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A REVISION OF DENDROBIUM SECTION OXYGLOSSUM (ORCHIDACEAE)

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ABSTRACT. *Dendrobium* section *Oxyglossum* is revised to include section *Cuthbertsonia* and the number of species reduced from 111 to 28. These are distributed throughout many islands of the southwest Pacific and centred in New Guinea. Two new species, *D. brassii* and *D. pachythrix*, are described. History, sectional position, taxonomic characters and distribution are discussed. The horticultural importance of the species is emphasized and cultural comments given. Keys, descriptions, maps, line-drawings and colour plates are provided and an index to species and synonyms added.

Contents

Introduction

Over recent years there has been increased study and interest in the genus *Dendrobium* Sweet, in particular those species from New Guinea, Australia and the Pacific Islands. As discussed by Cribb (1983), many of these species

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have been in cultivation for some time, with several being used as parents in hybridisation programmes. However, others have more recently been introduced into cultivation. The correct names of some of these species have long been in doubt and need clarification. This is being done as botanical revisions of the sections are completed and is the main purpose of the present paper.

The increasing cost of cultivating orchids in temperate climates has caused more growers to consider the miniature, cooler-growing orchids which require less space and heat. This has led to a greater demand for the smaller, cool-growing Dendrobiums such as those which are native to the Highlands of New Guinea, in particular species belonging to section *Oxyglossum* Schlechter (including section *Cuthbertsonia* Schlechter), and to a lesser extent those in sections *Latouria* Blume, *Pedilonum* (Blume) Lindley and *Calyptrochilus* Schlechter. The bright colours and longevity of the flowers greatly enhance the appeal of these species and they are sought by growers who have been fortunate enough to see good flowering specimens.

Interest in section *Oxyglossum* and other dendrobiums from New Guinea has also been stimulated by the increased availability of plants since about 1975, when several of the most common species were exported from Papua New Guinea under the guidance of the Department of Primary Industry. This was initiated by Mrs Andreé Millar, formerly Curator at the National Capital Botanic Gardens in Port Moresby. Additional interest in the study of these orchids has been generated by various private collections in Papua New Guinea as well as by many visiting botanists who have deposited dried and pickled specimens in most leading herbaria.

Section *Oxyglossum* comprises mainly mountain species many of which are difficult to grow outside their native habitats. Until 1975 there was no highland garden in Papua New Guinea where these orchids could be grown and studied as living subjects. However, the Highland Orchid Collection at 2200 metres above sea level at Laiagam in the Enga Province was established in that year and has assisted in this study. Of the overseas gardens, the Royal Botanic Garden Edinburgh probably has the best living collection of these orchids, and this has also been of considerable significance (Pottinger, 1987).

The notes on cultivation are somewhat brief but it is hoped that in the ensuing years much progress will be made in this area so that these species will become easier to grow. In future years it is likely that this group of orchids will find an important and enduring place in temperate orchid houses.

This study is the culmination of many years of collecting specimens and information and it is hoped that the results published here will provide a standard guide to these very attractive plants.

Taxonomic History

Genus and subgenus. A revision of the entire genus *Dendrobium* has not been attempted since the 1910 monograph by F. Kränzlin which was not well received by the leading orchidologists of the day. Schlechter (1912) for example was highly critical as his introductory comments and many other remarks on New Guinea *Dendrobium* reveal.

The subgenera recognized by Kränzlin have been treated variously by several authors. Brieger (1981) and Rauschert (1983) have attempted to split

Dendrobium into many new genera, but it is unfortunate that they have little working knowledge of the species in this genus and we fully endorse the remarks of Cribb (1983: 231) and Seidenfaden (1985: 7) in regard to their irresponsible actions.

SECTIONS. By far the most useful infrageneric taxon in *Dendrobium* is the section. For the New Guinea species at least, the subdivisión of *Dendrobium* by Schlechter (1912) has been little questioned and is still the most useful. It would also be safe to say that no one has equalled the knowledge which Schlechter and J. J. Smith (who followed his system) had of the New Guinea Orchidaceae. It was the sheer number of species that forced Schlechter to make his sectional divisions. Section *Oxyglossum* was first described by him in 1905.

There are approximately 30 sections within *Dendrobium* (*sens. lat.*) in New Guinea. In recent years three sectional revisions have been completed and published—*Latouria* Blume (Cribb, 1983), *Microphytanthe* Schlechter (Reeve, 1983) and *Spatulata* Lindley (Cribb, 1986).

It may be argued that in order to obtain a balanced hierarchy, sections *Calyptrochilus* Schlechter, *Cuthbertsonia* Schlechter, *Oxyglossum* Schlechter, *Pedilonum* (Blume) Lindley and *Platycaulon* Schlechter would be better treated as subsections of a broad section *Pedilonum* as already advocated informally by J. J. Smith (1922), but until someone with sufficient working knowledge of species in all sections makes a study of the entire genus, or at least subgenus, it is wisest not to make any major changes at this level. In considering the subject of sectional boundaries the words of John Lindley (1858) are worth remembering: 'In forming the sections now proposed, it will be seen that a regular sequence of the most nearly allied forms is not wholly obtained. However desirable, indeed, such an arrangement may be in theory, it is certainly unattainable in practice in cases where great numbers of species are brought together; for the points of resemblance and differences are so complicated, that, like countries in a geographical map when placed in a continuous series, some must of necessity be dissevered from those to which they are conterminous in nature'.

In the present study, the section *Oxyglossum* had seemed reasonably clear-cut, with three or four borderline species, whilst section *Cuthbertsonia* accommodated just a single species. The fact that they were often linked together and sometimes confused made it desirable for both sections to be treated at the same time. Better material of two of these borderline species has led us to revise our original intention and we have, perhaps somewhat contentiously, though already taken up by Cribb (1987) amalgamated the two sections.

SPECIES. In the search of literature a total of 96 different published species names has been found in section *Oxyglossum* and 15 in section *Cuthbertsonia*. Two further new species names are published here—*D. brassii* Reeve & Woods and *D. pachythrix* Reeve & Woods.

The revisionary work has largely been the careful delineation of species and assignation of names to synonymy. The overall reduction has been from 111 to 28, a ratio of four to one. This reduction is double that for the section *Latouria* and *Spatulata* revisions by Cribb (1983, 1986), and this highlights the difficulties and confusion which have existed during this classification.

Table 1 shows the reduction, listing the botanists chronologically (on the date of publication of their first species descriptions), in section *Oxyglossum* (including section *Cuthbertsonia*).

TABLE 1

The fate of species names in *Dendrobium* sect. *Oxyglossum* (including sect. *Cuthbertsonia*)

Author	Total	Reduced to synonymy	'Good' species	Subspecies	Varieties
J. Lindley	2		2		
H. N. Ridley	10	8	1		1
F. von Mueller	1		1		
F. Kränzlin	4		3	1	
R. A. Rolfe	2		1	1	
R. Schlechter*	42	29	9(10)	2	2
J. J. Smith	28	19	6	1	2
O. Stapf	1		1		
R. S. Rogers	1	1			
O. Ames	1	1			
N. Fukuyama	1	1			
L. O. Williams	2	2			
A. D. Hawkes & A. H. Heller*	1		(1)		
P. van Royen	15	13	1		1
T. M. Reeve & P. J. B. Woods**	2		2	(1)	(2)
Totals	113	74	28	6	8

* One of Schlechter's 'good' species, *D. coerulescens*, was found to be a later homonym and was renamed by Hawkes & Heller (1957). It should be noted that Schlechter's earlier work (1905, 1912) was more critical.

** The three Reeve & Woods infraspecific taxa were published as such, and are not included in the total number of species names.

This revision has been made after examination of hundreds of herbarium specimens as well as a great number of living plants. Our species concept, by today's standards, is a broad one, but we believe that it is a true synthesis in light of our long study of the variation which exists within species. In an earlier paper (Reeve & Woods, 1980), an outline was given of the major reasons why there has been considerable confusion regarding the taxonomy of section *Oxyglossum* which led to misidentifications and much duplication in naming. These reasons are repeated here.

1. Undoubtedly the main cause of confusion has been the lack of appreciation of the variation which occurs within the species of these sections.

Firstly the plant form may vary considerably, depending upon habitat, and these differences are more marked at higher altitudes. This may well be caused by the great temperature variation in the alpine zone. For example, *D. brevicaule* Rolfe, a common alpine species in New Guinea, shows a remarkable variation in plant form, especially subspecies *calcarium* (J. J. Smith) Reeve & Woods and *pentagonum* (Kränzl.) Reeve & Woods. If growing in deep shade (usually very cold) with competition from large cushions of moss, the plants will be long and straggly (pendulous) with elongated rhizomes. On the other hand, plants found growing exposed to the full sunlight (which is burning hot at high altitudes) are much more compact and stunted in their growth, without distinct rhizomes.

The fact that the different vegetative forms of these species are largely, if not wholly, due to environmental factors has been proved by collecting them and

growing them under uniform conditions at the Highland Orchid Collection, Laiagam, in Papua New Guinea.

Secondly, whilst the flowers are the best guide in identification, the numerous colour forms within a species have also created confusion. Some of the species in this section exhibit an amazing range of colour variation. This was not realised in the early days of collecting, so that sometimes botanists described a new species on the basis of a different colour and the fact that it had been collected from a different part of New Guinea. For about half of the species in this section the colour is constant (as far as we know) and, where distinctive, use of this feature has been made in the key.

Thirdly, undue emphasis has been put on such features as the number of veins in and the finely serrated edges of the petals and sepals, the length of the mentum and the shape of its tip, and the size of the crests or keels on the lateral sepals. Studies at Laiagam have shown that these features are quite variable and even different flowers on the same plant show a variation in the number of veins. The ovary cross-section has proved to be a fairly constant character and the size of the flowers is also quite a useful key character.

Whilst the earlier botanists often had scanty material for study, this should not be the case with modern botanists working on the New Guinea Orchidaceae. In his 1979 treatise of the alpine species, Dr P. van Royen has, in our opinion, underestimated the extent of intraspecific variation: we have therefore reduced 13 of his new species to synonymy.

2. Another reason for confusion in this group is the loss of Schlechter's holotype specimens which were destroyed in Berlin during the Second World War. Rudolf Schlechter described more species in this section than any other botanist, and many descriptions were based on a single specimen. Fortunately there are some duplicates at Ames (Harvard University), Bogor, British Museum (Natural History), Brussels, Edinburgh, Geneva, Kew, Leiden, Missouri Botanical Garden, Paris, Stockholm, Sydney, Vienna, Zurich and possibly elsewhere.

In this revision neotypes have been designated for all the missing or destroyed holotypes. These new types have been chosen in many cases from the same locality (or province).

3. A considerable amount of duplication in naming New Guinea plants occurred when German, Dutch and British botanists described the flora from different parts of the island. Many species of mountain orchids in New Guinea have a wide distribution from east to west throughout the Central Range (see maps). This, quite understandably was not realised at the time. Also, some publication dates were so close and communications so slow that botanists were not able to consult each others' work before publishing their new descriptions.

Distribution

The genus *Dendrobium* extends from Japan in the north to Stewart Island, New Zealand in the south and from the Himalayas in NW India (near Dehra Dun) in the west to the Society Islands in the east. The distribution of the genus in New Guinea, Australasia and the Pacific Islands is comprehensively discussed by Cribb (1987). The section under study here is distributed from Indonesia to Fiji, with most species being endemic to the large island of New Guinea (see

Map 1 p. 283). Two species are recorded from the small island of Ponape (Pohnpei) in the Caroline Islands group north of the equator and one from New Caledonia. Van Royen (1979) includes the Philippines in the distribution of section *Oxyglossum* but we have found no evidence to confirm this.

The main areas of distribution recognized in the species accounts are:

MICRONESIA—the islands of the northwest tropical Pacific Ocean including the Caroline Islands.

SULAWESI—formerly known as Celebes, Indonesia.

MOLUCCAS—the Indonesian islands between Sulawesi and West New Guinea. They are broadly divided into the North Moluccas (including the islands of Tidore and Halmaheira) and South Moluccas which includes the island of Seram.

WEST NEW GUINEA—the present province of Irian Jaya, Indonesia (west of longitude 141° except along the upper Fly River). This represents the former Dutch New Guinea (1828–1962).

EAST NEW GUINEA—now known as the independent state of Papua New Guinea, formerly a territory of Australia. The northern part was once a colony of Germany (1884–1914) and the southern part, known also as Papua, was once known as British New Guinea (1884–1906) until it was handed over for Australia to administer. The adjacent small islands, including those of the Louisiade Archipelago in the east, are included here.

BISMARCK ARCHIPELAGO—the larger islands to the north east of Papua New Guinea and including New Britain (East and West), New Ireland and Manus or the Admiralty Islands. These are now provinces of Papua New Guinea.

SOLOMON ISLANDS—divided into two political areas. The North Solomons (Bougainville and Buka) are a province of Papua New Guinea, whilst the many islands to the south are now known as the Solomon Islands (formerly the British Solomon Islands Protectorate).

NEW CALEDONIA.

SANTA CRUZ ISLANDS.

VANUATU—formerly the New Hebrides.

FIJI ISLANDS—usually referred to as Fiji.

Habitat

Members of this section are mountain species and usually grow at high elevations. Some 10 species grow in the alpine zone with both *D. brevicaule* and *D. dekockii* J. J. Smith occasionally extending up to 3800m. Two species, *D. cyanocentrum* Schlechter and *D. masarangense* Schlechter descend almost down to sea level. The probable reason for the occurrence of some species at lower altitudes is discussed under *D. violaceominiatum* Schlechter (see p. 212)

In commenting upon the habitats of species in section *Oxyglossum* Schlechter (1912, Engl, transl. 1982) stated 'That they always grow on more or less horizontal branches of trees in the primary forests. Only once did I find *D. cyanocentrum* Schltr. on thinner, perpendicular tree trunks. Most of the species occur in colonies, growing on the same tree, very often in large individual numbers'.

The majority of species grow on small branches and twigs, however several species are found on large vertical tree trunks. Included here are *D. cyanocentrum* as Schlechter noted, as well as the two mat-forming species *D.*

delicatulum Kränzl. and *D. putnamii* Hawkes & Heller. Once, in a very wet area, Reeve collected both *D. subacaule* Reinw. ex Lindl. and *D. undatialatum* Schlechter growing on the main trunks of *Pandanus*.

In areas where there is prolonged cloud cover and mists (i.e. high humidity) several species are found growing in large clumps of moss in what appears to be quite a delicate moisture balance. Species of this habitat are *D. brevicaule, D. cuthbertsonii* F. v. Muell., *D. laevifolium* Stapf, *D. nardoides* Schlechter, *D. petiolatum* Schlechter, *D. rupestre* J. J. Smith and *D. vexillarius*, J. J. Smith. Sometimes these clumps of moss and orchids occur on vertical trunks, particularly in the case of *D. cuthbertsonii*.

At higher altitudes and more frequently in wetter areas there is a tendency for plants to be terrestrial or semi-terrestrial. Some species frequently colonise banks, ditches and road-cuttings and occasionally grow on rocks. Included here are *D. cuthbertsonii, D. rupestre* and *D. vexillarius* var. *uncinatum* (Schlechter) Reeve & Woods, *D. pachythrix, D. puniceum* Ridley and *D. subacaule. D. brevicaule, D. delicatulum, D. hellwigianum* Kränzl., *D. nebularum* Schlechter, *D. subuliferum* J. J. Smith and *D. violaceum* Kränzl. have also been recorded as terrestrial. It is interesting to note that on road cuttings and ditches the roots of the orchids usually go right into the soil (which is often a red clay subsoil).

In the high-altitude grasslands of New Guinea, several species are epiphytes on trunks of tree-ferns, and provide a spectacular sight for those privileged to visit these areas. The species recorded on tree ferns are *D. brevicaule, D. cuthbertsonii, D. dekockii, D. sulphureum* Schlechter and *D. vexillarius* (especially var. *uncinatum*).

Most species prefer plenty of light, but there are some exceptions: *D. habbemense* van Royen, *D. petiolatum, D. vexillarius* var. *retroflexum* (J. J. Smith) Reeve & Woods, as well as a good proportion of *D. cuthbertsonii* plants, are usually found growing in quite shaded habitats, though never without the air movement which all these species require for survival. *D. habbemense,* in common with the widespread *D. lawesii* F. v. Muell. (section *Calyptrochilus*) occurs as an epiphyte on the lower trunks of trees and appears to have a lesser requirement for air movement.

Morphology

Roots. All the species have fusiform roots which grow in fairly close contact with the substrate; they are white when dry and often pinkish when wet. The root tips are normally green but those of *D. brassii, D. nebularum* and *D. rupestre* are usually orange-coloured, a feature which can only be observed in living material.

Rhizomes. In most species the rhizome is usually much abbreviated. A well-developed, branching rhizome is a feature of species such as *D. delicatulum* and *D. putnamii* which have a creeping habit.

Stems/pseudobulbs. In general the stems of most species arise in close proximity, are unbranched, may have few to many nodes, are cane-like or narrowly cylindrical or narrowly fusiform and often crowded so as to produce a tufted, erect habit. Several species develop thick fusiform or ovoid, few- to several-noded pseudobulbs as in *D. laevifolium, D. petiolatum* and *D. prasinum* Lindley, with an extreme condition of very small 2–3-noded, usually globose

pseudobulbs occurring in *D. delicatulum* and *D. putnamii*. Stems/pseudobulbs are clothed in leaf sheaths which are sometimes finely papillose and may eventually become distinctly fibrous. Species with pendulous stems also occur, for example, *D. habbemense* and *D. lancilabium* J. J. Smith, and decumbent or pendulous forms may occur in *D. brevicaule, D. sulphureum* and *D. vexillarius*. *D. habbemense, D. sulphureum* and some other species with well-developed stems and a lax habit may have a tendency to branch.

LEAVES. Many species have leaves which are linear, subulate or narrowly oblong. These shapes are often associated with species which have a relatively slender stem or pseudobulb. Broadly lanceolate, elliptic or ovate leaves are often associated with species which have a well-developed pseudobulb (e.g. *D. laevifolium* and *D. petiolatum*). Leaves mostly arise on the upper half of the stems or at the stem apex as in *D. delicatulum* and *D. putnamii*. A short or distinct petiole occurs in a few species (e.g. *D. petiolatum* and *D. brassii*), otherwise there is either a gradual or sudden transition from leaf blade to sheath. Occasionally the leaf sheaths are warty as in *D. brevicaule* and *D. dekockii*. Apart from *D. cuthbertsonii*, the leaves of which are normally finely verruculose, most species have glabrous, moderately stiff leaves although the terete leaves of *D. hellwigianum* are somewhat fleshy and the leaves of *D. puniceum* distinctly leathery. The apical margins of some species, for example *D. dekockii*, may be finely serrulate and a punctate surface is sometimes found as in *D. putnamii* and *D. rupestre*.

INFLORESCENCES. 1–4-flowered inflorescences represent the more commonly found state usually subsessile with a short bracteate rhachis, occasionally shortly pedunculate (e.g. *D. petiolatum* or *D. vexillarius*). The bracts are sometimes warty. The inflorescences may arise from leafy or leafless stems, terminally or subterminally, or less commonly from nodes along the upper half of the stem as in *D. habbemense*. Where flowers arise from leafless stems the pseudobulb is inclined to be pronounced as in *D. brassii, D. laevifolium, D. petiolatum, D. prasinum* and *D. undatialatum*. While flowers may also occur on leafless stems of those species with slender stems (e.g. *D. hellwigianum, D. nardoides* and *D. sulphureum*), flowers will also occur on leaf-bearing stems and both conditions may occur on the same plant at the same time. In most species the flowers are arranged on a somewhat abbreviated rhachis so as to seem paired, the labellum of each frequently facing the labellum of its neighbouring flower.

FLOWERS. In most species the resupinate flowers are held ± erect but in *D. cuthbertsonii* especially, and perhaps to a slightly lesser degree in *D. laevifolium* and *D. prasinum*, the flowers flop so as to place the labellum uppermost (a more obvious character when observed in living material). Many species are brightly coloured, some are white and two of those, *D. cyanocentrum* and *D. subuliferum* are scented. Most species have a characteristic flat flower (see Plate 15) formed by the spreading sepals and petals and by the sharply pointed labellum held tightly adnate to the column. The labellum is joined at its base to the elongated column-foot and forms with the lateral sepals a spur-like mentum with a distinctive fused basal portion (see Fig. 1). The mentum, which is usually filled with nectar to attract pollinators is, as with related sections (*Calyptrochilus, Pedilonum* and *Platycaulon* see p. 177–178) relatively long. Its length equals that of the column foot with a tip which varies from obtuse to distinctly bilobed. Reflexed sepals and petals are found in *D. cyanocentrum* and less

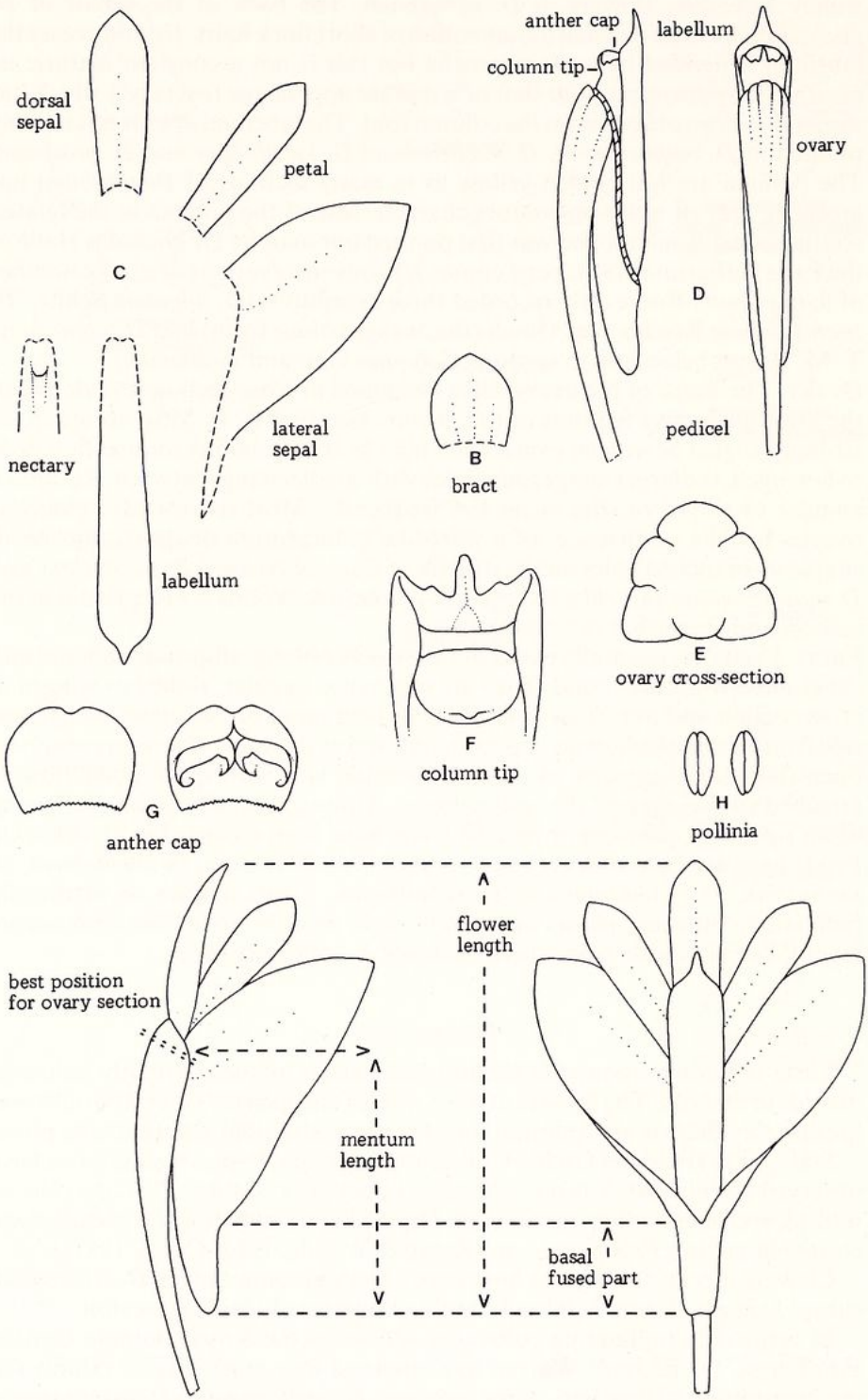


FIG. 1. Diagram of a generalized flower and its parts. D: left, side view; right, view from above. G: left, dorsal view; right, ventral view.
N.B. B–H are used for these same flower parts throughout Figs 4–37. A is always a habit drawing.

widely spreading flowers in *D. nebularum*. The back of the sepals of *D. pachythrix* have an unusual indumentum of short thick hairs. In many cases the labellum is divided by a cross lamella but this is not a constant feature; its position may correspond to that of a minute appendage (nectary?) which has sometimes been observed on the column foot. The labellum apex is not sharply pointed in *D. cuthbertsonii, D. habbemense, D. laevifolium* and *D. prasinum*. The pollinia are not golden-yellow as in many sections of *Dendrobium* but greenish, grey or maroon, colours characteristic of the pollinia in the related sections already mentioned was first pointed out to us by Dr Nicholas Hallé of the Paris herbarium (1981, pers. comm.). From observations of a large number of living plants Reeve only recorded three exceptions (*D. fulgidum* Schltr., *D. trichostomum* Reichb. f. ex Oliver (the orange colour form) and *D. womersleyi* T. M. Reeve, belonging to sections *Calyptrochilus* and *Pedilonum*).

OVARY. The shape of the ovary when examined in cross-section reveals one of the most distinctive features of this section (see Figs 2, 3). Most species have strongly angled or winged ovaries and may be triangular in cross-section or 3- to 5-winged, the larger wings sometimes with smaller wings between. Rounded, angular or ridged ovaries occur less frequently. Most species have glabrous ovaries but the occurrence of a wart-like indumentum or short, thickened, simple or branched hairs on the ovaries of *D. cuthbertsonii, D. pachythrix* and *D. masarangense* var. *chlorinum* (Ridley) Reeve & Woods is exceptional in the section and somewhat rare in the family.

FRUIT. Fruits are normally ovoid but narrowly oblong, ellipsoid, obovoid and subglobose fruits are found. They are trigonous, angular, ribbed or winged in cross-section and are either pendulous or held more or less erect. Sometimes ripe fruits retain the flowers in good condition at the apex. Reeve has observed open dispersing capsules of *D. hellwigianum* still with quite good flowers attached to the apex of the split capsule. Although usually green (yellowing when ripening), purplish or reddish fruits have been recorded in *D. dekockii*. Fruits have not been observed in *D. brassii, D. habbemense, D. lancilabium, D. pachythrix, D. petiolatum* and *D. subuliferum*. Fruits mature on artificially pollinated cultivated plants in seven to eight months and dehiscence occurs from the apex; viable seed where observed is uniformly green.

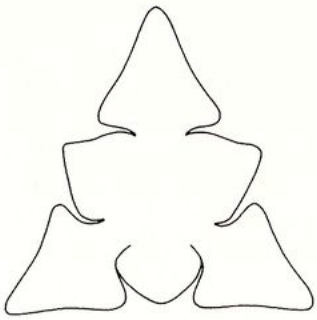
POLLINATION

Little is known about the natural pollination of these brightly coloured orchids in the wild. The flowers of most species are open for several months and presumably there is an optimum time for successful pollination to take place.

Staff at the Highland Orchid Collection, Laiagam, Papua New Guinea have observed the bird *Meledictes belfordi*, a honeyeater, visiting *D. violaceum*, as well as species of other sections of *Dendrobium* (including *D. pseudoglomeratum* in section *Pedilonum*—see Reeve & Woods, 1982; Cribb, 1987).

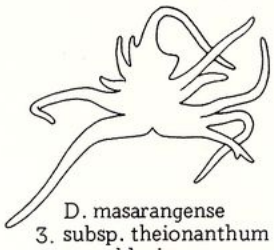
Cleistogamy and autogamy have been observed commonly in *D. delicatulum* subsp. *huliorum* Reeve & Woods, and less commonly in *D. puniceum*.

In artificially pollinating cultivated species at the Royal Botanic Garden Edinburgh, Dr Richard Warren has observed that most species exhibit self incompatibility. However, three species, *D. delicatulum, D. pentapterum* Schlechter and *D. violaceum*, may be selfed successfully. Much remains to be learnt in this field.



1. D. brevicaule subsp. pentagonum

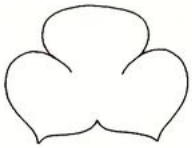
2. D. dekockii



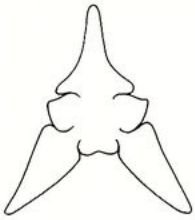
D. masarangense
3. subsp. theionanthum var. chlorinum

4. D. sulphureum var. sulphureum

3. D. masarangense subsp. masarangense

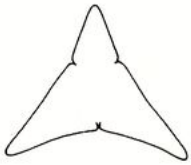


5. D. nardoides



6. D. subuliferum

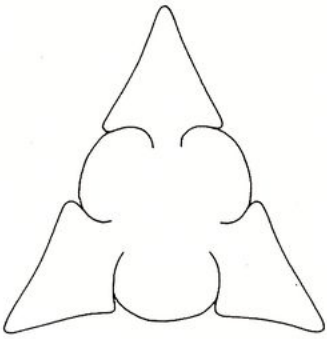
7. D. cyanocentrum



8. D. violaceominiatum

9. D. subacaule

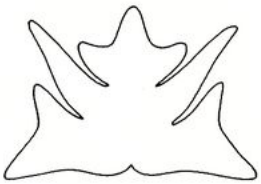
10. D. pachythrix



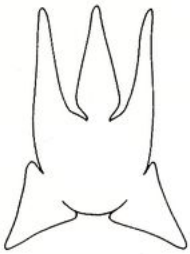
11. D. rupestre

12. D. putnamii

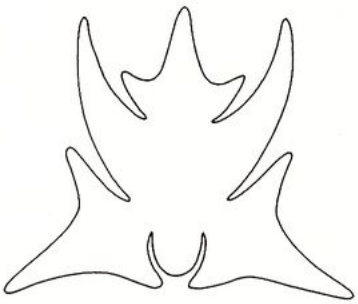
13. D. delicatulum subsp. delicatulum



14. D. puniceum

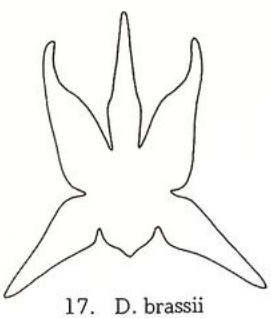


15. D. seranicum

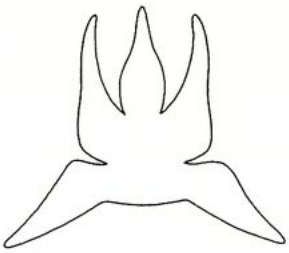


16. D. violaceum subsp. violaceum

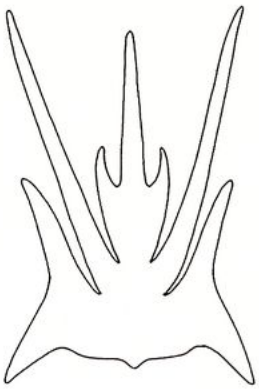
FIG. 2. Ovary cross-sections all × 10.



