette position.

Mais à côté de ces recherches et études monographiques se trouvent quelques publications éparses intéressant aussi directement la flore du Cameroun:

H. C. D. DE WIT. Revision of *Afrardisia* Mez (*Myrsinaceae*). Blumea, Suppl. 4: 242–262 (1958).

F. BRETELER. Revision of *Abrus* Adanson (*Papilionaceae*) with special reference to Africa. Blumea 10: 607–624 (1960).

T. HAGOS (et H. C. D. DE WIT). A revision of the genus *Parkia* R. Br. (*Mim.*) in Africa. Acta Bot. Neerl. 11: 231–265 (1962).

R. OLDEMAN. Revision of *Didelotia* Baill. (*Caesalpin.*). Blumea 12: 209–239 (1964).

M. RISSEEUW. A revision of the genus *Buchholzia* Engler (*Capp.*). Acta Bot. Neerl. 13: 161–174 (1964).

P. VAN MEER. A revision of the genus *Pentadesma* Sab. (*Guttiferae*). Bull. Jard. Bot. Bruxelles 35: 411–433 (1965).

F. BRETELER. The Atlantic species of *Rhizophora*. Acta Bot. Neerl. 18(3): 434–441 (1969).

J. BOS. On *Phyllobotryon* Muell. Arg. (*Flacourtiaceae*). Acta Bot. Neerl. 24(2): 229–236 (1975).

H. VAN DOORN-HOEKMAN. *Rhinopteryx* Niedenzu and *Acridocarpus* (G. Don) Guill. et Perr. (*Malpighiaceae*) united. Acta Bot. Neerl. 24 (1): 69–82 (1975).

F. BRETELER et A. SMISSAERT-HOUWING. Revision of *Atroxima* Stapf and *Carpolobia* G. Don (*Polygalaceae*). Meded. Landb. hogesch. Wageningen 77(18): 1–45 (1977).

N. HALLÉ et J. DE WILDE. *Trichostephanus acuminatus* Gilg (*Flacourtiacées*), une approche biosystématique. Adansonia, sér. 2, 18 (2): 167–182 (1978).

W. CRUSIO. A revision of *Anubias* Schott (*Araceae*). Meded. Landb. hogesch. Wageningen 79 (14): 1–48 (1979).

Toutes les récoltes et publications ci-dessus ne représentent en fait qu'une partie de la contribution des botanistes hollandais nommés à la connaissance de la flore et de la végétation de l'Afrique car leur activité s'est étendue aussi, à plusieurs reprises, à d'autres territoires africains, du Mali et de la Sierra Leone à l'Ethiopie, au Mozambique, à l'Afrique du Sud; en plusieurs territoires africains ont aussi travaillé d'autres botanistes hollandais qui n'ont pas fréquenté le Cameroun, encore élèves ou disciples de H. C. D. DE WIT, depuis 20 ou 25 ans. Dresser l'inventaire de toute cette activité dépasse le cadre de notre présentation mais, par le seul exemple camerounais, on mesure toute l'importance et le rôle des botanistes hollandais dans la contribution internationale à la connaissance de la botanique tropicale au cours des toutes dernières années, aussi combien l'oeuvre de H. C. D. DE WIT et de son École, en Afrique tropicale et plus spécialement au Cameroun, a été extraordinaire – il ne faut pas avoir peur de ce terme – durant ce bref laps de temps.

A la systématique fondamentale proprement dite, il faut ajouter tout le côté utilitaire de la botanique camerouno-hollandaise que l'on ne peut passer sous silence: Collecte spéciale de lianes forestières par BRETELER, venant enrichir la xylothèque de l'Herbier National de Yaoundé; récoltes pour études chimiques d'*Apocynaceae* et de *Loganiaceae* (aussi de *Menispermaceae* et d'autres plantes) par LEEUWENBERG, en compagnie du pharmacognosiste suédois FINN SANDBERG; recherches sur les relations des plantes et de la faune sauvage par GEERLING, dans le Nord Cameroun; études des produits végétaux commercialisés sur les marchés, sous toutes leurs formes, ainsi que des plantes alimentaires des marchés, des jardins de cases, des champs de cultures (et ceci pour les différentes régions écologiques du pays) par WESTPHAL. Ces deux derniers sujets font d'ailleurs l'objet de publications particulières de la part de leurs auteurs, soit parues (E. WESTPHAL, P. MBOUEMBOUE et MOUZONG BOYOMO. – A Conspectus of Spices in Cameroon. Comm. n° 7, Depart. Agric., ENSA, Centre Univ. de Dschang, 50 pp., 1978), soit à paraître (C. GEERLING. – Flore forestière de la savane ouest-africaine; E. WESTPHAL et al. – Les plantes alimentaires au Cameroun).

On ne peut manquer enfin de souligner la contribution de quelques uns de ces botanistes hollandais à des tâches d'enseignement de la botanique systématique, avec cours et travaux pratiques (en langue française!), particulièrement de W. DE WILDE et de LEEUWENBERG dans les premières années de fonctionnement de l'Ecole Supérieure d'Agriculture de Yaoundé, puis surtout de GEERLING, durant 4 ans, à l'Ecole de Faune de Garoua (avec des cours de botanique, d'écologie), ainsi que de WESTPHAL, durant 4 ans aussi, à l'Ecole Nationale Supérieure Agronomique de Nkolbisson près Yaoundé (avec des cours sur les cultures vivrières et maraîchères, les épices, les systèmes agricoles); tous les problèmes écologiques et agronomiques abordés reposaient sur de remarquables connaissances botaniques et l'enseignement fût toujours conduit dans le souci de concilier applications pratiques et rigueur taxonomique.

Que dire encore des enseignements dispensés, à Wageningen même, par les Assistants de H. C. D. DE WIT: BOS, BRETELER, J. DE WILDE, LEEUWENBERG qui assurent la formation, continue et méthodique, de jeunes systématiciens hollandais pour l'Afrique tropicale, en plus de leurs propres travaux personnels et de leurs séjours sur le terrain!

On revient ainsi rapidement au 'Grand patron' qui a monté ce Laboratoire – avec quelle maîtrise!, et à cet Herbier de Wageningen où l'on est toujours certain de recevoir un excellent accueil. A l'occasion, H. C. D. DE WIT vous y parlera, avec grande modestie, de son Encyclopédie ('De Wereld der planten', 3 vol. 1963–1966), de ses recherches sur les plantes aquatiques ('Aquariumplanten', 1966), toutes publications déjà traduites en plusieurs langues, de ses études sur quelque taxon indonésien ou africain; il évoquera aussi ses chansons françaises préférées, l'aspect touristique des derniers pays visités, quelques citations de RABELAIS ('Zeer beminde zoon', 1969, traduit en coopération avec WARNERS), même si GARGANTUA a oublié de dire à son fils PANTAGRUEL: 'En wat de kennis van de natuurlijke historie betreft, wil ik dat je je er geïnteresseerd aan wijdt, ... tous les arbres, arbustes et fructices des forestz, toutes les herbes de la terre...: niets zij je onbekend'. H. C. D. DE WIT, même sans ces conseils paternels, a montré combien il connaissait les plantes pour avoir su les faire étudier d'une aussi magistrale façon.

LES RÉCOLTES DE PAUL BRIART (1860–1920) AU SHABA (ZAÏRE)

L. Liben

Jardin botanique national de Belgique, Domaine de Bouchout, B-1860 Meise (Belgique)

Un heureux hasard m'a fait découvrir dans les archives du Jardin botanique national de Belgique un cahier de récolte anonyme mais admirablement illustré de dessins au crayon, la plupart réhaussés d'aquarelle, se rapportant aux récoltes de Paul Briart au Zaïre; il s'agit d'un cahier cartonné, ligné, de format 29 × 19,5 cm, contenant de longues descriptions d'une soixantaine de plantes, dont de très nombreuses orchidées; il est probable que les dessins ont été réalisés, en partie au moins, d'après du matériel frais, comme le suggèrent par exemple les no. 35 et 44 qui nous montrent le port de la plante, et le no. 22 qui représente, en couleur, une fleur d'orchidée dont le volume est rendu avec beaucoup de netteté et de réalisme. Peut-on en conclure que c'est Paul Briart lui-même qui a exécuté sur place tous les dessins et rédigé toutes ces minutieuses descriptions? Cela parait probable quand on lit une phrase telle que celle-ci *après* la description du no. 10, et que cette phrase est manifestement écrite de la même main que cette description: 'de nombreuses espèces de glaïeuls se rencontrent sur le cours du voyage que nous avons fait, depuis Ndounga, jusqu'à Mussima, n. point S extrême'. Si, comme je le pense, tout cela a été rédigé sur place, on ne peut qu'admirer le soin méticuleux avec lequel Briart a travaillé, dans des conditions qui d'après ses lettres de l'époque, étaient loin d'être confortables (Briart, 1892).

Nous ignorons si E. de Wildeman et Th. Durand, qui furent les premiers à publier les résultats de l'étude des collections Briart, connaissaient l'existence du cahier de récolte en question; ce qui est certain, c'est que d'éventuelles allusions à des notes ou croquis de Briart ne se rapportent pas nécessairement au cahier; au sujet de *Mellera briartii* De Wild. & Th. Dur., ces auteurs écrivent (1899: 212): 'L'échantillon dont nous venons de donner les caractères ne possède plus de fruits murs, ceux-ci ont été décrits d'après les notes manuscrites très soignées de M. Briart'. Le specimen est en effet fixé sur une feuille de papier portant par ailleurs une description (y compris des fruits) écrite à l'encre de la main d'Alexandre Briart, grand-père de Paul; la mention au crayon 'Rapides du Nzilo, Lualaba supérieur' est de la main de Paul Briart; en ce qui concerne les croquis, partie à l'encre, partie au crayon, qui accompagnent la description, il est impossible de les attribuer à l'un ou l'autre.

Paul Briart est mentionné dans le Sylloge de Th. & H. Durand (1909: 3) parmi les premiers récolteurs belges au Zaïre, après C. Callewaert, Fr. Hens, F. Demeuse, G. Descamps. Le sylloge lui attribue la récolte de 11 espèces et une variété de phanérogames nouvelles pour le Zaïre.

J'y ai en fait trouvé le nom de BRIART cité à propos des 16 espèces suivantes, mais d'aucune variété; le type des espèces dont le nom est en gras est un specimen BRIART:

Acanthaceae	**Barleria briartii** De Wild. & Th. Dur. (Nzilo, 1892)
	Mellera briartii De Wild. & Th. Dur. (Nzilo, 1892)
	Ruellia patula Jacq. (1e Katanga, 1894)
	Thunbergia parvifolia Lindau (1e Katanga, 1890)
Apocynaceae	*Carpodinus lanceolata* K. Schum. (Mange, Kasai)
Balsaminaceae	**Impatiens briartii** De Wild. & Th. Dur. (Nzilo, 1891)
Bignoniaceae	*Spathodea campanulata* P. Beauv. (1e Katanga)
Geraniaceae	*Biophytum sensitivum* (L.) DC. (Nzilo, 1891)
Iridaceae	**Geissorhiza briartii** De Wild. & Th. Dur. (Mussima, 1890)
Malvaceae	*Hibiscus micranthus* L.f. (Musumba, Lualaba supérieur)
Orchidaceae	*Disa erubescens* Rendle (Syn. **D. leopoldi** Kraenzl. p.p., Mussima, 1890)
	Disa walleri Reichb.f. (Syn. **D. leopoldi** Kraenzl. p.p., Mussima, 1890)
	Brachycorythis briartiana Kraenzl. (Mussima, 1890)
Scrophulariaceae	*Buchnera inflata* (De Wilde.) Skan ex Hemsl. (Syn. **Stellularia inflata** De Wild., Maniue, Katanga, 1892?)

Les sept specimens-types, et ceux-là seulement, ont été retrouvés dans les collections du Jardin botanique national de Belgique (BR); on ignore totalement ce qui a pu advenir des autres.

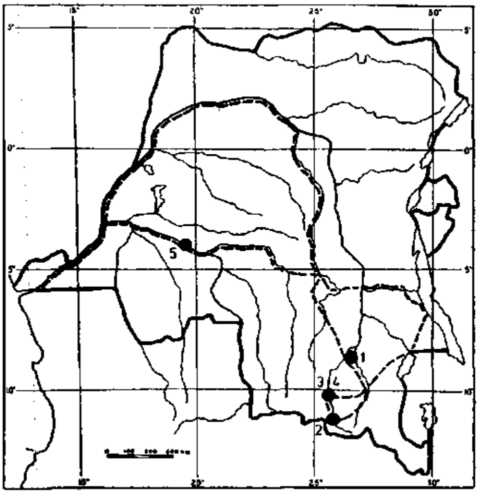
Trois des espèces nouvelles récoltées par BRIART sont, sans doute possible quant à leur identité, illustrées dans le cahier de récolte de P. BRIART, notamment: *Impatiens briartii* (no. 48), *Geissorhiza briartii* (no. 36) et *Disa leopoldi* (no. 12 et 47)[1]; sept autres dessins ont été, jusqu'à présent, identifiés jusqu'à l'espèce:

no. 10 *Gladiolus gregarius* Welw. ex. Bak. (*Iridaceae*)
no. 15 *Eulophia walleri* (Reichb. f.) Kraenzl. (*Orchidaceae*)
no. 16 *Habenaria zambesina* Reichb. f. (*Orchidaceae*)
no. 18 *Markhamia obtusifolia* (Bak.) Sprague (*Bignoniaceae*)
no. 22 *Habenaria edgari* Summ. (*Orchidaceae*)
no. 55 *Kosteletzkya buettneri* Gürke (*Malvaceae*)
no. 61 *Bombax buonopozense* P. Beauv. (*Bombacaceae*)

Retraçons succintement les circonstances dans lesquelles P. BRIART récolta des plantes au Congo: c'est en qualité de médecin de l'expédition DELCOMMUNE qu'il effectua son premier voyage en Afrique (GÉRARD: 171, 1948), qui fut aussi le plus fécond au point de vue botanique. Rappelons que l'expédition fut organisée par la

---

[1] La feuille d'herbier comporte en fait deux inflorescences: celle de gauche, actuellement étiquetée A, appartient à *Disa engleriana* Kraenzl. et est illustrée dans le cahier de récolte par le dessin no. 47; celle de droite, étiquetée B, appartient à *Disa walleri* Reichb.f. et est illustrée par le dessin no. 12. Je remercie Mr. D. GEERINCK qui a bien voulu me donner ces précisions et a déterminé les autres *Orchidaceae*, ainsi que les *Iridaceae*.



Itinéraire de Paul Briart au cours de l'expédition Delcommune (1890–1893) et lieux de récolte mentionnés dans le Sylloge de Th. & H. Durand (1909).

1. Musumba (1891) 26°35′ E 8°55′ S
2. Mussima (1891) 25°39′ E 11°23′ S
3. Maniue (1892) un peu au sud de Nzilo
4. Nzilo (1892) 25°28′ E 10°30′ S
5. Mange (1893) 19°35′ E 04°04′ S

CCCI (Compagnie du Congo pour le Commerce et l'Industrie) en vue d'explorer le Katanga (actuellement Shaba) menacé par les visées de la British South Africa, contrôlée par Cecil Rhodes (Janssens & Cateaux: 321, 1909). Briart s'embarque donc le 7 juin 1890 à Flessingue et débarque au mois d'août à Matadi (Janssens & Cateaux, loc. cit.: 321, 322), les principales étapes de l'expédition sont les suivantes[2]:

5 septembre 1890: départ de Matadi
27 septembre 1890: arrivée à Kinshasa
17 octobre 1890: départ du Stanley-pool en bateau pour remonter le fleuve Congo, puis le Lomani jusqu'à Bena-Kamba; ensuite, voyage par terre et par eau jusqu'à Gandu.
13 mai 1891: arrivée à Gandu (Janssens & Cateaux, 1908)
18 mai 1891: départ de Gandu vers Kabinda, puis vers le SE en direction du lac Kisale, où le capitaine Hakanson est tué le 30 août au cours d'une attaque des Baluba; Paul Briart le remplace comme chef de l'arrière-garde (Janssens & Cateaux: 322, 1908)
6 octobre 1891: arrivée à Bunkeya; l'expédition repart ensuite vers Lofoi où elle restera 20 jours (Briart: 150, 1892).
19 décembre 1891: arrivée à Mushima sur le Lualaba (Briart: 150, 1892), où Delcommune fait construire des embarcations pour descendre le fleuve; en fait elles n'iront pas plus loin que les rapides, infranchissables, de Nzilo; l'expédition repart alors vers Bunkeya où elle arrive le 8 juin 1892 (Janssens & Cateaux: 323, 1909), et poursuit sa route par Lofoi, Pweto, Mpala, pour suivre ensuite le cours de la Lukuga et arriver à Lusambo le 7 janvier 1893, après être repassée par Gandu; de Lusambo, elle rentre en bateau à Kinshasa où elle arrive le 5 février 1893. P. Briart revint peu après en Europe; il séjourna plusieurs fois en Afrique entre 1895 et 1908 (Gérard: 172, 1948).

Janssens et Cateaux (1908: 324) écrivent 'P. Briart rapporte d'Afrique une impor-

---

[2] Sauf indication contraire, les renseignements ci-dessous sont extraits de Van der Straeten (1951).

tante collection de documents scientifiques, sous forme d'échantillons d'histoire naturelle, de croquis, de notes sur le pays, sa flore, sa faune et ses habitants. Le plus riche trésor dont il a enrichi la science, est un registre d'observations météorologiques extrêmement complètes et consciencieusement rédigées.'

Tous les herbiers BRIART retrouvés dans les collections du Jardin botanique national de Belgique ont été récoltés au cours de l'expédition DELCOMMUNE, mais les dates renseignées dans le Sylloge sont quelque peu fantaisistes; par ailleurs, le Sylloge renseigne une seule espèce, *Carpodinus lanceolata* K. Schum., comme ayant été récoltée non pas au Katanga, mais à Mange, Kasai, vraisemblablement une escale sur la rivière Kasai au cours du voyage de retour. La carte indique les lieux de récolte avec les coordonnées géographiques et l'année de la récolte.

Sans doute l'intérêt de PAUL BRIART pour la botanique lui fut-il transmis par son grand-père ALEXANDRE BRIART (décédé en 1896) qui fut chirurgien aux armées belgo-hollandaises, puis médecin de plusieurs charbonnages du Centre (STOCKMANS, 1901); botaniste amateur et ami de FRANÇOIS CRÉPIN, il était membre de la Société royale de Botanique de Belgique, comme son petit-fils dont le nom figure dans la liste des membres à partir de l'année 1880. En 1951, Mr. LÉON ADANT-BRIART, de la Hestre, a fait don au Jardin botanique des collections d'ALEXANDRE BRIART, soit quelque 600 plantes de Belgique et 250 autres, notamment de Suisse. A. BRIART fut, semble-t-il, parmi les premiers à étudier les collections de son petit-fils, comme le suggèrent notamment la description écrite de sa main qui accompagne le type de *Mellera briartii*, ainsi que les commentaires, à l'encre noire, intercalés dans le cahier de P. BRIART, et concernant les no. 29, 59, 60 et 61.

Rappelons pour terminer que P. BRIART a écrit plusieurs articles sur des sujets variés, et notamment botaniques; on trouvera la plupart des titres dans JANSSENS & CATEAUX: 325–326 (1909).

OUVRAGES CITÉS:

BRIART, P. (1892), in Le mouvement géographique **9** (33): 149–150.

DE WILDEMAN, E. & DURAND, TH. (1899). Matériaux pour la flore du Congo, 6. Bull. Soc. Roy. Bot. Belg. **28** (2): 210.

DURAND, TH. & H. (1909). Sylloge Florae Congolanae (Phanerogamae): 1–716.

GÉRARD, A. S. (1948). Briart (Paul) in Biographie coloniale **1**: 171–173.

JANSSENS, E. & CATEAUX, A. (1909). Les Belges au Congo **33**: 321–326.

STOCKMANS, F. (1961). Briart (Alphonse) in Biographie nationale **3**: 124–127.

VAN DER STRAETEN, E. (1951). Delcommune (Alexandre J.P.) in Biographie coloniale **2**: 258–262.

INDIA IS THE NATIVE HOME OF THE PIGEONPEA

L. J. G. VAN DER MAESEN

Germplasm Botanist, Genetic Resources Unit
International Crops Research Institute for the Semi-Arid Tropics (ICRISAT)
Patancheru P.O. 502 324, Andhra Pradesh, India

ABSTRACT

This paper adds information relevant to the question: 'What is the native home of the pigeonpea?'. This question was posed by OZA (1972) and evidence has accumulated in favour of an Asiatic origin of *Cajanus cajan* (L.) Millsp.

1. ORIGIN OF THE PIGEONPEA

OZA (1972) briefly reviewed some of the literature on the origin of the pigeonpea (*Cajanus cajan* (L.) Millsp.), a topic that has interested many scientists and on which there are many opinions. ICRISAT's attention was drawn to this interesting question in the course of its crop-improvement programs and in particular while collection, conservation, and utilization of *Cajanus* genetic resources was in progress (VAN DER MAESEN, 1976). More-detailed reviews were prepared by DE (1974) and VERNON ROYES (1976). The latter considered the dispute settled in favour of Indian origin. The large diversity and presence of many wild relatives in India (*Atylosia* spp. and other members of the subtribe *Cajaninae*) were the main reasons for various authors (VAVILOV, BURKILL, MURDOCK, (see DE, 1974) and LACKEY, 1977) to settle for an Indian origin. Absence of reports of wild plants of *Cajanus cajan* in India originally induced DE CANDOLLE (1883) and his several followers to favour an African origin.

BRUCHER (1977) still favours African origin because of the presence of a single endemic West African species, *Cajanus kerstingii* Harms.

2. OCCURRENCE OF WILD PIGEONPEAS

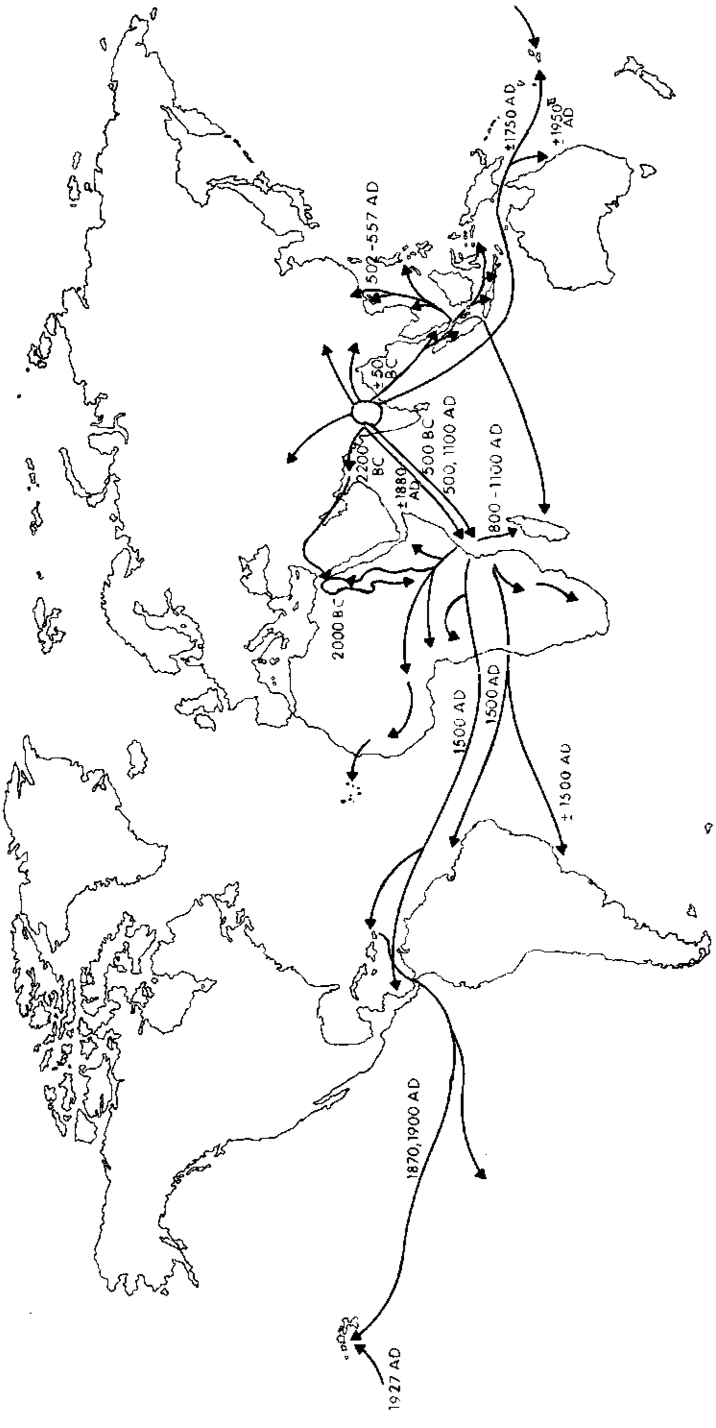
OZA (1972) appealed to naturalists to look for truly wild pigeonpeas, for truly wild *C. cajan* had not been found. Pigeonpeas growing wild were usually in circumstances where they had clearly escaped from cultivation, particularly in Africa. Pigeonpea, especially the perennial cultivars, is able to propagate itself. Very old perennial plants can be found, e.g. in Kenya, mainly in mixed cultivation or in back-yard plots. In India these also occur as a backyard vegetable crop, especially in tribal areas. In the Cumbum area of Kurnool district, Andhra Pradesh, a remnant population is reported from cultivations abandoned longer than sixty years ago by settlers who were evicted after illegally occupying forest land (L. J. REDDY, pers. commun.). On one of my own trips I observed *C. cajan* growing wild at about 1000 m altitude on Horseley Hills in the Chittoor district of Andhra Pradesh. I found plants along the roadside, with seedlings clustered together where pods had dropped. Obviously, seeds could have been spilt when being transported along the road. Grazing is not intense along these roads. The plants grew in the bushes close to the road and deeper inside as well. COLLETT & HEMSLEY (1890) reported wild occurrence of pigeonpeas in the Shan Hills Terai of Burma. Subspontaneous occurrence is not reported in India from herbarium labels or otherwise, probably due to the fairly intensive use of the land for agriculture and grazing. Only in reserved forests do pigeonpea plants have a chance to survive on their own.

3. PUTATIVE PROGENITOR OF PIGEONPEA

Atylosia cajanifolia Haines, described in 1920, is a wild species very similar to the pigeonpea, except for its large seed strophiole. The only generic character to separate *Cajanus* and *Atylosia* is the presence of a persistent seed strophiole. Nevertheless, seed strophioles are present in 144 of the 5800 pigeonpea entries available in the world collection of pigeonpea at ICRISAT Center. In March 1977 an ICRISAT expedition succeeded in finding *A. cajanifolia* on Bailadilla Hill, Bastar district, Madhya Pradesh, at 1000 m altitude and this was only the seventh documented gathering since the species was first collected. It is known from three locations in Orissa and Madhya Pradesh only. The vernacular name is 'ban arhar' which translates to 'wild pigeonpea'. This is presumably the link between *Atylosia* and *Cajanus*. Further evidence of its taxonomic state as a species separate from *C. cajan* is the existence of intergeneric crossing barriers, especially with pigeonpea as female parent. The reciprocal cross is not too difficult to obtain and in fact occurred naturally at ICRISAT Center. A plot of *A. cajanifolia* near pigeonpeas in the Botanical Garden produced hybrids through open pollination in addition to selfed seeds.

4. OCCURRENCE OF ATYLOSIA SPP. AND THEIR RELATION TO PIGEONPEA

The presence of many *Atylosia* species in India, some of which intercross with the pigeonpea, as well as the largest variation within the pigeonpea, points to an Indian origin. Northern Australia and Queensland have about ten species of *Atylosia*, most of which are endemic. *A. scarabaeoides*, which has the widest distribution of all the wild



Movement of pigeonpea from its center of diversity (prepared e.g. with data from De, 1974, and Vernon Royes, 1976).

species (India, Indo-China, Southeastern Asia, the Pacific Islands, Coastal Africa, and even Jamaica), is of apparent recent introduction outside Australasia. In West Africa *Cajanus kerstingii* Harms is found, but its seed strophiole makes it more properly an *Atylosia*. It looks similar to the pigeonpea but not so close as *A. cajanifolia*. *A. trinervia* (DC.) Gamble (South India) also has many similarities to pigeonpea; in 1977 'intergeneric' hybrids of *A. trinervia* with pigeonpea were obtained at ICRISAT. *A. lineata*, *A. sericea*, and *A. scarabaeoides* have earlier been successully crossed with pigeonpea (REDDY, 1973; DE, 1974, who also reported cytological details). Remarkable homology exists between the chromosomes of *Atylosia* and *Cajanus*. All mentioned species and all other species ever studied in *Atylosia* and *Cajanus* have 2n = 22 chromosomes. In several hybrids pairing is almost entirely normal.

In the context of the questionable nature of most reported intergeneric hybrids in *Leguminosae*, MC COMB (1975) considers the generic boundaries between *Atylosia* and *Cajanus* as misplaced. The hybrids obtained he judges to be of interspecific nature and, like most authors reporting cytology and hybridization, suggests a revision of the genera and a declaration of congenericity.

5. ARCHAEOLOGICAL REMAINS

The often repeated reference to *Cajanus* seeds in an Egyptian tomb of 2400–2200 B.C. really points to only one seed identified as such (SCHWEINFURTH, 1884). Funeral offerings in this tomb at Dra Abu Negga (Thebes) of the 12th dynasty consisted of barley, wheat, pomegranate, lentils, two broadbean seeds, and the single pigeonpea seed. This is apparently the only report of pigeonpea material found in Egyptian burial vaults and VERNON ROYES (1976) suggested reexamination of this seed. As evidence for an African origin it is very weak. Reports of archaeological remains in India became available only recently, so DE (1974) was not able to consider those. KAJALE (1974) reported an archaeological find of pigeonpea for the first time in India, at Bhokardan (Maharashtra). The seeds, of relatively small size, were found in deposits ranging in age from the 2nd century B.C. to the 3rd century A.D. From nearby Nevasa, two very small pigeonpea seeds were reported in Indo-Roman deposits dated 50 B.C. – 200 A.D. (KAJALE, 1976–1977) but these must have been some other pulse as KAJALE (1977) later states that Bhokardan yielded the only evidence available at that time.

As in Egypt, ancient remains are scarce but more are likely to be unearthed following closer scrutiny. The absence of very marked seed characteristics does not facilitate positive identification in the carbonised state.

6. LINGUISTIC EVIDENCE

DE (1974) reviewed the linguistic evidence. The earliest Indian name 'tuvari' dates from the third to fourth century A.D., but this in Sanskrit seems to have been adopted

Engraving of pigeonpea, from PLUKENET's Phytographia, tab. 213, fig. 3, 1692.

Phaseolus erectus incanus siliquis torosis Kayan dictus. Cajan arbor Indica folijs Trofolij bituminosi, siliquis Orobi Breyn *Prod. 1. forte Arbor trifolia Indica.* IB *tom. 2. Thora Paërou.* Hort. Malab. *P. 6. Anagyris Indica legumino sasiliquis torosis. PBP. Kajan. s. Katsjan Zeylanensibus. Lak-Goetum Chinensibus, uã Barbadensibus Nostratibus Pigeon-Pea*(ie) *Pisum columbarium nominatur.*

from earlier Dravidian local names. The age of African names cannot be ascertained but they are certainly old. American local names were derived from the African ones and both African and European languages are involved. The name 'pigeonpea' originated in the Americas (PLUKENET, 1692; MILLER, 1754) where the seeds were reported to be more important for pigeons than for human nutrition. No earlier references to this name were available to the author. All early references to Asiatic vernaculars including 'Kayan', hence *Cajanus*, are devoid of the name pigeonpea. A complete listing of all vernacular names runs into several pages of text.

7. CONCLUSION

Floristic, linguistic and cytological evidence points to an Indian origin of the pigeonpea, from where it was most probably distributed to Africa at least two millennia B.C. Africa is definitely a center of (secondary) diversity, since we have found there some characters not present in India (ivory flower colour and true purple stems). From Africa it was imported into the Americas. Eastwards, the crop reached Indonesia from where other introductions may have been made into Madagascar. The map is adapted from the data of the authors indicated. Present-day exchanges of landrace material and improved cultivars are taking place on a large scale between India, Africa, Latin America, and Australia. The details of taxonomy and vernacular names are under preparation by the author in a revision of the genera *Atylosia* and *Cajanus*.

8. REFERENCES

BRUCHER, H. Tropische Nutzpflanzen. Sprenger Verl. Berlin-Heidelberg-New York: 166–167 (1977).

CANDOLLE, A. DE. Origine des Plantes Cultivées. Paris: 266–268 (1883).

COLLETT, H. & HEMSLEY, W. B. On a Collection of Plants from Upper Burma and the Shan States. J. Linn. Soc. Bot. **28**: 48 (1890).

DE, D. N. Pigeonpea. In: Evolutionary Studies in World Crops; Diversity and Change in the Indian Subcontinent. Ed. Sir J. Hutchinson, London & Cambridge: 79–87 (1974).

HAINES, J. J. Plants from Bihar and Orissa. J. As. Soc. Beng. 1919 n.s. **15**: 312 (1920).

KAJALE, M. D. Plant Economy at Bhokardan. App. A in: Excavations at Bhokardan (Bhogavardhana) 1973. Nagpur University and Maharashtra Marathwada University. Eds. S. B. Dev & R. S. Gupta: **2**: 7–224 (1974).

ID. Ancient Plant Economy at Nevasa during Satavahana and Indo-Roman Periods. Bull. Deccan Coll. Res. Inst. **36**–1/4: 50–58 (1976–1977).

ID. Ancient grains from Excavations at Nevasa, Maharashtra. Geophylology **7**–1: 98–107 (1977).

LACKEY, J. A. A Synopsis of Phaseoleae. Unpubl. Thesis, Iowa State University: 28–29 (1977).

MAESEN, L. J. G. VAN DER. Germplasm collection and Evaluation in *Cicer* and *Cajanus*. Proceedings International Workshop on Grain Legumes. January 13–16, 1975. ICRISAT, Hyderabad: 229–237 (1976).

MC COMB, J. A. Is Intergeneric Hybridization in the Leguminosae possible? Euphytica **24**: 497–502 (1975).

MILLER, PH. Gardeners Dictionary ed. 4: Cytisus 22 (1754).

OZA, G. M. What is the Native Home of the Pigeonpea? Indian Forester **98**–8: 477–478 (1973).

PLUKENET, L. Phytographia, Tab. 213, fig. 3 (1692).

REDDY, L. J. Interrelationships of *Cajanus* and *Atylosia* species as revealed by hybridization and pachytene analysis. Unpubl. thesis, Kharagpur (1973).

SCHWEINFURTH, G. Further Discoveries in the Flora of Ancient Egypt. Nature **29**: 312–315 (1884).

ACKNOWLEDGEMENTS

The author is grateful for the comments and editing of G. D. BENGTSON, J. M. GREEN, M. H. MENGESHA and W. REED. ICRISAT receives support from a variety of donors, governments, foundations, incl. IBRD, IDRC, UNDP, USAID etc. The responsibility for all aspects of this publication rests with ICRISAT.

April, 1979
ICRISAT Journal Article no. 89

MERKMALS-INTROGRESSION BEI *FORSSKAOLEA* (URTICACEAE)

H. MERXMÜLLER UND H. ROESSLER

Institut für Systematische Botanik der Universität, München

1. EINLEITUNG

Die Gattung *Forsskaolea* L. besitzt zwar ein ausgedehntes altweltliches Verbreitungsgebiet von den Kapverden bis Indien und Südafrika, doch ist sie in weiten Teilen dieses Areals nur mit einer oder zwei Arten vertreten. So kommt im saharo-sindischen Bereich nur *F. tenacissima,* auf den Kanarischen Inseln nur *F. angustifolia,* in der Kapprovinz nur *F. candida* vor. Im nördlichen Ostafrika treten *F. tenacissima* und *F. viridis* auf; letztere Art hat im tropischen Afrika eine weite, wenn auch nicht geschlossene Verbreitung.

Anders liegen die Verhältnisse in Südwestafrika. Sicherlich kann es sich auch hier nicht um sehr viele Arten handeln; drei bzw. vier Arten waren bisher aus dem Gebiet angegeben, davon zwei, nämlich *F. hereroensis* und *F. eenii,* aus dem Gebiet beschrieben. Jedoch erwies es sich bei der Bearbeitung der Gattung für den 'Prodromus einer Flora von Südwestafrika' (ROESSLER 1967) als schwierig, wenn nicht unmöglich, die in den letzten Jahrzehnten erstmals in reicherem Maße gesammelten Belege sinnvoll zu ordnen und zu benennen. Die Bearbeitung wurde daher in bewußt provisorischer Form publiziert.

Diese Tatsache bewog uns, die Untersuchung und Analyse des heute vorliegenden, reichen Materials im Rahmen einer Zulassungsarbeit am Institut für Systematische Botanik der Universität München durchführen zu lassen. Fräulein ISOLDE MÜLLER hat sich dieser Aufgabe angenommen. Ihre als Manuskript niedergelegten Ergebnisse bilden, in veränderter und erweiterter Form, die Grundlage für die vorliegende Arbeit.

2. BISHERIGE FASSUNG DER ARTEN

Folgende bisher beschriebenen Sippen sind für Südwestafrika (und angrenzende Gebiete) in Betracht zu ziehen:

F. candida L.fil., Suppl.: 245 (1781)
F. viridis EHRENB. ex WEBB in HOOKER, Niger Fl.: 179 (1849)
F. candida L. fil. var. *virescens* WEDD. in DC., Prodr. 16(1):235^{56} (1869)
F. hereroensis SCHINZ in Bull. Herb. Boiss.4, App.3:51 (1896)

F. eenii RENDLE in Jour. Bot. (London) 55:203 (1917).

Die schon erwähnte *F. tenacissima* L. (unter Einschluß von *F. cossoniana* WEBB) mit nordhemisphärischer Verbreitung und die auf den Kanarischen Inseln endemische *F. angustifolia* RETZ. berühren unser Gebiet nicht und sind außerdem in sich recht einheitlich und gut abzutrennen; von der von den Kapverden beschriebenen *F. procridifolia* WEBB lag uns kein Material vor.

In den früheren Bearbeitungen tauchen die Probleme, mit denen wir konfrontiert sind, noch nicht auf. So kennt RENDLE (1917) aus Südwestafrika erst zwei Belege von *F. hereroensis*, einen Beleg von *F. eenii* und fünf Belege von *F. candida; F. viridis* war überhaupt noch nicht von dort bekannt. N. E. BROWN (1925) gibt aus dem südlichen Südwestafrika *F. candida* sowie einen Beleg von *F. hereroensis* an. Immerhin hält er bereits eine Aufsammlung (PEARSON 8546) für einen Bastard zwischen *F. candida* und *F. hereroensis* ('having the leaves and small involucre of the former combined with the lanceolate acute involucre-lobes of the latter').

Im 'Prodromus einer Flora von Südwestafrika' (ROESSLER 1967) versuchten wir, die Formenvielfalt auf drei Arten (*F. candida, F. hereroensis* und *F. viridis*) zu verteilen und wesentliche Teile des Materials in einer taxonomisch unverbindlichen Untergliederung von *F. candida* in Gruppen beschreibend darzustellen. Diese Darstellung konnte jedoch nicht befriedigen, zumal die Unterscheidung in drei Arten nach den gegebenen Schlüsselmerkmalen unzulänglich und unsicher war.

Es handelt sich also bei einer neuerlichen Bearbeitung zunächst einmal darum, die vorhandenen Merkmale nach ihrer Wertigkeit für die Sippentrennung zu prüfen und diejenigen Merkmale herauszufinden, die nicht einer modifikativen Variation unterliegen. Sodann war nach konstanten Kombinationen dieser Merkmale zu suchen.

3. DIE MERKMALE

3.1. *Blattgröße und Blattform*

Die absolute Blattgröße weist bei dem untersuchten Material einen beachtlichen Spielraum auf. Bei besonders kleinblätterigen Pflanzen messen die Blätter einschließlich Blattstiel nur etwa 1,5 cm, ihre Spreite 0,7–1 cm, bei besonders großblätterigen Pflanzen sind die Blätter insgesamt etwa 15 cm, ihre Spreite ca. 11 cm lang, d.h. es besteht im Extrem ein Größenunterschied von 1:10. Das betrifft jedoch immer nur einzelne, besonders auffallende Exemplare. Die überwiegende Anzahl hat Blätter von einer mittleren Größe, deren Spreite etwa 1,5–4 cm lang ist. Sicher ist die Blattgröße durch die Standortsverhältnisse beeinflußt. Aber selbst wenn sie für einzelne Populationen konstant sein sollte, so ist doch darauf keine Sippentrennung zu begründen.

Wichtiger ist auf jeden Fall die Blattform, ausgedrückt durch den Blattindex, d.h. das Verhältnis von Blattlänge (ohne den Blattstiel gemessen) zur Blattbreite. Während jedoch die beiden Arten *F. angustifolia* und *F. tenacissima* auch durch den Blattindex (erstere durch einen besonders hohen, letztere durch einen besonders niedrigen Wert) gut zu charakterisieren sind, liegt in Südwestafrika der Blattindex stets innerhalb desselben Variationsbereiches und auch die für verschiedene Individuengruppen erhaltenen Mittelwerte – die um 1,8–2 liegen – weisen keine charakteristischen Unterschiede auf. Da demnach der Blattindex für die Sippentrennung hier nicht brauchbar ist, wurde er in den folgenden Tabellen nicht berücksichtigt.

Selbstverständlich kann auch bei gleich oder annähernd gleichem Blattindex die etwa eiförmige Grundgestalt der Blätter etwas verschieden ausgeprägt sein, nämlich mehr oder weniger stark zugespitzt, eiförmig-abgestumpft oder elliptisch. Solche Unterschiede erweisen sich, zusammen mit anderen Merkmalen, als charakteristisch.

3.2. *Blattbehaarung*

Die Blattunterseite ist normalerweise filzig. Dieser Filz besteht aus sehr langen, dünnen, gekräuselten Haaren. Die Stärke des Filzes wechselt sehr; so kann die Blattunterseite dicht filzig sein und daher weiß aussehen, mit allen Abstufungen bis zu schwach filzig und ± grau oder auch völlig filzlos und ± grün. Im letzteren Fall sind aber die ganz jungen Blätter auch noch leicht filzig; erst beim Wachstum der Blätter tritt rasch völlige Verkahlung ein. Auf diese verschiedene Filzbehaarung nehmen die Epitheta '*candida*' und '*viridis*' Bezug. Es erwies sich jedoch, daß dieses Merkmal im Gebiet nur sehr unzureichend mit anderen Merkmalen korreliert ist. Besonders großblätterige Pflanzen haben meist nur einen schwachen Filz, umgekehrt sind jedoch kleine Blätter durchaus nicht immer stark filzig, sondern können sogar fast kahl bis ganz kahl sein.

Die Rauhheit der Blattoberfläche wird verursacht durch kurze, teils gerade, teils hakig gekrümmte, spröde, durchsichtige Haare. Form, Größe und Anzahl dieser Haare zeigen so geringfügige Unterschiede, daß sie von vornherein kein brauchbares Unterscheidungsmerkmal abgeben. Das gleiche gilt für die Haare auf den Blattnerven, dem Blattstiel und den Ästen.

Außerdem sei erwähnt, daß die Blattoberfläche kleine, dicht stehende, kreisrunde, flache Aufwölbungen zeigt, die durch darunterliegende, kugelige Kristalldrusen von Calciumcarbonat hervorgerufen sind.

Größere Bedeutung dagegen kommt den Haaren des Blattrandes zu. Sie sind in Größe und Form an einer Pflanze und auch bei Gruppen ähnlicher Pflanzen konstant, zeigen aber zwischen Gruppen verschiedenartiger Pflanzen charakteristische Unterschiede in ihrer Länge, ihrer Krümmung sowie der Breite ihrer Basis. Den besten Vergleich ermöglichen jeweils die an der Spitze der Blattzähne befindlichen Haare. Da der Blattrand meist etwas eingerollt ist, betrachtet man sie zweckmäßigerweise von der Blattunterseite her.

Als charakteristisch erweisen sich diese Randhaare zunächst bei den beiden hier nicht behandelten und, wie schon erwähnt, gut unterscheidbaren Arten *F. tenacissima* und *F. angustifolia*. Die erstere besitzt besonders lange und dabei relativ dünne und gerade, die letztere etwas kürzere, sehr kräftige, gegen die Basis hin stark verdickte, gerade bis schwach gekrümmte Haare.

Unter unserem südwestafrikanischen Material lassen sich im wesentlichen zwei Typen von Randhaaren erkennen: einerseits kurze (ca. 0,3 mm), gekrümmte, relativ dicke, weiß inkrustierte Haare mit breiter Basis (Abb. 1Bh), andererseits längere (ca. 0,5–0,8 mm), gerade oder ± gekrümmte, dünnere, an der Basis weniger stark verbreiterte Haare, die im einen Fall (Abb. 1Ah) besonders dünn und durchsichtig, im anderen (Abb. 1 Cg) etwas stärker und weiß inkrustiert sind.

3.3. *Blattrand*

Die Form des Blattrandes, d.h. die Art der Zähnung, verdient ohne Zweifel Beachtung. Zwei Grundtypen lassen sich erkennen: der geschweift-gezähnte Blattrand mit oft ziemlich weit voneinander entfernten Zähnen und seichten Buchten zwischen ihnen, in die sich ein sehr stumpfer Winkel legen läßt, und der gekerbt-gezähnte Blattrand mit stumpfen bis gerundeten Kerbzähnen und spitzen Kerbbuchten zwischen ihnen, in die sich ein entsprechend spitzer bis etwa rechter Winkel legen läßt. Diese beiden Grundtypen sind, auch wenn es zwischen ihnen Übergänge gibt, durchaus charakteristisch und deuten auf verschiedene Sippen hin.

3.4. *Blattdicke*

Da sich unter dem untersuchten Material sowohl relativ dicke, derbe, als auch dünne, zarte Blätter befinden, liegt es nahe, anhand von Blattquerschnitten zu prüfen, ob sich Unterschiede im Bau feststellen lassen, welche unter Umständen dicke und dünne Blätter verschiedenen Sippen zuweisen könnten. Es zeigt sich jedoch, daß sich beiderlei Blätter in ihrem anatomischen Bau durchaus nicht voneinander unterscheiden. Die unterschiedliche Dicke ist ausschließlich darauf zurückzuführen, daß die Zellen der oberen Epidermis und des Palisadenparenchyms bei den dicken Blättern gut doppelt so hoch sind wie bei den dünnen; auch das Schwammparenchym ist bei ersteren stärker ausgebildet und die Cuticula ist bis dreimal so dick.

Höchstwahrscheinlich ist die Blattdicke, ebenso wie die Blattgröße, durch Umwelteinflüsse modifizierbar; wenn auch kein direkter Zusammenhang zwischen Dicke und Größe besteht, so sind doch verständlicherweise die besonders großen Blätter auch immer dünner.

3.5. *Größe und Form der Hüllblätter*

Wesentlich charakteristischer als die Größe und Form der Blätter ist die Größe und Form der Hüllblätter. Beide Merkmalskomplexe sind übrigens nicht miteinander korreliert; große Hüllblätter sind durchaus nicht mit großen Blättern, kleine Hüllblätter nicht mit kleinen Blättern, breite Hüllblatter ebensowenig mit breiten Blättern gekoppelt.

Um die Merkmale der Hüllblätter vergleichen zu können, ist es wichtig, daß diese voll ausgewachsen sind. Das ist etwa dann der Fall, wenn die Früchte schon etwas entwickelt und die Antheren der männlichen Blüten abgefallen sind.

Die Hüllblätter zeigen eine lanzettliche bis obovate Grundform. Stets liegt die größte Breite etwa im oberen Drittel oder Viertel. Von hier aus sind sie nach unten hin etwas zusammengezogen oder auch gleichmäßig verschmälert, nach oben hin entweder (bei lanzettlicher Grundform) stark zugespitzt oder (bei mehr obovater Grundform) nur wenig zugespitzt, unregelmäßig abgestumpft bis abgerundet, häufig in ein vorgezoge-

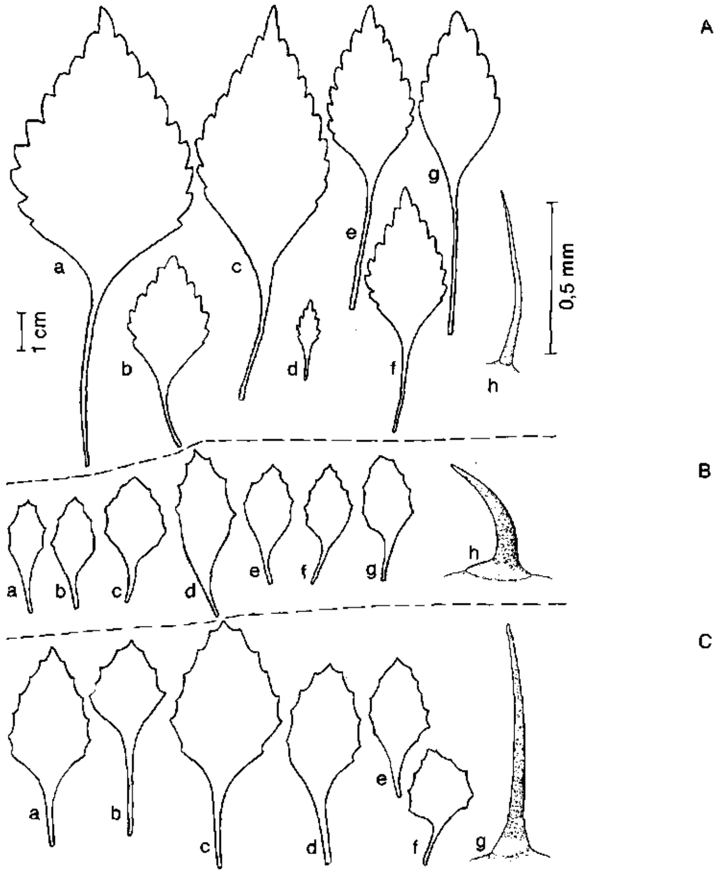


ABB. 1 Blattformen und Blattrandhaare. A: *F. viridis*. a: SEYDEL 1452. b: GIESS 13510. c: DE WINTER & LEISTNER 5222. d: GIESS 13308. e: MERXMÜLLER & GIESS 30507. f: MERXMÜLLER & GIESS 30415. g: MERXMÜLLER & GIESS 28060. h: Blattrandhaar. – B: *F. hereroensis*. a: DINTER 8189. b: MERXMÜLLER & GIESS 1646. c: HARDY 672. d: MERXMÜLLER & GIESS 28209. e: WETTSTEIN 334. f: GIESS & MÜLLER 14440. g: MERXMÜLLER & GIESS 3335. h: Blattrandhaar. – C: *F. candida*. a: KINGES 2127. b: GIESS 10421. c: STREY 2603. d: GIESS 13441. e: VOLK 12452. f: GIESS, VOLK & BLEISSNER 6965. g: Blattrandhaar.

nes Spitzchen auslaufend, manchmal (in Fällen besonders großer Breite) auch mehrzähnig.

Wie bei den Laubblättern erweist es sich als zweckmäßig, das Verhältnis von Länge zu Breite, also den Hüllblattindex, zu berechnen. Daneben ist aber auch die absolute Größe (Länge) der Hüllblätter wichtig.

3.6. *Zahlenverhältnisse innerhalb einer Infloreszenz*

Es handelt sich hierbei um die Zahl der Hüllblätter, der männlichen und der weiblichen Blüten. Der absolute Schwankungsbereich liegt zwischen 3–8 bei den Hüllblättern, 4–23 bei den männlichen und 2–7 bei den weiblichen Blüten. Zunächst läßt sich feststellen, daß an einer einzelnen Pflanze die Zahlenverhältnisse ziemlich konstant sind. Für einander ähnliche und in anderen Merkmalen übereinstimmende Individuen ergeben sich Zahlen innerhalb eines gewissen Schwankungsbereichs, wobei sich die Zahlenbereiche unterschiedlicher Individuengruppen zwar überlappen, aber doch um verschiedene Mittelwerte gruppieren.

3.7 *Pollen*

Nur anmerkungsweise sei erwähnt, daß palynologische Merkmale bei dem glatten Pollen dieser windbestäubten Gattung nicht zur Sippenunterscheidung herangezogen werden können.

4. DIE EINHEITLICHEN SIPPEN UND IHRE MERKMALSKORRELATIONEN

Im Bereich Südwestafrikas wurde das Bild bisher verwirrt durch eine Vielfalt von Einzelpopulationen mit sehr unterschiedlichem Habitus und starken Abweichungen besonders in den auffälligen Merkmalen wie Blattgröße, Blattform, Blattdicke und Stärke der Behaarung. Nachdem im vorigen Abschnitt die Merkmale im einzelnen diskutiert worden sind, gilt es nun, Kombinationen relevanter Merkmale zu finden, die einer mehr oder weniger großen Anzahl von Individuen bzw. Populationen gemeinsam sind und sich in dieser Form nur in einem bestimmten geographischen Bereich finden, also ein natürliches Areal aufweisen. Alle Abweichungen und Übergänge zwischen diesen 'Ecktypen' sollen dabei zunächst außer Betracht bleiben. Daß es solche 'Ecktypen', also Arten, geben muß, war von vornherein anzunehmen, denn es schien ausgeschlossen, den Formenreichtum der Forsskaoleen Südwestafrikas nur durch Variation einer einzigen Art erklären zu können.

TABELLE 1. *F. hereroensis*

	Hüllblatt-index	Hüllblatt-länge(mm)	Zahl der Hüllblätter	Zahl der ♂Blüten	Zahl der ♀Blüten
MERXMÜLLER & GIESS 1646	4,5	11,5	7	15	6
SEYDEL 702	6,5	14	5	9	4
WETTSTEIN 334	6,9	11	6	12	5
IHLENFELDT et al. 3145	5,5	11,5	5	9	4
MERXMÜLLER & GIESS 28209	5,7	13	6	12	5
VOLK 811	4,5	11,5	6	12	4
GIESS 2368	5,5	12	6	9	4
MERXMÜLLER & GIESS 3335	5,9	11,5	6	10	5
DINTER 8189	4,8	13,5	6	10	4
GIESS & MÜLLER 14440	4,4	12	7	15	5
HARDY 672	5,9	13	7	11	6
Mittelwert	5,5	12,2	6,1	11,3	4,7

4.1. *F. hereroensis*

Richten wir den Blick zunächst auf das Involucrum, so fällt eine Anzahl von Pflanzen auf, die sich durch besonders lange, dabei relativ schmale, in ihrer Form ausgesprochen lanzettliche, stark zugespitzte Hüllblätter auszeichnet. Solche Pflanzen sind schon bisher fast immer richtig, in Übereinstimmung mit der Originalbeschreibung und dem Typus, als *F. hereroensis* SCHINZ bezeichnet worden.

Diese Sippe hat die weitaus längsten Hüllblätter (Abb. 2 Cd) von 11–14 mm Länge (Mittelwert 12,2 mm). Infolge der schmalen, lanzettlichen Gestalt ist der Indexwert hoch, im Mittel 5,5. Im reifen Zustand sind die Hüllblätter stets bräunlich gefärbt, nie grün.

Bei allen Pflanzen mit diesen Involucralmerkmalen sind die Blätter ohne Ausnahme sehr seicht geschweift-gezähnt (Abb. 1 B) und haben am Rand die schon erwähnten kurzen (etwa 0,3 mm langen), kräftigen, gekrümmten Haare mit breiter Basis, die im folgenden als '*hereroensis*-Haare' bezeichnet werden sollen. Ohne Zweifel liegt hier eine echte Korrelation vor.

Form und Größe der Blätter sind beachtenswert einheitlich; sie sind durchweg ± elliptisch und etwa 1–3 cm lang. Besonders große Blätter kommen nie vor. Meist ist die Unterseite weiß- bis graufilzig, doch gibt es auch Pflanzen mit unterseits grünen, nicht filzigen Blättern.

Alles in allem ist diese Art durchaus einheitlich. Daß es sich um eine eigenständige Sippe handelt, wird durch das Areal bestätigt: Die vorliegenden Fundpunkte ergeben eine charakteristische Namib-Verbreitung (Karte 1).

In Tabelle 1 sind die Werte für die untersuchten Belege im einzelnen zusammengestellt.

Tabelle 2. *F. viridis*

	Hüllblatt-index	Hüllblatt-länge(mm)	Zahl der Hüllblätter	Zahl der ♂Blüten	Zahl der ♀Blüten
Schweinfurth 1658	2	5	4	8	3
Welwitsch 6291	2,1	4	3	4	2
Giess & Leippert 7590	1,8	6	3	5	2
Merxmüller & Giess 30507	1,9	6,7	4	7-8	3
Merxmüller & Giess 30415	1,8	5,5	4	9	3
De Winter & Leistner 5222	1,8	8,5	5	9	4
Rodin 9273	1,8	8	3	6	2
Walter 2/162	1,8	6	3	4	2
Volk 511	2,1	4,5	4	11	3
Giess 13308	2,1	6	4	6-7	3
Seydel 1452	2	6,2	4	11	3
Giess 13510	2,2	6	5	12	4
Merxmüller & Giess 28060	1,8	4,5	3	5	2
ex herb. Zuccarini	1,6	7	5	10	4
ex herb. Schultes	1,6	6,5	4	6	2
hort. Monac. (1846)	1,8	5	4	8	2
hort. Monac. (1850)	1,7	5	4	9	3
Mittelwert	1,9	5,9	3,9	7,7	2,8

4.2. *F. viridis*

Nach Abtrennung von *F. hereroensis* läßt sich eine Anzahl von Pflanzen aussondern, bei denen eine konstante Kombination von sehr kleinen Hüllen mit kerbzähnigen Blättern vorliegt. Alle diese Belege stammen aus der nördlichen Hälfte Südwestafrikas. Sie stimmen mit Pflanzen aus dem tropischen Afrika überein, welche schon immer mit der von den Kapverden beschriebenen *F. viridis* Ehrenb. ex Webb gleichgesetzt worden sind. Die Blätter der letzteren sind in der Originaldiagnose als '...foliis crenato-dentatis...', die Hüllblätter als '...late ovatis foliaceis obtusis vel obtusiusculis' beschrieben.

Es leuchet ein, daß diese Art, die uns auch aus Angola vorliegt, in den nördlichen Teil Südwestafrikas hineinreicht, im Süden dagegen völlig fehlt (Karte 1).

Nehmen wir nur eindeutige, untereinander in den wesentlichen Merkmalen übereinstimmende Individuen, deren Hüllblattlänge im allgemeinen 7 mm (höchstens 8,5 mm) nicht übersteigt, so läßt sich diese Sippe folgendermaßen charakterisieren:

Die Hüllblätter sind obovat bis ziemlich breit-obovat mit einem Index von durchschnittlich 1,9 (Schwankungsbereich 1,6–2,2), ihre absolute Länge beträgt 4–7(–8,5)mm mit einem Mittelwert von 5,9 mm. Nach oben hin sind die Hüllblätter breit dreieckig zulaufend bis abgerundet, manchmal in eine kleine Spitze vorgezogen oder auch mit mehreren Spitzen versehen (Abb. 2 Ca-c). Auch im reifen Zustand ist die

Hülle meist noch grün. Die Zahlenverhältnisse der einzelnen Infloreszenzen zeigen mit 3–5 Hüllblättern, 4–12 männlichen und 2–4 weiblichen Blüten einen gegenüber *F. hereroensis* (vgl. Tabelle 1) deutlich auf kleinere Zahlen verlagerten Streuungsbereich.

Die Blätter sind stets typisch kerbzähnig (Abb. 1A), die Randhaare sind wesentlich dünner, zarter und durchsichtig (weil kaum inkrustiert), außerdem länger (0,5–0,8 mm) als die *hereroensis*-Haare und meist weniger stark gekrümmt. Wenn auch der Blattindex kaum von dem von *F. hereroensis* abweicht, ist doch die Form der Blätter anders, nämlich eiförmig-zugespitzt. Sehr variabel dagegen ist die Blattgröße: Es finden sich sowohl besonders kleine (etwa 1–1,5 cm lange) wie große (etwa 7–8 cm lange) Blätter neben solchen mittlerer Größe. Daß die Blätter meistens relativ dünn sind, kann, wie oben schon besprochen, nicht als Charakteristikum gelten, denn es kommen ebenso auch derbere Blätter vor. Ebensowenig ist die Stärke des Filzes auf der Blattunterseite kennzeichnend: die Blätter sind fast filzfrei und grün bis dünnfilzig und weißlichgrau; dichter weißer Filz scheint allerdings kaum vorzukommen.

Es sei noch hervorgehoben, daß alle vorliegenden Pflanzen eindeutig krautig sind, auch dann, wenn es sich um kräftig entwickelte Pflanzen handelt. Bei *F. hereroensis* sind die Zweige nach unten hin stets mehr oder weniger verholzt.

Die Zahlenwerte für *F. viridis* sind in Tabelle 2 aufgeführt.

4.3. *F. candida*

Etwas schwieriger wird es, nach Abtrennung der beiden besprochenen Arten eine weitere auszugliedern. Da *F. candida* L.fil. aus der Kapprovinz beschrieben ist, liegt es nahe, von Aufsammlungen aus diesem Bereich auszugehen. Tatsächlich finden wir hier wieder eine konstante Merkmalskombination von geschweift-gezähnten Blättern, dünnen, langen, denen von *F. viridis* ähnlichen, aber etwas kräftigeren und stärker inkrustierten Randhaaren und obovaten, oft ziemlich breiten Hüllblättern von 7–12 (im Mittel 9,2) mm Länge und einem Index von 1,9–3,1 (Mittel 2,4). Die letzteren beiden Merkmalsbereiche liegen zwischen denen von *F. hereroensis* einerseits und *F. viridis* andererseits und überlappen sich mit beiden relativ wenig; die Mittelwerte sind deutlich verschieden.

Sucht man nun aus Südwestafrika alle jene Aufsammlungen heraus, die exakt zu dieser Gruppe passen, so stellt sich heraus, daß sie im südlichen Teil des Gebietes und zwar nicht im Namib-Bereich, sondern im Inneren des Landes vorkommen, also unmittelbar an die kapensischen Vorkommen (siehe N. E. Brown 1925) anschließen (Karte 1). Diese Sippe kann damit ohne Vorbehalt als *F. candida* L.fil. bezeichnet werden. Ihre weiteren Merkmale sind im einzelnen folgende:

Die Hüllblätter sind stets obovat bis breit-obovat, oft in der Form denen von *F. viridis* ähnlich aber länger, häufig auch etwas mehr zugespitzt (wenn auch nie so lang zugespitzt und lanzettlich ausgezogen wie bei *F. hereroensis*), manchmal ± stumpf bis abgerundet (Abb. 2 Ce). Bei der Reife ist die Hülle nicht grün, sondern hellbräunlich bis violettbräunlich.

Tabelle 3. *F. candida*

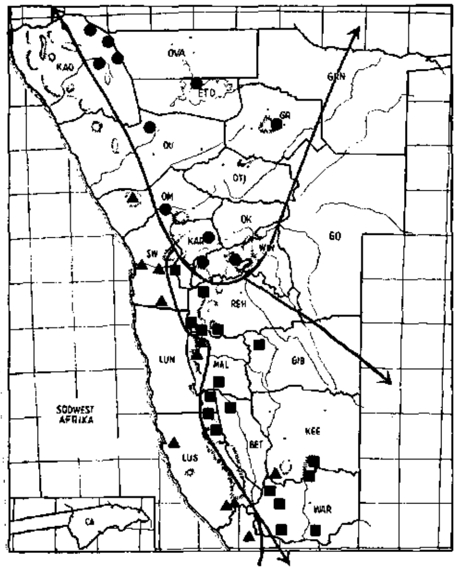
	Hüllblatt-index	Hüllblatt-länge(mm)	Zahl der Hüllblätter	Zahl der ♂Blüten	Zahl der ♀Blüten
Wettstein 333	2,7	11	6	16	5
Walter 4292	2,7	7	5	9	4
Strey 2603	2,3	8,2	7–8	17	6
Giess 13441	1,9	9	6	20	5
Giess 10421	2,8	8,3	6	16	4
Volk 12452	2,2	8,5	6	18	5
Volk 12487	2	11	7	19	6
Kinges 2127	2,4	9	6–7	16	5–6
Giess 2304	2,1	7,5	5	8	4
Giess 8826	2,2	10	7	19	6
Merxmüller & Giess 2881	2,6	11,7	6–8	22–23	6–7
Giess & Müller 11947	2,6	11,5	6	18	5
De Winter 3305	2,4	8,3	8	21	6
Giess, Volk & Bleissner 6907	2,1	7	7	15	6
Giess, Volk & Bleissner 6965	2	8	6	18	5
Giess & Müller 12291	2,5	11,5	5–6	13–14	4–5
Ihlenfeldt 1788	2,1	10	6	20	6
Leistner 2336	2,2	9,5	7	15	6
Schlieben 8832	2,3	10,5	7	18	5
Leistner 1905	2,6	7	5	12	4
Davidse 6144	2,1	9,2	5	13	4
Acocks 2408	3,1	9	6	10	5
Mittelwert	2,4	9,2	6,3	16,1	5,2

Die Zahlen innerhalb einer Infloreszenz sind: (5–)6–8 Hüllblätter, 8–23 männliche, 4–7 weibliche Blüten. Gegenüber *F. viridis* heben sich diese Zahlen deutlich ab, mit *F. hereroensis* überlappen sie sich weitgehend.