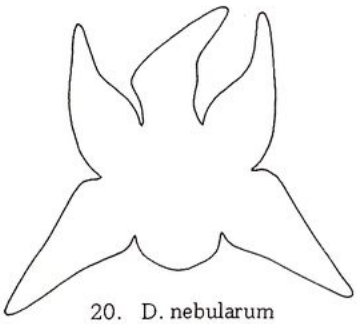
17. D. brassii



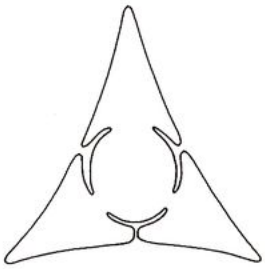
18. D. hellwigianum



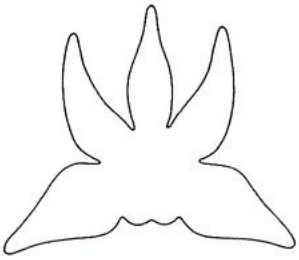
19. D. pentapterum



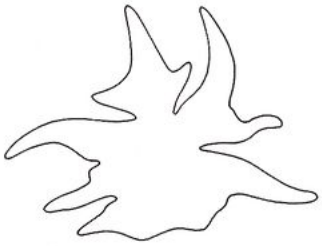
20. D. nebularum



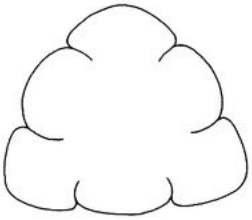
21. D. vexillarius
var. microblepharum



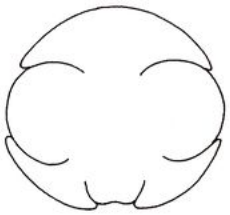
22. D. petiolatum



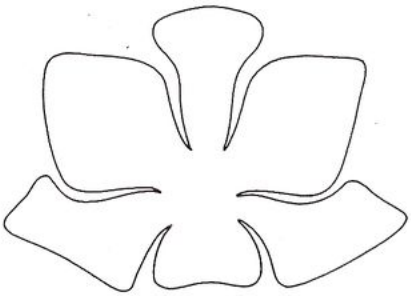
23. D. undatialatum



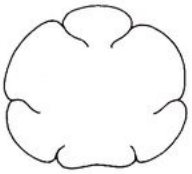
24. D. lancilabium



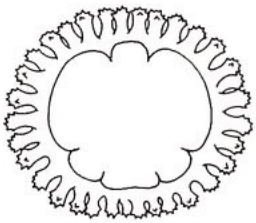
25. D. habbemense



26. D. prasinum



27. D. laevifolium



28. D. cuthbertsonii

FIG. 3. Ovary cross-sections all × 10.

Hybridization

Several putative natural hybrids (recorded below) have been reported—most from the Paiela area of the Enga Province, Papua New Guinea. These were seen amongst several thousand plants collected for cultivation and export between 1975 and 1983.

The main observation to note here is that natural hybrids are quite uncommon even though many species grow in close proximity to each other and are all in flower at the same time.

Three artificial hybrids have been produced within section *Oxyglossum*:— *D. laevifolium* × *D. prasinum*, *D. nardoides* × *D. sulphureum* and *D. pentapterum* × *D. vexillarius* var. *uncinatum*. None of these has yet flowered. Attempts to cross *D. cuthbertsonii* with *D. laevifolium*, *D. pentapterum*, *D. prasinum* and *D. vexillarius* have been unsuccessful (Warren, pers. comm.).

Records of putative natural hybrids

1. *D. brevicaule* × *D. dekockii*

East New Guinea: Madang Province, Mt Kapap, Teptep area (Finisterre Mts), 3300m, vi 1980, *Reeve* 506, 507 (E, K, L, LAE). Central Province, Mt Victoria, 3250m, *Craven* 2958 (K, L, LAE); Mt Kevive, *Croft et al.* LAE 65263 (L, LAE).

Pseudobulbs 1–3.5 × 0.2–0.3cm. Leaves 0.8–4.7 × 0.2–0.4cm. Flowers 3.5–4cm long, bright orange, anther also orange. Ovary 5-ribbed.

2. *D. dekockii* × *D. masarangense* subsp. *theionanthum* (Schltr) Reeve & Woods

East New Guinea: Enga Province, Porgera District, Alupai (near Mt Kaijende), 2900m, ix 1978, *Reeve* 160 (LAE).

A single plant was collected. The flowers were pale orange with greenish mentum and ovary, labellum greenish with orange tip. Ovary 5-ribbed. Pseudobulbs 3–5 × 0.2cm; leaves 0.5–1.5 × 0.1–0.15cm. This plant may be a hybrid (both of the supposed parents were growing in the vicinity) or less likely an orange form of *D. masarangense* (so far only recorded from the Vogelkop Peninsula in West New Guinea).

3. *D. cuthbertsonii* × *D. subacaule*

East New Guinea: Enga Province, Porgera District, Paiela Census Division, Waimeram, c.1800m, vii 1983, *Reeve* 1181 (E, LAE).

Leaves 0.7–1.5 × 0.2–0.3cm. Flowers c.1.8cm long. Ovary indistinctly ribbed.

A single plant was collected, with features intermediate between the two supposed parents. The flowers were red with golden yellow apex to the labellum; ovary and leaves with small verrucae.

4. *D. hellwigianum* × *D. violaceum*

East New Guinea: Enga Province, Porgera District, Paiela Census Division, Komanga, c.1800m, iv 1978, *Reeve* 159 (E, LAE).

Three plants were collected in the same vicinity. Flowers c.2.8cm long. Petals, upper sepal and tips of the lateral sepals bluish; labellum purple with orange unbent tip; ovary and mentum purple, ovary 5-ribbed with wings slightly undulating at the top end. Pseudobulbs 8–20 × 3–7mm; leaves

2–9 × 0.25–0.4cm, thickened and V-shaped in cross section. These plants grew and flowered well in cultivation.

5. *D. vexillarius* var. *microblepharum* (Schltr.) Reeve & Woods × *D. violaceum*
East New Guinea: Enga Province, Porgera District, Paiela Census Division, Komanga, c.1800m, vii 1977, *Reeve* 158 (E, LAE).

A single plant was collected. Pseudobulbs 4-leaved, 1–4 × 0.35–0.6cm; leaves 2–8 × 0.4–0.75cm. Flowers arising from the apices of leafless stems, orange with mentum and ovary light purple; labellum purplish with orange unbent tip; ovary 5-ribbed (intermediate between the two supposed parents).

Cytology

The chromosome numbers of some 250 species and 50 varieties of *Dendrobium* are now known (Hashimoto, 1987). There are three basic numbers in the genus, x = 18, 19 and 20, the majority of taxa being diploid. A few polyploids and aneuploids have also been recorded. (It is worth noting that many of the fine *Dendrobium* hybrid cultivars are polyploids.)

In a recent survey of some 82 taxa in 24 sections spread across 4 subgenera, Hashimoto (1987) confirms the earlier observations of Kamemoto and his collaborators (Kosaki, 1958; Kosaki & Kamemoto, 1961) that the commonest somatic number in the genus is 2n = 38 (60 taxa in 19 sections). He also showed that although much less common, the somatic number 2n = 40 occurs in 17 taxa (in 9 sections) of his sample. The diploid number of 2n = 36 is rare in *Dendrobium*, having been so far encountered in only two taxa, one each in sections *Latouria* and *Dichopus*.

Hashimoto (1987) also revealed the presence of a diversity of karyomorphological types and recognized 14 types. The grouping of the 82 taxa he examined, however, does not conform to Schlechter's sectional treatment of the genus.

Kamemoto (1987) also stressed the significant contribution made by studies on cross compatibility and meiotic chromosome pairing in interspecific hybrids on species relationships in the genus.

We thank Dr Kwiton Jong (Aberdeen) for kindly making the foregoing general comments.

Very little cytological investigation has been carried out on *Dendrobium* section *Oxyglossum*. Jones (1963) recorded an approximate number for *D. sophronites* (= *D. cuthbertsonii*) of 2n = c.80 and Hashimoto (1981) published a count for this species, again under *D. sophronites*, of 2n = 38 with the same number for *D. quinquecostatum* Schltr. (= *D. violaceum*). Jones, Lim & Cribb (1982) published chromosome counts for five species: *D. sulphureum*, 2n = 76, *D. hellwigianum*, *D. vexillarius*, *D. violaceum* and one unidentified species (possibly *D. masarangense*) all with 2n = 38 (*D. oreodoxa* Schltr. was mistakenly included in the section). Lim (1985) recorded *D. cuthbertsonii* as 2n = 76 and added *D. cyanocentrum*, *D. nebularum* and *D. petiolatum* all with 2n = 38. Apart from the first count for *D. cuthbertsonii*, the basic number for all species is x = 19 which is identical with most of the other New Guinea *Dendrobium* species so far examined. Most of the species studied were diploids, 2n = 38, except for *D. cuthbertsonii* in which a diploid and a tetraploid number have been reported, and *D. sulphureum* which was tetraploid.

Plant Exploration and Introduction

A glance at the list of exsiccatae (pp. 291–297) will confirm that the history of the collection of oxyglossum dendrobiums is much the same as that of general botanical collecting in the area. From the expeditions to the Pacific of Reinwardt in 1821 and Wilkes in 1840, to the recent Seram material of Operation Raleigh and that of Phillip Cribb *et al.* from the Solomon Islands and Vanuatu no major collector has failed to notice this group of orchids.

The first species to be introduced into cultivation seems to have been *D. laevifolium* in 1923 although *D. cuthbertsonii* is certainly the most commonly cultivated species of the section today. Prior to the establishment of the Highland Orchid Collection at Laiagam in 1975 plants were being distributed from Papua New Guinea to growers in Australia, the United States and Britain through the efforts of Mr John Womersley and his staff at the Division of Botany at Lae, by Mrs Andreé Millar, of the National Capital Botanic Gardens in Port Moresby and by a number of enthusiastic amateurs such as Mr Geoffrey Elworthy, an Australian planter at Merani Estate, Cape Rodney, Central Province.

Cultivation

The following notes are based on our observations of *Dendrobium* section *Oxyglossum* in nature and our knowledge of the species in cultivation particularly in Edinburgh and at Laiagam in Papua New Guinea which is at 2200m (c.7220ft). The cultural comments are also based on the knowledge and experience of growers in both hemispheres, principally in Australia, Britain and the United States, whose help we gratefully acknowledge (see p. 297). Northen (1980), Stocker (1983) and Cribb, Reeve & Woods (1985) contain useful guidance.

From observations of the habitats of the species (see p. 166) it can be seen that orchids occurring in the mountains of New Guinea experience cool conditions and high humidity. This is further discussed by Schlechter (1912, Engl. transl. 1982) in his introductory remarks. At 2600m (8500ft) the daytime temperatures range from approximately 10° to 25°C (50° to 77°F) with a humidity between 90% and 100% each night and during most of the day in the rainy season; in the 'dry' season the humidity may dip to as low as 35% for a few hours during the day with a corresponding increase in light intensity, at night temperatures around 5°C (40°F) often occur when there is little or no cloud cover. At 1500m (4920ft) the temperature range would be approximately 15° to 30°C (59° to 86°F). It may be deduced therefore that 'cool' to 'intermediate' house temperatures combining a fairly high humidity with good air movement and moderate shading, fulfil the basic requirements for successful culture.

Experience gained in growing species of this section at the Royal Botanic Garden Edinburgh has shown that plants grown vertically, mounted on slabs of tree-fern or the rough outer surface of cork-bark (*Quercus suber*), grow better than pot-grown plants, the former method providing good drainage and aeration though it must be emphasized that they cannot stand drought. Transfer of plants to bark or slabs is best attempted when a new flush of roots has appeared and a thin layer of either a compost suitable for epiphytes or live

sphagnum moss should be added. The roots should be secured to the mount with nylon string taking care not to damage them. It is important not to allow an excessive build-up of moss as this, combined with too frequent watering, tends to become soggy and will almost inevitably lead to the death of the plants especially if the moss is dead.

The two greenhouses which contain the orchid research collections at Edinburgh (which is at 56° latitude north) are of general purpose construction and measure approximately 6m (20ft) to the ridge, 2.15m (7ft) to the eaves and are about 9m (30ft) wide and 30.5m (100ft) long. The opening and closing of the vents is controlled by temperature-, wind direction- and rain-sensors. Other plant families are represented in the houses but are not mixed with the orchids. The plants are grown tied to slabs of either tree-fern or cork-bark which are suspended on both sides of vertically staged 'Netlon' (a plastic coated fencing material). The plants are placed randomly on this but are periodically repositioned should the lower plants become excessively wet or the upper ones over-dry or show signs of sun-scorch. No conscious attempt is made to place individual species in positions of either greater illumination or increased exposure to air-movement although the information from field notes and observations in nature would indicate that a need to experiment exists. An element of trial and error seems necessary to discover which position suits a particular plant best: as yet there seems no hard and fast rule to determine what is best for any one species, but cultural comments, whenever applicable, are included after the species descriptions. The authors would welcome advice and criticism on cultural methods.

Apart from *Dendrobium prasinum*, *D. laevifolium*, and seedlings of species being established which grow best in an 'intermediate' house with a night minimum temperature of between 14.5° and 18°C (58° and 65°F) and a day minimum of 21°C (70°F), species of this section are grown in a 'cool' house with a night minimum of 13°C (55°F) and day minimum of 15°C (61°F).

Humidity is provided by a manually operated overhead spray system which may be used frequently during hot sunny days in the summer. During the winter months less misting is required but humidity of between 60% and 80% is still maintained particularly during the night in the 'intermediate' house to compensate for the increase in temperature from the heating system. The Edinburgh plants are fed with 'Standard Maxicrop', which is a pure liquid seaweed fertilizer applied as a foliar feed every 10 to 14 days decreasing to a 4 or 5 week interval during winter months. Artificial lighting is not used. Shading, in the form of a fine-gauge, green plastic mesh netting, is provided above the plants as and when required during spring and autumn and is normally kept continuously above the plants during summer. Shading is not used during winter months. Plants in unshaded areas usually show leaf yellowing during the height of summer.

Normal precautions and controls for pests and diseases are recommended; slugs particularly cause serious damage.

Great care is required when attempting to propagate the plants using conventional methods and the removal and replanting of small peripheral pieces of leading growths is preferable to any drastic division of large established plants.

A useful article on successful cultivation of one species, *D. cuthbertsonii*, using artificial lights is given by John Sullivan (1986) where he also includes

information on watering, feeding, division and general culture of this adaptable species, much of which is relevant to other members of the section.

ASEPTIC SEED CULTURE (information kindly supplied by Dr R. C. Warren, Edinburgh).

Seed has been successfully set by controlled cross fertilization between different individuals of the following species: *D. cuthbertsonii, D. delicatulum, D. hellwigianum, D. pentapterum, D. prasinum, D. sulphureum, D. vexillarius* and *D. violaceum.* Seed is green on collection and remains green after sterilization and plating on to aseptic media. Germination is apparent after about four weeks as the protocorms swell.

Three media have been used—Murashige & Skoog (half strength with added trace elements), Vacin & Went, and Thompson's (Thompson, 1977). Each medium was supplemented with 0.1% peptone, 0.1% yeast extract, and pineapple juice with banana pulp (200ml and 40g respectively per litre). Best growth is obtained with Thompson's medium with a 14-hour day (warm white tubes) at about 20°C (68°F) day and 17°C (63°F) night. Replating is done at the first leaf stage on to similar media but with sugar concentrations lowered from 30g per litre to trace levels.

Plantlets are ready for transplanting after approximately nine months from sowing (e.g. *D. hellwigianum, D. prasinum*) although smaller species may be ready sooner (e.g. seven months for *D. delicatulum*). Following transference from aseptic culture to pot culture seedlings are grown on until established in a 'Dewpoint Cabinet' which is a closed propagation case, lit by fluorescent lamps, with bottom heat and a water trough to maintain a saturated atmosphere (see also Warren, 1986b, 1989). Although the times to flowering have not yet been determined, it is anticipated that most of the species already transplanted would flower between 18 months and two years after transplanting. Seedlings of *D. cuthbertsonii* supplied to a competent commercial grower started flowering one year after deflasking.

An orchid preservation scheme begun by the Scottish Orchid Society using species of this section for their project is discussed by three of the Society's members (Marsh *et al.*, 1989) and the policy of distributing species by the Royal Botanic Garden Edinburgh is commented on by Molly Pottinger (1987).

Taxonomic Treatment

Following the recommendation of a proposal by Holttum, Brieger & Cribb (1979, 1982) that *Dendrobium moniliforme* (L.) Sw. be accepted as the type species of *Dendrobium* Sw., section *Oxyglossum* falls into subgenus *Dendrobium* (formerly *Eudendrobium*). The main distinguishing features of subgenus *Dendrobium* are the leaves which are on distinct sheaths together with stems which are ± fleshy for the whole length (although sometimes very slender).

Section *Oxyglossum* belongs to a related group of sections all of which have a comparatively small flower with a fairly long mentum. The labellum never has distinct side lobes, is never rotund and is never hairy within. The sections of this related group which occur in New Guinea can be keyed out thus:

1. Stems markedly flattened .....sect. **Platycaulon**
+ Stems not markedly flattened.....2
2 Labellum apex hooded or cowl-shaped .....sect. **Calyptrochilus**
+ Labellum apex not hooded 3
3. Ovary winged or ribbed or verruculose or hirsute; petals and sepals usually sharply pointed and widely spreading, if not then inflorescence 1–2(–4)-flowered .....sect. **Oxyglossum**
+ Ovary neither winged nor verruculose; petals and sepals seldom sharply pointed, inflorescence usually many-flowered .....sect. **Pedilonum**

Dendrobium sect. **Oxyglossum** Schlechter in Schumann & Lauterbach, Nachträge zur Flora der Deutschen Schutzgebiete 149 (1905); Schltr. in Beih. Repert. Spec. Nov. Regni. Veg. 1: 446, 526, 527 (1912)—Engl. transl. 513, 565, 566 (1982); Smith in Nova Guinea 12: 65–67 (1913); Schltr. in Bot. Jahrb. 58: 107 (1923); Reeve in The Orchadian 6: 36 (1978); van Royen, The Alpine Flora of New Guinea 2: 362, 363 (1979), reprinted as The Orchids of the High Mountains of New Guinea 362, 363 (1980); Reeve & Woods in The Orchadian 6: 195, 196 (1980); Reeve in Australian Orchid Review 46: 104, 109 (1981); Woods & Cullen in Walters *et al* (eds.) The European Garden Flora 2: 216 (1984); Woods in Die Orchidee 40(4): 140, 1989.

Type: *D. cyanocentrum* Schltr. (lectotype chosen–van Royen, 1979).

Syn.: *Dendrobium* sect. *Cuthbertsonia* Schltr in Beih. Repert. Spec. Nov. Regni Veg. 1: 445, 446, 523, 524 (1912)—Engl. transl. 513, 563, 564 (1982); Smith in Nova Guinea 12: 65–67 (1913); Schltr. in Bot. Jahrb. 58: 107 (1923); Reeve in The Orchadian 6: 36 (1978) and in Australian Orchid Review 46: 109 (1981); Woods & Cullen in Walters *et al* (eds.) The European Garden Flora 2: 216 (1984). Type: *D. cuthbertsonii* F. von Mueller.

Pedilonum Blume sect. *Cuthbertsonia* (Schltr) Brieg. in Schltr Die Orchideen ed. 3, 1: 682–684 (1981).

Pedilonum Blume sect. *Oxyglossum* (Schltr) Brieg. in Schltr Die Orchideen ed. 3, 1: 684 (1981).

Small herbs, usually tufted, occasionally creeping, sometimes pendulous; epiphytic, occasionally terrestrial, rarely lithophytic. Stems usually tapered with one to several leaves near the apex. Inflorescences usually few-flowered (commonly 1–3, rarely up to 20), with flowers arising from both leafy and leafless stems, usually near the apex but also laterally. Flowers resupinate or not, often brightly coloured, long-lasting (up to 10 months), often with a conspicuously coloured lip-apex. Sepals and petals obtuse or acute to acuminate. Labellum simple to subtrilobate, ± saccate at base, apex ± obtuse to acute to acuminate sometimes recurved, adnate to column or ± boat-shaped. Ovary with ribs or wings, glabrous, sometimes densely papillose-hirsute.

Distribution: 28 species in the south west Pacific (see Map 1).

Artificial Key to the Species of Section Oxyglossum

1. Labellum linear-lanceolate, linear, oblong or linear-oblanceolate, apex acute, acuminate or cuspidate 2

+ Labellum obovate, oblanceolate or spathulate-rhombic, apex obtuse or acute 34

2. Flowers predominantly bright orange, sometimes orange-red or orange-yellow 3

+ Flowers red, pink, yellow, white, blue, purple, violet or grey 9

3. Ovary 3-winged or distinctly triangular in cross section 4

+ Ovary not 3-winged nor distinctly triangular in cross section (may be 5- or more winged, 5- or 6-ribbed, or indistinctly triangular) 6

4. Flowers less than 2cm long* ..... **9. D. subacaule**

+ Flowers more than 2cm long 5

5. Leaves ovate to oblong, usually slightly but abruptly narrowed above the middle; inflorescence 1(–2)-flowered, sessile ..... **24. D. lancilabium**

+ Leaves linear, linear-lanceolate or elliptic; inflorescence (1–)2–5(–7)-flowered, pedunculate ..... **21. D. vexillarius**

6. Flowers more than 2.8cm long; petals more than 3.8mm broad; anthers usually purple-black ..... **1. D. brevicaule**

+ Flowers less than 2.8cm (rarely to 3.2 cm long); petals less than 3.8mm broad; anthers not purple-black 7

7. Leaves usually more than 3.5mm broad; mentum apex obtuse, entire **14. D. puniceum**

+ Leaves less than 3.5mm broad; mentum apex bilobed 8

8. Flowers uniformly coloured, usually bright orange, 1.6–2.8(–3.2) cm long **2. D. dekockii**

+ Flowers not uniformly coloured, labellum green to blackish, 0.8–1.7cm long. ..... **3. D. masarangense** subsp. **theionanthum**

9. Ovary 3-winged or triangular in cross section (if indistinct, try this lead first) 10

+ Ovary 5–6-ribbed or with 5 or more wings 20

10. Stems to 40cm, often pendulous; leaves ovate to oblong, usually slightly but abruptly narrowed above the middle, 1.2–3.2 × 0.4–1.5cm **24. D. lancilabium**

+ Not as above, if stems pendulous then leaves not abruptly narrowed .11

11. Ovary distinctly 3-winged and flowers over 2.5cm long 12

+ Ovary usually distinctly triangular, if 3-winged then flowers less than 2.5cm long 13

12. Plants usually prostrate with rhizomes; pseudobulbs 0.5–2.5 × 0.3–0.7cm; leaves usually green above, purplish below; flowers to 3.3cm long, bright magenta purple (rarely yellowish) ..... **11. D. rupestre**

+ Plants tufted, 4–30cm high, stems over 2cm long, usually tapering; leaves

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* Flower length is measured from the tip of the dorsal sepal to the tip of the mentum. The length of the mentum is identical with the length of the column foot, and is not just the basal fused part.

usually of uniform colour (sometimes spotted or tinged purplish); flowers 2.5–5cm long.....**21. D. vexillarius**

13. Flowers bright yellow, creamy or yellowish green, 1.4–2.9cm long; labellum darker green with orange-red usually recurved apex ....**4. D. sulphureum**

\+ Flowers neither yellow nor yellowish green 14

14. Flowers predominantly white, whitish pink or whitish violet.....15

\+ Flowers predominantly blue, purple or red 16

15. Flowers pure white or almost so, 1.5–2.4cm long; petals obovate, more than 3mm broad.....**6. D. subuliferum**

\+ Flowers tinged pinkish or bluish, not pure white, 1.1–1.8cm long; petals less than 3mm broad .....**7. D. cyanocentrum**

16. Plants creeping with distinct rhizomes; pseudobulbs small, usually 2-leaved; leaves 0.25–1.8 × 0.1–0.25cm; flowers blue sometimes tinged violet, 1.1–1.5cm long; labellum apex orange to orange red .....**12. D. putnamii**

\+ Plants usually without distinct rhizomes, or, if with rhizomes, flowers over 1.6cm long 17

17. Flowers bluish violet to violet, 1.2–1.8cm long ....**8. D. violaceominiatum**

\+ Flower colour not as above, or, if similar, flowers over 1.8cm long 18

18. Flowers red or reddish purple .....**9. D. subacaule**

\+ Flowers purple or purplish pink 19

19. Leaves more than 2.5mm broad; ovary distinctly 3-winged; labellum apex orange .....**11. D. rupestre**

\+ Leaves less than 2mm broad; ovary indistinctly triangular; labellum apex scarlet .....**5. D. nardoides**

20. Plants prostrate (creeping), usually with distinct rhizomes; pseudobulbs small, globose to ovoid, sometimes clavate, 2-leaved; leaves ovate to elliptic; flowers 0.7–1.5cm long; ovary 5-ribbed .....**13. D. delicatulum**

\+ Plants not as above; tufted, rarely with rhizomes 21

21. Leaves distinctly petiolate 22

\+ Leaves not distinctly petiolate, although occasionally subpetiolate (*D. nebularum*).....23

22. Inflorescences subsessile, usually 2-flowered; flowers more than 2.2cm long .....**17. D. brassii**

\+ Inflorescences with distinct scape, usually many-flowered; flowers less than 2.2cm long.....**22. D. petiolatum**

23. Ovary hairy 24

\+ Ovary glabrous or shortly papillate.....25

24. Ovary and outside of sepals covered with short thick hairs; flowers red **10. D. pachythrix**

\+ Ovary hairy; sepals glabrous; flowers creamy to yellow **3. D. masarangense** subsp. **theionanthum** var. **chlorinum**

25. Pseudobulbs 1-leaved, occasionally 2-leaved; flowers whitish with orange-

yellow markings on labellum, 1.1–1.6 cm long; ovary wings strongly undulate; flower/mentum length ratio greater than 3*

23. D. undatialatum

\+ Plants not as above; flower/mentum length ratio less than 3.....26

26. Petals and sepals purplish-red to blood-red 27

\+ Petals and sepals white, yellow, pink, violet, purple or blue 28

27. Plants 2–8cm high; labellum 10–18 × 2–2.5mm.....**14. D. puniceum**

\+ Plants 8–30cm high; labellum 17–26 × 3–3.5mm .....**20. D. nebularum**

28. Flowers white to yellow sometimes greenish tinged 29

\+ Flowers pink, violet, purple or blue 32

29. Plants 1.5–7cm high; flowers 0.8–1.7cm long (rarely to 2.2cm); leaves up to 5.5cm long .....**3. D. masarangense**

\+ Plants 6–30cm high; flowers 1.7–3.5cm long; leaves up to 16cm long ..30

30. Leaves linear, ± terete, fleshy .....**18. D. hellwigianum**

\+ Leaves linear-lanceolate to elliptic, flat, not fleshy.....31

31. Inflorescence 1(–3)-flowered; flowers opening widely, labellum apex orange-red .....**19. D. pentapterum**

\+ Inflorescence 2–5-flowered; flowers not opening widely, labellum apex rarely contrasting .....**20. D. nebularum**

32. Labellum apex orange to scarlet [New Guinea].....33

\+ Labellum apex not markedly contrasting, at most with faint orange mark [Seram]..... **15. D. seranicum**

33. Dorsal sepal 12–20 × 4–7mm; leaves flat or V-shaped; ovary with 5 main and up to 8 additional wings or ribs .....**16. D. violaceum**

\+ Dorsal sepal 7–13 × 2–4mm; leaves ± terete, fleshy; ovary 5-winged, the dorsal 3 close together.....**18. D. hellwigianum**

34. Plants pendulous to semi-erect; stems slender near base, thickened towards apex, sometimes branched, up to 100cm long; labellum spathulate-rhombic

25. D. habbemense

\+ Plants usually tufted and clump-forming, occasionally stems elongating and shortly branched, up to 18cm long; labellum obovate or oblanceolate

35

35. Plants usually verruculose, papillose-hirsute, rarely glabrous; leaves 0.5–4.5cm long .....**28. D. cuthbertsonii**

\+ Plants glabrous; leaves (1.5–)2.5–14.5cm long 36

36. Flowers white or cream, often greenish tinged; mentum (5–)6–9mm long [Fiji].....**26. D. prasinum**

\+ Flowers pink, rose, mauve or cream; mentum 8–20mm long [Louisiade Archipelago to Vanuatu] .....**27. D. laevifolium**

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* Flower length is measured from the tip of the dorsal sepal to the tip of the mentum. The length of the mentum is identical with the length of the column foot, and is not just the basal fused part.

1. Dendrobium brevicaule Rolfe in Kew Bull. 1899: 110 (1899); Reeve & Woods in The Orchadian 6: 199 (1980). **Figs 4 & 5; Plates 1 & 2.**

Suberect to pendulous, tufted to branching epiphyte, to 20(–30)cm long. *Roots* 1–2mm diameter. *Rhizomes* very short, or up to 5cm long in branching forms, cylindrical; sheaths blackish at base. *Pseudobulbs* 0.4–10 (–12) × 0.15–0.9cm, fusiform to cylindrical, with 1–5 leaves at apex. *Leaves* 1–9 × 0.2–1.2cm, spreading to pendent, elliptic to linear, apex obtuse to acute, ± mucronate, green sometimes suffused with purple; sheaths ± warty. *Inflorescences* terminal on leafy stems, 1–3-flowered, subsessile; bracts ovate, ± funnel-shaped, apiculate to acuminate, ± warty. *Flowers* 2.8–5.8cm long, ± pendulous on flaccid pedicels, usually widely opening, long lasting; bright orange to orange-red, lip apex often more red (occasionally tinged purplish), anthers usually dark purplish to black. *Dorsal sepal* 10–20 × 4.5–9mm, oblong-elliptic to subrhombic, ± keeled, obtuse to acute. *Lateral sepals* 25–50 × 5–13mm, obliquely triangular-ovate, acute to acuminate or apiculate, sometimes conspicuously keeled (to 3.5mm high near apex), keels ± spurred at base; basal fused part 4–13mm long, subconical; mentum total length 14–34mm, tip obtuse to bilobed. *Petals* 8–16 × 4–7mm, elliptic to subspathulate, obtuse to acute or apiculate. *Labellum* 23–45 × 3–7mm, subtrilobate, linear-oblanceolate, adnate to column-foot at base, upper margins incurved, apex triangular-acute, usually slightly recurved, margins erose. *Column* 3.5–7.5mm long; foot 14–34mm long; anther 3–6mm broad; pollinia 2–3.5mm long. *Ovary* 5-winged or ribbed, sometimes the lateral 2 wings small; pedicel-ovary 25–65mm long, usually flaccid. *Fruit* to 18.5 × 12mm, ellipsoid.
Distribution: New Guinea (Map 2).
Epiphyte in alpine shrubberies and forest, or on *Cyathea* in grasslands, rarely terrestrial, 2900–4000m.

KEY TO SUBSPECIES

1. Plants tufted with stout crowded stems (usually epiphytic on *Cyathea*); pseudobulbs mostly over 0.5 cm diam.; leaves ± elliptic, mostly over 0.7cm broad ..... **1a.** subsp. **brevicaule**

\+ Plants tufted or branching; pseudobulbs less than 0.5cm diam.; leaves usually linear to lanceolate, mostly less than 0.7cm broad 2

2. Lateral sepals not conspicuously keeled, keels less than 1mm high
1b. subsp. **calcarium**

\+ Lateral sepals conspicuously keeled, keels over 1.5mm high
1c. subsp. **pentagonum**

1a. subsp. **brevicaule**. **Fig. 4A1, A2; Plates 1B, 2A.**
Type: East New Guinea, Central Province, Mt Scratchley, 3700m, x 1896, *Giulianetti* s.n. (holo.K).
Syn.: *D. cyatheicola* P. van Royen, The Alpine Flora of New Guinea 2: 435–438, fig. 151 (1979). Type: East New Guinea, Central Province, Goilala District, Mt Dickson, 3500m, 10 ii 1964, *Hartley* 12913 (holo.L; iso. AMES, CANB, LAE).
Pedilonum brevicaule (Rolfe) Rauschert in Feddes Repert. 94: 457 (1983).

FIG. 4. *Dendrobium brevicaule*: A1 subsp. *brevicaule*, habit; A2 subsp. *brevicaule*, habit; A3 subsp. *calcarium*, habit. A1 and A2 drawn from *Croft et al.* 61395. A3 drawn from *Veldkamp* 6547.

Subsp. *brevicaule* is recognized by its strongly tufted habit, with no rhizomes; *pseudobulbs* 1–4 × 0.4–0.9cm; *leaves* 1–9 × 0.6–1.2cm, ± elliptic; *flowers* 3.8–5.8cm long; *lateral sepals* without keels or only slightly crested.

Distribution: East New Guinea (Map 2); 9 collections examined.

EAST NEW GUINEA. Central Province: Mt Strong, *Stevens & Coode* LAE 51398 (E, K, LAE, L); Mt St Mary, *Szent-Ivany* 7 (LAE); Mt Dickson, *Hartley* 12913 (AMES, CANB, LAE, L); Mt Albert Edward, *Brass* 4294 (AMES, US), *Craven & Lelean* 2782 (K, LAE, L), *Croft et al.* LAE 61395 (K, LAE, L), *Foreman & Wardle* NGF 45602 (E-cult., K, LAE, L); Mt Scratchley, *Giulianetti* s.n. (K.); Mt Victoria, *Craven* 3045 (LAE).

Epiphyte, almost exclusively on *Cyathea* species, in high alpine grasslands, 3350–3800m.

Subsp. *brevicaule* is a very high altitude race of the species and occurs on most of the high mountains of the Central Province of Papua New Guinea, growing almost exclusively on tree-ferns in the alpine grasslands. Brass, in a field note on his specimen from Mt Albert Edward, records it as an epiphyte on *Dacrydium* also.

Schlechter (1912) pointed out that the type sheet of *D. brevicaule* Rolfe at Kew (*Giulianetti* s.n.) contained two different species. This observation was correct, the second species being *D. dekockii* J. J. Smith subsequently referred to under the synonyms *D. chrysornis* by Ridley (1916) and *D. gaudens* by van Royen (1979).

Further confusion arose when Rolfe or Ridley glued a *Kloss* collection from West New Guinea on to the type sheet of *D. brevicaule*. We have identified this as *D. vexillarius* var. *retroflexum* (the flowers were silvery-grey with violet tips), although van Royen (1979) incorrectly states that it is *D. rupestre*.

To add to the above confusion van Royen decided to split up the holotype of *D. brevicaule* into two parts, the smaller part being identified as *D. cyatheicola*. This was quite unnecessary as there is considerable size variation in all of the *Oxyglossum* species. Van Royen's new species *D. cyatheicola* merely represents the shorter forms of subsp. *brevicaule*, due mainly to greater exposure to the sun, and we have included it in synonymy here. It is also worth noting here that van Royen's (1979) illustration of *D. brevicaule* (fig. 150) is inaccurate. The leaves should be much wider—presumably they were not boiled up before sketching.

Subsp. *brevicaule*, with its brilliant orange flowers, is spectacular when large clumps are in full bloom. It also has the record for the longest flower in the section (up to 5.8cm long on *Craven* 3045). A good photograph appeared in 1975 in Eric Lindgren's book, *Wildlife in Papua New Guinea* (plate 181), where it is aptly called the 'Flame Orchid' (although the identification as *D. flammula* is incorrect). Unfortunately nothing is known about the cultivation of this subspecies.

1b. subsp. **calcarium** (J. J. Smith) T. M. Reeve & P. Woods, **comb. & stat. nov.** **Fig. 4 A3; Plate 2B.**

Syn.: *D. calcarium* J. J. Smith in Bull. Jard. Bot. Buitenz. sér. 2, 2: 13 (1911) & in Nova Guinea 12: 69, tab. 18, fig. 55 (1913). Lectotype (designated by P. van Royen, 1979): West New Guinea, Mt Goliath, 3250m, ii 1911, *de Kock* IX (BO n.v.).

D. montistellare P. van Royen forma *montistellare*, The Alpine Flora of New Guinea 2: 401–404, fig. 139 (1979). Type: West New Guinea,

Star Mountains, Mt Antares, 3000–3400m, 4 vii 1959, *Nicolas* 5A (holo. L).

D. montistellare P. van Royen forma *albescens* P. van Royen *op. cit.* 404–405. Type: East New Guinea, Western Highlands Province, Tomba track SW side of Mt Hagen, c.3000m, vi 1966, *Wheeler* ANU 6117 (holo. CANB; iso. L, LAE). Note: The colour notes on the label are almost certainly in error and probably refer to another collection. Even in the pressed state the orange pigmentation in the flowers is still recognizable.

D. quinquecristatum P. van Royen *op. cit.* 446–449, fig. 155. Type: West New Guinea, Mt Carstenz, South end of Meadow, 3510m, xii 1971, *Hope* ANU 16147 (holo. CANB).

D. aurantivinosum P. van Royen *op. cit.* 449–451, fig. 156. Type: East New Guinea, Western Province, Kiunga District, Star Mtns, 3350m, 13 vii 1967, *Ridsdale & Galore* NGF 33398 (holo. K; iso, LAE). Note: The holotype specimen is very small and is possibly a natural hybrid between *D. brevicaule* and *D. dekockii*. The LAE duplicate, however, is typical of subsp. *calcarium*.

Pedilonum calcarium (J. J. Sm.) Rauschert in Feddes Repert. 94: 458 (1983).

Subsp. *calcarium* is distinguished from subsp. *brevicaule* by its narrower *pseudobulbs* 0.4–12 × 0.15–0.5cm, and usually narrower linear to lanceolate *leaves* 1–8 × 0.2–0.7(–1)cm. The *flowers* are 2.8–4.5cm long with *lateral sepals* sometimes crested, keels less than 1mm high.

Distribution: New Guinea (Map 2); 49 collections examined.

WEST NEW GUINEA. Mt Carstenz, Mt Wilhelmina, Mt Goliath, Mt Antares.

EAST NEW GUINEA. Star Mountains, Mt Iambari, Mt Timtongopip, Mt Ialibu, Mt Giluwe, Mt Hagen (incl. Mt Kigum), Mt Wilhelm complex, Mt Kerigomna.

Epiphyte in alpine shrubberies and forest margins, rarely terrestrial, 2900–3650m.

Subsp. *calcarium* is the most widespread of the three subspecies and occurs from Mt Carstenz in the west to Mt Kerigomna (near Goroka) in the east.

D. saruwagedicum Schlechter, from the Saruwaged Mountains in Morobe Province, much further east, is known only from a brief description and possibly is referable to this subspecies. However, due to other collections from that area being clearly identified as subsp. *pentagonum* this name is tentatively included in synonymy there. There are also two specimens recorded from the Finisterre Mountains (*Reeve* 506 & 507) which may belong here. The pseudobulbs are more like those of *D. dekockii* and the flowers lack the typical purplish black anthers of *D. brevicaule* so they may possibly be natural hybrids.

This subspecies, as presently defined, is quite a variable one. The type of *D. calcarium*, as well as most of the specimens from the Star Mountains area, are more narrow-leaved than those from Mt Carstenz and Mt Wilhelmina in the west as well as populations to the east. However, further collecting over a wider area, particularly in West New Guinea, and study of the various populations are required before any further infraspecific subdivision is contemplated.

We were hesitant at first to make any division at all: our main concern being to carefully delineate the species. But when it was found that a fairly watertight key could be constructed, and the three entities showed reasonable geographical replacement, it was decided to divide this complex species into three subspecies.

Subsp *brevicaule* and *pentagonum* are more uniform, whereas subsp. *calcarium* at present contains everything that was left, and is not quite as homogeneous.

This subspecies was well illustrated by J. J. Smith in *Nova Guinea* (1913) and a typical form from the Star Mountains (*Veldkamp* 6547) is shown here (Fig. 4A3). It should be noted that van Royen's (1979) fig. 154 of NGF 45602 from Mt Albert Edward is referable to subsp. *brevicaule* and not to subsp. *calcarium*.

The size of the crests or keels on the sepals of this subspecies is quite variable and some forms have none at all. Others such as *Hope* ANU 16147 (the type of *D. quinquecristatum*) have recognizable crests, but they are all less than 1mm high and clearly distinguished from the very conspicuous keels to be found on the lateral sepals of subsp. *pentagonum*. The flowers are a brilliant orange to orange-red with the labellum sometimes red.

Like other subspecies of *D. brevicaule* these alpine subjects are quite difficult to cultivate. Whilst plants in the wild are tolerant of a large temperature range in the day (0°–25°C), *D. brevicaule* is subject to very low night temperatures, often near freezing point. At this altitude, the night relative humidity is 100% or almost so throughout the year.

1c. subsp. **pentagonum** (Kränzlin) T. M. Reeve & P. Woods, **comb. & stat. nov.**
Fig. 5: Plate 1A.

Syn.: *D. pentagonum* Kränzlin in Engler, Pflanzenr. 45: 128 (1910). Type: East New Guinea, Milne Bay Province, Mt Dayman, 3000m, iii 1894, *Armit* s.n. (B†). Neotype (designated here): East New Guinea, Central Province, Goilala District, Mt Albert Edward, Beres ridge (Murray Pass), 3200m, vii 1979, *Reeve* 457 (E; iso. CBG, K, L, LAE, UPNG).

? *D. saruwagedicum* Schltr in Repert. Spec. Nov. Regni Veg. 16: 217 (1919). Type: East New Guinea, Morobe Province, Saruwaged Mtns, Mt Bolan, 4000m, x 1912, *Keysser s.n.* (B†).

D. teligerum P. van Royen, The Alpine Flora of New Guinea 2: 420–424, fig. 146, plate 89 (1979). Type: East New Guinea, Central Province, Goilala District, Murray Pass (on Mt Albert Edward), 3000m, 24 ix 1967, *Dockrill [Elworthy]* NGF 7991 (holo. L, iso. LAE).

D. zaranense P. van Royen *op. cit.* 441–444, fig. 153. Type: East New Guinea, Morobe Province, Saruwaged Mtns, SW slope of Mt Enggom, Upper Zaran Creek, 3200m, 25 ii 1963, *van Royen* NGF 16176 (holo. L; iso. K, LAE).

Pedilonum pentagonum (Kränzlin) Rauschert in Feddes Rep. 94: 462 (1983).

? *P. saruwagedicum* (Schltr) Rauschert *op. cit.* 463.

Subsp. *pentagonum* is distinguished from subsp. *brevicaule* by the conspicuously crested *lateral sepals*, the keels 2–3.5mm high near apex, sometimes spurred at base. *Pseudobulbs* 1–12 × 0.15–0.4cm, cylindrical. *Leaves* 2–8 × 0.2–0.5cm, linear to lanceolate. *Flowers* 2.8–4.5cm long.

Distribution: East New Guinea (Map 2); 15 collections examined.

EAST NEW GUINEA. Eastern Highlands Province: Mt Piora, *Henty & Carlquist* NGF 16546 (LAE, L), *Sands, Pattison & Wood* S1516 (K), S1667(K). Morobe Province: Saruwaged Mountains, *Gillison* 150 (LAE), *van Royen* NGF 16176 (K, LAE, L); Mt Amungwiwa, south of Wau, *Corlett* 25121 (LAE), *van Royen* 11073 (LAE), *Womersley* NGF 17952 (LAE, L). Central Province: Mt Albert Edward, Murray Pass area, *Dockrill [Elworthy]* NGF 7991 (LAE, L), *Elworthy* s.n. (E-cult.), *Foreman & Wardle* NGF 45518 (K, LAE, L), *Millar* NGF 38309 (K, LAE, L), 40841 (K,

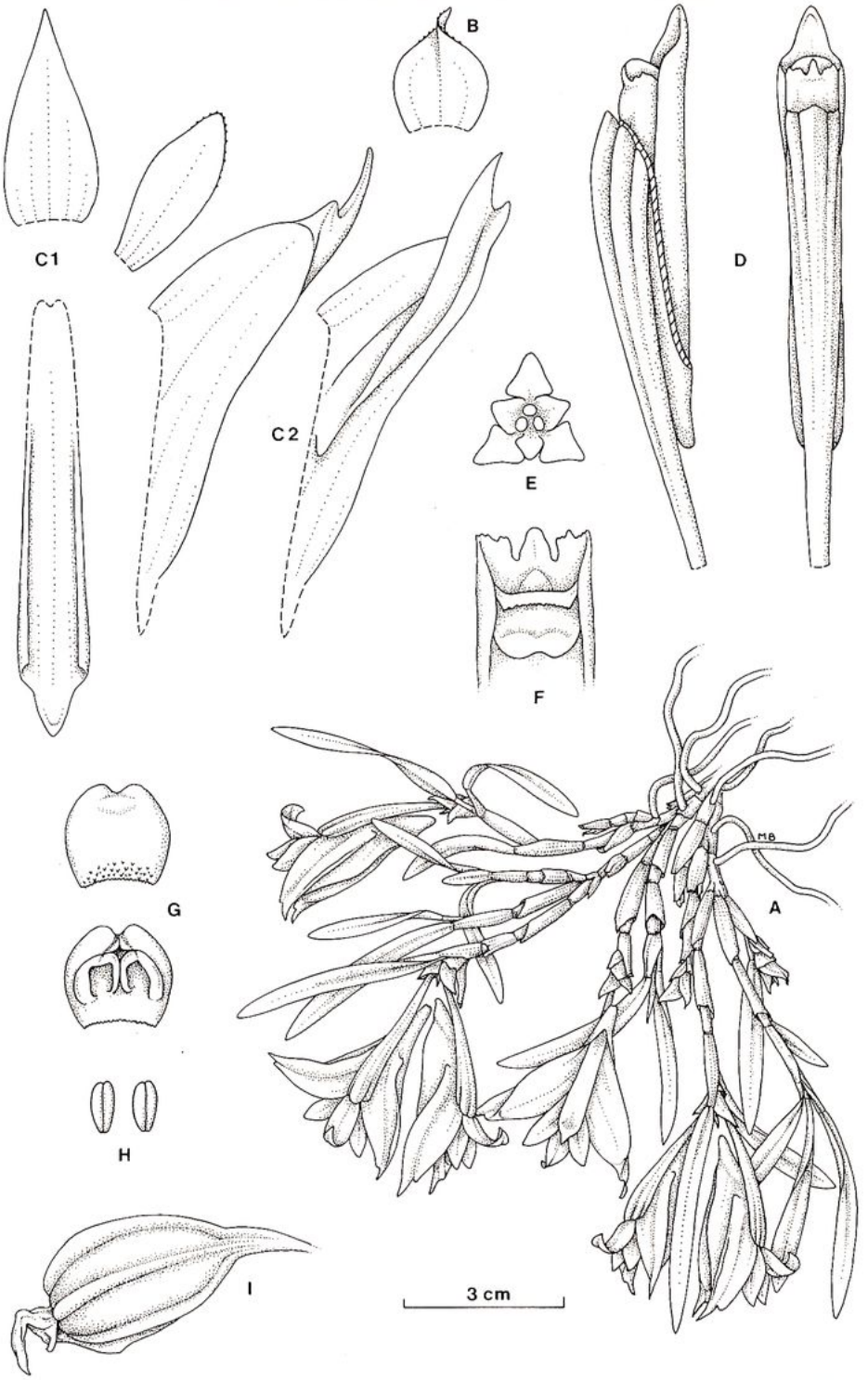


FIG 5. *Dendrobium brevicaule* subsp. *pentagonum*. A, habit; B, bract × 2; C1, sepals, petal & labellum × 2; C2, outer surface of lateral sepal × 2; D, labellum, ovary & column × 2; E, ovary cross-section × 4; F, column tip × 4; G, anther cap × 4; H, pollinia × 4; I, fruit × 1.3. All drawn from *Reeve* 457 (neotype).

LAE), *Reeve* 457 (CBG, E, K, LAE, L, UPNG), *Woods, Ridsdale & Elworthy* W. 3000 (E, LAE), W. 3095 (E). Milne Bay Province: Mt Dayman *Armit* s.n. (n.v.).
Epiphyte in alpine shrubberies, 3000–3600m.

This subspecies is known so far only from five mountains in the eastern part of New Guinea. On Mt Albert Edward two subspecies are found—subsp. *pentagonum* grows in the Murray Pass area at 3000–3200m, whilst subsp. *brevicaule* occurs nearer the summit at 3400–3800m.

Subsp. *pentagonum* is readily recognizable by the very large keels, up to 3.5mm high, on the outside of the lateral sepals.

Van Royen (1979) described this taxon twice but in his separate discussions for the new species his comments contradict each other. Despite the strongly keeled lateral sepals being included as part of van Royen's English translation of the type description of *D. pentagonum* (p. 430), and his comments on *D. zaranense* (p. 442), '. . . a striking species by its strongly crested lateral sepals', he manages to claim for *D. teligerum* (p. 424) that it differs from 'all other species in this section by the large crest on the outside of the lateral sepals'! Although his species descriptions appear to be reasonably accurate, many statements in his notes for the species in section *Oxyglossum* as well as the key are inaccurate and sometimes contradictory to the descriptions.

In common with subsp. *calcarium*, the vegetative form of subsp. *pentagonum* varies considerably depending upon the degree of exposure to the sun, but generally it has a more lax, branched, pendulous habit. The flowers are brilliant orange with the typical purplish-black anther caps.

2. Dendrobium dekockii J. J. Smith in Bull. Jard. Bot. Buitenz. sér. 2, 2: 14 (1911) & Nova Guinea 12: 68, tab. 18, fig. 54 (1913); P. van Royen, The Alpine Flora of New Guinea 2: 406, fig. 140 (1979); Reeve & Woods in The Orchadian 6: 199, (1980). **Fig. 6; Plates 3 & 4.**
Type: West New Guinea, Mt Goliath, 2700–3000m, ii 1911, *de Kock* 47 (holo. BO n.v.)
Syn.: *D. chrysornis* Ridley in Trans. Linn. Soc. Bot. 9: 173 (1916). Type: West New Guinea, Mt Carstenz, Camp XIII, 3200m, 29 i 1913, *Kloss* s.n. (holo. BM, iso. K).
D. montigenum Ridley *loc. cit.* Type: West New Guinea, Mt Carstenz, Camp XIII, 3200m, 29 i 1913, *Kloss* s.n. (holo. BM, iso. K).
D. erythrocarpum J. J. Smith in Nova Guinea 14: 429, tab. 67, fig. 78 (1929). Type: West New Guinea, Mt Doorman (north of Mt Wilhelmina), 3250m, 17 x 1920, *Lam* 1603 (holo. BO, iso. L).
D. cedricola P. van Royen, The Alpine Flora of New Guinea 2: 408–410, fig. 141 (1979). Type: West New Guinea, Lake Habbema (near Mt Wilhelmina), 3225m, viii 1938, *Brass* 9031 (holo. BM; iso. AMES, K, L, LAE).
D. gaudens P. van Royen *op. cit.* 417–420, fig. 145. Type: East New Guinea, Chimbu Province, Mt Wilhelm (Lake Aunde), 3800m, *van Royen* NGF 15130 (holo. L, iso. LAE).
D. kerewense P. van Royen *op. cit.* 438–441, fig. 152. Type: East New Guinea, Southern Highlands Province, Tari District, Mt Kerewa (Tari Gap area), 3140m, 5 vii 1966, *Vink* 17076 (holo. CANB; iso. L, LAE).

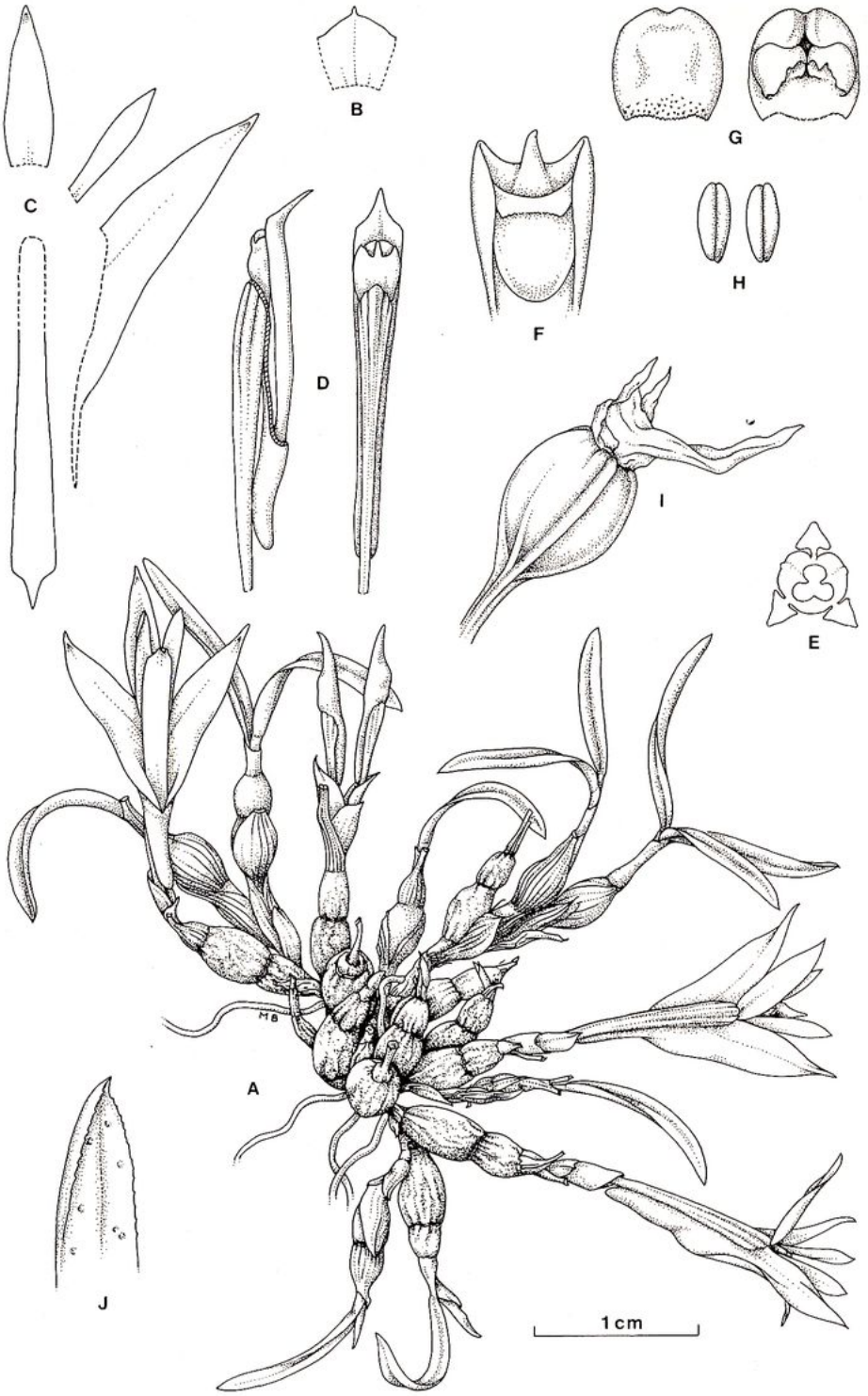


FIG. 6. *Dendrobium dekockii*. A, habit; B, bract × 3; C, sepals, petal & labellum × 3; D, labellum, ovary & column × 3; E, ovary cross-section × 10; F, column tip × 10; G, anther cap × 10; H, pollinia × 10; I, fruit × 1.3; J, leaf tip × 10. All drawn from *Reeve* 633, RBGE 82. 1021.

Pedilonum chrysornis (Ridley) Rauschert in Feddes Repert. 94: 458 (1983).

P. dekockii (J. J. Smith) Rauschert [sphalm *decockii*] *op. cit.* 459.

P. montigeum (Ridley) Rauschert *op. cit.* 461.

Erect to semipendulous, tufted, epiphyte, 2–8(–15)cm high. *Roots* 0.5–1.25mm diameter, purplish pink (especially when moist). *Rhizomes* usually very short, occasionally elongated and branching. *Pseudobulbs* 0.2–2.5(–5) × 0.1–0.6cm, polymorphous-ovoid, globose, fusiform, clavate, cylindrical or moniliform, often markedly constricted at central node, apex 1–4-leaved. *Leaves* 0.5–6 × 0.1–0.35cm, erect to spreading, linear to lanceolate, apex subacute, mucronate, green to dark purple, occasionally red; sheaths ± finely warty. *Inflorescences* terminal, mainly on leafy stems, 1–2(–3)-flowered, subsessile; bracts broadly ovate, apiculate to acuminate. *Flowers* 1.4–2.8cm long (rarely to 3.2cm long—usually at high altitude when epiphytic on *Cyathea*), erect to suberect, widely opening, long lasting, bright orange to orange-red, anthers similarly coloured. *Dorsal sepal* 5–14 × 2–4.5(–5.5)mm, lanceolate to elliptic, acute. *Lateral sepals* 11–30 × 3–6.5(–7.5)mm, obliquely triangular, sometimes markedly falcate; basal fused part 3–6mm long, subconical; mentum total length 9–21mm, tip usually bilobed. *Petals* 4–12 × 1–2.5(–3.5)mm, narrowly linear to subspathulate-elliptic, subacute to acuminate. *Labellum* 12–27 × 2–4mm, subtrilobate, linear-oblanceolate, adnate to column foot at base, upper margins incurved, apex shortly cuspidate to triangular-acuminate, erect to abruptly recurved, margins ± erose. *Column* 2–3.5mm long; foot 9–21mm long; anther 1.5–2.5mm broad; pollinia 1–1.5mm long. *Ovary* 5-ribbed, sometimes the 2 lateral ribs quite indistinct; pedicel-ovary 10–28mm long. *Fruit* 14 × 11.5mm long, obovoid becoming ellipsoid to subglobose, green, purplish or reddish.

Distribution: New Guinea (Map 3); 72 collections examined.

WEST NEW GUINEA. Mt Carstenz, Mt Doorman, Mt Wilhelmina, Mt Goliath.

EAST NEW GUINEA. West Sepik, Enga, Southern Highlands, Western Highlands, Chimbu, Eastern Highlands, Madang, Morobe and Central Provinces.

Epiphyte in alpine shrubberies and forest margins, often on *Dacrycarpus*, (2300–)2700–3800m.

This alpine species, often found growing together with *D. brevicaule*, is distinguished from that species by its smaller size and the shorter, more erect flowers which do not have purplish black anther caps. *D. dekockii* occurs on most of the high mountains in New Guinea and is quite abundant in some localities as on Mt Wilhelm, Papua New Guinea, where it grows epiphytically on stunted *Dacrycarpus* trees at c.3500m near the lower lake.

In addition to a large range in pseudobulb shape the plant form varies considerably from those with short lanceolate leaves to others with long narrow linear leaves. The flowers vary somewhat in shape as well as size. Plates 3 and 4 illustrate some of this variation. However there does not appear to be any consistency about the variation so we have not distinguished any infraspecific taxa. Another good illustration appears in Andreé Millar's *Orchids of Papua New Guinea* but under the incorrect name *D. oreocharis* (Millar, 1978: 36).

When H. N. Ridley described his two new species he was apparently unaware of J. J. Smith's earlier description of *D. dekockii*. His *D. chrysornis*, with larger flowers and narrow more falcate sepals, is very similar to the type

of *D. dekockii*, whilst *D. montigenum* has smaller flowers. The types of both his species came from the same locality near Mt Carstenz, West New Guinea and are treated in synonymy here.

Van Royen (1979) has added three further names which we are including in synonymy: *D. cedricola* and *D. gaudens* are quite typical, whilst the name *D. kerewense* was applied to a larger semi-pendulous specimen from the Tari Gap area in the Southern Highlands Province, Papua New Guinea. His Latin description of *D. kerewense* is based on the type (*Vink* 17076), but his English description is based on this and also *van Royen* 11232 from Mt Giluwe. Although we did not locate this specimen, it is distinctly larger (see range of measurements for sepals in the English description), and the fact that the anther colour is given as black (which is not on the *Vink* label) marks it clearly as *D. brevicaule*. Thus the English description and notes are based on two different species.

The following specimens from the Finisterre Mountains and the Owen Stanley Range (Mt Victoria and Mt Kenive) are possibly natural hybrids between *D. brevicaule* and *D. dekockii* but further collections are required from these areas to clarify their exact status. They are *Craven* 2958, *Croft et al.* LAE 65263, and *Reeve* 506 & 507.

D. dekockii, being an alpine member, has proved a rather difficult species to establish and to cultivate. Although some success has been achieved in growing this species at Laiagam, it has seldom flowered in cultivation. In nature the plants are usually quite floriferous and the bright orange flowers are a striking sight as they are often set amongst a very dark background of black epiphytic mosses which commonly clothe the branches of alpine *Dacrycarpus* and other host trees.

3. Dendrobium masarangense Schlechter in Repert. Spec. Nov. Regni Veg. 10: 78 (1911) & in Beih. Repert. Spec. Nov. Regni Veg. 74: tab. 32, fig. 128 (1934); Reeve & Woods in The Orchadian 6: 199 (1980). **Fig. 7; Plate 5.**

Erect tufted epiphyte, 1.5–7cm high. *Roots* 0.4–0.8mm diameter. *Rhizomes* usually very short, rarely elongated and branching. *Pseudobulbs* 0.2–2(–3) × 0.1–0.35cm, globose, obclavate, fusiform or cylindrical, apex 2–3(–4)-leaved. *Leaves* 1–5.5 × 0.05–0.2(–0.35)cm, erect to spreading, linear to lanceolate or subulate-filiform, occasionally semi-terete, ± rigid, apex acute; sheaths smooth, membranous, with age becoming fibrous. *Inflorescences* terminal, arising mainly from leafy stems, 1–3-flowered, subsessile or with distinct peduncle to 3mm long; bracts ovate, apiculate to acuminate. *Flowers* 0.8–1.7cm (very rarely to 2.2cm) long, usually widely opening, occasionally with sepals and petals reflexed, lasting c.6 months; white, orange, yellow, yellowish green or greenish white, labellum usually green, sometimes very dark, with yellow, orange or orange-red apex (or just below apex). *Dorsal sepal* 3–7(–9) × 1–2.5mm, ovate-lanceolate, elliptic (occasionally to obovate), obtuse to acuminate. *Lateral sepals* 7–15(–18) × 1.5–3(–4)mm, usually markedly oblique, narrowly triangular to ovate, subacute to acuminate or apiculate; basal fused part 2–5(–7)mm long, cylindrical to subconical, sometimes markedly incurved; mentum total length 4.5–10(–12)mm, tip obtuse sometimes bilobed. *Petals* 3–7(–9) × 0.5–1.7mm, linear, lanceolate or subspathulate, subacute to acuminate. *Labellum* 5.5–14(–17) × 1–2mm, subtrilobate, linear-oblanceolate, adnate to column foot at base with upper margins incurved, without a cross-

ridge, apex narrowly triangular, cuspidate, unbent, slightly deflexed to markedly recurved. *Column* 1.5–2mm long; foot 4.5–10(–12)mm long; anther 1–1.5mm broad; pollinia 0.5–1mm long. *Ovary* 5-ribbed, often very indistinct with lateral two ribs much reduced (sometimes almost absent), glabrous, shortly papillose or hairy; pedicel-ovary 6–21mm long. *Fruit* 8 × 4mm, ellipsoid.
Distribution: Salawesi, New Guinea, New Britain, Bougainville, Solomon Islands, Vanuatu, New Caledonia, Fiji (Map 4).
Epiphyte usually on small twigs and branches in lowland, montane and alpine forest, and in secondary vegetation 300–3250m.

Despite its very local name derived from the type locality, *D. masarangense* is in fact the most widespread species in the section being distributed from Sulawesi (Indonesia) in the west to Fiji in the east. It also has a large altitudinal range from almost sea-level in Vanuatu up to the alpine zone in New Guinea.

In our 1980 paper we followed Schlechter (1912) in keeping *D. masarangense* (syn. *D. pumilio*) and *D. theionanthum* separate. However, further examination of the specimens revealed very little morphological difference between the two species while in addition an interesting characteristic common to both was observed in the presence of a short peduncle on many (not all) specimens including the types of both *D. pumilio* and *D. theionanthum*. This feature was overlooked by Schlechter in his original descriptions. We have therefore decided to unite the two taxa but will keep them as distinct subspecies at this stage since they replace each other altitudinally and show a reasonably consistent colour difference.

D. masarangense is most closely allied to *D. sulphureum* but differs in the generally small size of the plants, the narrower leaves and in the usually smaller flowers which have a 5-ribbed (not triangular) ovary. Occasionally the indistinct ovary cross-sections may cause confusion but the species key takes account of this variation and should lead to the correct identification.

KEY TO SUBSPECIES AND VARIETIES

1. Flowers white; mentum often incurved [lowland plant below 1200m] **3a.** subsp. **masarangense**

\+ Flowers orange, yellow, greenish-yellow or greenish white; mentum not incurved [highland plant above 1200m except in Eastern Papua].....2

2. Ovary glabrous or shortly papillate **3bi.** subsp. **theionanthum** var. **theionanthum**

\+ Ovary hairy .....**3bii.** subsp. *theionanthum* var. **chlorinum**

3a. subsp. **masarangense.** **Fig. 7A1; Plate 5B.**
Type: Indonesia, North Sulawesi, Minahassa Peninsula, Mt Masarang, 1200m, xi 1909, *Schlechter* 20473 (B†). Neotype (designated here): New Britain, East New Britain Province, Rabaul District, Lackit, 750m, 3 iv 1968, *Ridsdale & Katik* 38046 (LAE; iso. K, L).
Syn.: *D. pumilio* Schltr in Beih. Repert. Spec. Nov. Regni Veg. 1: 527 (1912) & *ibid.* 21: tab. 178, fig. 666 (1928)–Engl. trans. 566, 699–fig. (1982). Syntypes: East New Guinea, Madang Province, Kani Mountains, 1000m, xi 1907, *Schlechter* 16545 (iso. BO, E, K, L, NSW); Finisterre

Mtns, 1000–1100m, vii 1908, *Schlechter* 17998 (iso. BO, E, K, L, NSW).

Distribution. Sulawesi to Fiji (Map 4); c.20 collections examined.