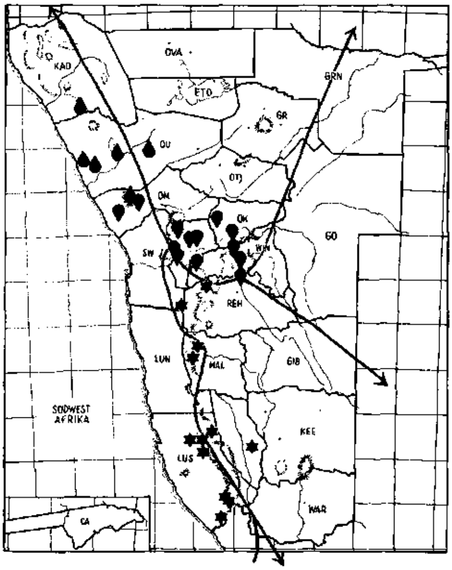
Der Blattrand ist bei *F. candida* geschweift-gezähnt, wobei die Zähne etwas stärker ausgeprägt sind als bei *F. hereroensis*, d.h. daß der in die Bucht zwischen zwei Zähne gelegte Winkel immer stumpf, aber in der Mehrzahl der Fälle nicht so groß ist wie bei *F. hereroensis* (Abb. 1 C). Die Blätter sind typisch eiförmig, weniger zur elliptischen Form neigend als bei *F. hereroensis* und auch nicht so zugespitzt wie bei *F. viridis*. Die Blattgröße ist wiederum variabel, wenn sie auch kaum über 4–5 cm Länge hinausgeht. Die Dicke der Blätter und die Stärke des Filzes auf der Unterseite sind kaum charakteristisch; die Unterseite kann filzlos und grün, dünnfilzig und grau oder dichterfilzig und weißlich sein. Auf Exemplare mit unterseits grünen Blättern bezieht sich der Name *F. candida* var. *virescens* Wedd.

Die Wuchsform ist, soweit an dem vorliegenden Material zu beurteilen, krautig bis basal leicht verholzend.

Die Zahlenwerte der einzelnen Belege finden sich in Tabelle 3.



Karte 1. Areale der Arten
● *F. viridis*
▲ *F. hereroensis*
■ *F. candida*



Karte 2. Areale der Übergangsformen
♠ Übergänge *F. viridis* gegen *F. hereroensis*
♥ Übergänge *F. viridis* gegen *F. candida*
(oder zum Teil *F. hereroensis*)
✱ Übergänge *F. hereroensis* gegen *F. candida*

5. DIE AREALE DER EINHEITLICHEN SIPPEN

Eine Punktkarte der bisher behandelten Aufsammlungen ergibt ein erstaunlich klares Bild (Karte 1), in dem die Areale der drei unterschiedenen Taxa aneinander grenzen, ohne sich wesentlich zu überlappen. Selbstverständlich mögen weitere Aufsammlungen dieses fast zu ideale Bild unschärfer machen; wir glauben jedoch nicht, daß dies zu wirklich wesentlichen Veränderungen führen könnte. Zusammen mit der Tatsache, daß alle von uns untersuchten, außerhalb Südwestafrikas gesammelten Belege ausnahmslos diesen typischen, 'unkritischen' Gruppen zuzurechnen waren, ergibt das nur einen möglichen Schluß:

In Südwestafrika berühren sich die Areale, etwa in Höhe des Wendekreises, der mehr tropischen *F. viridis* und der extratropischen *F. candida* auf breiter Front; ihnen beiden ist im Westen des Landes das Namib-Areal der *F. hereroensis* vorgelagert.

6. DIE ABERRANTEN BELEGE

Dieses eben gewonnene erfreuliche Bild wird freilich dadurch getrübt, daß es erst die eine Hälfte des uns vorliegenden *Forsskaolea*-Materials betrifft. Etwa gleichviele Belege aus Südwestafrika passen nicht in die von uns gebildeten Gruppen und würden bei einer gewaltsamen Einfügung die klaren Diagnosen der drei Arten wieder völlig unscharf machen. Eben diese Aufsammlungen waren es, die bisher jeden taxonomischen Ordnungsversuch zum Scheitern brachten.

In Anbetracht der oben geschilderten Arealstruktur erschien es zunächst von Interesse, der Verbreitung dieser untypischen Formen nachzugehen (Karte 2). Es ergab sich erneut ein recht charakteristisches Bild. Die kritischen Belege wurden fast ausschließlich in mehr oder minder großer Nähe unserer (sehr schematisch gezogenen) Arealgrenzen gesammelt: in breiter Nord-Süd-Erstreckung am östlichen Namibrand und am Escarpment einerseits, in einem Querband durch die Mitte des Landes andererseits.

Dieses Verbreitungsbild muß den Gedanken an eine introgressive Durchdringung der jeweils benachbarten Arten nahelegen. Mit dieser Hypothese steht im Einklang, daß sich in diesem restlichen Material keinerlei neue Merkmale fanden, sondern nur abweichende Kombinationen und Korrelationen sowie zwischen den Eckwerten liegende Maße und Zahlen. Wir suchten daher die betreffenden Belege unter diesem Gesichtspunkt zu analysieren.

6.1 *Übergänge von* F. viridis *zu* F. hereroensis *und* F. candida

Pflanzen, deren Blätter deutlich kerbzähnig sind oder wenigstens mehr zu gekerbt als zu geschweift neigen, finden sich ausschließlich im nördlichen Teil Südwestafrikas, bis zum Distrikt Windhoek im Süden. Die gegenüber *F. viridis* meist gröbere Kerbung (weiter voneinander entfernte Kerbzähne), Form und Ausmaße der Hüllblätter, zum Teil auch die Zahlenverhältnisse innerhalb der Infloreszenz (vgl. Tabelle 4) verbieten die Zuordnung zu *F. viridis*. In Abb. 2 A ist eine Auswahl an Blattformen dieses Übergangsbereichs dargestellt. Tabelle 4 bringt die Zahlenwerte aus dem Infloreszenzbereich; zum Vergleich sind die drei Arten in ihrer jeweiligen Variationsbreite und den Mittelwerten aufgeführt.

Es wird daraus ersichtlich, daß hier ein breites Merkmalsspektrum vorliegt, das den Bereich von *F. viridis* bis hin zu *F. hereroensis* und *F. candida* fast kontinuierlich ausfüllt. Die Blätter erinnern zum Teil noch sehr an *F. viridis*, besonders in ihrer Form mit der lang ausgezogenen Spitze, der Rand neigt deutlich zur Kerbung, doch sind die Kerbzähne häufig weiter voneinander entfernt als bei *F. viridis*. Die Hüllblätter sind gegenüber *F. viridis* entweder deutlich länger oder schmäler (Index über 2,2) oder beides, die Zahl der Hüllblätter und Blüten ist in verschiedenem Maße erhöht.

Welche von den beiden Arten *F. hereroensis* und *F. candida* jeweils an diesen Übergängen zu *F. viridis* beteiligt ist, kann in vielen Fällen nicht mit Sicherheit entschieden werden, denn beide Arten haben geschweifte Blätter, längere Hüllen und höhere Hüllblatt- und Blütenzahlen. In einigen Fällen aber sind die Hüllblätter auffallend lanzettlich und zugespitzt und neigen dadurch eindeutig mehr zu *F. hereroensis* als zu *F. candida*. Bezeichnenderweise treffen wir solche Formen im Namibbereich, nicht dagegen im weiter östlich gelegenen Landesinneren. Folgende Belege zeigen diesen *F.*

Tabelle 4. Übergangsbereich *F. viridis* gegen *F. hereroensis* und *F. candida*. Zum Vergleich sind am Ende der Tabelle von den drei Arten jeweils die Variationsbereiche und die Mittelwerte angegeben.

	Hüllblatt-index	Hüllblatt-länge(mm)	Zahl der Hüllblätter	Zahl der ♂Blüten	Zahl der ♀Blüten
De Winter & Leistner 5868	3,7	11	5	14	4
Giess, Volk & Bleissner 6188	3,1	9	4	6	3
Giess 8016	3,7	9,5	4	6	3
Kräusel 627	2,7	10	6	19	5
Merxmüller & Giess 30311	3,3	6	6	13	5
Wettstein 408	3,3	11	6	13	5
Giess 9658	3,6	7	4	6	3
Nordenstam 2522	3	8	6	15	5
Nordenstam 2442	3,3	8,5	5	14	4
Giess, Volk & Bleissner 5883	noch unreif		5	11	4
Seydel 2997a	3	7	5	11	4
Seydel 3498	3,5	9	5	13	4
Giess 3477	2,5	7,2	4	11	3
Seydel 219	2,4	8	5	13	4
Seydel 489	2,5	8	5	11	4
Merxmüller & Giess 1570	2,3	7	4	11	3
Dinter 7787	2,8	7	4	10	3
De Winter 2641	2,5	8,5	4	10	3
Walter 146	2,9	12	5	13	4
Merxmüller & Giess 3578	noch unreif		5	9	4
Kinges 2620	3,1	7	6	13	4
F. viridis	1,6–2,2	4–8,5	3–5	4–12	2–4
	1,9	5,9	3,9	7,7	2,8
F. hereroensis	4,4–6,9	11–14	5–7	9–15	4–6
	5,5	12,2	6,1	11,3	4,7
F. candida	1,9–3,1	7–11,7	5–8	8–23	4–7
	2,4	9,2	6,3	16,1	5,2

hereroensis-Einfluß: De Winter & Leistner 5868 von Sesfontein (Kaokoveld), Kräusel 627 vom Versteinerten Wald (Distr. Outjo), Giess 8016 und Giess, Volk & Bleissner 6188 aus der Gegend von Torrabai, Merxmüller & Giess 30311 von Franzfontein (Distr. Outjo), Wettstein 408 von den Brandbergen, sowie, weniger eindeutig, Belege aus dem Distrikt Karibib.

Bei einem Teil dieser Belege kann man, wenn auch nicht mit Sicherheit, in den Blattrandhaaren einen gewissen Einfluß von *F. hereroensis* erkennen; typische *hereroensis*-Haare mit verdickter Basis treten aber in diesem *viridis*-beeinflußten Übergangsmaterial nicht auf.

So müssen wir uns damit begnügen festzustellen, daß im nördlichen Südwestafrika verbreitet und in großer Zahl Formen auftreten, die in mannigfaltigen Abstufungen

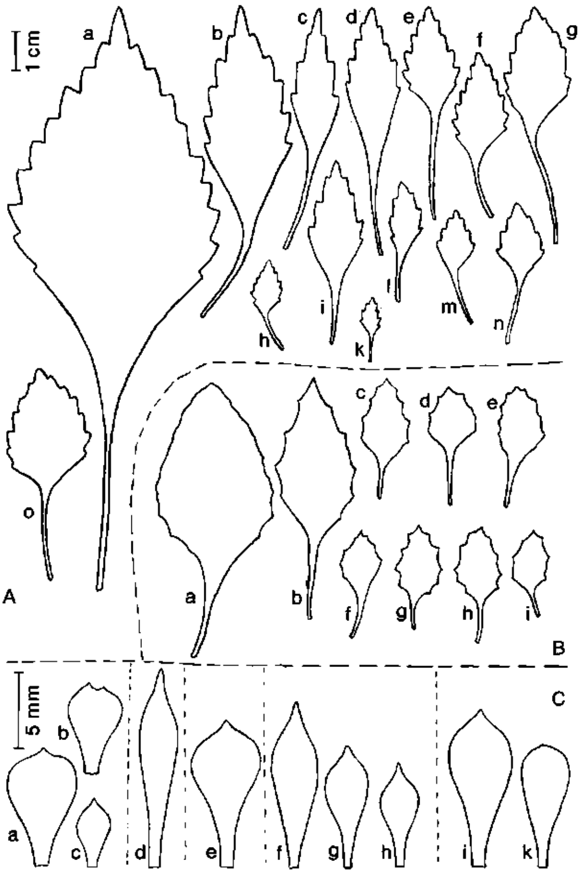


Abb. 2. Blattformen und Hüllblattformen. A: Blattformen aus dem Übergangsbereich *F. viridis* gegen *F. hereroensis* und *F. candida*. a: Giess, Volk & Bleissner 5883. b: Merxmüller & Giess 30311. c: Nordenstam 2522. d: Kinges 2620. e: Seydel 219. f: Seydel 489. g: De Winter & Leistner 5868. h: Wettstein 408. i: Merxmüller & Giess 3578. k: Seydel 2997a. l: Seydel 3498. m: Giess 3477. n: Nordenstam 2442. o: Merxmüller & Giess 1570. – B: Blattformen aus dem Übergangsbereich *F. hereroensis* gegen *F. candida*. a: Merxmüller & Giess 3399. b: Giess 14658. c: Merxmüller & Giess 32306. d: Merxmüller & Giess 28101. e: Merxmüller & Giess 28209a. f: Merxmüller & Giess 28211. g: Merxmüller & Giess 2357. h: Giess 14591. i: Merxmüller & Giess 32304. – C: Hüllblattformen (die Behaarung ist nicht dargestellt). *F. viridis:* a: Rodin 9273. b: Giess & Leippert 7590. c: Volk 511. *F. hereroensis*: d: Merxmüller & Giess 28209. *F. candida*: e: Leistner 2336. Übergangsformen *F. viridis* gegen *F. hereroensis* (f) und *F. candida* (g,h): f: De Winter & Leistner 5868. g: Nordenstam 2522. h: Dinter 7787. Übergangsformen *F. hereroensis* gegen *F. candida:* i: Giess 14591. k: Giess & Van Vuuren 794.

Merkmale von *F. viridis* einerseits mit Merkmalen von *F. hereroensis* und *F. candida* andererseits verbinden, wobei von den beiden letzteren der Einfluß von *F. hereroensis* im Namibbereich nachweisbar ist, während im übrigen Gebiet wohl eher *F. candida* (im Gebiet von Karibib unter Umständen beide) an der Merkmalsbildung beteiligt ist. Da sich die einzelnen Merkmalsbereiche unabhängig voneinander kombinieren können, entsteht eine große Vielfalt von habituell verschiedenen Formen.

In den Übergangsbereich *F. viridis – F. candida* gehört auch *F. eenii* Rendle, dessen Typus (Een, Dammaraland; BM) deutlich kerbzähnige Blätter hat, verbunden mit Hüllen, die länger sind als bei *F. viridis*. Die Synonymsetzung mit *F. candida* im Prodr. Fl. SWA (Roessler 1967) ist also nicht ganz korrekt.

6.2. *Übergänge von* F. hereroensis *zu* F. candida

Im gesamten südlichen Teil Südwestafrikas fehlt *F. viridis*. In Übereinstimmung damit haben alle kritischen Belege aus diesem Gebiet geschweift-gezähnte Blätter wie die beiden Arten *F. hereroensis* und *F. candida*, als deren Übergangsformen sie gedeutet werden können.

Abb. 2 B zeigt eine Auswahl von Blättern, Tabelle 5 führt die Zahlenwerte des Infloreszenzbereichs auf.

Da sowohl in der Blattform als auch in der Zähnung des Blattrandes nur geringfügige Unterschiede zwischen den beiden Ausgangsarten bestehen, läßt sich nach

Tabelle 5. Übergangsbereich *F. hereroensis* gegen *F. candida*. Zum Vergleich sind am Ende der Tabelle von den beiden Arten jeweils die Variationsbereiche und die Mittelwerte angegeben.

	Hüllblatt-index	Hüllblatt-länge (mm)	Zahl der Hüllblätter	Zahl der ♂Blüten	Zahl der ♀Blüten
Merxmüller & Giess 28101	3	7	5	12	5
Rehm s.n. (28.12.1948)	3,1	7	5	12	4
Merxmüller & Giess 28209a	2,6	13	6	13	4
Merxmüller & Giess 28211	3,2	9,5	6	13	5
Wettstein 320	2,2	10,5	6	12	5
Dinter 6143	1,9	7	5	10	5
Giess, Volk & Bleissner 5274	1,7	7	5	13	4
Merxmüller & Giess 2357	2,1	6	4	10	3
Giess & Van Vuuren 794	2,5	8	5	8	4
Giess 14591	2,6	10,5	5–6	13–15	4–5
Merxmüller & Giess 3398	2,7	7	4–5	9–10	3–4
Merxmüller & Giess 3399	2,2	9	6	18	5
Merxmüller & Giess 32304	2,8	6,5	5	10–11	4
Merxmüller & Giess 32306	2,3	9,5	5	13	4
Giess 14658	3	6,6	5	11	4
F. hereroensis	4,4–6,9	11–14	5–7	9–15	4–6
	5,5	12,2	6,1	11,3	4,7
F. candida	1,9–3,1	7–11,7	5–8	8–23	4–7
	2,4	9,2	6,3	16,1	5,2

diesen Merkmalen über deren wechselseitigen Einfluß kaum etwas aussagen. Von Bedeutung ist dagegen die Ausbildung der Blattrandhaare. Hier zeigt sich in fast allen Fällen ein deutlicher Einfluß von *F. hereroensis;* meistens sind die Randhaare sogar ebenso kurz, gekrümmt und basal verdickt wie bei typischer *F. hereroensis.* Das Involucrum dagegen ist, wie die Längenangaben und die Indexzahlen in Tabelle 5 zeigen, weit mehr an *F. candida* angenähert; die Hüllblätter überschreiten nur selten die für *F. candida* typische Länge und ihre Form ist häufig ± obovat, manchmal sogar ausgeprägt obovat, ebenso wie bei *F. candida.*

In den Zahlenverhältnissen der Infloreszenzen überdecken sich die beiden Ausgangsarten mit ihren Variationsbreiten, nur die Mittelwerte liegen etwas verschieden. Wenn auch auf Grund dieser Überschneidungen die Blütenzahlen bei unseren Übergangsformen nicht allzuviel aussagen, so ist immerhin auffallend, daß die Blütenzahlen gegenüber den Werten von *F. candida* gegen kleinere Zahlen hin verlagert sind, was einem Einfluß von *F. hereroensis* zugeschrieben werden kann.

Bei einigen Belegen aus dem Distrikt Lüderitz sind die Hüllblätter besonders kurz (unter 7 mm) und überschreiten damit den Variationsbereich, den wir bei der reinen *F. candida* gefunden haben, geringfügig nach unten. Ein Einfluß von *F. viridis*, an den man der Hüllblattlänge wegen denken könnte, ist in diesem Gebiet aber mit Sicherheit auszuschließen, zumal die Blätter typisch geschweift und die Pflanzen, wie überhaupt fast alle diese Zwischenformen, stärker verholzt sind, was bei *F. hereroensis* und *F. candida*, nicht aber bei *F. viridis* vorkommt.

Betrachten wir die Verbreitung (Karte 2), so zeigt sich, daß sich die als Übergangsformen zwischen *F. hereroensis* und *F. candida* vermuteten Pflanzen in dem Bereich finden, in dem sich die beiden Ausgangsarten berühren, nicht dagegen im Osten des Landes, wo *F. candida* allein vorkommt.

Verglichen mit dem oben behandelten, von *F. viridis* beeinflußten Übergangsmaterial, das eine besonders große habituelle Variation aufweist, ist das zwischen *F. hereroensis* und *F. candida* stehende Material etwas einheitlicher. Das dürfte daran liegen, daß letztere beiden Arten sowohl im Wuchs als auch in der Blattgestalt einander viel ähnlicher sind als *F. viridis.* Wie zu erwarten kommen aber auch innerhalb dieses Materials sowohl filzfreie grüne als auch filzige grau-weiße Blattunterseiten vor.

7. MERKMALS-INTROGRESSION

Da uns entsprechende experimentelle Untersuchungen derzeit nicht möglich sind, können wir keine Aussagen über die aktuelle Bastardfertilität der Arten machen (unsere 'Zwischenformen' sind offensichtlich fertil). An Primärbastarde ist jedenfalls kaum zu denken. Dagegen spricht weniger das häufige Fehlen benachbarter Eltern am Ort, das bei Windbestäubern nicht so sehr ins Gewicht fallen bräuchte, sondern eine zumindest gelegentlich von uns beobachtete Homogenität von Einzelpopulationen. Aus ähnlichen Gründen möchten wir nicht von 'Bastardschwärmen' sprechen, obwohl zumindest bei den *viridis*-Abkömmlingen die Einzelbelege fast lückenlos zu den anderen Arten überzuleiten scheinen. Was uns nachweisbar dünkt, ist ein 'Einsickern' von Merkmalen der jeweils einen Sippe in die benachbarten Arten, also der Vorgang, den wir seit ANDERSON als Introgression bezeichnen. Die einleitenden Bastardierungsvorgänge dürften hauptsächlich in der Vergangenheit stattgefunden oder zumindest schon vor sehr langer Zeit begonnen haben.

Aus diesen und anderen Überlegungen heraus konnten wir uns nicht entschließen, unsere 'Übergangsbereiche' taxonomisch zu fassen und entsprechend nomenklatorisch zu traktieren. Beschreibungen würden recht nichtssagend von bestimmten und unbestimmten Mischungen der Merkmalsgarnituren berichten; als Typen wären ebensowenig aussagekräftige Einzelexemplare aus Einzelpopulationen auszuwählen. Im übrigen sind wir nach wie vor der Ansicht, daß Sinn und Zweck der Systematik nicht darin bestehen, jedem einzelnen Herbarbogen ein möglichst detailliertes Namensetikett ankleben zu können, sondern darin, die biologische Struktur der von uns betrachteten Sippen aufzuklären.

8. BESTIMMUNGSSCHLÜSSEL FÜR DIE GATTUNG *Forsskaolea* IN SÜDWESTAFRIKA

1. Hüllblätter 11–14 mm lang, stark zugespitzt, lanzettlich, ihr Index im Mittel 5,5 (Schwankungsbereich 4,4–6,9). Blattrandhaare ca. 0,3 mm lang, gekrümmt, mit stark verbreiterter Basis (Abb. 1 Bh). Blätter sehr seicht geschweift-gezähnt (Abb. 1B a-g): . . . . **F. hereroensis**

1. Hüllblätter 4–11,7 mm lang, obovat bis breit-obovat, ± stumpf oder nur wenig zugespitzt, ihr Index zwischen 1,6 und 3,1 schwankend. Blattrandhaare länger (0,5–0,8 mm), gerade oder ± gebogen, dünner und mit weniger stark verdickter Basis (Abb. 1 Ah, 1 Cg).

2. Blätter stets gekerbt-gezähnt (Abb. 1 A). Hüllblätter 4–7 (–8,5) mm lang, mit einem Index von unter 2,2. Zahl der Hüllblätter 3–5, der weiblichen Blüten 2–4, der männlichen Blüten 4–12. Pflanzen krautig, kaum verholzend: . . . **F. viridis**

2. Blätter geschweift-gezähnt (Abb. 1 C). Hüllblätter 7–11,7 mm lang, mit einem Index von durchschnittlich 2,4 (Schwankungsbereich 1,9–3,1). Zahl der Hüllblätter 5–8, der weiblichen Blüten 4–7, der männlichen Blüten 8–23. Pflanzen häufig ± verholzend: . . . . **F. candida**

Wenn gekerbt-gezähnte Blätter in Verbindung mit längeren, schmäleren Hüllblättern und zahlreicheren Blüten vorliegen, so handelt es sich um Übergangsformen von *F. viridis* gegen *F. hereroensis* (küstennaher Bereich des nördlichen Südwestafrika) bzw. *F. candida* (Inland).

Wenn bei Vorliegen geschweift-gezähnter Blätter die Blattrandhaare ± denen von *F. hereroensis* entsprechen, die Hüllblätter jedoch kürzer und stumpfer sind, so liegen Zwischenformen von *F. hereroensis* und *F. candida* vor.

ZUSAMMENFASSUNG

Eine erneute Analyse der bislang taxonomisch schlecht zu fassenden *Forsskaolea*-Arten Südwestafrikas zeigt, daß die typischen Formen der drei akzeptierten Arten getrennte, aber aneinander grenzende Areale bewohnen: *F. viridis* das nördliche Inland, *F. candida* das südliche Inland und *F. hereroensis* die Namib. Die bislang so verwirrenden übrigen Formen sind größtenteils auf die Grenzzonen zwischen den drei Arten konzentriert. Ihre Verschiedenheit ist auf Merkmals-Introgression zurückzuführen.

SUMMARY

A re-investigation of the genus *Forsskaolea* (Urticaceae) in South West Africa demonstrates that the typical forms of the three species concerned inhabit separate but neighbouring areas: *F. viridis* the northern inland, *F. candida* the southern inland and *F. hereroensis* the Namib. The chaos of aberrant forms is concentrated around the border lines between the three species and its origin is interpreted as a case of introgression.

LITERATUR

BROWN, N. E. 1925. Urticaceae. In: W. T. THISELTON-DYER, Flora Capensis **5** (2): 541–561.

MÜLLER, I. 1974. Analyse der Gattung Forsskaolea. Manuskript.

RENDLE, A. B. 1917. Urticaceae. In: D. PRAIN, Flora of Tropical Africa **6** (2): 241-306.

ROESSLER, H. 1967. Urticaceae. In: H. MERXMÜLLER, Prodromus einer Flora von Südwestafrika, Lief. **9**. Verlag J. CRAMER, Lehre.

WEDDELL, H.-A. 1856. Monographie de la Famille des Urticées. Paris.

WEDDELL, H.-A. 1869. Urticaceae. In: A.P. DE CANDOLLE, Prodromus systematis naturalis regni vegetabilis **16** (1): 33-235^{64}.

SOBRE LOS EJES MIXTOS PLAGIO-ORTÓTROPOS EN ALGUNOS ÁRBOLES TROPICALES

ROELOF A. A. OLDEMAN

Universidad Agronómica, Departamento de Silvicultura,
Postbus 342, 6700 AH Wageningen, Países Bajos

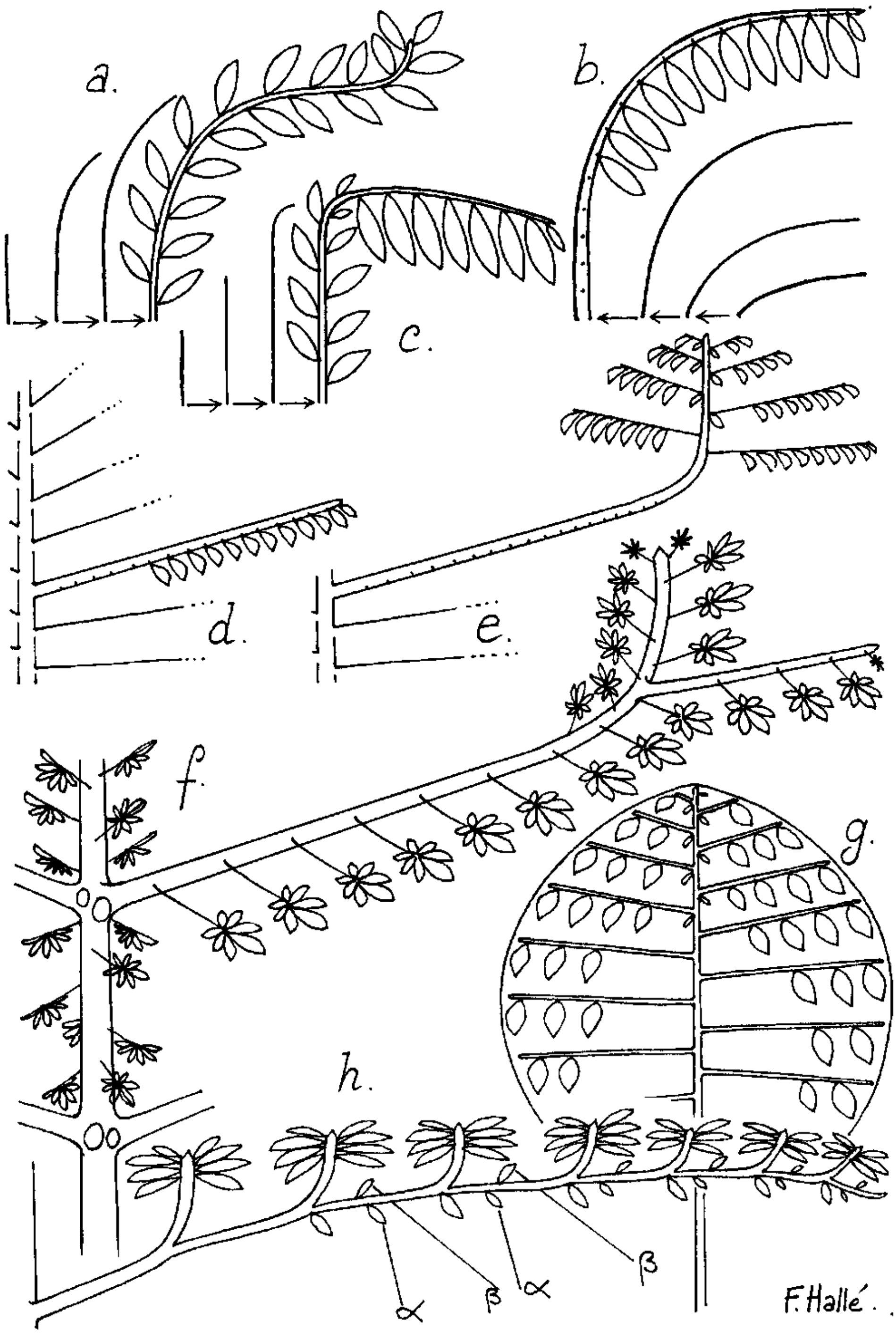
FRANCIS HALLÉ

BIOTROP, Casilla 17, Bogor, Rep. de Indonesia

Anteriormente describimos los ejes mixtos. Se trata de órganos construidos por la actividad alternante de un meristema que, desde un principio, muestra cierto tipo de funcionamiento y, luego se convierte para funcionar de otro modo. Reconocimos entonces tres tipos de ejes mixtos distintos en la bioarquitectura arbórea. El primer muestra una base ortótropa enderezada con función de tronco y después, continua formando una extremidad colgante también ortótropa pero, con función de rama. En el segundo tipo de eje mixto la base todavía es ortótropa, mientras que tiene extremidad plagiótropa. En el tercer tipo, por fin, ambas partes son plagiótropas (HALLÉ y OLDEMAN, 1970; fig. 1a-c).

En el mismo libro señalamos el caso singular de las ramas de *Trema orientalis* (L.) Blume (Ulmaceae). Este árbol pequeño, que crece dentro de la maleza secundaria africana tiene un tronco ortótropo con ramificación contínua en espiral. Desde un principio, los ejes laterales son de índole perfectamente plagiótropas, con hojas dístiquas. Tardiamente, estas ramas se enderezan, se vuelven ortótropas y, se ramifican como lo hizo antes el tronco (fig. 1d-e). OLDEMAN (1974) consideró la equivalencia arquitectural entre el árbol jóven y, la extremidad enderezada de la rama con su ramificación. Habló de reiteración por dediferenciación, del modelo de ROUX: veremos que ahora es posible considerar el fenómeno de otro modo. Esta bioarquitectura fué encontrada en todas especies del género *Trema* que examinamos.

Recién hallamos otro tipo de rama que permite la reevaluación de *Trema*. El primer ejemplo fué *Bombacopsis quinatus* L. (Bombacaceae), representado en las figuras 2 y 1f. Es un árbol maderable del cual están plantaciones en muchos paises americanos. Fué observado en un estadio jóven en la cercanía de Esmeraldas (Ecuador), donde se introdució desde la América Central. Su tronco es ortótropo, con hojas compuestas en espiral y, ramificación rítmica. En la 'jorqueta' más jóven, las ramas tienen hojas dístiquas. Subrayamos que es también excepcional encontrar hojas que, a la vez, son compuestas y dispuestas en dos séries. Tales ramas, aúnque hagan un ángulo agudo con el tronco y por ende, no son horizontales, sinembargo deben ser llamadas 'plagiótropas'.


a.
b.
c.
d.
e.
f.
g.
h.
α
β
α
β
F. Hallé.

Después de la formación de diez a doce hojas según este sistema, la filotaxis cambia y, se vuelve espiralizada. Desde este punto la rama se endereza, el crecimiento se vuelve más lento y la ramificación se efectua con ramas plagiótropas. Estas últimas siguen de nuevo una secuencia morfogenética, idéntica con la que vimos en el eje precedente (fig. 1f). Un caso muy comparable, hacía el número de hojas sobre la parte plagiótropa de la rama, se observó en Malesia (*Artocarpus* sp. ind., Penang Island, Rimba rekreasi). En Indonesia encontramos otro ejemplo de este tipo de eje en *Maesopsis eminii* Engl. (Rhamnaceae, originaria de Africa). Tal como las especies de *Trema*, *Maesopsis* fué descrito bajo el modelo de ROUX (HALLÉ et al., 1978).

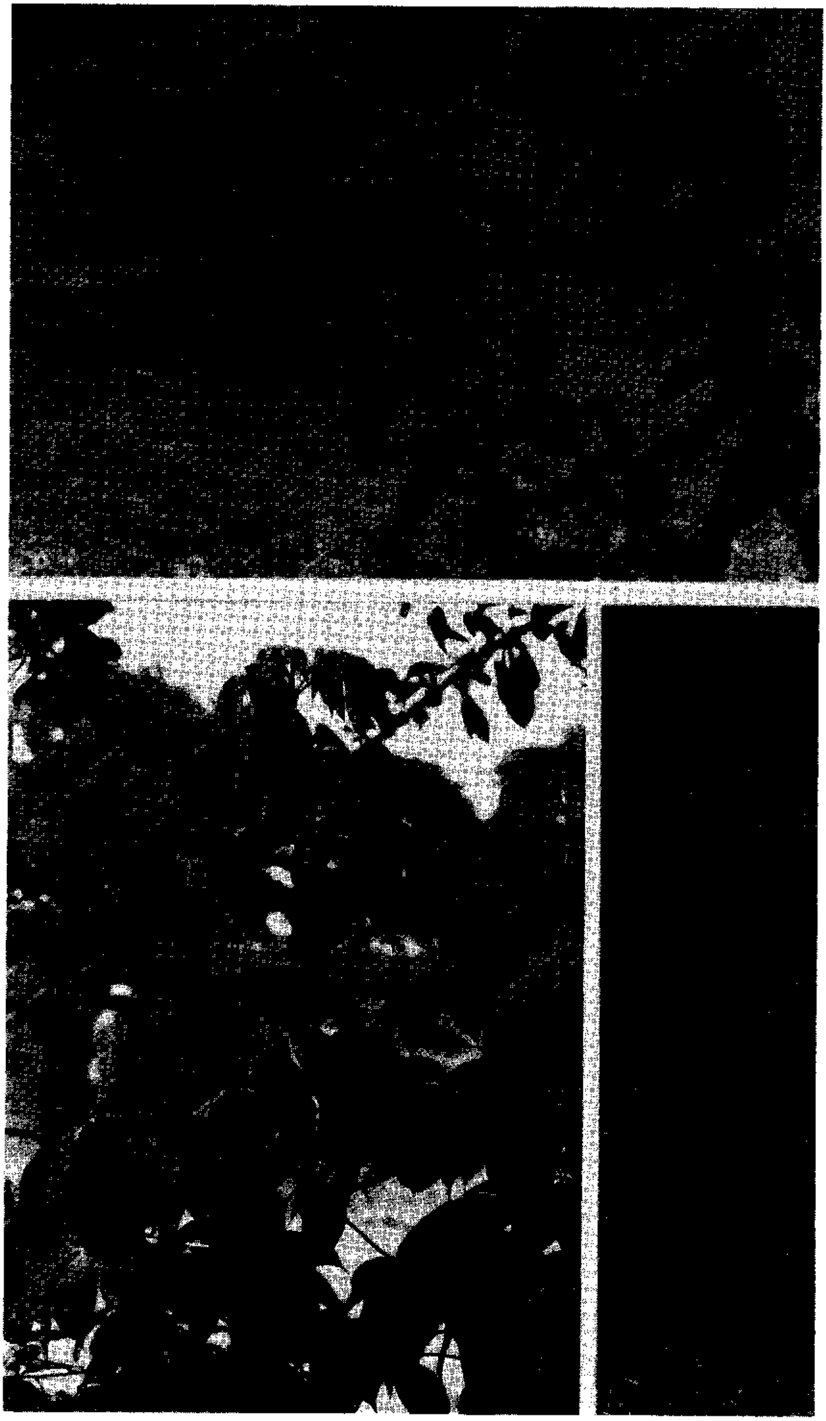
La comparición entre las ramas citadas sugiere una reducción del segmento plagiótropo, desde *Trema* y *Maesopsis* hacía *Bombacopsis* y *Artocarpus*. En consecuencia es interesante buscar casos con bases de rama aún más chicas. Los hallamos dentro del modelo de AUBRÉVILLE con 'Terminalia-branching' (CORNER, 1952). Las ramas de varias especies del género *Terminalia* (Combretaceae – fig. 1g) se componen de una serie sinpodial de ejes con parte basal horizontal, crecimiento rápido y sólo dos hojas, las prófilas α y β, automáticamente dístiquas. Después, la filotaxis se vuelve espiralizada, el eje se ramifica y por fin se endereza para conducirse como un braquiblasto. Otras especies de *Terminalia* muestran el modelo de ROUX con ramas plagiótropas que nunca tienen extremidades ortótropas (fig. 1h). En este género aún no conocemos transiciones entre los dos modelos arquitecturales de ROUX y, de AUBRÉVILLE.

Los ejemplos desde fig. 1e hacía fig. 1g constituyen una fila de reducción. Aquella puede compararse con las ramas articuladas que han sido descritas en las Rubiáceas

---

FIGURA 1: Los ejes mixtos y su contexto. a – eje mixto con base y extremidad ambas ortótropas; b – eje mixto con base y extremidad ambas plagiótropas; c – eje mixto con base ortótropa y extremidad plagiótropa; d – *Trema* sp. var. (Ulmaceae), crecimiento con ramas plagiótropas según el modelo de ROUX; e – misma especie, más tarde, con ramas de las cuales la extremidad se endereza, se vuelve ortótropa y, lleva ramas plagiótropas en espiral; f – *Bombacopsis quinatus* L. (Bombacaceae) con ramas compuestas por ejes mixtos plagio-ortótropos con base llevando diez a doce hojas compuestas en dos series (ver Fig. 2); g – *Terminalia brassii* Exell (Combretaceae) creciendo según el modelo de ROUX; compare con 1d; h – *Terminalia catappa* L. (Combretaceae), representante del modelo de AUBRÉVILLE: anotese que los ejes de las ramas pueden ser concibidos como versiones reducidas de los que lucen en 1f; las prófilas α y β son los rastros de la plagiotropía.

FIGURE 1: Mixed axes and their context. a – mixed axis with both base and end orthotropic; b – mixed axis with both its base and its end plagiotropic; c – mixed axis with orthotropic base and plagiotropic end; d – *Trema* sp. var. (Ulmaceae), growing with plagiotropic branches according to ROUX's model; e – same species, later, with branch ends growing up, becoming vertical and orthotropic and bearing plagiotropic branches, spirally inserted; f – *Bombacopsis quinatus* (Bombacaceae) with branches composed by mixed axes, each made up by a plagiotropic base with composed leaves in two rows and an orthotropic end; g – *Terminalia brassii* Exell (Combretaceae) growing according to ROUX's model, see fig. 1d; h – *Terminalia catappa* L. (Combretaceae), representing AUBRÉVILLE's model: note that the axes constituting the branches can be conceived as reduced versions of those figuring on 1f, with only the prophylls α and β representing the plagiotropy.



por Hallé (1967). Allá se trata de artículos con floración terminal. Las partes vegetativas de aquellas se reducen de una especie a otra. El caso extremo es un eje con una hoja única, la prófila α, que axila al artículo siguiente. El algodón (*Gossypium* sp. pl., Malvaceae) muestra tal bioarquitectura, mas con dos hojas por cada eje en la rama. En las dos series, la de Hallé y la que presentamos aquí, la reducción de los ejes se acompaña generalmente por una estructura más sinpodial de la rama entera, es decir por un número más grande de artículos.

Cuando no sigan esta regla general, hallamos algunos arbolitos que son formas de transición entre modelos bioarquitecturales. Estos se ubican entre los modelos de Petit y Cook (*Schumanniophyton*, Rubiaceae, Hallé y Oldeman, 1970), entre los de Fagerlind y Massart (*Quararibea* sp. pl., Bombacaceae, descritas bajo el modelo de Fagerlind – Hallé y Oldeman, 1970) y, finalmente entre los de Aubréville y Roux (casos descritos aquí). Aún no conocemos transiciones arquitecturales entre los modelos de Aubréville y de Cook: se trata aquí únicamente de las ramas y no, de la ramificación rítmica. En vez de tratar estas series como filas de reducción también es posible, por supuesto, concibirlas tal como una fila de evolución hacía arquitecturas más complejas.

Visto este conjunto de ejemplos y transiciones ya no es posible ver a las ramas enderezadas de *Trema* y *Maesopsis* como si fueron complejos reiterados. Son demasiado regulares para serlo. Además occurren también en malas condiciones, es decir que no son arquitecturas oportunistas como las reiteraciones.

Estos datos y consideraciones nos llevan a ensanchar la definición del modelo de Aubréville. Los ejes con base plagiótropa y extremidad ortótropa pueden ser llamados *ejes mixtos plágio-ortótropos*, puesto que tienen una inversión de las funciones meristemáticas durante el crecimiento. La base entonces toma aquí la función de una rama y la extremidad, de un tronco. Este representa el caso inverso de lo que pasa en los ejes de la figura 1a-c.

En consecuencia, el *modelo de* Aubréville se define así:

La bioarquitectura está determinada por un tronco monopodial ortótropo con crecimiento rítmico y filotaxis espiralizada o decusada; este tronco lleva seudoverticilos de ramas, cada una constituida por uno, o más ejes mixtos plagio-ortótropos con floración lateral. La base de esta definición ha sido tomada en Hallé et al. (1978). El alejamiento de la noción original de 'Terminalia-branching' está claro. Sinembargo, este tipo de

---

Figura 2: *Bombacopsis quinatus* L. (Bombacaceae). Arriba: eje mixto plagio-ortótropo con base que lleva una docena de hojas digitadas dístiquas y extremidad ortótropa; anotese el eje del mismo tipo que sigue prolongando la rama. Abajo en la izquierda: ramificación rítmica del tronco ortótropo. Abajo en la derecha: tronco, base espinosa. Esmeraldas, Ecuador, 1976.

Figure 2: *Bombacopsis quinatus* L. (Bombacaceae). Above: plagio-orthotropic mixed axis with a base bearing about twelve hand-shaped distichous leaves and with an orthotropic extremity. Note the equivalent axis extending the branch. Under, left: rhythmic branching of the orthotropic trunk. Under, right: spinous base of the trunk.

ramificación se incluye perfectamente dentro de la nueva definición, que es más sencilla y también más abstracta.

Otro modelo caracterizado por las ramas del modelo de AUBRÉVILLE es el *modelo hipotético I*, que había sido postulado por HALLÉ y OLDEMAN (1970). La definición de aquel debe ser modificada:

Tronco monopodial ortótropo con crecimiento contínuo y filotaxis espiralizada o decusada; este tronco se ramifica de un modo contínuo por ramas constituidas cada una por uno o más ejes mixtos plagio-ortótropos con floración lateral. Este modelo ahora está ejemplificado por las especies de los géneros *Trema* y *Maesopsis* que fueron descritas en estas páginas. No conocemos aún suficientemente especies que muestran este modelo para nombrar este último.

Por fin consideremos los tipos biológicos no arbóreos dentro de los cuales los ejes mixtos plagio-ortótropos constituyen una ventaja ecológica. La escasez de tales ejes entre los árboles ya sugiere que no son órganos optimales para la edificación de estas plantas. Efectivamente, los ejes mixtos plagio-ortótropos se encuentran más bien entre las hierbas (Helechos, Gramineae, Labiatae, Zingiberaceae, *Solanum* y otros grupos, ver también JEANNODA, 1977). Esto se entiende bién, considerando que tales ejes son instrumentos muy aptos para una vida rastrante, o sea también para la multiplicación vegetativa.

SUMMARY

In a former publication (HALLÉ and OLDEMAN, 1970) the authors described three kinds of mixed axes. These axes which show a changing meristematic behaviour during the formation of their extremities, are orthotropic/orthotropic, orthotropic/plagiotropic or plagiotropic/plagiotropic (Fig. 1a-c). Here, a fourth kind of mixed axis is described from *Bombacopsis quinatus* L. (Bombacaceae): it has a plagiotropic base and an orthotropic extremity. It can now be recognized that the branches of *Trema* sp. var. (Ulmaceae) represent the same kind of axis, and not a reiteration, and those of *Terminalia catappa* (Combretaceae) can be conceived as containing reduced plagio-orthotropic mixed axes. Hence, AUBRÉVILLE's model can be redefined: its architecture is determined by an orthotropic, monopodial trunk with rhythmic growth and spiral or decussate phyllotaxis; this trunk bears pseudo-verticils of branches, each of which is constituted by one or more mixed plagio-orthotropic axes with lateral flowers. The hypothetical model I, postulated by HALLÉ and OLDEMAN (1970) now is exemplified by *Trema* sp. var. (Ulmaceae) and *Maesopsis eminii* Engl. (Rhamnaceae) and defined as follows: Monopodial, orthotropic, continuously growing trunk with spiral or decussate phyllotaxis; this trunk branches continuously and bears branches each of which is constituted by one or more mixed plagio-orthotropic axes. Plagio-orthotropic axes seem to be rather unfit to build a tree structure; they are often found in creeping herbs.

BIBLIOGRAFÍA

CORNER, E. J. H., 1952, Wayside trees of Malaya – 2 vol. The Government Printer, Singapore.

HALLÉ, F., 1967, Etude biologique et morphologique de la tribu des Gardéniées (Rubiacées) Mém. ORSTOM, **22**, Paris.

HALLÉ, F., y OLDEMAN, R. A. A., 1970, Essai sur l'architecture et la dynamique de croissance des arbres tropicaux. Masson & Cie, Paris.

HALLÉ, F., OLDEMAN, R. A. A., y TOMLINSON, P. B., 1978, Tropical trees and forests, an architectural analysis. Springer Verlag, Heidelberg, Berlin.

JEANNODA, V., 1977, Contribution à l'étude de l'architecture des herbes. Thèse de Spécialité, Montpellier.

OLDEMAN, R. A. A., 1974, L'architecture de la forêt guyanaise. Mém. ORSTOM, **73**, Paris.

THE PUBLICATION OF BLUME's TABELLEN EN PLATEN VOOR DE JAVAANSCHE ORCHIDEEËN

C. G. G. J. van Steenis

Rijksherbarium, Leiden

This work, representing an annexe to Blume's 'Bijdragen', was, according to Blume (l.c. 266), intended to enable the public to understand the system of orchids he proposed (subdivision of the family and generic concepts).

The folio work consists of a title page (date 1825), followed by 5 two-page sized tables containing a key to his system and a census of the genera; it is titled: 'Clavis generum Orchidearum javanicarum', in a footnote indicated as 'Observat. Botanic. Fasc. VI, tab. I-V'.

This is followed by 16 folio plates with floral details (dissections) of 78 species.

De Wit (1948), in his so much appreciated efforts to elucidate the history and publications of Malesian botany, wrote about the publication of this work, that 'there is incontrovertible evidence that it forms part of the octavo 6th instalment' of Blume's Bijdragen. This statement is also accepted by Stafleu & Cowan (1976).

Blume dedicated this 6th instalment (pp. 261–284) entirely to an introduction of his work on *Orchidaceae*, largely devoted to an explanation in detail of their structure and variety.

He made also several remarks on his working conditions. He complained (l.c. 262) that he had for a long time no draughtsman and was only capable to make some rough life-sketches himself. Furthermore he complained of the lamented absence of vital contemporary research literature on the family by R. Brown, C.S. Kunth and L.M.A. du Petit-Thouars, which he only received during the printing of the tables containing his own system, the reason why he could only have the benefit of these in minor points during the printing (l.c. 263).

Blume was fully aware of the rather preliminary nature of his system and the delimitation of his many genera and species, among which many were new to science, but described in a very concise way. In order to cope with this he wanted to help the reader and clarify his system by the edition of the present work, which had to serve to make the reader familiar with structural details and variety of the various organs of the orchidaceous flower, about which matter he felt very much concerned.

This appears further from an important statement he made in this 6th instalment (l.c. 265–266) which reads as follows (translated): 'One will in future be better informed and more convinced' (of my generic delimitation) 'by drawings and detail dissections of some 200 species already sketched after the issue of my greater work on our flora' (that is obviously the anticipated Flora Javae) 'so that I must confine myself at present to detail drawings of flower parts of 12 different genera which I will add to one of the *subsequent* instalments, enabling to check the most important points on which my system is based' (italics mine, v.ST.).

In instalments 7 & 8 (pp. 285–434) BLUME gave the descriptions of a large number of genera (87) and species (298), of which 27 under the joint authorship with J.C. VAN HASSELT, with whom he had earlier contemplated to work out the *Orchidaceae* together, which was defeated by the latter's untimely death (l.c. 265, footnote).

Indeed, he gave at the end of the 8th instalment, which finalizes the treatment of the *Orchidaceae*, the captions of the 12 species of which he had earlier promised the drawings.

These 12 drawings are reproduced in the work here discussed and occupy plates 1 and 2.

From this we can deduce that these two plates were published not earlier than instalment 8.

However, we cannot conclude that the plates 3–16 were also published at that time. He had not promised them and did not give the captions to them.

This seems to indicate they were published later. For the reason of this we can only guess. It could well be that BLUME's draughtsman LATOUR, and the engraver VEELWAARD, steadily proceeded better than he had anticipated, that he made the utmost use of their capacity, and grasped the opportunity to continue the working out of the rough sketches he had made. This may well have led him to continue the work under review here in its own right, for a group in which he had such a tremendous interest.

This reasoning can be sustained by the fact that there are discrepancies between the names in the 'Bijdragen' and those in the 'Tabellen en Platen', in which the latter contain some additional species, indicating that they were a later improvement on the former, which would mean that they were also published later.

On pl. 6 fig. XXXIII he pictured *Calcearia fornicata*, on pl. 13 fig. LXVI(c) *Diphyes bicolor* and fig. LXVI(d) *Diphyes crassifolia*, and on pl. 15 fig. LXX *Taeniophyllum fornicatum*, all of which four are not mentioned in the Bijdragen.

Whether the Tabellen en Platen were published as a whole is yet uncertain. Anyway the synoptical key and pl. 1 and 2 were not published at the same time as instalment 6 of the Bijdragen, earliest with instalment 8. This could involve that pl. 3–16 were issued later separately.

But, if I am allowed to make a guess, I would suggest that the drawings and their engraving proceeded so well at the end of 1825, that BLUME took advantage to have as many of the sketches worked out, which gave opportunity to add several which he had not described in the Bijdragen. This would have caused a (possibly slight) delay in the issue of the Tabellen en Platen and pl. 1 and 2, which had to wait until pl. 16 was finished.

As DE WIT has cleverly unearthed that instalments 2–9, including all the *Orchidaceae*, have been published before 7 December 1825, my point of view involves that the Tabellen en Platen were issued as a whole, earliest end December 1825 or in the first months of 1826.

In either case pl. 3–16 were published later than the text on *Orchidaceae* in the Bijdragen.

The perspective he had earlier in mind, mentioned above, to include all these detailed plates in a later great work (l.c. 266), did for some reason or other not materialize. They were omitted from his volume on *Orchidaceae* in Flora of Java, nov. ser. (1858–1859); one finds in that work only casual references to the 'Tabellen en Platen', merely as 'Bijdr. fig. so and so'.

REFERENCES

STAFLEU, F.A. & R.S. COWAN. 1976. Taxonomic Literature, ed. 2, **1**: 235.

WIT, H.C.D. DE. 1948. Dates of publication of Malaysian phytotaxonomical literature. Fl. Mal. Bull. no **4**: 96.

FLORA AND VEGETATION OF THE LEEWARD ISLANDS OF THE NETHERLANDS ANTILLES
I. GENERAL INTRODUCTION AND COASTAL COMMUNITIES

A. L. Stoffers

Instituut voor Systematische Plantkunde, Utrecht

1. Introduction

1.1. General information

The Leeward islands of the Netherlands Antilles (Aruba, Bonaire, and Curaçao) form part of a row of small islands along the northern coast of Venezuela extending from Los Mongos in the west to Los Hermanos in the east. Aruba lies some 30 km north of the Peninsula of Paraguaná and is situated on the continental shelf of Venezuela. Curaçao lies 60 km and Bonaire 85 km off the South American mainland from where these islands are separated by the Bonaire Trench, which in places has a depth of over 2000 m.

The maximum length and the area of Aruba, Bonaire and Curaçao are 30 km and 175 sq. km., 35 km and 265 sq. km., and 60 km and 472 sq. km. respectively.

1.2. Climate

The islands fall within a relatively small area of low rainfall along the northern coast of Venezuela between the mouths of the Río Orinoco and the Río Magdalena. The mean annual rainfall for the years 1947–1977 is 374.9 mm for Aruba, 581.2 for Bonaire, and 570.8 mm for Curaçao. The highest point of Curaçao, Seroe Christoffel, however might receive more rain but accurate documentation is lacking.

Rainfall is very irregular, not only in quantity but also in spread over the year. Generally speaking it is scanty from February till september. During the rainy season lasting from October till January, the rain falls chiefly in heavy short-lived showers, which are often of local importance only.

The mean annual temperature on the islands is 27.5°C with only slight variations in the average daily temperatures. September is considered to be the hottest month with an average of 28.7°C, January as the coolest month with an average of 26.2°C.

The mean relative humidity is always rather high, the annual mean being 75.9%.

The prevailing tradewinds to which the islands are exposed blow from the east varying from east-north-east to east-south-east. Both wind-direction and wind-velocity are exceedingly constant and equable during the year. The mean annual wind-velocity is 7.2 m/sec, the maximum velocity amounts to 13.5 m/sec (records for the years 1947–1977 obtained at the Dr A. Plesman Airport, Curaçao).

The climate of this region belongs to the 'steppe climate' of KÖPPEN defined by the formule BShs′n′′i. Several small areas on the islands are however certainly drier than the rest and may qualify for definition as 'desert climate' in KÖPPEN's classification.

Consequently the vegetation is tropical but has a pronounced xeromorphic character with marked differences in structure and composition of species depending on geological and physiografic factors.

1.3. Geology

Aruba, Bonaire, and Curaçao have much in common in regard to geological features. Their basement consists of a series of volcanic and sedimentary rocks deposited in Cretaceous time. Diabases are widely distributed over all three islands. Among the sediments tuffs, tuffites, cherts, conglomerates, sandstones and shales are common. In the Upper Cretaceous (during the Laramide folding) a dioritic magma intruded into these Cretaceous and early Tertiary formations. Owing to the general uplift and subsequent denudation the older series has partly become removed exposing the diorite batholith in various places. In this respect however there has been a distinct divergence in development of the three islands. The folding of the Cretaceous strata and the tectonic uplift have been paramount in the case of Aruba. As a consequence the Cretaceous roof of the batholith has been removed to a great extent and the diorite batholith with its differentiates has become exposed over a large area. In Curaçao the processes of folding and uplift has been less pronounced. The Cretaceous roof is still intact and the diorite batholith outcrops appear solely as dioritic and porphyritic dikes piercing through the Cretaceous rocks in various places. The main body of the batholith remains covered. In Bonaire folding and uplift have been relatively weak and appear to have occurred in late Cretaceous time i.e. before these processes took place in Aruba and Curaçao. Only a single dike of porphyritic diorite in the north-western part of the island testifies to the presence of the deep-lying batholith. After a period of denudation the islands were repeatedly submerged during the Tertiary. During a partial transgression in the early Pleistocene all three of them were covered by a cap of reef limestone. This transgression was followed by a slight uplift and subsequent denudation of the limestone covering and the underlying older rocks. Glacial movements of the sea-level and tectonic movements of the islands themselves during Pleistocene and Holocene caused the forming of young limestone reefs and their subsequent emergence. The peculiar hand-shaped land-locked bays connected with the sea by narrow gorges owe their existence to the same movements. Intermittent elevation has shaped the sea-cut of the older limestone.

1.4. Physiography

In relation to the discussion on the coastal communities attention must be drawn to the following physiografic features.

In Aruba a neogene limestone formation partly encircles the older formations of the interior, especially along the south-western coast and in the eastern part of the island. Alluvial formations are found along the south-western coast near Savaneta, Spaans Lagoen, and near Oranjestad, along the western coast between Manchebo and Malmok and very locally along the northern and eastern coasts where they result in dune formation. Along the south-western coast about 1 km offshore lies a frequently interrupted wall of coral shingle and sand rising to a height of as much as 3 m above sea-level. The only land-locked bay is Spaans Lagoen.

The island of Bonaire consists for the greater part of neogene limestone, which encircles the older formations and occupies nearly two-thirds of the total island area. In the southern part this limestone formation forms a low tableland not rising 1.5 m above sea-level. In some places it is covered by debris. Here we find besides a number of salt pans large areas covered with coastal vegetation on limestone as well as on the alluvial deposits. Five open or land-locked bays are present in Bonaire: Lac and Lagoen along the eastern coast, Slagbaai and Boca Bartool on the western coast in the northern part of the island, and Goto-meer also in the west but situated along the southern coast.

In Curaçao neogene limestone also encircles the older formations becoming prominent along the northern and eastern coast and in the central part of the island. Several inland bays occur: Santa Marta Baai, Schottegat, and Spaanse Water along the south-western coast and St. Joris Baai along the north-eastern coast. Alluvial deposits are

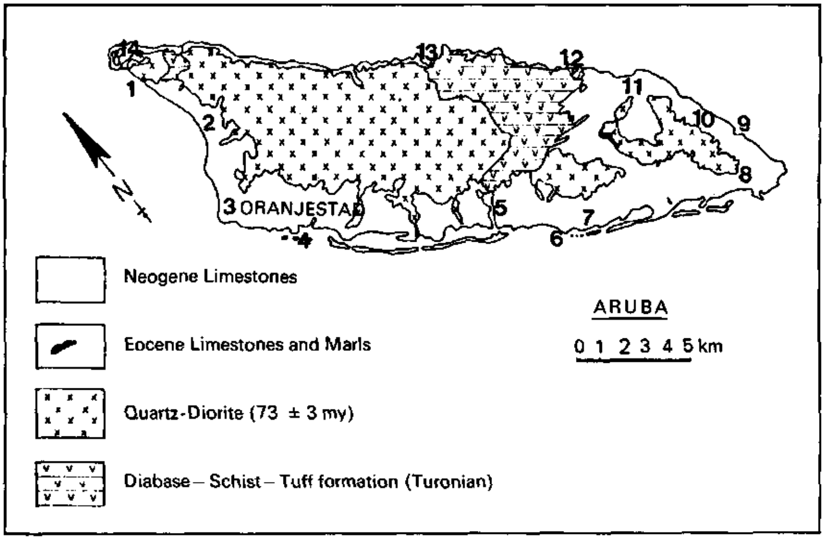


FIG. 1. Simplified geologic map of Aruba. (BEETS, 1972)
1: Malmok; 2. Salina Cerca; 3: Manchebo; 4: Paardenbaai; 5: Spaans Lagoen; 6: Pos Chiquito; 7: Savaneta; 8: Palu Marca; 9: Boca Grandi; 10: Pitchfield; 11: Cueba Huliba; 12: Boca Prins; 13: Andicouri; 14: Hudishibana.

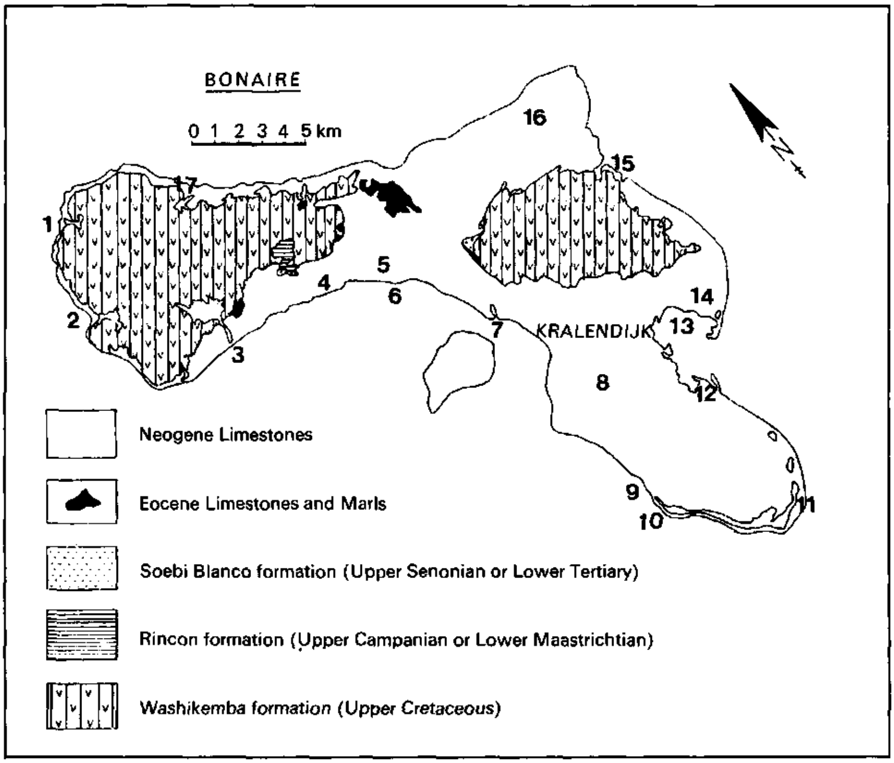


FIG. 2. Simplified geological map of Bonaire. (BEETS, 1972)
1: Boca Bartool; 2: Slagbaai; 3: Goto; 4: Karpata; 5: Columbia Plantation; 6: Barcadera; 7: Playa Lechi; 8: Lima Plantation; 9: Blauwe Pan; 10: Witte Pan; 11: Willemstoren; 12: Sorebon; 13: Lac; 14: Bacuna; 15: Lagoen; 16: Bolivia Plantation; 17: Salina Mathijs.

found along these bays and along the edges of 'salinas' such as there are Salina St. Marie, Fuik, and Lagoen Jan Thiel.

For detailed geological informations reference should be made to MOLENGRAAFF (1929), PIJPERS (1923), WESTERMANN 1932, 1949), and BEETS (1972).

2. FLORA

The first records on the flora of the islands go back as far as to PLUKENET. LINNAEUS mentioned in his Species Plantarum explicitedly 20 species occurring on Curaçao and one species from Aruba. Due to collections gathered by N. J. JACQUIN (1755–1757), W. F. R. SURINGAR (1885), F. A. F. C. WENT (1902) but in particular those assembled by I. BOLDINGH (1909–1910), Brother M. ARNOLDO BROEDERS (1945–1975), and the present author (1952→) the number of species known from the islands increased considerably. BOLDINGH's 'Flora voor de Nederlandsch West-Indische Eilanden' (1913) mentions 3 ferns and 380 angiosperms known from the Leeward Group. From the ANOLDO- and

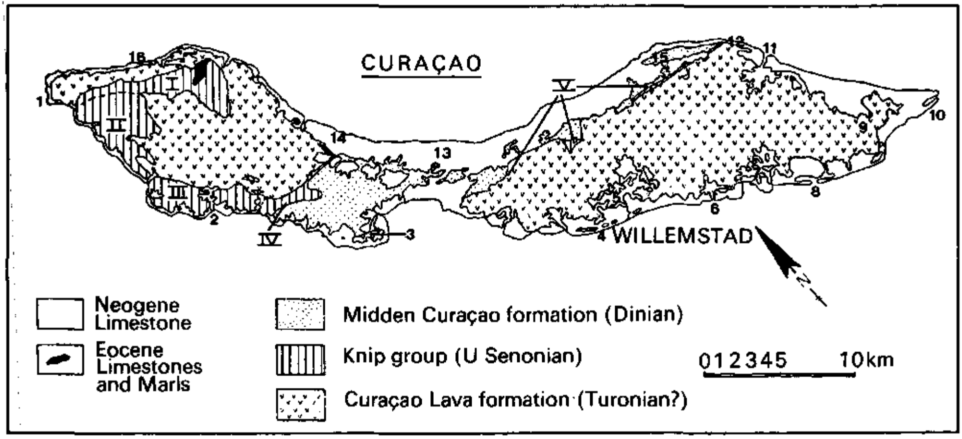


FIG. 3. Simplified geological map of Curaçao. (BEETS, 1972)
1: Westpunt; 2: Santa Marta Baai; 3. Salina St. Marie; 4: Rif; 5: Schottegat; 6: Lagoen Jan Thiel; 7: Spaanse Water; 8: Fuik Baai; 9: Klein St. Joris Plantation; 10: Awa di Oostpunt; 11: St. Joris Baai; 12: Koraal Tabak; 13: Hato; 14: San Pedro; 15: Ronde Klip Plantation; 16: Boca Table. (Roman numerals indicate geological subregions.)

STOFFERS-collections a large number of species new to the islands turned up, resulting in an increase from 383 to 496 taxa: 5 fern species, 484 angiospermous species and 7 varieties (LINDEMAN & STOFFERS 1963; ARNOLDO 1964).

Notwithstanding the thorough inventory of the flora in the past another 20 species turned up during recent field-work in the scheme of a more close study of the vegetation made possible by a grant from the Foundation WOTRO.