SULAWESI. Mt Masarang, *Schlechter* 20473 (B†).

EAST NEW GUINEA. West Sepik Province: *Schlechter* 20267 (B†). Western Highlands Province: ?*Reeve* 1125 (E, LAE). Madang Province: *Schlechter* 16545 (BO, E, K, L), 17998 (BO, E, K, L). Morobe Province: *Clemens* 11020 (AMES). Central Province: ?*Carr* 17254 (BM).

NEW BRITAIN. West New Britain Province: *Sayers* NGF 24213 (K, L). East New Britain Province: *Ridsdale & Katik* NGF 38046 (K, L).

BOUGAINVILLE. *Lavarack & Ridsdale* NGF 31374 (K, L), cult. Laiagam, *Robinson* in *Reeve* 1176 (E, LAE).

SOLOMON ISLANDS. Guadalcanal: *Hunt* 2936 (K).

VANUATU. Erromango, *Raynal* 16601 (P); Pentecost, *Wheatley* 113 (K).

FIJI VitiLevu: *Morrison* 1734 (cult. E) *Burness* s.n. (cult. E).

NEW CALEDONIA. Mt Dzumac, *Bégaud* s.n. (cult. *Bégaud* n.v.).

Epiphyte in lowland forest, 300–1200m.

Subsp. *masarangense* is recognized mainly by its white flowers, usually with orange or yellow below the apex of the labellum. The mentum is usually somewhat bent (more evident on dried specimens), and plants are often more lax in habit with less rigid leaves than subsp. *theionanthum*. However this is not a consistent feature, and *Clemens* 11020 (Fig. 7 A1) has rigid, semi-terete leaves.

This subspecies has a very wide distribution but is rather poorly represented in herbarium collections. Presumably it is often overlooked in the relatively tall lowland forests, due to its small size, narrow grass-like leaves and pale flowers. Schlechter (1912) recorded it as occurring in 'dense colonies consisting of large numbers of individuals'. In Sulawesi it has only been recorded once. It was recently discovered in Fiji by Alasdair Morrison, Gloucestershire, England and Don Burness (via Mrs Jean Murray) of Suva, Fiji, both of whom kindly forwarded living plants to Edinburgh for this study; unfortunately the plants only survived long enough for determination.

Dr Cribb has brought to our attention (pers. comm. Feb. 1989) a plant cultivated by J. Bégaud in Noumea, originally collected by him from branches above the River Oimé on Mt Dzumac in the south of New Caledonia. This not only represents a considerable extension of the range of the subspecies as previously known but also of the section.

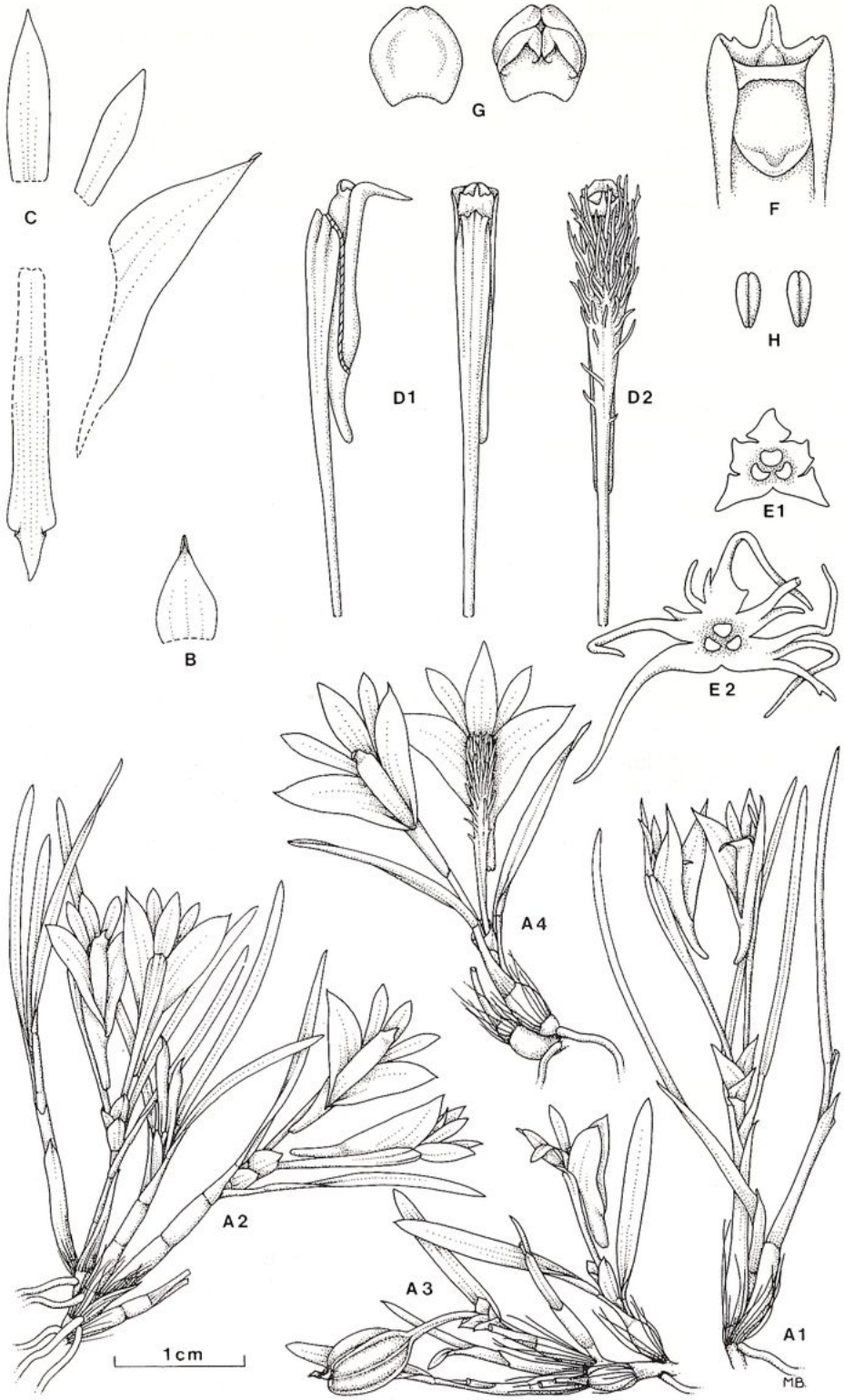
3b. subsp. **theionanthum** (Schlechter) T. M. Reeve & P. Woods, **comb. et stat. nov.**

3bi. var. **theionanthum.** **Fig. 7A2, A3; Plate 5A.**

Syn.: *D. theionanthum* Schltr in Beih. Repert. Spec. Nov. Regni Veg. 1: 528 (1912) & 21: tab. 178, fig. 667 (1928)—Engl. transl. 567, 699—fig. (1982). Type: East New Guinea, Morobe Province, Waria District, Dischore Mts, 1200m, v 1909, *Schlechter* 19630 (iso. AMES, BO, E, K, L, NSW).

D. frigidum Schltr in Beih. Repert. Spec. Nov. Regni Veg. 1: 534 (1912) & *ibid.* 21: tab. 181, fig. 676 (1928)—Engl. transl. 570, 701—fig. (1982). Type: East New Guinea, Madang Province, Ramu District, Bismarck Range, c.2500m, xi 1908, *Schlechter* 18723 (B†).

D. caespitificum Ridley in Trans. Linn. Soc. Bot. 9: 171 (1916). Type:


C
G
F
H
D1
D2
E1
E2
B
A4
A2
A3
A1
1cm
MB

West New Guinea, Mt Carstenz, Camp VIc, 1650m, ii 1913, *Kloss* s.n. (holo. BM). Note: There are 3 separate plant portions on the type sheet, two of which have flowers with hairy ovaries. From Ridley's protologue it is assumed that the single plant with glabrous flowers is the actual holotype.

D. gemma Schltr in Bot. Jahrb. 58: 108 (1923). Type: East Sepik Province, Angoram District, Schrader Mtns, 2070m, v 1913, *Ledermann* 1715 (B†).

D. pseudofrigidum J. J. Smith in Nova Guinea 14: 426, tab. 67, fig. 76 (1929). Type: West New Guinea, Mt Wilhelmina complex (Hellwig Mtns), 2600m, i 1913, *Pulle* 886 (iso. K, L).

D. monogrammoides J. J. Smith in Nova Guinea 14: 431, tab. 68, fig. 80 (1929). Type: West New Guinea, Mt Doorman (near Mamberamo River), 1420m, 1 x 1920, *Lam* 1438 (holo. BO; iso. L).

Pedilonum caespitificum (Ridley) Rauschert in Feddes Repert. 94: 458 (1983).

P. frigidum (Schltr) Rauschert *op. cit.* 459.

P. gemma (Schltr) Rauschert *loc. cit.*

P. theionanthum (Schltr) Rauschert *op. cit.* 464.

Distribution: New Guinea (Map 4); c.30 collections examined.

WEST NEW GUINEA. Vogelkop Peninsula, Mt Carstenz, Mt Doorman, Mt Wilhelmina (including Lake Habbema & Bele River).

EAST NEW GUINEA. East Sepik, Enga, Southern Highlands, Western Highlands, Chimbu, Eastern Highlands, Madang, Morobe, Central, Northern and Milne Bay Provinces, including Goodenough Island.

Epiphyte on twigs on exposed ridges. 1100–3250m.

Subsp. *theionanthum* is very widespread in New Guinea occurring throughout the island. Usually it grows above 1500m, but it may occur at lower altitudes on mountain ranges near the sea, and down to 1100m in the cooler south-eastern end of the Owen Stanley Range in Papua.

The two subspecies are separated mainly on colour and altitudinal differences. Whitish-flowered plants have been reported occasionally at high altitude so the differences are minor. Subsp. *theionanthum* is commonly bright greenish-yellow with orange to red labellum apex, or just below apex, but occasionally greenish white or orange forms are encountered. The orange form, with a very dark labellum, has been recorded from the Vogelkop Peninsula (*van Royen & Sleumer* 7165, 7872 & 8002), and once from the Enga Province of Papua New Guinea (*Reeve* 160). This last collection, of a single plant, was near to a population of *D. dekockii,* so might possibly represent a natural hybrid between these two species.

The large variation in plant form noted for this subspecies is due mainly, it seems, to the degree of exposure to the sun. Pseudobulbs may be long and cylindrical or short and globose. Leaves vary from flat to almost terete in cross-section. Sometimes the pseudobulbs and leaves are very small on exposed

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FIG. 7. *Dendrobium masarangense*. A1 subsp. *masarangense*, habit; A2 subsp. *theionanthum* var. *theionanthum* long-leaved form, habit; A3 subsp. *theionanthum* var. *theionanthum* short-leaved form, habit; A4 subsp. *theionanthum* var. *chlorinum*, habit. Dissection of subsp. *masarangense*: B, bract × 3.3; C, sepals, petal & labellum × 3.3; D1, labellum, ovary & column × 3.3; E1, ovary cross-section × 12; F, column tip × 12; G, anther cap × 12; H, pollinia × 12. Dissection of subsp. *chlorinum*: D2, ovary & column foot from above × 3.3; E2, ovary cross-section × 12. A1, B, C, D1, E1, F, G, H drawn from *Clemens* 11020; A2 & A3 from *Woods* 282; A4, D2 & E2 from *Kloss* s.n.

plants and all that is visible is a mass of flowers protruding from a hidden plant beneath. Occasionally on these exposed forms, the sepals and petals are reflexed, similar to the habit of *D. cyanocentrum*. Another variable feature with this subspecies is the ovary cross-section which ranges from distinctly 5-ribbed (almost winged) to rather indistinctly triangular. This sometimes gives difficulty in use of the key.

The flower size ranges from 0.7 to 1.7cm but once, on Mt Murray in the Southern Highlands Province of Papua New Guinea, plants with considerably larger flowers, up to 2.2cm long, were collected (*Reeve* 494). The ovary was distinctly 5-ribbed and the leaves narrow and grass-like which readily separated it from *D. sulphureum*. It is exceptions like these which make it difficult to construct clear-cut keys, and serve as a reminder that one can always be sure to discover something new and unexpected when collecting in the remote parts of New Guinea.

Van Royen (1979) has correctly included the synonyms *D. theionanthum* and *D. pseudofrigidum* as alpine species. However, many of the specimens cited by him are in fact referable to *D. sulphureum: van Balgooy* 190, *Hoogland & Pullen* 5527 , *Hoogland & Schodde* 6940, 7012 & 7280, *Vandenberg* NGF 39831, *Walker* ANU 822 and *Wade* ANU 7322 fall into this category. His fig. 128 is referable to *D. sulphureum* var. *cellulosum*.

This small subspecies is rather difficult to grow and it requires good drainage with plenty of air movement, conditions which have been observed in its natural habitat where it mostly occurs on steep exposed ridges and summits growing on the twigs of trees or shrubs and amongst young secondary regrowth. Once it was collected, in quite large clumps on tree trunks and branches, in a stand of dead *Casuarina oligodon* in a very wet valley (Inu Creek, Paiela, Enga Province, 2500m, *Reeve* 294).

3bii var. **chlorinum** (Ridley) T. M. Reeve and P. Woods, **comb. et stat. nov.**
Fig. 7A4, D2, E2.

Syn.: *D. chlorinum* Ridley in Trans. Linn. Soc. Bot. 9: 172 (1916). Type: West New Guinea, Mt Carstenz, Camps VIb, 1200m & VIc, 1650m, ii 1913, *Kloss* s.n. (holo. BM, iso. K).
Pedilonum chlorinum (Ridley) Rauschert in Feddes Repert. 94: 458 (1983).

Distribution: New Guinea (Map 4); 3 collections examined.
WEST NEW GUINEA. Mt Carstenz. 1200–1650m.

Var. *chlorinum* differs from the type variety by its distinctly hairy ovary. The hairs are simple to 2-armed, 0.5–2mm long, soft and tend to lie flat and parallel to the surface of the ovary (at least on pressed and boiled up herbarium specimens). The degree of hairiness varies amongst the population but in all other respects, including ovary cross-section, it is identical with var. *theionanthum*.

Var. *chlorinum* has only been recorded from the Mt Carstenz area but as collections from West New Guinea are rather sparse it may well have a much wider distribution.

4. Dendrobium sulphureum Schlechter in Beih. Repert. Spec. Nov. Regni Veg. 1: 534 (1912) & *ibid.* 21: tab. 181 fig. 677 (1928)—Engl. transl. 571, 701–fig. (1982); Reeve & Woods in The Orchadian 6: 199 (1980).
Figs 8 & 9: Plates 6 & 7.

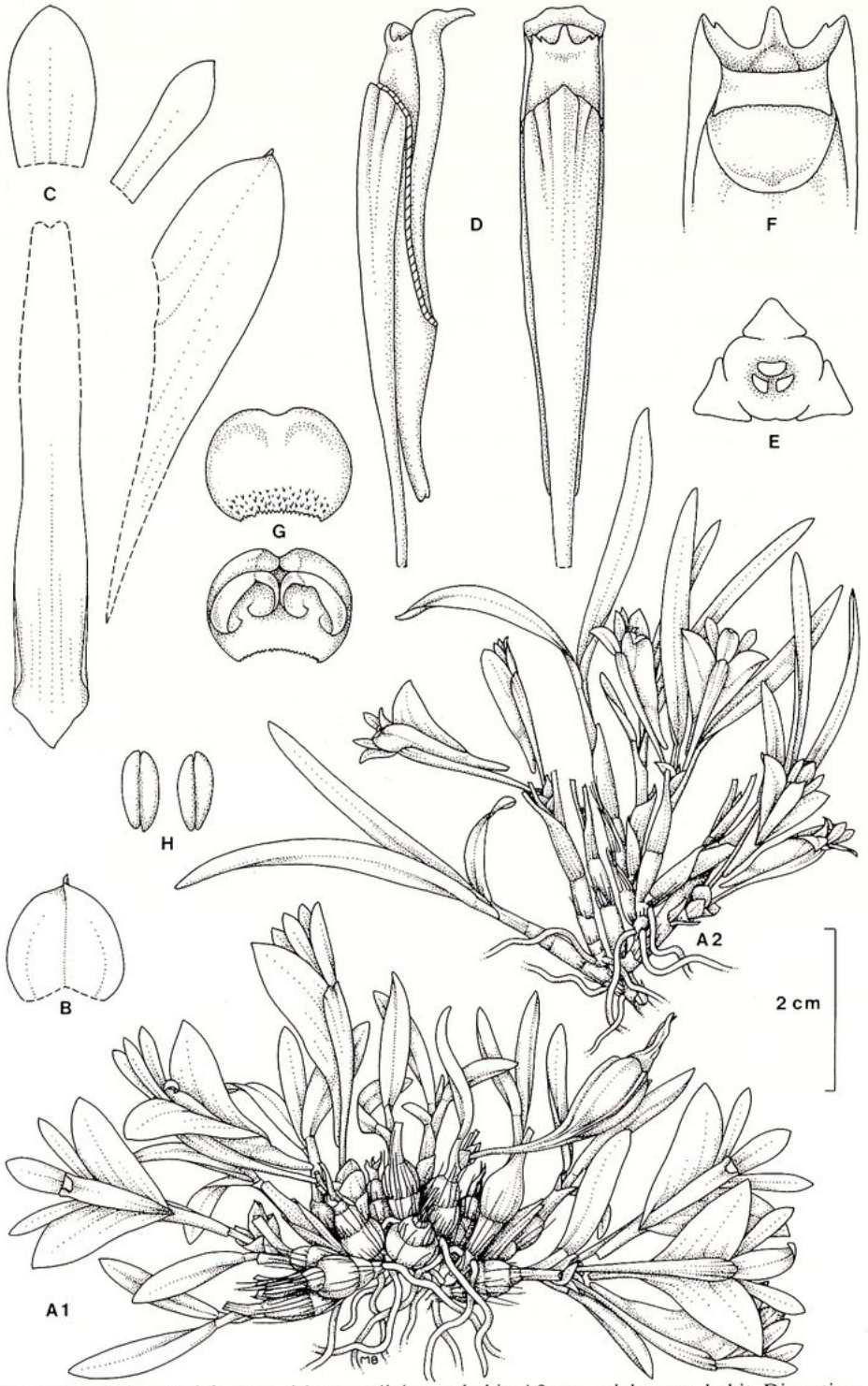


FIG. 8. *Dendrobium sulphureum*. A1 var. *cellulosum*, habit; A2 var. *sulphureum*, habit. Dissection of var. *sulphureum*: B, bract × 4; C, sepals, petal & labellum × 4; D, labellum, ovary & column × 4; E, ovary cross-section × 10; F, column tip × 10; G, anther cap × 10; H, pollinia × 10. A1 drawn from *Reeve* 704; A2—H from *Reeve* 483.

Tufted epiphyte, 2–13cm high, erect to semi-pendulous, often forming quite broad clumps or mats to 15cm or more wide. *Roots* 0.5–0.8mm diameter. *Rhizomes* short. *Pseudobulbs* 0.3–10 × 0.1–0.5cm, few to c.7-noded, ovoid to narrowly cylindrical; 1–8-leaved mostly from nodes at upper half or terminal. *Leaves* 0.4–5(–6) × 0.1–0.55cm, narrowly elliptic, oblanceolate or linear, texture either soft and then leaf often curved, or rigid and leaf usually straight, green sometimes purplish, apex obtuse or acute, narrowing towards base; sheaths often papery, persistent and only with age becoming fibrous. *Inflorescences* terminal or axillary, from leafy or leafless stems, 1–2(–4)-flowered; bracts 2–3mm, ovate, apiculate to acuminate. *Flowers* 1.4–2.95cm long, widely spreading, sepals and petals sometimes reflexed, bright yellow or greenish yellow, occasionally cream-white, labellum green to blackish green, rarely yellow, apex bright orange-scarlet, anther green. *Dorsal sepal* 4–11 × 1.5–4.5mm oblong to ovate, apex obtuse to acute, sometims apiculate. *Lateral sepals* 10–23 × 2–6mm, obliquely oblong to triangular, apex obtuse to acute sometimes apiculate; basal fused part 2.5–7mm, cylindrical; mentum total length 9–17.5mm, tip blunt, often bilobed. *Petals* 3.5–11 × 1–2.5mm, quite variable in shape, oblong to linear, sometimes spathulate, apex obtuse to acute or apiculate. *Labellum* 12–23 × 2–3mm, subtrilobate, narrowly oblong, adnate to column-foot at base, upper margins slightly incurved, with an indistinct transverse V-shaped ridge, apex triangular-ligulate to acuminate, normally recurved. *Column* c.2.6mm long; foot 9–16mm long; anther c.1.8mm wide; pollinia c.1mm long. *Ovary* triangular or rarely 5-ribbed; pedicel-ovary 10–23mm long. *Fruit* to 13 × 8–9mm, oblong-ovoid or globose, angular or trigonous, sometimes distinctly winged towards the pedicel, pendulous or sometimes erect.

Distribution: New Guinea (Map 5).

Epiphyte on trunks and twigs in montane cloud forest, on forest edges of subalpine grassland and on trees in open grassland, in moss and rain forest. Recorded on tree ferns, *Dacrycarpus* (*Podocarpus*) *compactus* and *Cordyline* (also observed planted on *Cordyline* in village). (800–) 1800–3656m.

Like many orchids collected and named by Schlechter, *Dendrobium sulphureum* was described from a specimen which was lost in the destruction of the Berlin herbarium on the night of 1–2 March, 1943. This single collection, of which no duplicates have been found, was collected during September 1909 in the Torricelli Mts in northwest Papua New Guinea. Eleven years later, on 31 October 1920, H. J. Lam collected a plant at 2200m on Doorman Top which is on the northern side of the main mountain chain in the western half of the island some 340km to the west of Schlechter's locality: we have not been able to examine this specimen which was preserved in alcohol and on which J. J. Smith based his description of *D. cellulosum*.

We have therefore only had Schlechter's and Smith's descriptions, each of which is fortunately supplemented by a dissectional drawing of a flower, on which to establish our identifications of the 60 or more available collections, all but one of which are from East New Guinea.

Originally (1980) amongst the materials examined we were able to recognize three fairly distinct entities and were then in no doubt that we were dealing with three clear-cut subspecies. We have to confess that there are some specimens scattered in various herbaria determined by us as *Dendrobium sulphureum*

subsp. *sulphureum*, *D. sulphureum* subsp. *cellulosum* and either *D. sulphureum* subsp. *pindaundense* or subsp. *rigidifolium*: all are either unpublished combinations or *nomina nuda*. Now, after several abortive attempts to key out these entities satisfactorily, we have arrived at the conclusion that recognition at varietal rank is all that can appropriately be given. The key which follows is meant only as an aid to gather together those entities which fit the varietal descriptions in the strict sense. Var. *sulphureum* merges on the one hand into var. *rigidifolium* and there are intermediate specimens: likewise it merges with var. *cellulosum*. However, the two extremes, var *rigidifolium*, and var. *cellulosum* are not likely to be confused.

KEY TO VARIETIES

1. Pseudobulbs mostly stem-like, cylindrical, elongated, often branched below, 4-or more noded (if short, flowers usually not more than 2cm long × 1.5cm wide); leaves 2–5(–8) scattered along upper part of stem, or apical, 6 or more times longer than broad.....2

\+ Pseudobulbs ovoid or conical, usually less than 4-noded; leaves usually 2, ± apical, less than 6 times longer than broad; flowers usually 2cm or more long × 1.7–2.5cm wide .....**4c.** var. **cellulosum**

2. Leaves rigid, ± erect, often in one plane and ± distichous; flowers usually more than 2cm long × 1.5cm wide, sepals and petals distinctly upward curved (i.e. upper surface ± concave) .....**4b.** var. **rigidifolium**

\+ Leaves firm but not stiffly rigid, ± spreading, margin often slightly undulate, not distichous; flowers usually less than 2cm long × 1.5cm wide

4a. var. **sulphureum**

4a. var. **sulphureum.** **Fig. 8A2, B–H; Plate 7**

Type: East New Guinea, Torricelli Mts, c.800m, ix 1909, *Schlechter* 20076 (B†). Neotype (designated here): East New Guinea, Enga Province, Lagaip district, Lake Inim, 2600m, *Reeve* 483 (neo E; isoneo. AMES, CBG, K, L, LAE, UPNG).

Syn.: *Pedilonum sulphureum* (Schltr.) Rauschert in Feddes Repert. 94: 464 (1983).

Var. *sulphureum* shares with var. *rigidifolium* the longer cylindrical stems but it has smaller flowers and spreading, less rigid leaves. Short-stemmed forms are very similar to var. *cellulosum* but may be recognized by their normally much smaller flowers.

Distribution: New Guinea (Map 5); c.20 collections examined.

?WEST NEW GUINEA. Cyclop Mts.

EAST NEW GUINEA. West Sepik, Enga, Southern Highlands, Western Highlands, Chimbu, Eastern Highlands, Madang, Morobe and Central provinces.

On rain- and moss-forest trees, often on *Cordyline*, mat-forming on moss-covered branches, roadside forest-bamboo regrowth, (800–)1800–2700 (–3450)m.

As mentioned, Schlechter's description is based on only one collection of what we interpret to have been a small and probably atypical plant, in which the ellipsoid-obclavate stems and leaves, 0.7–1.3 × 0.25–0.4cm, are much smaller than what we believe to be the average. Within a broad interpretation

of Schlechter's description we have been able to lump together about one third of the specimens examined which although distributed from 800 to 3450m appear to occur more commonly between 1800 and 2700m.

Although the specimen which we have chosen for the neotype is not from Schlechter's type locality (none was available), we think it encompasses sufficiently the range of smaller and larger sizes which will remove any confusion which would arise if attempting to identify specimens only on the basis of Schlechter's description.

The note on the field label of *van Royen & Sleumer* 5728 from 1000m near the Ifar to Ormoe path on the Faika riverbank in the Cyclop Mts, West New Guinea, describes the flower colour as lemon yellow with lip orange-yellow at apex. However the Leiden specimen is sterile and it is impossible to be certain whether it belongs here or with var. *cellulosum* although the lower altitude favours var. *sulphureum*. The paucity of records of this species in West New Guinea is puzzling and it is important therefore to draw attention to this specimen in the hope that further collections will be made in Irian Jaya.

The low altitude of 800m at which Schlechter originally collected the type obviously represents a cool climatic pocket from which we know other Schlechter collections within this section have been found e.g. *D. cyanocentrum* and *D. putnamii*.

Under *D. pseudofrigidum* and *D. theionanthum*, van Royen (1979) cites ten collections all of which we have examined and which are all quite clearly *D. sulphureum* (see p. 196). Of these, *Hoogland & Schodde* 6940, 7280, 7378; *Walker ANU* 822 & *Vandenberg NGF* 39831 are referable to *D. sulphureum* var. *sulphureum*.

Var. *sulphureum* appeared, incorrectly named as *D. pseudofrigidum*, on a 20 cent postage stamp issued in 1979 by Papua New Guinea. It seems the easiest of the varieties to cultivate and when grown well covers itself in flowers for many months.

4b. var. **rigidifolium** T. M. Reeve & P. Woods, **var. nov.** a var. *sulphureo* foliis erectis multo rigidioribus et floribus majoribus et sepalis et petalis valde recurvis distinguenda. **Fig. 9; Plate 6A.**

Type: East New Guinea. Eastern Highlands District, Mt Wilhelm, Kombugomambuno, base of Pindunde [Pindaunde] grass valley, 3300m, 3 v 1965, *Balgooy* 190 (holo. L; iso. CANB, LAE).

Var. *rigidifolium* differs from the type variety in its erectly held, rigid, ± distichous leaves and larger flowers with recurved sepals and petals and, in addition from var. *cellulosum*, in its longer stems the sheaths of which often appear to remain membranous. The lateral sepals in addition to being upward curved are also often concave along their upper surfaces.

Distribution: East New Guinea (Map 5); 26 collections examined.

EAST NEW GUINEA. Enga, Western Highlands, Chimbu, Eastern Highlands, Madang, Morobe, Central and Milne Bay Provinces.

Epiphyte in subalpine grassland and forest on *Dacrycarpus* and tree ferns, montane moss forest or rarely in rain forest, 1920–3650m.

Plants of distinctive dwarf habit have been observed e.g. *Reeve* 1042 from Tomba, 2800m, in Western Highlands Province; *Reeve* 272, Mt Alupai, 2900m, Enga Province and *Woods* with *Cruttwell et al.* 2490, Mt Simpson area between 2000 and 2376m, Milne Bay Province.

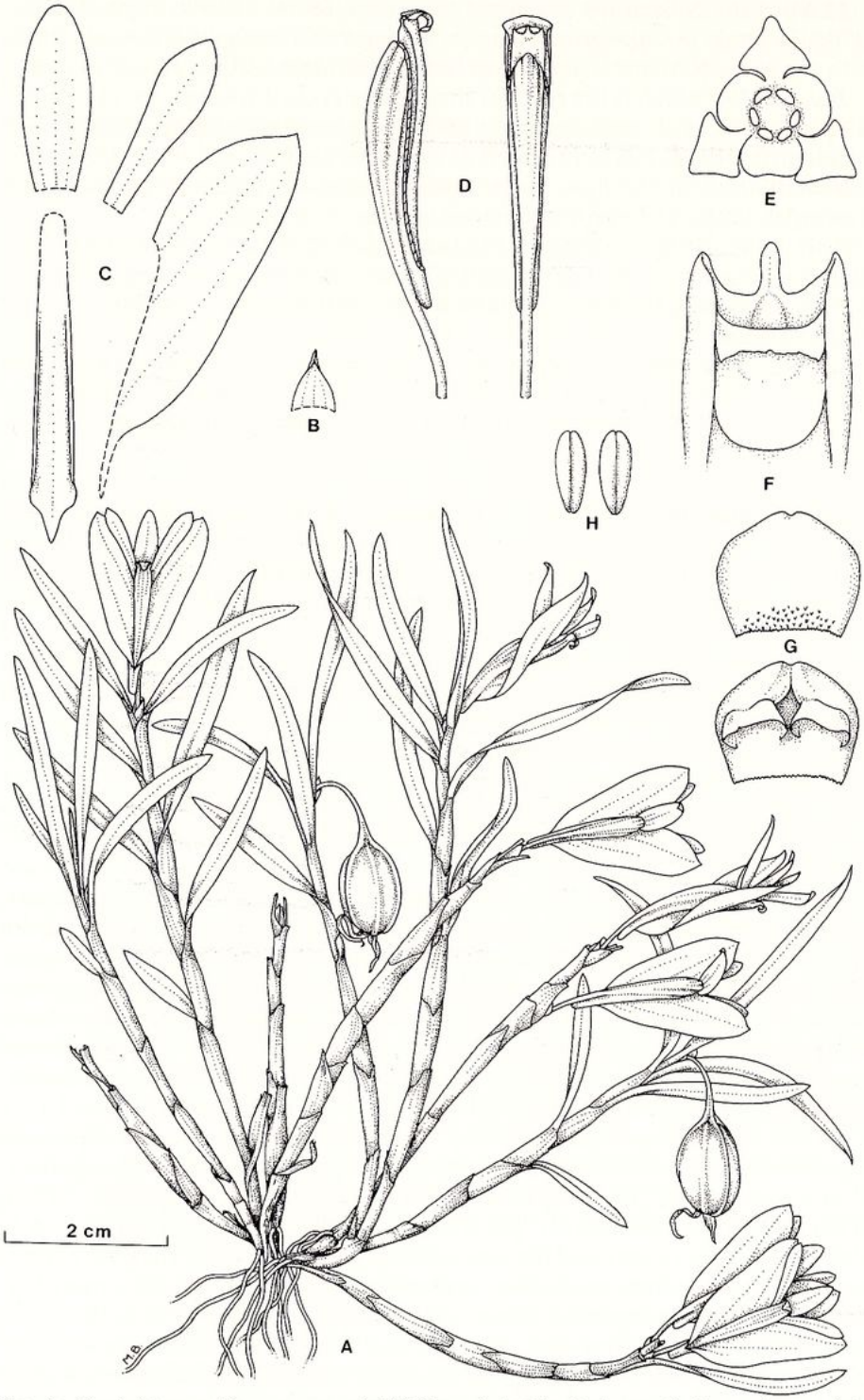


FIG. 9. *Dendrobium sulphureum* var. *rigidifolium*. A, habit; B, bract × 2; C, sepals, petal & labellum × 2; D, labellum, ovary & column × 2; E, ovary cross-section × 10; F, column tip × 10; G, anther cap × 10; H, pollinia × 10. All drawn from *Elworthy*, RBGE 75.2525.