Among the species characteristic of the coastal regions a number of ecological groups can be distinguished:

1. Halophytes.
    a. Mangrove species: *Rhizophora mangle* L., *Avicennia germinans* L., *Laguncularia racemosa* Gaertn. and (? semi-mangrove) *Conocarpus erecta* L.
    b. *Sesuvium portulacastrum* L., *Batis maritima* L., *Alternanthera halimifolia* Standl., *Philoxerus vermicularis* P. de Beauv., *Salicornia perennis* Mill., *Bontia daphnoides* L., and *Heliotropium curassavicum* L.
2. Species of the sandy soils.
   Cakile lanceolata O. E. Schulz, *Canavalia maritima* Urb., *Coccoloba uvifera* L., *Corchorus hirsutus* L., *Euphorbia mesembrianthemifolia* Jacq., *Ipomoea pes-caprae* R. Br. ssp. *brasiliensis* v. Ooststr., *Sporobolus virginicus* Kunth, *Suriana maritima* L., and *Tournefortia gnaphalodes* Kunth.
3. Species occurring in areas under influence of saltspray only: *Strumpfia maritima* Jacq. and *Ernodea littoralis* Sw.
4. Species common in the interior but also salt-resistent: *Lithophila muscoides* Sw., *Gundlachia corymbosa*, *Hippomane mancinella* L., *Tephrosia cinerea* Pers., *Sporo-*

bolus pyramidatus Hitchc., and *Stemodia maritima* L.

5. Species of the coral shingles or coastal limestones or having a preference to these habitats: *Atriplex pentandra* Standl., *Cyperus fuligineus* Chapman, *C. planifolius* L. C. Rich., *Fimbristylis spathacea* Roth, and probably also *Sophora tomentosa* L.

Apart from the terrestrial species the following marine angiosperms have been collected in this area:

Hydrocharitaceae: Halophila baillonis Aschers., *H. decipiens* Ostenfeld, and *Thalassia testudinum* Sol.;

Najadaceae: Najas guadelupensis Morong;

Potamogetonaceae: Cymodocea manatorum Aschers., *Halodule beaudettii* den Hartog, *Ruppia maritima* L., and *Syringodium filiformis* Kütz.

Probably these species occur most frequently in the inland bays where a layer of (muddy) sand covers the underlying rock. I have no knowledge at all of this marine vegetation and will make no attempt to include it in the present account. However, I will draw attention to the dense stands of *Thalassia* that occur as a result of a vigorous vegetative propagation on the sandy substrate. These stands can already be seen from the lower or lowest limestone plateau as e.g. at Lac and Lagoen (Bonaire), Paardenbaai (Aruba), and Spaanse Water, Awa di Oostpunt and St. Joris Baai (Curaçao).

3. VEGETATION

The vegetation of the islands has been described by BOLDINGH (1914): 'The general impression of the vegetation is that of a dry country, where thorny shrubs and cactuses predominate and more or less compete with each other'.

He distinguishes:

1. A *Croton* vegetation, determined by *Acacia* and *Croton*, and which is either of a *Capparis* or a *Rhacoma crossopetalum* type;
2. A littoral vegetation, difficult to differentiate from the former.

In addition to this, he states that in the higher parts the *Croton* vegetation changes into a more forest-like type.

In 1944 BEARD proposed a system of classification for the plant formations of the American tropics. The system has been restated on three occasions (BEARD 1945, 1949, 1955). Now it is generally accepted and has been used in studies of the vegetation of several islands in the Caribbean, in Venezuela, in Guyana, and in Suriname.

In this system there is a grouping at three levels:

1. a floristic grouping – the association or the community, bearing a floristic name;*
2. a physiognomic grouping – the formation, bearing a physiognomic name;

---

* The most abundant dominants are usually selected as the diagnostic species from which the assemblage is named but there is no absolute rule and any common species whose presence is felt to be diagnostic may be selected.

TABLE 1.

	Rhizophora community								Avicennia community					constancy	
Relevé number	1	2	3	4	5	6	7	8	9	10	11	12	13		
quadrate size (m^2)	200	200	200	200	200	200	200	200	200	200	200	200	200		
cover %	90	85	90	95	90	95	95	45	70	80	95	60	90		
water depth (cm)	+40	+70	+100	+60	+120	+60	+75	+30	+5	+10	−30	+5	<10		
number of taxa	2	3	2	2	2	1	2	2	3	1	1	3	2		
vegetation height (m)	4	5	7	6	7	6	7	3	5	6	5	5	4		
Rhizophora mangle	5.5	5.5	5.5	5.5	5.5	5.5	5.5	3.2						V	
Syringodium filiformis	+	+		+										II	
Thalassia testudinum			+				+							II	
Cymodocea manatorum		+			+									II	
Avicennia germinans								+.1	4.5	5.5	5.5	4.5	5.5	I	V
Batis maritima									+.1			+.1	r		III
Salicornia perennis									r			+.1			II

TABLE 1. (cont.)

	Laguncularia community					Conocarpus community					
Relevé number	14	15	16	17	18	19	20	21	22		
quadrate size (m^2)	100	75	75	100	100	75	100	100	100		
cover %	80	70	90	95	90	70	30	65	80		
water depth (cm)	−5	−15	−15	−5	−10	−30	−20	−10	−40		
number of taxa	3	2	1	4	2	5	2	4	4		
vegetation height (m)	3	4	3	3½	3	3	2	2½	3½		
Laguncularia racemosa	5.5	4.5	5.5	4.5	4.5					V	
Conocarpus erecta	r			r		4.5	3.4	4.5	4.4	II	V
Sesuvium portulacastrum				+.2	+.2	r		r		II	III
Philoxerus vermicularis		2.3				+.1				I	I
Stemodia maritima						+.2			r		III
Batis maritima	+.1			r				r	+.1	III	III
Sporobolus pyramidatus							1.2				I
Bontia daphnoides						r		1.1	r		IV

Curaçao: 1, 2, 14, 15 Rif; 3, 9, 16, 19. Spaanse water; 20. Santa Marta Baai;
Aruba: 4, 13, 17, 22. Spaans Lagoen; 5, 11 Pos Chiquito; 21. Salina Cerca;
Bonaire: 6, 7, 10, 12, 18 Lac; 8. Lagoen.

3. a habitat grouping – the formation series, bearing a habitat name.

With regard to the coastal vegetation STOFFERS (1956) distinguished the following categories:

Dry evergreen formations	
Littoral woodland	Herbaceous strand community
	Strand scrub community
Rock pavement vegetation	*Conocarpus* community
Edaphic formations	
Mangrove woodland	
Vegetation of saltflats and salinas.	

In the present paper the mangrove forest, salt-flat vegetation, beach- and strand vegetation, and the vegetation of the rock-pavement will be discussed.

Mangrove forest.

The common New World mangrove species *Rhizophora mangle*, *Avicennia germinans*, and *Laguncularia racemosa* as well as the semi(?)-mangrove species *Conocarpus erecta* are present.

The mangrove forests are restricted to a few localities: along inland-bays and scattered on the lee-side of the islands. They do not occupy vast regions and have a simple structure. Moreover, they have been badly affected by human interference in particular by cutting to obtain fire-wood.

1. *Rhizophora* community.

From the relevés in table 1 it is clear that *Rhizophora* occupies the outer belt of the mangrove forests. The first stage represented in the pioneer zone by scattered to rather close low trees gradually passing into the zone of mature trees reaching a height of 6 m or more. The pioneer family is often restricted to a narrow fringe in front of or below the mature trees. In both pioneer and mature zone seagrasses such as *Thalassia testudinum* and *Syringodium filiformis* may be present. The *Rhizophora* community exists as a pure community.

2. *Avicennia* community.

The *Rhizophora* community which varies considerably in width is followed by an *Avicennia* community on the higher grounds which are flooded at high tide only. The species is adapted to the swamp habitat by pneumatophores which emerge above the soil surface by negative geotropy. The community exists as an almost pure stand but on the higher grounds it becomes invaded by *Batis maritima* and *Salicornia perennis*. These succulent halophytes may form small mats by vegetative propagation.

3. *Laguncularia* and *Conocarpus* community.

In or behind the *Avicennia* belt *Laguncularia racemosa* and/or *Conocarpus erecta* may become prominent especially on sites that are clearly affected by human interference. The importance of these species is possibly due to the degree of disturbance.

Both species also occur scattered along salt-flats and along the shores.

The status of *Conocarpus* is a peculiar one. Since the species does not posses stilt-roots or pneumatophores nor exhibits vivipary it is often regarded as being not a true mangrove species. It is tolerant to a variety of conditions and, besides the habitats mentioned, occurs also in littoral woodland, *Hippomane* woodland, and is prominent in vegetations of the rock-pavement. Moreover, it is also found in the interior of the islands on weak saline soils.

The mangrove woodlands in the Caribbean have been classified variously. BØRGESEN (1909) distinguished one wide mangrove vegetation apart from a *Conocarpus* formation. RAUNKIAER (1934) accepted BØRGESEN's formations but divided the mangrove formation into a *Rhizophora*-, an *Avicennia*-, and a *Laguncularia*-facies. Contrary to most ecologists STEHLÉ (1935) regards the American mangrove as a single association, dominated by *Rhizophora* and *Avicennia*. DAVIS (1940) drew attention to the serial character of the mangrove, whereas CHAPMAN (1944, 1976) pointed out that the mangroves are partly serial and partly climax vegetations depending on the sites where they occur. Both accept a *Rhizophora*-, an *Avicennia*-, a *Laguncularia*-, and a *Conocarpus* consocies. In addition DAVIS accepted a 'Mature mangrove associes', consisting of large trees of *Rhizophora* and *Avicennia*. LINDEMAN (1953) correlates his 'mixed mangrove forest' in Suriname with DAVIS' mature mangrove associes.

In the BRAUN-BLANQUET system of plant classification CHAPMAN (1976) proposes the following syntaxa in America:

Alliance	Order	Association
Rhizophoretalia	*Rhizophorion occidentalis*	*Rhizophoretum mangleae*
Avicennietalia	*Avicennion occidentalis*	*Avicennietum germinansii* (= *Avicennietum nitidae* Lindeman)
Combretalia	*Lagunicularion*	*Lagunicularietum racemosae*
	Conocarpion	*Conocarpetum erectae*

Vegetation of the salt-flats.

Salt-flats are to be found behind the mangroves, on alluvial deposits along land-locked bays, and along salinas. They are characterized by temporary inundation by sea-water alternating with drying out of the soil by evaporation and as a consequence by a strong increase of salinity. In the lower parts of the salinas brackish and salty pools are often present in which *Ruppia maritima* and *Najas guadelupensis* are common. On the lower grounds which are inundated frequently and during a long period the succulent halophytes *Batis maritima* and *Salicornia perennis* form the vegetation as a rule in a mosaic due to vigorous vegetative growth. On the higher grounds *Sesuvium portulacastrum*, also a succulent, and *Heliotropium curassavicum* are the most promi-

TABLE 2.

	Sesuvium portulacastrum – Heliotropium curassavicum community									Transition				Batis maritima – Salicornia perennis community							constancy	
Relevé number	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20		
quadrate size (m^2)	5	5	5	5	5	5	4	5	4	5	5	5	5	5	5	5	5	5	5	5		
cover %	80	100	85	50	40	80	50	80	60	50	60	40	10	70	60	60	55	60	20	55		
number of taxa	3	3	4	3	3	2	4	2	3	4	4	3	3	2	2	2	1	2	2	1		
vegetation height	10	5	7	5	5	5	5	5	5	20	25	20	10	25	25	25	15	20	15	25		
water depth (cm)	−2	−5	−20	−25	−10	−40	−20	−4	−20	0	0	−6	0	+10	+8	+10	+10	+15	+5	+20		
Sesuvium portulacastrum	5.5	3.3	5.5	5.5	3.4	5.5	3.4	5.5	5.5	3.3	2.3	3.4	+.1								V	V
Heliotropium curassavicum	1.2	1.2	2.2	r	1.2		2.2	+.1	2.2	+.1	+.2	1.2									V	IV
Philoxerus vermicularis		4.3	r		r																II	
Trianthema portulacastrum				+.2			+.1														II	
Sporobolus pyramidatus	+.2		+.2						+.2												II	
Sporobolus virginicus						2.2	r														II	
Batis maritima										r	3.2	1.1	1.2	4.5	4.3	3.2	4.4	4.5	2.3	4.5	V	V
Salicornia perennis										1.2	3.2		1.2	1.2	2.3	2.2		2.4	2.3		IV	IV

Aruba: 6, Boca Grandi; 7, 20. Spaans Lagoen; Bonaire: Blauwe Pan; 9. Sorebon, near Lac; 10, 19 Lac; 13. Saline Mathijs; 17. Playa Lechi; 18. Witte Pan; Curaçao: 1, 2, 3. Rif; 4. Jan Thiel; 5, 16. St. Joris Baai; 11, 14, 15. Awa di Oostpunt; 12. Salina St. Marie.

nent species. In those parts of the salinas that are covered by alluvial sand-layers *Salicornia* and *Batis* decrease in number and vitality whereas *Sporobolus virginicus*, a pioneer of the sandy sea-shores, takes their place.

From the relevés given in table 2 the conclusion can be drawn that two communities can be distinguished on salt-flats:

1. The *Batis maritima–Salicornia perennis* community in frequently inundated habitats.
2. The *Sesuvium portulacastrum–Heliotropium curassavicum* community in the non- or shortly flooded higher grounds.

Both communities appear to have their optimum on silty or clayish saline substrates, but occur also on sandy soils.

Some scattered shrubs of *Conocarpus* and *Laguncularia* may be found along the borders of salinas but they never form dense stands.

Beach- and strand-vegetation.

The beaches on the islands consist either of sand of calcareous rocks or of coral shingles. The beach-sands are highly calcareous. Sandy beaches are mainly to be found on the lee-sides where they are mostly a popular resort and as a consequence the vegetation has been badly affected. They are also to be found at the weather-sides but then on the inner side of protected inland-bays only. The differences between the vegetations of sandy and coral shingle beaches are obvious.

TABLE 3.

	Ipomoea pes-caprae – Canavalia maritima community										con-stancy
Relevé number	1	2	3	4	5	6	7	8	9	10	
quadrate size (m^2)	300	200	200	100	100	100	100	50	200	200	
cover %	10	60	30	80	10	10	5	5	80	5	
number of taxa	6	4	2	3	4	4	4	2	3	2	
vegetation height (cm)	15	20	10	10	10	15	20	5	15	10	
Sporobolus virginicus	1.2	4.5	3.3	4.4	1.3	1.2	+.2	1.2	5.5	1.2	V
Ipomoea pes-caprae	2.2						1.1				I
Sesuvium portulacastrum	+.1	+.1			+.2	r		r			III
Lithophila muscoides	+.8				+.2	+.2	r			+.2	III
Heliotropium curassavicum	+.1					+.1					I
Cyperus oxylepis		2.3									I
Fimbristylis spathacea	1.2								+.1		I
Euphorbia thymifolia			r	+.1	+.1		r		+.1		III
Sporobolus pyramidatus		+.1		r							I

Aruba: 1. Boca Grandi; 2. Salina Cerca; 3. Hudishibana; 4. west of Andicouri, near Boca Mahos; Bonaire: 5. Playa Chiquito; 6. near Willemstoren; 7. near Lac; Curaçao: 8. west of Hato; 9. Lagoen Jan Thiel; 10. Klein St. Joris Plantation.

TABLE 4.

	Tournefortia gnaphalodes – Suriana maritima community										constancy
Relevé number	1	2	3	4	5	6	7	8	9	10	
quadrate size (m^2)	200	200	300	300	300	300	200	200	300	200	
cover %	30	40	10	15	40	30	40	40	15	20	
number of taxa	4	5	5	6	5	4	6	4	5	4	
vegetation height (cm)	50	70	50	70	80	60	50	70	40	60	
Tournefortia gnaphalodes	1.1	3.1	2.1	2.2	2.1	2.1	1.2	3.2	1.2	2.1	V
Suriana maritima	3.2	1.2	1.1	+.1	2.1	2.1	3.1		2.1	r	V
Euphorbia mesembrianthemifolia	1.1	+.2	+.1	+.1	1.1		2.3	r	r	+.1	V
Lithophila muscoides	+.2	r	r	+.2	+.2	+.2	+.2	+.2	r	r	V
Sporobolus virginicus				r	r		r				II
Sporobolus pyramidatus			r			1.1		+.1	r		II
Cyperus planifolius		+.2					r				I
Egletes prostrata				r							I

Aruba: 1, 2. Manchebo; 3. Boca Grandi; 4. dunes near Prins; Bonaire: 5. Playa Chiquito; 6. near Willemstoren; 7. north of Willemstoren; Curaçao; 8: Klein St. Joris Plantation, near the coast; 9: east of Hato; 10: Awa di Oostpunt.

The vegetation of the sandy beaches is clearly serial in character ranging from a herbaceous strand-vegetation to open littoral woodland.

1. The *Ipomoea pes-caprae – Canavalia maritima* community.

This herbaceous strand-community begins above the tidal-limits with a very open vegetation in which the typical sandbinders *Ipomoea pes-caprae* and *Sporobolus virginicus* are frequent whereas the associate *Canavalia maritima* is sparse. Although *Canavalia* is known from two localities only it is prefered to denote the community after *Canavalia* and *Ipomoea* because these species are characteristic of the sandy beaches in both Old and New World tropics. In small depressions *Sesuvium portulacastrum* and *Heliotropium curassavicum* occur but always as small or open patches. (Table 3.)

The community was indicated as 'beach vegetation' by GLEASON & COOK (1926), as formation à *Ipomoea pes-caprae* et *Canavalia maritima*' by STEHLÉ (1935). CHAPMAN (1944) described it as '*Sesuvium-Sporobolus-Ipomoea* associes' whereas BEARD (1949) considered it to be the 'pioneer of the sand-dune vegetation'. Using the BRAUN-BLANQUET system LINDEMAN (1953) denoted it the *Ipomoeeto-Canavalietum americanum*. BØRGESEN (1909) included the vegetation of the sand-dunes and therefore used the '*Pes-caprae* formation' in a broader sense.

2. *Tournefortia gnaphalodes – Suriana maritima* community.

On higher grounds the vegetation mentioned above is succeeded by the *Tournefortia*

TABLE 5.

	Coccoloba uvifera community	
Relevé number	1	2
quadrate size (m^2)	400	400
cover %	15	25
number of taxa	10	7
Coccoloba uvifera	2.1	3.1
Cakile lanceolata	+.1	r
Corchorus hirsutus	+.1	r
Cenchrus echinatus	+.2	+.2
Capraria biflora	+.1	
Heliotropium angiospermum	+.1	
Euphorbia mesembrianthemifolia	r	
Fimbristylis spathacea	r	
Euphorbia thymifolia	+.1	+.1
Dactyloctenium aegyptium		+.2
Eragrostis ciliaris var. ciliaris	+.2	+.2

Aruba: 1. near Boca Grandi; 2. Andicouri.

gnaphalodes – Suriana maritima community, a vegetation dominated by these two shrubs and associated with a number of species as given in table 4. This vegetation is confined to sandy sites and typical for sand-dunes. Continuous supply of sand by the strong tradewinds seems to be one of the most important factors. A fragmentary development of the community is a common feature and open, nearly pure stands of *Tournefortia*, *Suriana* or *Euphorbia mesembrianthemifolia (= E. buxifolia)* are common and to be found on Aruba e.g. in the north-western part of the island and near Boca Prins, on Bonaire in the southern part and along the northern coast, and on Curaçao in the very eastern part and in several places along the northern coast.

The vegetation is known as 'strand scrub associes' (DAVIS, 1942) to distinguish it from the 'strand dune associes' (DAVIS, 1942) characterized by the herbaceous species. According to ASPREY & ROBBINS (1953) the strand dune associes is well developed in Jamaica whereas the strand scrub associes is seldom well developed due to the limited width of the beaches and to human interference. The latter associes is comparable with the '*Tournefortia* facies' of RAUNKIAER (1934).

3. *Coccoloba uvifera* community.

On the highest grounds the littoral woodland comes into existence, dominated by the common Caribbean tree *Coccoloba uvifera*. It is represented by an open stand of *Coccoloba* associated with scattered shrubs and herbs (table 5). The woodland is known from Boca Grandi ('Sea grape grove') and Andicouri.

TABLE 6.

Relevé number	1	2	3	4	5	1	2	3	1	2
quadrate size (m^2)	300	250	300	200	250	400	250	300	1000	500
cover %	5	15	5	5	10	20	20	15	45	60
number of taxa	5	4	6	3	3	2	3	3	11	8
vegetation height	25	30	25	15	20	60	70	80	400	150
substrate	c.s.	c.s.	c.s.	c.s.	c.s.	sand	sand	sand	l.s.	l.s.
Fimbristylis spathacea	+.2	2.2	1.2	+.1	1.2					
Cyperus planifolius	1.2	1.2	1.2	1.2	1.2					
Cyperus fuligineus	+.1	+.1	1.2	+.1	+.1					+.2
Suriana maritima	+.1	r				2.2	+.2	+.2		
Tournefortia gnaphalodes			+			+.1	2.1	2.1		
Euphorbia mesembrianthemifolia			r				+.1	+.1		
Conocarpus erecta	+.1									
Coccoloba uvifera									2.1	3.2
Metopium brownei									+.1	
Bontia daphnoides									3.2	2.1
Rhacoma crossopetalum									+.1	r
Sophora tomentosa									r	
Jacquinia barbasco									r	
Condalia henriquezii									r	+.1
Bumelia obovata									r	
Antirrhea acutata									r	1.1
Erithalis fruticosa									r	2.3
Thespesia populnea									r	
Ernodea littoralis			r							+.2

c.s. = coral shingle; l.s. = limestone. Curaçao: 1. Bullenbaai near Salina St. Marie; 2. Fuik; 4. Rif; Bonaire: 3. Karpata; 5. Witte Pan.
Relevés 1–5 represent the *Fimbristylis spathacea – Cyperus planifolius* community, relevés 1–3 the *Tournefortia gnaphalodes – Suriana maritima* community, and relevés 1–2 the *Coccoloba uvifera – Rhacoma crossopetalum* community.

This community has been classified as *Coccoloba uvifera* formation (RAUNKIAER, 1934; STEHLÉ, 1935), as strand woodland association (DAVIS, 1942; ASPREY & ROBBINS, 1953), and beach forest (MARSHALL, 1934).

The vegetation series on limestone is quite different and starts on the coral shingle with an open plant-growth in which *Fimbristylis* and *Cyperus* dominate. Locally sand-deposits may be present and there *Suriana maritima*, *Tournefortia gnaphalodes*, and *Euphorbia mesembrianthemifolia* occur. In the higher parts where coral shingles overlie the limestone plateau a woodland exists. *Coccoloba uvifera* and *Rhacoma crossopetalum* dominate whilst scattered specimens of *Sophora tomentosa*, *Bumelia obovata*, *Jacquinia barbasco*, and *Condalia henriquezii* are to be found. In the shrub-layer *Antirrhea acutata* and *Erithalis fruticosa*, typical species of the limestone area are present, though in small numbers. (Table 6).

The *Fimbristylis spathacea – Cyperus planifolius* community is frequently found on coral-shingle walls along the coast whereas the *Coccoloba uvifera – Rhacoma crossopetalum* community is rare.

The important role of *Rhacoma crossopetalum* in the strand-vegetation was also mentioned by RAUNKIAER (1934) with regard to St. Croix, and by ASPREY & ROBBINS (1953) for the coastal ledge near Falmouth, Jamaica. For Pova Beach, Aruba, STOFFERS (1956) mentioned a littoral woodland in which *Rhacoma* was dominant, associated with *Erithalis, Corchorus hirsutus, Cyperus planifolius, Croton flavens*, and *Cordia curassavica*. Since *Coccoloba uvifera* was entirely absent it was named the *Rhacoma crossopetalum* type of littoral woodland. Now this vegetation has disappeared and is replaced by hotels.

In several places along the coast especially where the gullies debouch into the sea a growth of *Hippomane mancinella* can be found. Here as well as in the interior *Hippomane* is a tree of up to 13 m tall which forms stands together with a number of species such as *Phyllanthus botryanthus, Croton flavens, Lantana camara, Cordia alba* and *Acacia tortuosa*. Sometimes it is associated with more or less halophytic species such as *Bontia daphnoides, Conocarpus erecta*, and even *Batis maritima*.

Knowledge of the ecology of *Hippomane* is still far from complete. BØRGESEN (1909) records the species on St. Croix as the second most abundant species in his *Coccoloba uvifera* formation and RAUNKIAER also regards it as belonging to this type of vegetation. STEHLÉ (1935) mentions the species as sometimes occurring in the 'formation à *Coccoloba uvifera*' but as usually forming pure growths. BEARD mentions it as occurring in pure stands of 20 m height in the vegetation of salt-flats. GOODING et al. (1965) record *Hippomane* as a frequent component of the sandy bush *(Coccoloba uvifera)* association and according to ASPREY & ROBBINS (1953) the species is an important constituent in the strand-woodland association. All authors record its occurrence on sandy plains. ADAMS (1972) however mentions that in Jamaica *Hippomane* is rather local and not common in thickets on limestone and at salina-margins, never far from the sea. In the islands under discussion *Hippomane* was found frequently at an altitude of over 60 m at the foot of escarpments of the limestone plateaus. Moreover it is an important component of the vegetation of the rock-pavement as will be seen later. An investigation on the ecology of *Hippomane* is therefore badly needed.

Vegetation of the rock-pavement.

The rock-pavement substratum may occur on the coasts on uplifted coral reefs and consists of a very hard type of limestone which erodes into sharp edges that give a metallic ring when struck. The limestone plateaus show a karren habit, often known as 'dogtooth limestone'.

Especially on the weather-side of the islands conditions are very unfavourable on the rock-pavement as a result of the influence of the trade-winds, the salt-spray, and shortness of soil. When rain-water runs off from the hills more inland the honey-comb structures of the limestone become filled with alluvial deposits. This factor as well as

TABLE 7.

	Cereus repandus – Melocactus community					Con-stancy
Relevé number	1	2	3	4	5	
quadrate size (m²)	800	800	800	800	800	
cover %	10	15	15	5	5	
number of taxa	5	5	5	4	5	
Cereus repandus	1.1	+		+		IV
Cephalocereus lanuginosus			r			I
Lemaireocereus griseus		r			r	II
Opuntia wentiana		r			r	II
Melocactus spp.	1.1	2.1	2.1	1.1	1.1	V
Acacia tortuosa	r		r			II
Jatropha gossypifolia			r	r		II
Euphorbia thymifolia	+.1				+.1	II
Lithophila muscoides	+.2	+.2	+.2	+.2	+.2	V

Bonaire: 1, 2, 3. Lagoen; 4, 5. Bacuna.

velocity and salt-content of the trade-wind are related to the plant-communities that can be recognized on the rock-pavement.

1. *Cereus repandus – Melocactus* community.

This community inhabits the coastal limestone terrace under strong wind-influence but where the influence of salt-spray is strongly reduced. The community occurs on all of the islands but is best developed on Bonaire near Lagoen and Bacuna. Here acres of rather bare substratum are found on which numerous specimens of *Melocactus* and a few scattered columnar cacti especially *Cereus repandus* but also *Lemaireocereus griseus* are to be found. In 3 quadrates of 100 sq. m. 78 + 0 + 0, 54 + 2 + 1, and 109 + 1 + 0 specimens of *Melocactus*, *Cereus* and *Lemaireocereus* respectively were counted. Scattered depressed specimens of *Acacia tortuosa* were noted as well. The columnar cacti reach a height of 8 m or even more. (Table 7).

2. *Conocarpus erecta – Lithophila muscoides* community.

On the tuffoid limestone in southern Bonaire which is often flooded with fresh or brackish water as well as along the weather-side coasts an open vegetation of scattered pure patches of stunted and depressed shrubs of *Conocarpus erecta* is formed. These patches are several sq. m. in size. Judging from the sites where the community is found in relation to heavy surfs, so-called 'spuiters', as well as the occurrence of species such as *Cyperus fuligineus*, *Fimbristylis ferruginea* and *Sporobolus pyramidatus* the influence of salt-loaden sea winds is of great importance. The *Conocarpus* community is an open vegetation where on the bare limestone in addition to *Conocarpus* shrubs only widely scattered small shrubs and herbs occur (Table 8).

TABLE 8.

	Conocarpus erecta – Lithophila muscoides community										constancy
Relevé number	1	2	3	4	5	6	7	8	9	10	
quadrate size (m^2)	800	800	800	800	800	800	800	800	800	800	
cover %	70	45	40	60	30	30	35	45	20	30	
number of taxa	6	4	7	6	5	7	8	7	9	8	
vegetation height	60	80	70	60	75	100	90	90	50	60	
Conocarpus erecta	4.4	3.4	3.3	4.3	3.2	1.3	3.2	3.3	2.2	2.2	V
Lithophila muscoides	+.2	+.2	+.2	+.2	+.2	+.2	1.2	+.1	+.2	+.1	V
Euphorbia thymifolia	+.1	+.1	+.1	+.1	+.1	+.2	1.2	+.1	+.2	+.1	V
Aristida adscencionis	+.2	+.2	+.2	+.2	+.2	+.2	+.2	+.2	+.2	+.2	V
Cyperus planifolius	+.2			+.2		+.2	1.2	+.2	+.2		III
Paspalum laxum			+.2			+.2	+.2		+.2	+.2	III
Sesuvium portulacastrum			r			r			r	+.2	II
Strumpfia maritima			r		r				r		II
Sporobolus pyramidatus				+.1			+.1		+.1		II
Jatropha gossypifolia	r							r			I
Melocactus sp.							r				I
Opuntia wentiana								+.1			I
Tournefortia gnaphalodes										1.1	I
Sporobolus virginicus										+.2	I

Curaçao: 1. San Pedro; 2. west of Hato; 3. east of Hato; 4. near Awa di Oostpunt; 5. near Ronde Klip; Bonaire: 6. south of Lima Plantation; 7. Bacuna; 8. near Willemstoren; 9. north of Lagoen, 10. west of Lac.

Locally the total cover may decrease to less than 5%. Fine examples are to be found on the lowest limestone plateau of southern Bonaire, on the dogtooth limestone along the northern coast of Curaçao, as well as in the eastern part near Awa di Oostpunt.

Near the lee-side of southern Bonaire *Conocarpus* is not depressed but a rather tall shrub that becomes mixed with *Metopium brownei.*

3. *Hippomane mancinella – Lithophila muscoides* community.

On the rock-pavement on the weather-side of the islands a similar vegetation as the preceeding community is formed by *Hippomane mancinella:* depressed more or less stunted shrubs form scattered pure patches of several sq.m. in size. (Table 9). Like in the *Conocarpus* community common species such as *Lithophila muscoides, Euphorbia thymifolia,* and *Jatropha gossypifolia* are to be found, whereas *Cyperus fuligineus* and *Fimbristylis ferruginea* are wanting. Therefore it is concluded that the influence of salt-loaden sea-winds is less important than in the case of the *Conocarpus* community. The community exists along the northern coast of Curaçao and Bonaire in the higher parts of the lower limestone plateau and in the southern part of Bonaire.

TABLE 9.

	Hippomane mancinella – Lithophila muscoides community										constancy
Relevé number	1	2	3	4	5	6	7	8	9	10	
quadrate size (m^2)	800	800	800	800	800	800	800	800	800	800	
cover %	10	40	20	45	20	35	20	15	20	15	
number of taxa	6	4	5	6	5	5	6	5	5	5	
vegetation height (cm)	80	150	50	100	120	160	130	70	120	100	
Hippomane mancinella	2.2	3.3	2.2	3.3	2.3	3.3	2.2	2.2	2.3	2.3	V
Lithophila muscoides	+.2	+.2	+.2	+.2	+.2	+.2	+.1	+.2	+.2	+.2	V
Euphorbia thymifolia	+.1	+.1	+.1	+.1	+.1	+.1		+.1		+.1	IV
Opuntia wentiana	r			r	+.1	r		+.1	r	r	IV
Erithalis fruticosa	r	+.1								r	II
Cereus repandus				+.1			r		+.1		II
Jatropha gossypifolia	+.1		r				+.1		r		II
Portulaca phaeosperma					r	r					I
Bontia daphnoides				r			r				I
Conocarpus erecta			r								I
Cordia curassavica							r				I
Lemaireocereus griseus								r			I

Aruba: 1. Palu Marca; Bonaire: 2. Playa Chiquito, 3. south of Lima Plantation, 4. Bacuna near Lac; Curaçao: 5. Westpunt, 6. Boca Table, 7. San Pedro, 8. west of Hato, 9. Koraal Tabak, 10. Klein St. Joris Plantation.

4. *Strumpfia maritima – Ernodea littoralis* community.

Like the preceeding communities an open vegetation on the bare dogtooth limestone with a cover ranging from 75% to less than 5%. (Table 10.) Both saltspray and windinfluence are strong. The narrow- and hardleaved *Strumpfia* is the most prominent species associated with a few species only of which *Ernodea littoralis* is the most characteristic besides a few common and widely scattered common species such as *Opuntia wentiana*, *Sesuvium portulacastrum*, *Lithophila muscoides*, and *Jatropha gossypifolia*. The community is also found on the perpendicular escarpments of the second limestone plateau at Bolivia Plantation, Bonaire and Klein St. Joris Plantation, Curaçao. Moreover it is found at the leeside of Bonaire near Barcadera, where it forms a rather dense vegetation in a narrow strip not over 20 m from the coastal line.

5. *Gundlachia corymbosa* community.

When the honeycomb structures of the limestone are filled up by alluvial deposits supplied by rain-water running off from the inland hills an open vegetation can be found in which *Gundlachia corymbosa* dominates associated with some halophytes such as *Sesuvium portulacastrum* and *Stemodia maritima* while *Bontia daphnoides* is also

TABLE 10.

	Strumpfia maritima – Ernodea littoralis community										con-stancy
Relevé number	1	2	3	4	5	6	7	8	9	10	
quadrate size (m^2)	400	400	400	400	400	400	400	400	400	400	
cover %	25	80	75	20	60	60	65	30	10	20	
number of taxa	7	7	5	6	6	6	6	6	7	6	
vegetation height	15	20	30	25	30	20	25	20	15	30	
Strumpfia maritima	2.2	5.1	5.1	2.2	4.2	4.2	4.3	3.1	1.1	2.1	V
Ernodea littoralis		+.1	+.1	r	1.1	1.1	+.1	+.1	+.1		IV
Lithophila muscoides	1.2	+.2	+.2	1.2	+.2	+.2	+.2	+.2	+.2	+.2	V
Aristida adscencionis	+.2	+.2	+.2	+.2	+.2	+.2	+.2	+.2	+.2	+.2	V
Cyperus fuligineus	r	+.2	r		+.2	1.2	1.2	+.1	+.1	r	V
Euphorbia thymifolia	+.2			+.2	+.2	+.2	+.2	+.2		r	IV
Sesuvium portulacastrum				r						+.2	I
Paspalum laxum	+.2								+.2		I
Gundlachia corymbosa		+.1									I
Melocactus sp.	r								r		I
Cordia curassavica		r									I

Aruba: 1. near Cueba Huliba; Bonaire: 2, 3. Bolivia Plantation; 4. Spelonk; 5. Barcadera; 6. Colombia Plantation; 7. southern Bonaire; Curaçao: 8. west of Hato; 9. perpendicular cliff Klein St. Joris Plantation; 10. Awa di Oostpunt.

TABLE 11.

	Gundlachia corymbosa community					con-stancy
Relevé number	1	2	3	4	5	
quadrate size (m^2)	400	400	400	400	400	
cover %	20	10	20	25	10	
number of taxa	7	4	5	6	4	
vegetation height	50	40	60	60	50	
Gundlachia corymbosa	2.1	1.1	2.2	3.2	2.2	V
Euphorbia thymifolia	+.2		+.2	+.2	+.2	IV
Lithophila muscoides	+.1	+.2	+.2	+.2	+.2	V
Sesuvium portulacastrum	+.1	+.1				II
Sporobolus pyramidatus		+.1			+.1	II
Corchorus hirsutus			+.1	+.1		II
Capraria biflora			+.1	+.1		II
Cordia curassavica	+.2					I
Opuntia wentiana	+.1					I
Paspalum laxum	+.2					I
Heliotropium curassavicum				r		I

Aruba: 3, 4. west of Rincón; 5. near Pitchfield; Curaçao: 1. San Pedro; 2. west of Hato.

present. Occasionally species of the sandy soils are present a.o. *Corchorus hirsutus*. The community is only known from San Pedro and a locality west of Hato, Curaçao, west of Rincón and near Pitchfield, Aruba.

Along the weather-side of the islands vegetations in which species such as *Prosopis juliflora*, *Acacia tortuosa*, *Capparis cynophallophora*, *Capparis indica*, *Pithecellobium unguis-cati*, columnar cacti and *Opuntia* prevail are frequently found. These vegetations are closely related to cactus-thorn scrub and thorn woodland communities and will be discussed in relation to the seasonal and dry evergreen formations.

ACKNOWLEDGEMENTS.

Thanks are due to Dr. I. Kristensen, Director of the Caribbean Marine Biological Institute (CARMABI) in Curaçao for providing facilities, to Mr E. A. MENNEGA for correcting the English text, and to the Netherlands Foundation for the Advancement of Tropical Research (WOTRO) for supporting fieldwork.

REFERENCES

ADAMS, C. D., Flowering plants of Jamaica. University of the West Indies, Mona, Jamaica. 1972.

ARNOLDO, FR. M., Zakflora. Uitgaven 'Natuurwetenschappelijke Werkgroep Nederlandse Antillen', Curaçao. No. **16**. 1964.

ASPREY, G. F. & R. G. ROBBINS, The vegetation of Jamaica. Ecol. Monogr. **23**: 359–411. 1953.

BEARD, J. S., Climax vegetation in tropical America. Ecology **25**: 127–158. 1944.

BEARD, J. S., Some ecological work in the Caribbean. Empire For. Journ. **24**: 40–46. 1945.

BEARD, J. S., The natural vegetation of the Windward and Leeward Islands. Oxford For. Mem. **20**: 1949.

BEARD, J. S., The classification of tropical American vegetation-types. Ecology **36**: 89–100. 1955.

BEETS, D. J., Lithology and stratigraphy of the Cretaceous and Danian succession of Curaçao. Uitgaven 'Natuurwet. Studiekring Suriname en de Ned. Antillen', Utrecht. **70**. 1972.

BOLDINGH, I., Flora voor de Nederlandsch West-Indische Eilanden, Amsterdam. 1913.

BOLDINGH, I., The flora of the Dutch West Indian Islands. II. The flora of Curaçao, Aruba and Bonaire. E. J. Brill. Leiden. 1914.

BØRGESEN, F., Notes on the shore vegetation of the Danish West Indian Islands. Bot. Tidskr. **29**: 201–259. 1909.

CHAPMAN, V. J., 1939 Cambridge University expedition to Jamaica, part 1–3. Journ. Linn. Soc. London **52**: 407–533. 1944.

CHAPMAN, V. J., Mangrove vegetation. J. Cramer, Vaduz. 1976.

DAVIS, J. H., The ecology and geologic role of mangroves in Florida. Publ. Carneg. Inst. No. **517**: 303–412. 1940.

DAVIS, J. H., The ecology and the vegetation and topography of the Sand Keys of Florida. Publ. Carneg. Inst. No. **524**: 117–195. 1942.

GLEASON, H. A. & M. T. COOK, Plant ecology of Porto Rico and the Virgin Islands. Sci. Surv. Porto Rico and the Virgin Islands **7**. New York. 1926.

GOODING, E. G. B., A. R. LOVELESS & G. R. PROCTOR, Flora of Barbados. London, 1965.

LINDEMAN, J. C., The vegetation of the coastal region of Suriname. Thesis. Utrecht.

LINDEMAN, J. C. & A. L. STOFFERS, Cyperaceae and Gramineae, in A. L. STOFFERS, Flora of the Neth. Antilles **1**: 85–203. 1963. Uitgaven 'Natuurwet. Studiekring Suriname en de Ned. Antillen', Utrecht. **36**. 1963.

MARSHALL, R. C., Physiography and vegetation of Trinidad and Tobago. Oxford For. Mem. **17**. 1934.

MOOLENGRAAFF, G. J. H., Geologie en geohydrologie van het eiland Curaçao. Thesis. Delft. 1929.

PIJPERS, P., Geology and paleontology of Bonaire (D.W.I.). Thesis. Utrecht. 1933.

RAUNKIAER, C., The life-forms of plants and statistical plant geography. Oxford. 1934.

STEHLÉ, H., Essai d'écologie et de géographie botanique: Flore de la Guadeloupe. Basse Terre, Guadeloupe. 1935.

STOFFERS, A. L., The vegetation of the Netherlands Antilles. Uitgaven 'Natuurwet. Studiekring Suriname en de Ned. Antillen', Utrecht. **15**. 1956.

WESTERMANN, J. H., The geology of Aruba. Thesis. Utrecht. 1932.

WESTERMANN, J. H., Overzicht van de geologische en mijnbouwkundige kennis der Nederlandse Antillen. Meded. Kon. Ver. Ind. Instituut, Amsterdam. **85**. 1949.

SETARIA CLIVALIS (RIDL.) VELDK., COMB. NOV. (GRAMINEAE)

J. F. VELDKAMP

Rijksherbarium, Leiden

SUMMARY

The epithet of *Setaria laxa* Merr. (*Gramineae*) is antedated by half a year by that of *Panicum clivale* Ridl. The necessary new combination is here proposed and a full description of this rare Malesian species is given. Some remarks are made on its affinities and those within *Setaria*. It is suggested that *Holcolemma* and *Paspalidium* are probably not distinct from *Setaria*.

DEDICATION

On the occasion of the retirement of Prof. Dr. H. C. D. DE WIT I am honoured to be able to present this small note on *Setaria*, the South African representatives of which he studied for his Ph. D. thesis.

INTRODUCTION

A relatively rare species of *Setaria* from Malesia has generally been called *S. laxa* Merr. This name was published on December 31st, 1906, and turns out to be antedated by *Panicum clivale* Ridl., published in June of the same year. The necessary new combination *S. clivalis* (Ridl.) Veldk. is therefore proposed here.

Setaria is generally divided into four sections or subgenera, *Panicatrix*, *Paurochaetium*, *Ptychophyllum*, and *Setaria* proper, distinguished mainly by the absence or presence of pleats in the leaves, effuse or spike-like inflorescences, and the number of bristles below the spikelets. It seemed, at first, not difficult to assign a place to *S. clivalis*. It has been placed with some doubt close to § *Ptychophyllum* by MERRILL (1906), and later in the otherwise African § *Panicatrix* by PILGER (1940), which latter position initially seemed acceptable aside from the disjunct distribution of the group resulting from its inclusion.

Ptychophyllum is generally said to be distinct from *Panicatrix* by the presence of pleated leaves and rather large, effuse panicles with usually not turgid, green spikelets; in the latter group the leaves would be small and not pleated, while the panicles would be less effuse with more turgid, usually purplish spikelets. A study of the various representatives enumerated by STAPF & HUBBARD (1930) shows that some species attributed to *Panicatrix* have plicate leaves after all: *S. subesetosa*, already mentioned by them as an exception, and also the closely related *S. longiseta*, as I could observe when in Ghana; furthermore the variability in the laxity of the panicle is too great to be of any use in the delimitation of infrageneric taxa, while the tumidity and colour of the spikelets does not help very much, either. The two can not be distinguished satisfactorily by these characters and I don't think that there are any others. It seems more natural to assume that the species of '*Panicatrix*' have originated polyphyletically and -topically from '*Ptychophyllum*', which would then account for the apparent distributional disjunction of '*Panicatrix*'. Such a derivation has the implicit support of ROMINGER (1962, p. 10, 11), who gave a list of primitive and advanced characters in *Setaria*. Here he actually summarized the differences between *Ptychophyllum* and the § *Setaria* and suggested that *S. vulpiseta* would be an intermediate. More such intermediates are provided by '*Panicatrix*' and several other species from South America with more or less effuse inflorescences, which fit neither '*Panicatrix*' nor § *Setaria* very well. These clinal variations seem to rule out the possibility to distinguish *Ptychophyllum* as a separate genus, as has occasionally been suggested (see also DE WIT, 1941, p. 6).

The above is but an example of the presently unsatisfactory infrageneric subdivision of *Setaria*. During the course of this study the many species represented in Leiden were looked at, from which the following observations could be made.

The number of the bristles below the spikelet, so 'typical' for *Setaria*, is by itself not of such great significance as is suggested by the various (artificial) keys to the species and genera of the *Paniceae*. The genus *Holcolemma* is delimitated mainly by the absence of bristles against *Setaria*, but simultaneously it is admitted that a few, easily overlooked ones may be present in an inflorescence. It would differ furthermore by the subequal glumes and a furrowed lower lemma. The spikelets of *H. canaliculatum* (its typespecies and the only one I could study) are actually not very different from those seen in *Setaria* spp.: here the lemma is often longitudinally furrowed, too. The species in fact looks like a depauperate *S. clivalis* with poor, more compact inflorescences. I see no reason not to include it in *Setaria*. The only other species, *H. transiens*, only seen from its description and figure looks like a depauperate *Setaria*, too.

The § *Paurochaetium*, which is also characterized by few bristles in the inflorescence, seems equally unnatural, as was already remarked by ROMINGER(l.c., p. 10, 25). The genus *Paspalidium* is not mentioned by him, possibly because the only two North American species were generally included in *Panicum* (as § *Geminata*) by HITCHCOCK & CHASE (1910, 1950). In the 'typical' representatives of this genus (*P. flavidum, P. geminatum, P. paludivagum, P. punctatum*) the partial inflorescences are distichously arranged, secund, flattened and spike-like with more or less flattened prolongations of the rachis. As a monstruosity it has once been observed in *P. flavidum* that sterile prolongations, homologous with pedicels of a tertiary branch and with the bristles of *Setaria* were present; they were fused with the winged margin of the secondary rachis

(Mr. S. A. J. ZAAT, or. comm.). When the partial inflorescences are more racemose the strong distichousness becomes less evident and especially the primary branches become quaquaversal, but quaquaversal and distichous branches may occur in the same inflorescence. Simultanously the number of bristles in the partial inflorescences increases in such species and in this way it seems purely artificial to distinguish *Paspalidium* from *Setaria*. Such intermediates are found in Australia, where they have been called *Paspalidia*, in South America, where they have generally been included in *Panicum* and now in *Setaria*, in Africa (*Paspalidium desertorum*, *Setaria angustissima*), and in Madagascar (*Setaria scottii*); they link *Paspalidium* to *Paurochaetium*.

It seems highly necessary to set up a new system, but to do so here was far beyond the scope of this paper. I hope to discuss some aspects more fully elsewhere.

Setaria clivalis (Ridl.) Veldk., *comb. nov.* **Fig. 1, Map 1.**

Panicum clivale Ridl., J. Str. Br. Roy. As. Soc. 45 (June 1906) 242. – *Setaria laxa* Merr. var. *nativitatis* Jansen, Reinwardtia 2 (1953) 343 ('*navitatis*'), nom, superfl. – Type: Ridley 99 (SING, holo, n.v.; BM), Christmas Isl., c. 300 km S. of Java.

Chamaeraphis gracilis Hack., Bot. Jb. 6 (1885) 236. – *Panicum chamaeraphoides* Hack. ex Koord., Exk. Fl. Java 1 (1911) 135; Back., Handb. Fl. Java 2 (1928) 140; Onkr. Suikerr. (1928) 93, t. 86; in Heyne, Nutt. Pl. Indonesia, ed. 3 (1950) 214; non *P. gracile* R. Br. (1810), nec al. – *Setaria chamaeraphoides* Back. in Heyne, Nutt. Pl. Ned. Ind. 1 (1922) 203; non *S. gracilis* H.B.K. (1915). – Type: Zeye s.n. (W, holo, n.v.), Timor, prope Kupang, Baung.

Setaria laxa Merr., Philip. J. Sc. 1, Suppl. (31 Dec. 1906) 366; Enum. Philip. Fl. Pl. 1 (1923) 73; Pilg. in E. & P., Nat. Pfl. Fam., ed. 2, 14e (1940) 72; Jansen, Reinwardtia 2

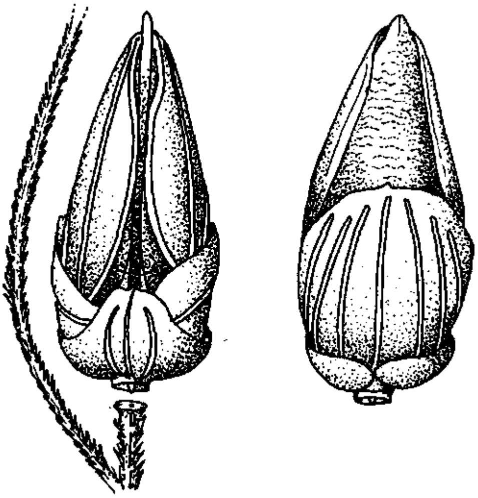
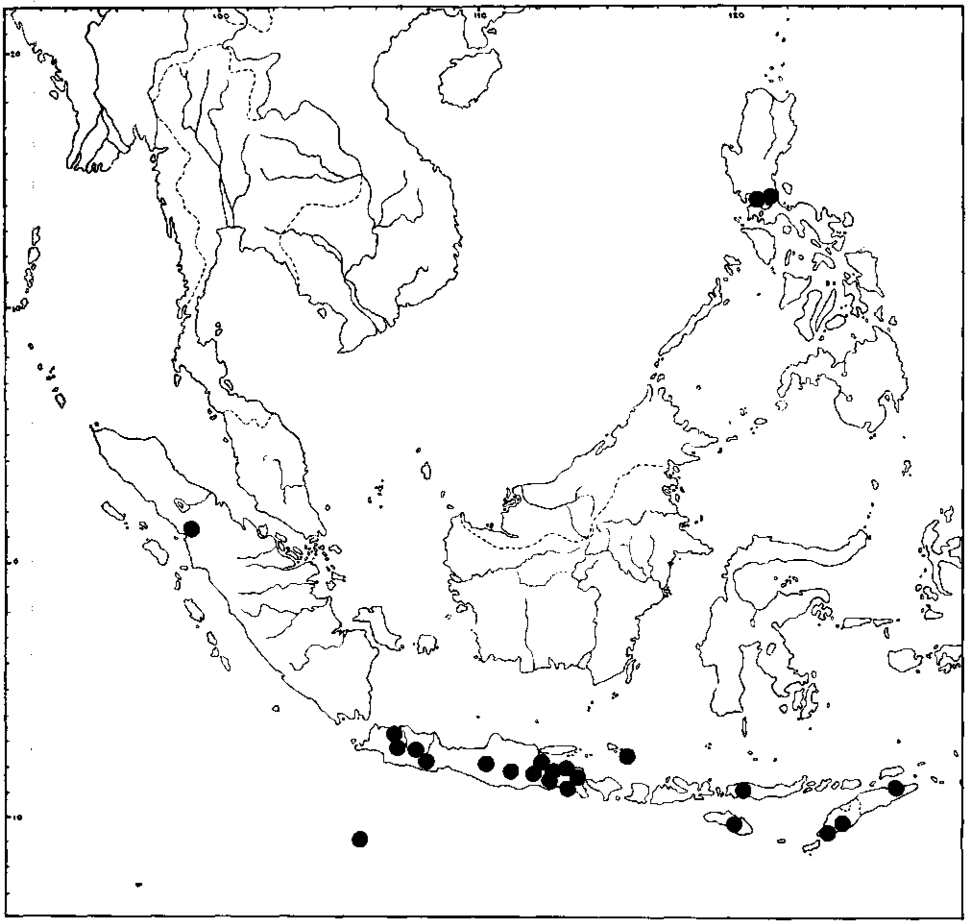


FIG. 1. *Setaria clivalis* (Ridl.) Veldk. – Spikelet abaxial (left), adaxial (right). 20 ×. (*Backer 3773*).

(1953) 343; Monod de Froideville in Back. & Bakh. f., Fl. Java 3 (1968) 572. – Type: Hallier f. 4153 (PNH, holo, †; L), Philippines, Luzon, Prov. Laguna, Los Baños.
Setaria javana Herm. in Cohn, Beitr. Biol. Pfl. 10 (1910) 50. – Type: Horsfield 974 (LE, holo, n.v.; BM) Java, Solo.

Lax semi-annual, probably somewhat scrambling, up to 150 cm high, branching intravaginally in the lower nodes. Culm smooth, glabrous; nodes dark, constricted (i.s.). Sheath smooth, glabrous but for the upper margins and the collar to somewhat pilose all over; ligule 0.5–0.75 mm high; blade soft, flaccid, flat, (4–)19–28 cm by (3–)5–9 mm, gradually passing into the often indistinctly pseudo-petiolate base, widest in the lower half, apex acuminate, both sides moderately pilose and scaberulous, somewhat pinninerved in the lower half, midrib distinct, caniculate above, exserted beneath. Peduncles exserted, smooth, glabrous. Panicle effuse, ± erect, (12–)20–38 cm long; axis and branches angular, scaberulous and subglabrous to moderately pilose; branches usually ascending, few-spikeled, the lower solitary to several fascicled together; pedicels usually with 1 (or 2 or 0) somewhat undulate, terete, 3–14(–18) mm long, antrorsely scaberulous bristles. Spikelets solitary or a few ± crowded together, spaced, ovate-oblong, plano-convex, the flat abaxial side longitudinally caniculate, 2–2.4 mm long, green to purplish. Glumes herbaceous, clasping at base, pale, nerves green, glabrous, smooth; the lower subrotund to deltoid, 0.6–0.75 mm long, slightly apiculate, 3-nerved; the upper elliptic, 1.15–1.5 mm long, 0.5–0.67 times as long as the spikelet, obtuse, 5–7-nerved. Lower floret sterile, paleate; lemma as long as the spikelet, with a triangular and slit-like depression in the median between the tumid sides, produced as a strong girder on the inside, apex slightly carinate, apiculate, 5-nerved, midrib scaberulous, otherwise smooth, herbaceous; palea slightly shorter, oblong, membraneous, keels thicker, smooth, apex rounded. Fertile lemma as long as the spikelet, sometimes slightly protruding, slightly acuminate and rostrate, pusticulate with undulating transverse lines, faintly 5-nerved, yellowish-brown to purplish. Lodicules obcuneate, c. 0.3 mm long. Anthers 1–1.2 mm long, blackish (i.s.). Styles apical, free to base; stigmas dark, about as long as the branches, emerging apically. Caryopsis ovoid, plano-convex, c. 1.75 mm long, white; hilum subbasal, punctiform; embryo ovate-elliptic-oblong, 0.5–0.6 times as long as the fruit.

Distribution (see pl. 1). SUMATRA: Tapanuli, Batang Toru (Funke s.n.). – JAVA: Jakarta (Hallier f. s.n.), Weltevreden (Backer s.n.), Bogor (Backer 36052); Priangan, Dago (Popta 00147/35), Trogen (Reinwardt ? s.n.); Surakarta, Bojolali (Beguin s.n.); Madiun, Ngebel (Koorders 37947); Surabaya (Dorgelo 585, 2460, 3144, 3316); Malang (Westenberg s.n.), Bangil (Backer 7606), Nongkojajar (v. Breemen 7), Wonosari (Mousset s.n.), G. Semeru (Backer 3773), Paiton (Backer 12989); Besuki, Puger (Koorders 21157), N.-slope G. Ijen (Backer 30798). – CHRISTMAS ISL.: (Ridley 99). – KANGEAN ARCH.: (Backer 29511, 29923, Beguin E2), Sepanjang (Backer 28854). – LESSER SUNDA ISL.: Lombok, Labuanhaji (Bloembergen 3043); Sumba, Kendara (Iboet 156);



MAP 1. Distribution of *Setaria clivalis* (Ridl.) Veldk.

Flores (specimen at present unavailable); Timor: (Berthe-Friedberg 1227; Kooy 394), Oil Laku (Walsh 1B), Kupang, Baung (Zeye s.n.), Desa Baumata (Bloembergen 3548), Loli (v. Maarseveen 11; Monod de Froideville 1106), Nikiniki (Kooy 213), Bahadato, Fatulia (Metzner 163). – PHILIPPINES: Luzon (Merrill Phil. Pl. 595), Manila (Merrill 7440), Prov. Rizal, Pasig (Kneucker 824 Merrill), Prov. Laguna, Los Baños (Hallier f. 4153; PNH 22690 Sulit). – ORIGIN UNKNOWN: Hb. D. v. Royen s.n. (probably Java). – The records for India and Burma in Hook. f., Fl. Br. Ind. 7 (1897) 62 of *Chamaeraphis gracilis* refer to *Pseudoraphis minuta* (Mez) Pilg. (fide Bor, Grasses, 1960, 353).

Ecology. Shady places in forests, under shrubbery, in bambu- and jati-forests; on calcareous soil; also in coastal areas. Apparently prefering a distinct dry monsoon. Up to 1150 m alt. in Java.

Uses. Readily eaten by cattle and in Besuki collected as fodder when other herbage becomes scarce. Nutritional value high to very high, but yield insufficient. Young shoots sometimes used for vegetables (*S. palmifolia* is similarily eaten and quite palatable, JFV). (Backer, 1950; Popta 00147/35).

Vernacular names. (Em-)prit-(em-)pritan, kembangan, krepaan (lembat) (Jav.), dipadian, kitiran (Mad.), wulu-wulu (Sumba), kolun meo (Timor).

Anatomy. Culm and leaf (Hermann, 1910, sub *S. javana*, p. 30, 38, resp.).

Notes. JANSEN regarded the type of *S. clivalis* as representing a distinct variety of *S. laxa*; his epithet '*navitatis*' is an obvious misprint for '*nativitatis*', referring to Christmas: the name is correctly written on his label. I think it is merely a depauperate specimen. The leaves are flat, not involute, the inflorescence is similar in composition to small panicles observed in Javanese specimens, where the spikelets are not 'usually in cluster of 4–6', but only occasionally so, many spikelets being solitary, while the bristles are very variable in length.

The Philippine specimens are just as variable in their indument and panicle structure as the Javanese ones.

Contrary to HACKEL (1885) and HERMANN (1910) the lower florets of all spikelets studied were sterile and never male.

Additional distribution (information obtained during print): Java: JAKARTA (Kuntze Sn., de la Savinière s.n.); Surakarta (Horsfield 974); Malang, Lawang (Buijsman s.n.). – LESSER SUNDA ISL.: Timor, between Soe and Kapan (Monod de Froideville 1542a). – BORNEO: Banjarmassin (Motley 209).

ACKNOWLEDGEMENTS

I would like to thank Msrs. TH. R. LOCHER and S. A. J. ZAAT, Leiden, for their observations on *Paspalidium* and *Setaria* made during a course in advanced angiosperm taxonomy at the Rijksherbarium.

LITERATURE

HITCHCOCK, A. S. & A. CHASE. 1910. The North American species of *Panicum*. Contr. U. S. Nat. Hb. **15**: 19.

—. 1950. Manual of the grasses of the United States, ed. **2**: 626. New York.

MERRILL, E. D. 1906. An enumeration of Philippine *Gramineae* with keys to genera and species. Philip. J. Sc. **1**, Suppl.: 366.

PILGER, R. 1940. *Gramineae*. 3. (Unterfamilie *Panicoideae*), in E. & P., Nat. Pfl. Fam., ed. 2, **14e**: 72. Leipzig.

ROMINGER, J. M. 1962. Taxonomy of *Setaria* (*Gramineae*) in North America. Illinois Biol. Mon. **29**: 1–132.

STAPF, O. & C. E. HUBBARD. 1930. *Gramineae*. Fl. Trop. Afr. **9**: 768–868. Ashford.

WIT, H. C. D. DE. 1941. Contributions to the knowledge of the genus *Setaria* Beauv. in South Africa. Bull. Bot. Gard. Btzg. **III**, 17: 1–87.

HEMIPILIA FORMOSANA Hayata

P. VERMEULEN

formerly Hugo de Vries Laboratory,
Municipal University of Amsterdam, The Netherlands

Hemipilia formosana is an East-Asiatic terrestrial orchid from Formosa (Taiwan) as the name already indicates. The species occurs in the Mt. Central Range, on Mt. Morrison at 2400–2700 m altitude in uncultivated *Miscanthus* fields (*Saccharinae*). It is an inconspicuous plant not exceeding 25 cm in height with a single flat leaf, adpressed to the ground, and a raceme of small flowers of about the same size as those of *Dactylorhiza maculata* and white and pink in colour. The species *Hemipilia formosana* is depicted in the booklet by CHOW CHENG: Formosan Orchids and in HAYATA: Icones Plantarum Formosanarum, vol. IV, pl. XXV. The genus *Hemipilia* has about 15 species, most of them occurring on the mountains of western China. There are no species of *Hemipilia* in Japan. I grew *H. formosana*, the Mt. Morrison orchid, in my greenhouse where it came into flower and fruit. It was long flowering, for over four weeks. The lateral sepals are white and patent, the lip is white and pink and the long spur is nearly horizontal. All the *Hemipilia*-species are unifoliate. Other unifoliate genera are *Aorchis* and *Amitostigma* in Asia and some also in the boreal parts of the northern hemisphere: *Amerorchis*, *Lysiella*. All these unifoliate genera belong to the subfamily *Orchidoideae* of the family *Orchidaceae* s.s. These are the *Basitonae* of PFITZER, because the glands, the viscid discs or viscidia are at the base of the pollinia. LINDLEY used the name *Ophrydeae* for this group, which he saw as a tribus or tribe. This name was also used by BENTHAM. All genera belonging to this subfamily are terrestrials with very few exceptions. All the basitonic species have in principle two viscidia because they developed originally on the lateral stigmalobes. The two viscid discs in this group are always connected by a tape. Tape and viscidia together form the rostellum. The two viscid discs may be concrescent ultimately to form a single one as in *Serapias* and *Anacamptis*. If there is a connection it can be a straight or bent band, sometimes a fold and in *Habenaria* and related genera a voluminous organ. The connection between the two viscid discs is maintained in all genera of the *Orchidoideae*. Evidently the connection is important for the feeding of the viscidia which have no vascular tissue.

As early as 1835 the genus *Hemipilia* was described by LINDLEY on p. 296 in: The Genera and Species of Orchidaceous Plants, as follows:

Perianthium Orchidis. Calcar elongatum. Columna cum basi labelli subconnata. Anthera subhorizontalis; basibus divergentibus adnatis. Glandulae apicibus canalium (cucullis dimidiatis) inflexis tectae. Rostellum fornicatum, liberum, ultra lobos an-

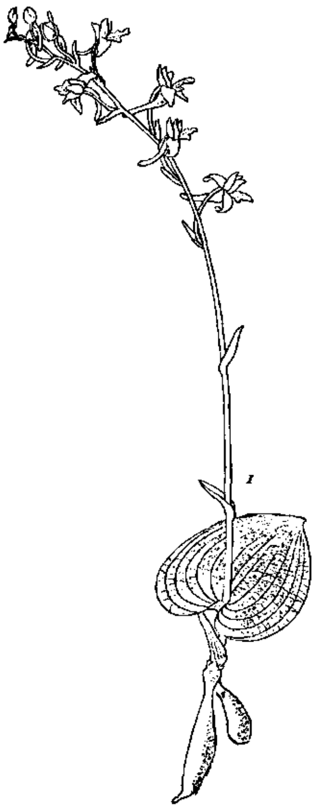


FIG. 1. *Hemipilia formosana* Hayata after HAYATA, somewhat reduced.

therae projiciens. Processus carnosi o. – Folium solitarium. Racemus secundus, multiflorus. Radices tuberculosae.

On the same page LINDLEY writes: this genus differs from *Platanthera* in having the glands of the pollen masses concealed by the inflexed points of the stigmatic canals, which thus form an imperfect pouch, and in the enlarged projecting upper lip of the stigma or rostellum. *Gymnadenia chusua* approaches it in structure but the cells of the anther of that species are parallel, not contiguous.

Here it seems that LINDLEY sees the glands as belonging to the pollen masses. The same opinion has GARAY (1960), but as always in the *Orchideae*, they form part of the rostellum. In fig. 2, E, kl. s (left) a small elliptic area is dotted in the gland. This is the end of the caudicula with which it is fastened to the gland, as is shown in fig. D.

There is no reason to make an exception for *Hemipilia*: the caudicula is enclosed in the end of the anther cell and the viscidium is found at the end of the rostellum arm. Because the rostellum is so large here, it is thought that one half of the gland is formed by the rostellum and the other half by the anther sac. We see here a connation of rostellum arm and anther sac, as in *Habenaria*. This is a transition between the condition in *Habenaria* and *Gymnadenia*.

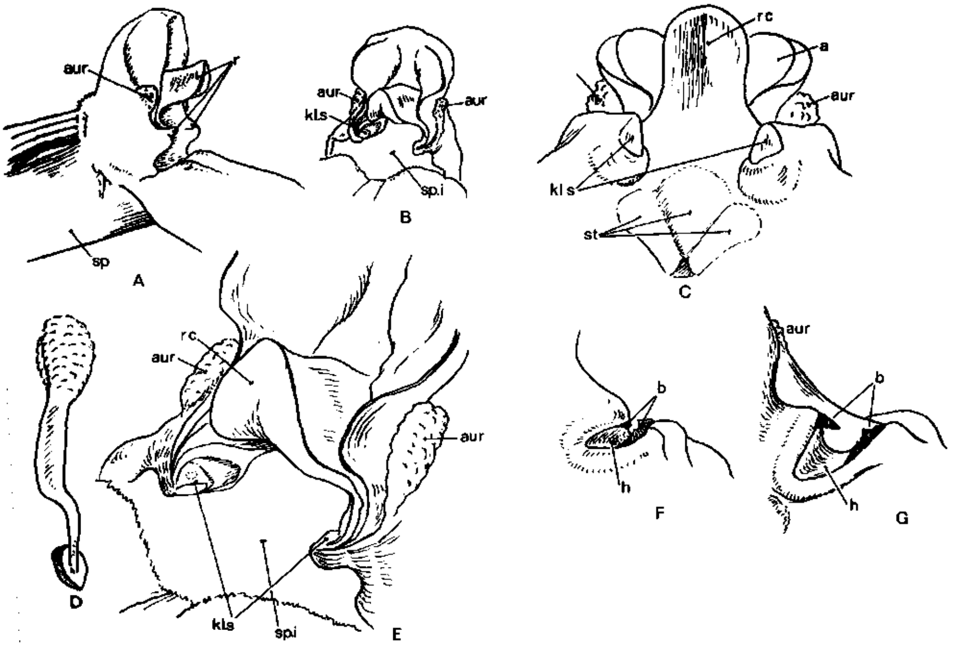


FIG. 2. *Hemipilia formosana* Hayata – A. Column with spur, base of the lip and top of the ovarium; B. Column with entrance of the spur; C. Rostellum seen from the underside; D. Right pollinium with caudicle and viscidium, which is thick and transparant, ± triangular pyramidal with rounded edges; E. Rostellum and surrounding parts; the dotted oval on the left viscidium is the place where the caudicle is attached; F. and G. Cavity where the viscidium is taken away.
a = anther; aur = auricula (called staminodium); b = remnants of the cover of the viscidium; kl.s. = viscidia; sp = spur; sp.i. = entrance of spur; rc = rostellum; st = stigma; h = cavity, where the viscidium is removed.

Several other species of *Hemipilia* has been described, most of them from the mountains of western China. According to SENGHAS, 1973, there are now 17 species.

Hemipilia formosana was described from Formosa (Taiwan) in 1911 by HAYATA. The description is rather detailed, but, as is so often the case, a description of the tubers is missing. There is no description given of the rostellum nor the glands. The plant which was described came from Mt. Morrison at an elevation of 2500 m and was collected in Oct. 1906 (no. 2331). It is said that the species is very near *Hemipilia cordifolia* Lindl., 1835, but neatly distinguishable by its larger spur and the entire lamina of the lip. Because the description was made from a dried plant, the colour of the flower and that of the leaves was not mentioned. The single leaf is greyish green, but mottled with darker green. The flowers are for the greater part white but the centre of the lip is pink.

The specimens which I had in my greenhouse had cylindrical tubers, a fully grown one, 5 cm long and 1 cm broad which formed the shoot and a young one developing for the next years growth. The stalk, ± 25 cm high, had only one cordate leaf lying flat on the soil, greyish green and mottled. On the stalk two small bract-like leaves were present. The raceme was about 10 cm long and bore about 10 flowers, turned towards one side. The lateral sepals were patent and the petals formed a hood with the third sepal. The lip is triangular with small undulations below, pink with a white area in the centre and with two deep-purple elevations on the base. The nearly horizontal spur is ± 13 mm long and cylindrical. The gynostemium has a straight anther with divaricating thecae. The rostellum is hood-shaped with two arms (each ending in a viscidium) translucent and covered with a membrane. The caudiculae, when removed from the thecae, are elliptically connected at the back of the viscidia. The rostellum is much larger than in East-Asian genera (*Ponerorchis, Amitostigma,* etc.).

The rostellum is an organ characteristic of the Family *Orchidaceae* s.s. and not occurring in the *Apostasiaceae* nor in the *Cypripediaceae* (or any other plant family). The name 'rostellum' was introduced in 1817 by the French botanist L. C. RICHARD and has been in general use ever since. After DARWIN published his book 'Fertilisation of Orchids' in 1862 the rostellum has been considered in relation with pollination of the orchid flowers by insects or other animals. The rostellum has a fixed position, viz., between the stigma and the fertile stamen. DARWIN's theory that the rostellum of the *Orchidaceae* is the sterile (i.e. median) stigmalobe, which theory was supported by EICHLER in his Blütendiagramme, 1875, is found in all books on Taxonomy. This view of DARWIN's, however, is erroneous in its generalisation. If one takes the trouble to look at the stigma of the *Orchidaceae* carefully, either macroscopically or by studying microtome sections, it appears that in numerous orchid genera such as *Disa, Platanthera, Orchis, Epipactis, Cattleya, Cymbidium, Dendrobium,* etc. the stigma possesses three lobes in addition to an organ which may be indicated as being the rostellum. Starting from a three-lobed normal stigma (such as the one we find in the *Cypripediaceae,* which have no rostellum and where the three lobes are visible by a Y-shaped division) a corresponding structure of the stigma appears to occur in the *Orchidaceae* s.s. Here the stylar channel is situated in the middle of the stigma surface. The three lobes are not always easily distinguishable, however, the stigma often being covered with a mucous layer, but if the latter is removed and the light is favourable, the three lobes can be distinguished in their Y-shaped arrangement.

In all these cases the entrance of the stylar channel can be observed medially. Sometimes (as in, e.g. *Oncidium*) the median lobe is the largest. Consequently DARWIN's opinion cannot possibly be correct; for, if the stigma is threelobed, the rostellum cannot be the median lobe, and can at most only be a part of it. Even if there is a large number of genera in the *Orchidaceae* s.s. with three stigmalobes, this does not mean that there are no exceptions. In the tribus *Habenarieae* (with the genera *Habenaria, Bonatea* and a few related ones) we find only two stigmalobes, which are placed on stigmaphores and which protrude from the flower. Here the median stigmalobe appears to have completely disappeared. In several other genera of the tribe *Orchideae,* such as *Gymnadenia* and *Anacamptis,* the median stigmalobe is smaller than the lateral ones and thus tends to disappear. In the two latter genera the rostellum corresponds with that of *Orchis* c.s. but in *Habenaria*, *Bonatea*, *Disperis* and related genera the rostellum has developed into a large organ with two arms. In *Hemipilia* there are still three but not easily distinguishable stigmalobes. The rostellum is already on the way to become larger, with two arms, each with a viscidium, here covered with a membrane.

If the rostellum is not the median stigmalobe, what, then, is it? In the *Orchidoideae*

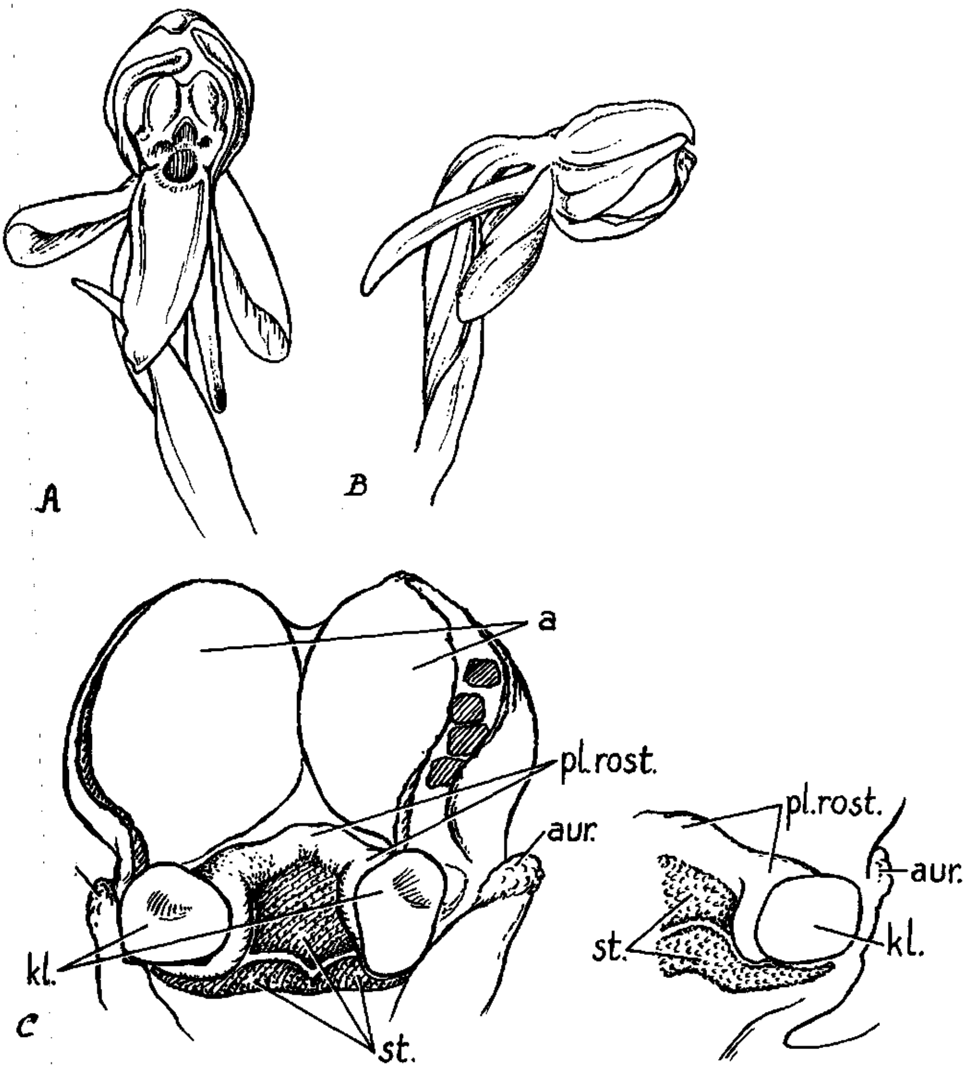


FIG. 3. *Limnorchis sparsiflora* (S. Watson) Rydb. (= *Platanthera sparsiflora* (S. Watson) Schl. – A. front view of a flower; B. lateral view; C. column.
a = thecae of the anther; aur = auricula (called 'staminodium'); kl = viscidia; pl. rost = fold of the rostellum.

the genus *Plantanthera* seems to be a primitive one on account the turnip-shaped tuber and a primitive (or even missing) rostellum. In his descriptions of the different genera RICHARD says of *Platanthera*: rostellum absent. However, a study of sections (see VERMEULEN in: Acta Bot. Neerl. 8, p. 344; 1959) reveals that a part of the gynostemium above the median stigmalobe is free from the remainder and is to be regarded as the initial phase of the tape of the rostellum whereas the glands take their origin on the lateral stigmalobes and therefore always are in twofold. In related genera (*Coeloglossum*) the rostellum takes the form of a tape with the viscidia at its ends. It develops independent as a new organ as does the corona in the *Asclepiadaceae*. In several

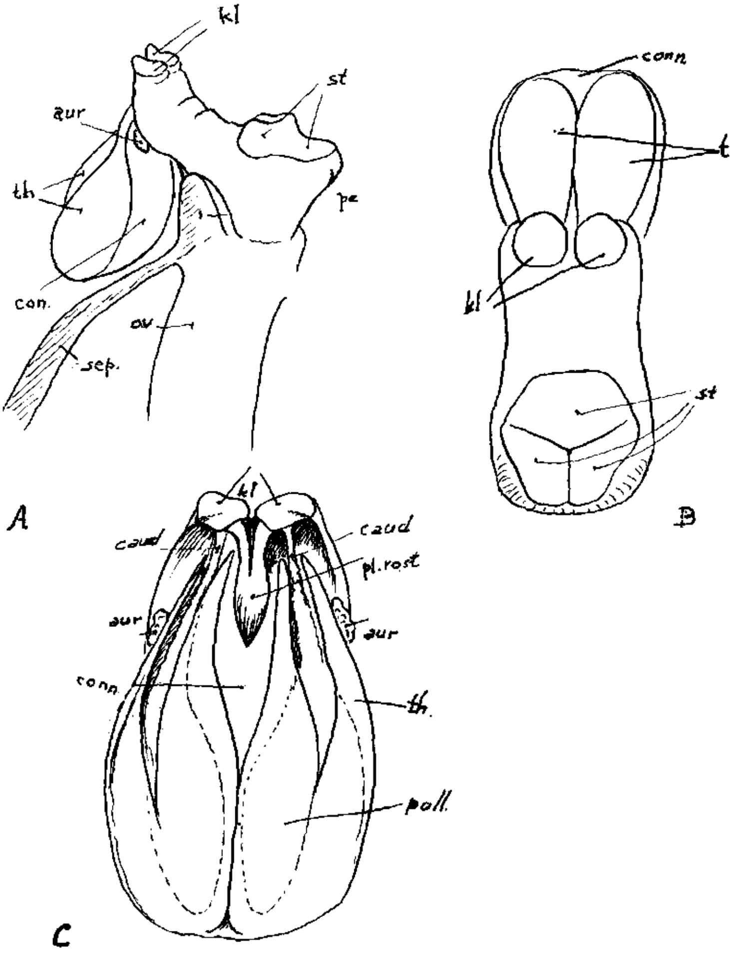


FIG. 4. Column of *Disa draconis* Sw. – A = top of the column with the hanging anther, lateral view; B = upper view of the column; C = anther and rostellum.
aur = auricula (called 'staminodium'); conn = connective; kl = viscidium; pe = insertion of petal; pl = fold of the rostellum; poll = pollinium (in the theca); sep = sepal; th = theca of the anther.

respects this family behaves in the same manner as the *Orchidaceae*: in the pollination by insects, the presence of pollinia, the translators (instead of viscidia) and of a corona (as a new organ) the family exhibits an analogous development.

In his survey of the characteristics of the *Orchidaceae-Monandrae* MANSFELD (Flora 142. Band, p. 78; 1954) reported that in *Disa uniflora* Berg. the rostellum is an organ independent of the median stigmalobe. This was quite incomprehensible to him, but he suggests that it can be interpreted as an outgrowth of the back of the unpaired stigmalobe and thus he tried to save the theory of DARWIN-EICHLER.

In *Disa draconis* Sw. (Fig. 4) the stigma has three lobes and the stigma and the viscidia are spatially separated. The anther is reflexed and drooping. Between the

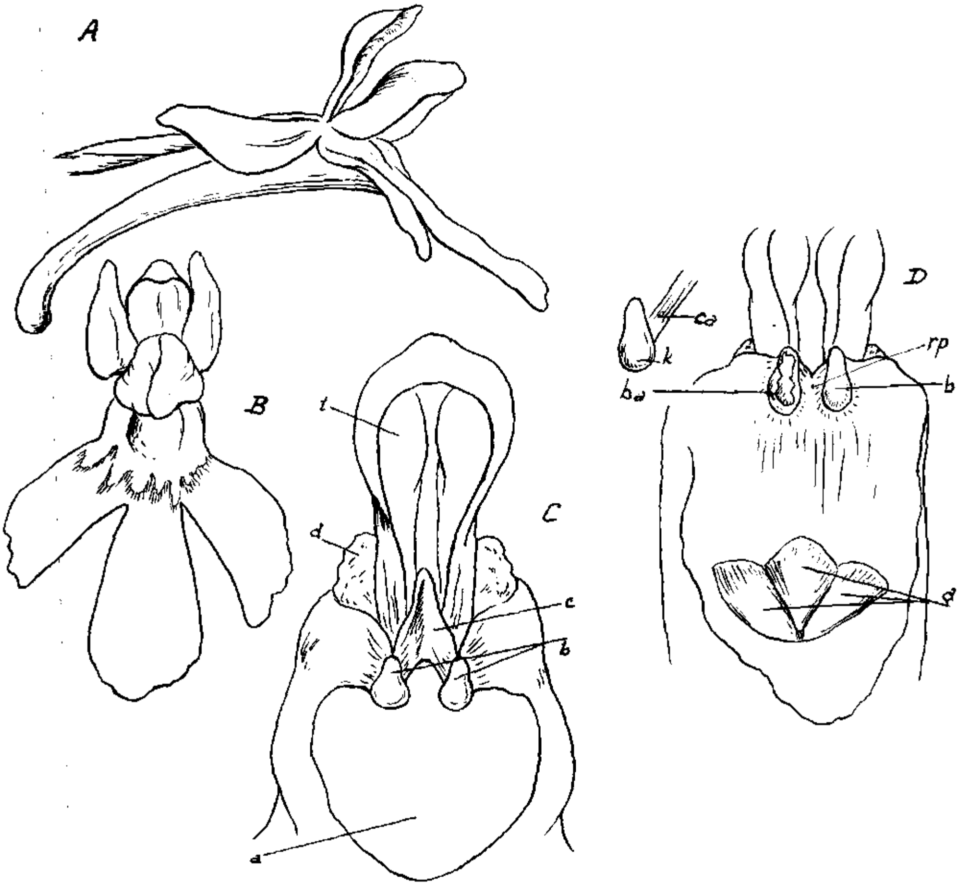


FIG. 5. *Ponerorchis graminifolia* Rchb.f. – A. Flower, lateral view; B. id., front view; C. Gynostemium; D. Part of gynostemium.
a = stigma; b = viscidium covered by membrane; ba = viscidium removed, remnants of membrane; c = rostellum; ca = caudicula of pollinium; d = auricula, called 'staminodium'; k = viscidium; rp = rostellum seen from below; t = anther sac.

viscidia lies a fold. It is easy to suppose, as DARWIN did, that the two viscidia were further removed from one another but in the course of evolution of the genus developed the tendency to approach one another. The fold between the viscidia arose because the distance became smaller.

In the American species *Limnorchis sparsiflora* (S. Wats.) Rydb. (= *Platanthera sparsiflora* (S. Wats.) Schlechter) the rostellum lies horizontally round the three-lobed stigma (Fig. 3). In the East-Asian *Ponerorchis graminifolia* Rchb. f. the rostellum forms a slanting fold (Fig. 5). In *Hemipilia* the rostellum is saddle-shaped. Here it forms a transition to such *Habenarieae* as *Bonatea speciosa* Willd. (Fig. 6).

What is the place of *Hemipilia* in the system of the *Orchidales?* The genus belongs to the family *Orchidaceae* s.s. and to the subfamily *Orchidoideae* (= *Basitonae*). In this subfamily several tribes has been distinguished. There is no consensus of opinion regarding this classification. LINDLEY (1835) and BENTHAM (1881) see the subfamily as a tribe (*Ophrydeae*, the older rendering, not applied to a subfamily). LINDLEY in his book makes an artificial analysis of the genera founded on the presence or absence of a pouch around the viscidia. The South-African genera are included in the group without a pouch. *Hemipilia* is described with a hood consisting of two halves, which, I suppose, means that one half of the anther sac and half of the rostellum together form the gland. BENTHAM divides the tribe *Ophrydeae* in the South-African subtribes *Diseae* and *Corycieae* and classified the representatives mainly occurring in the northern hemisphere under the *Euophrydeae* (with the glands of the pollinia enclosed in a pouch) and the *Habenarieae* (with the glands nude or rarely canaliculate by the lobes of the rostellum, or half-included by the swollen tops of the anther sacs. The last additions

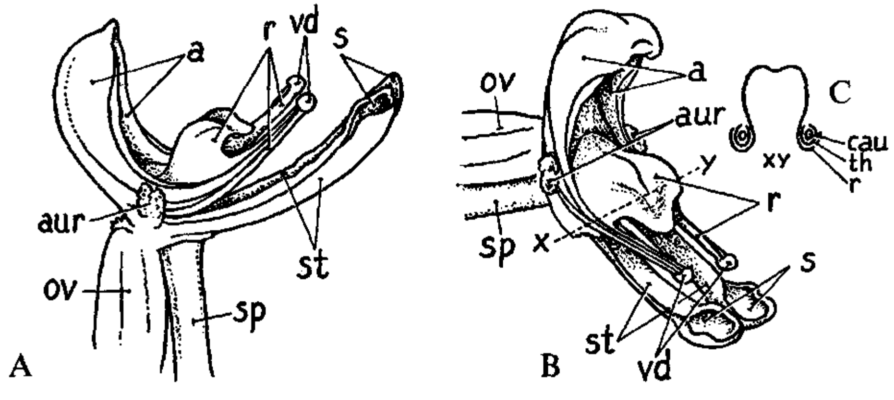


FIG. 6. *Bonatea speciosa* Willd. A. Column lateral view; B. Column seen from above; C. Section of the rostellum after x-y.
a = anther; aur = auricle (called 'staminodium'); cau = caudicles; ov = ovarium; r = rostellum with two arms; s = stigma's; sp = spur; st = stigmaphores; th = thecae with caudicles enclosed; vd = viscidia.
x-y = plane of section.

relate especially to *Hemipilia* and *Tulotis*. *Hemipilia* is referable to the *Habenarieae*, notwithstanding the viscidia are covered by a membrane.

PFITZER in 'Entwurf einer natürlichen Anordnung der Orchideen' distinguishes in the *Basitonae*:

a) the *Serapiadeae* with the glandulae of the pollinia included in pouches and
b) the *Gymnadenieae* with the glands of the pollinia included by valves of the anther or nude and
c) the *Habenarieae* with the glands included by valves or nude and the stigma with two processes;
d) the *Satyrieae* and e) the *Corycieae*, mostly in South Africa.

Hemipilia is referred to the *Gymnadenieae* and again valves are mentioned. In our drawing (fig. 2, E) no valves are present. The glands are covered by a membrane, which is seen in F and G.

SCHLECHTER divides the *Basitonae* in three groups: the *Habenariinae*, the *Disaeinae*, and the *Disperidinae*. As subordinate groups of the *Habenariinae*, the *Serapiadeae*, the *Gymnadenieae* and the *Habenarieae* are maintained. Because in SCHLECHTER's opinion the genus *Gymnadenia* is difficult to maintain, SCHLECHTER changed the name '*Gymnadenieae*' in '*Platanthereae*'. He says: The presence or absence of a pouch under the viscidia is a characteristic of secondary importance and in several related genera often very variable (SCHLECHTER: Orchideen, 1st ed. p. 40, 1915), and I agree with him. In the 3rd ed. of SCHLECHTER (4. Lieferung, p. 202), SENGHAS again divides the tribus *Orchideae* in the group *Plantantherinae* (without pouch) and the *Orchidinae* (with pouch). In my opinion the presence of a pouch is a much overestimated classificatory character. It is a feature discovered in the 19th Century when the morphology paramounts. In the 20th Century, however, the cytology became important and vegetative morphology outside the flower was also taken into account. The presence of a pouch or of a membrane on the viscidia, as in *Ponerorchis* and some species of *Amitostigma*, is difficult to establish especially in dried material and it is hard to say whether there is a real pouch or only a membrane over the viscidium. In *Orchis* or *Ophrys* the pouches can easily be discerned in fresh material and also in close-ups of the flowers. If only the presence or absence of the pouch is considered for purposes of classification unnatural groups are formed. This is evident in the 3th edition of SCHLECHTER in which *Gymnadenia* and *Dactylorhiza* share many features but *Gymnadenia* (without a pouch) and *Dactylorhiza* (with a pouch) fall into different subtribes. I proposed an alternative classification in LANDWEHR's 'Wilde Orchideeën van Europa', 1977, vol. 2, p. 554 and 556.

I divide the subfamily of the *Orchidoideae* into the following tribes: *Orchideae*, *Habenarieae*, *Corycieae* and *Satyrieae* (the latter not mentioned but following PFITZER & SENGHAS).

The tribe *Orchideae* is divided in 5 subtribes:

1. Subtr. *Galearinae*, type *Galearis spectabilis* (L.) P. F. Hunt.
2. – *Platantherinae*, type *Platanthera bifolia* (L.) Rich.

A. *Platantheriinae*, type *Platanthera bifolia* (L.) Rich.
B. *Herminiinae*, type *Herminium monorchis* (L.) R. Br.
3. Subtr. *Dactylorhizinae*, type *Dactylorhiza maculata* (L.) Soó
4. – *Orchidinae*, type *Orchis militaris* L.
5. – *Ophrydinae*, type *Ophrys insectifera* L.

(*Androcorythinae* and *Huttonaeinae* are not mentioned.)

In the *Dactylorhizinae* the genera *Dactylorhiza*, *Gymnadenia*, *Coeloglossum* and *Nigritella* are included of which only *Dactylorhiza* has a pouch around the viscidia. I united the four genera, because they have the same basic chromosome-numbers ($2n = 40$, 80 or 120), palmate tubers and leaves dispersed along the stalk (no rosette) and lack a bract-like spathe around the inflorescence. Polyploidy is found in the genera *Dactylorhiza* and *Gymnadenia*. All these shared characteristics justify the merging of these genera into the same subtribe of the *Dactylorhizinae*.

The *Orchis*- and *Ophrys* groups have leaves in a rosette, have a bract-like leaf as a spathe around the inflorescence and 32–42 chromosomes and they do not exhibit polyploidy. The differences between the flowers of *Orchis* and *Ophrys* are so great (spur – no spur; one pouch – two separated pouches; glabrous lip – lip hirsute) that it is justified to consider these two groups as subtribes.

Of the other two groups (subtribes) the *Galearinae* have the viscidia in pouches or nude. They have only one or two (three) leaves. *Galearis* and *Amerorchis* have rootstocks, *Pseudorchis* has thick fleshy roots.

In the *Platantherinae* two groups are distinguished: The *Platanthera*-group has a spurred lip and a turnip-shaped, ellipsoid or globose tuber. The *Herminium*-group has a saccate lip and a globose or ellipsoid tuber.

In which of the subtribes does *Hemipilia* belong? This genus has two viscidia each covered by a membrane. This cover ruptures if an insect, looking for nectar, presses its head against the viscidium. The viscidium sticks to the head after the covering membrane is ruptured, some remains being left behind. The species of *Hemipilia* have like *Amerorchis* only a single leaf. The species of *Ponerorchis* have also a membrane over each viscidium and they have two or three leaves. The tubers are small and ellipsoid or globose. The tubers of *Hemipilia formosana* are cylindrical and different of those of *H. cordifolia*, which are ellipsoid.

It will be the best to bring the genera *Hemipilia* and *Ponerorchis* notwithstanding they have the viscidia covered by a membrane (they possess no real pouch) to the *Platantheriinae*. They have a real spur, globose, ellipsoid or cylindrical tubers. In this conception I follow BENTHAM, who reckons the genus *Hemipilia* to his *Habenarieae*, without a pouch. Perhaps it would be preferable to unite the genera with a single or with two leaves, such as *Amerorchis*, *Aorchis* and *Hemipilia* in a separate subtribe, but this requires a more thorough knowledge of the Asiatic species.

I am much indebted to Prof. Dr. A. D. J. MEEUSE for his assistance with the formulation and corrections of the English text and to Mr J. VUIJK who made the drawings 2–6.

A CONSPECTUS OF SPICES IN CAMEROON

E. Westphal[1], P. Mbouemboue and Mouzong Boyomo

National Advanced School of Agriculture
University Centre of Dschang, Cameroon

Contents

1. Introduction

This study partly presents the results of a survey of edible plants, carried out at the National Advanced School of Agriculture of Cameroon, during the period 1975–1979. This survey was undertaken in order to obtain a clear picture of the various plants used for food, and to incorporate knowledge of their uses and possible modes of cultivation into lectures on food crop production presented to students of the School. Results obtained for food crops (e.g. vegetables, tuber crops) will be reported in due course.

More than 50 different spices have been found in Cameroon, but only about 30 are treated here.

2. Materials and methods

Specimens and seed samples were collected in gardens, sometimes in fields, at market places and from the wild in most parts of Cameroon. Market places, in particular,

---

[1]) Present address: Department of Tropical Crop Science, Univ. of Agric., Wageningen, The Netherlands.

proved to be important sources to master the abundance of spices used. Most spices are presented in the form of seeds and fruits. Identification proved to be very difficult in many cases, and numerous field trips were carried out to obtain complete plant material. However, with the aid of various keys and using identified herbarium specimens present in the National Herbarium of Cameroon (YA) and the Wageningen Herbarium (WAG) collected by various botanists, it was possible to identify most specimens. A more elaborate study is still necessary to solve all the taxonomic problems encountered in the preliminary account.

Seed samples were sown in the Hortus Botanicus Nkolbissonnensis and in the greenhouse of the Department of Tropical Crop Science and the Laboratory of Plant Taxonomy and Plant Geography in Wageningen. Most seeds from wild sources did not germinate or they germinated very slowly. Whenever possible, seedlings, flowering and fruiting material as well as seeds of each spice were dried and /or preserved in spirit. All specimens collected are conserved in the Wageningen Herbarium, but a duplicate of each dried specimen is present in the National Herbarium of Cameroon. Unless otherwise stated, the WESTPHAL & WESTPHAL-STEVELS collection numbers are those preserved in the Wageningen Herbarium, and indicated by WP.

The short descriptions are based on specimens grown in Cameroon. In other words, this study is solely based on plant specimens collected in Cameroon and preserved subsequently, and thus readily accessible for consultation. Although the type specimens for most spices dealt with, have been designated already at some time by others, information on them is not included in the present study, as consultation of these type specimens was physically impossible at the time since most of them being conserved in European herbaria. Consultation and comparison of the type material with samples collected in Cameroon is essential to eliminate taxonomic uncertainties. Possibly, this may be done in a more elaborate study in the future. Although not ideal, it is scientifically correct to publish these preliminary results based on specimens collected in Cameroon, identified to the best of our knowledge, and permanently available for consultation. Besides, publication of the results at this moment is of immediate practical value for Cameroon.

3. CLIMATE AND VEGETATION

Wet equatorial region. South Cameroon, between 2 and 6° North, experiences a wet equatorial climate (Guinea type) with more than 1500 mm precipitation annually, two rainy seasons (March–June, September–November), and two dry seasons (July–August, December–March). At the south coast a maritime type exists with over 2500 mm rainfall annually and only 2 months receive less than 100 mm. On the plateau region south of 5° N temperatures are moderate (average annual 23 °C) due to elevation (up to 700 m), and precipitation is less (about 1500 mm annually). Climax vegetation: evergreen tropical rainforest, and at most parts of the coast mangrove vegetation. North of 5° N the small dry season diminishes and the large dry one takes about 4 months (Guinea-Sudanic type). Here the vegetation changes into woodland ('forest savanna') with large residual forest areas in certain regions (Djerem, Mbam, mountain areas), and gallery forest along the rivers.

The coastal region neighbouring Mount Cameroon and the high plateau region of Western Cameroon experience a modification of the wet equatorial climate, the so-called cameroonian type, due to the presence of high elevation. Here a long rainy season of 9 months with a short dry season interspersed with rainy intervals is present with maximum rainfall during July and August. The lowland areas receive 4000–10000 mm rainfall per year, experience high temperatures (average annual 26 °C) and high humidities. The high plateau area has lower temperatures (average annual 20 °C at 1300 m), with average rainfall of 2000 mm. At about 1800 m elevation rainforest disappears and highland savanna comes in (the grassfields).

Drier northern region. North of the 6° parallel rainfall diminishes gradually and falls in one season which becomes shorter when going further north (Sudanic-Sahelian type). In the Bénoué river basin annual precipitation varies from 1300 mm to 900 mm going from south to north. Rainfall comes in a period of 6 months and temperature amplitudes are marked (average annual 28 °C at Garoua). Vegetation consists of woodland ('Guinea-Sudan savanna'), but because of burning practices herbs are increasing. South of the Bénoué basin the highland of Adamaoua is situated with about 1600 mm rainfall per year spread over a period of more than 7 months. Temperatures are moderate (at Ngaoundéré the average annual is 23°C). Here woodland rich of trees and shrubs exists with gallery forests along the rivers. Because of burning this vegetation type is deteriorating rapidly.

North of the Bénoué river basin rainfall becomes less than 900 mm per year and the length of the dry season increases (more than 7 months). Maroua exhibits a rainy season from mid-May to September with about 800 mm annually. In the Mandara Mountains west of Maroua rainfall is higher, up to 980 mm annually, and temperature lower, whereas in the Tchad Plain the rainy season is reduced to 3 months with 700–550 mm rainfall per year. Here the vegetation changes from woodland ('Sudan type') into scrub vegetation ('Sahel savanna'), whereas the zones inundated during a part of the year (yaéré) are covered with a steppe-like vegetation (Loung, 1975).

4. Uses

Spices are those vegetable products which are used to add piquancy and flavour to dishes because of their odour, flavour, or pungent qualities. They consist of rhizomes, roots, barks, leaves, fruits, seeds and other plant parts. Most of them are fragrant, aromatic, and pungent. In general, they are used in such small quantities that the nutrients they contain do not contribute very much to the diet (Cobley & Steel, 1976).

The difference between spices and condiments is not always clearly indicated in literature. A spice is a vegetable product used for flavouring food. Sometimes a spice may be a mixture of some spices (e.g. curry) without addition of non-spicy components, and used wholly or as a powder. Condiments are sometimes defined either as a mixture of spices or as a mixture of vegetable products not exclusively based on spices (MAISTRE, 1964).

Spices owe their flavouring properties to the presence of essential oils and resinous components. Essential oils occur in secretory cells, vittae, glands, and other special tissues, and are responsible for the aroma and taste of most spices. Grinding of spices breaks down or exposes these tissues causing the loss of aromatic principles by evaporation. Resinous components, associated with volatile oils, are known as oleoresins. The pungent principles of e.g. ginger and pepper are contained in their oleoresins (COBLEY & STEEL, 1976).

When food (e.g. rice, millet) lacks natural flavour, the use of spices in preparing dishes becomes important to maintain palatability and to avoid monotony. The spices greatly assist the digestive processes and may have medicinal properties as well. Therefore, they cannot be separated from medicinal crops, as is true for many spices in Cameroon used medicinally as well (ZIPCY et al., 1976).

In Cameroon, numerous spices are used to add flavour to various sauces, like the yellow sauce for taro, meat or fish sauces, vegetable sauces, and 'nkui' sauce. Nkui is mainly prepared from branches of *Triumfetta cordifolia* A. Rich. producing a sticky, mucilaginous fluid to which numerous spices (fruits, seeds, barks, roots) are added. This sauce is eaten with couscous of maize (GRIMALDI & BIKIA, 1977; MASSEYEFF, PIERMÉ & BERGERET, 1958; PELÉ & LE BERRE, 1966; WESTPHAL, 1978).

5. SPICES IN CAMEROON

5.1. Literature. Much scattered information is available in literature on plants used for food in Cameroon, spices included. DALZIEL (1955) included information on the former British Cameroons, whereas BUSSON (1965) in dealing with West Africa included Cameroon in his considerations as well. RAPONDA-WALKER & SILLANS (1961), in treating useful plants of Gabon, provided information applicable also for Cameroon. HÉDIN (1930) included observations on uses as food when describing the value of forest trees for timber. MILDBRAED (1913b) and TESSMANN (1913) gave lengthy accounts of their expeditions in Cameroon, including the occurrence of food plants and spices. MALZY (1954) and JACQUES-FÉLIX (1940) related information on useful plants to herbarium specimens, whereas many other did not. Identification proves then difficult and too often impossible, although valuable information is still provided (BEBEY EYIDI, PIERMÉ & MASSEYEFF, 1961–1962; BERGERET, 1955; MASSEYEFF, CAMBON & BERGERET, 1958; MASSEYEFF, CAMBON & BERGERET, 1959; MASSEYEFF, PIERMÉ & BERGERET, 1958; PELÉ & LE BERRE, 1966).

Finally, in the various installments of the Flora of Cameroon, information is given

Table 1. Spices not further included in this survey.

Family	Species	Common names	Parts used (with specimens collected)
Annonaceae	?*Isolona campanulata* Engl. & Diels	ndin	seeds (*WP 10012*)
	?*Xylopia acutiflora* (Dunal) A. Rich.		seeds (*WP9456, 9457, 10057, 10058*)
Euphorbiaceae	*Bridelia tenuifolia* Muell.	tiktika	bark
Gramineae	*Cymbopogon citratus* (DC.) Stapf	ossanga, citronelle, lemongrass	leaves
Guttiferae	*Garcinia* spp.	essok	bark, seeds (*WP 8712*) (in palm wine)
Labiatae	*Mentha* sp.	mint, menthe hako chai	leaves (*WP 9574, 9702, 9725*)
	Thymus vulgaris	thyme, thym	young twigs (*WP9442, 10013*)
Lauraceae	*Cinnamomum* sp.	cannelle	leaves (*WP9830, 10203*)
	?*Cinnamomum* sp.	kempo	bark (*WP9888, 10148, 10181*)
Liliaceae	*Allium sativum* L.	garlic, ail	bulbs (*WP 10019*)
Meliaceae	*Khaya senegalensis* A. Juss.	daleloi	bark (sorgho beer)
Mimosaceae	*Dichrostachys glomerata* (Forsk.) Chiov.	nashu zonbo	fruits (*WP 9957, 9992*)
	Prosopis africana (Guill. & Perr.) Taub.	kohi	seeds
Papilionaceae	*Trigonella foenum-graecum* L.	fenugreek, fénugrèc	seeds (*WP 9697*)
Ranunculaceae	*Nigella* sp.	black cumin	seeds (*WP 9716*)
Umbelliferae	*Apium graveolens* L. var. *dulce* (Mill.) DC.	celery, céleri	leaves + petioles
	Foeniculum vulgare Mill.	fennel, fenouille	leaves
	Petroselinum crispum (Mill.) Nym. ex A.W. Hill	parsley, persil	leaves
Zingiberaceae	*Aframomum* spp.	essong, cho(co), chouoko, bongo balim	seeds (see under 17.1.6)
	?*Curcuma domestica* Vahl	turmeric, curcuma	rhizomes (*WP 9014, 9666, 9713*)

on the use of plants, but often not on edible qualities (e.g. KOECHLIN (1965) for species of *Aframomum* K. Schum.).

5.2. Spices excluded from further treatment. Several species, being either recently introduced, or less important, or still very difficult to identify, are not included in the more detailed treatment. They are listed in Table 1 (WESTPHAL, 1978).

TABLE 2. Spices and their parts used.

Parts used	Family	Species
Rhizomes	Cyperaceae	Scleria striatinux
	Zingiberaceae	Zingiber officinale
Roots	Compositae	Echinops giganteus var. lelyi
	Moraceae	Dorstenia scabra
	Pentadiplandraceae	Pentadiplandra brazzeana
	Periplocaceae	Mondia whitei
Bark	Caesalpiniaceae	Scorodophloeus zenkeri
	Huaceae	?Afrostyrax kamerunensis A. lepidophyllus ?Hua gabonii
	Olacaceae	Olax gambecola
Leaves	Labiatae	Aeolanthus heliotropioides Ocimum basilicum, O. gratissimum Plectranthus glandulosus
Fruits	Mimosaceae	Tetrapleura tetraptera
	Piperaceae	Piper guineense, P. nigrum
	Rutaceae	Fagara leprieurii, F. tessmannii
	Solanaceae	Capsicum annuum, C. frutescens Solanum gilo
Fruit pulp	Caesalpiniaceae	Tamarindus indica
Seeds	Annonaceae	Monodora spp., Xylopia spp.
	Caesalpiniaceae	Scorodophloeus zenkeri
	Euphorbiaceae	Ricinodendron heudelotii
	Huaceae	Afrostyrax lepidophyllus ? Hua gabonii
	Lauraceae	Beilschmiedia spp.
	Mimosaceae	Amblygonocarpus andongensis Parkia spp.
	Olacaceae	Olax spp.
	Zingiberaceae	Aframomum spp.
Cotyledons	Simarubaceae	Irvingia gabonensis

5.3. Conspectus of spices. Spices are alphabetically arranged according to family, genus and species. For each species, the following aspects are dealt with: taxonomic literature, description, distribution, names, uses, material and notes.

A summary of the spices treated is given in Table 2 according to the parts used.

(1) ANNONACEAE

(1.1) **Monodora** Dunal, in Monogr. Anonac.: 34,79 (1817). – Oliver, in F.T.A. *1*: 37 (1868). – Engler & Diels, in Engl. Monogr. Afr. Pflanzenfam. *6*: 84 (1901). – R. E. Fries, in Engler & Prantl, Nat. Pflanzenfam. ed. 2, *17a*, 2: 168 (1959). – Le Thomas, in Fl. Gabon *16*: 338 (1969). – Verdcourt, in F. T. E. A. Annonaceae: 117 (1971).

Description of the genus. Trees or shrubs, sometimes lianoid, glabrous or with simple hairs. Flowers hermaphrodite, solitary, sometimes in 2-few flowered cymes, terminal or extra-axillary, pedicellate, sometimes very conspicuously so; bracteole single, often large and leafy, persistent. Sepals 3, free, shorter than the petals. Petals 6, in 2 whorls of 3, unequal, all united at base, very often with markedly crisped or undulate margins, the outer broad at base, usually spreading or curved, inner about clawed, often with apices connivent at the tips. Stamens numerous, filaments absent. Carpels several, united into a conical or globose, 1-celled ovary with numerous ovules and parietal placentation. Fruit syncarpous, globose, ellipsoid or obovoid, with numerous seeds and leatherly or woody pericarp. Seeds irregularly arranged, mostly shiny brown; aril absent; endosperm ruminate.

The seeds of the following species are used as condiment, but information is not always accurate where Cameroon is concerned.

(1.1.1) **M. brevipes** Benth., in Trans. Linn. Soc. London *23*: 475 (1862).

This wide shrub or tree, with yellowish-cream and conspicuously blotched petals, is found in Cameroon. No specific information on the use of seeds is found, although BUSSON (1965) refers to its distribution from Guinea to Cameroon, where crushed seeds are utilized for seasoning dishes.

(1.1.2) **M. crispata** Engler & Diels, in Notizbl. Bot. Gart. Berl. *2*: 301 (1899). – See also Keay, in F.W.T.A. ed. 2, *1* (1): 54 (1954), and Aubréville, in Fl. Forst. C.I. ed. 2, *1*: 152, tab. 42 (1959).

It is found in Cameroon under the local name 'nding' (teste *Letouzey 4578*). The seeds have the taste of nutmeg (LE THOMAS, 1969), but specific information as to its use as condiment is not available for the territory.

(1.1.3) **M. myristica** (Gaertn.) Dunal, in Monogr. Anonac.: 80 (1817). – Engler & Diels, in Engl. Monogr. Afr. Pflanzenfam. *6*: 86, tab. 30A (1901). – Oliver, in F.T.A. *1*: 37 (1868). – Keay, in F. W. T. A. ed. 2, *1* (1): 54 (1954). – Le Thomas, in Fl. Gabon *16*: 342

(1969). – Verdcourt, in F.T.E.A. Annonaceae: 118 (1971).
= *Annona myristica* Gaertn., in Fruct. *2*: 194, tab. 125/1 (1791).

Description. A tree, up to 18 m high. Leaves elliptic to obovate, rounded at base, acuminate, 15–45 × 5–20 cm. Flowers large, fragrant, on long pedicels; sepals lanceolate, with wavy crispate margins, up to 3,5 cm long; petals yellow and red, the inner 3 spotted red outside and green inside, outer petals up to 10 cm long. Fruit globular, up to 10–15 cm in diam. Seeds numerous, oblong, laterally slightly compressed, shiny light brown, up to 20 × 12 mm.

Distribution. West and Southern Cameroon. Wild.

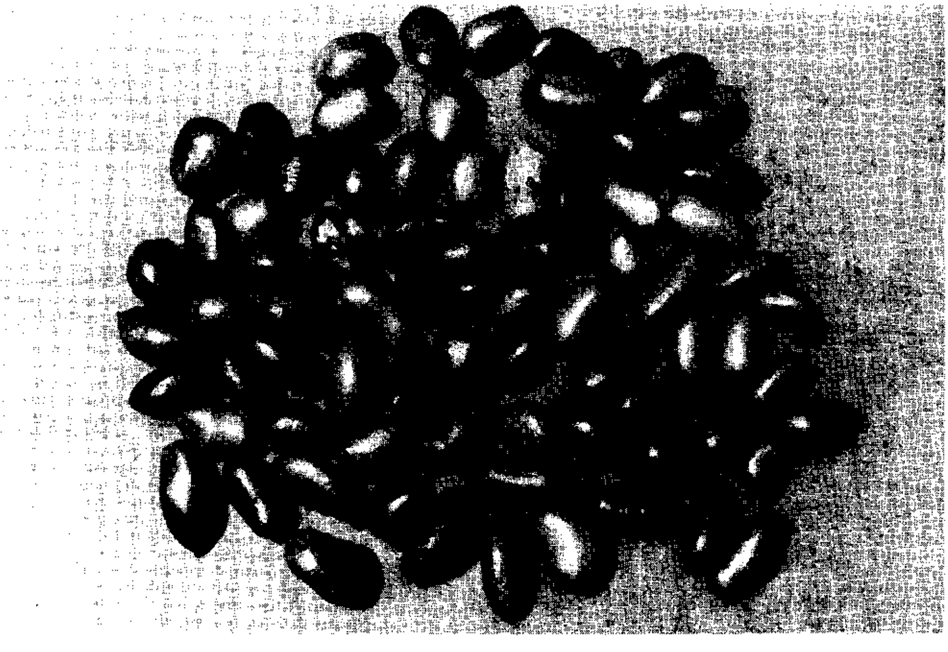
Names. Fausse noix de muscade, ndin(g), fep, pebe, manguen.

Uses. The crushed seeds are used as condiment, e.g. in meat sauce and in 'nkui' (BUSSON, 1965; GRIMALDI & BIKIA, 1977; HÉDIN, 1930; PELÉ & LE BERRE, 1966).

Material. *WP 8707, 8832, 8892, 9149, 9473, 9538, 9558, 9883, 10173, 10204.* These specimens (including mostly seed samples) closely resemble the specimen in YA (teste *Letouzey 13825*) having a mature fruit with seeds. On other herbarium sheets the name 'ndin' is added. It is highly likely that the seed samples collected belong to *M. myristica*. See photograph 1.

(1.1.4) **M. tenuifolia** Benth., in Trans. Linn. Soc. London *23*: 475 (1862).

This small tree, occurring in Cameroon, produces aromatic seeds which are utilized



PHOT. 1. *Annonaceae*. Seeds of *Monodora myristica* (Gaertn.) Dunal (*WP 9473*). (All photographs made by E. WESTPHAL).

as condiment, which are less appreciated in Africa (Busson, 1965). Le Thomas (1969) mentions only its use as a medicin for Gabon. Specific information on its utilisation in Cameroon is not available.

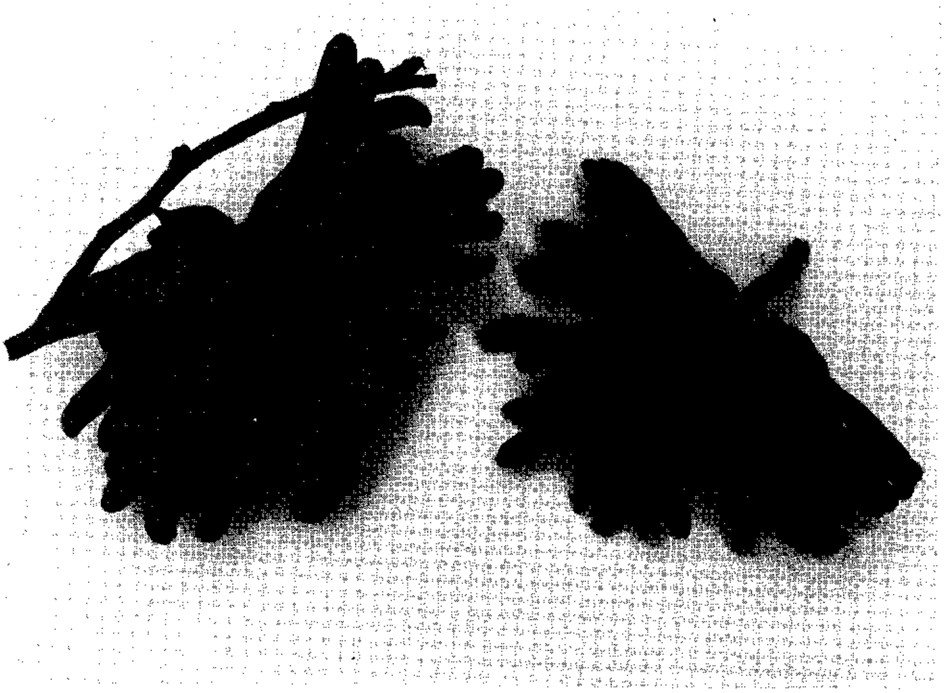
(1.2) **Xylopia** L., in Syst. Nat. ed. 10: 1241, 1250, 1378 (1759), nom. conserv. – Oliver, in F.T.A. *1*: 29 (1868). – Engler & Diels, in Engl. Monogr. Afr. Pflanzenfam. *6*: 57 (1901). – Le Thomas, in Fl. Gabon *16*: 151 (1969). – Verdcourt, in F.T.E.A. Annonaceae: 72 (1971).

Description of the genus. Trees, shrubs or shrublets, only rarely climbing or not. Flowers hermaphrodite, solitary, fasciculate or in cymes, axillary, sessile or stalked; buds ovoid, subglobose or more usually narrowly conical and 3-angled; bracteoles 1–5, deciduous or persistent. Sepals 3, more of less united, very much smaller than the external petals. Petals 6 in 2 whorls of 3, subequal or the outer ones larger, free, thick, flattened or angular, enlarged at base. Stamens numerous, with filaments articulated, sometimes partly united at base and enclosing the gynoecium. Carpels few to many, free, ovoid-oblong or flattened, with 1-many 1–2 seriate ovules. Monocarp dehiscent or indehiscent, obovoid to cylindric, sessile or mostly stipitate, 1–8(-many)-seeded, more or less fleshy. Seeds vertical to horizontal, collateral or 2-seriate; aril often present but often inconspicuous; endosperm ruminate.

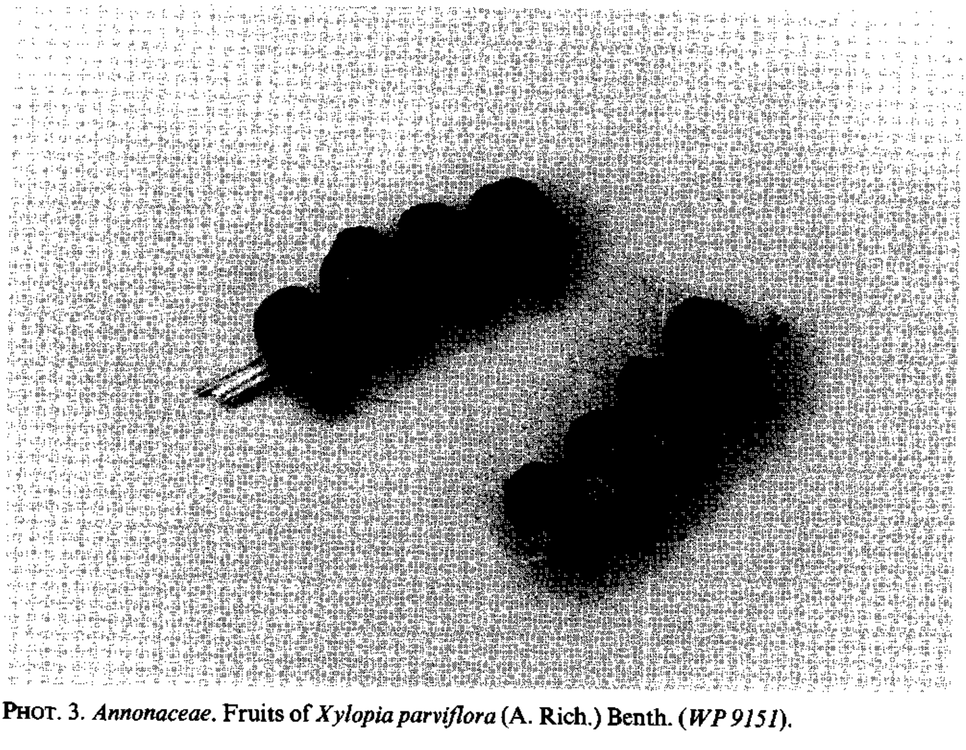
Several species are recorded in literature for the use of their seeds as condiments. For Cameroon, at least 2 species are utilized by the people: *X. aethiopica* (Dunal) A. Rich. and *X. parviflora* (A. Rich.) Benth. Fruits collected at the Bamenda market (teste *WP 9456, 9457, 10057, 10058*), of which the seeds are used as a condiment, are very similar to the ones of *X. acutiflora* (Dunal) A. Rich. (teste *Inger Nordal 937*, *de Wilde & de Wilde-Duyfjes 2703*). The first two species are treated below.

(1.2.1) **X. aethiopica** (Dunal) A. Rich., in Ramon de la Sagra, Hist. Iles Cub. Bot. Pl. Vasc. *1*: 53 (1845). – Oliver, in F.T.A. *1*: 30 (1868). – Engler & Diels, in Engl. Monogr. Afr. Pflanzenfam. *6*: 60, tab. 21 (1901). – Keay, in F.W.T.A. ed. 2, *1* (1): 41 (1954). – Le Thomas, in Fl. Gabon *16*: 165, tab. 30 (1969).
= *Unona aethiopica* Dunal, in Monogr. Anonac.: 97, 113 (1817). – DC., in Syst. Nat.: 496 (1817).

Description. A tree, up to 30 m high. Leaves petioled, elliptic to oblong, gradually acuminate at top, obtuse or rounded at base, coriaceous, glabrous and shiny above, appressed pubescent to glabrescent below, reticulate, up to 15 × 6 cm. Flowers greenish-white, fragrant, solitary or fasciculate (2–6), pedicelled, with 2 reduced bracteoles. Flower bud linear. Sepals small, greenish. Outer petals about 5 cm long, thick and gradually narrowed to the apex, tomentose on the outside; inner petals smaller, reddish, tomentulose on both sides. Stamens seriate, with external staminodes larger than the fertile stamens, with inner staminodes smaller. Carpels up to 30, about 5 mm long. Fruit a cluster of mericarps; mericarp cylindrical, dehiscent, glabrous, smooth, up to 5–6 cm long, 4–9-seeded, green outside becoming dark brown, red inside. Seeds



PHOT. 2. *Annonaceae*. Fruits of *Xylopia aethiopica* (Dunal) A. Rich. (*WP 9153*).



PHOT. 3. *Annonaceae*. Fruits of *Xylopia parviflora* (A. Rich.) Benth. (*WP 9151*).

vertical, 1-seriate, ellipsoid, shiny brown, up to 6 × 3 mm; aril small, bilobed, orange-whitish.

Distribution. In forest areas of West and Southern Cameroon. Wild.

Names. Poivre de Guinée, poivre d'Ethiopie, nbikii, kountsé, kozé, witi, kimbadjé.

Uses. The seeds are strongly spicy and used crushed to flavour meat and fish sauces and 'nkui' (BUSSON, 1965; GRIMALDI & BIKIA, 1977; HÉDIN, 1930; PELÉ & LE BERRE, 1966).

Material. *Letouzey 1611, 8186; McKey 28; de Wilde & de Wilde-Duyfjes 1322; WP 8711, 8819, 9153, 9472, 9874, 9953, 10025, 10056, 10202.* See photograph 2.

(1.2.2) **X. parviflora** (A. Rich.) Benth., in Trans. Linn. Soc. London *23*: 479 (1862), p.p. excl. specim. Mann 914. – Oliver, in F.T.A. *1*: 31 (1868), p.p. – Engler & Diels, in Monogr. Afr. Pflanzenfam. *6*: 64 (1901), p.p. – Keay, in F.W.T.A. ed. 2, *1* (1): 41 (1954). – Le Thomas, in Fl. Gabon *16*: 175, tab. 31, p.p. (1969).
= *Uvaria parviflora* A. Rich., in Guill., Perr. & A. Rich., Fl. Senegamb. Tent.: 9, tab. 3, fig. 1 (1831).

Description. Small tree or shrub, up to 20 m high; branchlets and leaves thinly pilose or pubescent or appressed pilose when young. Leaves petioled, ovate to elliptic, obtuse or slightly acuminate at top, rounded at base, up to 8 × 4 cm. Flowers on short pedicels or subsessile, axillary, solitary or fasciculate (2–3); bracteoles 2–3, small; sepals small, green; petals up to about 5 cm long, with crimson base and yellow-green tails; carpels 4–6, small. Fruit pedicelled; mericarps subsessile, oblong to cylindrical, obtuse or pointed at top, with fruit wall slightly bulging over the seeds or sometimes slightly ribbed, dehiscent, up to 4 × 1,5 cm, green outside becoming brown, red inside. Seeds horizontal, 2-seriate, ellipsoid to reniform, about 10 × 7 mm, green to brown.

Distribution. In West, Central and Southern Cameroon. Wild.

Names. Ké, ki, nshe, batu, chamgang.

Uses. Crushed seeds are used to flavour sauces, in particular 'nkui'. It is often found in the Bamiléké region, where the fruits are sold in strings on pieces of raphia up to 1 m long (BERGERET 1955; GRIMALDI & BIKIA, 1977; LE THOMAS, 1969).

Material. *Jacques-Félix 8724, 9110; Leeuwenberg 7033; Letouzey 2459, 4498, 9614, 12138; Satabie 15; Villiers 666; Vroumsia Tchinaye 103; de Wilde & de Wilde-Duyfjes 2676; WP8713, 9151, 9420, 9882, 10029, 10030, 10031, 10032, 10047, 10048, 10049, 10172.* See photograph 3.

(2) CAESALPINIACEAE

(2.1) **Scorodophloeus zenkeri** Harms, in Engler Bot. Jahrb. *30*: 78 (1901). – Pellegrin, in Lég. Gabon: 134 (1948). – Aubréville, in Fl. Cam. *9*: 84, tab. 15 (1970).

Description. A tree, up to 16 m high, with smooth bark becoming scaly when older, grey, strongly smelling of garlic. Leaves simply pinnate, 5–10 pairs of leaflets;

rachis furrowed, slightly winged, up to 10 cm long; leaflets alternate, sessile, oblong, rounded at top, obliquely truncate at base, glabrous to glabrescent, up to 2,5 × 0,5 cm. Inflorescence an axillary or terminal raceme, pubescent; pedicels up to 8 mm long, with halfway 2 lanceolate bracteoles; flowers white. Fruit flattened, woody, apiculate, rather smooth, one suture broadened and slightly winged, up to 10 × 4,5 cm. Seeds oval-shaped, flat, with thin testa with wavy ridges when dry, with strong garlic odour, up to 2 cm in diam. Seedlings with hypogeal germination.

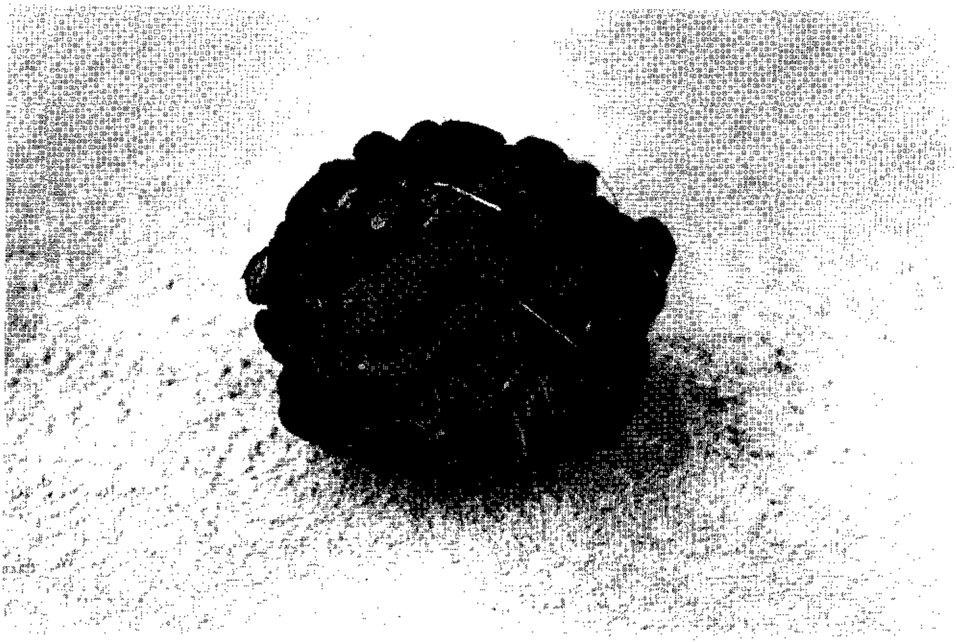
Distribution. In forest regions of southern and West Cameroon. Wild.

Names. Olom, koublelo, loum, bobimbi (for the bark); ?doum, doumka, kaplet (for the seeds); arbre à ail (general).

Uses. Bark and seeds are used in flavouring sauces, e.g. 'nkui' (BERGERET, 1955; CHEVALIER, 1947b; GRIMALDI & BIKIA, 1977; HÉDIN, 1930; MASSEYEFF, PIERMÉ & BERGERET, 1958; MILDBRAED, 1913a, 1913b; PELÉ & LE BERRE, 1966). According to AUBRÉVILLE (1970) also the young leaves are used as condiment.

Material. *Bos 4781; Bullock 629, 687; Letouzey SRF Cam. 1225, 12212, 12229; WP 8809, 9575, 9886, 9951, 10041* (bark); *WP 8753, 9155, 9423, 9879, 9880, 9952, 10027, 10151* (seeds). See photograph 5.

(2.2) **Tamarindus indica** L., in Sp. Pl. ed. 1: 34 (1753). – Léonard, in Fl. C. B. *3*: 436 (1952). – Keay, in F.W.T.A. ed. 2, *1*(2): 477 (1958). – Aubréville, in Fl. Cam. *9*: 295 (1970). – Brenan, in F.T.E.A. Leg. Caesalp.: 153, tab. 32 (1967).



PHOT. 4. *Caesalpiniaceae*. Ball of fruits of *Tamarindus indica* L.

Description. A tree, 3–24 m high, crown rounded; young branchlets pubescent or puberulous; bark rough, grey or grey-black. Leaves paripinnate; leaflets 10–18 pairs, opposite, narrowly oblong, rounded and asymmetric at base, rounded or emarginate at top, glabrous, reticulate on both surfaces, up to 20 × 8 mm. Flowers in small terminal, glabrous racemes; pedicels about 5 mm long; sepals up to 7 mm long, pale yellow inside, reddish outside; petals longer, gold with red veines. Fruit curved, oblong, saucage-like, usually obtuse at base and apex, mucronate, irregularly constricted, covered with brown scurf, about 10 cm long; innerpart pulpy, intersected by fibres. Seeds rhombic, chestnut-brown, about 15 × 10 mm.

Distribution. North Cameroon. Wild.

Names. Tamarind, tamarinier, dja'abe, djapé.

Uses. The rather tart, brown pulp of the fruit is eaten fresh; mixed with sugar, it makes a sweet meat (tamarind balls); it is used for seasoning other food; a refreshing acid drink and sherbet are made with it. The seeds may be eaten after the removal of the testa and roasting or boiling. Flowers and leaves are used in salads and soups. Many parts of the tree are used in native medicines in Africa and Asia (AUBRÉVILLE, 1970; BUSSON, 1965; MALZY, 1954; MASSEYEFF, CAMBON & BERGERET, 1959; PELÉ & LE BERRE, 1966; PURSEGLOVE, 1968).

Material. *Baniekona 7; Banza 3; Biholong 78; Geerling & Mene 4638; Letouzey 6187, 6375; Malzy 560; Surville 444; de Wilde & de Wilde-Duyfjes 2963, 3058; WP 8954, 9092, 9665, 10189, 10190.* See photograph 4.

(3) COMPOSITAE

(3.1) **Echinops giganteus** A. Rich., in Tent. Fl. Abyss. *1*: 449 (1848).
– Oliver & Hiern, in F.T.A. *3*: 432 (1877).
= *E. velutinus* O. Hoffm., in Engl. Bot. Jahrb. *30*: 440 (1901).

var. **lelyi** (C. D. Adams) C. D. Adams, in J. W. Afr. Sci. Assoc. ined. (1963).
– Adams, in F.W.T.A. ed. 2, *2*: 291 (1963).
= *E. velutinus* var. *lelyi* C. D. Adams, in J.W. Afr. Sci. Assoc. 3 (1): 113 (1957).

Description. An erect, branched, pubescent herb, with tuberous roots, up to 2 m high. Stems ribbed, striate, hispid, and sometimes also more or less woolly. Leaves obovate, deeply parted, shortly stalked, furrowed at base, with lobes mostly lanceolate, deeply toothed, the teeth terminating in long spinous points, with upper leaves elliptical, deeply toothed and smaller, shortly and densely setose above and on the veines beneath, withish-tomentose (cottony) beneath, up to 40 × 20 cm. Inflorescence a globose head, about 5 cm in diam. on strongly hispid stalk. Flowers pedicelled; at base of pedicel surrounded by a tuft of lanceolate bracts, many of them fasciculate-spinous from a knot neat the tip; corolla whitish. Fruit (achene) glabrescent near the apex with pappus of numerous ciliate, unequal scales connate below into a short tube.

Distribution. North and West Cameroon. Wild.

Names. Chamgué, chamguen.

Uses. Dried roots are crushed and used to flavour taro sauce and 'nkui' sauce in the Bamiléké region (BERGERET, 1955).

Material. *Biholong 149; Malzy 436; J. & A. Raynal 12166, 12893; Surville 402; de Wilde & de Wilde-Duyfjes 3377; WP 8842, 9887, 9890, 9995, 9999, 10042.*

(4) CYPERACEAE

(4.1) **Scleria striatinux** De Wild., in Rev. Zool. Afr. *14*, Suppl. Bot.: 22, tab. 5 (1926), as *striatonux*. – Napper in Kew Bull. *25*: 442 (1971). – Hooper & Napper, in F.W.T.A. ed. 2, *3* (2): 343 (1972). – Lowe & Stanfield, in F. Nig., Cyperaceae: 137 (1974).

Description. A rather grass-like, glabrous sedge, with a slender, brown-red rhizome, up to 60 cm high. Leaves rather few in number, borne at intervals along the stems, 8–24 cm long. Inflorescence a terminal, much-branched panicle, up to 10 cm long. Spikelets about 5 cm long with purplish bracts. Fruits globose, up to 2 mm in diam., white, with a pointed apex, slightly rough.

Distribution. In open woodland or grassland up to fairly high altitudes, e.g. in West and North Cameroon. Wild.

Names. Genna, nangni.