Most of the collections examined have been found at fairly high altitudes (2740–3650m). *D. sulphureum* reaches its most southerly and easterly limits with the records of var. *rigidifolium* from Central and Milne Bay Provinces.

Balgooy 190 which is the type for this variety is cited wrongly by van Royen (1979, p. 372) as *D. theionanthum*: under *D. pseudofrigidum* (p. 375) he also misidentifies *Wade* ANU 7322 and *Hoogland & Pullen* 5527 which are also *D. sulphureum* var. *rigidifolium*. In the Leiden material *Hoogland & Pullen* 5527 is a mixed collection of var. *rigidifolium* and var. *cellulosum*.

As has already been mentioned the unpublished epithet '*pindaundense*' is to be found on some of our determination labels. This referred to the type locality but was eventually thought unsuitable due to the fairly widespread distribution of the variety.

In cultivation some plants of var. *rigidifolium* may be less easy to recognize when var. *sulphureum* is not available for comparison. However the leaves are always clearly stiff to the touch. Apparently this variety is less easy to grow than var. *sulphureum*.

4c. var. **cellulosum** (J. J. Smith) T. M. Reeve & P. Woods, **comb. et stat. nov.** **Fig. 8A1; Plate 6B.**

Syn.: *D. cellulosum* J. J. Smith in Nova Guinea 14: 428, tab. 67 fig. 77 (1929). Type: West New Guinea, Mt Doorman, 2200m, 31 x 1920, *H. J. Lam* 1832 (BO, alcohol—n.v.).

Var. *cellulosum* differs from var. *rigidifolium* in the shorter stems and fewer, broader, elliptic leaves. It has larger flowers than in var. *sulphureum*. The flowers often seem to overtop the leaves.

Distribution: New Guinea (Map 5); 16 collections examined.

WEST NEW GUINEA.. Mt Doorman, ? Cyclop Mts.

EAST NEW GUINEA. Enga, Southern Highlands, Chimbu and Eastern Highlands provinces.

Epiphyte on trees in montane forest, tree ferns on forest edges and alpine grassland, 2200–3450m

With the exception of the sterile specimen from the Cyclop mountains, already discussed under var. *sulphureum*, the only record of the species from West New Guinea is Lam's type collection of *D. cellulosum* from Mt Doorman. Specimens examined from East New Guinea agree well with the type description and dispel any suspicions that the taxon might have been assigned elsewhere: the flower and leaf size and ovary shape distinguish it from similarly coloured species (*D. masarangense* subsp. *theionanthum* or *D. vexillarius* var. *vexillarius*) which occur in the same locality.

Of the 16 specimens examined by us at least two are mixed collections: *Hoogland & Pullen* 5527 (L) has been mentioned already under var. *rigidifolium*; *Rees & Reeve* 218 (E, K, LAE) from Crater Lake south east of Laiagam, 3450m in Enga Province includes one plant of var. *sulphureum*. This is exceptionally high for the type variety and the accompanying field note that the ovary cross-section may vary from triangular to slightly 5-ribbed even on the same plant makes it an interesting collection worthy of further field studies in the area.

A good illustration of this variety, as *D. pseudofrigidum*, drawn from *Hoogland & Schodde* 7012, is depicted in van Royen (1979: 373). It is unfortunate that this is again based on a misidentification as are two of his citations of that species on page 375: *Vandenberg* NGF 39663 and *Hoogland & Pullen* 5527 p.p. are also referable to *D. sulphureum* var. *cellulosum*.

The flowers of var. *cellulosum* are large in comparison to its overall height and the size of the leaves. This makes it a most attractive plant but despite this it does not seem to have been successfully introduced into cultivation.

5. Dendrobium nardoides Schlechter in Beih. Repert. Spec. Nov. Regni Veg. 1: 529 (1912) & 21: tab. 179, fig. 668 (1928)—Engl. transl. 567, 699–fig. (1982); Reeve & Woods in The Orchadian 6: 200 (1980). **Fig. 10; Plate 8A.**
Type: East New Guinea, Madang Province, Ramu District, Bismarck Mountains, c.2000m, 14 xi 1908, *Schlechter* 18729 (iso. AMES, E, K, L, NSW).
Syn.: ?*D. oligoblepharon* Schltr in Beih. Repert. Spec. Nov. Regni Veg. 1: 529 (1912) & 21: tab. 179, fig. 669 (1928)—Engl. transl. 568, 699–fig. (1982). Type: East New Guinea, Morobe Province, Waria District, Dischore Mtns, c.1200m, vi 1909, *Schlechter* 19801 (B†).
Pedilonum nardoides (Schltr) Rauschert in Feddes Repert. 94: 461 (1983).
?*P. oligoblepharon* (Schltr) Rauschert *op. cit.* 462.

Erect tufted epiphyte, 1–7(–10)cm high, forming loose to dense clumps in moss, occasionally up to 20(–30)cm across, often with ascending habit of growth due to competition from mosses. *Roots* 0.4–1mm diameter. *Rhizomes* usually short, sometimes elongated, to 1.2cm long. *Pseudobulbs* 0.3–2.5 × 0.15–0.6cm, ovoid to cylindrical, covered with whitish-brown aristate bracts, apex 1–4-leaved. *Leaves* 0.8–6 × 0.05–0.15cm, erect to spreading, linear-subulate, apex acute, channelled above, often rigid; sheaths smooth, pale green sometimes flushed purple, old sheaths persistent. *Inflorescences* terminal, arising from both leafy and leafless stems, 1–2-flowered, subsessile; bracts ovate to suborbicular, apiculate to aristate. *Flowers* 1.1–2.1cm long, usually not widely opening, bright purplish-pink with labellum apex scarlet and mentum often whitish. *Dorsal sepal* 4.5–9.5 × 2–3mm, oblong-lanceolate, apiculate to acuminate. *Lateral sepals* 11–20 × 2.2–3.5mm, oblique oblong-lanceolate, acuminate; basal fused part 2.5–5mm long, usually swollen (inflated), cylindrical (rarely subconical); mentum total length 5–10.5mm, tip obtuse. *Petals* 4–9 × 1–2mm, linear to oblanceolate, acute to apiculate. *Labellum* 9.5–16 × 1–2mm, subtrilobate, linear oblanceolate, adnate to column foot at base with upper margins incurved, apex subacute to subacuminate, usually slightly recurved. *Column* 1.5–2mm long; foot 5–10.5mm long; anther 1–1.5mm broad; pollinia c.1mm long. *Ovary* cross-section variable, usually ± triangular but often indistinct, sometimes 5–6-ribbed (regular); pedicel-ovary 8–17mm long, pedicel curving backwards as fruit develops. *Fruit* 12 × 8mm, ovoid.
Distribution: New Guinea (Map 6); 22 collections examined.
EAST NEW GUINEA. West Sepik, Enga, Southern Highlands, Western Highlands, Eastern Highlands, Madang, Morobe, Central & Milne Bay Provinces, including Goodenough Island.
Epiphyte in montane cloud forest, growing usually in large clumps of mosses, (1200–) 2000–3200m.

D. nardoides is a charming dwarf species confined mainly to the high altitude montane forests and almost invariably observed growing in clumps with epiphytic mosses. Sometimes these clumps become very large and dense, and Schlechter named this species because of its likeness to *Nardus stricta,* the European Mat-grass.

So far *D. nardoides* has only been collected in East New Guinea, including Goodenough Island in the D'Entrecasteaux group of islands (*Cruttwell* 1425).

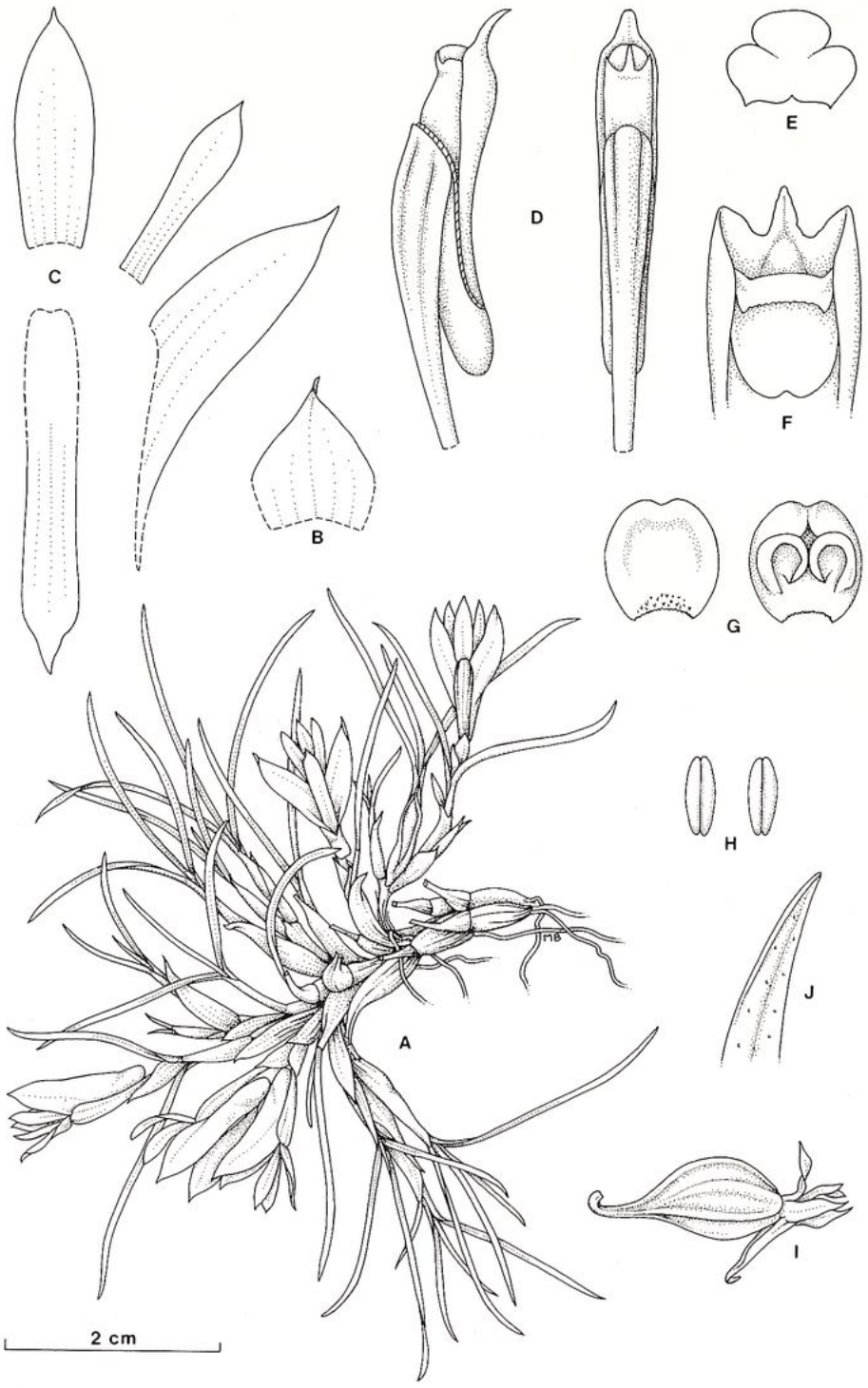


FIG. 10. *Dendrobium nardoides*. A, habit; B, bract × 3; C, sepals, petal & labellum × 3; D, labellum, ovary & column × 3; E, ovary cross-section × 8; F, column tip × 8; G, anther cap × 8; H, pollinia × 8; I, fruit × 1.3; J, leaf tip × 8. A, J drawn from *Elworthy*, RBGE 75.1991; B–I from *Argent*, RBGE 71.1640.

Since there is a collection from the Star Mountains (*Veldkamp* 6848) it very likely occurs in West New Guinea as well. The species does extend into the alpine zone, to 3200m, but was not included in the treatment of the alpine flora by van Royen (1979).

This is one of the few species in this section which show significant variation in the ovary cross-sections; from triangular to regularly 6-ribbed. The differences in the ovary sections was one of the main reasons why Schlechter separated *D. nardoides* and *D. oligoblepharon*. We have tentatively included the latter in synonymy here even though the altitude of origin (1200m) is much lower than all other records, and the colour of the labellum apex, according to Schlechter a luminous cinnabar-red, is slightly different.

Unlike most of the other high altitude species in section *Oxyglossum*, the inflorescences of *D. nardoides* are often single-flowered. As far as we know the colour of the flowers is constant being bright purplish-pink. Apart from the one exception noted above, the lip apex is always scarlet.

6. Dendrobium subuliferum J. J. Smith in Bull. Jard. Bot. Buitenz. sér. 2, 2: 15 (1911) & Nova Guinea 12: 63 tab. 17 fig. 51 (1913); van Royen, The Alpine Flora of New Guinea 2: 415–417 fig. 144 (1979); Reeve & Woods in The Orchadian 6: 200 (1980); Oddy & Bell in J. Orch. Soc. Great Britain 37, 2: 38, 39 fig. 5 (1988). **Fig. 11; Plate 8B.**

Type: West New Guinea, Mt Goliath, 300m, v 1911, *de Kock* 199 (holo. BO n.v.).

Syn.: *D. subuliferum* J. J. Smith var. *gautierense* J. J. Smith in Nova Guinea 12: 332 (1916). Type: West New Guinea, Gautier Mts, 300m, xi 1911, *Gjellerup* 827 (holo. BO n.v.).

Pedilonum subuliferum (J. J. Smith) Rauschert in Feddes Repert. 94: 464 (1983).

Erect, suberect or tufted epiphyte, 2–10cm high, often with ascending habit due to competition with mosses. *Roots* 0.4–1mm. *Rhizomes* usually short, sometimes to c. 1cm long. *Pseudobulbs* 0.5–2.5 × 0.15–0.35cm, ovoid to narrowly fusiform, 3–6-noded, apex 2–4-leaved. *Leaves* 1–5 × 0.075–0.2cm, erect to spreading, linear-subulate, thick, often rigid, midrib impressed above, lower surface convex, apex acute or apiculate, sometimes minutely papillose; sheaths ± ribbed, with age becoming fibrous. *Inflorescence* terminal, mainly from leafy stems, 1- rarely 2-flowered, bracts 7 × 5mm scarious, ovate-triangular, usually sheathing tip of mentum, distinctly 3-nerved, apex apiculate or acuminate. *Flowers* 1.5–2.2cm, usually widely opening to 2.4cm, white sometimes with red to purplish striations on inside of labellum; anther usually purplish; sometimes fragrant. *Dorsal sepal* 7–13 × 3–6mm, ovate-triangular to ovate-elliptic, acuminate or apiculate. *Lateral sepals* 14.5–20 × 3.2–5.5mm, ovate-oblong to ovate- elliptic, sometimes slightly keeled, strongly acuminate to subulate-acuminate; basal fused part 2–3mm long, subconical; mentum total length 6–8mm long, tip usually concealed by bract, obtuse or (± unequally) shortly bi-lobed. *Petals* 7.5–12 × 3.5–8mm, broadly obovate-spathulate, upper margins often finely ciliate, apex apiculate. *Labellum* 13–18 × 2.5–3.5mm, simple to slightly trilobate, oblanceolate, adnate to column-foot at base, margins of the apical part slightly upcurved, basal part with V-shaped transverse ridge, apex acuminate to narrowly triangular, straight or slightly deflexed, sometimes slightly upcurved. *Column* c.2mm long; foot 6–8mm long, blunt

FIG. 11. *Dendrobium subuliferum*. A1, A2, A3, habit; B, bract × 2.6; C, sepals, petal & labellum × 2.6; D, labellum, ovary & column × 2.6; E, ovary cross-section × 8; F, column tip × 8; G, anther cap × 8; H, pollinia × 8. A1 drawn from *Reeve* 490; A2 from *Kalkman & Vervoort* 4033; A3 and B–H from *Kalkman & Tissing* K 4176.

tooth at base present; anther 2–3mm broad; pollinia c.0.6–0.8mm long. Ovary 3-winged; pedicel-ovary 7–13mm. *Fruit* not observed.

Distribution: New Guinea (Map 6); 8 collections examined.

WEST NEW GUINEA. Vogelkop Peninsula, Gautier Mts, Mt Goliath, Star Mts, Tembagapura.

EAST NEW GUINEA. West Sepik, Southern Highlands and Morobe provinces.

Epiphyte in primary and secondary forest, occasionally terrestrial, 300–2000m.

This little known species with its beautiful white flowers and very distinctive broad petals is represented in herbaria by a mere handful of specimens from both West and East New Guinea all collected from between 300 and 2000m, although van Royen (1979) included it in his Alpine Flora erroneously giving the altitude as 3000m.

The field note accompanying Henty's collection (NGF 20885) from Telefomin states that the flowers were fragrant: only one other species in this section is known to have scented flowers—the closely related *D. cyanocentrum* from which it differs in its large predominantly white, usually single flowers with broad obovate-spathulate petals normally wider than the sepals: the sepals and petals are not reflexed. In habit, *D. nardoides* is not dissimilar but is easily differentiated by its purplish and mostly smaller flowers.

The character of a long drawn out labellum used by Smith to distinguish *D. subuliferum* var. *gautierense* is not sufficient to warrant its recognition.

The flowers of *Reeve* 382 & 490 from Erave and *van Royen & Sleumer* 7659 from the Vogelkop peninsula are relatively small and are recorded as showing some red or purplish striations or nerves, whereas other specimens have larger flowers and are pure white with a purple anther and sometimes greenish sepal tips. Further field observations are necessary to show whether *D. subuliferum* and *D. cyanocentrum* hybridize; the two species are known to grow together.

A single plant collected by Mr Clive Jermy in 1965 was successfully grown in Edinburgh for several years (cult. RBGE 65.0311).

Oddy & Bell (1988) refer to a plant at Kew 'growing as a cushion of green quills'; the lip of the flower which they describe as 'soft yellow' and the column having a 'flush of pink'. Distributional information in this article is erroneous but Miss Bell (pers. comm.) has clarified that the plant referred to is from New Guinea where it was collected in 1986 at Tembagapura, in central Irian Jaya, by Maclennan (no. 13) at an altitude of 1829m (observed growing up to 2438m). Examination of slides kindly made available by Miss Bell and more recently by Dr & Mrs Maclennan has helped confirm the identity of this plant.

7. Dendrobium cyanocentrum Schlechter in Schumann & Lauterbach Nachträge zur Flora der Deutschen Schutzgebiete 160 (1905); in Beih. Repert. Spec. Nov. Regni Veg. 1: 527 (1912) & 21: tab. 178, fig. 665 (1928)—Engl. transl. 566, 698–fig. (1982); Reeve & Woods in The Orchadian 6: 200 (1980).

Fig. 12; Plate 9.

Type: East New Guinea, Madang Province, Bismarck Range, c.900m, i 1902, *Schlechter* 13930 (BM, BR, K, P).

Syn.: *D. lapeyrouseoides* Schltr in Beih. Repert. Spec. Nov. Regni. Veg. 1: 530 (1912) & 21: tab fig. 670 (1928)—Engl. transl. 568, 700-fig. (1982). Type: East New Guinea, Madang Province, Finisterre range, 1000m, vii 1908, *Schlechter* 18054 (B†).

D. flavispiculum J. J. Smith in Repert. Spec. Nov. Regni Veg. 12: 120

(1913) & Nova Guinea 12: 333, tab. 120, fig. 219 (1916). Type: West New Guinea, Legare River, c.100m, vi 1912, *Janowsky* 88 (n.v.).

Pedilonum cyanocentrum (Schltr) Rauschert in Feddes Repert. 94: 458 (1983).

P. flavispiculum (J. J. Smith) Rauschert *op. cit.* 459.

P. lapeyrouseoides (Schltr) Rauschert *op. cit.* 460.

Erect to semi-pendulous tufted epiphyte, 1.5–8cm high, often forming clumps to 12cm across. *Roots* 0.4–1mm diameter. *Rhizomes* short, to c.3mm long. *Pseudobulbs* 0.3–2.5 × 0.15–0.4cm, ovoid, obclavate to cylindrical, greenish or greenish yellow or reddish, 2–3(–4)-leaved at apex. *Leaves* 1–6 × 0.1–0.3cm, erect to spreading, linear-subulate, flat to shallowly V-shaped in section, pale yellowish green to dark green above, paler, sometimes purplish red below, apex acute to subacuminate, sometimes apiculate or obliquely pointed; sheaths pale green, ± membranous, with age becoming fibrous. *Inflorescences* terminal from leafy or leafless pseudobulbs, 1(–2)-flowered, subsessile; bracts c.3.5 × 2.7mm, ovate-acuminate, usually enclosing mentum apex. *Flowers* 1.1–1.8cm (measured to tip of dorsal sepal in erect position), sepals and petals usually strongly reflexed and with age often bent back parallel to pedicel and ovary, colour very variable, white to greenish white suffused with pink, purple or blue especially towards base of sepals and petals and on veins; labellum purple, purplish brown, yellowish brown, orange, yellow or green, nerves often darker; anther violet, blue, green or yellow. *Dorsal sepal* 5—7.5 × 2–3mm, lanceolate to narrowly ovate or ovate-triangular, strongly acuminate-subulate, becoming strongly reflexed and often convex. *Lateral sepals* 10.5–17 × 2–3mm, ovate-triangular, strongly acuminate-subulate, usually strongly reflexed; basal fused part 1.5–3mm, subconical; mentum total length 5.5–10mm, tip obtuse to shortly bilobed, usually enclosed by bract. *Petals* 4–6.5 × 1.5–3mm narrowly ovate-triangular to obovate, occasionally linear-ligulate, usually reflexed. *Labellum* 10–14 × 1.5–2.5mm, linear-lanceolate, subtrilobate, adnate to column foot at base, apical part with margins only slightly incurved, transverse callus present, V-shaped or M-shaped or emarginate, apex of lip narrowly triangular acuminate or ± cuspidate, usually straight or sometimes slightly deflexed. *Column* 1.5–2mm long; foot 5.5–10mm long; anther 1.5–2.5mm broad; pollinia 0.6–1mm long. Ovary 3-winged to triangular in cross-section; pedicel-ovary 7–15mm long. *Fruit* 12 × 7mm; narrowly ovoid, winged.

Distribution: New Guinea (Map 7); 14 collections examined.

WEST NEW GUINEA.. Legare River, Idenburg River, Cyclop Mts.

EAST NEW GUINEA. West Sepik, Western Highlands, Southern Highlands, Madang, Morobe and Central provinces.

Epiphyte in rain forest, forest clearings or on trees on river banks, 100–1300m.

Dendrobium cyanocentrum is the type species of the section having been described, along with *D. pentapterum,* from material collected by Schlechter during his first expedition to New Guinea in 1901–1902.

The sharply pointed reflexed sepals and petals serve to distinguish *D. cyanocentrum* from all other species in the section. Philip Spence (1972) likened the flowers to a diving bird. The flowers, of a variable and delicate hue, tend to be hidden amongst the leaves.

We placed *D. lapeyrouseoides,* of which we have seen no material, into synonymy with slight hesitancy as its description makes no mention of reflexed

A

B

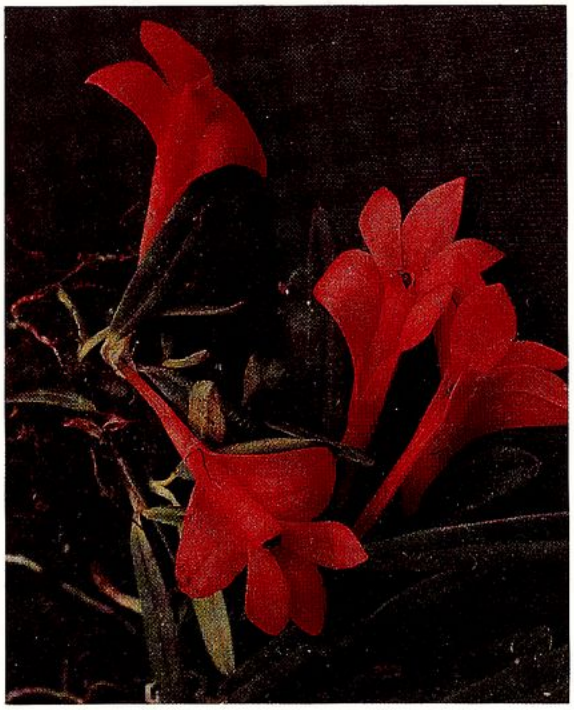


PLATE 1 A, *D. brevicaule* subsp. *pentagonum* (*Reeve* 457). B, *D. brevicaule* (*Reeve* 81).

A

B

PLATE 2 A, *D. brevicaule* (*van Balgooy* 14). B, *D. brevicaule* subsp. *calcarium*, Lae.

PLATE 3 *D. dekockii* (*Argent*, cult. RBGE 72.0065).

A

B

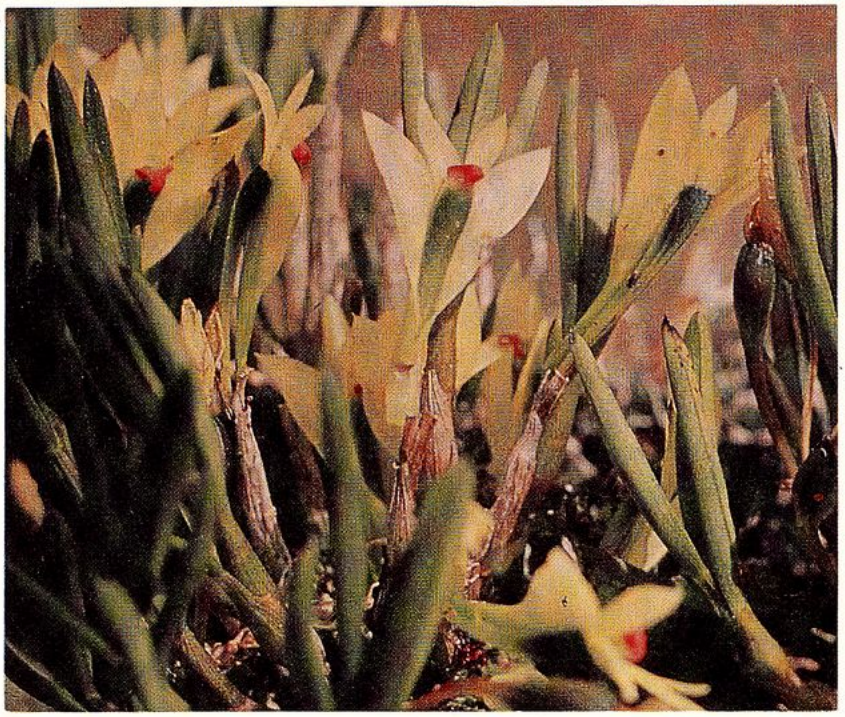
PLATE 4 A, *D. dekockii* (*Wood* 30993). B, *D. dekockii* on *Cyathea* (*Wood* s.n.), Mount Piora, Eastern Highlands District, Papua New Guinea.

A

B

PLATE 5 A, *D. masarangense* subsp. *theionanthum* (PNGH 166). B, *D. masarangense* subsp. *masarangense* (*Reeve* 1125).

A



B

PLATE 6 A, *D. sulphureum* var. *rigidifolium* (*van Balgooy* 190). B, *D. sulphureum* var. *cellulosum* (*Reeve* 248).

A

B

PLATE 7 A, *D. sulphureum* var. *sulphureum* (*Elworthy*, cult. RBGE 75.2010). B, *D. sulphureum* var. *sulphureum*, in fruit (*Elworthy*, cult RBGE 75.2010).

A

B

PLATE 8 A, *D. nardoides* (*Argent*, cult RBGE 71.1640). B, *D. subuliferum* (*Jermy*, cult. RBGE 65.0311).

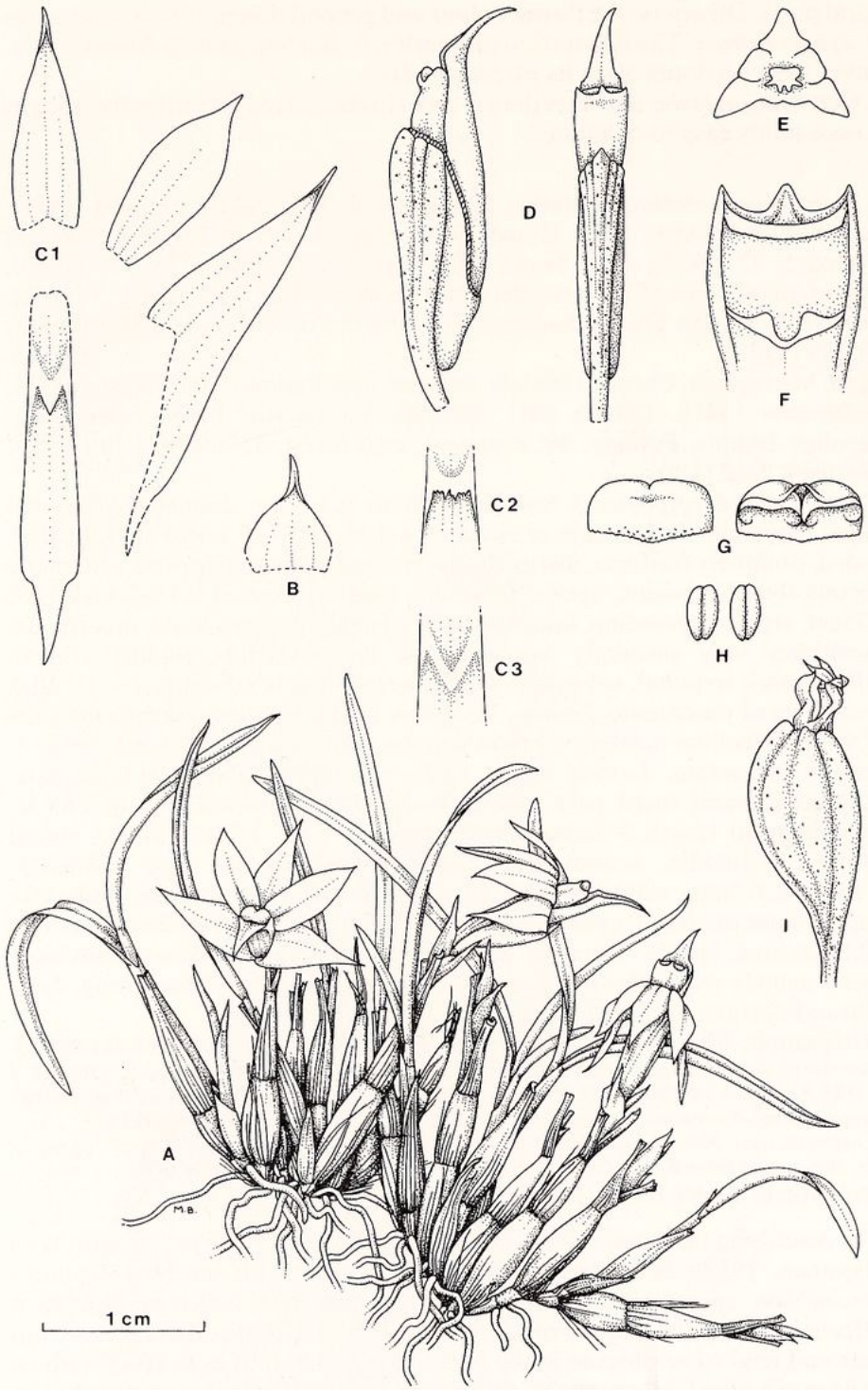


FIG. 12. *Dendrobium cyanocentrum*. A, habit; B bract × 4; C1, sepals, petal & labellum × 4; C2 & C3, cross-ridges on labellum × 4; D, labellum, ovary & column × 4; E, ovary cross-section × 10; F, column tip × 10; G, anther cap × 10; H, pollinia × 10; I, fruit × 2. A–C1, D–I drawn from *Reeve* 381; C2 from *Cruttwell* 373; C3 from *Brass* 13456.

floral parts. Otherwise the flower colour and general description seem close to *D. cyanocentrum*. The illustration of Smith's *D. flavispiculum* in *Nova Guinea* leaves us in no doubt as to its placement here.

Occurring at lower altitudes than is usual in the section this attractive species is reasonably easy to cultivate.

8. Dendrobium violaceominiatum Schlechter in Bot. Jahrb. 56: 470 (1921); Kanehira in J. Dept. Agric. Kyushu Imp. Univ. 4: 297 (1935); Hosokawa in Kudoa 5: 92 (1937), & in Trans. Nat. Hist. Soc. Formosa 33: 119 (1943); Glassman in Flora of Ponape, Bernice P. Bishop Mus. Bull. 209: 117 (1952); Reeve & Woods in The Orchadian 6: 201 (1980); Fosberg et al. in Micronesica 20: 119 (1987). **Fig. 13.**

Type: Micronesia, Caroline Islands, Ponape, near Patapat, 200–300m, xi 1913, *Ledermann* 13415, 13459b (B†). Neotype (designated here): Micronesia, Caroline Islands, Ponape, Mt Poaipoai, rain forest, 1500ft, 8–9 July 1949, *Glassman* 2482 (US).