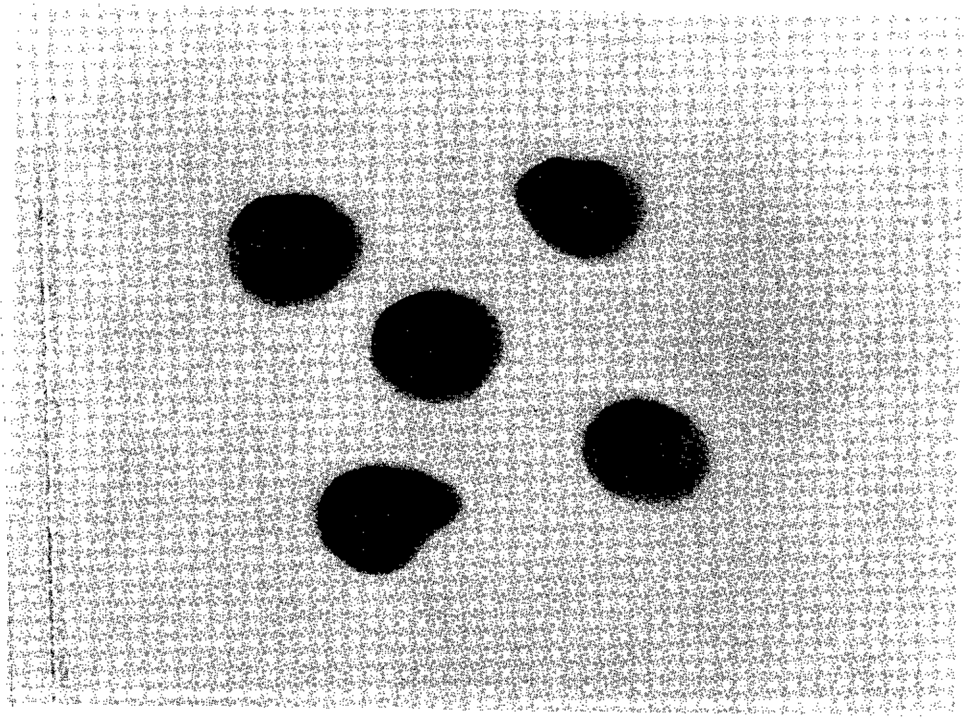
Uses. The dried rhizomes are used in taro sauce, and possibly in other sauces as well, in the Bamiléké region (GRIMALDI & BIKIA, 1977).

Material. *Brunt 387; Daramola 41058; Mbenkum 376; J. & A. Raynal 11970; de Wilde & de Wilde-Duyfjes 2313; WP 8840, 9440, 9894, 9964, 10001.*

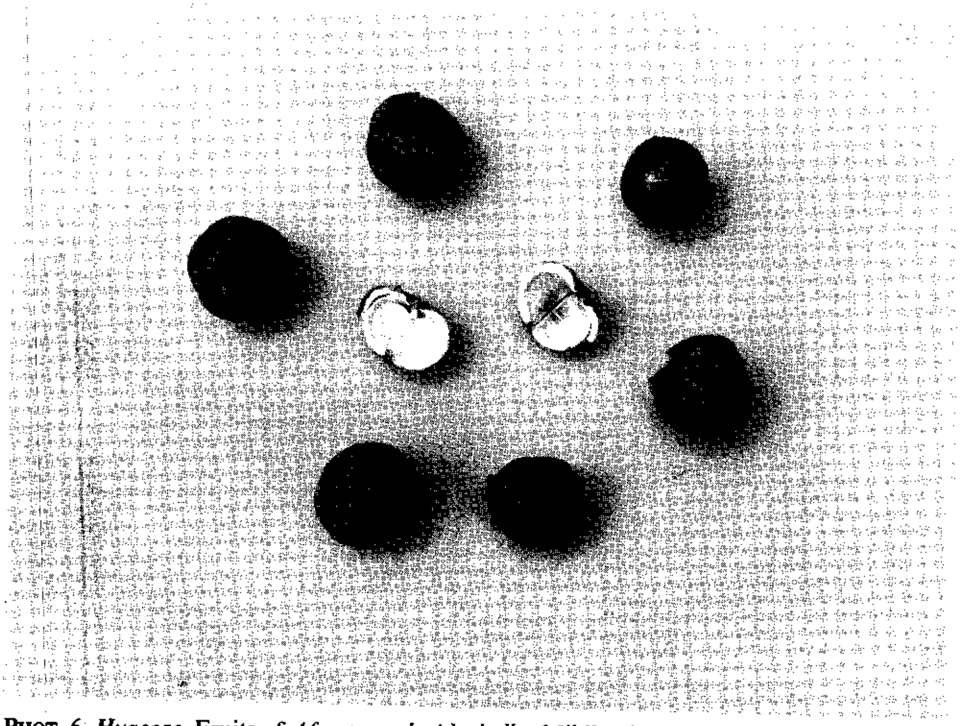
(5) EUPHORBIACEAE

(5.1) **Ricinodendron heudelotii** (Baill.) Pierre ex Pax, in Engl. Pflanzenr. Euph. *3*: 46, tab. 13, C-D, 16 (1911). – Mildbraed, in ZW. Deutsch. Zentr.-Afr.-Exp. 1910–1911, *2*: 13 (1922). – Keay, in F.W.T.A. ed. 2, *1* (2): 393 (1958).
= *R. heudelotii* (Baill.) Pierre ex Heckel ssp. *africanum* (Müll.-Arg.) J. Léonard, in Bull. Jard. Bot. Etat Brux. *31*: 398 (1961). – Léonard, in Fl. C.B. *8* (1): 116 (1962).
= *R. africanum* Müll.-Arg., in Flora *47*: (1864) sub *africanus*. – Hutchinson, in F.T.A. *6* (1): 745 (1913).

Description. A large deciduous tree, up to 45 m high; young branches with stellate indumentum. Leaves digitately 3–5-foliate; leaflets sessile, obovate to elliptic, acuminate, narrowed to the base, glandular-denticulate, stellate puberulous when young, up to 22 × 12 cm; stipules large, foliaceous, persistent, suborbicular, deeply toothed, up to 2 cm long. Male and female inflorescences yellow tomentose, flowers with white petals. Fruit 2-lobed, 2-celled, indehiscent, hard, black when mature, up to 3 × 4 cm. Seeds



PHOT. 5. *Caesalpiniaceae*. Seeds of *Scorodophloeus zenkeri* Harms (*WP 9155*).



PHOT. 6. *Huaceae*. Fruits of *Afrostyrax lepidophyllus* Mildbr. (*WP 9152*).

subglobose, slightly furrowed vertically, about 1 cm in diam.

Distribution. West and South Cameroon. Wild.

Names. Ezezan , djansan, njansa.

Uses. Fruits are depulped and cooked, then the seeds are freed from the hard lignified inner fruit shell and dried. Crushed seeds form a flour-like substance rich in oil and having a pleasant taste. It is added to fish, meat, and vegetable dishes in the same way as with groundnut paste (BUSSON, 1965; GRIMALDI & BIKIA, 1977; HÉDIN, 1930; PELÉ & LE BERRE, 1966).

Material. *Leeuwenberg 5970; Letouzey 8023; Surville 637; de Wilde & de Wilde-Duyfjes 2016; WP 8695, 8904, 9154, 9834, 9873, 10210.*

(6) HUACEAE

(6.1) **Afrostyrax lepidophyllus** Mildbr., in Engler Bot. Jahrb. *49*: 556 (1913). – W. Robyns, in Bull. Soc. Roy. Bot. Belg. *91*: 95 (1958). – A. Robyns, in Fl. Afr. Centr. Huaceae: 8, tab. 2 (1976).

Description. A tree, up to 25 m high, infrequently a small tree of 3 m high, with brown-yellowish bark. Leaves short-petioled, elliptic, obtuse at base, acuminate at apex, papery, reticulate on both surfaces, greyish-green, up to 20 × 9 cm. Bracts deciduous. Flowers clustered in axillary fascicles; pedicels about 1 cm long, densely lepidote as are the outside calyx and outside corolla; petals small, yellow-orange; ovary densely pubescent. Fruit globular, slightly longitudinally furrowed, with small apical pore, brown, tomentellous but glabrous when fully mature, 1-seeded, rarely 2-seeded. Seeds about globular, flattered at base, furrowed, light brown-yellowish, about 2 cm in diam., with endosperm giving a strong garlic odour.

Distribution. In forest regions of West and Southern Cameroon. Wild.

Names. Mban olom, lem, lemtong.

Uses. Crushed seeds are used to flavour sauces, e.g. 'nkui'. In Zaïre and Gabon, the bark is used crushed and added to vegetable dishes (A. ROBYNS, 1976; BRETELER & DE WILDE, pers. comm., 1978). The use of the bark in Cameroon is recorded by MILDBRAED (1913a, 1913b).

Material. *Letouzey 3207, 3218, 3732, 12302, 13814, 14529; McKey 3* ('seeds utilized as an onion substitute'); *WP 8716, 9152, 9424, 9881, 9940, 10026, 10059*. Also included were specimens collected in Gabon by *Breteler & de Wilde (242, 635, 700)*. See photograph 6.

Note 1. Since no specimens with fruits from Cameroon were available, material from Gabon has been used for the description and identification. The Gabonese specimens, with the information provided, decided in favour of *A. lepidophyllus*.

Note 2. The *Huaceae* are a family from tropical West and Central Africa with two genera (and 3 species): *Hua* Pierre ex De Wild. and *Afrostyrax* Perkins & Gilg (BAAS, 1972; CHEVALIER, 1947a; A. ROBYNS, 1976). These 2 genera consist of shrubs or trees which are used by the population as a spice because of the strong garlic flavour of their young leaves, bark and seeds (GERMAIN, 1963; MILDBRAED, 1913a; RAPONDA-WALKER & SILLANS, 1961). The 3 species referred to as having strong garlic flavour are the following:

(a) *Hua gabonii* Pierre ex De Wild., in Ann. Mus. Congo, Bot., ser. 5, 1: 289, tab. 65 (1906). – Engler & Krause, in Engler Bot. Jahrb. *49*: 554 (1913). – Chevalier, in Rev. int. Bot. appl. Agric. trop. *27*: 24 (1947b). – Germain, in Fl. C.B. *10*: 317, tab. 28 (1963). – A. Robyns, in Fl. Afr. Centr. Huaceae: 2, tab. 1 (1976).

In Zaïre, young shoots are used as condiment; meat is enveloped in older leaves and left smothering in hot ashes (A. Robyns, 1976). In Gabon, bark and seed are utilized as condiment in sauces (RAPONDA-WALKER & SILLANS, 1961). The plant has been found in South Cameroon (teste *Letouzey 9382, de Wilde & de Wilde-Duyfjes 2815*), having a garlic smell, but nothing is known about the use of it in Cameroon, which is however likely.

(b) *Afrostyrax kamerunensis* Perkins & Gilg, in Engler Bot. Jahrb. *43*: 217, tab. on p. 215 (1909). – Chevalier, in Rev. int. Bot. appl. Agric. trop. *27*: tab. 21 (1947c). – W. Robyns, in Bull. Soc. Roy. Bot. Belg. *91*: 94 (1958). – A. Robyns, in Fl. Afr. Centr. Huaceae: 5 (1976).

In Zaïre, an infusion of the bark is used as a garlic condiment (A. ROBYNS, 1976). MILDBRAED (1913) mentions the use of this plant for South Cameroon. It has been collected several times in this region (teste *Bos 3579, 4771, 5094, 7287; Letouzey 1226, 9100, 12384;* and others).

(c) *Afrostyrax lepidophyllus:* see above.

Note 3. Other garlic smelling taxa found in Cameroon:

(a) *Scorodophloeus zenkeri*: see above.

(b) *Olax* spp., notably, following VILLIERS (1973):

(b1) *O. gambecola* Baillon, in Adansonia, ser. 1, *3*: 121 (1862). – Sleumer, in Engler Pflanzenfam. ed. 2, *16B*: 24 (1935). – Keay in F.W.T.A. ed. 2, *1* (2): 646 (1958). – Villiers, in Fl. Cam. *15*: 111, tab. 28, 1–6 (1973).

The bark and the seeds give a strong garlic odour, and are used as condiments.

(b2) *O. latifolia* Engl., in Notizbl. bot. Gart. Berl. *2*: 284 (1899). – Sleumer, in Engler Pflanzenfam. ed 2, *16B*: 24 (1935). – Keay in F.W.T.A. ed. 2, *1* (2): 646 (1958). – Villiers, in Fl. Cam. *15*: 122, tab. 29, 11–19 (1973).

The seeds are eaten after being roasted.

(b3) *O. subscorpioidea* Oliver, in F.T.A. *1*: 350 (1868). – Dalziel, in Usef. Pl. W.T.A.: 294 (1934). – Sleumer, in Engler Pflanzenfam. ed. 2, *16B*: 24, tab. 13, e-g (1935). – Villiers, in Fl. Cam. *15*: 115, tab. 28, 17–26 (1973).

Leaves and the wood have a garlic odour. The fruits are eaten.

(7) LABIATAE

(7.1) **Aeolanthus heliotropioides** Oliv., in Trans. Linn. Soc. *29*: 137, tab. 82 (1875). – Baker, in F.T.A. *5*: 393 (1900). – Morton, in F.W.T.A. ed. 2, *2*: 457 (1963).

Description. An erect, much-branched, robust, aromatic, glandular-pubescent annual herb, about 60 cm high, with slender branchlets. Leaves sessile, linear-oblong, entire or slightly crenate, obtuse, slightly pubescent, about 5 × 1,5 cm. Panicles lax, large, much branched, with spikes 2–5 cm long with small flowers; rachis densely villose. Bracts oblong, ciliate. Calyx small, hardened, pubescent. Corolla 2-lipped, pale violet, pubescent. Fruits oblong, opening circularly at base, loosing dark shiny brown seeds.

Distribution. As useful plants only found on markets of Southern Cameroon, but is also found in the North although no information on its possible use has been collected for that region. A wild growing plant, but sometimes cultivated.

Names. Otek, odegeleh, otèglè.

Uses. Young parts used in flavouring dishes (?Tessmann, 1913).

Material. *Letouzey 5896, 23700 SRF Cam.; J. & A. Raynal 12966 SRF Cam., WP 8754, 8821, 8961, 9013, 9292, 9307, 9966.*

PHOT. 7. *Labiatae*. Flowering plants of *Ocimum basilicum* L.

(7.2) **Ocimum basilicum** L., in Sp. Pl. ed. 1: 597 (1753). – Benth., in Hooker Niger Fl.: 488 (1849). – Baker, in F.T.A. *5*: 336 (1900). – Morton, in F.W.T.A. ed 2, *2*: 452 (1963). – Raponda-Walker & Sillans, in Plantes utiles Gabon: 212 (1961).

Description. An erect, glandular annual, aromatic herb, with much-branched glabrous or slightly pubescent stems, up to 60 cm high. Leaves petioled, varying in shape, ovate and entire, about 2 cm long, or larger and dentate, slightly pubescent. Racemes rather dense, up to 20 cm long, flowers in whorls, shortly pedicelled. Bracts ovate, strongly veined, about as long as the whorls, ciliate. Calyx with prominent upper lobes. Corolla up to 1 cm long, two-lipped, white or tinged, or more or less purple; stamens and style protruding. Fruit small, covered by bract and enlarged calyx. Seeds small, brown.

Distribution. Found in all parts of Cameroon, especially in the more wetter areas. Cultivated.

Names. Osim, basilic.

Uses. The leaves are used for flavouring dishes (GRIMALDI & BIKIA, 1977; PELE & LE BERRE, 1966; PURSEGLOVE, 1968; TESSMANN, 1913).

Material. *Bounougou 176; Letouzey 6145, 7493; J. & A. Raynal 12040, 12910; de Wilde & de Wilde-Duyfjes 3346; WP 8732, 8735, 8743, 8786, 8787, 8789, 8790, 8817, 8822, 9304, 9305, 9425, 9555, 9599, 9730, 9783, 9858.* See photograph 7.

(7.3) **Ocimum gratissimum** L., in Sp. Pl. ed. 1: 1197 (1753). – Morton, in F.W.T.A. ed. 2, *2*: 452 (1963).
= *O. viride* Willd., in Enum. Pl. Hort. Berol.: 629 (1809). – Bentham, in Hook. Niger Fl.: 488 (1849). – Baker, in F.T.A. *5*: 337 (1900).

Description. An erect, much-branched, aromatic, slightly glandular, pubescent, perennial shrubby herb, up to 1 m high. Leaves long-petioled, ovate-obovate, acute, with slightly dented margin, about 12 × 5 cm. Racemes lax, up to 20 cm long; flowers shortly pedicelled. Bracts obovate ending in a pointed apex, decidous. Calyx with upperlip, other lobes rather prominent, acute. Corolla 2-lipped, white, twice as long as the calyx; stamens and style protruding. Fruit small, covered by enlarged calyx. Seeds small, black, slightly reticulate.

Distribution. Mainly in South and West Cameroon. Cultivated.

Names. Messeb, ndoum.

Uses. The leaves are used for flavouring dishes (GRIMALDI & BIKIA, 1977; MASSEYEFF, CAMBON & BERGERET, 1959; PELÉ & LE BERRE, 1966; TESSMANN, 1913). It is also used medically (MILDBRAED, 1913b).

Material. *Biholong 302; Bos 3451; Breteler 581; Letouzey 4904, 7905; J. & A. Raynal 11409 SRF Cam.; WP 8818, 9306, 9759, 9934, 9967, 10074.*

(7.4) **Plectranthus glandulosus** Hook. fil., in J. Linn. Soc. *6*: 17 (1861). – Baker, in F.T.A. *5*: 411 (1900). – Morton, in F.W.T.A. ed. 2, *2*: 460 (1963).

Description. A much-branched, erect, glandular-pubescent, aromatic herb, up to

1 m high, with slender pilose branchlets. Leaves long-petioled, cordate-ovate, acuminate, crenate, up to 12 × 6 cm. Inflorescence a loose, terminal panicle; branchlets slender. Bracts small, deciduous. Pedicels up to 1 cm long. Calyx with short tube, upper teeth large, lower ones smaller growing out when fruit develops. Corolla more than 1 cm long, violet. Fruit envelopped in enlarged calyx. Seeds small, ellipsoid, brownish, with very fine reticulation.

Distribution. In various parts of Cameroon. At some market places of Southern Cameroon found as a cultivated plant.

Name. Avas.

Uses. The leaves are used for flavouring dishes (TESSMANN, 1913). The plant is also used as a medicin.

Material. *Letouzey 12231, 13180; J. & A. Raynal 12377; WP 8761, 8972, 9286, 9784.*

(8) LAURACEAE

(8.1) **Beilschmiedia** Nees, in Wallich, Pl. Asiat. Rar. *2*: 69 (1831). – Robyns & Wilczek, in Bull. Jard. Bot. Etat. Brux. *19*: 459 (1949), *20*: 197 (1950). – Robyns & Wilczek, in Fl. C.B. *2*: 409 (1951). – Fouilloy, in Fl. Cam. *18*: 7 (1974).
= *Tylostemon* Engler, in Bot. Jahrb. *26*: 389 (1899).

Description of the genus. Trees or treelets with alternate, coriaceous leaves. Inflorescence an axillary raceme or panicle. Bracts deciduous, absent on the pedicels. Flowers hermaphrodite; perianth shortly tubular with tepals finally falling off. Stamens in 4 whorls of 3 each, fertile, but in innermost whorl reduced to staminodes, although sometimes fertile or absent. Ovary sessile, superior, unilocular, 1-ovulate; style variable in length; stigma pointed or capitate. Fruit a nearly dry berry, variable in shape, with base of calyx persistent or not.

The majority of the Zaïran species have an aromatic bark, giving the odour of cinnamon or terebenthine. The fruits seem to be utilized by local peoples as condiment (ROBYNS & WILCZEK, 1951). For Cameroon, 41 species have been distinguished (FOUILLOY, 1974). It was not possible to relate the seeds and fruits, found at the market places under the name 'kanda', to specimens in the Herbarium of Yaoundé. Most herbarium specimens were without fruits. Likely, the seeds of several species are collected by the people. The following taxa are possibly used (teste FOUILLOY, 1974):

(8.1.1) **B. jacques-felixii** Robyns & Wilczek, in Bull. Jard. Bot. Etat Brux. *20*: 203 (1950).

The seeds are used as condiment.

(8.1.2) **B. louisii** Robyns & Wilczek, in Bull. jard. Bot. Etat Brux. *19*: 471 (1949).

Condiment with the taste of cinnamon (likely the seeds are meant).

(8.1.3) **B. mannii** (Meissner) Benth. & Hook. fil., in Gen. Pl. *3*: 158 (1880).

No information on the use is provided by FOUILLOY. Nevertheless, it is a well-known species of which the seeds are used as condiment (BUSSON, 1965). According to VOORHOEVE (1965), the cotyledons do not separate longitudinally in the seed but transversely. This is not the case in the seeds collected at the market places. Most seeds separate longitudinally. Nevertheless, certain ones do split longitudinally but have half way a kind of transverse traject as well. It is likely that the way in which cotyledons are separating from each other is a constant character for each species.

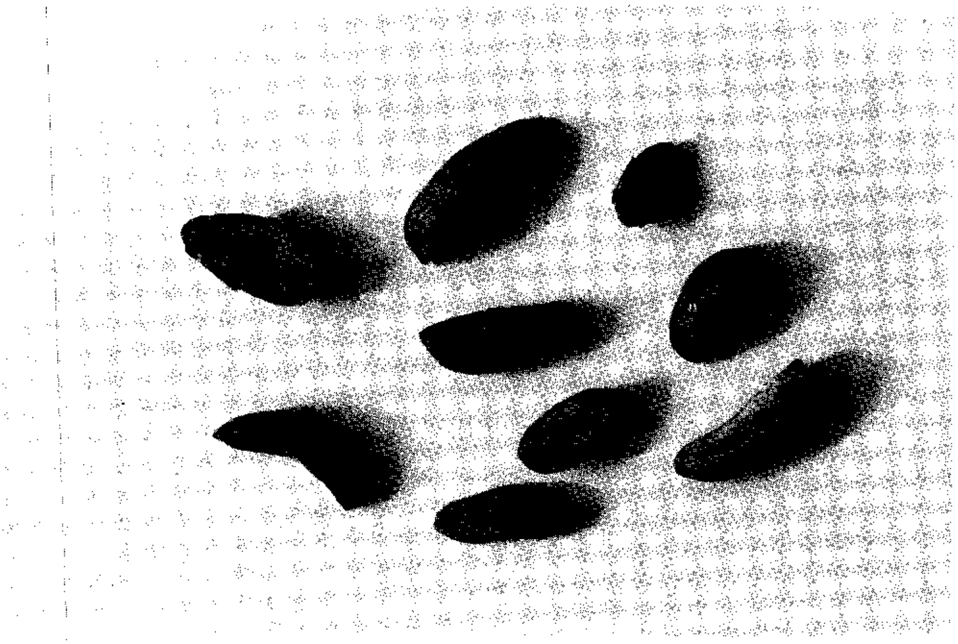
(8.1.4) **B. zenkeri** Engler, in Bot. Jahrb. *26*: 388, tab. 9 (1898).

Only the local name 'kanda' is given. This species is well represented in the Yaoundé Herbarium, often with the name 'kanda'. It is not unlikely that this species is often used by the local people.

Distribution of the species. Mostly in the South-Eastern and Central parts of Cameroon. Wild.

Names. Kanda, kandi, gimfu, gaala, mtamtou.

Uses. Dried cotyledons are crushed, giving a red-brownish flour. It becomes glutinous after adding water (MASSEYEFF, PIERMÉ & BERGERET, 1958). It is used as condiment in fish sauces (East province), and in other sauces as well (BUSSON, 1965; GRIMALDI & BIKIA, 1977; PELÉ & LE BERRE, 1966).



PHOT. 8. *Lauraceae*. Seeds of *Beilschmiedia* sp. (*WP 9150*).

Material. *WP 8773, 8784, 9033, 9150, 9308, 9795, 9875, 10020, 10149, 10150, 10171, 10206*. See photograph 8.

(9)MIMOSACEAE

(9.1) **Amblygonocarpus andongensis** (Welw. ex Oliv.) Exell & Torre, in Bol. Soc. Brot., ser. 2, *29*: 42 (1955). – Keay, in F.W.T.A. ed. 2, *1* (2): 492 (1958). – Brenan, in F.T.E.A., Leg. Mimosoideae: 32, tab. 9 (1959).
= *Tetrapleura andongensis* Welw. ex Oliv., in F.T.A. *2*: 331 (1871).
= *Amblygonocarpus schweinfurthii* Harms, in Engler Bot. Jahrb. *26*: 255 (1899).

Description. A tree, 6–25 m high, altogether glabrous. Leaves bipinnate; pinnae 2–5 pairs, opposite or subopposite, without glands between; leaflets alternate, broadly obovate-elliptic, emarginate at apex, glaucous, about 2,5 × 1,5 cm. Racemes usually paired, shortly pedunculate, about 7 cm long, pedicels 3 cm long; calyx very short, 5-toothed; corolla yellowish. Fruit tetragonal, pointed at apex, up to 15 cm long, about 2 cm broad, with a woody shiny pericarp. Seeds ovoid, compressed, hard, shiny dark brown, about 10 × 7 mm.

Distribution. North Cameroon in savannah area. Wild.

Name. Gono.

Uses. Seeds are fermented like those of *Parkia* spp., and used as a condiment (CHEVASSUS-AGNES, 1973).

Material. *Letouzey 3549, 6038, 6597; WP 9134, 9720.*

(9.2) **Parkia** R. Br., in Denh. & Clapp., Narr. Trav. Disc. Africa, App.: 234 (1826). – Gilbert & Boutique, in Fl. C.B. *3*: 141 (1952). – Aubréville, in Fl. For. C.I. ed. 2, *1*: 236 (1959). – Brenan, in F.T.E.A., Leg. Mimosoideae: 7 (1959). – Hagos, in Acta Bot. Neerl. *11*: 233 (1962).

Description of the genus. Trees without spines or prickles. Leaves bipinnate; leaflets about numerous; petiole usually glandular on its upperside. Inflorescences capitate, shortly claviform (with a globose apical part abruptly narrowed into a short cylindrical neck); heads stalked, solitary or paniculate. Flowers in upper part of heads hermaphrodite, in lower part male or neuter. Calyx gamesepalous, with 4–5 segments. Corolla with 5 petals, free or about united. Stamens 10, anthers glandular. Pods oblong to linear, straight or curved, dehiscent or not, usually about thick and often woody, or somewhat fleshy when living. Seeds ellipsoid to oblong, compressed.

A genus of about 40 species, widely distributed throughout the tropics; about 7 species in Africa and Malagasy. From at least 4 species in Africa, the seeds are used for food or as condiment:

- *P. bicolor* A. Chev., in Bull. Soc. Fr. 55, Mém. 8: 34 (1908).
- *P. filicoidea* Welw. ex Oliv., in F.T.A. *2*: 324, pro parte (1871).

These two species belong to the wetter regions, in particular in forest areas.

– *P. africana* R. Br., in Denh. & Clapp., Narr. Trav. Disc. Africa, App.: 234 (1826). = *P. clappertoniana* Keay, in Bull. Jard. Bot. Brux. *25*: 209 (1955).
– *P. biglobosa* (Jacq.) Benth., in Hook. Journ. Bot. *4*: 328 (1842).

These two species belong to drier areas. The last one is of particular interest and will be treated below.

(9.2.1) **P. biglobosa** (Jacq.) Benth., also Oliver, in F.T.A. *2*: 324 (1871).
– Keay, in F.W.T.A. ed 2, *1* (2): 487 (1958).
= *Mimosa biglobosa* Jacq., in Sel. Stirp. Am. Hist.: 267–8, tab. 179, fig. 871 (1763).

Description. Tree, up to 9–15 m high, with wide spreading crown. Leaves bipinnate; pinnae 8–30 pairs, alternate or opposite towards the apices of pinnae; rachis greyish-puberulous; leaflets 33–65 on each side of the pinna, oblong, asymmetrically truncate at base, about 18 × 3 mm. Inflorescences capitate, shortly claviform; heads stalked, pendent. Flowers reddish with short corolla lobes. Fruit oblong to linear, slightly curved, compressed, becoming woody at age, valves slightly depressed between the seeds, about 30 × 2 cm. Seeds oblong, compressed, shiny dark brown, 15 × 10 mm, embedded in yellowish pulp.

Distribution. North Cameroon. Wild.

Names. African locust bean, néré, nounoundjé, naredjé, kaloua (seed).

Uses. The pulp is edible. Seeds are decorticated, crushed and left to ferment, then dried and made into cigar-like structures or balls (dadaoua). It is then used to flavour sauces and has a penetrant odour (BUSSON, 1965; CHEVASSUS- AGNES, 1973; MASSEYEFF, CAMBON & BERGERET, 1959; PELÉ & LE BERRE, 1966).

Material. ?*Malzy 369; WP 9077, 9121, 9663, 9721, 9838.*

Note. MALZY (1954) reported that *P. filicoidea* is used in the same way in North Cameroon. DE WILDE collected *P. africana* in the North (teste *J. J. de Wilde 8749*).

(9.3) **Tetrapleura tetraptera** (Schumach. & Thonn.) Taub., in Bot. Centralbl. *47*: 395 (1891). – Gilbert & Boutique, in Fl. C.B. *3*: 218 (1952). – Keay, in F.W.T.A. ed 2, *1* (2): 493, tab. 157 (1958), – Brenan, in F.T.E.A., Leg. Mimosoideae: 32, tab. 8 (1959).
= *Adenanthera tetraptera* Schumach. & Thonn., in Beskr. Guin. Pl.: 213 (1827).

Description. A forest tree, up to 24 m high, with dark green foliage. Leaves bipinnate; pinnae 5–9 pairs; rachis slightly pubescent; leaflets 6–12 on each side of the pinna, oblong, rounded at each end, slightly pubescent beneath, about 17 × 5 mm. Axillary racemes solitary or more together, pedunculate, up to 7 cm long; flowers creamy or pink, turning orange. Fruit slightly curved, oblong, woody, rounded at apex, 15 cm long or more, glossy dark brown, with each valve with a longitudinal winglike rather fleshy ridge about 2 cm broad, the fruit in cross section about cruciform. Seeds oval-shaped, hard, dark-brown, about 7 × 3 mm. Fruit has a typical smell.

Distribution. South and West Cameroon in forest areas. Wild.

Names. Essessek, titjong, sanas, pa'ase.

Uses. Pieces of decorticated fruits are used as condiment in sauces (GRIMALDI & BIKIA, 1977; Hédin, 1930).

Material. *Bos 3158, 5995; Breteler 1050; Letouzey 3315; Mbarga 49; Mejou 1858 SRF Cam.; Mpom 15, 160, 502; Nana 109, 379, 487; WP 8715, 10033, 10187.*

(10) MORACEAE

(10.1) **Dorstenia scabra** (Bureau) Engl., in Monogr. Afr. Morac.: 20 (1898). – Rendle, in F.T.A. *6* (2): 51 (1917). – Keay, in F.W.T.A. ed. 2, *1* (2): 599 (1958).
= *D. psilurus* Welw. var. *scabra* Bureau, in DC. Prodr. *17*: 273 (1873). – Hauman, in Fl. C.B. *1*: 70 (1948).

Description. An erect, sparsely pubescent herb with red-brown roots, up to 1 m high; branches pubescent in the younger parts. Leaves ovate-elliptic, acuminate, mucronate, base obtuse, sometimes lobulate-toothed in the upperpart, up to 17 × 9 cm. Inflorescence solitary, axillary, with stalk about 1 cm long; receptacle narrowly elongate-triangular, becoming almost linear above the middle, keeled, held vertically, finely pilose on the stalk and keel, about 3,5 cm long, with a long slender awn above (up to 4,5 cm long), and a short basal awn (about 0,5 cm long); male and female flowers very small, the last ones few in the median line in the lower half, absent from the upper portion.

Distribution. South and West Cameroon in forest areas. Wild.

Names. Afousi, fouzi, woussi, kwenok.

Uses. Dried roots are crushed and used to flavour sauce and 'nkui' sauce in the Bamiléké region.

Material. *Biholong 267; Letouzey 2109, 5577, 9622, 11967; de Wilde & de Wilde-Duyfjes 1678; WP 8841, 9438, 9891, 9958, 9990, 9994, 10043, 10053.*
See photograph 9.

(11) PENTADIPLANDRACEAE

(11.1) **Pentadiplandra brazzeana** Baillon, in Bull. Soc. Linn. Paris *1*: 611 (1868). – Pax & K. Hoffmann, in Engler & Prantl., Nat. Pflanzenfam. ed. 2, *17b*: 206, tab. 114 (1936). – Hauman & Wilczek, in Fl. C. B. *2*: 480 (1951). – Keay, in F.W.T.A. ed 2, *1* (2): 651, tab. 182 (1958). – Villiers, in Fl. Cam. *15*: 164, tab. 36 (1973).
= *Cercopetalum dasyanthum* Gilg, in Engler Bot. Jahrb. *24*: 308, tab. 3 (1897).

Description. Arborescent shrub or climber with glabrous branchlets, up to 6–20 m long. Leaves elliptic-obovate, obliquely acuminate, attenuate at base, glabrous and with closely reticulate prominent venation on both surfaces, up to 12 × 6 cm. Inflorescences short; axillary and terminal racemes with conspicuous flowers on pedicels of about 1–2 cm; flowers male, female or hermaphrodite; bracts lanceolate, less than 1 cm; sepals nearly free, lanceolate; petals free, white or yellowish, with red spots towards the tips, up to 1,5 cm. Fruit ovoid-globose, markedly mucronate at top, red when mature, about 2,5 cm in diam.; pulp sweet, reddish. Seeds reniform, with dense woolly indumentum.

Distribution. Mostly in the wetter parts of Cameroon, e.g. West and South Cameroon. Wild.

Names. Kaouzi, djifeu, dzifa.

Uses. Dried, crushed roots are used to flavour taro sauce and 'nkui' (BERGERET, 1955). Also used medicinally (VILLIERS, 1973).

Material. *Breteler 710, 1036, 1900; Leeuwenberg 7377; Letouzey 2766, 3198, 3532, 4575, 5609, 9750, 10736, 12244; Nana 278; J. & A. Raynal 9742; de Wilde & de Wilde-Duyfjes 1146, 1641A, 1889B; WP 8838, 9893, 9959, 10011, 10018, 10044, 10045.*

(12) PERIPLOCACEAE

(12.1) **Mondia whitei** (Hook. fil.) Skeels, in Bull. U.S. Dep. Agric. Bur. Pl. Ind. no. *223*: 45 (1911). – Bullock, in Kew Bull. *15*: 203 (1961). – Bullock, in F.W.T.A. ed. 2, *2*: 82 (1963).
= *Chlorocodon whitei* Hook, fil., in Bot. Mag. *97*: tab. 5898 (1871). – N.E. Brown, in F.T.A. *4* (1): 255 (1904).

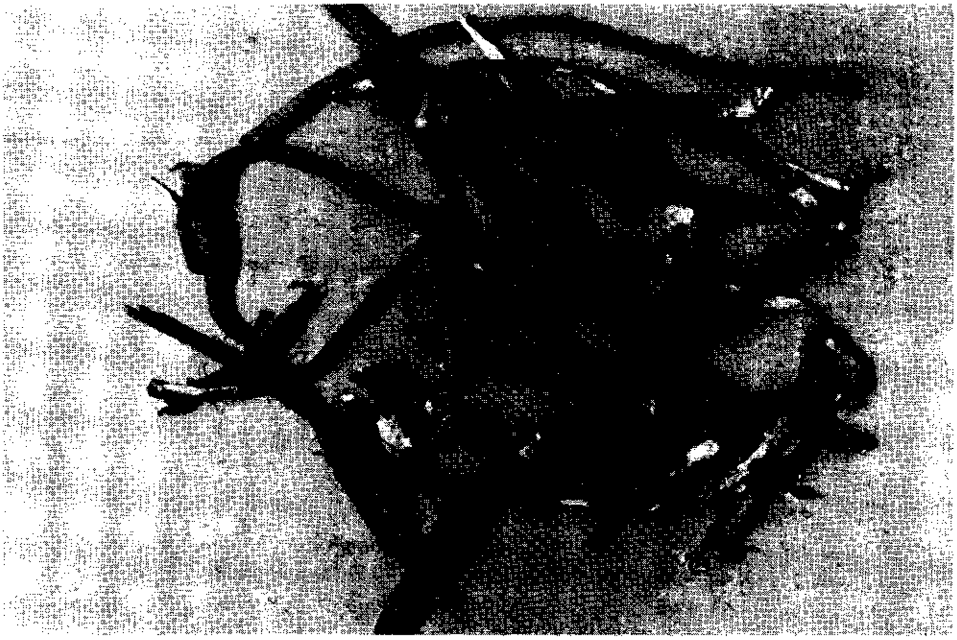
Description. A woody climber producing a milky juice, with a large tuberous rootstock. Stems twining, pubescent to glabrescent, with persistent stipular frills at the nodes. Leaves petiolate, broadly ovate-obovate, shortly acuminate, rounded to cordate at base, glabrescent, up to 20 × 15 cm, but often smaller. Flowers in lax, pedunculate, axillary panicles, up to 15 cm long; pedicel slender, up to 2 cm long, pubescent as is the peduncle; bracts small; calyx small, pubescent; corolla lobed almost to the base, pale greenish-white or cream, violet tinged inside. Follicles somewhat woody, lanciform, horizontally divaricate, up to 9 × 2 cm.

Distribution. In the drier forest areas of Cameroon, e.g. West and South Cameroon. Wild.

Names. Leuté, djefsé, limtsa.

Uses. The rind of the roots is dried, crushed and used to flavour 'nkui' and taro sauce. It has a sweet smell.

Material. *Biholong 186; Breteler 2947; Letouzey 2294, 4894, 4947, 7417; Ogu 178; de Wilde & de Wilde-Duyfjes 2621B; WP 8839, 9439, 9889, 9991, 9996, 10017, 10046, 10050.* See photograph 10.



Phot. 9. *Moraceae*. Roots of *Dorstenia scabra* (Bureau) Engler (*WP 9438*).

Phot. 10. *Periplocaceae*. Roots of *Mondia whitei* (Hook. fil.) Skeels (*WP 9439*).

(13) Piperaceae

(13.1) **Piper guineense** Schumach. & Thonn., in K. Danske Vid. Selsk. Nat. Mat. Afhandl. *3*: 39 (1828). – Baker & Wight, in F.T.A. *6* (1): 145 (1913). – Engler, in Mildbr. Deutsch. Zentr. – Afr. – Exp. 1907–1908, *2*: 177 (1914). – Balle, in Fl. C.B. *1*: 17 (1948). – Keay, in F.W.T.A. ed. 2, *1* (1): 84 (1954). – Raponda-Walker & Sillans, in Plantes utiles Gabon: 347 (1961).

Description. A glabrous climber, up to 9–12 m, on trees by means of adventitious rootlets. Leaves petioled, ovate, acuminate, equally or unequally cordate or cuneate at base, lateral nerves about 2 on each side of the lower half of the midrib, coriaceous, dark green, up to 12 × 7 cm. Inflorescence solitary, pendent, leaf-opposed or terminal, shortly peduncled, about 3 cm long, when in fruit up to 6 cm long; flowers small, unisexual, apparently sessile of nearly so. Fruits on pedicel, up to 5 mm long, globose, shortly mucronate, about 3–5 mm in diam., orange-red when rype, black when dry.

Distribution. In West an Southern Cameroon in forest areas. Wild, sometimes deliberately planted.

Names. West African black or Ashanti pepper, Guinea pepper, poivre de Guinée, poivre de brousse, poivre noir de l'Afrique Tropicale, sop, lobo, chitta.

Uses. Dried fruits used as condiment in meat sauce and 'nkui' (BERGERET, 1955; BUSSON, 1965; GRIMALDI & BIKIA, 1977; PELÉ & LE BERRE, 1966).

Material. *Bamps 1375; Biholong 745, 1135; Breteler 1348, 1490, 1732; Leeuwenberg 2433, 5756, 6366; Letouzey 1448, 4335, 7646, 9755, 11016, 11791, 12599, 14843, 14844; Nditapah 14; Ogu 171; J. & A. Raynal 9962; Surville 623; WP 8777, 8791, 8849, 9146, 9431, 9797, 9816, 9878, 9897, 9954, 9998, 10071.*

(13.2) **Piper nigrum** L., in Sp. Pl. ed. 1: 28 (1753). – Raponda-Walker & Sillans, in Plantes utiles Gabon: 348 (1961). – Purseglove, in Trop. Crops. Dicotyl. *2*: 442 (1968).

Description. A glabrous, perennial climber, up to 10 m high, in cultivation up to 4 m high, on supports by means of adventitious rootlets. Leafes petioled, ovate, acuminate, cordate or obtuse at base, lateral nerves about 2 on each side of the lower half of the midrib, coriaceous, dark green, up to 20 × 12 cm. Inflorescence solitary, pendent, leaf-opposed or terminal, shortly peduncled, about 3–15 cm long when in fruit; flowers small, unisexual or hermaphrodite (as in most cvs), sessile. Fruits sessile, globose, shortly mucronate, about 4–6 mm in diam., red when mature, black and shrivelled when dry. Black pepper is the dried fruit; white pepper is the seed enveloped in the white endocarp after fermentation and drying.

Distribution. South and West Cameroon. In West Cameroon, on small plantation scale. Cultivated.

Names. Pepper, poivre.

Uses. Both black and white pepper are ground and used in powdered form. It is used as a condiment and has many culinary uses. It is not often found at the market places, because there are plenty of other wild spices used by the local people. Black and white pepper are manufactured in Cameroon and sold in the shops (PELÉ & LE BERRE, 1966).

Material. *WP 9896, 9931, 9963, 10073.*

(14) RUTACEAE

(14.1) **Fagara** L., in Syst. ed. 10: 897 (1759). – Engler, in Engler & Prantl, Nat. Pflanzenfam. ed 2, *19A*: 217 (1931). – Letouzey, in Fl. Cam. *1*: 39 (1963).

Description of the genus. Trees, treelets and lianes, often with spines and with glands on leaves and fruits. Generally dioecious. Leaves compound, with more than 3 leaflets. Inflorescence an axillary or terminal panicle; flowers sessile or shortly pedicelled; ♂ flowers with 4–5 stamens; ♀ flowers with 4–5 staminodes or none, with gynoecium well developed. Fruit, a follicle (1–2), dry or slightly fleshy, generally 1-seeded. Seeds blue-black, often protruding from the mature fruit.

About 13 species are to be found in Cameroon, two of those give fruits used as condiment. It is possible that fruits from other *Fagara* spp. are used as well, but they were not found in the markets.

(14.1.1) **Fagara leprieurii** (Guill. & Perr.) Engler, in Engler & Prantl, Nat. Pflanzenfam. *3*, 4: 118 (1896). – Keay, in F.W.T.A. ed. 2, *1* (2): 686 (1958). – Gilbert, in Fl. C.B. *7*: 80 (1958). – Letouzey, in Fl. Cam. *1*: 66, tab. 7 (1963).
– *Zanthoxylum leprieurii* Guill. & Perr., in Fl. Seneg. *1*: 141 (1830). – Oliver, in F.T.A. *1*: 306 (1868).

Description. An understory forest tree, less than 15 m high; stems covered with large, broad based thornes having sharp points. Leaves up to 15–55 cm, composed of 4–8 pairs of leaflets; leaflets petiolulate, oblong to elliptic, often obliquely so, acuminate at top, cuneate at base, margins crenulate, with translucent glands scattered over the surface, nearly glabrous, up to 15 × 6 cm long. Flowers in small terminal fascicles, mainly on the lateral branches of the inflorescence, subsessile or shortly pedicelled, white; main axis and laterals puberulous to subglabrescent. Fruit globose, shortly pedicelled, glandulous, with small pits, brown, up to 5 mm in diam., mostly 1-seeded, commonly closed. Seed subglobose, very dark blue-black.

Distribution. West and Southern Cameroon. Wild.

Names. Minlam, melem.

Uses. Fruits are used crushed to flavour taro sauce. Frequently found in the Bamiléké region (GRIMALDI & BIKIA, 1977).

Material. *Breteler 1662; Letouzey 4378, 4876, 14233; Nana 105; de Wilde & de Wilde-Duyfjes 2625; WP 8710, 8778, 8909, 9147, 9421, 9896, 9936, 9955, 9993, 10002, 10024.* See photographs 11 and 13.

(14.1.2)**Fagara tessmannii** Engler, in Engler Bot. Jahrb. *46*: 406 (1911). – Letouzey, in Fl. Cam. *1*: 55, tab. 4 (1963). – Voorhoeve, in Lib. forest trees: 335, tab. 64 (1965).

Phot. 11. *Rutaceae. Fagara leprieurii* (Guill. & Perr.) Engler in flower (*WP 9993*).

Phot. 12. *Rutaceae. Fagara tessmannii* Engler in fruit (*WP 10055*).

Description. A medium-sized, armed tree, up to 40 m high. Leaves compound, up to 50–100 cm long; petiole 10–20 cm long, swollen at base, rachis slightly flattened; leaflets 10–30, subopposite, petioluled, ovate to oblong, acuminate at top, unequal sided at base, about cuneate, coriaceous, speckled with translucent glands, midrib prominent. Inflorescence a terminal panicle, much branched, with many flowers; pedicel and branched rachis puberulous, becoming nearly glabrous when in fruit; flowers unisexual, sessile, small, greenish-white. Fruit subglobular, glandular, dehiscent, opening with 2 coriaceous valves with rough surface, up to 5 mm in diam., 1-seeded. Seed protruding from the fruit, ovoid, slightly laterally compressed, dark shiny blue-black.

Distribution. West and Southern Cameroon. Wild, but sometimes planted.

Names. Nashou, na'ashou.

Uses. Fruits are used crushed to flavour 'nkui' sauce. Frequently found in the Bamiliéké region (GRIMALDI & BIKIA, 1977).

Material. *Jacques-Félix 8803; Letouzey 2438, 2548, 4449, 4841, 5901, 14698; Nana 36, 229; WP 8779, 8876, 9148, 9422, 9877, 9956, 10021, 10022, 10023, 10054; 10055.* See photographs 12 and 13.

Note. *F. macrophylla* (Oliv.) Engler is closely related to *F. tessmannii*. Further study is needed to verify whether both species ought to be combined (VOORHOEVE, 1965).

(15) SIMARUBACEAE

(15.1) **Irvingia gabonensis** (Aubry-Lecomte ex O'Rorke) Baillon, in Trait. Méd., Phan. *2*: 881 (1883). – Engler, in Engler & Prantl Nat. Pflanzenfam. ed. 2, *19A*: 398, tab. 187 (1931). – Aubréville, in Fl. Gabon *3*: 22 (1962). – Gilbert, in Fl. C.B. *7*: 115 (1958). – Keay, in F.W.T.A. ed. 2, *1* (2): 693 (1958).

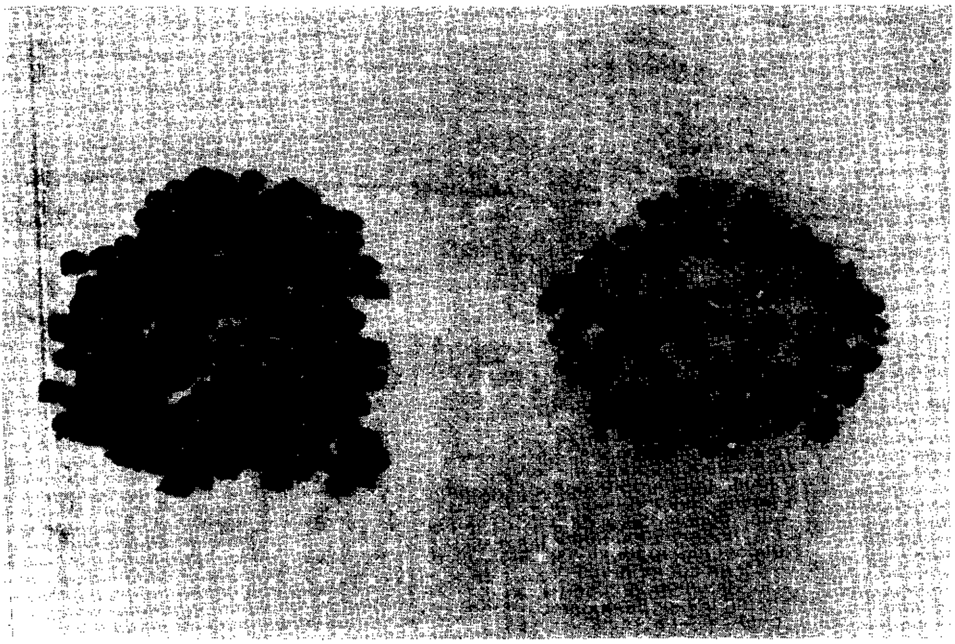
= *Mangifera gabonensis* Aubry-Lecomte ex O'Rorke, in Journ. Pharm. et Chim. *31*: 275 (1857).

Description. A forest tree, up to 35 m high with dark green shiny foliage; stems and branches grey-brown to brown. Leaves short-petioled, stiffly, obovate to elliptic, more or less cuneate or narrowly rounded at base, acuminate at top, prominently reticulate on both sides, dark green, up to 16 × 7 cm; stipules caducous. Flowers in short clustered, mostly axillary racemes or subpaniculate; pedicels slender, up to 5 mm long. Flowers small, greenish, fragrant. Fruits broadly ellipsoid, somewhat flattened, skin smooth, yellow when mature, fibrous fruit pulp and hard endocarp, about 5 cm long. Seedling with epigeal germination; cotyledons thick, purplish; first leaves papery-membranous.

Distribution. In forest areas of West and Southern Cameroon. Wild.

Names. Mangue sauvage, mban ndok, ndo, njaka.

Uses. The dried cotyledons are crushed and used to flavour different kinds of sauces (e.g. fish, meat). The fruit flesh is edible (BERGERET & MASSEYEFF, 1958; BUSSON, 1965; GRIMALDI & BIKIA, 1977; MASSEYEFF, CAMBON & BERGERET, 1959; MASSEYEFF, PIERMÉ



PHOT. 13. *Rutaceae*. Fruits of *Fagara leprieurii* (left) and *F. tessmannii* (right) (*WP 9421* and *WP 9422*, respectively).

& BERGERET, 1958; PELÉ & LE BERRE, 1966).

Material. *Bos 3205, 4188, 6635; Leeuwenberg 5218, 5256; Letouzey 4479, 11401, 11503; Mpom 254; Nana 92; Ogu 79; de Wilde & de Wilde-Duyfjes 2143; WP 9885, 10131.*

(16) SOLANACEAE

(16.1) **Capsicum annuum** L., in Sp. Pl. ed. 1: 188 (1753). – Wight, in F.T.A. *4* (2): 251 (1906). – Hepper, in F.W.T.A. ed. 2, *2*: 328 (1963). – Purseglove, in Trop. Crops Dicotyl. *2*: 527 (1968).

Description. A stout, much-branched herb, up to 0,5–1,5 m high, with angular, glabrous stems, cultivated as an annual. Leaves petioled, broadly lanceolate to ovate, acuminate at apex, cuneate or abruptly acute at base, glabrescent, up to 8 × 5 cm. Flowers solitary or in pairs, terminal, but because of form of branching appearing axillary; pedicel up to 1,5 cm long, swollen in upper part; calyx campanulate, 5-dentate, usually enlarging and enclosing base of fruit; corolla campanulate, 5-lobed, 8–15 mm in diam., white or greenish. Fruit a more or less elongated berry, pendent or erect, subglobose to conical, sometimes wrinkled, usually produced singly, 1–30 cm long, red, orange, yellow, brown, cream or purplish when mature; seeds 3–5 mm long, pale yellow.

Distribution. Found every where in Cameroon. Cultivated. The most important spice.

Names. Ondondo, piment, chillies.

Uses. Sweet peppers have the mildest flavour with little of the pungent principle; they are eaten raw in salads and cooked in various ways. Chillies are the dried ripe fruits of pungent forms of *C. annuum* and sometimes *C. frutescens*. In its powdered from, it constitutes red or cayenne pepper. Both chillies and cayenne pepper are used for culinary purposes and for seasonings. African chillies are very pungent. They are found at every market in Cameroon (BEBEY EYIDI, PIERMÉ & MASSEYEFF, 1961–62; BERGERET, 1955; BERGERET & MASSEYEFF, 1958; GRIMALDI & BIKIA, 1977; MASSEYEFF, CAMBON & BERGERET, 1958; MASSEYEFF, CAMBON & BERGERET, 1959; MASSEYEFF, PIERMÉ & BERGERET, 1958; PELÉ & LE BERRE, 1966; PURSEGLOVE, 1968; TESSMANN, 1913).

Material. *Dang 353; WP 9666, 9713, 9808, 9820, 9923, 9924, 9961, 9962, 9984, 9985, 10081* (flowers white, single; fruits red, not wrinkled, pendent); *WP 9824, 9825, 9851, 9852, 10097, 10098, 10112* (flowers greenish, not small, in groups; fruits red or orange-yellow, wrinkled, usually in pairs, pendent).

Note 1. The second group consists of annual plants with very pungent fruits, especially the yellow-orange ones. They are frequently found at the market places.

Note 2. For the names employed for the cultivated species of *Capsicum*, see HEISER & PICKERSGILL (1969).

(16.2) **Capsicum frutescens** L., in Sp. Pl. ed. 1: 189 (1753). – Wight, in F.T.A. *4* (2): 251 (1906). – Hepper, in F.W.T.A. ed. 2, *2*: 328 (1963).

Description. A perennial subshrub, much-branched, very similar to *C. annuum* but readily distinguished by its more or less shrubby habit. Flowers generally more than 1 per cluster, smaller than those of *C. annuum*, with pedicels long, thickened upwards, erect and slightly bent at the apex; corolla white or pale yellowish-green. Fruits usually 2 or more from each flower cluster, erect, much smaller than in *C. annuum* and rarely exceeding 2 cm in length, conical, red or yellow when mature, extremely pungent.

Distribution. Found everywhere in Cameroon. Cultivated.

Names. Ondondo beloa, pili-pili.

Uses. See under *Capsicum annuum* for information on pungent peppers.

Material. *Breteler 349; Dang 83; SRF/Cam 16028, 16034, 16139; WP 8721, 9436, 9650, 9664, 9827, 9828, 9844, 9861, 9862, 10082, 10084, 10099, 10100, 10109, 10110, 10111, 10144, 10145, 10146.*

(16.3) **Solanum gilo** Raddi, in Atti Soc. Ital. Sci. Modena *18*: 31 (1820). – Bitter, in Fedde Rep. *16*: 48 (1923). – Hepper, in F.W.T.A. ed. 2, *2*: 332 (1963).

Description. Herb, up to 1 m, because of lateral branching flattened above, with copious stellate indumentum. Branches green turning greyish when older. Leaves with petiole grooved above, ovate to obovate, oblique at base, acuminate at top, with marked lobes up to 2 cm and acuminate, main veins densely pubescent as is the underside of the leaf, up to 18 × 10 cm. Inflorescence axillary, with 1–5 flowers, but generally 1–2, short-peduncled. Flowers pubescent, with pedicel about 1 cm long; calyx campanulate with lanceolate lobes, up to 8 mm long; corolla whitish, up to 1 cm. Fruit globular (up to 3 cm in diam.) or ellipsoid (up to 4 cm long), more or less shiny, slightly rough to the touch, turning bright red or orange-red when mature (never white, violet or yellow), many seeded. Seed kidney-shaped, flattened, yellow, 3 mm long.

Distribution. In the Western part of Cameroon, in particular the Bamiléké region. Cultivated.

Names. Gedjo, nguejo, nsube, sebo.

Uses. Dried fruits, being bitter, are used to flavour sauces, e.g. taro sauce and 'nkui'.

Material. *WP 8725, 8846, 8852, 9418, 9426, 9526, 9596, 9621, 9634, 9635, 9641, 9642, 9653, 9654, 9884, 10028; Nr 2245 SRF Cam.* See photograph 14.

Note. According to HEPPER (1963), *Solanum gilo* var. *gilo*, *S. gilo* var. *piereanum* (Paillieux & Bois) Bitter, *S. incanum* L., *S. melongena* L. var. *melongena*, and *S. melongena* var. *inerme* Dunal are closely related. They all have inflorescences lateral, axillary, extra-axillary or leaf-opposed, stellate indumentum (always fairly copious), and flowers subsolitary to about 4 together. The flowers in *S. gilo* are white, with corolla 12–16 mm in diam., whereas in the other 2 species flowers are almost purple-

PHOT. 14. *Solanaceae.* Different fruit types of *Solanum gilo* Raddi (left: *WP 9418*; right: *WP 9426*).

violet (rarely white), with corolla up to 3 cm in diam. The relationships between these cultivated taxa need further study.

(17) ZINGIBERACEAE

(17.1) **Aframomum** K. Schum., in Engler Pflanzenr. *4*, 46: 201 (1904). – Koechlin, in Fl. Cam. *4*: 42 (1965).
= *Amomum* L., pro parte, in Sp. Pl. ed. 1: 1 (1753). – Baker, in F.T.A. *7*: 302 (1898).

Description of the genus. Perennial, rhizomatous, aromatic herbs, up to several m high. Leafy shoots erect, formed of long leafsheaths, distichous; lamina often subsessile, linear to lanceolate, acuminate at top, attenuate or round and sometimes asymmetrical at base, glabrous or sometimes pubescent at underside, 20–80 × 1,5–8 cm; ligule more or less developed, sometimes membraneous, entire or bifid. Inflorescence a spike (simple or capituliform) or a raceme (with one or more flowers per spike), borne at the base of a leafy shoot or on a rhizome, on peduncles widely varying in length; the different parts covered with imbricate bracts, sometimes reddish-tinged. Flowers often large, fragile, pink, red, yellow or white; calyx tubular, membranous, often splitted laterally; corolla small-tubed, trilobed, with upper lobe well-developed, oblong, with lateral lobes smaller, narrower, triangular. Labellum often large and showy, semi funnel-shaped with expanded limb and undulating edges, sometimes longly ligulate with crisped edges. Lateral staminodes absent or reduced to denticles. Stamen with short filament; anthers long; connective appendaged, generally 3-lobed. Style enlarged above anthers into a cupular stigma. Fruit a berry, ovoid, generally red when mature, sometimes with a sterile beak. Seeds numerous, often very aromatic, arillate, enveloped in a sour-tasting pulpe, varying in shape (angular, globose, ellipsoid, hook-shaped) and colour (black to pale grey or various shades of brown); surface smooth, striate or tuberculate.

About 50 species are found in tropical Africa, of which 20 are listed in the Flora of Cameroon (1965). The seeds of several species are used as a condiment.

The genus *Aframomum* presents many problems (BURTT & SMITH, 1972; LOCK & HALL, 1973; LOCK & HALL, 1975).

Note 1. Collecting complete plants. Many collections consist of detached inflorescences with small pieces of leafy stem, because the plants are often large. Some species produce flowers on rhizomes, remote from the leafy shoots and, if other species of *Aframomum* are growing alongside, mixed gatherings are readily made. Flowers are ephemeral, fragile and difficult to preserve and their structure tends to be lost in drying. There is also the problem of the old names which were given to specimens consisting only of fruits and seeds because of their former importance in pharmacy as 'grains of paradise'. Such material was often of uncertain origin, and the names have often been misapplied, or applied to several taxa, by later authors (teste Hepper, 1967–1968). It is therefore important to study the living plants in their natural habitat. Besides, leaves, flowers and fruits should be very carefully correlated by collectors.

Note 2. Characters to distinguish genera and species. The sterile appendage at the apex of the anther connective is not always 3-lobed in *Aframomum*, and entire or absent in *Amomum* L., as was conceived by Schumann (1904) in distinguishing the 2 genera. In *Aframomum* the fruit is always fleshy and indehiscent, while in *Amomum* it tends to be dry and dehiscent. The fruit of *Aframomum* is not always flask-shaped, neither does it always have a long sterile beak. The absence of a common morphological origin for the beak (being the solid base of the corolla tube, either the solid sterile apex of the ovary, or the accrescent calyx) makes it of doubtful value in defining the genus.

Other useful characters in distinguishing the species of *Aframomum* may be the vein spacing and the indumentum of the leaves, the pattern on the leafsheaths (smooth, longitudinally ridged, with a reticulate pattern, often with small gland-like hairs), the degree of dehiscence of the anthers, the structure of the nectaries at the base of the style, and the form, colour and surface pattern of the seeds.

The following species are used as condiment in Cameroon:

(17.1.1) **Aframomum citratum** (Pereira ex Oliv. & Hanb.) K. Schum., in Engler Pflanzenr. *4*, 46: 214 (1904). – Koechlin, in Fl. Cam. *4*: 54, tab. 11, p.p. (1965). – Hepper, in F.W.T.A. ed. 2, *3* (1): 76 (1968).
= *Amomum citratum* Pereira, in Pharm. Journ. Trans. ser. 1, *9*: 313–314 (1849–50), nomen nudum. – Oliver & Hanbury, in Journ. Linn. Soc. Lond. *7*: 110 (1864). – Hooker fil., in Icon. Pl. *25*: tab. 2478 (1896).

Description. A herb, up to 4 m high, reddish when young. Lamina petiolate, with 'petiole' up to 2 cm long, rounded at base, asymmetrical; ligule membraneous, bifid, up to 2,5 cm, with lobes acute. Inflorescence a spike (capituliform), globose, many-flowered, shortly peduncled, at base of leafy shoot, with large, imbricate, reddish bracts. Corolla mauve; dorsal lobe oblong, up to 5 cm long; lateral lobes lanceolate. Labellum mauve, spreading, 7 × 5 cm. Fruit ovoid, about 3 cm long, with persistent calyx at least the same length. Seeds oblong, angular, about 5 mm long, with surface striate to slightly tuberculate.

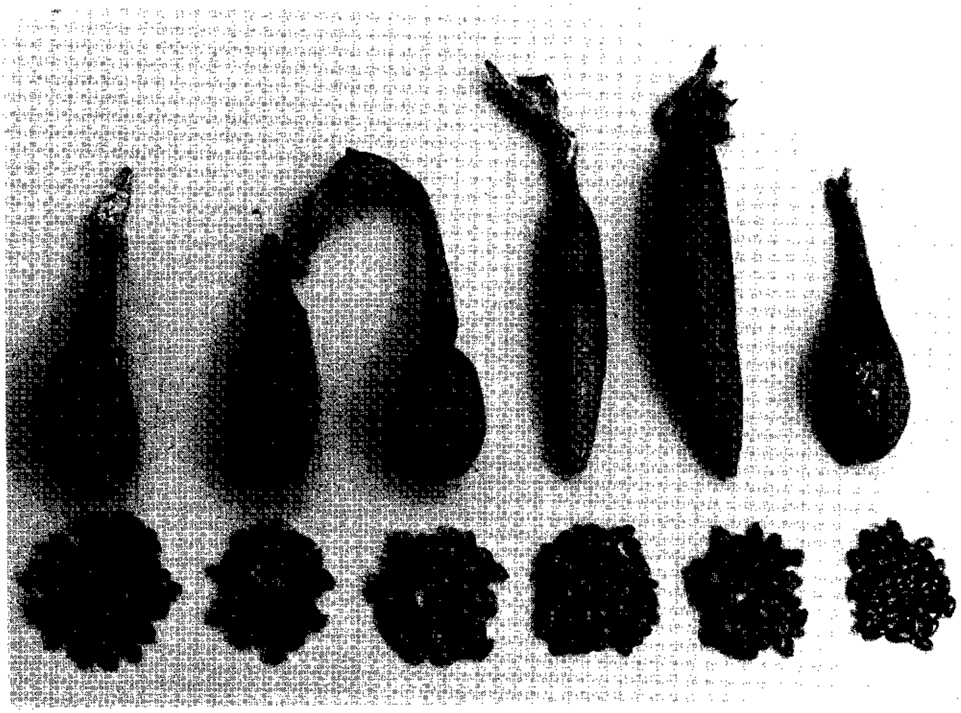
Distribution. In forest region, in particular in the Bassa region of South Cameroon. Wild.

Names. Maniguette odorante, mvonlo, mbak, bakim, etutu.

Uses. Crushed seeds are used to flavour sauces (e.g. fish sauce). It is also used as medicin (GRIMALDI & BIKIA, 1977).

Material. *WP 8704, 9156, 9627, 9869, 10197, 10198, 10199, 10200, 10211, 10212, 10213*. See photograph 15.

(17.1.2) **Aframomum latifolium** (Afzel.) K. Schum., in Engler Pflanzenr. *4*, 46: 209 (1904). – Hepper, in F.W.T.A. ed. 2, *3* (1): 77 (1968).
= *Amomum latifolium* Afzel., in Remed. Guin. Coll. I: 5 (1813). – Baker, in F.T.A. *7*: 305 (1898).



PHOT. 15. *Zingiberaceae*. Different fruits of *Aframomum* K. Schum. species. From left to right: *A. melegueta* (Rosc.) K. Schum. (*WP 8701*); ?*A. sulcatum* (Oliv. & Hanb.) K. Schum. (*WP 9160*); *A. citratum* (Pereira ex Oliv. & Hanb.) K. Schum. (*WP 9156*); *A. letestuanum* Gagnepain (*WP 9157, WP* 9161); ?*A. daniellii* (Hook fil.) K. Schum. (*WP 9158*).

= ? *Aframomum kayserianum* (K. Schum.) K. Schum., in Engler Pflanzenr. *4*, 46: 210 (1904). – Koechlin, in Fl. Cam. *4*: 66, tab. 14, 5–6 (1965).

= *Amomum kayserianum* K. Schum., in Engler Bot. Jahrb. *15*: 415 (1892)

= *Aframomum alboviolaceum* (Ridl.) K. Schum. ssp. *latifolium* (K. Schum) Lock: nomen nudum (1976).

Description. A herb, up to 3 m high. Lamina petioled, acute to shortly tailed at apex, rounded at base, up to 20 × 5 cm; ligule short. Inflorescence short, up to 10 cm long, with several flowers, pedunculate, arising separately on creeping rhizome. Flowers white or slightly pinkish. Fruits ovoid, up to 7 cm long, shortly beaked.

Distribution. Possibly, it is a species of the savannah regions of Cameroon. Wild. The leaves presented at the markets are cultivated around the houses (e.g. the Lékié region North of Yaoundé).

Name. Odjom.

Uses. Leaves are used as condiment in the preparation of dishes.

Material. ? *Surville 585; WP 8742, 9287, 9613.*

Note 1. TESSMANN (1913) mentions *A. alboviolaceum* (plant: adzom; fruit: esun)

PHOT. 16. *Zingiberaceae.* Fruits of *Aframomum melegueta.*

with edible fruits. He added that this fruit belongs to the category 'good for blackmen, no good for whitemen'. PELÉ & LE BERRE (1966) refer to a species (plant: adzom; fruit: esson) of which the fruits are edible. No reference is made to the use of the leaves.

Note 2. Under the name 'adjom' two types of plants were collected from the wild around Akonolinga, the leaves of which are used as condiment. They grow on wet places and are collected when either young or older. Plants without flowers and fruits were found, which makes identification difficult. Material: *WP 10218 – WP 10228.*

(17.1.3)**Aframomum letestuanum** Gagnepain, in Bull. Soc. Bot. France *55*: 37 (1908). – Koechlin, in Fl. Cam. *4*: 60, tab. 13, 1–4 (1965).

Description. A waxy herb, up to 3 m high. Lamina sessile, auriculate at base, longely acuminate at top, 20–40 × 3–10 cm; ligule nearly absent. Inflorescence a raceme, arising at base of leafy shoots, with main axe 0,5–1 m long, with long side branches having 1-flowered spikes arranged distichously, covered with bracts up to 6 cm long; bracts of spikes smaller, reddish tinged at top; calyx up to 3,5 cm long, red-violet at top; corolla light violet; dorsal lobe elliptic, 6 × 3 cm; lateral lobes triangular, 5 × 1 cm. Labellum light violet, oval, 6 × 4–6 cm. Fruit fusiform, up to 10 cm long, with large sterile apex (calyx) at top of about 5 cm long, smooth when mature and pink with dark pink blotches, slightly ribbed when dried and brown. Seeds pyramidal to angular, up to 4 mm long, brown, slightly striate to tuberculate, with a sweet taste.

Distribution. In forest regions of Cameroon. Fresh mature fruits infrequently found at the market places of South Cameroon. Wild but also sometimes cultivated (e.g. Bamiléké region).

Name. Ndidim.

Uses. Seeds are used as spice, stimulant and medicinally.

Material. ? *Letouzey 5396, 10676; WP 8708, 8759, 9157, 9161, 9624, 9761, 9870, 9901, 9921, 10037, 10038, 10105, 10133, 10162, 10174, 10175, 10176, 10177, 10207.* See photograph 15.

Note 1. KOECHLIN (1965) describes *A. pruinosum* Gagnepain as being pruinose, whereas *A. letestuanum* is not. The last species has auricles at the base of the lamina, the first one longely acuminate apices. The fruit is fusiform for *A. pruinosum*, whereas no fruit has been described by KOECHLIN for *A. letestuanum*. Specimens *WP 10133* and *10162*, however, are pruinose, have auriculated lamina with longely acuminate apices, and fusiform fruits. The description for both species given by KOECHLIN is based on a few specimens (2 for each). Moreover, the description of *A. pruinosum* is based on complete plants, whereas that of *A. letestuanum* is not (teste KOECHLIN). It seems doubtful whether 2 species are involved. Possibly they should merge into one and, if desirable, differences between them may be recognized at a lower taxonomic level.

Note 2. Recent studies of J. C. A. M. LEESBERG in 1979, by comparing specimens collected in West and Central Africa (including Cameroon) with the type material as described by GAGNEPAIN, provided further evidence that *A. letestuanum* and *A. pruinosum* possibly belong to one species. Further studies to verify several characters mentioned by GAGNEPAIN at living material are required before definite conclusions can be drawn.

(17.1.4) **Aframomum melegueta** (Rosc.) K. Schum., in Engler Pflanzenr. *4*, 46: 204 (1904). – Baker, in F.T.A. *7*: 303 (1898). – Koechlin, in Fl. Cam. *4*: 68, tab. 14, 1–4 (1965). – Hepper, in F.W.T.A. ed. 2, *3* (1): 76 (1968).
= *Amomum melegueta* Roscoe, in Monandr. Pl.: tab. 98 (1828).

Description. A herb, up to 2 m high. Lamina sessile, narrow, tailed at top, 20 × 3 cm; ligule very small, truncate. Inflorescence a spike, 1(–2)-flowered, at the base of the leafy shoot, up to 14 cm long; calyx about 4,5 cm long; corolla pink or mauve, with tube 5 cm long; dorsal lobe oblong, up to 4 cm long; lateral lobes smaller, lanceolate. Labellum fan-shaped, mauve, with yellow mark near the base, up to about 8 cm long. Fruit ovoid, up to 5 cm long, red when mature, with a sterile beak of about 4 cm long. Seeds globular to ovoid, with a beak-shaped hilum, about 4 mm long, brown, with granular surface.

Distribution. In the wetter parts of Cameroon. Cultivated and presumably also wild.

Names. Grains of paradise, melegueta pepper, maniguette piquante, graine-de-Paradis, ndong, sok, mbongo.

Uses. The seeds are pungent and are used as a condiment, stimulant and as medicin as well (GRIMALDI & BIKIA, 1977; LOCK, HALL & ABBIW, 1977; PELÉ & LE BERRE, 1966; PURSEGLOVE, 1972; VAN HARTEN, 1970).

Material. *Dang 284; Letouzey 1017, 2128; WP 8701, 8769, 8774, 8823, 9127, 9159, 9369, 9444, 9496, 9559, 9572, 9625, 9764, 9765, 9768, 9868, 9920, 10135, 10229.* See photographs 15 and 16.

(17.1.5) **Aframomum polyanthum** (K. Schum.) K. Schum., in Engler Pflanzenr. *4*, 46: 207 (1904). – Koechlin, in Fl. Cam. *4*: 49, tab. 9, 4 (1965). – N. Hallé, in Adansonia, Sér. 2, *7*: 73, tab. 1 & 2 (1967). – Hepper, in F.W.T.A. ed. 2, *3* (1): 75 (1968).
= *Amomum polyanthum* K. Schum., in Engler Bot. Jahrb. *15*: 411 (1892).

Description. A herb, up to 3–4 m high. Lamina petioled, pubescent, 55 × 15 cm; ligule up to 1 cm long. Inflorescence capituliform, with many small flowers up to 3,5 cm long, pedunculate, peduncle 15–25 cm long, with papery bracts hardly imbricate, up to 3 cm long and reddish-tinged; calyx 3 cm long; corolla with small lobes; lobes red, up to 1 cm long. Labellum about 2,5 × 3 cm, yellowish with red stripes, with edges undulating. Fruits in starlike clusters, longitudinally ribbed, bright red or dark red-violet, 5 × 3 cm, with a small sterile beak. Seeds hook-shaped or more or less straight, pointed and curved at the apex, with beak-shaped hilum, about 10 mm long, slightly glossy with tuberculate surface.

Distribution. In the wetter parts of Cameroon. Wild.

Names. Tsona, choco.

Uses. The fruit pulp is sweet and edible. The seeds are sometimes used as condiment.

Material. *Breteler 588; Letouzey 1830, 3725; J. & A. Raynal 12060; WP 9162, 10006, 10155, 10168, 10169, 10185.*

(17.1.6) **Aframomum** spp. Several other species of *Aframomum* have been found in market places for use as condiment or as medicin as well. The identification proved to be difficult and further study is necessary. The following taxa can be distinguished, according to KOECHLIN's key of *Aframomum* in Cameroon (1965):

(a) 'Essong'. Wild growing plant in southern Cameroon. Flowers with red petals; labellum narrow, orange-reddish. Fruits bright red, smooth, up to about 6 cm long. Seeds ellipsoid, shiny brown-black, up to 5 mm long. Possibly, this is *A. daniellii* (Hook. fil.) K. Schum.

Material. *WP 9041, 9158, 9623, 10163, 10164, 10165, 10166, 10167, 10201.* See photograph 15.

(b) 'Cho', 'choco', 'chokwoup', 'chèchou'. Wild growing plant found in Bamiléké region of Western Cameroon. Flowers with orange-yellow petals; labellum narrow, whitish. Fruits bright red, smooth, up to 6 cm long. Seeds ellipsoid, shiny brown-black, up to 5 mm long. It strongly resembles 'essong'. Possibly, this is *A. hanburyi* K. Schum.

Material. *WP 10003, 10152, 10161, 10186, 10208.*

(c) 'Chouoko', 'chonco', 'choco'. Cultivated in the Bamiléké region, but probably also wild. Flowers pale mauve. Fruits ovoid, bright red, deeply longitudinally furrowed, up to 6 cm long. Seeds ovoid, slightly angular, slightly shiny brown, up to 4 mm in diam. Possibly, this is *A. sulcatum* (Oliv. et Hanb.) K. Schum.

Material. *WP 10154, 10156, 10161, 10178, 10179, 10180, 10182, 10183, 10184, 10209.*

(d) 'Bongo balim', 'mbongo balim'. Cultivated in the Bassa region, but probably also found wild. Flowers pale mauve. Fruits ovoid, bright red, deeply longitudinally furrowed, up to 6 cm long. Seeds angular, brown, up to 5 mm long. It resembles 'chouoko', but the seeds are not ovoid, but clearly more angular.

Material. *WP 8705, 8706, 9160, 9871, 10153, 10157, 10192, 10193, 10194, 10195, 10196, 10214, 10215, 10216, 10217.* See photograph 15.

(17.2) **Zingiber officinale** Rosc., in Trans. Linn. Soc. *8*: 348 (1807).
- Koechlin, in Fl. Cam. *4*: 23 (1965).
= *Amomum zingiber* L., in Sp. Pl. ed. 1 : 1 (1753).

Description. A slender, aromatic, perennial herb, up to 1 m high. Rhizome thick and hard, laterally compressed, often palmately branched, pale yellow within, covered with distichous scales. Leafy shoots annual, erect, formed of long leafsheaths, glabrous except for short hairs near base of each leafblade, usually bearing 8–12 distichous leaves; lamina sessile, linear to lanceolate, acuminate at top, attenuate at base, thin, dark green, about 20 × 2 cm; ligule membranous, bilobed, about 5 mm long. Inflorescence rarely present, arising directly from rhizome, spiciform; peduncle up to 20 cm long, covered with bracts; spike cylindrical, cone like, up to 7 cm long, bracts appressed, ovate, reddish-tinged, up to 2,5 cm long, with translucent markings. Flowers produced singly in axil of each bract, fragile, bracteolate; calyx spathaceous, up to 1 cm long; corolla tube about 2 cm long with 3 yellowish lobes, with upper lobe 1,5–2,5 cm long, curved over the anther, with side lobes smaller. Labellum oblong, over 1 cm long, purple with cream blotches. Stamen shortly filamented; anthers 9 mm long with connective prolonged into a slender curved beaklike appendage, 7 mm long, containing upper part of style. Stigma protruding just below apex of appendage. (Fruit, seldom produced, a thinwalled capsule, with small black arillate seeds.)

Distribution. In the wetter parts of Cameroon. Cultivated.

Names. Ginger, gingembre, ndjindja.

Uses. The dried rhizomes, which may be scraped or peeled before drying, constitute the spice, and is esteemed for its flavour, pungency and aroma. African ginger is darker in colour and lacks the fine aroma but is very pungent. It is widely used in local medicine (GRIMALDI & BIKIA, 1977; PELÉ & LE BERRE, 1966; PURSEGLOVE 1972).

Material. *WP 9454, 9750, 9895, 10090, 10106, 10107; WP 10158, 10230* (flowers).

6. DISCUSSION AND CONCLUSIONS

The majority of the spices treated concerns wild growing plants. Most of them are found in the wetter parts of Cameroon, in particular in the western and the southern regions of the country.

Of all the spices, including cultivated taxa, the *Capsicum* peppers are the most important. They are found in every market. Only the variation they display differs from place to place.

Noteworthy are the plants which are used because of the garlic odour they display (bark, fruit, seed). They are found in the *Caesalpiniaceae*, *Huaceae*, and *Olacaceae*. Still there is the cultivated garlic, *Allium sativum*, which is usually grown on higher elevations.

Roots are particularly favoured in the Bamiléké region for seasoning sauces. At least 5 taxa were found belonging to the *Compositae*, *Cyperaceae*, *Moraceae*, *Pentadiplandraceae*, and *Periplocaceae*.

Also barks have been found, with 1 taxon dominating the scene: *Scorodophloeus zenkeri*. However, other barks are used as well, but less frequent and have not been identified.

Although the wealth of spices used is remarkable, it is likely that in the future cultivated spices will become more dominant because of changes in life caused by modernization. Then, spices like nutmeg, cinnamon, vanilla, pepper and ginger may become more prominent at the expense of the currently used wild spices. It is also thinkable that some wild spices, like *Piper guineense*, are taken into cultivation and improved by selection and breeding. A summary of the spices treated, arranged according to the part (s) of the plant used, has already been given in Table 2.

7. ACKNOWLEDGEMENTS

Thanks are due to:

- Dr. G. BOL ALIMA, director-general of the University Centre of Dschang, Cameroon, for permission to publish the results of this study;
- the Director and Staff of the National Herbarium of Cameroon, Yaoundé, for their help and the facilities provided;
- Messrs P. DEHOK and A. NLOGA, ENSA, Nkolbisson, for collecting plant specimens and information on the occurrence of spices.

8. LITERATURE

AUBRÉVILLE, A. (1970). Légumineuses (Césalpinioïdées), in Flore du Cameroun **9**. Paris.

BAAS, P. (1972). Anatomical contributions to plant taxonomy II. The affinities of *Hua* Pierre and *Afrostyrax* Perkins & Gilg. Blumea **20**: 161–192.

BEBEY EYIDI, R., M. L. PIERMÉ & R. MASSEYEFF (1961–1962). Une enquête sur l'alimentation à Douala (quartier New-Bell). Rech. & Etud. Cam. **5**: 3–45.

BERGERET, B. (1955). Les marchés Bamiléké de saison sèche. Orstom (Ircam). Yaoundé.

BERGERET, B. & R. MASSEYEFF (1958). La vitamine C dans les fruits et légumes du Sud-Cameroun. Qual. Plant. Mater. veget. **3-4**: 192–201.

BURTT, B. L. & R. M. SMITH (1972). Key species in the taxonomic history of *Zingiberaceae*. Notes Roy. Bot. Gard. Edinburgh **31**: 177–228.

BUSSON, F. (1965). Plantes alimentaires de l'Ouest Africain. Paris.

CHEVALIER, A. (1947a). La famille des *Huaceae* et ses affinités. Rev. Int. Bot. appl. Agric. trop. **27** (291-292): 26–29.

CHEVALIER, A. (1947b). Les arbres à ail d'Afrique équatoriale. Rev. Int. Bot. appl. Agric. trop. **27** (291-292): 22–25.

CHEVALIER, A. (1947c). Arbres à ail, Huacacées et Styrax à benjoin. Rev. Int. Bot. appl. Agric. trop. **27**. (299–300): 401–407.

CHEVASSUS-AGNES, S. (1973). Alimentation et nutrition lipidique des Bayas de l'Adamaoua. Orstom. Yaoundé.

COBLEY, L. S. & W. M. STEEL (1976). An introduction to the botany of Tropical Crops. 2nd ed. London.

DALZIEL, J. M. (1955). The useful plants of Tropical West Africa. 2nd printing. London.

FOUILLOY, R. (1974). Lauracées, Myristicacées, Monimiacées, in Flore du Cameroun **18**. Paris.

GRIMALDI, J. & A. BIKIA (1977). Le grand livre de la cuisine camerounaise. Yaoundé.

HAGOS, T. H. (1962). A revision of the genus *Parkia* R. Br. (*Mim.*) in Africa. Acta Bot. Neerl. **11**: 231–265.

HALLÉ, N. (1967). *Aframomum polyanthum* (K. Schum.) K. Schum. et *Costus dinklagei* K. Schum. Adansonia sér. 2, **7** (1): 73–80.

HARTEN, A. M. van (1970). Melegueta pepper. Econ. Bot. **24**: 208–216.

HÉDIN, L. (1930). Etude sur la forêt et les bois du Cameroun sous mandat français. Paris.

HEISER, C. B. & B. PICKERSGILL (1969). Names for the cultivated *Capsicum* species (*Solanaceae*). Taxon **18**: 277–283.

HEPPER, F. N. (1967–1968). The identity of grains-of-paradise and melegueta pepper (*Aframomum*, *Zingiberaceae*) in West Africa. Kew Bull. **21**: 129–137.

JACQUES-FÉLIX, H. (1940). L'Agriculture des noirs au Cameroun: enquête sur les plantes cultivées, sur les outils agricoles et sur les greniers. Revue Bot. appl. Agric. trop. **20** (232): 815–838.

KOECHLIN, J. (1965). Scitaminales, in Flore du Cameroun **4**. Paris.

LETOUZEY, R. (1963). Rutacées, Zygophyllacées, Balanitacées, in Flore du Cameroun **1**. Paris.

LOCK, J. M. & J. B. HALL (1973). Three new species of *Aframomum* K. Schum. (*Zingiberaceae*) from Ghana, with notes on spherical geocarpic fruits in the genus. Kew Bull. **28**: 441–449.

LOCK, J. M. & J. B. HALL (1975). Taxonomic studies in the genus *Aframomum* (*Zingiberaceae*). Boissiera **24**: 225–231.

LOCK, J. M., J. B. HALL & D. K. ABBIW (1977). The cultivation of Melegueta pepper (*Aframomum melegueta*) in Ghana. Econ. Bot. **31** (3): 321–330.

LOUNG, J. F. (1973). Géographie. Le Cameroun. Paris.

MAISTRE, J. (1964). Les plantes à épices. Paris.

MALZY, P. (1954). Quelques plantes du Nord Cameroun et leurs utilisations. J. Agric. trop. Bot. appl. 1 (5–6): 168–169, 171.

MASSEYEFF, R., A. CAMBON & B. BERGERET (1958). Le groupement d'Evodoula (Cameroun). Etude de l'alimentation. Orstom. Paris.

MASSEYEFF, R., A. CAMBON & B. BERGERET (1959). Enquête sur l'alimentation au Cameroun. III Golompoui (Subdivision de Yagoua). Ircam. Yaoundé.

Masseyeff, R., M. L. Piermé & B. Bergeret (1958). Enquêtes sur l'alimentation au Cameroun. II Subdivision de Batouri. Orstom. Paris.

Mildbraed, J. (1913a). Ueber die Gattungen *Afrostyrax* Perk. & Gilg und *Hua* Pierre und die 'Knoblauch Rinden' Westafrikas. Engler Bot. Jahrb. **49**: 552–559.

Mildbraed, J. (1913b). Von den Bulus genutzte wild wachsende Pflanzen des Südkameruner Waldlandes. Notizbl. Kön. bot. Gart. und Mus. Berl., Appendix 27: 1–43.

Pelé, J. & S. Le Berre (1966). Les aliments d'origine végétale au Cameroun. Orstom. Yaoundé.

Purseglove, J. W. (1968). Tropical Crops. Dicotyledons. London: 204–206, 524–530, 634–637.

Purseglove, J. W. (1972). Tropical Crops. Monocotyledons. London: 520, 533–540.

Raponda-Walker, A. & R. Sillans (1961). Les plantes utiles du Gabon. Paris.

Robyns, A. (1976). *Huaceae*, in Flore d'Afrique Centrale (Zaïre, Ruanda, Burundi). Bruxelles.

Tessmann, G. (1913). Die Pangwe. Völkerkundliche Monographie eines westafrikanischen Negerstammes. Erster Band. Berlin: 143–171.

Thomas, A. Le (1969). Annonacées, in Flore du Gabon **16**. Paris.

Villiers, J. F. (1973). Icacinacées, Olacacées, Pentadiplandracées, Opiliacées, Octoknémacées, in Flore du Cameroun **15**. Paris.

Voorhoeve, A. G. (1965). Liberian high forest trees. Pudoc. Wageningen.

Westphal, E. (1978). Spices. 2nd ed. Ecole Nationale Supérieure Agronomique, Univ. de Yaoundé.

Zipcy, E., F. Pélissier & D. Lemordant (1976). Ethnopharmacologie camerounaise. J. Agric. trop. Bot. appl. **23** (1–3): 1–17.

9. INDEX OF VERNACULAR NAMES

BEGONIA SECTION SQUAMIBEGONIA WARB. A TAXONOMIC REVISION

J. J. F. E. DE WILDE (taxonomy) and J. C. ARENDS (cytology)

Laboratory of Plant Taxonomy and Plant Geography,
Agricultural University, Wageningen, The Netherlands

CONTENTS

SUMMARY

Within African *Begoniaceae Begonia* sect. *Squamibegonia* WARB. constitutes a small and clearly delimitated taxon. The section is typified and circumscribed anew. All species-names formerly admitted to the section are critically reviewed and as a result some of them are transferred to other sections. Finally, after revision, only three species are recognized within sect. *Squamibegonia* viz. *B. ampla* HOOK. F., *B. poculifera* HOOK. F. and *B. bonus-henricus* J. J. DE WILDE, the last species is described here for the first time. Segregation of *B. poculifera* was found possible only on an infraspecific level, resulting in the recognition of *B. poculifera* var. *poculifera* and *B. poculifera* var. *teusziana* (J. BRAUN et K. SCHUM.) J. J. DE WILDE. All taxa are typified, circumscribed and pictured. Their synonymy, distribution and ecology is given. The somatic chromosome number of *B. ampla* and *B. poculifera* is $2n = 36$. The total number of chromosomes which can be observed is usually higher. This phenomenon is attributed to the occurrence of B-chromosomes. A key to the species is added.

1. INTRODUCTION

Recently BARKLEY (1972) listed about 2600 species-names as published within the *Begoniaceae*. Many of them are no doubt synonyms, hence the estimate by LAWRENCE (1955) that the family comprises a little over 800 species, appears to give a better indication of the size of the family. The three genera presently recognized viz. *Begonia* L., *Symbegonia* WARB. and *Hillebrandia* OLIV. contain about 800, 12 and 1 species respectively. The monotypic genus *Hillebrandia* is restricted to Hawaii, *Symbegonia* to New Guinea. The pan-tropical genus *Begonia* is widely distributed having its greatest development in the Neotropics, although a great number of species (about 250 published species-names) occur in Africa and the Madagascar region as well. IRMSCHER (1925), the last monographer of the family, recognized 60 sections of which only one (*Begoniastrum* A.DC.) is represented in both America and Asia. The African and Madagascan species belong to 12 sections, eight of which are continental, whereas another three occur in Madagascar and the adjacent islands. One section (*Mezierea* (GAUD.) WARB.) is found on the continent and the Madagascar region as well. Later IRMSCHER (1961) and also HALLÉ (1967) doubted the validity of a number of these African sections.

An interesting feature of the family is the vast amount of species with a narrow distribution, which more in particular leads to a marked massing of endemic species in certain restricted regions. In respect to *Begonia* endemics in Africa many of them seem to occur in the Lower Guinea Subcentre of endemism as recognized by WHITE (1979). Species such as *B. asplenifolia* HOOK.F., *B. bonus-henricus* J. J. DE WILDE, *B. ferramica* N. HALLÉ, *B. filicifolia* N. HALLÉ, *B. peperomioides* HOOK.F. and *B. vittariifolia* N. HALLÉ are known from one or a very few finding-localities only. At present many, if not all, of these African rainforest species are endangered by habitat destruction. The extinction of some species, particularly of those belonging to the sections *Loasibegonia* A.DC. and *Scutobegonia* WARB., is certainly not imaginary as the culture of the plants has been found difficult also under greenhouse conditions.

Although in recent years compilations of *Begonia* were published in some African regional floras (WILCZEK, 1969; R. FERNANDES, 1970; KUPICHA, 1978) the monographic work on the family for Africa stagnated after IRMSCHER's death in 1968. Therefore it was decided to continue the study of the continental African *Begonias* as started by IRMSCHER in 1961. Simultaneously the species of the Madagascar region are studied at the Muséum National d'Histoire Naturelle, at Paris.

2. CIRCUMSCRIPTION OF *Begonia* SECT. *Squamibegonia* WARB.

2.1. *History of the section and the species-names admitted to it*

The section *Squamibegonia* was erected by WARBURG in 1894 (in ENGLER and PRANTL, Nat. Pflanzenf. 1st ed. 3(6a): 121) in his treatise of the *Begoniaceae* on a worldwide scale. With another section, *Mezierea* (GAUD.) WARB., *Squamibegonia* is delimited in the key from the remaining 56 sections as recognized by WARBURG by their fleshy, apterous, indehiscent, berrylike fruits. The at that time newly erected section *Squamibegonia* is composed of species which are climbing by roots and generally have short inflorescences often enveloped by usually persistent big bracts. Furthermore the indumentum consists of scales. *Mezierea* on the contrary includes species which are predominantly upright plants, rarely climbers. Their inflorescences are large and provided with medium-sized bracts. An indumentum is either absent or it is composed of hairs. Both sections are distributed in tropical Africa but section *Mezierea* also occurs on Madagascar, the Comores and on Mauritius.

Following the key WARBURG gives a circumscription of each of the sections (l.c. page 139). Apart from the above-mentioned characters used in the key, no more diagnostic characters to differentiate *Squamibegonia* and *Mezierea* are given. Within *Squamibegonia* he (l.c. page 140) admitted 7 species. Among these he mentioned *B. ampla* HOOK. F., *B. poculifera* HOOK. F., *B. baccata* HOOK. F. and *B. cataractarum* J. BR. et K. SCHUM., all but *B. ampla* distributed in W. Africa. *B. ampla*, according to WARBURG, is also found in the E. African lake area.

IRMSCHER, the renowned specialist of the *Begoniaceae*, treated the family for the second edition of Die natürlichen Pflanzenfamilien (IRMSCHER in ENGL. and PRANTL, Nat. Pflanzenf. 2nd ed. 21: 548. 1925). As regards the circumscription of the sections *Mezierea* and *Squamibegonia* nothing is changed. IRMSCHER (l.c. page 574) also stated that section *Squamibegonia* is composed of about 7 species, all distributed in the Guinean forest-area. As examples he mentioned *B. ampla* HOOK.F., *B. poculifera* HOOK.F., *B. adolfi-friderici* GILG and *B. rhopalocarpa* WARB., but omitted *B. baccata* and *B. cataractarum*. No indication concerning the sectional status of the last two names was given. However, figure 262 (l.c. page 565) showing a transverse section of the ovary of *B. baccata*, was exactly copied from the first edition. The figure is still indicated as '*B. (Squamibegonia) baccata* HOOK.F.'.

The following validly published names have been assigned in the past to section *Squamibegonia*. The names are arranged chronologically.

B. baccata HOOK.F., 1866
B. ampla HOOK.F., 1871
B. loranthoides HOOK.F., 1871
B. poculifera HOOK.F., 1871
B. cataractarum J. BRAUN et K. SCHUMANN, 1889
B. teusziana J. BRAUN et K. SCHUMANN, 1889
B. henriquesii C.DC., 1893
B. rhopalocarpa WARB., 1895
B. duruensis DE WILD., 1908
B. haullevilleana DE WILD., 1908
B. injoloensis DE WILD., 1908
B. adolfi-friderici GILG, 1913

B. crateris EXELL, 1944
B. zimmermannii PETER ex IRMSCHER, 1961.

2.2. *Description and delimitation of* Begonia *sect.* Squamibegonia WARB.

Section *Squamibegonia* WARB. in ENGL., Nat. Pflanzenf. 1st ed. 3(6a): 139. 1894, partly (excl. *B. baccata* HOOK.F. and *B. cataractarum* J.BR. et K.SCH.); IRMSCHER in ENGL., Nat. Pflanzenf. 2nd ed. 21: 574. 1925, partly (excl. *B. rhopalocarpa* WARB.); BARANOV and BARKLEY, The sections of the genus *Begonia*: 21. 1974.
Lectotype species: *B. ampla* HOOK.F.

More or less branched monoecious epiphytes or rupestrals. Stems erect, pendent or creeping. In particular basal parts of older stems becoming woody, the nodes somewhat thickened and often with adventitious roots. Indumentum squamulose, varying in density, composed of peltate, sessile, helicoidal hairs with a fringed or denticulate margin, sometimes the hairs almost stellate. Stipules readily caducous, boat-shaped, the outer stipule of each pair conspicuously keeled in the upper part. Leaves petioled, never peltate. Inflorescences axillary, peduncled, cymose, containing male and female flowers, proterandrous-androgynous. The flower-bearing part of the inflorescence (except the open flowers) enveloped and concealed by a flattened cup formed by two, free, with the margins largely overlapping, persistent, boat-shaped pseudo-bracts*. Axes of the inflorescence very short, not developing, the flowers at anthesis exserted from the cup by means of a 'perianth-cylinder', the development of which, in female flowers, is a striking character of the section. Perianth-segments (tepals) two in flowers of either sex, white or pinkish, often with red longitudinal stripes extending from the base to halfway or more up; the tepals fused at the very base and forming with the inner floral parts the perianth-cylinder below. In male flowers the solid perianth-cylinder with an articulation implanted on top of the pedicel; the flower after anthesis withering and as a whole falling at the articulation, the true pedicel remaining. Androecium fasciculate, filaments fused at the very base, otherwise free. In female flowers the perianth-tube (hollow in the very centre) implanted on the ovary; the perianth after anthesis sometimes breaking away from the apex of the ovary, sometimes persistent when fruiting. Styles 4(–5), fused at the very base, otherwise free, implanted on top of the perianth-tube just above the point where the 'tepals' become free. Each style forked in the upper part like a horseshoe, the arms of the shoe with a 1–1.5 turn spirally twisted. Stigmatic tissue forming a continuous band from one arm to the other and following helically the morphologically outer face of the arms. Ovary shortly stipitate, obovoid, 4(–5)-locular. Placentation axile; placenta cushion-shaped, ellipsoid, deeply bifid in the upper part, solid beneath (see Fig. 4 (9, 10 and 11, a–e)), in vivo filling the locule and bearing numerous ovules on the convex surface. Infructescence at maturity

---

* According to IRMSCHER (l.c. page 562. 1925) these bracts are homologous with the stipules, hence he denoted them as pseudobracts, which is followed here. For convenience, pseudobracts of higher order have been called bracts.

falling often as a whole from the axil of the supporting leaf, containing 1–4 fruits which are still more or less enveloped by the now somewhat gaping, persistent, pseudobracts. Mature fruit berrylike, globose, obovoid or ovoid, whitish, shortly stipitate, often mucronulate at the apex; the pericarp rather rapidly disintegrating. Mature seeds small, brown; testa thin and brittle, finely alveolate.

2.3. *A review of the present species situation*

Begonia baccata was validly published by J. D. HOOKER in CURTIS' Bot. Mag. Vol. 92, Ser. III, tab. 5554, 1866. The coloured plate accompanying the description which shows a flowering branch and details of the flower and ovary was made by FITCH from a living specimen at Kew in 1865. This material was sent by G. MANN from the island of São Tomé to the Royal Gardens in 1961. The drawing creates (erroneously) the impression that the inflorescences are unisexual. HOOKER, in the protologue, states, 'for the details of this I am indebted to Mr. FITCH's careful drawing, not having had the opportunity of examining the plant when in flower'. Although, apparently HOOKER's diagnosis is based for the greater part on FITCH's drawing, he must have had at hand also MANN's herbarium collection of the plant which was received at Kew in November 1861. It is represented at Kew by five sheets, containing leaves, stem, flowers and mature fruits (*G. Mann no. 1087*; K, holotype, isotypes at B and P). Both the type material and the drawing match the diagnosis perfectly and there is no doubt about the identity of *B. baccata* HOOK.F. However, in a discussion to the diagnosis HOOKER states that MANN collected the species also in Fernando Po 'growing on (?) an epiphyte at an altitude of 1300 feet'. And again, in the following description, he states that the flowers are white and pink in dried material from Fernando Po. Without doubt, HOOKER refers here to *Mann no. 314*, also present at K, a collection on which he based (together with *Barter no. 1989*, collected in Principe) *Begonia ampla* in 1871 (see under *B. ampla* HOOK.F. page 385). With regard to the fruit HOOKER states that according to MANN this is 'a large, nearly spherical, fleshy, indehiscent berry'.

In 1871, HOOKER (HOOK.F. in OLIV., Flora of Trop. Afr. Vol. 2: 573) gives an emended description of *B. baccata*, referring to the specimen from São Tomé (*Mann no. 1087*). In passing, it may be noted that here the peduncles (in fact the inflorescences!) are described as unisexual, a character which he certainly took from FITCH's drawing.

In 1978 at the Department of Horticulture of the Agricultural University at Wageningen a plant of *B. baccata* flowered and eventually after self pollination set fruit. The plant was acquired by the kindness of Mr. TH. J. BREDERO, who brought it from São Tomé (Lagôa Amelia) to Wageningen in February 1977. The following observations have been made from this flowering specimen (Herb. *J. J. De Wilde no. 8775*, WAG):

1. Young inflorescence enveloped by pseudo-bracts, but these bracts as well as bracts of higher order gradually deciduous in the course of flowering. The first pair of pseudo-bracts already shed at the time of anthesis of the first male flowers. Inflorescence proterandrous-androgynous, most often all male flowers shed at the

time of anthesis of female flowers. This explains HOOKER's statement: 'peduncles unisexual' as he did not see the flowering plant himself. All bracts shed when the last female flowers reach anthesis.

2. Axes of the cymose inflorescence elongating in anthesis, finally the infructescence a widely open dichotomously branched cyme up to 25 cm long (including the up to 11 cm long peduncle).
3. Perianth-segments ('tepals') pure white, in female flowers implanted directly on top of the ovary, without a perianth-cylinder.
4. Ovary globose, longitudinally shallowly (4–)5(–6)-grooved, (4–)5(–6)-locular. Placentation parietal, the placentas fused in the ovary-centre, creating the impression of an ovary partitioned by true septa. The septiform placentas branching once or often twice, the branches left and right almost opposite and ovuliferous while the septiform part remains sterile. The finally (4–)5(–6)-locular ovary contains in each of its locules half of the ovules of two septiform placentas. (A similar situation is found in *Begonia* section *Tetraphila* A.DC., as described by DE WILDE and ARENDS, 1979.)
5. Fruits at maturity globose, berrylike, 15–25 mm diameter, reddish-orange, dehiscent, the thin fleshy pericarp rupturing from the apex towards the base, forming (4–)5(–6) irregular-shaped transitory valves.
6. Mature fruit sitting on a ca 15 mm long, somewhat swollen (2.5 mm diam.), dirty-white stipe. The fruits caducous together with the stipe, leaving behind the persistent axes of the infructescence.

The characters mentioned above, one by one, and certainly when combined, strongly deviate from the circumscription as presented for section *Squamibegonia* WARB. (see 2.2). Although we found no essential difference in the shape of the hairs of *B. baccata* as compared to the hairs of the species admitted by us in *Squamibegonia*, we feel that *B. baccata* should not be included in this section. For the moment we hesitatingly refer the species to section *Mezierea* (GAUD.) WARB., although preliminary observations on the chromosome numbers (unpublished) and the morphology of the testa appear not to support this. A similar proposal was made by BARKLEY (1972) who however did not present any explanation for this opinion. *B. baccata* is endemic to São Tomé.

Begonia ampla HOOK.F. is designated by BARANOV and BARKLEY (1974) as lectotype species of section *Squamibegonia* WARB. Detailed information is given on page 385.

Begonia loranthoides HOOK.F. was transferred to section *Tetraphila* A.DC. by DE WILDE and ARENDS (1979).

Begonia poculifera HOOK.F., in every respect, fits into section *Squamibegonia* WARB. The species is treated on page 392.

Begonia cataractarum was validly published by J. BRAUN and K. SCHUMANN in Mittheilungen von Forschungsreisenden und Gelehrten aus den Deutschen Schutzgebieten 2: 167. 1889. No material is cited. The protologue indicates as finding-locality 'Edeafälle', without doubt the falls in the Sanaga river near Edea in Cameroun.

In the Berlin herbarium (B) there is a specimen collected by BRAUN bearing a collector's label marked: 'Aug. 88. Malimba *85* (*Begoniae*)'. At a separate label going with this specimen is written: '*Begonia cataractarum* JOH. BR. et K. SCH.'. This specimen, however, differs in every detail from BRAUN and SCHUMANN's description of *B. cataractarum*. Certainly for this reason WARBURG wrote on this second label: 'diese Etiquette muss durch Verwechselung hierher gekommen sein, dagegen ist das Originalexemplar von *B. cataractarum* augenblicklich (1894) nicht im Herbar von Berlin'. Nevertheless, it must have been this particular specimen on which WARBURG (loc. cit. page 140. 1894) based his conviction that *B. cataractarum* belonged in his new section *Squamibegonia*. Moreover, when WARBURG described *B. rhopalocarpa* (in ENGL., Bot. Jahrb. 22 (1): 40. 1895) he also based this new species, among other specimens, on *Braun no. 85* from Malimba. *B. rhopalocarpa* was placed by WARBURG into *Squamibegonia* but belongs to section *Tetraphila* A.DC. (DE WILDE and ARENDS, 1979). In the same publication (loc. cit.: 34. 1895) WARBURG, while publishing *B. epilobioides*, concludes the protologue to this species with the remark: 'Dass diese Art mit *B. cataractarum* K.SCH et J.BR. identisch sei, ist nicht ausgeschlossen; doch fehlen hier die Originalexemplare zum Vergleich'. *B. epilobioides*, based on *Dusén no. 254* (B), is placed by WARBURG in section *Fusibegonia* WARB. (a later, heterotypic synonym of section *Tetraphila* A.DC.).

Summarizing it can be stated that already WARBURG finally concluded that *B. cataractarum* J.BR. et K.SCHUM. ought to be placed in *Tetraphila*. In our opinion this is without the slightest doubt correct. All data in the protologue point to this section and although no type material could be traced, we strongly feel that *B. cataractarum* J.BR. et K.SCHUM. is a later heterotypic synonym of *B. (Tetraphila) polygonoides* HOOK.F.

Begonia teusziana J. BR. et K.SCHUM. is in this revision treated as a variety of *B. poculifera* HOOK.F. Details are given on page 404.

Begonia henriquesii C.DC. was brought into synonymy of *B. loranthoides* HOOK.F. subsp. *loranthoides* and this taxon transferred to section *Tetraphila* A.DC. by DE WILDE and ARENDS (1979).

Begonia rhopalocarpa WARB. was transferred to section *Tetraphila* A.DC., and treated as a subspecies of *B. loranthoides* HOOK.F. by DE WILDE and ARENDS (1979).

Begonia duruensis DE WILD. is in this revision placed in synonymy to *B. ampla* HOOK.F. (see page 385).

Begonia haullevilleana DE WILD. is synonymous to *B. poculifera* HOOK.F. var. *poculifera*. For details see page 398.

Begonia injoloensis DE WILD. was treated as a synonym of *B. loranthoides* HOOK.F. subsp. *rhopalocarpa* (WARB.) J. J. DE WILDE in section *Tetraphila* A.DC. by DE WILDE and ARENDS (1979).

Begonia adolfi-friderici GILG is placed here in synonymy to *B. poculifera* HOOK.F. var. *poculifera*. Details are given on page 400.

Begonia crateris was validly published by EXELL (Cat. Vasc. Pl. S. Tomé: 189, fig. 9. 1944), based on *Exell no. 224* (holotype in BM, COI, isotype). EXELL, in the protologue, states that it is closely related to *B. baccata* HOOK.F. We support this opinion as we were able to examine complete material collected in the type locality by Miss LIZA GROENEN-

DIJK (*no. 107*, WAG). Among the diagnostic characters mentioned by EXELL to keep *B. crateris* separate from *B. baccata*, only the leaf-character (most often peltate in *B. crateris*) most likely holds. Mature fruits of *B. crateris* are baccate, very similar to those of *B. baccata*. Following a similar argumentation as in the case of *B. baccata* (see page 381), we exclude *B. crateris* from *Squamibegonia*.

Begonia zimmermannii, a manuscript name proposed by A. PETER, was validated by IRMSCHER in Engl. Bot. Jahrb. 81 (1/2): 181. 1961. IRMSCHER's description is based on *Greenway no. 1045*, collected at Amani in Tanzania (holotype and isotype at K, isotypes in B and EA). GREENWAY, in his collector's note, stated that he found it 'a common epiphyte on tall forest trees in evergreen rain forest'. Although it may be common locally, the species is very poorly represented in the herbaria. Apart from the type we only examined *Grote no. 3694* (B, EA) and *Zimmermann no. 6650* (EA), all collected in or near the type-locality. Both the specimens and IRMSCHER's diagnosis leave no doubt that *B. zimmermannii* PETER ex IRMSCH. must be placed in section *Tetraphila* A.DC. IRMSCHER, in the protologue, accommodated the species with doubt in section *Squamibegonia*, probably guided by the type of indumentum. To our present knowledge, within African *Begoniaceae*, the indumentum is not a reliable character and of little value for the determination of sections.

3. DESCRIPTION OF THE SPECIES OF *Begonia* SECT. *Squamibegonia* WARB.

3.1. Key to the species

1. Thin-stemmed epiphyte, stems 1–1.5 mm diam. Petioles (3–)5–12(–15) mm long. Leaf-blade almost symmetric, ovate to narrowly ovate, densely matted with a persistent indumentum on the lower surface. Cameroun. . . . . **B. bonus-henricus**

1. Epiphytes or rupestrals, stems 2 mm diam. and more. Petioles at least 12 mm long. Leaves differently shaped and lacking a densely matted indumentum.

    2. Leaves ovate or broadly ovate, deeply cordate to cordate at the base and with a distinct indumentum of a stellate type of hairs on the lower surface. Central Africa and islands in the Gulf of Guinea. . . . . **B. ampla**

    2. Leaves and indumentum otherwise.

        3. Leaves falcate to fan-shaped, strongly asymmetric. Indumentum predominantly consisting of scaly hairs with a denticulate or fringed margin. Central Africa and Fernando Póo. . . . . **B. poculifera**

        3. Leaves not falcate or fan-shaped, slightly asymmetric; the blade ovate or broadly ovate to sub-orbicular. Indumentum varying, sometimes the leaves almost glabrous. São Tomé and Annobon. . . . . **B. ampla**

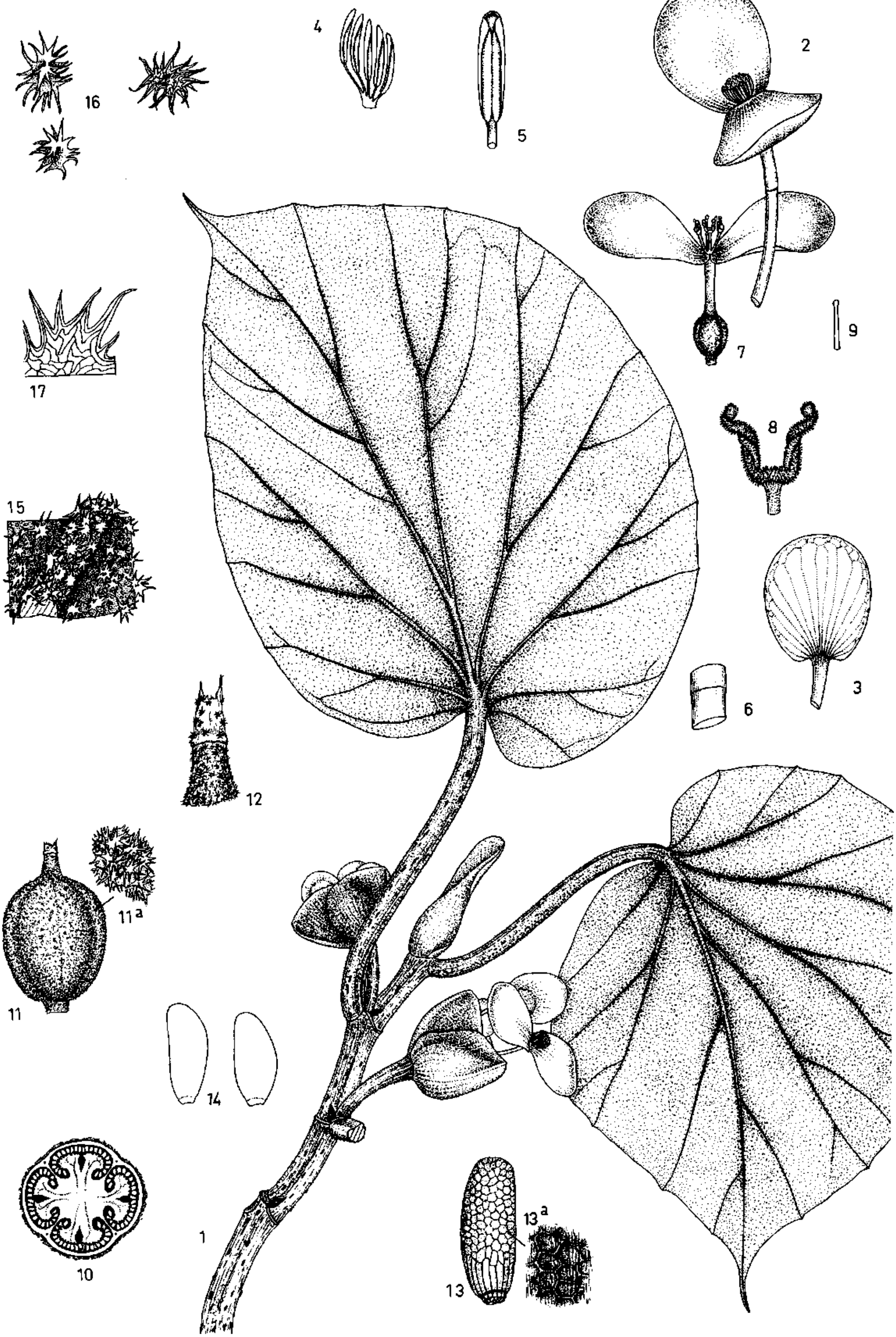
3.2. **Begonia ampla** HOOK.F. **Fig. 1; Map 1**

HOOK.F. in OLIVER, Fl. Trop. Afr. 2: 574. 1871; C. DE CANDOLLE in Bol. Soc. Brot. 10: 124. 1893; O. WARBURG in ENGL., Nat. Pflanzenf. 1st ed. 3(6a): 140, fig. 44D. 1894; O. WARBURG in ENGL., Bot. Jahrb. 22(1): 40. 1895; DE WILD. in Ann. Mus. du Congo, Sér. 5 (Bot.) 3: 451. 1912; ENGLER in ENGL. and DRUDE, Veg. der Erde 9, Die Pflanzenw. Afr. 3(2): 614. 1921; E. IRMSCHER in ENGL., Nat. Pflanzenf. 2nd ed. 21: 574, fig. 254D. 1925; HUTCH. and DALZ., Fl. W. Trop. Afr. 1st ed. 1(1): 188, fig. 82E. 1927; EXELL, Cat. Vasc. Pl. S. Tomé: 187. 1944; W. ROBIJNS, Fl. Spermat. Parc Nat. Albert 1: 646. 1948; HUTCH. and DALZ., Fl. W. Trop. Afr. 2nd ed. 1(1): 219, fig. 86E. 1954; R. WILCZEK in Fl. du Congo, – Rwand. – Bur., *Begoniaceae*: 8. 1969.

Syntypes: *Mann no. 314*, 3 sheets (Fernando Po, 'epiphyte 1 ft high, calyx green, corolla white and red, 1.300 ft', lectotype, K; ibid., 'sent before, 1–2.000 ft up the mountain, epiphyte on trees', iso-lectotypes, K); *Barter no. 1989* (Principe, paratype, K).

Synonym: *Begonia duruensis* DE WILD. in Ann. Mus. du Congo, Sér. 5 (Bot.) 2: 318. 1908; TH. and HÉL. DURAND, Syll. Fl. Cong.: 233. 1909; DE WILD. in Bull. Jard. Bot. Brux. 5: 366. 1919; R. WILCZEK in Fl. du Congo, – Rwand. – Bur., *Begoniaceae*: 8. 1969 (in synonymy to *B. ampla*). Syntypes: *Seret no. 544*, 3 sheets (Zaïre: without further locality, paratype, BR); *Seret no. 544-a*, with the addition 'a' added by WILCZEK in 1968 (Zaïre: Ubangi-Uele, Mugdangba, Near Duru, paratype, BR); *Seret no. 544-b*, id. (Zaïre: ibid., Sabona, S. of Dungu, lectotype, BR); *Seret no. 544-c*, id. (Zaïre: ibid., Nala, paratype, BR); *Seret no. 544-d*, id. (Zaïre: ibid., near Arebi, paratype, BR).

Description. Stout epiphyte or rupestral, not or rarely branched, the stems up to 1 m long by up to 1.5 cm in diam. Some plants may even reach 2 m long, but on the other hand seemingly young, very short-stemmed individuals may already be flowering. Leaves and inflorescences usually found towards the apex of the stem. Stems, and in particular the older parts, woody, pale grey to pale brown, the upper younger parts covered with an often rather dense indumentum of usually rusty, peltate-helicoid, sitting, scaly, fringed or denticulate, sometimes nearly stellate hairs; the indumentum often more or less disappearing with age and the stems becoming scurfy to partly glabrous. The nodes somewhat thickened and rather often with adventitious roots. Especially the older and thicker stems with very conspicuous hooflike scars of fallen leaves. The surface of the scars concavely sunk, dark – often reddish – brown, contrasting with the paler stems, up to 1 cm diam.; on the upper side bordered by a nearly annular scar formed by the pair of fallen stipules. Internodes varying in length, up to 5 cm long, most often much shorter.


16
4
5
2
17
7
9
8
15
3
6
12
11ª
11
14
10
1
13ª
13

Stipules readily caducous, narrowly ovate to more or less triangular, boat-shaped, sharply acute to obtuse at the apex, usually with a rather dense indumentum outside (however, sometimes nearly glabrous), glabrous inside, up to 5 × 2 cm, pale green in vivo.

Leaves long petioled, petioles of full grown leaves stout, angular (rounded and ridged), red coloured in vivo according to the labels, (5–)7–22 cm long, most often with an indumentum as described above for the stems, rarely nearly glabrous; blade obliquely ovate, obliquely broadly ovate or obliquely very broadly ovate, rarely nearly circular, 8–29 × 6–23 cm, cordate or even deeply cordate at the base, only rarely the base truncate, caudate to acute at the apex, the acumen up to 2.5 cm long, margin entire or obscurely toothed at the tip of the nerves, nearly glabrous or with a rather loose indumentum of more or less stellate peltate-helicoid hairs on the upper surface, the indumentum on the lower surface much more dense, sometimes even very dense, hairs of a stellate type always present especially on the nerves and towards the base, dark green above, glaucous-green or, especially in young leaves, purplish beneath, palmately 5–8-nerved, the nerves arising from the base, or the central ones from somewhat above the base, all or all except the lateral (outer) nerves 1–4 times dichotomously branched, the branches reaching the margin and often forming here a small tooth (see above), prominent and often red or purplish beneath, not or very slightly prominent above.

Inflorescences axillary, proterandrous-androgynous, many-flowered (up to 14♂ and 6♀ flowers in one inflorescence). Peduncle 0.5–3(–3.5) cm long, bearing at the apex a flattened cup composed of 2 free but with the margins largely overlapping persistent pseudo-bracts that contains the remaining and most often concealed part of the inflorescence. Cups (measured on dried herbarium specimens) (1–)3–4(–5) cm wide, (1.5–)2–3(–3.5) cm high, widest at the apex, smallest at the base, the lateral edges curved and the cups cup-shaped, the edges usually not tapering towards the base. The 2 separate, narrowly boat-shaped outer pseudo-bracts of the cup measuring up to 3.5 × 3 cm in outline (measured while being folded along approx. the median), nearly always with a loose indumentum of more or less stellate hairs at the outer side.

Inside the above described outermost pair of pseudo-bracts unrolls the remainder of the cymose inflorescence, which, judging from dried material, seems to follow the same

---

FIG. 1. ***Begonia ampla*** HOOK.F. – 1: flowering branch (×½); 2: ♂ fl. (×1); 3: tepal, ♂ fl., outer side (×1); 4: androecium, side-view, schematic (magnified); 5: stamen, front side (×6); 6: articulation in stalk of ♂ fl. (×4); 7: ♀ fl. (×1); 8: one style, abaxial side (×6); 9: capitate stigmatic papilla (magnified); 10: transverse sect. of ovary, ca in the middle (×8); 11: mature fruit (×2); 11-a: idem, detail of matted indumentum (magnified); 12: apex of mature fruit with frayed remnant of perianth-cylinder (magnified); 13: mature seed (×30); 13-a: idem, detail of testa (×90); 14: different seed-shapes (magnified); 15: fragment of underside of leaf (×9); 16: peltate-helicoid hairs from 15, frontal-view (×18); 17: idem, segment at a larger magnification, showing details. – 1: *Mildbraed 6249*; 2–9: *Leeuwenberg 9949*; 10: reconstructed from *Bequaert 4481*; 11–14: *Le Testu 5410*; 15–17: *Mildbraed 6249*.

pattern as described under *B. poculifera*, with the exception that the branches of the 1st order of the cyme are somewhat developed and may reach up to 3 mm long. Furthermore, there are indications that within an inflorescence the number of ♂ flowers may exceed that of the other species within this section. (A clear insight into the morphology of the inflorescence is only possible with living material at hand.)

Male flower: Perianth-segments ('tepals') two, obovate to broadly obovate, 16–20 × 13–19 mm, pinkish or white with longitudinal red stripes, sometimes with a very few scattered pale brown stellate hairs, in dried material conspicuously veined lengthwise (veins up to 20), otherwise transparent; the 'tepals' fused at their very base and forming a narrow up to 16 mm long by 1 mm in diam. solid 'perianth-cylinder' below, which, with a hardly perceptible but nevertheless distinct articulation is implanted on the up to 14 mm long and 1 mm thick pedicel. (The support of a single male flower combined up to 30 mm.) Flowers after anthesis withering, shriveling and falling into one piece from the articulation, the true pedicels staying behind, withering and still present as thin flat pale brown threads at the time when the female flowers are at anthesis. Androecium fasciculate, stamens 25–55. Filaments practically free (fused at the extreme base over ca 0.2 mm), up to 1.8 mm long, the shortest filaments of the fascicule only 0.2 mm long. Anthers up to ca 3 mm long by 0.6–0.7 mm wide, narrowly obovate, with a somewhat thickened obtuse connective at the apex, opening more or less laterally, lengthwise.

Female flower: Perianth-segments ('tepals') two, obovate to nearly circular, cuneate to slightly cordate at the base, 17–27 × 14–20 mm, often somewhat bigger than compared to the corresponding parts of the male flowers, otherwise as in male flowers; the 'tepals' fused at their base and forming there below a 7–15 mm long, in the very centre hollow, glabrous 'perianth-cylinder' which is implanted on top of the ovary. Styles 4, fused at the very base over ca 0.5 mm. Free parts of the styles 3 mm long, densely papillose, horseshoe-shaped forked thereupon, the arms of the horseshoe ca 2(–3) mm long, spirally twisted one time, covered with a continuous (also spirally twisted) band of coarsely papillose stigmatic (?) tissue on one side. Ovary stipitate, stipe 1–1.5 mm long, by 1 mm diam., slightly tapering towards the base, the ovary obovoid, 5.5–7.5 × 6–7 mm, covered with a loose indumentum of stellate peltate-helicoid hairs especially towards the apex, 4-locular with axile placentation.

Infructescences containing the mature fruits probably falling as a whole; the many bracts which enclose the fruits like the pericarp disintegrating.

Mature *fruits* globose-(ob)ovoid, usually 10–12 × 8–11 mm but up to 38 × 22 mm in *Groenendijk no. 126* from São Tomé, baccate, covered with a more or less dense indumentum of sessile stellate peltate-helicoid hairs, rarely almost glabrous, the indumentum often more distinct towards the apex; very shortly stipitate at the base (stipe 1–1.5 mm long); obtuse above but at the top with an apicula. The apicula up to 3 mm long, somewhat tapering, the apex terminated by a frayed scar on the place where the perianth-cylinder has broken down.

Seeds 0.7 × 0.3 mm, brown-red, alveolate.

Notes to the synonym. The type material of *B. duruensis* De Wild., cited above (*Seret no. 544* and *Seret nos 544-a* till *544-d*) is remarkably homogeneous and matches in every respect the circumscription of *B. ampla* Hook.f. as given in the present treatment. The length of the peduncle, mentioned by De Wildeman in the protologue to *B. duruensis* as a differential character of this taxon and *B. ampla*, is found to be variable not only in *B. ampla* but also in the other species of the section *Squamibegonia*. *Mann no. 314*, the lectotype of *B. ampla*, collected on Fernando Po, shows peduncles of only 0.5 cm long. According to the identification label going with *Seret no. 544-b*, also Irmscher, in 1961, was already of the opinion that *B. duruensis* ought to be placed into the synonymy of *B. ampla* Hook.f.

Note 1: A specimen collected by Léonard in Zaïre (*no. 3866*, BR, K) shows leaves which are strongly aberrant in shape. The blades are falcate with a leaf-ratio of 2:1 and obtuse at the base, characters at first glance pointing to *B. poculifera* Hook.f. var *poculifera*. On closer examination, however, all parts of this specimen are abundantly covered with hairs of the stellate type characteristic and diagnostic for *B. ampla*. Moreover, the petioles are long (5–6 cm), the inflorescences broad, cup-shaped and shortly peduncled (peduncle 1.5 cm long). No other specimens showing this character-combination came to our attention. *Léonard no. 3866* is identified here as *B. ampla* Hook.f., especially in consideration of the type of indumentum; it might well be the result of hybridization. Unfortunately, this specimen was used for the drawing showing the leaves and indumentum of *B. haullevilleana* De Wild. in Wilczek's account of the *Begoniaceae* in the Flora of Zaïre, Rwanda and Burundi (l.c. 1969, plate 1, A and B). In the present revision *B. haullevilleana* is placed in synonymy to *B. poculifera* Hook.f. var. *poculifera*, characterized by a different, not stellate, type of indumentum (see page 400).

Note 2: Some of the specimens of *B. ampla* collected on the islands São Tomé and Annobon in the Gulf of Guinea are often difficult to identify, e.g. *Chevalier nos 14.198*, *14.488-bis* and *Rozeira no. 2970*. These specimens are almost missing the diagnostic stellate type of indumentum. However, careful examination of young developing leaves often reveals the presence of these readily caducous hairs. Moreover, the leaves of these plants are often only slightly cordate or even truncate at the base. The character combination (type of indumentum and shape of the leaf-base) which is diagnostic on the continent and also holds for the majority of the specimens collected on the islands, seems to become fallible for a part of the island populations. Intermediates (e.g. *Quintas no. 149 (999)* and *Wrigley and Melville no. 29)* linking the above mentioned extremes with typical idividuals (e.g. *Rozeira nos 2874* and *2968-A*) do occur, and we found no sense in segregating the aberrant specimens from São Tomé and Annobon on an infraspecific level.

Distribution: Cameroun, Fernando Po, Principe, São Tomé, Annobon, Gabon, Congo (Brazzaville), Zaïre, Rwanda, Uganda.

Ecological and biological notes: Nearly without exception it is stated in the collectors' notes that *B. ampla* is found growing as an epiphyte on tree-trunks. EXELL, however, who collected it on the island of Principe, found it growing on a perpendicular rock (teste *Exell no. 585*, BM). Also GROENENDIJK who collected the species several times on São Tomé, reports it frequently growing on rocks (*Groenendijk nos 39, 52, 69, 106, 126*, all in WAG). LEEUWENBERG mentioned it growing both as an epiphyte and on rocks in the same locality on Mt Nlonako in Cameroun (*Leeuwenberg no. 8801*, WAG). BRETELER and DE WILDE (*no. 36*, WAG) collected a vegetative specimen growing on wet rocks close to the waterfalls in the Tchimbélé River in Gabon. Also from Zaïre there is a record that the species was found as a rupestral (*Germain no. 5318*, BR).

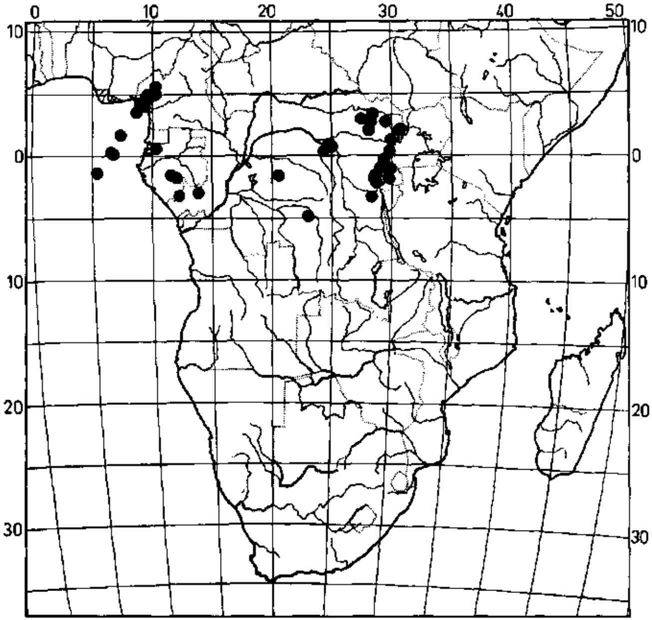
On the African mainland the species seems confined to altitudes above 500 m (more than 30 records), with only one slight exception viz. JEAN LOUIS (*no. 15.523*, BR), who found it in Zaïre at the sources of the Ngula River (01° 05′N. – 24° 57′ E.) at an altitude of 470 m. The highest altitudes on record are BEQUAERT (*no. 4481*, BR) in Zaïre's Ruwenzori Mountains at 1800 m and S. PAULO (*no. 664*, K) who collected it in Kigezi District in Uganda at the same altitude. In contrast to this are altitudes of collections made on the islands of the Gulf of Guinea. Here the species locally descends to sea level (e.g. *Exell no. 585*, BM, from Principe and *Groenendijk nos 39, 52, 69, 106, 126*, WAG, from São Tomé). According to EXELL (l.c. 1944, pag. 2, 3) all these islands have 'a typical equatorial climate, hot but not excessively so, with considerable rainfall and very high humidity'.

It appears that *B. ampla* is a sciophilous species found both in original and secondary forest types, preferably in moist conditions where there is a high relative humidity. Many collectors mentioned that it was found epiphitic on trees growing on the edge of watercourses or in swamps.

The flowers are reported rose-coloured (teste *Barter no. 1989*, K, *Léonard no. 1.454*, BR, and others) but most often white with crimson streaks (numerous collectors). Mature fruits are yellowish (*J. Lebrun no. 3293*, BR), pale orange to pale salmon-pink, with seeds on orange placenta's (*Groenendijk no. 126*, WAG), or white (*Melville no. 473*, BM). In Zaïre the species seems to flower about the year round, for April only there is no record (30 records from Zaïre). From the other countries where it is distributed the information is too scanty that any conclusion can be made.

Vernacular names: See WILCZEK (l.c.: 9. 1969).

Uses: According to the collectors' notes of BOONE the leaves are used as a remedy against cough near Nala in Zaïre (only one record; teste *Boone no. 162*, BR).



MAP 1. Black dots indicate localities where *B. ampla* HOOK.F. was collected.

Specimens examined:

CAMEROUN: Basosi Distr., Kumba, *Dundas FHI-15327* (K); near N'Diam, base of Cameroun Mt, *Dusén s.n. (G, 2 sheets); Bibundi, Dusén 275* (B); ibid., *Jungner 73* (B, UPS); Bare station, Moam R., *Ledermann 1292* (B); Dschang, *Ledermann 1563* (B); Bare station, *Ledermann 6134* (B); Mt. Nlonako, near Nkongsamba, *Leeuwenberg 8801* (WAG); base of Manengouba Mts, 4 km W.N.W. of Nkongsamba, *Leeuwenberg 9949* (WAG); 40 km N. of Kumba, near Supé, between Ekona and Boubaji, *Letouzey 14.354* (P, YA); western slope of Mt. Nlonako, 5 km S.S.E. of Nkongsamba, *Letouzey 14.489* (P, WAG, YA); Isongo, Bibundi Plantation, W. of Cameroun Mt., *Mildbraed 10.642* (B); Barombi, *Preuss 447* (B, BM, COI, HBG); Victoria region, between Isongo and Bakingele, *Preuss 1378* (B); 14 km E.S.E. of Bafang, Bandoumkassa, *Satabie 122* (P, YA); Victoria, Debundscha Crater, *Swarbrick 2454* (FHI, YA); Kumba Distr., 74 km on the road Kumba-Mamfe, near Ewane, *Tamajong FHI-23451* (K).

EQUATORIAL GUINEA: Fernando Póo: Pico de Sta. Isabel, *Boughey 173* (K); sin.loc., *Mann 314*, 3 sheets (K, lectotype and isolectotypes); Moka, *Melville 473* (BM, K); above Basilé, northern slope of the Pico de Sta. Isabel, *Mildbraed 6249* (B, HBG); Caldera Prov., San Carlos, Ruiché trail, *Sanford 4436* (MO); ibid., *Sanford 4445* (IFE).

PRINCIPE: sin.loc., *Barter 1989* (K, paratype); between Terreiro Velho and Infante D. Henrique, *Exell 585* (BM, COI); Infante D. Henrique, road to Praia Grande, *Rozeira 438* (COI).