Small tufted epiphyte, 3–5cm high. *Roots* 0.5–1mm diameter. *Rhizomes* short, indistinct. *Pseudobulbs* crowded, 0.4–1.8(–2.4) × (0.1–)0.3–0.75cm, 2–4-noded, obliquely fusiform, distinctly clothed and often overtopped with many fibrous sheath remains, apex 1–2, rarely 3-leaved. *Leaves* 0.15–7.4 × 0.125–0.55cm, erect to spreading, linear to narrowly elliptic, apex acute, mucronate, sometimes very distinctly narrowed at base; sheaths slightly ribbed. *Inflorescence* terminal, subsessile, 1–2-flowered; bracts 2.5–5mm, ovate, apex acuminate or mucronate. *Flowers* 1.2–1.8cm long, lavender, pale bluish-violet or violet, labellum scarlet or bright orange. *Dorsal sepal* 5–9.5 × 2–3mm, 3-nerved, lanceolate. *Lateral sepals* 12–16 × 3–3.5mm, obliquely lanceolate, acuminate; basal fused part 2–3mm long, broadly cylindrical, tip obtuse; mentum total length 5–7mm, obtuse. *Petals* 6–8 × 1–1.5mm, linear, widest above the middle, acuminate, narrowing towards the base. *Labellum* 7–10.5 × 1.5–2mm, subtrilobulate, adnate to column-foot at base, transverse ridge present or absent, apex narrowly triangular, straight or deflexed. *Column* c.2.5mm long; foot 5–7mm long; anther c.1.5mm broad; pollinia c.1mm long. *Ovary* acutely triangular in cross-section; pedicel-ovary 8–12mm long. *Fruit* ellipsoid-clavate, 3 winged (from Schlechter's description).

Distribution: Micronesia, Solomon Islands (Map 8); 6 collections examined.

CAROLINE ISLANDS. Ponape: Nipit-One, ix 1940, *Hosokawa* 9589 (US); Mt Poaipoai, 1500ft, 8–9 vii 1949, *Glassman* 2482 (US); Mt Seleteneh, U District, trail ascending northwest face, through *Campnosperma-Parinarium-Myristica* forest, up to 2000ft, 6 ii 1965, *Stone* 5406 (L).

SOLOMON ISLANDS. New Georgia: *Piottite &Dickson* P1(K); *Wickison* 8 (K). Kolombangara: S. side, 5km inland from Ringgi Cove, 500m, 1 xi 1984, *Cribb & Campbell* 5108 (K).

Epiphytic in mossy forest, 200–600m.

In describing this species from Ponape (pronounced Pon : pey according to Glassman, 1952), Schlechter suggested an affinity with the New Guinean *Dendrobium lapeyrouseoides* (= *D. cyanocentrum*) from which he thought it differed in the colour and size of the flower and its lip. These differences are not clear and tend to be obscure in the herbarium material of both species which we have examined. More reliable differences may be seen in the linear-subulate leaves of *D. cyanocentrum* which also has strongly reflexed sepals and petals, rare in *D. violaceominiatum* although *Cribb & Campbell* 5108 does exhibit this character.

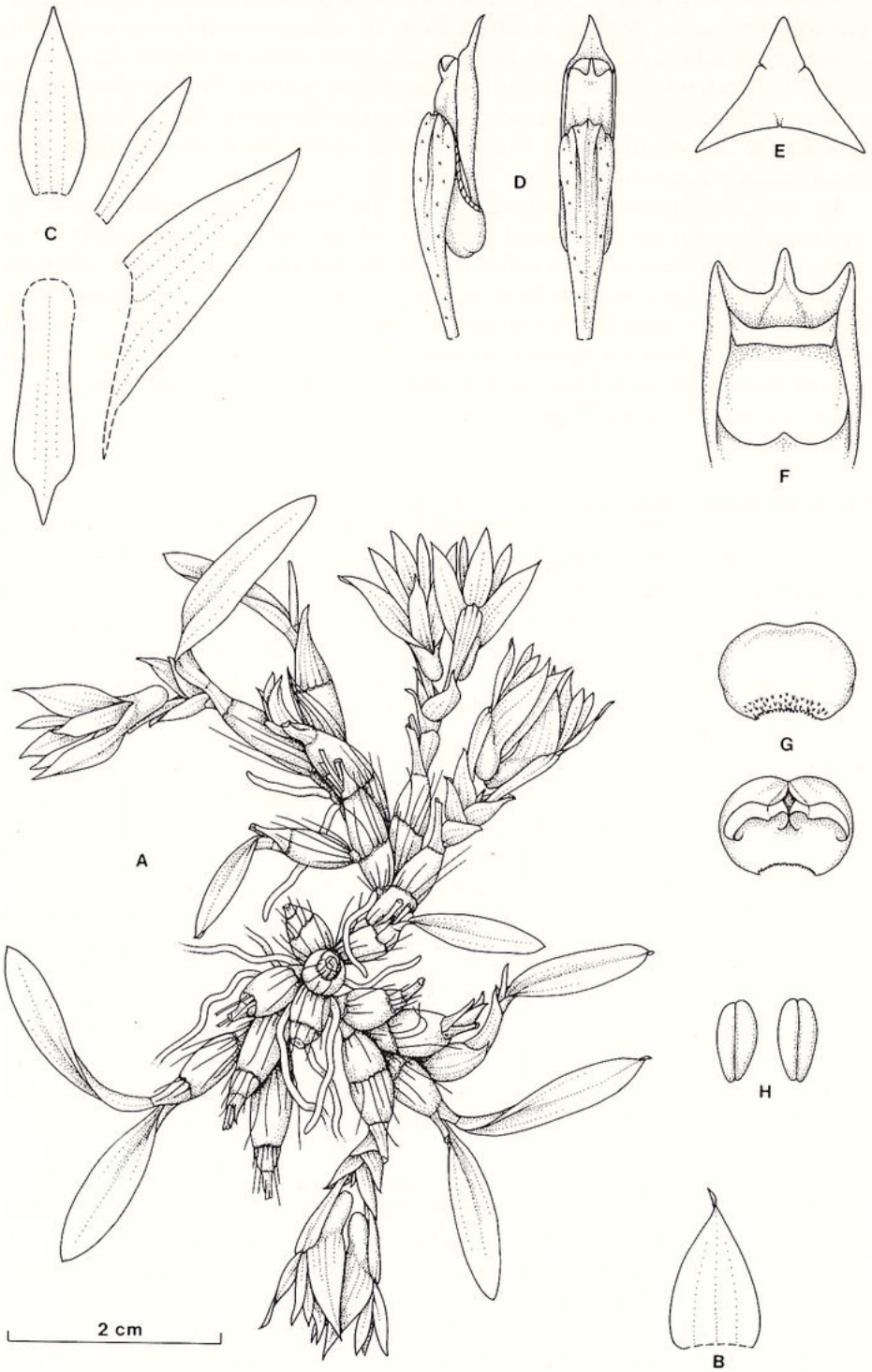


FIG. 13. *Dendrobium violaceominiatum*. A, habit; B, bract × 3; C, sepals, petal & labellum × 3; D, labellum, ovary & column × 3; E, ovary cross-section × 10; F, column tip × 10; G, anther cap × 10; H, pollinia × 10. All drawn from *Glassman* 2482.

The widely distributed *D. delicatulum* is the only other species of this section known to occur on Ponape; it differs from *D. violaceominiatum* in its creeping habit, spheroidal, spaced pseudobulbs and short ovate to elliptic leaves. The island of Ponape represents the northernmost station for members of the section, the nearest relatives occurring on the Bismarck Archipelago some 1300km to the south west. For a related taxon from Seram see Species Insufficiently Known (p. 281).

In our preliminary account (1980) we misleadingly referred to *D. violaceominiatum* as a lowland member of the section on account of its occurrence between 200 and 600m but we did not take into consideration the fact that the moss-forest habitat in which members of the section are most frequently found may develop at much lower elevations on isolated mountain peaks of much lower altitude than the main ranges, particularly when near coastal areas or on small islands. This lowering of the upper vegetational zones is known as the *Massenerhebung* effect (Richards, 1964, Whitmore, 1975). The species is not known in cultivation.

9. Dendrobium subacaule [Reinwardt ex] Lindley in J. Linn. Soc. Bot. 3: 11 (1858); Miquel in Fl. Ind. Bat. 3: 637 (1859)); Reichenbach. f. in Walp. Ann 6: 307 (1861); Kränzlin in Engler, Pflanzenr. 45: 279 (1910)—*pro parte*; Ridley in Trans. Linn. Soc. Bot. 9: 171 (1916); J. J. Smith in Bull. Jard. Bot. Buitenz, sér. 3, 11: 77–78 (1930); Reeve & Woods in The Orchadian 6: 201 (1980); Northen, Miniature Orchids 66, plate C26 (1980); Woods & Cullen in Walters et al. (eds) The European Garden Flora 2: 217 (1984). **Fig. 14; Plate 10A, B.**
Type: North Moluccas, Tidore Island, Mt Tidore, viii 1821, *Reinwardt* s.n. (holo. K; iso. L, W).

Syn.: *D. begoniicarpum* J. J. Smith in Bull. Jard. Bot. Buitenz. sér. 2, 3: 74 (1912) & Nova Guinea 12: 67, tab. 18, fig. 53 (1913). Type: West New Guinea, Cyclop Mtns, c.1500m, vi 1911, *Gjellerup* 566 (holo. BO n.v.)

D. tricostatum Schltr in Beih. Repert. Spec. Nov. Regni Veg. 1: 532 (1912) & 21: tab. 180, fig. 674 (1928)—Engl. transl. 570, 701–fig. (1982). Type: East New Guinea, West Sepik Province, Torricelli Mtns, 800m, ix 1909, *Schlechter* 20207 (B†).

D. oreocharis Schltr in Beih. Repert. Spec. Nov. Regni Veg. 1: 533 (1912) & 21 : tab. 180, fig. 675 (1928)—Engl. transl. 570, 701–fig. (1982). Type: East New Guinea, Madang Province, Ramu District, Bismarck Mtns, 2500m, xi 1908, *Schlechter* 18753 (iso. E, K, NSW). Note: The *Schlechter* 18753 sheets have been incorrectly labelled as *D. fulgens*.

D. begoniicarpum J. J. Smith var. *parviflorum* J. J. Smith in Nova Guinea 12: 68 (1913). Type: West New Guinea, Cyclop Mtns, c.1800m, ?*Gjellerup* s.n. (BO n.v.)

D. junzaingense J. J. Smith in Bot. Jahrb. 66: 197 (1934). Type: East New Guinea, Morobe Province, Finschafen District, Sattelberg up to Junzaing, c.800–1500m, 11 i 1929, *Mayr* 704 (B†).

Pedilonum tricostatum (Schltr) Brieger in Die Orchideen ed. 3, 1: 684 (1981).

P. begoniicarpum (J. J. Smith) Rauschert in Feddes Repert. 94: 457 (1983).

FIG. 14. *Dendrobium subacaule*. A, habit; B, bract × 5; C, sepals, petal & labellum × 5; D, labellum, ovary & column × 5; E, ovary cross-section × 14; F, column tip × 14; G, anther cap × 14; H, pollinia × 14; I, fruit × 5; J, leaf × 4. All drawn from *Woods* 296.

P. junzaingense (J. J. Smith) Rauschert *op. cit.* 460.
P. oreocharis (Schltr) Rauschert *op. cit.* 462.
P. subacaule (Reinw. ex Lindley) Rauschert *op. cit.* 464.
D. delicatulum sensu Schltr (non Kränzlin) in Beih. Repert. Spec. Nov. Regni Veg. 1: 532 (1912) & 21: tab. 180, fig. 673 (1928)—Engl. transl. 569, 700–fig. (1982).

Small erect to suberect tufted (occasionally creeping and mat-forming) epiphyte, 1–5cm high. *Roots* 0.4–1mm diameter. *Rhizomes* usually very short, occasionally elongated, up to 0.6cm long. *Pseudobulbs* 0.3–1.5 × 0.1–0.45cm, clavate, globose, obclavate, fusiform or cylindrical, apex 2–3(–4)-leaved. *Leaves* 0.4–2.1 × 0.1–0.5(–0.75)cm, suberect to spreading, lanceolate to elliptic, apex acute to obtuse, mucronate, green to purplish red; sheaths slightly ribbed. *Inflorescences* terminal, arising mainly from leafy stems, 1–3-flowered, subsessile; bracts ovate, apiculate to acuminate. *Flowers* 0.9–1.9cm long, widely opening, lasting c.6 months, red, purplish red, orange-red, orange or yellowish, with orange labellum. *Dorsal sepal* 3.5–7.5 × 1.5–3mm, oblong-ovate to oblong-triangular, acute to subacuminate or apiculate, ± carinate (mid-vein). *Lateral sepals* 9–18.5 × 2–4mm, oblique ovate-triangular, apiculate to acuminate, usually keeled; basal fused part 2–6mm long, cylindrical to subconical; mentum total length 6–11mm, tip obtuse or shortly bilobed. *Petals* 3–7 × 0.7–1.7mm, oblique, linear to lanceolate, acute to acuminate. *Labellum* 7.5–17 × 1.5–2.3mm, subtrilobate, linear-oblanceolate, adnate to column-foot at base, upper margins incurved, without a cross-ridge, apex cuspidate, unbent or slightly deflexed. *Column* 1.8–2.5mm long; foot 6–11mm long; anther 1–1.8mm broad; pollinia 0.5–1mm long. *Ovary* sharply 3-winged with dorsal wing often projecting up behind base of dorsal sepal; pedicel-ovary 7–18mm long. *Fruit* (immature) 6 × 3mm, narrowly oblong.

Distribution: Moluccas, New Guinea, Solomon Islands (Map 9); 48 collections examined.

MOLUCCAS. Tidore Island.

WEST NEW GUINEA. Vogelkop Peninsula, Mt Carstenz, Idenburg River, Cyclop Mtns & Orion Mtns.

EAST NEW GUINEA. West Sepik, Enga, Southern Highlands, Western Highlands, Eastern Highlands, Madang, Morobe, Central & Milne Bay Provinces.

SOLOMON ISLANDS. Guadalcanal.

Epiphyte, usually on small twigs and branches, occasionally terrestrial or lithophytic, 750–2500m.

D. subacaule was the first member of section *Oxyglossum* to be discovered when C. G. C. Reinwardt (1773–1854), the founder of the Buitenzorg, now Bogor, Botanic Gardens in Java, made a collecting expedition to the North Moluccas (now part of Indonesia) in 1821. But it was not until 1859 that J. Lindley, the English botanist and orchidologist, described the new species in a paper entitled 'Contributions to the Orchidology of India'. Descriptions were brief and concise in those times but Lindley's protologue did include the all-critical ovary cross-section and fortunately, the Reinwardt specimens are still extant and are identical to the New Guinea and Solomon Islands material which we have examined.

From the New Guinea collections this species was later described several times under different names and, although most of the type material is now lost, we have found no difficulty in assigning these names to synonymy.

The earliest New Guinea collection, from Mt Obree in the Central Province,

(*Sayer* s.n.), was deposited in the Melbourne herbarium and incorrectly identified there as *D. puniceum* Ridley by F. von Mueller. This may have led Kränzlin (1910) to include *D. puniceum* in synonymy with *D. subacaule*, which union was warmly and correctly disputed by Schlechter (1912). Much of the early confusion, and especially the indiscriminate lumping by Kränzlin, was due to the fact that little attention was given to the shape of the ovary cross-section and too much emphasis placed on minor features such as colour.

Of the subsequent botanists who worked on the New Guinea flora at the beginning of the century, only Ridley (1916) recognized that New Guinea specimens (*Kloss* s.n.) were identical to *D. subacaule* from the Moluccas. J. J. Smith, who was a fairly careful descriptive botanist, published a fuller description of *D. subacaule* in 1930 based on fresh collections from Tidore Island in the Moluccas (*Lam* 3732). His final comment was 'This little plant has been confounded with some Papuan species; therefore I give a full description . . .' Perhaps this reveals something of J. J. Smith's thoughts on the distribution of New Guinea species, or his rather narrow species concept.

D. subacaule is one of the smallest species in the section and is readily recognized by its short lanceolate to elliptic leaves and its red or orange flowers which have a sharply 3-winged ovary. It usually grows in small tufts, sometimes seen in large numbers, but a few collections from SE New Guinea exhibit a more distinct creeping and mat-forming habit (e.g. *Cruttwell* 843 from the Milne Bay Province). This species has sometimes been confused with *D. delicatulum* but the latter can always be distinguished by its 5-ribbed ovary. The other close ally, *D. pachythrix*, also differs by its 5-ribbed ovary which, with the sepals, has an indumentum of short thick hairs.

Very little variation is observed in the widespread populations of *D. subacaule* except in colour and, to a certain extent, size. *Cruttwell* 382, also from the Milne Bay Province, is a much bigger plant in all respects and it would be interesting to investigate the chromosome count in this population to see if polyploidy accounts for these larger plants.

In cultivation *D. subacaule* seems fairly difficult to grow and requires very good aeration and drainage. At Laiagam, Papua New Guinea, it grows well only at the top of posts 2 metres above the ground. In nature it is commonly seen on small twigs and branches where it presents a striking sight. In habitats exposed to the sun the flowers are brilliantly coloured and this led to Cruttwell (1977) preparing an article for the *Orchid Digest* entitled 'Twigs Aflame'; a colour illustration appeared there under the synonym *D. tricostatum*.

For a few years from 1963 plants of *Woods* 296 were grown very successfully at Edinburgh and for a shorter time at Kew.

D. subacaule has only been reintroduced to glasshouse cultivation in recent years and some notes, together with a colour plate, are to be found in R. Northen's (1980) book 'Miniature Orchids'.

10. Dendrobium pachythrix T. M. Reeve & P. Woods, **sp. nov.**

Fig. 15; Plate 10C.

D. subacauli Lindley affinis sed differt ovario quinquecostato et ovario et sepalis extra pilis crassis brevibus indutis.

Type: East New Guinea, Enga Province, Kompiam District, Koipapalu Range near Yengis, c.1500m, iii 1981, *Daniels* in herb Reeve 552 (holo. LAE; iso. E, K).

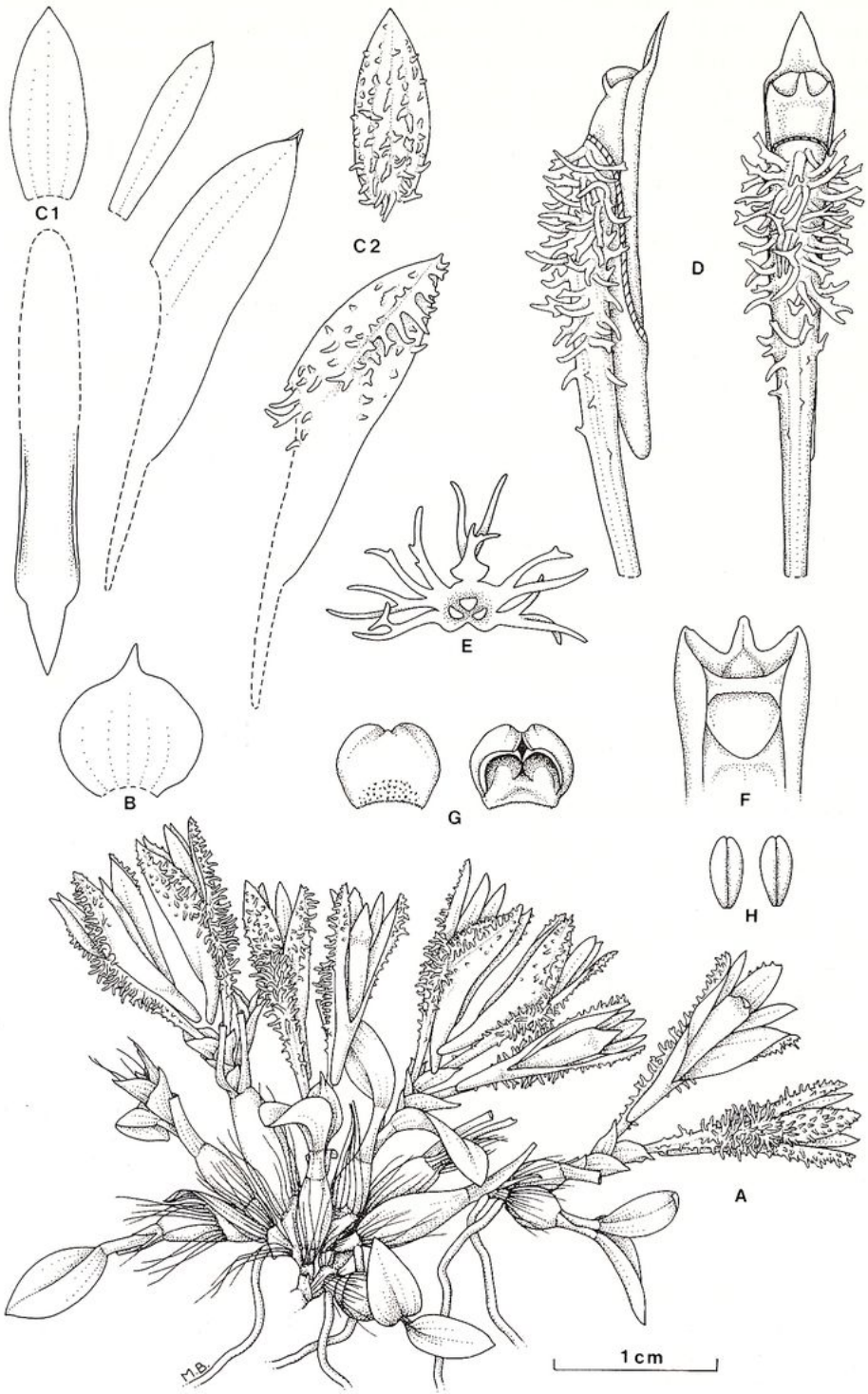


FIG. 15. *Dendrobium pachythrix*. A, habit; B, bract × 5; C, sepals, petal & labellum × 5; D, labellum, ovary & column × 5; E, ovary cross-section × 10; F, column tip × 10; G, anther cap × 10; H, pollinia × 10. All drawn from *Reeve* 552.

Small erect to suberect epiphyte, 1–3cm high. *Roots* c.0.5mm diameter. *Rhizomes* up to 3mm long. *Pseudobulbs* 0.4–1.2 × 0.2–0.4cm, globose to fusiform, reddish, apex (1–)2-leaved. *Leaves* 0.5–1.2 × 0.15–0.4cm, erect to spreading, ovate to lanceolate, apex mucronate, green to purplish green on top, purplish underneath; sheaths smooth, ± membranous, with age becoming fibrous. *Inflorescences* terminal, arising mainly from leafy stems, 2–3-flowered, subsessile; bracts suborbicular, apiculate to acuminate. *Flowers* 1.1–1.7cm long, long lasting, red with orange labellum tipped pale red. *Dorsal sepal* 4–7 × 1.5–2.2mm, oblong-ovate to oblong-elliptic, subacute to acute, outer side covered with thick hairs which are shorter towards the apex. *Lateral sepals* 11–16 × 2.5–3.5mm, oblique, oblong-elliptic, acute to apiculate, outer side of free part covered with thick hairs (shorter ones ± papillose), hairs longest along the mid-vein; basal fused part 3–6mm long, narrowly cylindrical; mentum total length 6.5–9.5mm, tip obtuse or shortly bilobed. *Petals* 4–6.5 × 0.07–1mm, linear to oblanceolate, acute. *Labellum* 10–14 × 1.5–2mm, subtrilobate, linear-oblanceolate, adnate to column-foot at base, upper margins incurved, apex narrowly triangular, unbent or slightly deflexed. *Column* 1.5–2mm long; foot 6.5–9.5mm long; anther c.1.5mm broad; pollinia c.0.8mm long. *Ovary* 5-ribbed, covered with short thick hairs which are simple to 2–3-armed, hairs shorter and sparser on pedicel; pedicel-ovary 9–16mm long. *Fruit* not observed.
Distribution: New Guinea (Map 10); 2 collections examined.
EAST NEW GUINEA. Enga Province: Kompiam District, c.1500m, iii 1981 *Daniels* in herb. Reeve 552 (E, K, LAE). Western Highlands Province: Baiyer River Subdistrict, Trauna-Jimi ridge, 1700m, 5 vii 1981, *Gunther* 4/81 (E, LAE).
Epiphyte or terrestrial (on road cutting), 1500–1700m.

This recently discovered species is most closely allied to *D. subacaule* which it resembles in habit and flower colour. It is distinguished by the 5-ribbed ovary (not sharply 3-winged) and the indumentum of short thick hairs on the ovary and the outside of the sepals. The thick hairs, from which the Greek epithet *pachythrix* is derived, are simple to 2–3-armed in the type and are up to 1.5mm long. The smallest of them are found towards the apices of the sepals and lower down on the pedicel and could be classified as papillae.

There are only two other members of section *Oxyglossum* with an indumentum on the ovary, *D. masarangense* subsp. *theionanthum* var. *chlorinum* and the variable *D. cuthbertsonii*, but neither has hairy sepals.

D. pachythrix was discovered in 1981 in two separate localities 50km apart by different officers of the Department of Primary Industry in Papua New Guinea. Mr Peter Daniels (from Siassi Island), formerly part-time officer at the Highland Orchid Collection, Laiagam, had the honour of discovering it first in the remote Yengis area in the NE part of the Enga Province. A single plant was collected and then established in cultivation at Laiagam. Over a period of two years parts of this small plant were harvested to provide adequate type material, once again highlighting the importance of living collections in studying the Orchidaceae.

The second discovery was made by Mr Martin Gunther, Agronomist-in-Charge at the Kuk Agricultural Research Station near Mount Hagen. The plants were growing terrestrially on a road cutting between Baiyer River and the lower Jimi valley to the north of Mt Hagen in the Western Highlands Province.

From limited experience it seems that the requirements for the cultivation of

D. pachythrix are similar to those for the other small tufted species in the section. At Laiagam the type plant thrives on a *Nothofagus* post at 3 metres above ground-level.

11. Dendrobium rupestre J. J. Smith in Bull. Jard. Bot. Buitenz. sér. 2, 2: 15 (1911) & Nova Guinea 12: 64, tab. 17, fig. 52 (1913) & 12: 334 (1916); P. van Royen, The Alpine Flora of New Guinea 2: 412–415 (*pro parte*), fig. 143 (1979); Reeve & Woods in The Orchadian 6: 201, 205 (1980); Reeve in Aust. Orchid Rev. 46(2): 107–colour pl. (1981). **Fig. 16, Plate 10D.**
Lectotype (designated by P. van Royen, 1979): West New Guinea, Mt Goliath, 2000m, iv 1911, *de Kock* 166 (BO n.v.).

Small creeping, occasionally tufted, epiphytic, lithophytic or terrestrial plant, to 6cm high, sometimes forming large mats. *Roots* to 1.5mm diameter, tips usually orange. *Rhizomes* prostrate, branched, to 1.7cm long. *Pseudobulbs* 0.5–2.5 × 0.3–0.7cm, very variable in shape from shortly globose or ovoid to cylindrical, apex 1–2-leaved. *Leaves* 0.7–4.5 × 0.3–1.4cm, elliptic to lanceolate, apex acute-mucronate, ± minutely pitted on top, green, usually purplish underneath; sheaths smooth or slightly ribbed, ± persistent. *Inflorescences* terminal, 1–3-flowered, subsessile; bracts ovate, acute to apiculate. *Flowers* 1.8–3.3cm long, usually widely opening up to 3.2cm broad, long lasting, bright purple with labellum apex orange (rarely pale purple or greenish yellow). *Dorsal sepal* 8.5–15 × 3–5.5mm, ovate-elliptic to ovate-oblong, acute-mucronate to subacuminate. *Lateral sepals* 17–30 × 4–7.5mm, obliquely ovate-oblong, acute to subacuminate, keeled; basal fused part 3–6mm long, subconical; mentum total length 9–16mm long, tip obtuse or bilobed. *Petals* 8–14 × 2.5–4.5mm, lanceolate-spathulate, acute to apiculate. *Labellum* 16–25 × 3–4mm, subtrilobate, oblanceolate, adnate to column-foot at base, apical margins incurved, apex narrowly-triangular to acuminate, not recurved. *Column* c.3mm long; foot 9–16mm long; anther c.2.5mm broad; pollinia c.1.5mm long. *Ovary* distinctly 3-winged; pedicel-ovary 14–28mm long. *Fruit* 18 × 9.5mm, ovoid.
Distribution: New Guinea (Map 10); 13 collections examined.
WEST NEW GUINEA. Treub Mts south of Mt Wilhelmina & Mt Goliath.
EAST NEW GUINEA. Western, Southern Highlands, Enga, Western Highlands, Chimbu, Morobe & Northern Provinces.
Epiphyte in montane forests, particularly on *Nothofagus*, occasionally terrestrial or lithophytic, 1500–3100m.

Although not a common species, *D. rupestre* does have a fairly wide distribution in New Guinea. Usually it is seen as an epiphyte in *Nothofagus* forests where it may form large mats, but in suitably exposed habitats it may grow terrestrially or as a lithophyte in association with mosses. Terrestrial forms have larger roots as illustrated in Fig. 16. This specimen (*Johntari & Reeve* R. 1127) was collected on a steep road cutting, a habitat quite frequently colonised by orchids.

The first recording of *D. rupestre* was from West New Guinea, on Mt Goliath at 2800m (*de Kock* II & 166), and the correct altitude was published with the original description (J. J. Smith, 1911). However the subsequent lengthier description given by J. J. Smith (1913) stated the altitude incorrectly as 3800m. This error, which was probably typographic, has been copied by subsequent authors, but it is clearly an impossibility as the summit of Mt Goliath is only 3340m!

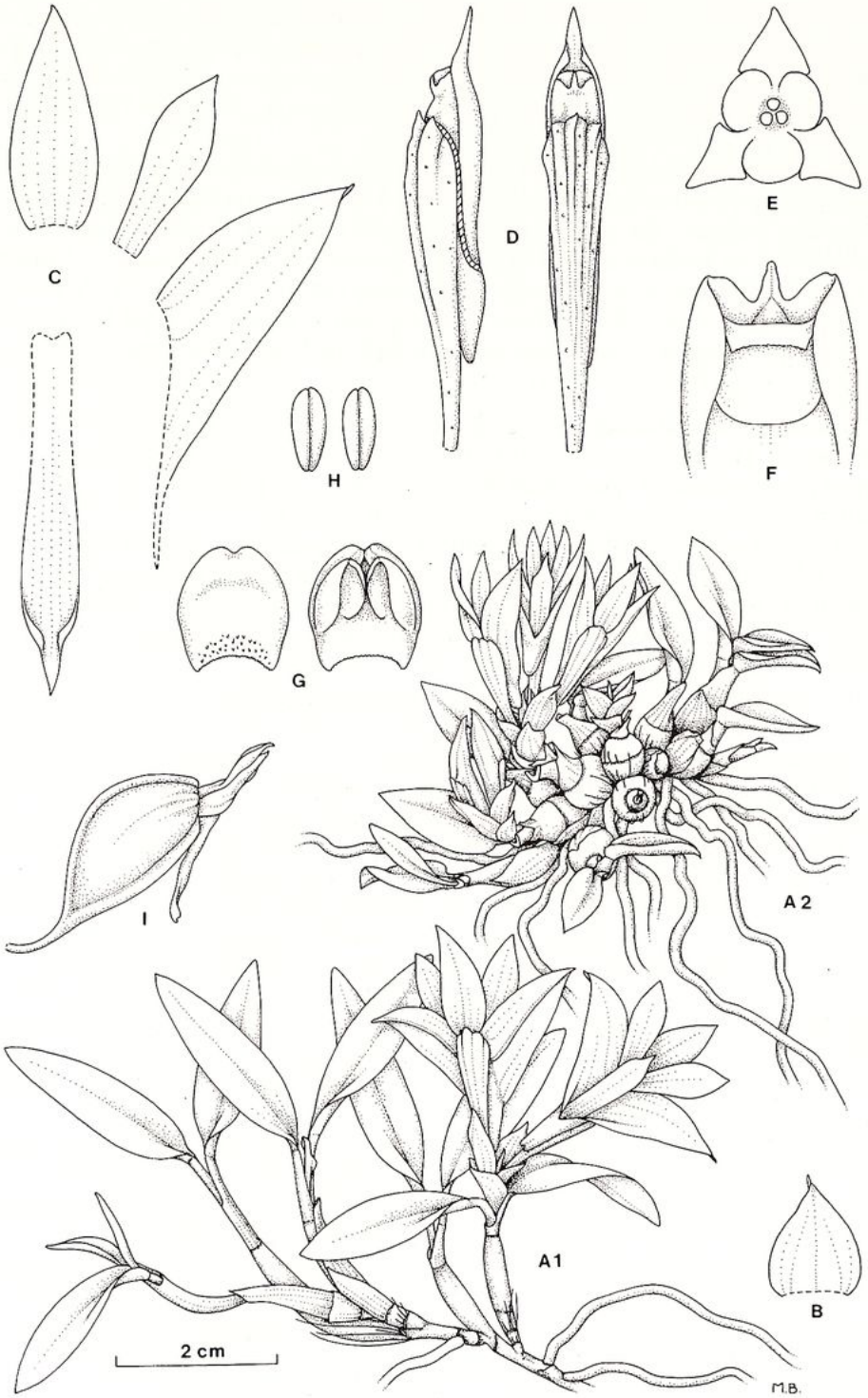


FIG. 16. *Dendrobium rupestre*. A1 and A2, habit; B, bract × 2; C, sepals, petal & labellum × 2; D, labellum, ovary & column × 2; E, ovary cross-section × 6; F, column tip × 6; G, anther cap × 6; H, pollinia × 6; I, fruit × 1.3. A1 drawn from *Reeve* 83; A2 from *Reeve* 1127; B–H from *Reeve* 466; I from *Carr* 10555.