SÃO TOMÉ: Porto Alegre, southern region, *Chevalier 14.198* (P); Monte Rosa, southwest region, *Chevalier 14.488-bis* (P); Praia Grande, ca 5 km W. of Ribeira Peixe, *Groenendijk 39* (WAG); Porto Alegre area, between Vila Conceição and Ponta Baleia, *Groenendijk 52* (WAG); ibid., *Groenendijk 69* (WAG); ibid., *Groenendijk 106* (WAG); ibid., *Groenendijk 126* (WAG); between Bindá and Juliana de Sousa, *Groenendijk 130* (WAG); Nova Moka, *Moller 178* (COI); Angolares littoral, Angra de S. João, *Quintas 149* (K; aberrant by truncate leaf-bases, the same collection under *no. 999* in COI); between Preserverança and Novo Brasil, *Rozeira 2874* (COI); Santo António, Praia Lança, *Rozeira 2911* (COI); near the Caué River, *Rozeira 2968-A* (COI); between Quija and Chufe-Chufe, *Rozeira 2970* (COI).

Annobon: Pic Santiago, W. of the Crater Lake, *Descoings 12.850* (P); edge of N. Crater, *Mildbraed 6515* (B); Quioveo, *Mildbraed 6533* (B, HBG); summit of the Santa Mina, *Mildbraed 6698* (B); ridge of Crater Lake, *Wrigley and Melville 29* (BM, BR, K, P).

Gabon: Tchimbélé River, waterfall near hydroëlectric power station, *Breteler and De Wilde 36* (WAG); illegible, *Le Testu 5258* (BM); waterfall of the Boumi R., near Mbigou, *Le Testu 5410* (BM, BR, MO, P); illegible, *Le Testu s.n.* (BM).

Congo (Brazzaville): Yomi region, Zanaga, along road Bouyala-Kimboto, *Sita 3308* (P); Divenié region, road to Malinga, near the village Mouolo, *Sita 3864* (P).

Zaïre: Ruwenzori, Lanuri R., *Bequaert 4481* (BR); Masisi, *Bequaert 6360* (BR); Nala, *Boone 162* (BR); Katana-Kahusi, *Boutakoff s.n.* (BR); Irangi, *Cambridge Congo Exp. 311* (BM, BR); Walikale Terr., Musenge, *Christiaensen 294* (BR); Kalehe Terr., near Irangi, 110 km on the road Kavumu-Walikale, *Christiaensen 1913* (BR); ibid., *Christiaensen 2028* (BR); ibid., *Christiaensen 2066* (BR, K); Lomani R., *Demeuse 104* (BR); Parc National Albert, *Donis 4055* (BR); Mbole Terr., Tshuapa R. Distr., Monkoto, *Dubois 122* (BR, WAG); S. of Rumangabo, *Germain 3442* (BR, K); Mt. Hoyo, Irumu, W. of Lake Albert, *Germain 5318* (BR, K); Mugungura, near Irango (not localized), *Gille 157* (BR); Walikale Terr., Kibati, *Gutzwiller 1150* (BR); ibid., *Gutzwiller 1350* (BR, K); Masisi Terr., Kikoma, *Gutzwiller 1623* (BR, K); Walikale Terr., Ironga, Mutongo, *Gutzwiller 2765* (BR, K); ibid., *Gutzwiller 3322* (BR, K); near caves of Kondue, *E. and M. Laurent s.n.* (BR); cultivated at Eala, *M. Laurent 899* (BR); near Wamba, forest on bank of the Nepoko R., *Lebrun 3293* (BR, K); between Masisi and Walikale, *Lebrun 5102* (BR,. WAG); Kembe Terr., Walikale, *Léonard 1.454* (BR, K); Shabunda Terr., Kimbili, *Léonard 3866* (BR, K, aberrant specimen, see note 1 above); 39 km on the road Bengamisa-Yangambi, *Louis 8233* (BR); sources of the Ngula R., 60 km from Weko, *Louis 15467* (BR, EA); ibid., *Louis 15523* (BM, BR, K, P); near Irangi, 109 km on the road Kavumu-Walikale, *Pierlot 628* (BR); near Kisangani, *Pynaert 73* (B, BR); Kalehe Terr., near Irangi, on the road Bukavu-Walikale, *Sebald 4959* (STU); sin. loc., *Seret 544* (BR, paratype of *B. duruensis* De Wild.); Ubangi-Uele, Mugdangba, near Duru, *Seret 544-a* (B, BR, paratype of *B. duruensis* De Wild.); Sabona, S. of Dungu, *Seret 544-b* (BR, lectotype of *B. duruensis* De Wild.); near Nala, *Seret 544-c* (BR, paratype of *B. duruensis* De Wild.); near Arebi, *Seret 544-d* (BR, paratype of *B. duruensis);* Ituri R., *Stuhlmann 2656* (B); ibid., *Stuhlmann 2715* (B); Kalehe Terr., Irangi, *Troupin 2482* (BR); Walikale Terr., 52 km N.E. of Masisi, near Mutongo, *Troupin 3000* (BR, K); Kalehe Terr., Irangi, 110 km on the road Kavumu-Walikale, *Troupin 3348, 3462, 3466, 3552, 3749, 3751, 3917, 4732* (BR).

Rwanda: W. Mpororo region, Kajonsa, Issassi R., *Stuhlmann 3094* (B).

Uganda: Kigezi Distr., Ishasha gorge at Kayonza For. Res., *Eggeling 4196* (K); ibid., *S. Paulo 664* (BR, EA, K); ibid., *Purseglove P- 2006* (EA, K).

3.3. **Begonia poculifera** Hook.f. **Fig. 2, 3, 4; Map 2, 3**

Begonia poculifera Hook.f. in Oliver, Fl.Trop.Afr. 2: 574. 1871; O. Warburg in Engl., Nat. Pflanzenf. 1st ed. 3 (6a): 140. 1894; Engler in Engl. and Drude, Veg. der Erde 9, Die Pflanzenw. Afr. 3(2): 614. 1921; Irmscher in Engl., Nat. Pflanzenf. 2nd ed. 21: 574. 1925; Hutch. and Dalz., Fl. W. Trop. Afr. 1st ed. 1(1): 188, fig. 82D. 1927; Hutch. and Dalz., Fl. W. Trop. Afr. 2nd ed. 1(1): 219, fig. 86D. 1954.

Syntypes: *Mann no. 561* (Fernando Po, 'epiphyte 1–2 ft on trees, 2000 ft up the mountain', paratype, K); *Mann no. 1276* (Cameroun, 'climbing plant 6 ft high, Cameroun Mountains, elevation 4000 ft', lectotype, K; duplicate at P).

Description. Epiphyte, rarely terrestrial and then growing on rocks, often more or less branched, in some cases the plant with a bushy appearance; the stems erect or pendulous, more or less woody, in particular towards the base, up to 2 m long. Stems variable in diameter, sometimes slender, much branched, curved and only 1.5 mm in the upper parts, sometimes stout, very woody and up to 12 mm near the base, more or less terete in transverse section, smooth, slightly glossy, brownish-green to dark red-brown in vivo, greyish, pale brown or brown and often longitudinally finely ridged in sicco. Young stems squamulose, the more or less dense scaly indumentum consisting of peltate, sessile, helicoidal, greyish-transparent and near the centre often pale brownish, rather irregularly shaped hairs with a more or less denticulate margin (Fig. 3 (18–22) and Fig. 4 (15–17)). The hairs often coherent in clusters and very much appressed to the finely alveolate epiderm, sometimes loosely scattered; the indumentum usually disappearing with age and the stems becoming scurfy or glabrous and glossy. The nodes somewhat thickened and quite often with adventitious roots. Especially the older and thicker stems with conspicuously hoofshaped to nearly circular scars of fallen leaves, these scars bordered above by a nearly annular scar formed by the pair of fallen stipules and often also by a smaller, axillary, transversely elliptic scar left by a fallen inflorescence. Laterally of the scar left by the inflorescence there is often a more or less developed patent pointed dormant bud. Without exception these buds are found on the side (+ side sensu IRMSCHER, l.c. page 552, 1925) away from the side where the leaf-apexes are found. Internodes varying in length, up to 10 cm long, usually much shorter.

Stipules readily caducous, boat-shaped, folded along the median, up to 5.5 × 1.5 cm in folded position, narrowly ovate to ovate or more or less triangular, acute to obtuse at the apex; the bigger (outermost) stipule of each pair closely embracing the smaller (inner) one with widely overlapping margins. The outer stipule conspicuously keeled in the upper part and more or less densely squamulose, the inner stipule not keeled and with less indumentum; both sometimes with globose, sessile, multicellular, whitish or brownish-black glandular trichomes (Meyensche Perldrüse) loosely scattered in a zone along the central fold inside (very conspicuous in vivo), otherwise glabrous inside. In vivo the stipules glossy pale green or pink, more or less transparent, with distinct longitudinal venation; the veins branching and anastomosing towards above and forming a widely elongate reticulum.

Leaves often, but not always, confined to the upper parts of the stems, soft, somewhat fleshy or slightly leathery, shining on the upper surface when young. Petioles of fully developed leaves flattened or furrowed above, sometimes terete, wine-red or brownish-red and with a few scattered contrasting elongated pale green lenticels in vivo, varying in length, 1–14 cm long (the highest dimensions measured on material of plants in cultivation), most often with an indumentum as described above for the stems, rarely becoming glabrescent. The blade asymmetric, obliquely-narrowly ovate, -ovate or -broadly ovate, most often falcate to fan-shaped, (3.5–)7–19(–22) × (1.8–) 3–19 cm,* obtuse, truncate, cordate or cuneate at the base, acuminate to cuspidate or more rarely acute at the apex; acumen if present 0.5–2 cm long; margin entire, obscurely lobed or coarsely toothed at the tip of the main lateral nerves; both sides covered with a more or less dense indumentum of greyish to pale brown scaly hairs (description of hairs see above), especially very young leaves sometimes densely clothed with this type of indumentum, old leaves becoming glabrescent on the lower surface; glossy bright green or rather dull green and often with a narrow purplish edge above, paler green and sometimes with a reddish tinge or even wine-red all over beneath (in vivo), palmately 3–7-nerved, the central (main) nerve often strongly dichotomously branched shortly (up to 2 cm) above the base, the other nerves also branching, the branches reaching the leaf-margin or not, the nerves prominent beneath, less so above and in vivo even somewhat impressed on the upper surface, pale green or wine-red, the red colouration if present especially pronounced on the lower surface (in vivo), often loosely scattered with minute (in vivo red) narrowly elliptic dots on which most often is implanted a peltate, transparent scale sitting on a blackish, glandular, swollen and wrinkled, probably multicellular stalk. Veins inconspicuous.

Inflorescences axillary, directed away from the patent axillary bud (see above), all facing the minus(–)side, proterandrous-androgynous (containing male and female flowers, the male flowers reaching anthesis before the female flowers). Peduncle (0.5–)1.5–4(–7) cm long, flattened and slightly broadening towards above, otherwise terete, in vivo often curved and up to 3 mm diam., brownish-green to bright dark red, usually with some scattered lenticellike longitudinally elongated greenish-white spots and with a more or less dense scurfy greyish-white squamose indumentum; bearing at the apex a flattened cup composed of two free but with the margins largely overlapping persistent (pseudo**)-bracts (bracts of the 1st order) that conceal the remaining part of the inflorescence. Cups (measured on dried herbarium specimens) 10–40(–50) mm wide at apex, 10–25(–30) mm high, widest at the apex, smallest at the base, concave above (adaxial side), convex beneath, the lateral edges curved or tapering along more or less straight lines towards the base and the cups 'cup'- or 'beaker'-shaped; in vivo glossy pale green to brilliant red on the light exposed adaxial (upper) side, the abaxial (lower) side of the cup often only with a red edge, otherwise yellowish-green, nearly glabrous or with a loose scaly indumentum especially along the edges. The two separate outer pseudo-bracts of the cup each narrowly boat-shaped, measuring up to 3 × 2.5 cm in outline (measured while being folded along approx. the median), often somewhat transparent and with a conspicuous venation in vivo, the veins 6–8 on either side of the fold, running parallel near the base, branching, anastomosing and widely reticulate upwards.

---

* Measured as indicated in Fig. 3(2).

** See foot note page 380.

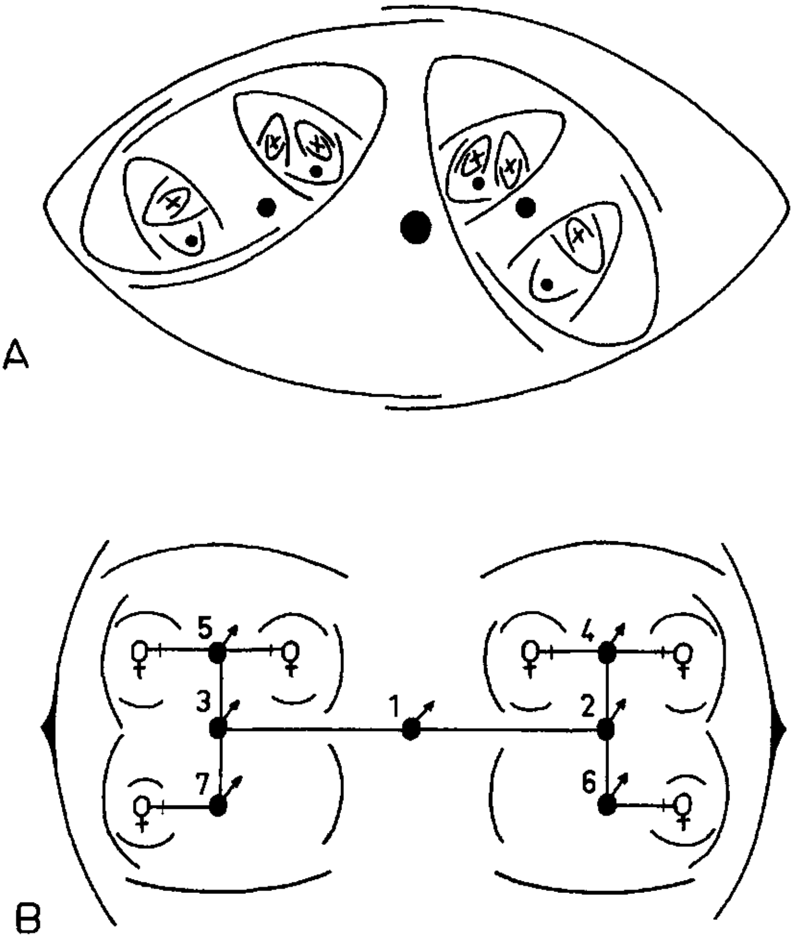


FIG. 2. A: Schematic representation of an inflorescence of *Begonia poculifera* var. *teusziana* (J. BRAUN et K. SCHUM.) J. J. DE WILDE comprising 7 male flowers (●), 6 female flowers (×) and 26 bracts. B: The same inflorescence represented in a diagram. The numbers 1 to 7 indicate the sequence of the development and flowering of the male flowers(♂). Pseudo-bracts 1st order are almost equal in size, subsequent pairs are always unequal. (From *Leeuwenberg no. 10.002*, WAG, also in cultivation at Wageningen).

Within this outer pair of pseudo-bracts unrolls the remainder of the cymose inflorescence. Up to eight female and seven male flowers can be found developing in the inflorescence, which in that case reaches branches of the fourth order (see Fig. 2). A higher number of flowers has never been observed, while a minimum number of two female flowers was once found in a depauperated inflorescence of a cultivated plant. At all dichasial branchings the main axis is on principle terminated by a male flower, although the central male flower terminating the peduncle and also the male flowers terminating the axes of the first branching order may often be suppressed. In that case only a threadlike, flattened, pale brown (often two times hooked) up to 1.7 cm long rudiment can be found. Each male flower is subtended by two bracts; the bracts becoming smaller with higher order; in shape the bracts basically identical with the bracts first-order as depicted (Fig. 3 and 4). The female flowers after monochasial branching borne on the lateral axes of the highest order (consequently the terminal and the other lateral axis of the ultimate dichasial branching suppressed). In one case, however, it was found that the other lateral axis was not suppressed, but after subsequent monochasial branching supported the ultimate female flower. It is to be noted that the axis referred to above are in reality reduced or absent. Without exception also each individual female flower is subtended by two bracts.

Flowering within the androgynous inflorescence is strictly proterandrous, the male flower(s) of the lowest possible order reaching anthesis first, those of a consecutive higher order (if present) opening later as indicated by numbers 1 to 7 in the diagram (Fig. 2, B). The female flowers likewise developing in successive order. A plant in cultivation, however, showed an inflorescence in which the last male flower was still at anthesis simultaneous with three female flowers.

Male flower: Perianth-segments (tepals) two, broadly elliptic to transversely broadly elliptic (nearly circular) or obovate to broadly obovate, (4–)12–25(–29) × (3–)10–21(–28) mm, white or pinkish outside, with red longitudinal stripes on the inner side from the base halfway up, the adaxial (upper) tepal more clearly striped than the other, glabrous or with a few scattered peltate scaly hairs; the tepals fused at their often slightly cordate extreme base and forming a white, narrow, solid, 3–12(–16) mm long by 1–2 mm wide perianth-cylinder there below, which, with a hardly perceptible but distinct articulation is implanted on the 8–14 mm long, also white, pedicel (the support of a single male flower combined up to 30 mm long, permitting the flowers at anthesis to exsert from the cup formed by the pseudo-bracts). Flowers after anthesis withering, shriveling and most often falling as a whole from the articulation, the true pedicels staying behind, withering and still present as thin, flattened, brownish threads at the time the female flowers are at anthesis. Androecium fasciculate, stamens (10–)15–40(–45), arranged in the way of a raceme of bananas. Filaments fused at the extreme base over 0.2–0.5 mm, otherwise free, up to 2 mm long, the shortest filaments of the fascicule (adaxial side) only 0.1–0.3 mm long. Anthers in vivo up to 3.5 × 0.8 mm, narrowly obovate, obtuse or truncate at apex, opening laterally, lengthwise, in such a way that the opened slits are directed upwards, all facing the axis of the flower.

Female flower: Perianth-segments (tepals) two, in shape and dimensions more or less similar to the corresponding male flowers, often somewhat smaller, sometimes nearly circular and up to 22 mm diam.; the segments fused at the base and forming a 5–15 mm long, in the very centre hollow cylindric perianth-tube which is often covered with a loose scaly transparent indumentum. Styles 4(–5), fused at the base over 0.5–2 mm. Free parts of the styles 1–3 mm long, very minutely puberulous all over, horseshoe-like forked upwards; the arms of the horseshoe 1–2.5 mm long, each arm spirally twisted with ca 1.5 turn, the twist concentrated in the capitate upper part, densely papillose all over, the papillae longer and glanduliferous in a broad band continuous from one arm to the other and following helically the morphologically outer face of the arms (stigmatic tissue?). Ovary (in vivo) shortly stipitate; stipe white, fleshy, 0.5–2 mm long by up to 1.5 mm diam.; obovoid, 4–9 × 2–6 mm, slightly 4(–5)-grooved, whitish often tinged with pink in the upper part and with squamose indumentum, 4(–5)-locular and with axile placentation.

Infructescences bearing up to 4 fruits (usually 1–3); the pseudo-bracts persistent, in vivo the adaxial (upper) side of the cup often brilliant dark red, the pseudo-bracts gaping and showing partly the berrylike white or somewhat pinkish fruit(s), in sicco the persistent bracts shriveled, pale brown.

Mature *fruit* (in vivo) glossy, pale greenish-white and often purplish tinged in the upper part, almost glabrous or with an indumentum of helicoidal hairs all over, obovoid, longitudinally more or less 4(–5)-grooved, 8–23 × 5–18 mm (the highest dimensions measured in vivo), shortly stipitate at the base, stipe 0.5–2 mm long; the fruit usually obtuse above but at the centre more or less abruptly tapering into an apiculate up to 1.5 mm long apex (sometimes the fruit more flattened at the top), the apex terminated by a brownish flattened and often frayed scar on the place where the perianth-tube was attached. Sometimes the perianth-tube not breaking and the shriveled remnants of the perianth-segments and styles still more or less complete present on top of the already mature fruit (see Phot. 1). Pericarp (in vivo) thin, soft, flexible, somewhat transparent, like a loose chemise enveloping the white, swollen, fleshy, 4(–5)-lobed mass of seed-bearing placenta-tissue, but in an advanced stage of ripening of the fruit still attached to the 4(–5) septa; finally the pericarp only connected with the base and apex of the central axis of the fruit. Placentas 4(–5), axile, filling up the 4(–5) locules but leaving free short parts (ca 1–1.5 mm long) of the central axis at the base and at the apex of the fruit; the numerous small seeds attached at their base and pressed against the placenta-tissue.

Mature *seeds* up to 0.8 × 0.3 mm, glossy light brown, narrowly obovoid to narrowly ellipsoid, finely alveolate, the alveolae roundish but narrowly rectangular in a longitudinal direction near the base. The seed around the hilum darker brown and the alveolae here roundish again. Testa thin, comparatively hard but brittle. Whitish cotyledons filling the seed completely.

Seedling: In cultivation seedlings were above the substrate about one month after sowing; germination epigeal; cotyledons opposite, foliaceous, green, glabrous, symmetric, broadly ovate, ca 2 mm diam., very shortly stalked with a petiole less than 0.2 mm long. Hypocotyl ca 5 mm long. Epicotyl very short, less than 0.5 mm long. First leaf above the cotyledons developed ca 2 months after sowing, petiole ca 2 mm long, the blade conspicuous bright glossy green above, symmetric, elliptic to obovate, ca 7 × 5 mm, with a few scattered branched hairs on the margin. Second leaf developed about one month later, ca twice as big, still symmetric, margin slightly undulate and with scattered branched hairs; petiole up to 4 mm long.

Key to the varieties

1. Ratio maximum length: breadth of the lamina of full-grown leaves 2:1 to 3:1*. Petioles 1–4(–6) cm long. Leaf-margin usually entire, rarely obscurely toothed or lobed at the tip of the main lateral nerves . . . . **a. var. poculifera**

1. Leaf-ratio of full-grown leaves 3:2 to 1:1. Petioles 2.5–10(–14) cm long. Leaf-margin coarsely toothed to obscurely lobed, almost never completely entire . . . . **b. var. teusziana**

a. var. poculifera **Fig. 3; Phot. 1; Map 2**

Literature referring to *B. poculifera* var. *poculifera:* Hook.f. l.c. 1871; Engler l.c., 1921 (partly, excl. the as a synonym cited *B. teusziana* (erroneously spelled '*teuscziana*') J. Braun et K. Schum., which belongs to var. *teusziana*); Irmscher l.c. 1925; Hutch. and Dalz. l.c., 1927; Hutch. and Dalz. l.c., 1954 (partly, fig. 86D belongs to var. *poculifera*).

Typification: See under the species.

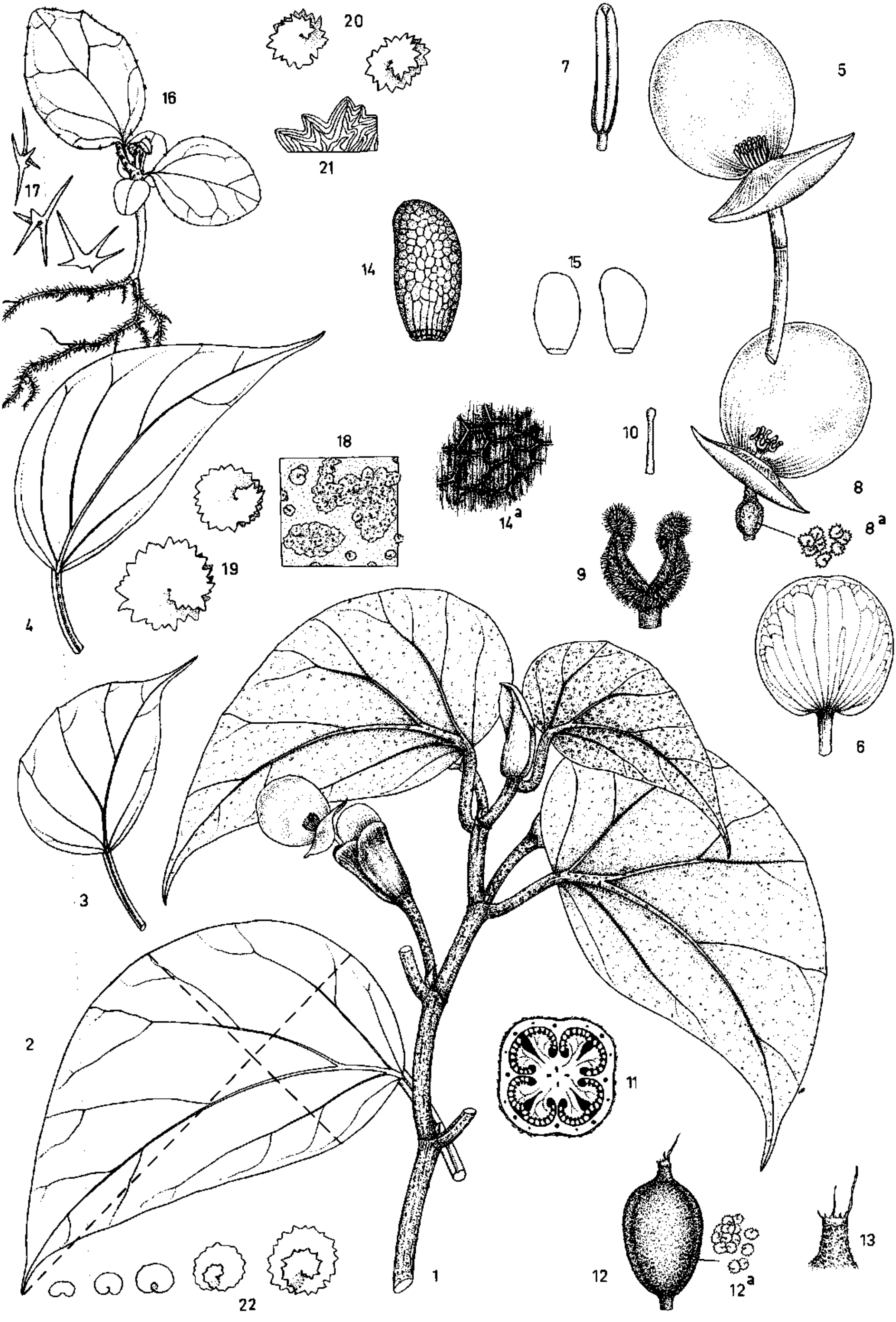
Synonyms: *Begonia haullevilleana* De Wild. in Ann. Mus. Congo, Sér. 5 (Bot.) 2: 320. 1908; Th. and H. Durand, Syll. Fl. Congol.: 234. 1909; É. de Wildeman in Bull. Jard. Bot. Brux. 5: 366. 1919; Engler in Engl. and Drude, Veg. der Erde 9, Die Pflanzenw. Afr. 3(2): 614. 1921; R. Wilczek in Fl. du Congo, - Rwand. - Bur., *Begoniaceae*: 9, pl. 1, C-H. 1969, partly, excl. *A. Léonard no. 3866*, Pl. 1, A and B; R. Fernandes in Conspec. Fl. Angol. 4: 293. 1970. Type: *F. Seret no. 866* (Zaire: between Zobia and Buta, holotype, BR).

Begonia adolfi-friderici Gilg in Mildbraed, Wiss. Erg. Deutsch. Zentr. Afr. Exp.

Fig. 3. *Begonia poculifera* Hook.f. var. *poculifera* – 1: flowering branch (× ½); 2, 3 and 4: different leaf shapes; the leaf-ratio mentioned in the text measured as indicated in 2 (× ½); 5: ♂ fl. (× 1); 6: tepal, ♂ fl., outer side (× 1); 7: stamen, front side (× 6); 8: ♀ fl. (× 1); 8-a: squamose indumentum on ovary (magnified); 9: upper part of a style, abaxial side (× 6); 10: capitate stigmatic papilla (magnified); 11: transverse sect. of ovary, ca in the middle (× 12); 12: mature fruit (× 2); 12-a: idem, detail of indumentum (magnified); 13: apex of mature fruit showing frayed remnant of perianth-cylinder (magnified); 14: mature seed (× 30); 14-a: idem, detail of testa (× 90); 15: different seed-shapes (magnified); 16: seedling ca a hundred days after sowing (× 3); 17: idem, hairs from leaf-margin (magnified); 18: clustered hairs on the upper surface of a leaf (× 3); 19, 20: peltate-helicoid hairs, frontal view, from a leaf and from a young ovary respectively (× 18); 21: idem, segment at a larger magnification; 22: idem, development of a hair, schematic (magnified). – 1, 5-11: *Mann 1276* and living material (*J. J. De Wilde 8787*); 2: *Lewalle 3773*; 3: *Satabie 261*; 4: *Seret 866*; 12-15: *J. J. De Wilde 8771*; 16–17: *J. J. De Wilde 8772*; 18–19: *Mann 1276;* 20–22: *J. J. De Wilde 8787.*

---

* See Fig. 3 (2) for determination of the leaf ratio.


20
7
5
16
21
17
14
15
10
18
14a
8
8a
9
19
4
6
3
2
11
1
12
12a
13
22

1907–1908, 2 (Bot.): 574. 1913; ENGLER loc.cit.: 614. 1921; IRMSCHER in ENGL., Nat. Pflanzenf. 2nd ed. 21: 574. 1925; R. WILCZEK l.c.: 10. 1969. Type: *Mildbraed no. 3242* (Zaire: Ituri, between Mawambi and Awakubi (presently spelled Avakubi), near Fariala, holotype and two isotypes in B).

Description: see under the species.

Notes to the synonyms: *B. haullevilleana* DE WILD. (l.c., 1908) is based on *Seret no. 866* (BR), collected in Zaïre in a forest along the road from Zobia to Buta.

In a remark added to the diagnosis DE WILDEMAN stated that the new described species showed certain analogies with *B. poculifera* and with *B. ampla* HOOK.F. (in this sequence!) 'se différenciant des deux par ses inflorescences plus courtement pédicellées, du premier par la forme de ses feuilles non cordées à la base, du second par leurs dimensions plus réduites'.

Certainly an error slipped into his text (the names should be reversed!) as the leaves of *B. poculifera* are at best slightly cordate at the base and this only rarely so. On the contrary *B. ampla* HOOK.F. is most often characterized by a cordate or even deeply cordate leaf-base.

As regards the length of the peduncle, ca 1 cm long in *Seret no. 866*, this comes very well within the range of variation of both *B. ampla* HOOK.F. and *B. poculifera* HOOK.F. Having assumed the reversed sequence of the names, the shape of the leaves of *Seret no. 866* is indeed unlike from the ones found usually in *B. ampla*. However, care must be taken, and it is especially the type of indumentum found on the leaves of *Seret no. 866* that distinguishes it from *B. ampla*, the latter generally characterized by hairs of a distinct stellate type. Examining the large range of variation found in shape and dimensions of leaves of *B. poculifera* and failing to reveal any other diagnostic characters or character-combinations to distinguish between *B. poculifera* and *B. haullevilleana*, the latter is reduced here to a synonym of *B. poculifera* HOOK.F. Leaf-ratio, length of the petioles and other characters indicate that *Seret no. 866*, and hence the name *B. haullevilleana* DE WILD., belongs to *B. poculifera* var. *poculifera*.

B. adolfi-friderici GILG (l.c., 1913) was described after a specimen collected by MILDBRAED (*no. 3242*) in Zaïre. The holotype is in Berlin. It fits in every respect the protologue with the exception that young leaves are, on the upper surface, covered with a distinct indumentum of scattered, sessile peltate hairs (the protologue states: 'Folia... supra glabra'). The conspicuous falcate leaves are rather narrow ('semi-lunato-curvata'), the inflorescences small (cups ca 1 × 1 cm in outline) and poor-flowered. These characters are slightly aberrant from those usually found in *B. poculifera* HOOK.F., and certainly when they are compared with the type material of the last name. Examination of the whole range of material, however, shows that the above mentioned characters vary widely within *B. poculifera*, and that there is no reason to distinguish *B. adolfi-friderici* as a distinct taxon. WILCZEK (l.c., 1969), maintained *B. adolfi-friderici* as a distinct species, separate from *B. haullevilleana*, using a number of

PHOT. 1. *Begonia poculifera* HOOK.F. var. *poculifera:* infructescence, the almost mature berry-like fruits still crowned by the shriveled remnants of perianth and styles. (*Van Setten 428*; phot. J. C. ARENDS).

characters which, in our opinion, all break down when considered individually as well as in combination. His description of *B. adolfi-friderici*, which is based on *Mildbraed no. 3242* (the type) only, contains a number of inaccuracies. Among them are: the length of the petioles, 1.5–3.5 cm according to WILCZEK, but 1.5–4.5 cm in reality; the indumentum on the upper surface of the leaves is variable with the age of the leaves, but the leaves are glabrous according to WILCZEK; the length of the perianth-cylinder of the female flowers ('a colonne apical de 1.5 cm de long' according to WILCZEK) barely 0.5 cm long on the type specimen and finally the placentation which is axile but parietal according to WILCZEK.

As a consequence the name *B. adolfi-friderici* is placed here into synonymy of *B. poculifera* HOOK.F. According to the characters of *Mildbraed no. 3242*, the specimen is identified as the variety *poculifera*.

Distribution (hitherto known): Nigeria, Cameroun, Fernando Póo, Gabon, Zaïre, Rwanda, Burundi, Tanzania, Angola.

Ecological and biological notes: Collectors' notes confirm that *B. poculifera* var. *poculifera* is a somewhat woody, often more or less scandent epiphyte on trees, most often found on the lower moss-covered parts of tree-trunks or on low thick branches. In a few cases the species was collected near ground-level and is reported then as growing on fallen trees. Exceptionally it seems to be found also growing on the soil e.g. 'among grasses and rocks at edge of flush' (*Sanford no. 5531*, K, MO). EXELL, on Fernando Póo, collected it among rushes along the edge of Lake Moka, at an altitude of ca 1800 m (teste *Exell no. 801*, BM).

The altitudinal range of the species, according to ca 40 records, stretches between 470 and 2250 m. A distinct optimum is found between 1200 and 1900 m, thus in the lower part of the afromontane vegetation-zone, where it grows in ombrophilous (sub)-montane mist or cloud forests. The lowest records (470 m) within this range come from near Yangambi in Zaïre (*Louis nos 15333* and *15791*, BR). The highest altitude on record is *Breteler c.s. no. MC-161* (K, P, WAG) from the Cameroun Mountain, where it was collected at an altitude of 2250 m.

Most often the flowers are reported white with pink, red or purple lines. Only twice pink flowers are mentioned (teste *Christiaensen no. 2010*, BR, K and *Letouzey no. 9584*, K, P). CARMICHAEL only, in his collectors' notes, stated that the flowers diffuse a sweet perfume (teste *Carmichael no. 411*, EA, K).

Mature fruits are recorded being red (*Melville no. 421*, BM, K, and *Bouxin no. 439*, BR). Mature fruits seen by the senior author on plants in cultivation at the Botanic Garden at Meise, Belgium, were whitish with reddish tinge towards the apex (*J. J. de Wilde no. 8771*, WAG).

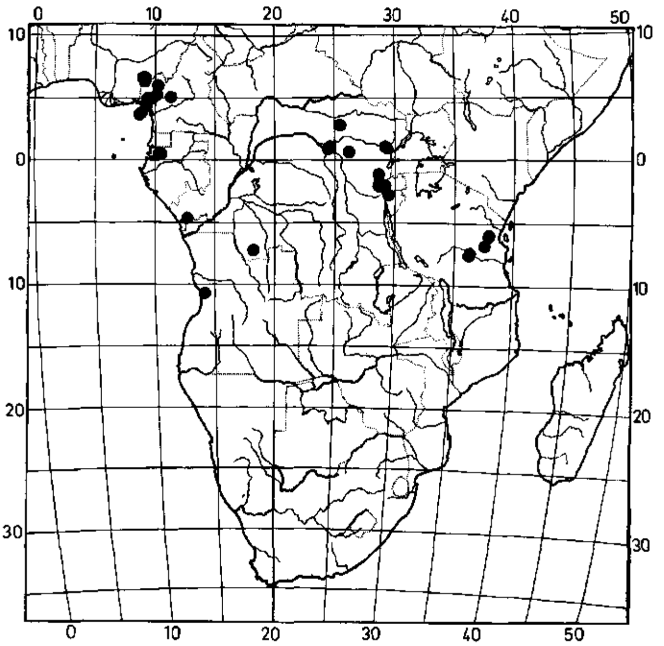
Vernacular names: Zaïre: *kalokosa* (dial. Kirega), *ngongolya* (dial. Kihunde), *isowe* (dial. Turumbu). Rwanda: *ingurukizi*.

Uses: According to CLAESSENS (*no. 315*, BR) a decoction of the leaves is used by pregnant women to stimulate lactation.

Specimens examined:

NIGERIA: Ogoja Prov., Obudu plateau, *Head 94* (K); ibid., Ikwette, *Savory and Keay FHI-25244;* ibid., *Stone 67* (K); ibid., *Stone 68* (K); ibid., *Tuley 632* (K).

CAMEROUN: below Mann's Spring, Cameroun Mt., *Brenan 9388* (BM, K, P); Cameroun Mt., *Breteler c.s. MC-161* (K, P, WAG); Northern slopes of Cameroun Mt., *Davies FHI-37497* (K);



Map 2. Localities where *B. poculifera* Hook.f. var. *poculifera* was collected.

Buea, *Deistel 128-b* (B); ibid., *Deistel 661* (B); above Musake, Cameroun Mt., *Hutchinson and Metcalfe 1* (K); Manengouba Mts, *Leeuwenberg 9955* (WAG); Golep (or Ngoro) Mt., 36 km N. of Bafia, *Letouzey 9584* (K, P, YA); Manengouba Mts, Mueba, 7 km S. of Bangem, *Letouzey 13932* (BR, P, WAG, YA); N.W. slope of Mt. Koupé, above Nyassosso, *Letouzey 14685* (P, YA); Cameroun Mt., *Maitland 898* (FHI, K); Cameroun Mt., *Mann 1276* (K, lectotype of *B. poculifera* Hook.f., duplicate in P); Cameroun Mt., above Buea, *Migeod 76* (BM, partly, otherwise var. *teusziana*); ibid., *Morton GC-6725* (K); Bamboutos Mts, Menoua, near Dschang, *Sanford 5531* (K, MO); ibid., near Nkongsamba, *Sanford 5544* (K); Roumpi Mts, summit of Mt. Rata, 36 km N.W. of Kumba, *Satabie 261* (P, YA); Bafut-Ngemba For. Res., *Tiku in FHI-22170* (K).

Equatorial Guinea: Fernando Póo: Moka Lake, *Exell 800 and 801* (BM); sin. loc., *Mann 561* (K, paratype of *B. poculifera* Hook.f.); Moka, *Melville 421* (BM, K); N. slope of Pico de Sta. Isabel, above Basilé, *Mildbraed 6324* (B, HBG); above San Carlos, near Musola, *Mildbraed 7058* (B, HBG); Pico de Sta. Isabel, along T.V. track, *Sanford 5981* (IFE).

Gabon: Monts de Cristal, near Nkan, *N. Hallé and Villiers 4811* (P); ibid., *N. Hallé and Villiers 5050* (P, intermediate between var. *poculifera* and var. *teusziana).*

Zaïre: Kalehe Terr., Irangi, *Bamps 2918* (BR); Kiwangala, *Callens 3285* (K); Kalehe Terr., near Irangi, 110 km on the road Kavumu-Walikale, *Christiaensen 2010* (BR, K); Bafwasende Terr., near Bafwaboli, *Claessens 315* (BR); Kalehe Terr., near Bunyakiri, *Gutzwiller 2196* (BR); Masisi Terr., Nyabiondo, *Gutzwiller 3261* (BR); Idjwi island in Lake Kivu, *Humbert 8414* (P); between Irumu and Mambasa, *Lebrun 4185* (BR, K); 20 km N.E. of Yambao, *Louis 15333* (BR); along the Lusambila R., near Yangambi, *Louis 15791* (BR); Ituri, between Mawambi and Avakubi, near Fariala, *Mildbraed 3242* (B, holotype of *B. adolfi-friderici* Gilg); 58 km on the road Bukavu-Walikale, *Sebald 5002* (STU); between Bali and Matanga-Pamba, E. of Buta, *Seret 122* (BR); between Zobia and Buta, *Seret 866* (BR, holotype of *B. haullevilleana* DE WILD.).

RWANDA: Cyangugu, Nyongwe forest, near Gisakura, *Bouxin 439* (BR); ibid., *Bouxin 971* (BR).

BURUNDI: Bubanza Terr., Mabayi, Lua R., *Lewalle 3773* (BR).

TANZANIA: Uluguru Mts., Tanana, *Bruce 790* (BM, K); Iringa Distr., near Kalimbili, *Carmichael 411* (EA, K); Morogoro Distr., Nguru Mts, N.W. slopes of Mkobwe near Turiani, *Drummond and Hemsley 1897* (BR, EA, K); Nguru Mts, *Sacleux 821* (P); ibid., *Schlieben 3350* (B).

ANGOLA: Cabinda: Maiombe, Belize, M'Bulu hills, Nzanza-Lufo R., *Gossweiler 7991* (BM); Cuanza Sul: Amboim, Capir, near Carloango-Cuvo R., *Gossweiler 9937* (B, BM, K).

CULTA: Bot. Gardens, Meise, Belgium, *J. J. de Wilde 8771* (WAG, spirit material only); University for Agriculture, Wageningen, the Netherlands, *J. J. de Wilde 8772* (WAG, seedlings of *J. J. de Wilde 8771*, spirit material only); ibid., *J. J. de Wilde 8787* (WAG, from a plant in cultivation, introduced from the Botanic Garden at Munich and probably originating from Nigeria); ibid., *Van Setten 428* (WAG, from a plant introduced by BRETELER and DE WILDE from near Asok, Monts de Cristal, Gabon).

b. var. teusziana (J. BRAUN et K. SCHUM.) J. J. DE WILDE, *nov. comb. et stat.* **Fig. 4; Phot. 2; Map 3**

Basionym: *Begonia teusziana* J. BRAUN et K. SCHUM. in Mitt. Forschungsreisenden und Gelehrten deutsch. Schutzg. 2: 168. 1889. Type: *J. Braun no. 85* (*'No 1168'*) (Cameroun: Malimba, holotype in B).

Note: The holotype mentioned above bears a collectors' label with in pencil written on it 'Aug. 88. Malimba N = *85* 5 Bogen (*Begoniae*)' and printed in the upper righthand corner '*No 1168*', which was later crossed in pencil. This is to be noted since there exists in the Berlin Herbarium (B) another collection by J. BRAUN marked on the collectors' label: 'Aug. 88. Malimba *85* (*Begoniae*)'. This last collection was designated by the present authors as a paratype of *B. rhopalocarpa* WARB. (see Acta Bot. Neerl. 28(4/5): 367. 1979).

Literature referring to *B. poculifera* var. *teusziana*: O. WARBURG in ENGL., Bot. Jahrb. 22(1): 39. 1895 (partly, the cited specimens and the name *B. teusziana* J. BR. et K.SCHUM., placed there in synonymy to *B. poculifera*, belong to var. *teusziana*); ENGLER l.c., 1921 (where the name *B. teusziana* is cited in synonymy to *B. poculifera*); HUTCH. and DALZ. l.c., 1954 (a part of the cited material only).

Differential characters: A stout epiphyte, the stems usually erect, up to 2 m long, often sparsely branched and bearing the leaves and inflorescences frequently towards the apex of the stem; the plants in general more robust in appearance as compared to var. *poculifera*.

Fully developed leaves fan-shaped to broadly-falcate, 8.5–19(–22) × 6.5–19 cm; palmately (4–)5–7-nerved as compared to usually falcate and 3–5-nerved in var. *poculifera*; the margin most often coarsely toothed or at least obscurely lobed, rarely entire;

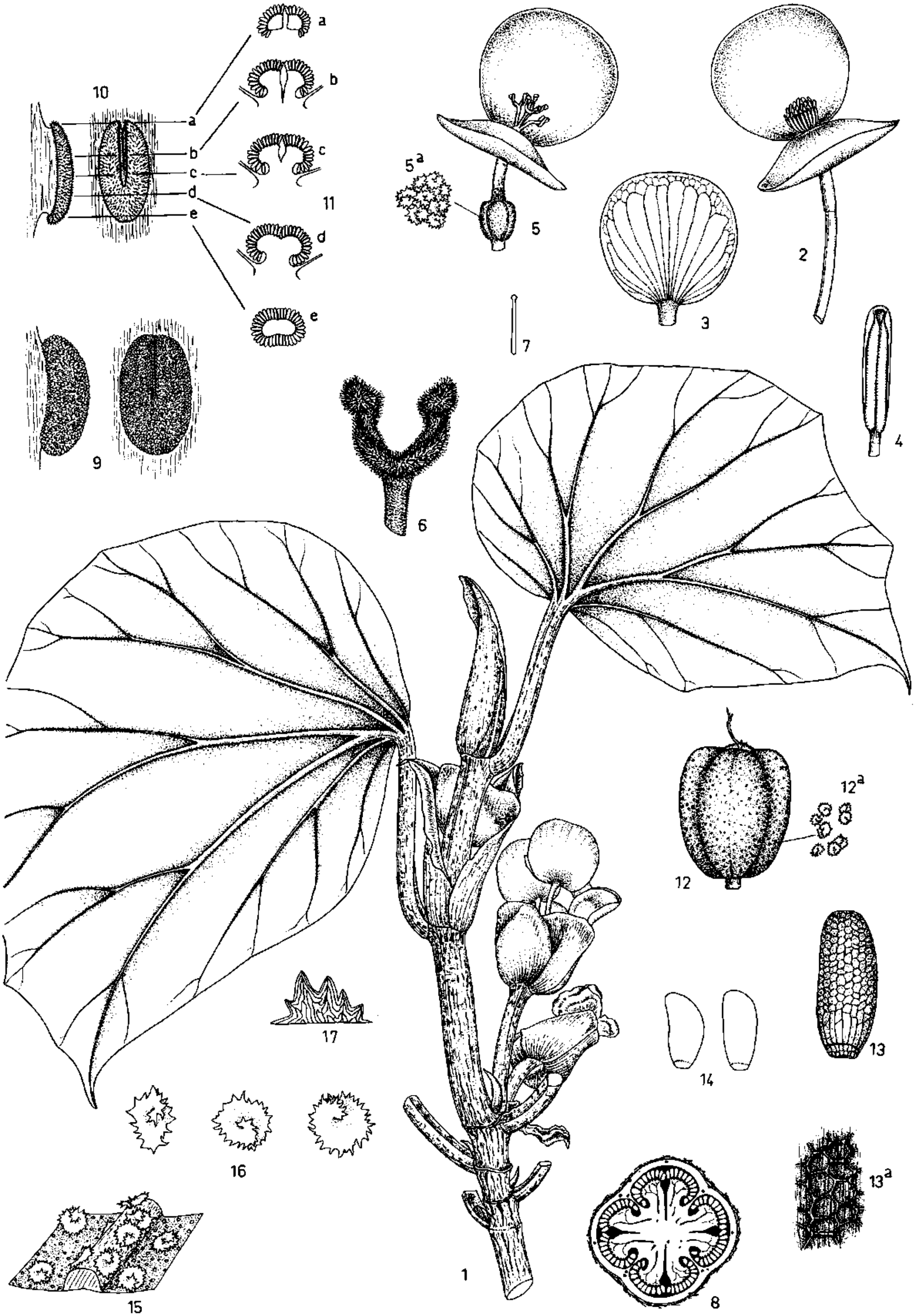
petioles in vivo flattened or slightly furrowed above as compared to most often almost terete in var. *poculifera*, 2.5–10(–14) cm long (1–4(–6) cm in var. *poculifera*).

The cups formed by the persistent outer pseudobracts of the inflorescence usually with curved lateral edges and the cups more cup-shaped as compared to var. *poculifera* where these lateral edges tend to taper along straight lines towards the base of the cup and hence shows cups which are more beaker-shaped. The cups in vivo most often glossy brilliant red on the light exposed side as compared to pale green with often only a reddish tinge in var. *poculifera*.

Distribution: Nigeria, Cameroun, Fernando Póo, Gabon.

Ecological and biological notes: The ecological requirements of *B. poculifera* var. *teusziana* seem to coincide with those of the closely related sympatric var. *poculifera* (see there). According to the collectors' notes var. *teusziana* is mainly found between altitudes of 600–1800 m, falling well within the altitudinal range of var. *poculifera*.

PHOT. 2. *Begonia poculifera* HOOK.F. var. *teusziana* (J. BRAUN et K. SCHUM.) J. J. DE WILDE: inflorescence, pseudo-bracts 1st order partly removed; a male flower at anthesis, female flowers still closed; withered remnant of the flower-stalk of a fallen male flower distinctly present (*J. J. De Wilde 8764*; phot. J. W. MUGGE).


a
b
10
a
b
c
d
e
c
5a
11
d
5
2
e
3
7
4
9
6
12a
12
13
17
14
16
13a
15
1
8

An interesting exception to this pattern is found in *Braun no. 85* (*'No 1168'*), the type of var. *teusziana*, collected near Malimba, at the mouth of the Sanaga River in Cameroun. Although no altitude is indicated in the collectors' notes, this must have been near sea-level. In our opinion, this collection constitutes a good example of a taxon which, normally, is found in the (sub)montane zone but, due to ecological similarities between the montane environment and the coastal habitat may occur occasionally also near sea-level. The principal binding ecological factor between both habitats is the frequently occurring very high relative humidity of the air (cf. R. Schnell, Introduction à la Phytogéographie des Pays Tropicaux 2: 781. 1971). A similar reasoning may apply for *B. ampla* Hook.f. which occurs near sea-level on the islands of the Gulf of Guinea too (see also under that species).

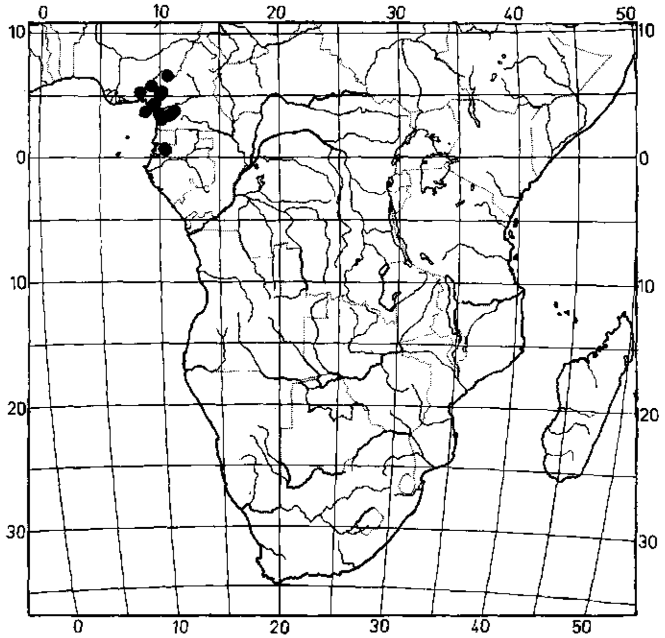
From the data so far available it is hard to understand which phenomena are responsible for maintaining the morphological discontinuity between both variable taxa. Plants from both varieties, collected in wild populations from different geographic origin and cultivated under equal conditions in a glasshouse at Wageningen maintained their morphologic differences. A series of seedlings and subsequently flowering plants belonging to var. *poculifera* (teste *J. J. de Wilde no. 8772*, WAG) grown from seeds obtained from a fruit produced as the result of geitonogamy in the Botanic gardens at Meise, Belgium, were remarkable homogeneous in appearance. Additional field observation and probably laboratory experiments are needed to elucidate this question.

In vivo the bracts embracing the flowering part of the inflorescence contain a watery juice in which the flower-buds and later on the young fruits are embedded (teste *J. J. de Wilde no. 8662-A*, WAG).

Dr. J. Doorenbos observed on plants in cultivation at Wageningen, that infructescences containing mature fruits dropped as a whole, the peduncle included (verbal communication).

Considering the epiphytic way of growing, transport of seeds is probable by means of animals.

Fig. 4. *Begonia poculifera* Hook.f. var. *teusziana* (J. Braun et K. Schum.)J. J. De Wilde – 1: flowering branch (× ½); 2: ♂fl. (× 1); 3: tepal, ♂ fl., outer side (× 1); 4: stamen, front side (× 6); 5: ♀fl. (× 1); 5-a: squamose indumentum on ovary (magnified); 6: upper part of a style, abaxial side (× 6); 7: capitate stigmatic papilla (magnified); 8: transverse sect. of ovary, ca in the middle (× 8); 9: ovuliferous placenta, front- and side-view (magnified); 10: idem, ovules removed (magnified); 11(a–e): transverse sections of ovuliferous placenta on different heights, as indicated in 10, schematic (magnified); 12: mature fruit (× 1); 12-a: idem, detail of indumentum (magnified); 13: mature seed (× 30); 13-a: idem, detail of testa (× 90); 14: different seed-shapes (magnified); 15: fragment of underside of leaf (× 9); 16: peltate-helicoid hairs, frontal view (× 18); 17: idem, segment at a larger magnification. – 1–17: *Leeuwenberg 10.002*, *J.J. De Wilde 8764* and living material from the same clonal background.



Map 3. Spot distribution map giving localities where *B. poculifera* var. *teusziana* (J. Braun et K. Schum.) J. J. De Wilde was collected.

Specimens examined:

Nigeria: Eastern region, near Oban, Niaji, *Talbot 589* (BM); ibid., *Talbot 590* (BM).

Cameroun: near Lolodorf, Heimannshof, *Annet 395* (P); near Malimba, *Braun 85* (*'No 1168'*) (B, type of *B. teusziana* J. Braun et K. Schum.); Cameroun Mt., Buea, *Deistel 60* (B); ibid., *Deistel 189* (B); ibid., *Deistel 209* (B); 14 km along the road Dschang-Mélong, *J. J. de Wilde 8662-A*(WAG); Nanpé, ca 10 km W. of Bangante, *W. J. de Wilde and De Wilde-Duyfjes 2389* (BR, WAG); near Nkongsamba, Mt. Nlonako, *Hedin Lon. 16* (P); Cameroun Mt., between Musake and Buea, *Hutchinson and Metcalfe 69* (K); near Yaoundé, *Jacques-Félix 5073* (P); Ndonge, Mt. Nlonako, *Ledermann 6178* (B); N. of Fondjanti, 12 km on the road Bafang-Nkondjok, *Leeuwenberg 10.002* (WAG); near Mbem, 40 km E.S.E. of Nkambe, *Letouzey 8851* (P, YA); Ngwon, a hill 38 km E. of Kribi, *Letouzey 9370* (P, YA); 25 km W. of Ngoulémakong, Akoumokeguen (or Ngoakèle) hill, *Letouzey 11.429-bis* (P, YA); 30 km S.E. of Mamfe, crest of Mt. Nta Ali, *Letouzey 13.860* (P, WAG, YA); 15 km N.W. of Nkongsamba, Manengouba Mts, trail from Bangem towards the lakes, *Letouzey 14.384* (P, WAG, YA); Cameroun Mt., above Buea, *Migeod 76* (BM, partly, otherwise var. *poculifera*, K); ibid., W. of Buea, *Preuss 883* (B, BM); ibid., *Preuss 889* (B, COI, HBG); ibid., near Buea, *Preuss 900* (B); Lolodorf, Mapinda hill, *Staudt 336* (B); Mamfe Distr., Mune River For. Res., on the Kanta-Nga path, *Tamajong FHI-22.148* (FHI, K).

Equatorial Guinea: Fernando Póo: Northern slope of Pico de Sta. Isabel, above Basilé, *Mildbraed 6437* (B, HBG).

Gabon: ca 5 km along the road Asok-hydroëlectric power station in the Tchimbélé R., *Breteler and De Wilde 203* (WAG); Mount Méla, ca 1,5 hours walking distance S. of the village Méla, *Breteler and De Wilde 314* (WAG).

CULTA: Department of Horticulture, Univ. for Agriculture, Wageningen, the Netherlands; from introduced material of *Leeuwenberg no. 10.002, J. J. F. E. de Wilde 8764* (WAG).

3.4. **Begonia bonus-henricus** J. J. DE WILDE, *sp. nov.* **Fig. 5, 6; Map 4**

Type: *J. J. F. E. de Wilde no. 8281-A* (Cameroun: ca 15 km S.E. of Ebolowa, hills situated between N'Koemvone and N'Kolandom, 2°48′N. × 11°9′E., holotype in WAG; isotypes: BR, K, P, WAG, YA).

Epiphytica, monoeca, caulibus tenuibus, ± repentibus, interdum pendulis, crescens in truncis arborum vel in ramis crassis. Caules plerumque teretes, usque 60 cm longi, 1–1.5(–2.5) mm diametro, saepe nodis radicantibus, indumento ± persistente, squamuloso, ferrugineo usque fere griseo obtecti.

Stipulae mox deciduae, usque ad 16 mm longae, stipulae externae parte superiori conspicue carinatae, dense squamulosae. Folia diu persistentia, crasse carnosa, petiolis (3–)5–12(–15) mm longis, laminis symmetricis vel paululum asymmetricis, ovatis vel anguste ovatis, 3.5–10 × 1.5–3.5 cm, costa petiolum continuante vel lamina subscutata inconspicue palmati 3–(4–5) nervia, basi obtusa vel cuneata, apice acuminata vel fere cuspidata, margine integra vel paululum undulata vel supra medium obscure obtuse dentata, praesertim subtus dense obtecta indumento persistente pilis peltatis helicoideis subsessilibus formato.

Inflorescentia axillaris, cymosa, protrandro-androgyna, continens usque 3 flores masculos et etiam vel tantum unum florum femineum; pedunculo 3–12 mm longo, apice cupulam complanatam ferens; cupula indicata composita duobus bracteis liberis sed margine late imbricatis, persistentibus, carnosis partem reliquum inflorescentiae occultans. Flos masculus pedicello articulato usque ad 15 mm longo suffultus, perianthii segmentis (tepalis) duobus, late obovatis, 8–10 mm, albis, tepalo adaxiali purpureo-rubro-striato. Androecium fasciculatum, stamina 18–26 filamentis fere liberis. Flos femineus segmentis perianthii (tepalis) segmentis floris masculi similibus vel paululum majoribus, segmentis basi fusis tubum perianthii cylindricum centro cavum 2–3 mm longum in apice ovarii depositum formantibus. Styli 4, ima basi fusi, ceterum liberi, stylus quivis hippocrepiformis, apice bifurcatus, brachiis spiraliter contortis, papillosis, glanduliferis.

Ovarium brevissime stipitatum, obovoideum, 4 × 3.5 mm, dense squamulosum, 4-loculare, placentis axillaribus. Infrutescentia bracteis persistentibus fructum albidum bacciformem semper partim obtegentibus. Fructus globoso-obovoideus, ca 12 × 10 mm, squamulosis, breviter stipitatus, apice mucronulatus, pericarpio tenuiter coriaceo.

Semen 0.8–0.9 × 0.3 mm, anguste ellipsoideum, saepe paululum curvatum, delicate areolatum.

Etymology: Lat. bonus: good; Henricus: Henry; bonus-henricus: Good

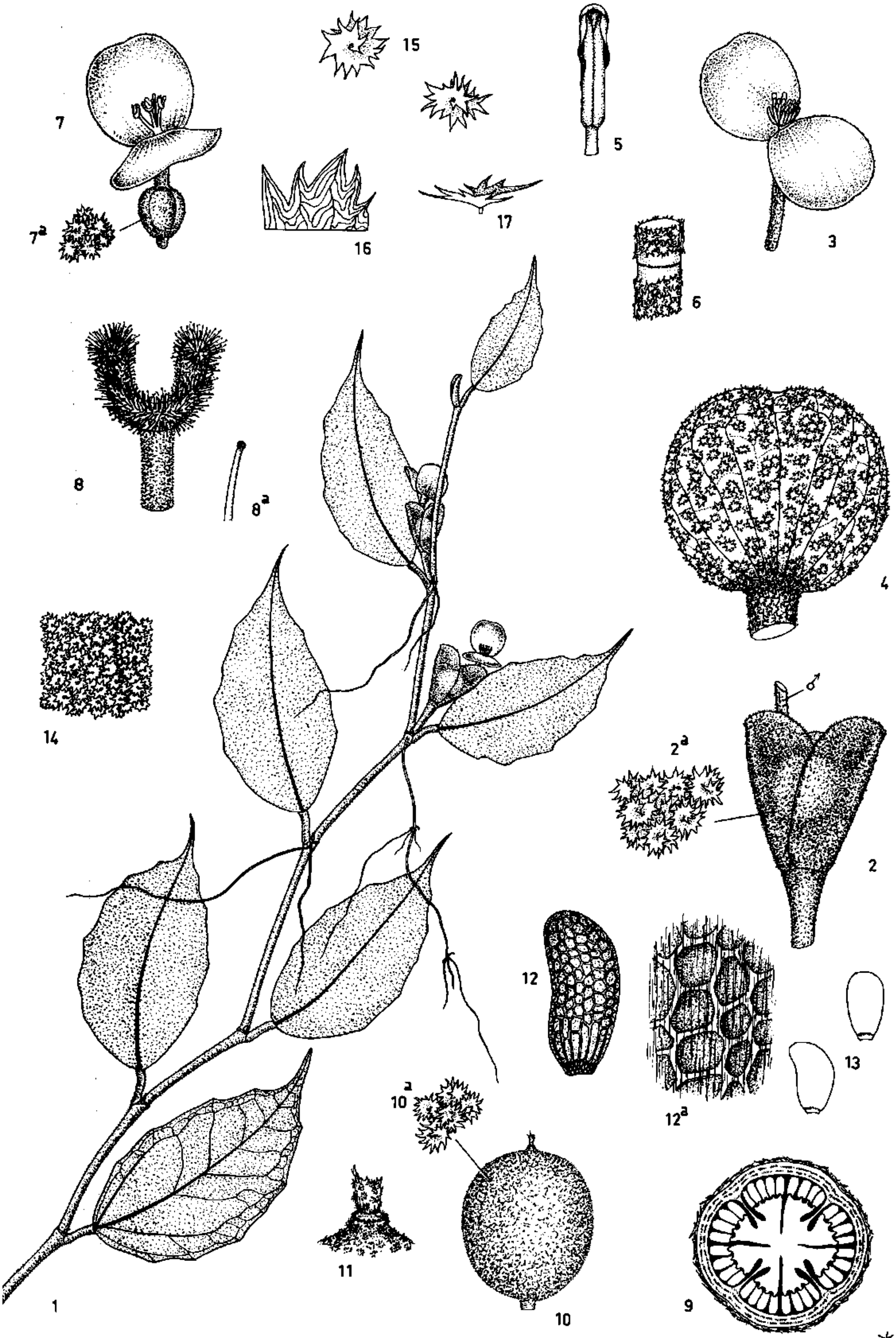
Henry. *Begonia bonus-henricus* is named in honour of Professor Dr. HENDRIK CORNELIS DIRK DE WIT, born 1909, founder of the African section and later Director of the Laboratory for Plant Taxonomy and Plant Geography of the University for Agriculture at Wageningen, the Netherlands. Here, from 1953–1980, his infectious enthusiasm inspired the team of botanists working with him on the African flora with the maxim: 'Non sine pugna'. Setting up an institute for taxonomic botany in Holland, at this time, was by no means easy; however, faced with difficulties DE WIT used to say: 'Struggle is a characteristic of life'.

An eminent authority on the African flora, a connoisseur of tropical fragrance, he loved and loves travelling in Africa, combining a warm heart for its people with a keen eye for its plants. In Dutch: 'Een brave Hendrik' is a saying used to indicate, jocularly, a good boy, a holy Harry. HENDRIK C. D. DE WIT, however, to the best of our knowledge, was never a paragon of virtue. See also C. A. BACKER, Verklarend Woordenboek: 74. 1936, where it is explained that the German name Heinrich (in Dutch: Hendrik) is derived from the word Heimrih, meaning: 'The governor of the house'.

Dr. W. T. STEARN (the British Museum, Natural History) kindly informed us that the epithet, here used as a substantive in apposition, has a pre-Linnaean precedent in the name *Bonus Henricus* used by CASPAR BAUHIN for *Chenopodium bonus-henricus* L., which was a latinization of its widely used vernacular name.

Description: Thin stemmed, often more or less creeping, sometimes pendent epiphyte, usually branched in the lower part; stems not infrequently growing in a zigzag form, regularly rooting at the nodes, up to 60 cm long and in general only ca 1–1.5 mm thick, the somewhat woodened basal parts sometimes up to 2.5 mm in diam; growing on tree-trunks or on thick branches. The stems terete or slightly grooved and somewhat angled, covered with a rather long-lasting dense scurfy indumentum of peltate-helicoid, sessile, greyish-white, near the centre brownish, irregularly shaped hairs with a more or less denticulate margin, ferrugineous when young, becoming more greyish with age. The nodes slightly thickened, with inconspicuous stipular scars, and as a rule especially on the somewhat older parts with one or with a few adventitious roots. The internodes up to 6.5 cm long, usually shorter.

FIG. 5. *Begonia bonus-henricus* J. J. DE WILDE – 1: flowering plant ($\times \frac{2}{3}$); 2: inflorescence, a male flower removed (×2); 2-a: detail of indumentum (magnified); 3: ♂ fl. (×2); 4: tepal, ♂ fl., outer side (×4); 5: stamen, front side (×10); 6: articulation in stalk of male flower, indumentum localy removed (×6); 7: ♀ fl. (×2); 7-a: detail of indumentum (magnified); 8: one style, abaxial side (×16); 8-a: capitate stigmatic papilla (magnified); 9: transverse sect. of young ovary, ca in the middle (×14); 10: mature fruit (×2); 10-a: detail of indumentum (magnified); 11. apex of mature fruit showing frayed remnant of perianth-cylinder (magnified); 12. mature seed, side-view (×30); 12-a: idem, detail of testa (×90); 13: different shapes of seeds (magnified); 14: fragment of underside of leaf (×6); 15: peltate-helicoid hairs, frontal-view (×20); 16: idem, segment at a larger magnification; 17: idem, side-view, schematic (magnified). – 1–17: *J. J. De Wilde 8404* and spirit material from the same collection.