D. rupestre does however grow at up to 3100m so was properly included as an alpine species by van Royen (1979). His illustration of *Sayers* NGF 21211 in fig. 143 is correct, but the description is based on more than one species including different varieties of *D. vexillarius* (*Kloss* s.n., *Kalkman* 5186, *Brass* 9434).

This species has proved to be very difficult to cultivate and prefers to grow amongst live mosses in what appears to be a very delicate moisture-humidity-drainage balance. Its widely opening bright magenta flowers with orange labellum apex make it one of the most attractive species in the section. Martin Gunther (pers. comm.) reports paler flowered forms from the Western Highlands Province, Papua New Guinea, and a single plant of a greenish yellow form has been collected in the Southern Highlands Province (*Reeve* 1136).

12. Dendrobium putnamii Hawkes & Heller in Lloydia 20: 122 (1957); Reeve & Woods in The Orchadian 6: 201 (1980). **Fig. 17; Plate 11A.**

Neotype (designated here): East New Guinea, Enga Province, Meriamanda, Wabag, 2700m, *Reeve* 299 (neo. E; isoneo. K, LAE).

Syn.: *D. coerulescens* Schltr in Beih. Repert. Spec. Nov. Regni Veg. 1: 531 (1912) & 21: t. 179, fig. 671 (1928) non Wallich ex Lindley (1838)—Engl. transl. 568, 700–fig. (1982). Type: East New Guinea, West Sepik Province, Torricelli Mountains, c.800m, ix 1909, *Schlechter* 20151 (B†).

Pedilonum putnamii (Hawkes & Heller) Rauschert in Feddes Repert. 94: 462 (1983).

Small creeping or tufted (if exposed) epiphyte, 1–3cm high, usually forming a loose mat. *Roots* c.0.5mm in diameter. *Rhizomes* usually distinct, to 1.5cm long. *Pseudobulbs* 0.2–1 × 0.15–0.4cm, 2–3-noded, crowded or more commonly to 1.5cm apart, set obliquely or erect on rhizome, fusiform, ovoid or spherical, sometimes slightly curved, with 1–3 (usually 2) terminal leaves. *Leaves* 0.25–1.2(–1.8) × 0.1–0.25cm, spreading to suberect, lanceolate to linear, usually curved, green to purplish red, sometimes somewhat punctate apex mucronate, attenuated near base; sheaths membranous. *Inflorescences* terminal, 1(–2)-flowered, subsessile, produced infrequently; bracts c.4mm long, ovate, membranous, apex apiculate to acuminate. *Flowers* 1.1–1.5cm long, lasting several months, pale blue, sometimes tinged violet and apices of sepals tinged orange; labellum pale blue, apex orange to orange-red. *Dorsal sepal* 4.5–7.5 × 2mm, lanceolate, apiculate to shortly acuminate. *Lateral sepals* 9–14 × 2.5mm, obliquely lanceolate, apiculate to acuminate; basal fused part c.2.5mm long, cylindrical to subconical; mentum total length 6.5–8mm, tip obtuse. *Petals* 4–7.25 × 1.25–2mm, narrowly oblanceolate, acute to acuminate. *Labellum* 7.5–11.5 × 1.5mm, simple to indistinctly trilobulate, linear, adnate to column foot at base, apical part free, margins incurved embracing column, cross-ridge absent, apex triangular acute, straight or slightly deflexed. *Column* dark blue, 2mm long; foot 6.5–8mm long; anther 1.5mm broad, pollinia 1.2mm long. *Ovary* triangular in cross-section; pedicel-ovary 7–10mm long. *Fruit* not observed.

Distribution: New Guinea (Map 10); 3 collections examined.

EAST NEW GUINEA. West Sepik Province: Torricelli Mts, c.800m, ix 1909, *Schlechter* 20151 (B†). Enga Province, Wabag District, Meriamanda, 2700m, xi 1978, *Reeve* 299 (E, K, LAE); also observed at Sirunki, Laiagam, 3000m, *Reeve* (no specimens). Western Highlands Province: Mt

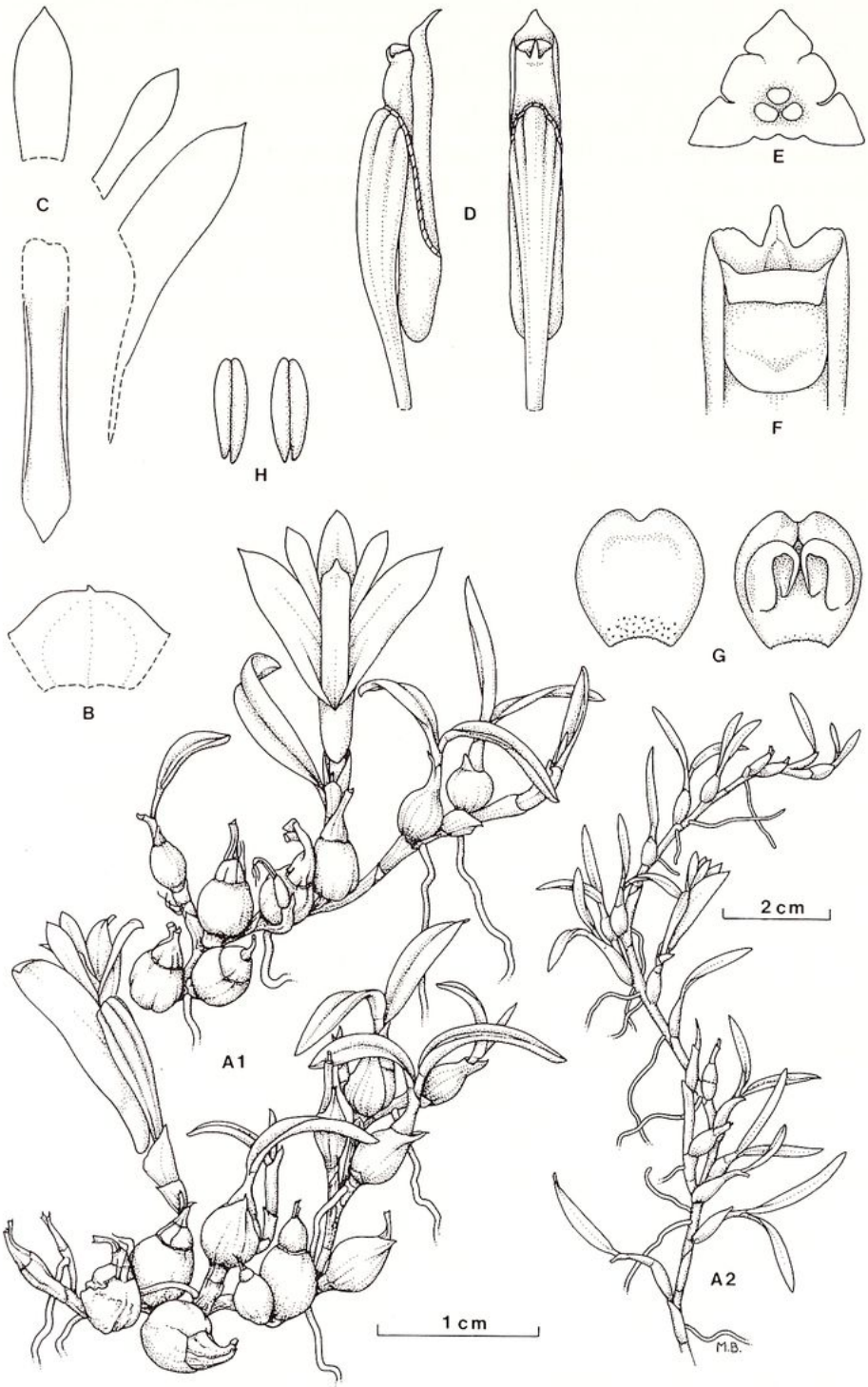


FIG. 17. *Dendrobium putnamii*. A1 & A2, habit; B, bract × 3; C, sepals, petal & labellum × 3; D, labellum, ovary & column × 3; E, ovary cross-section × 10; F, column tip × 10; G, anther cap × 10; H, pollinia × 10. A1 drawn from *Reeve* 299, RBGE 82.0995; A2 from *Miller & Garay* NGF 18694, B–H from *Reeve* 628, RBGE 82.0996;.

Hagen District, Kundip, 2100m, ix 1963, *Miller & Garay* NGF 18694 (LAE). Eastern Highlands Province: Lufa District, Mt Michael, 2500m, xii 1978, cultivated Laiagam vii 1983, *Reeve* 628 (E, LAE).

Epiphyte forming large mats on trunks and side branches of trees, 800–3000m.

Schlechter found this species once only and his single specimen had been collected with a solitary flower. Despite careful searching he never found it again and assumed it to be rare. This still seems to be the case as indicated by the few collections cited, all of which bear few flowers. The species seems to have a distinct distribution between the Torricelli Mts on the northwest coast of Papua New Guinea and the Eastern and Western Highlands and Enga Provinces. The low altitude of c.800m recorded for Schlechter's collection seems odd as recent collections have all been from 2000m and above. Assuming that this is a plant of cooler altitudes one might guess that Schlechter's collection may have been from a cold air pocket in its station in the Torricellis, another example of the Massenerhebung effect (see p. 212).

Reeve has observed that this species forms large mats on the branches of trees and that shade-grown plants usually have more widely-spaced pseudobulbs and longer leaves than those in open exposures. The flowers are a beautiful pale blue sometimes tinged violet, the lip apex is orange-red as are occcasionally the tips of the sepals. Schlechter describes the extreme tip of the labellum as pale blue. In its creeping habit *D. putnamii* is not unlike *D. delicatulum* but differs in its narrower, linear-lanceolate not ovate leaves and in its triangular ovary.

Charles S. Putnam, after whom Hawkes & Heller renamed this species, was for a number of years editor of the *Bulletin of the Hawaii Orchid Society;* he had no connections with New Guinea.

In cultivation this species is easy to grow but it is as tardy in producing flowers as it is in nature. Despite this the dainty little blue flowers are rewarding; perhaps experimentation with growing conditions might stimulate increased flowering.

We are grateful to Mr E. Henty, Lae, who made available the drawing by B. D. Kannar of *Millar & Garay* 18694 on which our figure 17A2 is based.

13. Dendrobium delicatulum Kränzlin in Bot. Jahrb. 16: 17 (1892); Reeve & Woods in The Orchadian 7: 18–21, 19–fig. (1981) non F. v. Mueller & Kränzlin (1894); Fosberg *et al.* in Micronesica 20: 118 (1987). **Fig. 18; Plate 11 B-D.**

Small creeping mat-forming epiphyte, to 4.5cm high. *Roots* 0.3–0.5(–1)mm diameter. *Rhizomes* 0.2–1.3 × c.0.1cm, prostrate, branched. *Pseudobulbs* 0.2–1.5 × 0.2–0.9cm, globose, ellipsoid or ovoid (occasionally obovoid), often obliquely placed on rhizome, dark reddish or greenish yellow, apex 2-leaved. *Leaves* 0.3–1.5(–2.0) × 0.2–0.8cm, spreading, ovate to elliptic, apex acute-mucronate to apiculate, green, ± purplish underneath; sheaths smooth, membranous, pale green sometimes flushed red. *Inflorescence* terminal, arising from both leafless and leafy stems (from between the leaves), 1–3-flowered (commonly 2-flowered); bracts ovate; apiculate to acuminate. *Flowers* 0.7–1.5cm long, mostly widely opening, sometimes cleistogamous; red, pink-purple, violet, blue or whitish yellow, labellum apex usually orange to orange-red (except in subsp. *huliorum*). *Dorsal sepal* 3–8 × 1.5–2.5mm, ovate-oblong to oblong-lanceolate, acute to acuminate. *Lateral sepals* 7–14 × 2–3mm, oblique ovate-elliptic, carinate, apiculate to acuminate; basal fused part 1–2.5mm long,

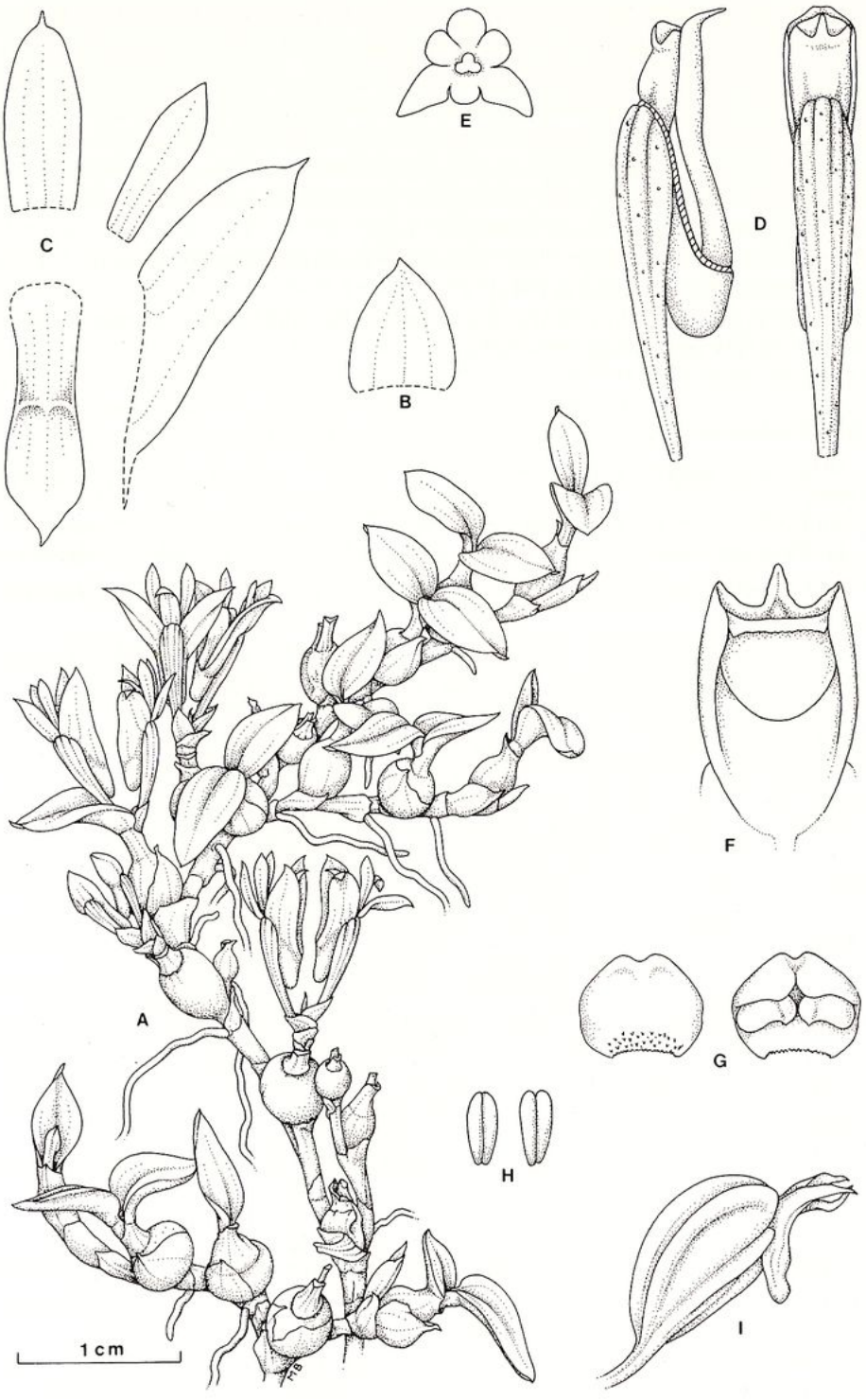


FIG. 18. *Dendrobium delicatulum* subsp. *delicatulum*. A, habit; B, bract × 6; C, sepals, petal & labellum × 6; D, labellum, ovary & column × 6; E, ovary cross-section × 14; F, column tip × 14; G, anther cap × 14; H, pollinia × 14; I, fruit × 3. All drawn from *Reeve* 297, RBGE 82.0997.

cylindrical occasionally subconical, usually somewhat swollen and large in proportion to the rest of the flower; mentum total length 4–7.5mm, tip obtuse. *Petals* 3–7 × 1–2mm, oblong-lanceolate, subacute to apiculate. *Labellum* 5.5–12 × 1–2mm, subtrilobate, linear-oblanceolate, adnate to column foot at base, free part usually with small central cross-ridge, apex acute to acuminate, usually reflexed. *Column* 2–3mm long; foot 4–7.5mm long; anther 1mm broad; pollinia c.0.5mm long. *Ovary* distinctly 5-ribbed or 5-winged; pedicel-ovary 5–11mm long. *Fruit* 8.5 × 4.5mm, ovoid.

Distribution: Sulawesi, New Guinea, Bougainville, Solomon Islands, Micronesia, Fiji, Vanuatu. (Map 11).

Epiphyte, growing both on tree trunks as well as smaller branches in montane forest, rarely terrestrial, 600–2650m.

KEY TO SUBSPECIES

1. Flowers whitish yellow ..... **13c.** subsp. **huliorum**
\+ Flowers red, pinkish purple, violet or blue 2
2. Flowers less than 1.2cm long ..... **13a.** subsp. **delicatulum**
\+ Flowers more than 1.2cm long ..... **13b.** subsp. **parvulum**

13a. subsp. **delicatulum.** **Fig. 18; Plate 11 C &D.**

Type: East New Guinea, Madang Province, Saidor District, Finisterre Mountains, 1700m, 13 x 1888, *Hellwig* 303 (B†). Neotype (designated by T. M. Reeve & P. Woods, 1981): East New Guinea, Madang Province, Ramu District, Simbai, 1500m, 3 v 1967, *Millar* NGF 22862 (LAE, iso. K).

Syn.: *D. minutum* Schltr in Beih. Repert. Spec. Nov. Regni Veg. 1: 531 (1912) & 21: tab. 180, fig. 672 (1928)—Engl. transl. 569, 700–fig. (1982). Type: East New Guinea, Madang Province, Bismarck Mountains, 2500m, 14 xi 1908, *Schlechter* 18754 (iso. AMES, BO, E, K, L, NSW). *Note*: *Schlechter* 18754 sheets sometimes have other incorrect names on them such as '*D. altigenum*' or '*D. gemma*'.

D. nanarauticola Fukuyama in Bot. Mag. Tokyo 51: 900, fig. 1 (1937); Williams in Bot. Mus. Leafl. Harvard 7: 141–142 (1939); Hosokawa in Trans. Nat. Hist. Soc. Formosa 33: 118 (1943); Glassman in Flora of Ponape, Bernice P. Bishop Mus. Bull. 209: 117 (1952). Type: Micronesia, Caroline Islands, Ponape Island, Mt Nanaraut, 680m, 23 viii 1933, *Hosokawa* 6003 (holo. TAI n.v.).

Pedilonum delicatulum (Kränzlin) Rauschert in Feddes Repert. 94: 459 (1983).

P. minutum (Schltr) Rauschert *op. cit.* 461.

Subsp. *delicatulum* is recognized by its smaller (7–12mm long) red, purplish pink, violet or blue flowers. Plants are up to 3cm high with pseudobulbs 2–7 × 2–7mm, usually dark reddish in colour.

Distribution: New Guinea, Bougainville, Solomon Islands (Kolombangara), Caroline Islands (Ponape), Fiji (Viti Levu); Vanuatu (Santo). (Map 11); 30 collections examined.

600–2650m.

This subspecies has a very wide distribution. It occurs throughout New

Guinea including the adjacent island of Japen in West New Guinea (*Cheeseman* 1336) and Karkar in East New Guinea (*Ridsdale* NGF 36702). It is also recorded from Bougainville, from Kolombangara in the Solomon Islands (*Craven & Schodde* C.149), from Santo, Vanuatu (*Cribbs & Wheatley* 109) and has been collected several times on the island of Ponape in the Caroline Islands some 1500km north of Bougainville.

We are grateful to Miss Lewis and Dr Cribb for drawing our attention to an herbarium specimen which we had overlooked at Kew: *Horne* 739 'not common, small species among moss on trees near the sea at Na Vesi, near Suva, Viti Levu, Fiji. June 1878'. Miss Lewis has determined this as *Dendrobium* cf. *delicatulum* and one of us (PW) has seen the sheet which is possibly adequate for confirmation of the specimen's identity as *D. delicatulum*. However as there are no flowers on the specimen, a positive identification of this as the first record of this species for Fiji must await further collection.

The Ponape specimens have been known under the name *D. nanarauticola* Fukuyama, but the flowers are identical with the New Guinea material. The leaves on the three Ponape collections examined are consistently elliptic whereas the New Guinea specimens have leaves varying from ovate to elliptic. However, we do not think this difference warrants any taxonomic recognition. The colour of the flowers of *D. delicatulum* from Ponape are purplish pink (rose).

In our earlier paper on this species (Reeve & Woods, 1981) some observations were made regarding the distribution of the colour forms of subsp. *delicatulum*. As well as being common in East New Guinea, further evidence has shown that the purple-flowered form also occurs in West New Guinea (*Brass* 11311 & 11593). So far the blue colour form has only been recorded west of Laiagam (143°30'E).

Subsp. *delicatulum*, particularly the blue form, is very attractive and it is a magnificent sight to see the trunk of a tree covered up to 1m across with this orchid in full flower. In New Guinea flowering is non-seasonal but October to April appears to be the peak period. The flowers last 3–4 months at the Highland Orchid Collection, Laiagam. Plants are difficult to establish unless a reasonably large piece is collected: once established it is hardy and vigorous.

13b. subsp. **parvulum** (Rolfe) T. M. Reeve & P. Woods in The Orchadian 7: 20 (1981).

Syn.: *D. parvulum* Rolfe in Kew Bull. 127 (1899); Schltr in Repert. Spec. Nov. Regni Veg. 10: 78 (1911) & 21: 150 (1925). Type: N E Celebes, Minahassa Province, Mt Klabat, 19 i 1895, *Koorders* 29565 B (holo. K).

Sarcopodium parvulum (Rolfe) Kränzlin in Engl. Pflanzenr. 45: 322 (1910).

Katherinea parvula (Rolfe) A. D. Hawkes in Lloydia 19: 96 (1956).

Subsp. *parvulum* is recognized by its larger flowers, 12–15mm long.

Distribution: Sulawesi, New Guinea (Map 11); 3 collections examined.

SULAWESI. Minahassa Peninsula, Mt Klabat, *Koorders* 29565B (K); Mt Masarang, *Schlechter* 20471 (AMES, L, NSW).

WEST NEW GUINEA. Waigeo Island, *Cheeseman* 1158 (BM).

900–1200m.

The plants of subsp. *parvulum* are identical with those of the typical

subspecies except for the flowers which, paradoxically, are significantly larger in the above-listed collections. The flowers are violet-pink and the labellum apex is bright orange-red. It may well be that the differences are not great enough to keep this subspecies separate but we will have to wait until further specimens are available in order to make a proper judgement.

Only a single *Oxyglossum* species (*D. subacaule*) has so far been discovered in the North Moluccas, but *D. delicatulum* subsp. *parvulum* is also likely to be found there since it occurs both to the east and to the west of the group.

13c. subsp. **huliorum** T. M. Reeve & P. Woods in The Orchadian 7: 21 (1981). Type: East New Guinea, Southern Highlands Province, Tari District, Tani, 1700m, vii 1980, *Reeve* 306 (holo. LAE; iso. AMES, CBG, E, K, L, NSW, UPNG). **Plate 11B.**

Subsp. *huliorum* differs from the typical subspecies in the following respects. It is often a larger plant up to 4.5cm high; *pseudobulbs* 5–15 × 2–9mm, greenish yellow to yellow; *leaves* green on both sides; *flowers* 7–10mm long, uniformly whitish yellow with yellow or purplish red anthers, not widely opening and usually self-pollinating, sometimes cleistogamous.

Distribution: New Guinea (Map 11); 7 collections examined.

EAST NEW GUINEA. Southern Highlands, Enga, Western Highlands, Chimbu and Eastern Highlands Provinces.

1400–1800m.

Subsp. *huliorum* is usually self-pollinating, a character not commonly found in any other *Oxyglossum* species, and in nature plants may often be seen covered with small 5-winged fruits. However, despite such prolific fruit-setting this subspecies is not common except in parts of the Tari District (the type locality). The epithet commemorates the Huli clan of Melanesians who live in this area.

The flowers of this subspecies are small, pale and rarely opening, so it is probably the least desirable member of the section. An attractive display can be achieved by growing different forms of *D. delicatulum* mixed together on a large slab, and for such purposes subsp. *huliorum* may find a place in cultivation. Even when not in flower the larger yellowish pseudobulbs of this subspecies conrast favourably with the smaller, reddish stems of subsp. *delicatulum*.

14. Dendrobium puniceum Ridley in Journ. Bot. 24: 324 (1886); Schlechter in Beih. Repert. Spec. Nov. Regni Veg. 1: 535 (1912) and 21: tab. 181, fig. 678 (1928)—Engl. trans. 571, 702–fig. (1982); Reeve & Woods in The Orchadian 6: 203 (1980). **Fig. 19. Plate 12A.**

Syntypes: East New Guinea, Mt Wari Wari, c.1525m, *H. O. Forbes* 425 (BM); Mt Korkoko, *H. O. Forbes* 598 (BM).

Syn.: *D. cerasinum* Ridley l. c.; Kränzlin in Pflanzenreich 45: 279 (1910). Type: East New Guinea, Mt Gawada, *H. O. Forbes* 517 (holo. BM).

D. scarlatinum Schltr in Beih. Repert. Spec. Nov. Regni Veg. 1: 535 (1912) and 21: tab. 181, fig. 679 (1928)—Engl. transl. 571, 702–fig. (1982). Type: East New Guinea, Finisterre Mts, c.1100m, *Schlechter* 17966 (iso. BO, E, K, L).

D. discrepans J. J. Smith in Feddes Repert. 12: 120 (1913) and Nova Guinea 12: 334, tab. 120, fig. 220 (1916). Type: West New Guinea, Gautier Mountains, 900m, *Gjellerup* 870 (holo. BO n.v.).

D. lateriflorum Ridley in Trans. Linn. Soc. Bot. Ser. 2, 9: 172 (1916). Type: West New Guinea, Mt Carstenz, Camp VIb, c. 1190m, *Kloss* (holo. BM).

D. adolphi Schltr in Repert. Spec. Nov. Regni Veg. 17: 373 (1921). Type: East New Guinea, inland from Angriffshafen [Vanimo Harbour] *Kempter* (holo. B†).

Pedilonum puniceum (Ridley) Brieger in Schltr, Die Orchideen ed. 3, 1 (11/12): 684 (1981).

P. adolphi (Schltr) Rauschert in Feddes Repert. 94: 457 (1983).

P. cerasinum (Ridley) Rauschert *op. cit.* 458.

P. discrepans (J. J. Smith) Rauschert *op. cit.* 459.

P. lateriflorum (Ridley) Rauschert *op. cit.* 460.

P. scarlatinum (Schltr) Rauschert *op. cit.* 463.

Dendrobium subacaule sensu Kränzlin in Engler, Pflanzenr. 45: 279 (1910)–pro parte non Lindley.

Erect to suberect tufted epiphyte 2–8cm high. *Roots* to 1.5mm diameter. *Rhizomes* usually very short, occasionally elongated to 5mm. *Pseudobulbs* 0.3–2.2 × 0.2–0.7cm, cylindrical, narrowly conical or obclavate, apex 1–2(–3)-leaved. *Leaves* 1.0–5.4 × 0.25–1cm, linear, oblong, lanceolate or narrowly elliptic, subacute to obtuse, mucronate; sheaths slightly ribbed, with age becoming fibrous. *Inflorescences* terminal arising from both leafy and leafless stems, subsessile, commonly 2-flowered; bracts 4–10mm, ovate-apiculate. *Flowers* 1.3– 2.2cm, not or sometimes widely spreading to c.1.8cm wide, sometimes cleistogamous, purplish red, blood red or orange-red, labellum orange to yellow, apex sometimes tipped red. *Dorsal sepal* 5–9 × 2.5–3mm, ovate-lanceolate, acute, ± mucronate, distinctly keeled. *Lateral sepals* 13–21 × 3–4.5mm, obliquely triangular or lanceolate, acute to subacuminate, distinctly keeled; basal fused part 2–3mm, conical to subconical usually distinctly contracted, tip obtuse; mentum total length 8–12mm. *Petals* 4.5–8.5 × 1–2mm, linear to linear-spathulate, widest at upper $\frac{1}{3}$, acute. *Labellum* 10–18 × 2–2.5mm, linear to narrowly lanceolate, adnate to column-foot at base with a transverse Y-shaped often indistinct ridge 2.5mm long in basal $\frac{1}{4}$–$\frac{1}{3}$, apical part free; apex subtrilobate, acute, downward bent or occasionally straight. *Column* 2–3mm long; foot 8–12mm long; anther 1.5–2mm broad; pollinia c.1mm long. *Ovary* 5-winged, sometimes with 5 less distinct ribs or shallow wings alternating with main wings, dorsal wings projecting distinctly and shortly upward at base of dorsal sepal; pedicel-ovary 11–18mm long. *Fruit* 9 × 5.5mm, ovoid.

Distribution: New Guinea, Bismarck Archipelago, Solomon Islands (Map 12); 19 collections examined.

WEST NEW GUINEA. Mt Gautier, Mt Carstenz, Vogelkop.

EAST NEW GUINEA. West Sepik, Western Highlands, Southern Highlands, Madang, Morobe, Central and Milne Bay Provinces including Normanby, Misima and Tagula (Sudest) Islands.

NEW BRITAIN. West New Britain province.

SOLOMON ISLANDS. Kolombangara, Guadacanal.

Epiphyte on small twigs, in moss or rain forest, one record from *Agathis* sp. 400–1700m.

The purplish red, blood-red or orange-red flowers, somewhat distinctively thickened leaves and 5-winged ovary with the wings sometimes alternating with less distinct ribs and the upper three wings at their apices projecting above the base of the dorsal sepal, are sufficient to distinguish this species from most others in the section.