15
7
5
3
7a
16
17
6
8
8a
4
14
2a
♂
2
12
12a
13
10a
11
10
9
1

Stipules early caducous, up to 16 × 3.5 mm in folded position, narrowly ovate, obtuse at apex. The outermost stipule of each pair boat-shaped, folded along the median and closely embracing the smaller (inner) one, conspicuously keeled outside in the upper part and densely squamulose, the inner stipule not keeled and more or less glabrous.

Leaves long persistent, thick fleshy and rather pale green above in vivo; petioles furrowed above, otherwise terete, (3–)5–12(–15) mm long, with a dense indumentum similar to the one described above for the stems. The blade symmetric or slightly asymmetric, ovate to narrowly ovate, 3.5–10.5 × 1.5–3.5 cm, obtuse to cuneate at the base, acuminate to nearly cuspidate or rarely acute or obtuse at the apex, acumen if present 4–15 mm long, margin entire or slightly undulate or faintly obtusely toothed in the upper half, above greyish with a more or less closed flaky indumentum, sometimes the indumentum disappearing with age and the upper surface becoming brown, the lower surface densely matted with a persistent indumentum of peltate-helicoid, sitting, denticulate or fringed hairs, the hairs glossy silvery-grey or pale brown around the depressed centre, some hairs brownish all over, bringing about a finely pitted appearance; the midrib continuing the petiole or the blade faintly subscutate, inconspicuously palmately 3(4–5)-nerved on both surfaces, the nervation often obscured by the indumentum.

Inflorescences found in the axils of the terminal leaves, basically proterandrous-androgynous. Peduncle 3–12 mm long, covered with a scaly indumentum, somewhat flattened, broadening towards above, bearing at the apex a flattened cup composed of two free at the margins largely overlapping persistent fleshy pseudo-bracts (bracts of the first order) that conceal the remaining part of the inflorescence. Cups (measured on dried herbarium specimens) 8–15 mm wide at apex, 8–12 mm high, the folded bracts divergent from each other above, the lateral edges of the cups tapering along straight or very slightly curved lines towards the base and the cups more or less obcordate. The two separate outer pseudo-bracts of the cup each narrowly folded along approximately the median, boat-shaped, in folded position measuring up to ca 12 × 6 mm; 7–8-nerved, the nerves straight and nearly parallel near the base, dichotomously branching higher up, forming a widely reticulate venation, the veins not reaching the margin; covered with a dense indumentum outside, nearly glabrous inside.

Inside the above described outermost pair of pseudo-bracts (Fig. 6, I) is found the remaining part of the cymose inflorescence. From the comparatively few (six) inflorescences that could be analysed one was found to contain only one female flower subtended by altogether four bracts (Fig. 6, 1), a second contained one female flower and two male flowers subtended by altogether eight bracts (Fig. 6, 3), two consisted of one female and one male flower also subtended by eight bracts (Fig. 6, 2), and finally another two inflorescences contained one female and three male flowers subtended by altogether ten bracts (Fig. 6, 4). The bracts inside the outermost pair of bracts (I) successively becoming smaller and more transparent, paired, one bract of each pair smaller than the other. From shape, dimension and implantation of the bracts, to-

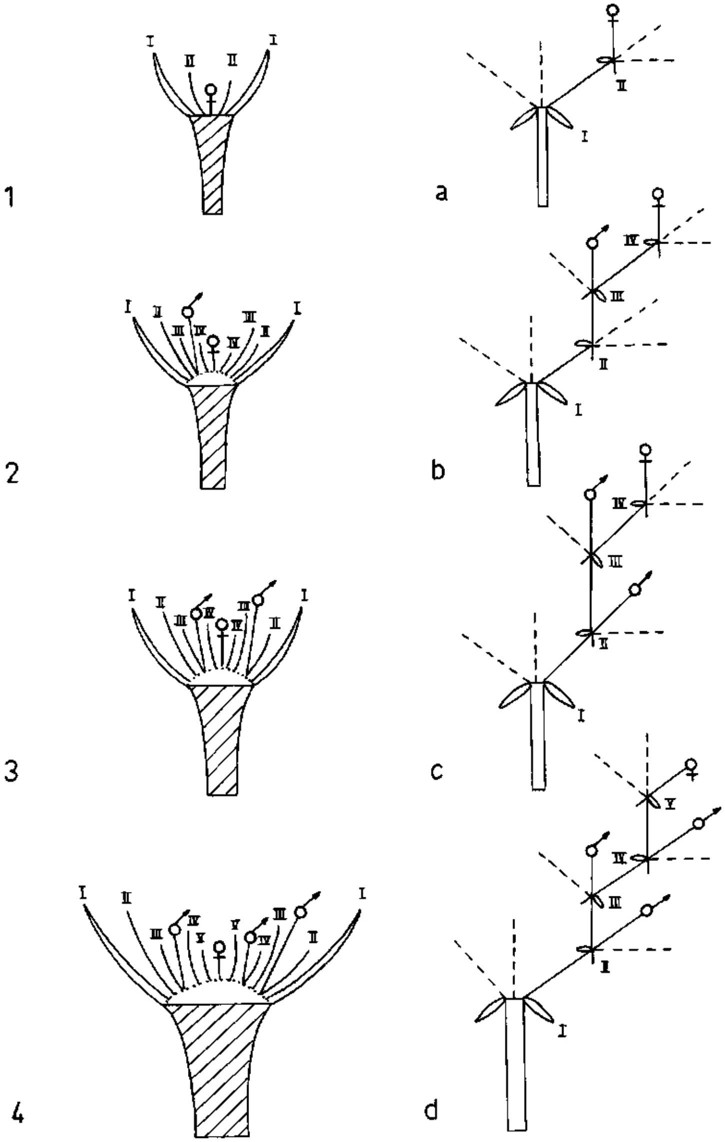


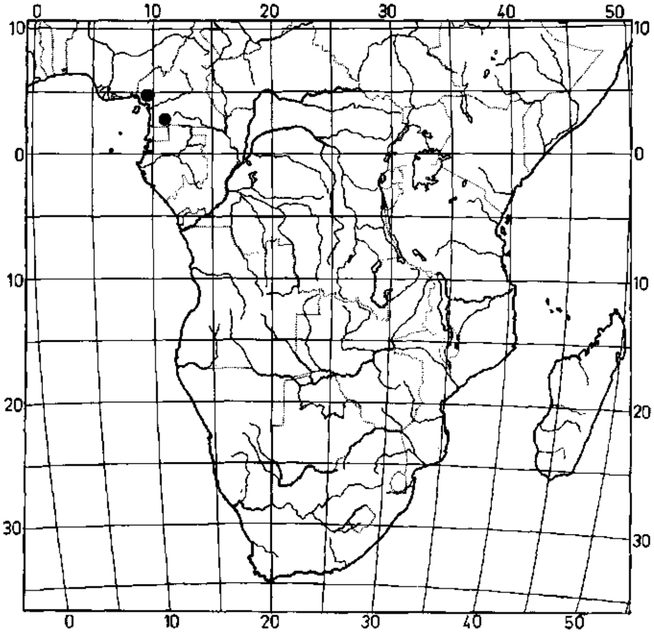
FIG. 6. *Begonia bonus-henricus* J. J. DE WILDE – 1–4: schematic representation showing the sequence of pseudo-bracts and flowers as found in inflorescences analyzed on *J. J. De Wilde nos. 8281-A* and *8404*(WAG); a–d: derived schemes of cincinnal monochasia (pseudaxes in reality nil). For explanation see text.

gether with flowering sequence and sexuality of the flowers (see Fig. 6, 1–4), and through comparison with the structure of the inflorescence of the other taxa found in the section *Squamibegonia* it is clear that the inflorescence of *B. bonus-henricus* is a monochasium and more in particular a cincinnal cyme (Fig. 6, a-d). The one female flower of the inflorescence is always found on the lateral axis of the highest reached branching order, the terminal and the opposite axis of the ultimate dichasial branching are suppressed. At all branchings of the pseudaxis this is on principle terminated by a male flower, however the male flower terminating the peduncle is always reduced, sometimes the male flower terminating the axis of the first branching order is reduced also (Fig. 6, a and b). In addition the ultimate branching bearing the female flower is always lacking a male flower. Flowering within the androgynous inflorescences is proterandrous, the female flower still enclosed within its subtending bracts at the moment when the last male flower is at anthesis. The female flower at anthesis hardly exserted from the cup.

Male flower: Perianth-segments ('tepals') two, broadly obovate, 8–10 mm diam., white, the adaxial (upper) tepal with 9–10 purplish-red longitudinal stripes extending outward from the base to halfway up, covered with loosely scattered scaly hairs outside, glabrous inside; the tepals fused at the very base and forming a white, lepidote, slightly flattened, solid, 3.5–6 mm long perianth-cylinder there below, which, with a distinct articulation is implanted on the 6.5–9 mm long, also white and lepidote, pedicel (the support of a single male flower combined up to 15 mm long). Androecium fasciculate, stamens 18–26, arranged in the way of a raceme of bananas, the stamens closely appressed one against the other. Filaments fused at the extreme base (ca 0.2 mm), otherwise free, the longest up to 1 mm long, the adaxial stamens of the bundle with nearly sessile anthers. Anthers 1.5–1.7 × 0.4–0.5 mm, narrowly obovate, obtuse or truncate at apex, opening with slits lengthwise in such a way that the slits start introrse at the apex and become lateral near the base.

Female flower: Perianth-segments ('tepals') two, similar to the segments of male flowers, sometimes somewhat larger, up to 13 mm diam.; the segments fused at the base and forming a 2–3 mm long, ca 1 mm wide, in the centre hollow, cylindric perianth-tube covered with a lepidote-stellate indumentum. Styles 4, fused at the very base over ca 0.5 mm. Free parts of the styles ca 1.5 mm long, densely covered with minute glanduliferous trichomes, horseshoe-shaped forked there above, the arms of the horseshoe 0.8 mm long, each arm spirally twisted with ca 1 turn, the twist concentrated in the upper part, the surface densely papillose all over, the trichomes longer and more distinct gladuliferous in a band continuous from one arm to the other and following helically the morphologically outer surface of the arms. Ovary stipitate; stipe ca 0.5 mm long; obovoid, more or less truncate above, bearing in the centre at the apex the perianth-tube, 4 × 3.5 mm, densely covered with a lepidote indumentum, 4-locular. Placentation axile.

Infructescence with persistent gaping pseudo-bracts, showing the one berry-like whitish fruit. Mature fruit (studied from spirit material) still with lepidote indumentum, globose-obovoid, ca 12 × 10 mm, very shortly stipitate at the base (stipe ca 0.5



MAP 4. Hitherto known stations of *B. bonus-henricus* J. J. DE WILDE.

mm long), mucronulate in the centre of the otherwise obtuse apex, mucro less than 0.5 mm, bearing at its apex a ca 2 mm long frayed remnant of the perianth-tube. Pericarp thin leathery, slightly transparent.

Mature *seed* 0.8–0.9 mm long by 0.3 mm wide, narrowly ellipsoid, sometimes slightly curved. Testa comparatively hard but brittle, glossy brown, alveolate by a very conspicuous network of prominent brownish-yellow ribs, giving the seed a pitted appearance. The alveolae small, roundish to 5-gonous, elongated and larger in a zone above the hilum but again becoming roundish and very minute just around the hilum.

Distribution: Hitherto only known from Cameroun.

Ecology: From the five collections only that came to our attention sofar, it appears that *B. bonus-henricus* occurs as a typical epiphyte in the transitional zone between lowland rainforest and (sub-)montane forest, between about 600 and 1000 m altitude. LETOUZEY, in his field notes, describes its habitat as forest rich in *Allanblackia floribunda* OLIV., *Coelocaryon preussii* WARB., *Santiria trimera* (OLIV.) AUBR. etc., in between 500 and 900 m altitude (teste *Letouzy no. 14663*, P, YA). The senior author found it at the summit of a hill near Ebolowa, at 970 m altitude, epiphytic on a tree-branch, together with epiphytic mosses, ferns, *Lycopodium* spec., and the orchid *Polystachya caloglossa* RCHB.F. Among the trees in this forest type were noted *Garcinia* species and *Leplaea mayombensis* (PELLEGR.) STANER (teste *J. J. de Wilde nos. 8403, 8404, 8404-A* and *8405-A*, WAG). Nearly all trees in this forest-type were covered with epiphytes.

The fact that *B. bonus-henricus* was found growing in penumbra either on tree-trunks well above ground-level or on the low branches of the crown of taller trees and that, moreover, it has most of its parts protected by a continuous dense indumentum, points to a mesophytic epiphyte in the sense as used by OLIVER. (W. R. B. OLIVER in Journal of Ecology 18: 1–50. 1930, distinguishes between hygrophytic, mesophytic and xerophytic epiphytes, using among others the above mentioned ecological criteria.)

Specimens examined:

CAMEROUN: ca 15 km S.E. of Ebolowa, hills situated between N'Koemvone and N'Kolandom, 2°48'N. × 11°9'E., *J. J. de Wilde 8281-A* (WAG, holotype of *B. bonus-henricus*; isotypes in BR, K, P, WAG, YA); ibid., *J. J. de Wilde 8404* (WAG, YA); hill N.W. of N'Gussi, 15 km N.N.W. of Tombel, *Letouzey 14663* (P, YA); track between Butu and Dikome Balue via Lokando, 34 km N.W. of Kumba, *Satabie 251* (P, YA); Kumba area, Bakossi, near the village Ngomboku, *Swarbrick 2381* (YA).

4. SOMATIC CHROMOSOME NUMBERS

Except for *B. bonus-henricus*, the new species, all taxa recognized in this monograph are represented in the living plant collections of the department of Horticulture and the department of Plant Taxonomy. Some plants were acquired from botanical gardens, the majority however was collected by various persons during recent years. The specimens which were analyzed have been vouchered, except for one plant from Gabon, which unfortunately died before material could be collected for herbarium purposes. Permanent squash preparations of root tips were made as mentioned in the previous paper (DE WILDE & ARENDS, 1979). All data pertaining to the plant specimens are presented in table 1. Black and white photographs were made using a Carl Zeiss planapochromatic objective (63 ×). Colour transparencies which were employed for karyotype analysis were made with a similar objective but with phase contrast equipment.

As the chromosomes of the species concerned are small (up to approximately 2 mμ) they are currently fairly difficult to analyse. The combination of distinct chromosomes and well spread metaphase plates is a rare event. Therefore a sufficient number of slides was prepared so that a reliable analysis can be presented.

From the analysis of good cells it is concluded that there is variation in the number of chromosomes, whereas the karyotypes of *B. ampla* and *B. poculifera* are similar. The somatic number of both species is given as $2n = 36$, with most cells showing an additional number of B-chromosomes. The latter are small and generally cannot be distinguished from other small somatic chromosomes. As to the number of B-chromosomes this will be discussed below.

Table 1: Plant specimens of *Begonia* section *Squamibegonia* analyzed for chromosome number.

Taxon	Collection number	Collector	Provenance	Voucher (WAG)	Slide number
B. ampla	T 1237; 79-1	Groenendijk	São Tomé	*Groenendijk 126*	5–19, 20, 21
B. ampla	T 1240; 79–14	Groenendijk	São Tomé	*Van Veldhuizen 639*	4–55, 56, 69, 70, 71, 72, 73, 74, 75; 5–18
B. poculifera var. *poculifera*	T 1058; 00–657	–	Culta, München (Nigeria)	*J. J. De Wilde 8787*	1–48
B. poculifera var. *poculifera*	T 1183; 78–543	Br. & de W.	Gabon	–	3–16
B. poculifera var. *poculifera*	T 1208; 78–525	Br. & de W.	Gabon	*Van Setten 428*	3–17; 4–41, 42, 43, 50
B. poculifera var. *poculifera*	– ; 00–629	–	Culta, Brussels	*J.J. De Wilde 8771, 8772*	4–49, 80
B. poculifera var. *teusziana*	T 1201; 78–532	Br. & de W.	Gabon	*Br. & de W. 203*	3–23; 4–37, 45, 46, 83
B. poculifera var. *teusziana*	T 1061; 00–653	Leeuwenberg	Cameroun	*Leeuwenberg 10.002*	1–49; 2–28; 3–5, 6

Abbreviations Br. & de W. = Breteler & J. J. De Wilde.

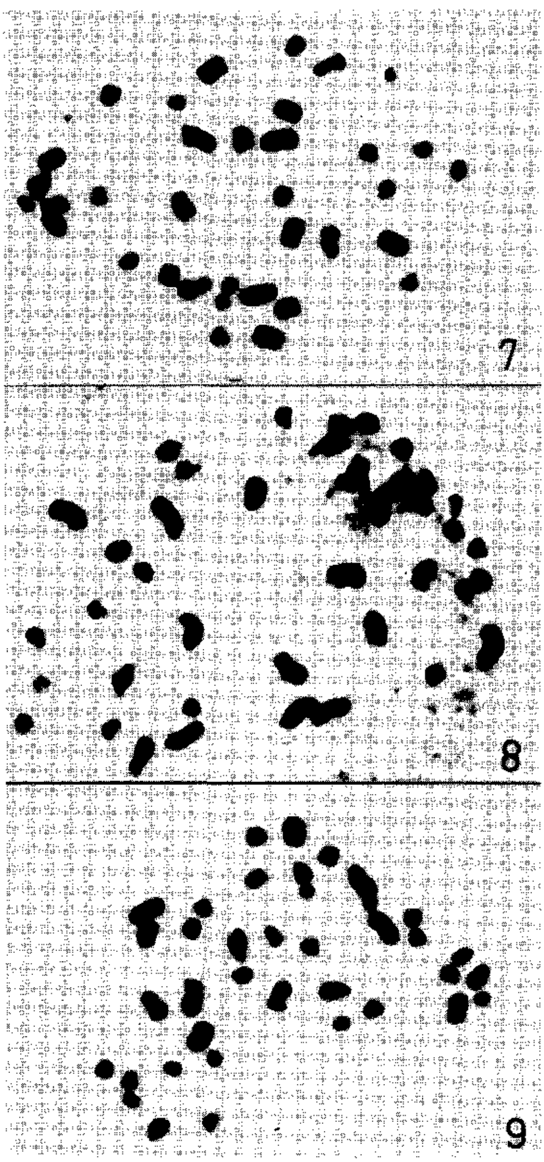


FIG. 7, 8 and 9: three root tip cells in somatic metaphase demonstrating the variation in total number of chromosomes. FIG. 7: *B. ampla*, coll. number 79-1, 2n = 36 + O B chromosomes. FIG. 8: *B. ampla*, coll. number 79-14, 2n = 36 + 4 B chromosomes. FIG. 9: *B. poculifera* var. *teusziana*, coll. number 73-543, 2n = 36 + 2 B chromosomes. 3000 ×.

For analysis of the karyotypes colour transparencies were projected from which the individual chromosomes were measured and the position of the centromeres located. The chromosomes can according to their sizes be grouped into two. The length of the chromosomes of the first group ranges from approximately 1 to 2 mμ. This group comprises sixteen chromosomes, with almost median centromeres. The remainder of the chromosomes (irrespective whether they are B-chromosomes or not) are smaller, having sizes of approximately 0.5 mμ or less. Generally they do not show centromeres but in some cases it could be seen that they are telocentric. Some metaphase plates showing the two distinct groups of larger and smaller chromosomes are presented in figures 7, 8 and 9.

In respect to the taxonomy of these two species of *Squamibegonia* neither karyotype morphology nor chromosome number offers any information which corroborates their separation as based on morphological characters. On the other hand their karyotypes having larger next to small chromosomes are different from the ones found in a section as for example *Tetraphila*. The karyotypes of the latter section are less asymmetric (unpublished). It was found however that the karyotypes of *B. crateris* and *B. baccata* appear to be similar to the karyotype of *Squamibegonia*. Hence the exclusion of these two species from *Squamibegonia* (see pp. 381–384) is to be based on characters, other than karyotype.

In the following some details concerning the chromosome numbers found for the different plant specimens are presented.

a. *B. ampla*

Plant material of this species originated from São Tomé. Cuttings from *Groenendijk no. 126* yielded metaphase configurations with 2n = 36 (see fig. 7), 2n = 37 and 2n = 38 respectively. Another batch of plants which were grown from a single fruit also collected by GROENENDIJK yielded metaphase configurations with 2n = 38, 2n = 39 and 2n = 40 (fig. 8) respectively. In some cases different numbers were observed within the root tips taken from the same plant. Hence it is concluded that next to some variation between plants from different populations there is also variation in total chromosome number within single specimens. For the materials of *B. ampla* the variation thus ranges from 2n = 36 to 2n = 40.

b. *B. poculifera* var. *poculifera*

The materials originated from Gabon and botanical gardens in Munich (plant presumably from Nigeria) and Brussels. Most metaphase configurations showed clearly 2n = 38 chromosomes. In some cells however 2n = 39 chromosomes were counted with certainty. Still other cells had 2n = 38 with in addition two distinct chromosome like structures. In some cells finally only 2n = 37 could be counted. The range of the somatic chromosome number of this variety of *B. poculifera* thus varies from 2n = 37 to 2n = 40.

c. *B. poculifera* var. *teusziana*

The plants originated from Gabon and Cameroun respectively. Some distinct metaphase configurations in the plant from Gabon showed 2n = 38 chromosomes (fig. 9), but 2n = 39, 2n = 40 and again 2n = 37 were counted also. In the plant collected by LEEUWENBERG (*no. 10.002*) in Cameroun the highest totals of chromosomes were scored. Next to a number of $2n = 38$ other cells with up to even $2n = 45$ chromosomes were counted.

In conclusion it is summarized that the number of somatic chromosomes found in *B. ampla* starts from $2n = 36$. For *B. poculifera* s.l. the number starts from $2n = 37$. In both species higher numbers are frequently observed. This phenomenon can be best attributed to the occurrence of B-chromosomes. As chromosome numbers of $2n = 36$ have not been observed in *B. poculifera* it is assumed that in the case of cells with $2n = 37$ there is at least one B-chromosome present. Increase of the somatic number by two to four B-chromosomes appears to be a regular feature; but a still higher number can in some instances be found also. It may be mentioned that REIMANN-PHILIPP & POHL (1971) concluded that there is variation within certain limits in respect to the chromosome number of varieties of *B. semperflorens* LINK et OTTO. They did not however attribute this phenomenon to the occurrence of B-chromosomes. LEGRO & DOORENBOS (1969) mentioned and showed among others that *B. cathayana* has normally $2n = 22$, but occasionally has $2n = 20$. In other cases they observed in some species small additional chromosomal structures which they added as '+' next to the somatic number regularly counted for the section concerned.

5. ACKNOWLEDGEMENTS

Professor H. C. D. DE WIT has during our studies contributed by his remarks and propositions when we showed and discussed those items, which in our opinion, were worthwhile to be discussed with fellow taxonomists. He nevertheless was not aware of our intention to dedicate this paper and even a new *Begonia* species to him at the occasion of his retirement. We hope he will appreciate the paper as a sincere tribute.

As always we had to rely on the attainments of several members of the staff. The drawings of Miss IKE ZEWALD present an important feature of this monograph.

We also want to express our gratitude to Mrs. Dr. G. J. H. AMSHOFF, who translated the diagnosis of the new species into Latin.

The manuscript was patiently and skillfully typewritten by Mrs. J. M. VAN MEDENBACH DE ROOY-RONKEL and Miss MARINA WASSINK. Mr. G. BOELEMA saved us quite a few errors and time by correcting the proofs. Mr. FRANK VAN DER LAAN was occasionally invited to give his interpretations of the often difficult to analyse karyotypes. His remarks are gratefully acknowledged. Professor Y. SAGAWA (Univ. of Hawaii, Honolulu) gave his much appreciated advice on the presentation of the karyological analysis.

From the Department of Horticulture of this University Professor J. DOORENBOS and Mr. J. J. KARPER certainly contributed to the realization of this treatise. Their invaluable comments resulted from reading the manuscript, growing the plants and hearing our opinions, which we expressed during the not seldom vivid discussions.

Many observations were made from living plants. These were partly collected by Dr.

F. J. BRETELER and the senior author in Gabon (1978). The expedition was partly financed by the Netherlands Foundation for the Advancement of Tropical Research (WOTRO).

The help from Miss LIZA GROENENDIJK by collecting living specimens of *Begonia ampla* HOOK.F. from São Tomé is gratefully acknowledged.

Thanks are due to the Directors and Curators of the herbaria cited in the text. Without exception they all willingly put herbarium materials at our disposal.

6. LITERATURE REFERENCES

BARANOV, A. & F. A. BARKLEY. 1974. The Sections of the genus *Begonia*: 1–28.

BARKLEY, F. A. 1972. The species of the *Begoniaceae*: 1–120.

DE WILDE, J. J. F. E. & J. C. ARENDS. 1979. *Begonia loranthoides* Hook.f. (sect. *Tetraphila* A.D.C.) in: Acta Bot. Neerl. **28** (4/5): 357–374.

FERNANDES, R. 1970. *Begoniaceae* in: Conspectus Florae Angolensis **4**: 289–301.

HALLÉ, N. 1967. Deux *Begonia* du Gabon analysés sur le vif: *B. triflora* Irmsch. et *B. ferramica* sp. nov. in: Adansonia ser. 2, **7** (4): 507–512.

IRMSCHER, E. 1925. *Begoniaceae* in: E. & P., Nat. Pflanzenfam. 2nd ed. **21**: 548–588.

IRMSCHER, E. 1961. Monographische Revision der *Begoniaceen* Afrikas I. in: ENGLER, Bot. Jahrb. **81** (1–2): 110.

KUPICHA, F. K. 1978. *Begoniaceae* in: Flora Zambesiaca **4**: 499–506.

LAWRENCE, G. H. M. 2nd printing 1955. Taxonomy of vascular Plants: 621.

LEGRO, R. A. H. & J. DOORENBOS. 1969. Chromosome numbers in *Begonia* in: Neth. J. Agric. Sci. **17**: 189–202.

REIMANN-PHILIPP, R. & C. M. POHL. 1971. Cytologische Untersuchungen an *Begonia semperflorens* Link et Otto in: Z. Pflanzenzüchtg. **66**: 189–202.

WILCZEK, R. 1969. *Begoniaceae* in: Flore du Congo, du Rwanda et du Burundi: 1–53.

WHITE, F. 1979. The Guineo-Congolian Region and its relationships to other phytochoria in: Bull. Jard. Bot. Nat. Belg. **49** (1–2): 11–55.

NOTES ON THE NOMENCLATURE OF DIGITALIS HYBRIDS

D. O. WIJNANDS and J. BELDER

Laboratory of Plant Taxonomy and Plant Geography and Botanical Gardens, Agricultural University, Wageningen, The Netherlands

SUMMARY

Digitalis sibirica Lindley is shown to be a superfluous name for *D. orientalis* Mill. The nomenclature of hybrid foxgloves is discussed. An interpretation of the illustrations in LINDLEY'S Digitalium Monographia is appended.

DIGITALIS SIBIRICA LINDLEY; BOTANICAL GARDENS HAUNTED BY A PLANTLESS NAME

The sibirian foxglove is a very dubious species. It was described by JOHN LINDLEY (1799–1865), who is generally known as an orchidologist, in his Digitalium Monographia of 1821, where he gives a description on page 16 and an illustration in tabula XI. The luxuriant plant as drawn by FERDINAND BAUER grew in the private garden of Mr. BELL. LINDLEY based his species entirely on this drawing, no specimen has been preserved. For the understanding of his species no other element is available, apart from the cited synonym: *calycinis foliolis acutis, foliis ovato-lanceolatis nervosis, Digitalis* no. 9 of MILLER.

WERNER (1960: 249) assumes this is in error for *Digitalis* no. 7 in the 8th edition of the Gardener's Dictionary. WERNER'S assumption is incorrect since there is a *Digitalis* with the phrase-name cited above marked no. 9 in the 7th edition of this Dictionary, published in 1759, in which MILLER did not adopt the nomenclatural system of LINNAEUS. In the 8th edition (1768), the first where MILLER did use binomial names, this plant is adorned with the epithet *orientalis*. When LINDLEY cited in 1821 an element in synonymy from 1759 that had received a valid name in 1768, the new species he created is a later synonym of *D. orientalis* Mill. quoad nomen under art. 63 of the Leningrad Code. WERNER (1960: 249) excludes the MILLER synonym from *D. sibirica*, probably misled by his wrong assumption on LINDLEY'S reference to MILLER. For nomenclatural analysis the reference to MILLER is essential and can not be discarded.

At present *D. orientalis* Mill. is in the synonymy of *D. grandiflora* Mill. The later homonym *D. orientalis* Lam. has *D. cariensis* Boiss. ex Jaub. & Spach ssp. *lamarckii* (Ivanina) Werner as its correct name.

LINDLEY'S name is thus dealt with, but not his plant. LINDLEY had some doubt about his synonym: 'si recte ejus synonymon citaverim' and omitted a part of MILLER'S name:

'non ramosa'. BELL's plant shows a branched inflorescence. In this expression of doubt we see no reason to regard it as an exclusion under art. 63.2 of the Code.

The flowers point to a species of the section *Globiflorae* Bentham, the corolla is ventricose and the central lobe of the lower lip is long. The inflorescence is erect, not nodding at the top, and slender. The flowers are directed to all sides. LINDLEY describes: 'corolla ventricosa; labio porrecto'. BENTHAM (1846: 450) confirms 'forma corolla *Digitalis laevigata* similior', LEDEBOUR repeats this statement in the Flora Rossica 3: 227.

The distribution traditionally (e.g. WETTSTEIN 1895: 88) given for *D. sibirica* is Sibiria and Tartaria, it is composed of the alleged origin of BELL's plant: Sibiria and MILLER's *D. orientalis* from Tartaria. As WERNER (1960: 252) notes, no recent Sovjet flora lists *D. sibirica*. Although many botanists have *D. sibirica* in enumerations, nobody knows it from own experience, e.g. BENTHAM (1846: 450): 'mihi planta ignota'. Only HIMMELBAUER and ZWILLINGER (1927: 645–646) describe the plant in their pharmacological work and give an illustration of a leaf that found its way to the Index Londinensis. Their description allows for a tentative identification as *D. grandiflora* Mill.

From the foregoing we conclude that LINDLEY's plant is of garden origin, closely related to, if not conspecific with *Digitalis laevigata* Waldst. & Kit. but possibly a hybrid with *D. grandiflora* Mill. Sterile hybrids of *Digitalis* sect. *Globiflorae* with either *D. grandiflora* or *D. lutea* occur oceasionally in gardens (WERNER 1962: 181). Also the species of this section, e.g. *D. laevigata*, *D. ferruginea* L. and *D. lanata* Ehrh. to name the more common ones in collections, hybridize among each other.

Our study of these matters has a practical motive: the confused nomenclature of *Digitalis* in botanical gardens. For the species the revisions of IVANINA 1955 and WERNER 1960, 1962 solved many problems, but WERNER touches hardly on the nomenclature of hybrids and IVANINA's treatment of them cannot satisfy us; it is rather uncritical.

Since we are building up a foxglove-collection we encounter hybrids occasionally and would like to name them correctly. Especially *D. sibirica* proves a constant source of error, as WERNER (1962: 168) and HENSEN (1963: 33) noted already. The name *Digitalis sibirica* still appears frequently in seedlists. Seeds offered under this name usually produce plants of *D. lutea* L. ssp. *lutea*.

Since the name *D. sibirica* Lindley is not available for *D. grandiflora* × *D. laevigata*, we searched for a better name. In the first place *D.* × *fuscescens* Waldst. & Kit. (Pl. Rar. Hung 3: 304. 1812) must be considered. IVANINA (1955: 248) used it for *D. grandiflora* × *D. laevigata*, but Soó (1966: 358) has it for *D. grandiflora* × *D. ferruginea* and HENSEN (1963: 31) for *D. grandiflora* × *D. laevigata* vel *lanata*.

According to STAFLEU (1967: 488) and STAFLEU and COWAN (1979: 555) KITAIBEL's herbarium is in BP, PR and BM. There is no material of this species there. JÁVORKA (1929: 113) states KITAIBEL sent his specimens to WILLDENOW. Although ca. 750 sheets in WILLDENOW's herbarium came from KITAIBEL (HIEPKO 1972), nr. 11403 *Digitalis* *fuscescens* is written up in WILLDENOW's hand. Although it is likely that nr. 11403 is a KITAIBEL specimen, it can not be proved. Therefore we propose as lectotype WALDSTEIN and KITAIBEL, Pl. Rar. Hung. 3: t. 274 (1812). A future monographer should however take nr. 11403 as a very important specimen, we have seen only the microfiche.

The type-illustration represents *D. laevigata*, the pubescence of the inflorescence is atypical for that species and might be interpreted as introgression from a hairy representative of the *Globiflorae* Benth., e.g. *D. ferruginea* L. or *D. lanata* Ehrh. We see no trace of *D. grandiflora* Mill. and thus cannot accept it for the alleged provenance. Also *D. ochroleuca* Jacq. cited by Lindley for *D. fuscescens*, does not qualify. It is a synonym of *D. grandiflora* Mill., to which also the specimen in LINDLEY's herbarium (CGE) belongs.

Specimens seen for *D. grandiflora* Mill. × *D.* sect. *Globiflorae* Benth.: H.L.B. cult. 1897 (L no. 908.226–626) *D. laevigata* as parent?; Hort. Drsd. s.n. (L no. 910.78–153) *D. lanata* as parent?; Hensen 1417 culta B.G. Wag. no. 1137/61 (WAG) *D. lanata* as parent?

NOMENCLATURE OF HYBRID FOXGLOVES

The disappointing experiences with the names *D. sibirica* and *D. fuscescens* urged us to have a closer look into other names of hybrid foxgloves. We do not intend to present a monograph and abstain from decisions that might restrict the freedom of a future monographer. Since we feel nomina ambigua are a burden on taxonomy that should be reduced to a minimum we have provisionally placed some names in the synonymy of the most obvious parent of the alleged hybrid.

The interpretation of chance hybrids of unknown parentage is a cumbersome and rather subjective matter even with living plants, as we know from our own experience. Even the decision whether a given plant is a hybrid or not is often debatable. Nomenclature of foxglove hybrids often depends on such interpretations and thus has an undesirable built-in instability. We do not wish to evoke instability, but from the continued use of clearly misapplied names one should refrain.

D. × coutinhi Samp. ex Rozeira, Mem. Soc. Brot. 3: 160. 1944.

In the above quoted way WERNER (1960: 247) accepts this name for *D. purpurea* L. × *D. thapsi* L. Since there is only the name and three cited specimens in ROZEIRA's publication but no valid description or indication of parentage, the name is validly published nor validated and still a nomen nudum. Also citation as SAMP. ex WERNER is not justified. The correct spelling would be '*coutinhoi*'.

Specimen seen: J. Belder 393 culta B.G. Nijmegen (WAG).

D. × denticulata Tausch, Flora 29: 389. 1836.

This name is interpreted as *D.* × *purpurascens* Roth by ROUY (1909: 103) and

Ivanina (1955: 226). As Tausch's description points to *D. laevigata* Waldst. & Kit. and nothing can be said with certainty about a possible hybrid origin, e.g. from sect. *Tubiflorae*, we place it in the synonymy of *D. laevigata*.

D. × **ditellae** Trotter, Malpighia 22: 74. 1908.

D. ferruginea L. × *D. lutea* L. ssp. *australis* (Ten.) Arcang. (= *D. micrantha* Roth).

The original spelling of the epithet is *di-tellae*, following art. 73.10 of the Leningrad Code it is corrected here.

D. × **fucata** Ehrh., Beitr. zur Naturkunde 7: 151. 1792.

This name is interpreted as *D.* × *purpurascens* Roth 1800 by Rouy (1909: 103) and Ivanina (1955: 226). Hartl (1966: 121) has it for *D. grandiflora* Mill. × *D. purpurea* L. = *D. fulva* auct. non Lindl. 1821. *D.* × *fucata* Ehrh. has priority over both names.

Since the type-specimen 'aus dem Herbar der ehem. Königl. Gärten zu Herrenhausen', *Digitalis fucata* scripsit Ehrhart (GOET) belongs to *D. lutea* L. × *D. purpurea* L. and the diagnosis describes it as having the habit of *D. lutea* with reddish flowers, we accept *D.* × *fucata* Ehrh. as the correct name for this hybrid. It replaces *D.* × *purpurascens* Roth, up till now the generally accepted name for it.

Often a distinction is made between *D.* × *purpurascens*, close to *D. purpurea*, and *D.* × *lutescens*, close to *D. lutea*. Introgression between both species and hybrids is so complex that it seems not advisable to distinguish nothomorphs presently. The type-specimen is close to *D. lutea* L.

Synonyms:

D. × *erubescens* Ait. f., Hort. Kew. ed. 2, 4: 29. 1812
D. × *fuscopunctata* Tausch, Flora 29: 389. 1836
D. × *lindleyana* Tausch, Flora 29: 389. 1836
D. × *longiflora* Lej., Rev. fl. Spa: 126. 1825
D. × *lutescens* Lindl., Dig. Mon. 22 t. 21. 1821
D. × *purpurascens* Roth, Catalecta Bot. 2: 62. 1800
D. × *rigida* Lindl., Dig. Mon. 21 t. 19. 1821
D. × *tubiflora* Lindl., Dig. Mon. 22 t. 22. 1821
D. × *tubulosa* Tausch, Flora 29: 390. 1836.

Selected specimens: Ruppert s.n. near Oberstein 7-8-1910 (AMD no. 97803, L no. 921.17–42); Nahe s.n. near Oberstein 15-7-1858 (AMD no. 98135); Herb. Schultes s.n. (L no. 908.227–302); Bordère s.n. XII 1867 Pyrenees (L no. 908.227–292); Herb. Trevirani s.n. (L no. 908.22–311); Müller s.n. prope Cusel 15-7-1840 (L no. 908.227–293); Bogenhard s.n. near Oberstein 1839 (L no. 910.73–122 & –123); Herb. Forster s.n. (L no. 908.227–312); V. Ooststroom 15414 Vosges 3-6-1951 (L).

Cultivated material: Hort. Herrenhausen s.n. (GOET) type; Hensen 1469 B.G. Wag. no. 1688/61 (WAG); Hort. Rot. s.n. 1845–'50 (L no. 936.218–270; id. no. 936.218–229); Hort. Bonn s.n. 1829 (L no. 908.227–307); Boom 20564, proeftuin De Goor no. 51150 garden origin Rome 5-10-1951 (WAHO); Boom 22719 proeftuin De

PHOT. 1: Type specimen of *Digitalis* × *fucata* Ehrh. '*Digitalis fucata*' in EHRHART's handwriting, reproduced from the verso of the sheet. – Foto J. W. MUGGE.

Goor no. 513056 garden origin Szeged as *D. sibirica* 26-6-1952 (WAHO); Tausch s.n. '*D. tubulosa* Tausch cult.', type of *D. tubulosa* fide curator PRC; Tausch s.n. '*D. purpurascens* Roth cult. in h. Bot. Prag.' (PRC); Herb. Pers. s.n. (L no. 908.227–787); Herb. v. Royen (L no. 913.3.19).

The last two specimens differ from the others with a one-sided inflorescence in having a cyclic inflorescence.

D × **fulva** Lindl., Dig. Mon. 15.t. 9. 1821.

This name is traditionally, e.g. ROUY (1909: 101), IVANINA (1955: 226), HARTL (1966: 121), STAFF BAILEY HORT. (1976: 385), interpreted as *D. grandiflora* Mill. × *D. purpurea* L. The plant is close to *D. lutea* L. We see no influence of *D. purpurea* L.; hybrid influence could be from the sect. *Globiflorae* Benth., e.g. *D. ferruginea* L. as LINDLEY suspected. The name must remain a nomen ambiguum.

Since both *D.* × *fulva* Lindl. and *D.* × *fucata* Ehrh. are not available for *D. grandiflora* × *D. purpurea* and *D.* × *fuscescens* Kirschl., Prodr. fl. Alsace: 103. 1836 is a later homonym of *D.* × *fuscescens* Waldst. & Kit. 1812, no correct name is available for this hybrid. In his Flora d'Alsace 1852: 582 KIRSCHLEGER cited his name in the synonymy of his new hybrid formula *D. purpureo-ochroleuca*, together with *D.* × *fucata* Ehrh. and *D.* × *lutescens* Lindl., names applying to *D. purpurea* × *D. lutea*. Therefore *D.* × *fuscescens* Kirschl. might well belong to the synomymy of *D.* × *fucata* Ehrh.

Specimens seen for *D. lutea* × *D.* sect. *Globiflorae*: Boom 30059 culta Rossdorf nursery Keyser & Seibert (WAHO); Boom 25611 Herrenhausen Berggarten 1-8-1953 (WAHO); An. s.n. culta Siegfried Zofingen VII-1953 (Herb. Pharm. Lab. Leiden).

D. × **hybrida** Kölr. in Acta Acad. Petersb. 1: 215. 1777.

This name is cited by IVANINA (1955: 226) under *D. purpurea* L. × *D. lutea* L. together with many synonyms of *D.* × *purpurascens* Roth. KÖLREUTER published a historically very interesting paper (l.c.: 215–233) on hybrid foxgloves in which he describes many hybridisation experiments and the plants resulting from them, many years before MENDEL's publication. KÖLREUTER did not coin any names for his plants. '*D. hybrida* Kölr.' as cited by IVANINA is considered here the singular form of the title of KÖLREUTER's paper: Digitales Hybridae. The name is not published and has no status under the Code.

KÖLREUTER's work is well known in biohistory, although STAFLEU (1971: 256) does not refer to his work on *Digitalis*. His successful hybridisations are *D. lutea* ♀ × *D. purpurea* ♂, *D. lutea* ♀ × *D. thapsi* ♂, *D. ferruginea* ♀ × *D. grandiflora* ♂, *D. purpurea* ♀ × *D. thapsi* ♂ and *D. thapsi* ♀ × *D. purpurea* ♂.

D. × **kotukovii** Ivanina, Act. Inst. Kom. 11: 225. 1955

Invalid name without a description in Latin. Described as *D. grandiflora* Mill. × *D. purpurea* L., judging from the illustration possibly *D. mertonensis* Buxt. & Darl.

D. × media Roth, Catalecta Bot. 2: 60. 1800
D. intermedia Pers. Syn. 2: 167. 1819.
D. grandiflora Mill. × *D. lutea* L.

Specimens seen: Bogenhard s.n. 7-7-1840 near Oberstein (L no. 910.73–128); Herb. W. D. J. Koch s.n. (L no. 910.73–129).

D. mertonensis Buxton & Darlington, Nature 127: 94. 1931
D. kotukovii Ivanina nom. non rite publ.
Fertile allotetraploid of *D. grandiflora* Mill. × *D. purpurea* L.

Specimen seen: J. Belder 575 B.G. Wag. no. 22004 (WAG).

D. minor L., Mantissa Altera: 567. 1771.

This name is cited in the synonymy of *D.* × *coutinhoi* as a nomen ambiguum by WERNER (1960: 247). WERNER has not seen the type, LINN 775.2, a cultivated plant from Uppsala. The short pedicels and lack of yellow glands (there are some glandular hairs on the sepals) do not point to *D. thapsi.* The plant is pubescent, especially the younger parts, not glabrous as WERNER assumes from the protologue. In general habit the specimen is a dwarfed *D. purpurea.* We consider *D. minor* L. belongs in the synonymy of *D. purpurea* L., essentially in the same line as HEYWOOD 1956: 198.

An earlier hybrid mentioned by LINNAEUS (1756: 57) is *D. purpurea* L. × *D. serotina* nom. nud. based on BOCCONE 1697: 108 t. 85 '*Digitalis angusto Verbascifolio montana*'. We take this for a dwarf montane form of *D. purpurea* L. LINNAEUS (1763: 867) (followed by LINDLEY 1821: 10) cites BOCCONE's plant in the synonymy of *D. thapsi* L., where it does not belong, also since BOCCONE gives its distribution as 'Toscana e Savoia'. BOCCONE contains, contrary to what may be expected from the title, 'Musea di planti rara della Sicilia, Malta, Corsica, Italia, Piemonte, e Germania', some Spanish plants, e.g. *Digitalis obscura* L.: '*Digitalis angustifolia Hispanica*' p. 138 t. 98.

D. × macedonica Heywood, Kew Bull. (6): 149. 1951
D. laevigata Waldst. & Kit. ssp. *graeca* (Ivanina) Werner × *D. viridiflora* Lindl.

WERNER (1960: 252) gives the above cited interpretation of HEYWOOD's species. HEYWOOD (1972: 241) maintains his species with some doubt. *D.* × *nadji* Heldr. ex Nadji, the Oriental Digitalis 1899, could well be identical with *D. macedonica,* see WERNER 1960: 253. Eventually, when the search for a Nadji herbarium proves fruitless, neotypification of *D.* × *nadji* with E.K. Balls & W. Balfour Gourlay B. 3529 (K), the type of *D. macedonica,* could solve the nomenclatural problem.

In Index Kewensis Suppl. 13: 44. 1966 this name is incorrectly cited as *D.* × *macedonica* (Heywood) Werner, the same error is made with *D.* × *sibirica* (Lindley) Werner.

D. × purpurascens Roth, Catalecta Bot. 2: 62. 1800

This name is generally accepted for *D. lutea* L. × *D. purpurea* L., e.g. HEYWOOD (1972: 240). It is the commonest hybrid foxglove, sometimes forming populations independent from those of the parent species since it is fertile. The correct name is shown to be *D.* × *fucata* Ehrh.

ROTH differentiates his plant from *D. ambigua* (= *D. grandiflora* Mill.) and *D. lutea* obviously he can not decide which one is involved in the hybrid, neither can we. Since we are not sure that the present interpretation is incorrect, we accept it in the synonymy of *D.* × *fucata* Ehrh.

D. × rhodopaea Toman & Starý, Preslia 36: 309. 1964
D. lanata Ehrh. × *D. viridiflora* Lindl.

D. × ujhelyi Augustin & Szathmáry, Magyar Bot. Lapok 29: 149–152. 1930
D. × *sanctacatalinensis* V. Olah, Lilloa 25: 639. 1951

A name without a Latin description. Hartl 1966: 129 accepted it for this hybrid.
D. lanata Ehrh. × *D. lutea* L.

The original spelling of the epithet is *ujhelyii*, in accordance with art. 73.10 of the Leningrad Code it is corrected.

D. × velenovskyana Soó, Acta Bot. Acad. Sci. Hung. 12: 358. 1966

Nomen novum for *D.* × *fuscescens* Velen. Fl. Bulg.: 422. 1891 non Waldst. & Kit. 1812 nec Kirschleger 1836.
D. grandiflora Mill. × *D. lanata* Ehrh.

CONCLUSION

Some names applied to *Digitalis* hybrids seem to be misapplied or invalid: *D. fulva* Lindley, *D. fuscescens* Waldst. & Kit. and *D. coutinhoi* Rozeira. The hybrids conventionally covered by these names are more clearly named by their hybrid formulae. The correct name for *D. lutea* L. × *D. purpurea* L. is *D.* × *fucata* Ehrh. Names of natural *Digitalis* hybrids that can be applied are: *D.* × *ditellae* Trotter, *D.* × *rhodopaea* Toman & Starý, *D.* × *ujhelyi* Augustin & Szathmary, and *D.* × *velenovskyana* Soó.

INTERPRETATION OF LINDLEY'S DIGITALIUM MONOGRAFIA

tab. 1	*D. thapsi*	= *D. thapsi* L., flower and fruit analysis
tab. 2	*D. purpurea*	= *D. purpurea* L.
tab. 3	*D. thapsi*	= *D. thapsi* L.
tab. 4	*D. thapsi*	= *D. purpurea* L.

tab. 5 *D. minor* = *D. purpurea* L. × ? *D. obscura* L.
tab. 6 *D. minor* = *D. purpurea* L. × ? *D. thapsi* L.
tab. 7 *D. ambigua* = *D. grandiflora* Mill.
tab. 8 *D. ochroleuca* = *D. grandiflora* Mill.
tab. 9 *D. fulva* = *D. lutea* L. × *D.* sect. *Globiflorae* Benth.
tab 10 *D. laevigata* = *D. laevigata* Waldst. & Kit. ssp. *laevigata*
tab. 11 *D. sibirica* = *D. laevigata* Waldst. & Kit.
tab. 12 *D. ferruginea* = *D. ferruginea* L.
tab. 13 *D. aurea* = *D. ferruginea* L.
tab. 14 *D. leucophaea* = *D. lanata* Ehrh. ssp. *leucophaea* (Sibth. & Sm.) Werner
tab. 15 *D. lanata* = *D. lanata* Ehrh. ssp. *lanata*
tab. 16 *D. orientalis* = *D. cariensis* Boiss. ex Jaub. & Spach ssp. *lamarckii* (Ivanina) Werner
tab. 17 *D. parviflora* = *D. parviflora* Jacq.
tab. 18 *D. viridiflora* = *D. viridiflora* Lindl.
tab. 19 *D. rigida* = *D. purpurea* L. × *D. lutea* L.
tab. 20 *D. purpurascens* = *D. purpurea* L. × *D. lutea* L.
tab. 21 *D. lutescens* = *D. purpurea* L. × *D. lutea* L.
tab. 22 *D. tubiflora* = *D. purpurea* L. × *D. lutea* L. (very close to *D. lutea* L.)
tab. 23 *D. lutea* = *D. lutea* L.
tab. 24 *D. lutea* γ = *D. purpurea* L. × *D. lutea* L.
tab. 25 *D. lutea* δ = *D. purpurea* L. × *D. lutea* L.
tab. 26 *D. obscura* = *D. obscura* L. ssp. *obscura*
tab. 27 *D. canariensis* = *Isoplexis canariensis* (L.) Loud.
tab. 28 *D. sceptrum* = *Isoplexis sceptrum* (L.f.) Loud.

References

Bentham, G. 1846. *Digitalis* in De Candolle, Prodomus Systematis Naturalis vol. **10**.

Boccone, P. 1697. Museo di pianti rara della Sicilia, Malta, Corsica, Italia, Piemonte, e Germania.

Hartl, D. 1966. *Scrophulariaceae* in Hegi, Illustrierte Flora von Mittel-Europa **VI/I** Lief. 2.

Hensen, K. J. W. 1963. Het *Digitalis* sortiment. Med. Bot. T. en Belm. Arb. **VII** (2): 31–34.

Heywood, V. H. 1956. *Digitalis* in P. H. Synge (ed.) Supplement to the Dictionary of Gardening.

Heywood, V. H. 1972. *Digitalis* in T. G. Tutin et al., Flora Europaea vol. **3**.

Hiepko, P. 1972. Introduction to Herbarium Willdenow. Alphabetical Index.

Himmelbauer, W. und Zwillinger, E. 1927. Formenkreis in der Gattung *Digitalis* L., Botanica Generalis vol. **3**.

IVANINA, L. I. 1955. Die Gattung *Digitalis* L. und Ihre praktische Anwendung (Russ.) Acta Inst. Bot. Komarov. Acad. Sci. URSS, ser. 1, **11**: 198–302.

JAVORKÁ, S. 1929. Herbarium Kitaibelianum. Ann. Hist. Mus. natl. Hung. **26**.

LEDEBOUR, C. F. VON. 1847. Flora Rossica vol. **3**.

LINNAEUS, C. 1756. Plantae Hybridae (J. J. HAARTMAN def.) Amoen. Ac. **3** (Orig. 1751).

LINNAEUS, C. 1763. Species Plantarum ed. 2 vol. **2**.

MILLER, PH. (1756–)1759. The Gardener's Dictionary, ed. **7**.

MILLER, PH. 1768. The Gardener's Dictionary, ed. **8**.

ROUY, G. 1909. Flore de France, vol. **11**.

SOÓ, R. 1966. Species et combinationes novae florae europeae praecipue Hungariae V. Act. Bot. Acad. Sci. Hung. **12**.

STAFF BAILEY HORTORIUM. 1976. Hortus Third.

STAFLEU, F. A. 1967. Taxonomic Literature.

STAFLEU, F. A. 1971. Linnaeus and the Linnaeans.

STAFLEU, F. A. and COWAN, R. S. 1979. Taxonomic Literáture vol. **2**.

WERNER, K. 1960. Zur Nomenklatur und Taxonomie von *Digitalis* L. Botanische Jahrbücher vol. **79**.

WERNER, K. 1962. Die kultivierten *Digitalis*-Arten. Die Kulturpflanze, Beiheft **3**.

WETTSTEIN, R. VON. 1891. *Scrophulariaceae* in ENGLER, Die Nat. Pflanzenfamilien **4**: **3b** Lief. **67**.

ACKNOWLEDGMENTS

We would like to thank the directors of the herbaria cited for the use of herbarium material; Dr. P. HIEPKO (B), Dr. J. LEWIS (BM), Dr. J. JOSÁK (PR) and Dr. Z. DEBRECZY (BP) for information on the location of KITAIBEL's specimens; Mr. A. PLAIZIER (Wageningen) for inspection of the type of *D. minor* L. at the Linnean Society of London; the gardeners of the Wageningen Botanical Gardens for the cultivation of the *Digitalis* collection.

BOTANICAL GARDENS, PUBLIC PARKS, ROAD SIDES, HISTORICAL GARDENS, HISTORICAL ARABLE FIELDS, NATURE RESERVES AND PRIVATE GARDENS AS GENEBANKS OF CULTIVATED CROPS

A. C. Zeven

Institute of Plant Breeding-I.v.P., Agricultural University, Wageningen, the Netherlands

Summary

As the maintenance costs of genebanks are very high, it is proposed that parts of the collections of the genebank be maintained in botanical gardens, public parks, road sides, historical gardens, historical arable fields, nature reserves and private gardens. Hence there should be a close cooperation between the personnel of the genebanks and those connected with botanical gardens, etc.

It is also proposed that owners of private gardens be encouraged to grow their own long established cultivars. By doing so they will maintain a great genetic wealth, also for the benefit of the plant breeders. Owing to the proximity of many private gardens hybridisation will occur between cultivars of a crop resulting in new genotypes and phenotypes. These new types should also be included in the collection of the genebank. Further, the herbarium of the future Dutch genebank should closely cooperate with the Herbarium of the Department of Plant Systematics of Wageningen Agricultural University.

Introduction

For the breeding of new cultivars of crops we need genetic variation. This variation is found in wild relatives and old, obsolete and modern cultivars and therefore they should be preserved. An institution that maintains and studies a collection of the above material is called a genebank, or a germplasm bank. The size of a collection for a specific crop depends on the type of that crop, the available material and even more on the financial situation of the genebank, because costs, especially those of the maintenance of collection, are very high. Therefore ways are sought to reduce these costs.

Botanical gardens, public parks, road sides, historical gardens, historical arable fields, nature reserves and private gardens are established to grow plants for man to study and to recreate. Among the plants grown there could be wild relatives and old cultivars of the cultivated crops. A display collection could easily be a genebank collection as well.

BOTANICAL GARDENS, PUBLIC PARKS AND ROAD SIDES

In botanical gardens, public parks and road sides many plants are grown to please the visitors. There are also special collections on show that are cultivated as a study object, or for reference. Such collections could be developed into a genebank for the crop or the species studied. If so, conservation should be enforced by law and funds should be made available for the maintenance and study of such collection. In the Netherlands there is no national genebank and, as far as I know, no collection in botanical gardens or public parks is protected by law. As long as there is no official genebank in the Netherlands it is difficult to centralize the supervision of all important collections with breeding value.

A few examples concerning the Netherlands are given here. In the Westbroekpark of the Hague there is a large rose cultivar collection. This collection could be of major importance to the rose breeders and therefore it should be protected by law.

A collection of wild *Rosa* species and old cultivars is grown in the Botanical Gardens of Wageningen Agricultural University. Here the collection serves a multiple purpose: a display for visitors, a source of genetic variation and a study object. But it is not protected by law. The maintenance costs of the Dutch Hortus Bulborum (VAN EIJK, 1973), which accomodates some 1000 old and new cultivars of tulip and other bulb species, is very high, but could be reduced by growing part of the cultivars in botanical gardens, and public parks. A number of the old cultivars could also be preserved in a 'historical corner' of the Keukenhof bulb flower exhibition near Haarlem. Some of these can also be grown in Historical gardens (see below).

Old cultivars of ornamental trees or trees for timber like the poplar (*Populus* sp.) are maintained by growing them on roadsides. Old cultivars of osiers (*Salix* spp.), an almost historical crop in the Netherlands, are planted in the polders and elsewhere to maintain the various cultivars.

There are more collections in the Netherlands and some are or could be grown in botanical gardens, public parks and road sides. Boards of botanical gardens may find it unattractive to grow a collection of old cultivars of a crop like the carrot, but a collection of wild *Solanum* species related to the potato is a pleasure to the eye during flowering time.

Botanical gardens also preserve species and cultivars in their living seed collections. Among them there are seed collections of threatened wild plants and these may be relatives of cultivated crops. In such way botanical gardens add to the maintenance of genetic variation. A possible natural hybridization has no consequence for the plant breeders. In fact, it may increase the genetic variation.

Some of the above collections are well administrated, others are not. More work must be done for further evaluation of their breeding value. This can be done by specialists and genebank personnel. The collected data should be stored in the databank of the genebank.

HISTORICAL GARDENS, HISTORICAL ARABLE FIELDS AND 'ONKRUIDAKKERS'

Old cultivars could also be maintained in socalled historical gardens, historical arable fields and 'onkruidakkers' (arable fields in which weed communities are studied and are on show). Historical gardens can be created around a historical monument. When this monument is restored to style of a certain period the area around that monument should also be included and restored to the garden style of the same period. Unfortunately, this is seldom done. But some historical gardens exist, not only around a restored monument but also for instance in an 'open air museum'.

Historical arable fields are fields managed with agronomy methods of the 19th century. They are established for recreation.

When such gardens and fields are established, one should grow the cultivars of the period in which the gardens and the fields were designed and established. However, as the desired cultivars are in general not available, other cultivars of the same crop are grown. From a historical point of view this is wrong, but for the maintenance of genetic variation it is not a disadvantage. Therefore, such gardens and fields may be used to maintain genetic variation. In fact, those involved will be satisfied; the general public because it believes to be looking at an old crop, the landscaper/curator because he has to grow plants, and further the seed trader and the genebank personnel because of their respective interests.

When applying methods of the 19th century or earlier – these are often nowadays called 'alternative methods' – one should realize that weeds were a major problem at that time. So STARING (1861) said 'how strange would it be if our bulb fields around Haarlem were free of pestweeds'. He gave some numbers of weed seeds in sowing seed. So in the sowing seed of ryegrass used for one hectare were 900000 weed seeds. And in the sowing seed of white clover used for one hectare 5500000 weed seeds were estimated which will be added to the already present weed seeds. Among the weed flora there are relatives of our cultivated plants, like the wild carrot, wild grasses (most grass cultivars are on large scale propagated wild plants), white clover, red clover etc. Among them there may be indigenous and exotic cultivated plants that have run wild. For instance in the 19th century the orange lily (*Lilium bulbiferum* L.) introduced from South Germany into a farmer's garden had run wild in rye fields (VAN OOSTROOM, 1962). Nowadays, this species does not belong anymore to the weed flora. It should be re-introduced.

Since a few years socalled 'onkruidakkers' have been established mainly for recreational purposes. There are many weeds and those related to our cultivated plants may form a rich source of genetic variation. This variation can be increased by actually introducing other species like the orange lily or by bringing in other genotypes. However, the present custom of buying clean sowing seed is not the best way to increase and maintain the genetic variation of the weed flora. In fact, sowing seed should be taken from the uncleaned harvest seeds.

The evolution of the weed flora should be studied. This should not only be done on a special level, on a botanical variety level, on a morphotype level, but also on a genotype level. The last is made quite possible by chromatography and electrophoresis. Plant sociologists and plant systematicists should be trained to work with these methods. The assembled data should be stored in the databank.

NATURE RESERVES

Nature reserves and especially those established in a centre of diversity of one or more domesticated plants can be a wealth of genes for breeding. In some recently established nature reserves parts which had been used by man will develop into the climax vegetation. This type of vegetation will probably suppress grasses, in a way similar to the establishment of nature reserves in the overgrazed land in Israel. This resulted first in the growth of masses of wild wheats and wild barley. Apparently the seeds of these species were still present in the 'soil seed bank'. In due course shrubs and trees develop and shade the wild wheats and wild barley causing their disappearance. If it is decided that such a nature reserve is also a natural genebank for our bread wheat, durum wheat and barley, steps should be taken to maintain the flora of wild wheats and wild barley. This can be realized by cutting the shrubs and trees and, when not harmful to the soil, by harrowing. In the harrowed soil aggressive pioneer plants will grow and among them are the wild wheats and wild barley.

The establishment of nature reserves in river flats and river valleys in the Netherlands and other countries should be considered as these areas are specially rich in genetic variation of grasses (DUYVENDAK & LUESINK, 1979). When doing so it should be borne in mind that the genetic wealth originates from the influx of grass seeds when the area is annually or regularly flooded. Hence, the establishment of a nature reserve in such an area should be combined with a rule that regulation of the river or stream may not be altered. In such nature reserves, plant systematicists should study the flora to know which wild plant species related to domesticated plants are present. Plant sociologists should study the flora and indicate when and where steps should be taken to promote the development of the wild relatives. Genebank personnel should study the flora to know which useful genes are available to breeders. All data should be stored in the databank.

PRIVATE GARDENS

In private gardens – for ornamentals, potherbs or vegetables – there is still a wealth of plant species and cultivars. The reason is that many private growers prefer to grow their own, often inherited, material or grow old established material often obtained from neighbours.

To proof that in a highly industrialized country as the Netherlands a lot of genetic variation is still present in private gardens I collected the dry seed-bush type of the common bean (*Phaseolus vulgaris* L.) (ZEVEN, 1978, 1979). Since the genetic wealth of the common bean in the Netherlands is not even scantily described, it is difficult to decide whether the collection existing of ca 100 accessions represents to some extent the types grown in the Netherlands at present.

In other countries similar work has been done. For instance with peony cultivars in Sweden (D. O. WIJNANDS, personal communication) and with rose cultivars in Great Britain (see for review THOMAS, 1971). These collections showed that genetic wealth is still available in private gardens of highly industrialized countries. The owners of such gardens are in general not interested in modern varieties as they prefer their own 'quality' and when more produce is desired some more plants are grown. In fact, for the breeders' own sake these gardeners should not be encouraged to grow modern varieties. Let them maintain the much needed genetic wealth. Furthermore, as more hobbyists like to grow 'old' varieties these should be made available to them. In this way they also help to maintain genetic variation. The genebank should also maintain these varieties to avoid their loss, as private gardeners cannot be enforced to maintain the old varieties.

Since private gardens are often close to each other like allottment gardens and backyard gardens in towns and villages hybridisation between the various varieties of a crop may take place. This results in new genotypes and phenotypes. Therefore, such gardens should be visited from time to time to collect these new types. This can be done by the genebank personnel.

Information of material in private gardens and in the collection of the genebank should be stored in the databank of the genebank.

CONCLUSIONS

Genetic variation is highly desired to continue the breeding of still better varieties. Therefore genetic variation should be collected and maintained by genebanks. The maintenance is costly and therefore parts of the collections should be maintained in botanical gardens, public parks, road sides, historical gardens, historical arable fields, 'onkruidakkers', nature reserves and private gardens.

In the Netherlands there is not yet a central genebank and except for the Solanum collections (WAC) no collection is protected by law. Proposals have reached the Dutch Ministry of Agriculture and Fisheries to establish such a central genebank (Genenbank Nederland, 1979). When established the Dutch genebank – Genenbank Nederland – can arrange and supervise the maintenance of the collections by themselves and by others.

The genebank personnel should assess the collections for their breeding values. Per accession there should be a herbarium specimen – also of modern cultivars. In the Netherlands, the herbarium work of the genebank could best be done in close cooperation with the Herbarium Vadense of the Department of Plant Systematics of Wageningen Agricultural University as this herbarium should be the place in the Netherlands to specialize in collection of cultivars of domesticated crops.

ACKNOWLEDGEMENTS

Dr. A. M. VAN HARTEN, Institute of Plant Breeding-I.v.P. and Drs. D. O. WIJNANDS, Department of Plant Systematics, both of the Agricultural University at Wageningen have critically read the text and made several suggestions. Their help is gratefully acknowledged.

REFERENCES

DUYVENDAK, R. & B. LUESINK. 1979. Preservation of genetic resources in grasses. p. 67–73 in (Eds. A. C. ZEVEN & A. M. VAN HARTEN), Procs. Conf. Broadening the genetic base of crops. Wageningen. 347 p.
VAN EIJK, J. P. 1973. 'Hortus bulborum', belangrijk reservoir voor veredeling (Important pool for breeding). Meded. IVT, Wageningen no. 374, 12 pp.
GENENBANK NEDERLAND. Nota of de Werkgroep Genenbank Wageningen. Wageningen, 23 p.
VAN OOSTROOM, S. J. 1962. Flora van Nederland. 15th ed. Groningen. 892 p.
STARING, W. C. H. 1861. Onkruid. Almanak voor de landman: 52–61.
THOMAS, G. S. 1971. The old shrub roses. London. 232 p.
ZEVEN, A. C. 1978. Op zoek naar stambonen. Tweestromenland no. 29: 3–9.
ZEVEN, A. C. 1979. Collecting genetic resources in highly industrialized Europe especially the Netherlands. p. 49–58 (Eds. A. C. ZEVEN & A. M. VAN HARTEN), Procs. Conf. Broadening the genetic base of crops. Wageningen, 347 p.

REGISTER OF SCIENTIFIC PLANT NAMES

New names are in **bold** face. Figures, photographs and maps are indicated by an asterisk attached to their page numbers.