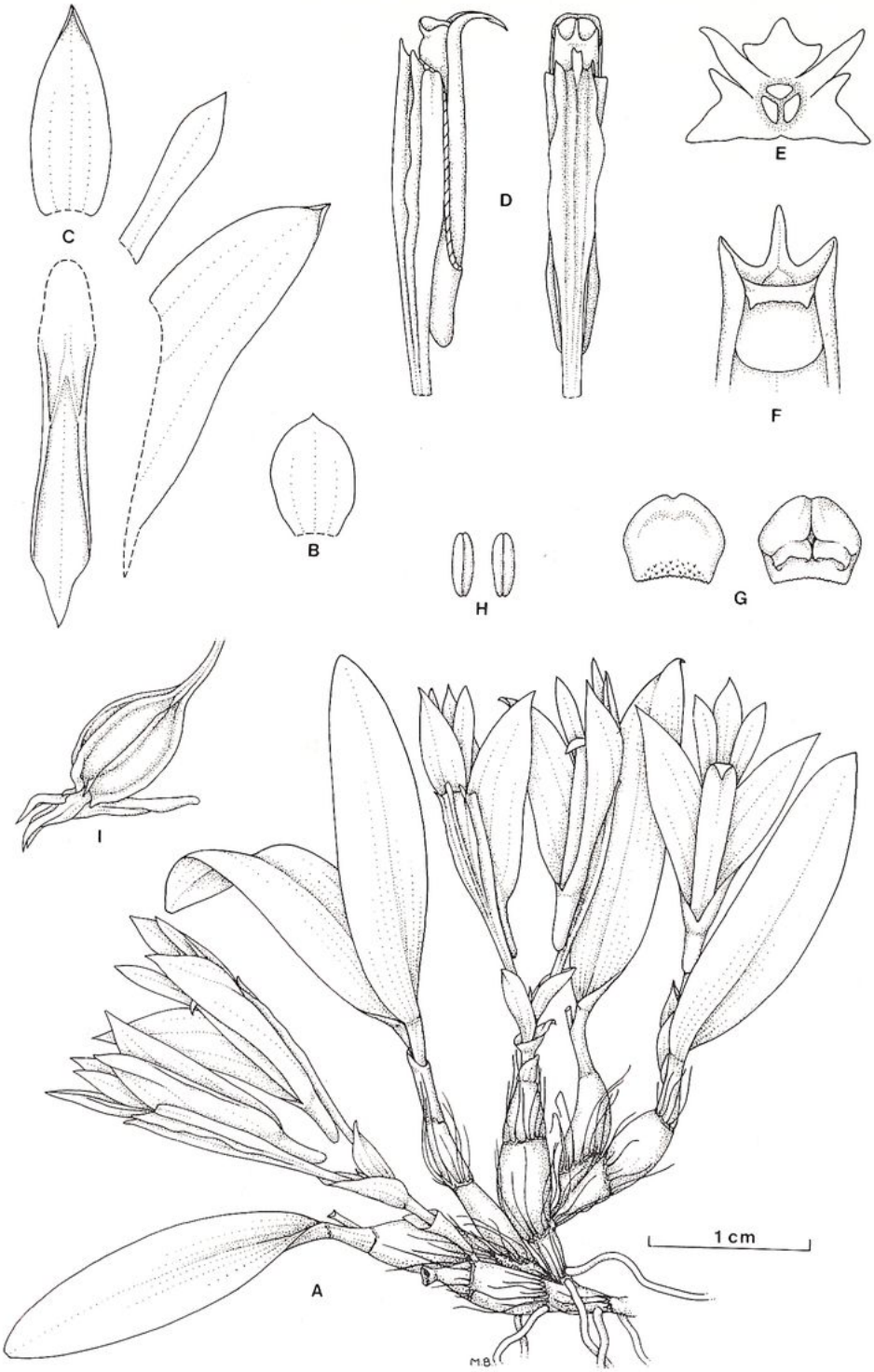


FIG. 19. *Dendrobium puniceum* A, habit; B, bract × 3; C, sepals, petal & labellum × 3; D, labellum, ovary & column × 3; E, ovary cross-section × 8; F, column tip × 8; G, anther cap × 8; H, pollinia × 8; I, fruit × 2. All drawn from *Brass* 25760.

Schlechter (1912) contrasted the 10-ridged ovary of *D. puniceum* with the 5-ridged ovary of *D. scarlatinum* but this difference is no more than consistent with the absence or presence of the alternating ridges. Schlechter's drawings of *D. puniceum* and *D. scarlatinum* and Smith's of *D. discrepans* all clearly show the forward extended dorsal keels, an unusual character in the section and probably sufficient evidence in itself to justify the synonymy.

D. seranicum is probably the species most closely related to *D. puniceum* but is insufficiently known for assessment of the relationship. *D. puniceum* differs from *D. seranicum* in its shorter mentum and shorter basal fused part.

A cleistogamous population has been observed at Erave, Enga province and is represented by *Reeve* 710 (see p. 170).

On the basis of the material and references available for study, *D. puniceum* appears to have a widespread distribution with three localities recorded for Irian Jaya; the other stations for it show a more or less evenly scattered but sparse pattern over Papua New Guinea, New Britain, the Louisiade archipelago and the Solomon Islands.

The early confusion caused by von Mueller's and Kränzlin's misapplication of *D. puniceum* for *D. subacaule* is fully discussed under the latter species.

Insufficient information is available for a fair assessment of *D. puniceum* in cultivation. January, May, July, October and November are the months recorded for its flowering in the wild.

15. Dendrobium seranicum J. J. Smith in Bull. Jard. Bot. Buitenz. sér. 3, 10: 150 (1928); Reeve & Woods in The Orchadian, 6: 203 (1980). **Figs 20, 21.**
Type: Central Seram, Goenoeng Moerkele [Gunung Merkele], 1000–1900m, 30 vi 1918, *Kornasi* in herb. Rutten 1449 (holo. BO*, iso. L.).
Syn.: *Pedilonum seranicum* (J. J. Smith) Rauschert in Feddes Repert. 94: 464 (1984).

Tufted herb to c.12cm high. *Roots* c.1mm in diameter. *Rhizomes* to 1.5cm *Pseudobulbs* 0.5–2.5 × 0.2–0.6cm, 3–5-noded, ovoid to fusiform, sometimes conspicuously sheathed, apex 2–4-leaved. *Leaves* 1.2–7.2 × 0.15–0.45cm, linear to narrowly lanceolate, thick, stiff and straight or slightly curved, somewhat grooved or concave along upper surface, apex obtuse, acute or apiculate, scarcely narrowed at base; sheaths 0.6–1cm long, ovate, membranous, prominently nerved, nerves somewhat minutely verruculose. *Inflorescences* 1–2, sessile, arising from older pseudobulbs, 1–4-flowered, bearing several triangular or ovate-acuminate membranous sheaths; bracts to c.6mm long, similar to sheaths but slightly longer. *Flowers* 1.8–2.4cm long, wide opening to 1.8cm, pale to mid-pink, labellum pink, sometimes with a faint orange mark (this contrasts with Smith's description of a dark violet flower with yellow labellum). *Dorsal sepal* 6–9 × 2–4mm, ovate-oblong, acuminate. *Lateral sepals* 15–23 × 3–4mm, obliquely lanceolate-triangular, acuminate; basal fused part 4.5–6.5mm, narrowly conical; mentum total length 11–16mm long, tip obtuse, bifid or not. *Petals* 6–8.5 × 1.5–2(–3)mm, lanceolate narrowing towards base, apex acute. *Labellum* 15–21 × 2–3mm, subtrilobate, linear spathulate, basal part adnate to column-foot, cross-ridge absent, apical part free, margins slightly upcurved, apex not or slightly deflexed, triangular acute to acuminate. *Column* 2.5–4 × 2.5mm; foot 11–16mm long; anther 1.3 × 1.3–2.5mm; pollinia

* examined at Bogor by Dr G Argent, October 1984.

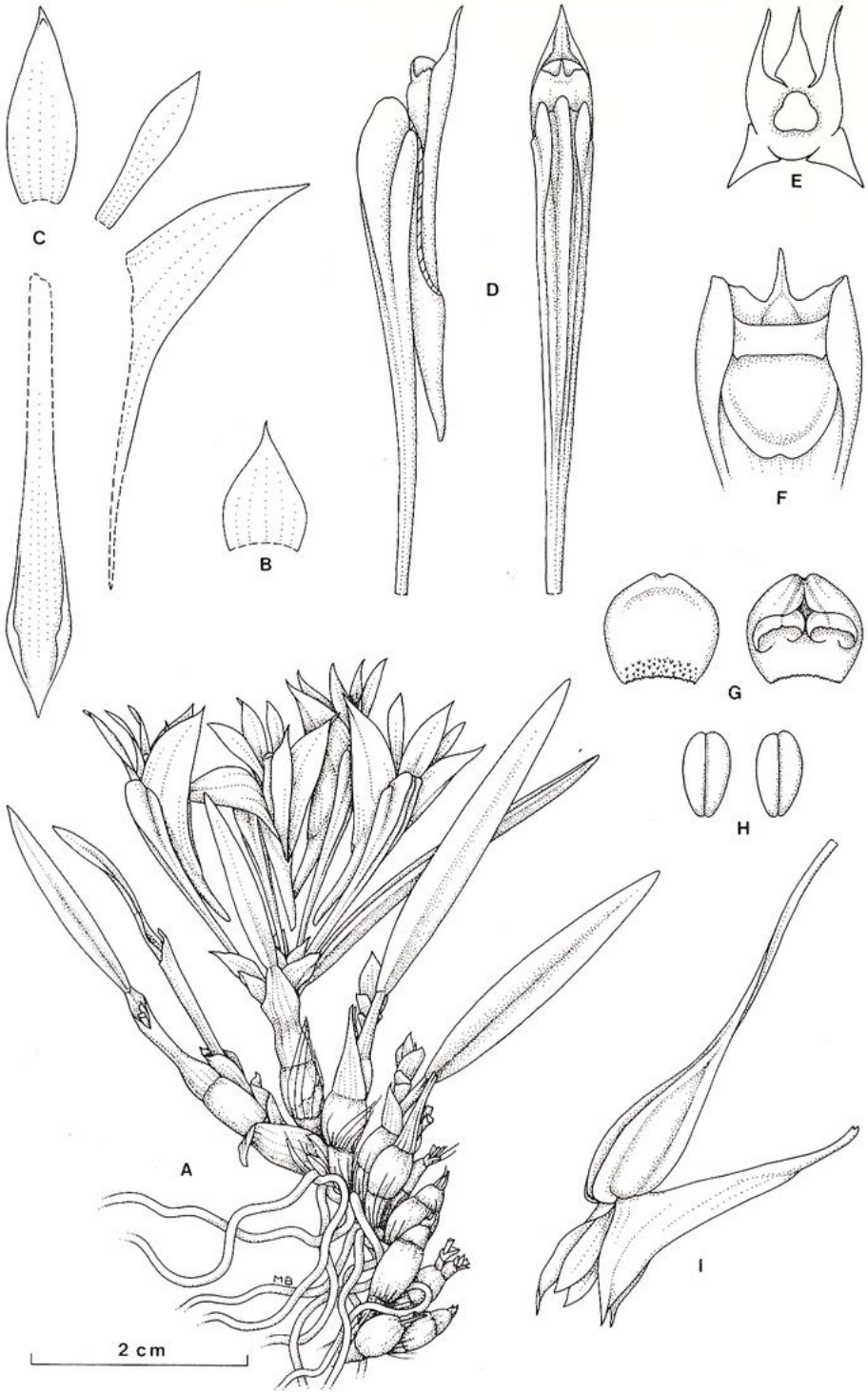


FIG. 20. *Dendrobium seranicum*. A, habit; B, bract × 2.6; C, sepals, petal & labellum × 2.6; D, labellum, ovary & column × 2.6; E, ovary cross-section × 8; F, column tip × 8; G, anther cap × 8; H, pollinia × 8; I, fruit × 2.6. All drawn from *Kornasi* in herb. Rutten 1449 (type).

FIG. 21. *Dendrobium seranicum*. A1 & A2, habit; C, sepals, petal & labellum × 3; E1 & E2, ovary cross-sections × 14. A1, E1 drawn from *Argent* C 8738; A2, C & E2 from *Edwards* 202, RBGE 86.1074.

0.8–1.5mm long. *Ovary* 5-winged in cross section, the 3 dorsal wings sometimes closely set so that the ovary may seem 3-winged; pedicel-ovary 17–26mm long. *Fruit* (immature) 9 × 3.5mm, oblong-ovoid.

Distribution. Indonesia (Seram). (Map 8).

SERAM (CERAM). Recorded originally from Goenoeng Moerkele.

Growing in forest, presumably epiphytically, 1000–1900m.

Some of the measurements and descriptive comments given in the original description did not agree with our examination of the Leiden isotype and we were therefore concerned that the holotype at Bogor might have differed considerably or that the Leiden and Bogor specimens might even have represented a mixed gathering of quite distinct taxa. We were fortunate to have the Bogor specimen examined by our colleague Dr G. Argent while visiting Java during October 1984 and any further doubt that the specimens might be different were dispelled when it was seen that his measurements of leaves and flowers agreed with ours.

Smith's description was from herbarium specimens and materials preserved in alcohol and, although no spirit material under this name was discovered by Argent at Bogor, we no longer have any doubt that some of the measurements given in Smith's description must be disregarded.

We can only guess that Smith's usually meticulous work may have lapsed during the course of reviewing the Seram orchid material and that part of the descriptions of two quite different species became transposed during preparation and that the error remained undetected. This is of course entirely conjectural.

The discrepancies between Smith's measurements and ours are summarized in Table 2.

The affinities of this little known species seem to lie somewhere between *D. hellwigianum*, from eastern New Guinea, and *D. puniceum*. It differs from the former by its broader, flatter leaves but shares the character of the three dorsal wings being set closely together thus sometimes appearing as one. From *D. puniceum*, which occurs in western New Guinea but not in Seram, it differs by its longer mentum with longer basal fused part.

The only other species of sect. *Oxyglossum* known to occur in Seram are *D. nebularum* and the Eyma collection of *D. vexillarius* ?var. *uncinatum* (see

TABLE 2

Comparative Measurements for *D. seranicum*

	J. J. Smith	Reeve & Woods
Leaves	2.1–2.7 × 0.65–0.7cm	1.2–4.4 × 0.15–0.45cm
Flowers	2.8cm long	1.8–2.4cm long
Dorsal sepal	11 × 3.4mm	6–9 × 2–4mm
Lateral sepals	26.5 × 5.25mm	15–23 × 3–4mm
Mentum	18.5mm	11–16mm
Petals	11 × 2.5–3mm	6–8.5 × 1.5–2mm
Column foot	20mm	11–16mm

The labellum measurements have not been included as it seems that two differing sets of these appear in Smith's description, neither of them agreeing with ours.

p. 250, 282). *D. nebularum* was described by Smith as *D. murkelense* at the same time and from the same collection as *D. seranicum*. Apart from sharing the 5-winged ovary character the two species are quite distinct.

More recently, during 1986 and 1987, colleagues at Edinburgh, G. Argent and I. Edwards participated in an Operation Raleigh expedition to the Manusela National Park in central Seram and they, with Margaret Dickson, have been able to collect material of this species which is now represented at Edinburgh by seven living collections, five of which have flowered. Examination of these has enabled us to amend Smith's description. The most notable difference is that the flower colour of the recent collections is very pale pink and the anther, column and the apical third of the lip is sometimes slightly darker and may have a faint orange mark at the widest part. The leaves of the living collections are much more lax than those represented by the Kornasi specimens (see Fig. 21).

So far there have been no difficulties in growing this species at Edinburgh. The plants are on bark placed in intermediate house conditions. The flowers are of short duration lasting about two weeks.

16. Dendrobium violaceum Kränzlin in Engl. Pflanzenr. 45: 108 (1910); Woods & Cullen in Walters *et al.* (eds) The European Garden Flora 2: 217 (1984); Cribb, Reeve & Woods in The Kew Magazine 2(3): 302, t.40 (1985); Karasawa, Orchid Atlas 4: 104 t.120, 249 (1986)—as *D. cyanocentrum;* R. Jenny in Orchideenkarten 527–530, Beitrage zür Die Orchidee 39(2), (1988).

Figs 22, 23; Plate 12 B & C.

Erect tufted epiphyte, 8–30(–40)cm high. *Roots* to 1.5mm diameter, white (purplish pink when moist). *Rhizomes* short. *Pseudobulbs* 1–5(–7) × 0.3–1.5cm, fusiform to ovoid, usually constricted at the nodes, (2–)3(–5) leaves arising together from the apex of new stems. *Leaves* 5–30 × 0.075–0.8(–1.1)cm, erect to spreading, jointed at base, linear occasionally linear-lanceolate, apex obtuse to subacute, often mucronate; sheaths slightly ± persistent. *Inflorescences* arising from the upper nodes of defoliated stems, subsessile, 1–4-flowered; peduncle 2–5mm long; bracts 8–24mm long, ovate, apiculate to acuminate. *Flowers* 2.8–4.5cm long, usually widely opening, lasting c.6 months; sepals and petals pink to deep violet, occasionally with bluish tips, rarely all blue or white, labellum dark purple with orange to scarlet-red apex. *Dorsal sepal* 12–20 × 4–7mm, oblong-ovate, acuminate. *Lateral sepals* 27–45 × 8–14mm, triangular, acuminate; basal fused part cylindrical, 4–15mm long; mentum total length 15–28mm, tip bilobed occasionally obtuse. *Petals* 9–16 × 2.5–4.5mm, obliquely lanceolate-elliptic, apiculate to acuminate. *Labellum* 22–37 × 3–5mm, subtrilobate, linear-oblanceolate, adnate to column foot at base, margins slightly incurved, cross-ridge absent, apical part free, apex not recurved, acuminate. *Column* c.4mm long; foot 15–28mm long; anther c.3mm broad; pollinia dark in colour, c.1.5mm long. *Ovary* with 5(–6) main wings and up to 8 (usually 4) additional smaller wings or ribs, dorsal wings usually undulate; pedicel-ovary 19–35mm long. *Fruit* to 25 × 6mm, narrowly pyriform.

Distribution: New Guinea (Map 13).

Epiphyte in juvenile secondary forest, margins of primary montane forest, etc., rarely terrestrial or lithophytic, 750–2000m.

FIG. 22. *Dendrobium violaceum* subsp. *violaceum*. A, habit; B, bract × 1.3; C, sepals, petal & labellum × 1.3; D, labellum, ovary & column × 1.3; E, ovary cross-section × 6; F, column tip × 6; G, anther cap × 6; H, pollinia × 6; I, immature fruit × 1.3. A & I drawn from *Pullen* 7999; B–H from *Reeve* 79, RBGE 82. 1001.

KEY TO SUBSPECIES

1. Leaves more than 2mm broad.....**16a.** subsp. **violaceum**
+ Leaves less than 2mm broad .....**16b.** subsp. **cyperifolium**

16a. subsp. **violaceum.** **Fig. 22; Plate 12B.**

Type: East New Guinea, Milne Bay Province, Mt Mitu, *Micholitz* s.n. (holo. B†). Neotype (designated here): Milne Bay Province, Rabaraba District, Bonenau near Mt Dayman, 1000m, 14 viii 1969, *Pullen* 7999 (neo. LAE; iso. CANB, L).

Syn.: *D. tenuicalcar* J. J. Smith in Bull. Dep. Agric. Ind. neerl. 45: 6(1911) & in Nova Guinea 8: 574, tab. 95c (1911). Type: East New Guinea, Central Range, Sepik River catchment, 1500m, xi 1910, *Gjellerup* 390 (holo. BO, n.v.).

D. quinquecostatum Schltr. in Beih. Repert. Spec. Nov. Regni Veg. 1: 537 (1912) & 21: tab. 182, fig. 680 (1928)—Engl. transl. 572, 702–fig. (1983). Type: East New Guinea, Morobe Province, Waria District, Dischore Range, 1200m, vi 1909, *Schlechter* 19743 (B†).

D. dryadum Schltr in Beih. Repert. Spec. Nov. Regni Veg. 1: 537 (1912) & 21: tab. 182, fig 681 (1928)—Engl. trans. 573, 702–fig. (1983); Northen, Miniature Orchids 63–64, pl. c–21 (1980). Type: East New Guinea, Madang Province, Finisterre Range, 1200m, vii 1908, *Schlechter* 18211 (iso. AD, AMES, L, NSW).

D. brachyacron Schltr in Repert. Spec. Nov. Regni Veg. 16: 44 (1919). Type: East New Guinea, West Sepik Province, inland from Angriffshafen, *Kempter* s.n. (B†).

D. geminiflorum Schltr in Repert. Spec. Nov. Regni Veg. 16: 112 (1919). Type: East New Guinea, Morobe Province, Waria District, *Kempf* s.n. (B†).

D. pityphyllum Schltr in Repert. Spec. Nov. Regni Veg. 16: 113 (1919). Type: East New Guinea, West Sepik Province, inland from Angriffshafen, *Kempter* s.n. (B†).

D. allioides J. J. Smith in Nova Guinea 18: 49, t.10, fig. 29 (1934). Type: West New Guinea, West Nassau Mountains, 1800m, x 1926, *Doctors van Leeuwen* 10974 (holo. L.).

Pedilonum quinquecostatum (Schltr) Brieger in Die Orchideen ed. 3, 1: 684 (1981).

P. brachyacron (Schltr) Rauschert in Feddes Repert. 94: 457 (1983).

P. dryadum (Schltr) Rauschert *op. cit.* 459 (1983).

P. geminiflorum (Schltr) Rauschert *loc. cit.*

P. pityphyllum (Schltr) Rauschert *op. cit.* 462 (1983).

P. tenuicalcar (J. J. Smith) Rauschert *op. cit.* 462 (1983).

Subsp. *violaceum* is recognized by its wider leaves which are 2–11mm broad.

Distribution: New Guinea (Map 13); 30 collections examined. Throughout New Guinea from West Nassau Mountains, West New Guinea to Milne Bay Province, East New Guinea.

750–2000m.

Subsp *violaceum* is one of the more widespread members of the section, being recorded from many parts of the New Guinea mainland. In some localities

such as Milne Bay Province and the Telefomin-Tari-Porgera area of Papua New Guinea (near the border between East and West New Guinea) it is quite common. So far it has not been collected on any of the adjacent islands.

Plants vary considerably in size and shape but the leaves are usually distinctive being long, linear and arising together from the top of the pseudobulbs. In exposed habitats plants have shorter, wider and more rigid leaves.

As well as being one of the largest of all the oxyglossums, subsp. *violaceum* also has very attractive flowers. Commonly they are pink to violet, but there are some forms with bluish tips. The rare variant with all-blue tepals, only found once in a remote valley in the Southern Highlands Province, Papua New Guinea, has the largest blue flowers known amongst all the New Guinea orchids, and would certainly be a very desirable plant to introduce into cultivation.

The ovary wings on the flowers are interesting as the number varies from 5 to as many as 13. However, there are always 5 or 6 main wings and the dorsal 3 are usually undulate, sometimes quite markedly. This degree of undulation has been found to increase if plants are exposed to greater sunlight.

Flowering is non-seasonal, but with the inflorescences lasting 6 months or more, this subspecies is in flower for most of the year in the wild. In cultivation it has proved to be rather difficult. It does prefer fairly exposed habitats so should be given plenty of light and air movement. In the past it has sometimes been known in cultivation under its synonyms *D. quinquecostatum* or *D. dryadum* (see Northen, 1980).

A natural hybrid between *D. violaceum* and *D. hellwigianum* is recorded (see p. 173 and Plate 13B).

16b subsp. **cyperifolium** (Schlechter) T. M. Reeve & P. Woods, **comb. et stat. nov.** **Fig. 23: Plate 12C.**

Syn.: *D. cyperifolium* Schltr in Bot. Jahrb. 58: 108 (1923). Syntypes: East New Guinea, East Sepik Province, Ambunti District, Hunstein Range, 1350m, viii 1912 & ii 1913, *Ledermann* 8487a & 10935a (B†). Neotype (designated here): Mt Hunstein, 1350m, 10 viii 1966, *Hoogland & Craven* 10918 (LAE; iso. BRI, CANB, K, L).

D. igneoviolaceum J. J. Smith in Nova Guinea 14: 430, t.68: 79 (1929). Type: West New Guinea, Mt Carstenz, 1800m, vii 1914, *Doorman* 12 (holo. BO n.v.).

D. scotiiferum J. J. Smith in Bot. Jahrb. 66: 196 (1934). Type: West New Guinea, Hollandia, Cyclop Mountains, 1400m, 8 ix 1929, *Mayr* 596 (holo. L).

Pedilonum cyperifolium (Schltr) Rauschert in Feddes Repert. 94: 459 (1983).

P. scotiiferum (J. J. Smith) Rauschert *op. cit.* 463 (1983).

Subsp. *cyperifolium* is distinguished from the typical subspecies by its narow leaves 0.75–2mm broad.

Distribution: New Guinea (Map 13); 11 collections examined.

WEST NEW GUINEA. Mt Carstenz, Wissel Lakes, Idenburg River, Cyclop Mts.

EAST NEW GUINEA. West Sepik, East Sepik and Enga Provinces.

1200–1850m.

Subsp. *cyperifolium* occurs mainly in West New Guinea but it is also recorded from the Lumi, Ambunti and Maramuni Districts on the Sepik River

FIG. 23. *Dendrobium violaceum* subsp. *cyperifolium*. A, habit; B, bract × 1.3; C, sepals, petal & labellum × 1.3; D, labellum, ovary & column × 1.3; E, ovary cross-section × 6; F, column tip × 6; G, anther cap × 6; H, pollinia × 6; I, fruit × 1.3. All drawn from *Reeve* 521, RBGE 82.1003.

catchment in Papua New Guinea. Originally collected from Hunstein Range near Ambunti by C. Ledermann, the type specimens were later lost in Berlin. Further good collections were subsequently made in the locality by R. D. Hoogland and L. A. Craven in 1966, and one of these specimens has been chosen here as a neotype.

This subspecies represents a race found in the northern and western parts of the island.

17. Dendrobium brassii T. M. Reeve & P. Woods, **sp. nov. Fig. 24; Plate 13A.** *D. violaceo* Kränzlin characteribus florum similis sed pseudobulbis 1(–2)-foliatis, foliisque lanceolatis distincte petiolatis differt. A *D. petiolato* Schlechter species nova foliis angustioribus, inflorescentiis subsessilibus bifloris et floribus majoribus recedit.

Type: East New Guinea, Northern Province, Kokoda subdistrict, Alola, 14 xii 1935, *Carr* 16838 (holo. BM).

Erect to pendent, ± tufted epiphyte, 8–22cm high. *Roots* to 1.5mm diameter, white with orange tips. *Rhizomes* short, occasionally elongated if plants growing in moss. *Pseudobulbs* 0.5–2.5 (–5) × 0.4–1.2cm, shortly fusiform to ovoid with central node contracted, occasionally elongated, ± rugose, apex 1(–2)-leaved. *Leaves* 5–16 × 0.4–1.3cm, erect to spreading or pendent, distinctly petiolate, narrowly lanceolate, apex acute, green sometimes suffused purplish; sheaths to 4.5cm long, cylindrical, petioliform, purplish. *Inflorescences* terminal on defoliated pseudobulbs, subsessile, 2-flowered; bracts ovate, apiculate. *Flowers* 2.2–3.2cm long, lasting c.6 months, pink to violet with labellum apex orange. *Dorsal sepal* 9–14 × 4.5–6.5mm, ovate-elliptic acute. *Lateral sepals* 27–45 × 8–14mm, triangular, acute to apiculate; basal fused part 5–8mm long, subconical; mentum total length 13–18mm, tip bilobed or obtuse. *Petals* 9–13 × 2.5–4mm, oblong-obovate, acute to apiculate. *Labellum* 19–26 × 3.5–4.5mm, simple to subtrilobate, linear-oblanceolate, adnate to column foot at base with apical margins incurved, without a cross-ridge, apex not recurved, acute to apiculate. *Column* c.4 × 3.5mm; foot 13–18mm long; anthers c.3mm broad; pollinia c.1.8mm long. *Ovary* 5(–6)-winged, three dorsal wings ± undulate; pedicel-ovary 20–28mm long. *Fruit* not observed.

Distribution: New Guinea (Map 14); 6 collections examined.

EAST NEW GUINEA. Central Province: Goilala District, Woitape, 2000m, ix 1977, *Howcroft* LAE 64098 (E, LAE); Port Moresby District, Kagi Gap area on Kokoda Trail, 1920m, 17 ix 1973, *Croft and Lelean* NGF 34774 (K, LAE). Northern Province: Kokoda subdistrict, Alola, 14 xii 1935, *Carr* 16838 (BM). Milne Bay Province: Rabaraba District, Mt Dayman area, 1800m, 20 vi 1953, *Brass* 22982 (AMES); near Bonenau, 1550m, 23 vii 1968, *Woods and Cruttwell* W. 2599A (E); Mt Mon, 1700m, vii 1974, *Cruttwell* 1739 (K).

Epiphyte in exposed *Nothofagus* and *Castanopsis* forest, 1500–2200m.

This new species has been recorded only a few times from the Papuan Mountains in East New Guinea and apparently it has never been seen in abundance.

Before the distribution was known it was thought that this uncommon species might be a putative hybrid between *D. violaceum* and *D. petiolatum*, but with homogeneous collections coming from three different localities over a distance of 300km, together with the fact that *D. petiolatum* has only once been recorded in the area (Cruttwell, pers. comm.), and considering the general rarity of hybrids in this section, it now appears fairly certain that *D. brassii* is a distinct and fixed entity worthy of specific status.

FIG. 24. *Dendrobium brassii* . A, habit; B, bract × 2; C, sepals, petal & labellum × 2; D, labellum, ovary & column × 2; E, ovary cross-section × 6; F, column tip × 6; G, anther cap × 6; H, pollinia × 6. A-F drawn from *Woods* 2599A, RBGE 68.2147; G & H from *Howcroft* LAE 64098.

The new species has similar flowers to those of *D. violaceum,* but differs in the 1(–2)-leaved pseudobulbs and the lanceolate leaves which are distinctly petiolate. From *D. petiolatum* it differs in the narrower leaves, in the subsessile 2-flowered inflorescences and in the larger size of the flowers.

D. brassii was first collected by C. E. Carr in December 1935, only a few months before his untimely death from blackwater fever. As both Carr and his Tamil assistant Mayandy have already been honoured in specific epithets within *Dendrobium,* the new name commemorates L. J. Brass, the most prolific of all plant collectors in New Guinea. He was the second person to collect this species, this time from Mt Dayman at the eastern end of its known range, during the Fourth Archbold Expedition to New Guinea in 1953.

The flowers vary from purplish pink to violet and the labellum apex is orange. The habit of growth of *D. brassii* appears to be a little straggly, especially when growing in moss, somewhat reminiscent of the habit of *D. aurantiroseum* [P. van Royen ex] T. M. Reeve of sect. *Pedilonum.*

Woods 2599 has been in cultivation at the Royal Botanic Garden Edinburgh since 1968. It has been grown vertically on a piece of fern slab, successfully but slowly, and has only recently flowered. It does not appear to pose any problems in cultivation.

18. Dendrobium hellwigianum Kränzlin in Bot. Jahrb. 16: 16 (1892) & Engl., Pflanzenr. 45: 279 (1910) descr. emend; Woods & Cullen in Walters *et al.* The European Garden Flora 2: 217 (1984); Cribb, Reeve & Woods in The Kew Magazine 2(3): 298, t.38 (1985); Karasawa, Orchid Atlas 4: 104, t.120, 249 (1986)—as *D. coerulescens*; Warren in Brazilian Orchids Newsletter 3: 6 (1986). **Fig. 25; Plate 14A & B.**

Type: East New Guinea, Madang Province, Saidor District, Finisterre Mountains, 2000m, 15 x 1888, *Hellwig* 323 (B†). Neotype (designated here): Finisterre Mountains, Japmawan, 1500–1900m, vi 1980, *Reeve* 503 (LAE, iso. E).

Syn.: *D. rhaphiotes* Schltr in Repert Spec. Nov. Regni Veg. 16: 115 (1919). Type: East New Guinea, Morobe Province, Waria District, *Kempf* s.n. (B†).

D. geluanum Schltr in Repert Spec. Nov. Regni Veg. 17: 374 (1921). Type: East New Guinea, Madang Province, Finisterre Mountains, 1700m, vi 1907, *Werner* 76 (B†).

D. cyananthum Williams in Bot. Mus. Leafl. Harvard 12: 156 (1946). Type: East New Guinea, Morobe Province, Amieng on Yaneng River (tributary of Busu River), 1500–1800m, 26 iii 1941, *Clemens* 12089b (holo. AMES).

Erect to spreading, tufted sometimes branching epiphyte to 24cm high, mature plants often curved, ascending habit of growth due to older pseudobulbs becoming more pendent with age. *Roots* 0.5–1.5mm diameter, white. *Rhizomes* usually short but sometimes elongated (with new stems arising 1 or 2 nodes up from base of previously formed pseudobulbs). *Pseudobulbs* 1–8 × 0.2–0.6(–0.8)cm, fusiform to cylindric, somewhat constricted at the nodes, sometimes slightly curved, with 1–5 leaves arising from the apex of new stems. *Leaves* 1.5–16 × 0.05–0.25cm, erect to suberect, terete to subterete, ± channelled, apex acute to obtuse, fleshy; sheaths smooth, pale green sometimes flushed red, old sheaths persistent, papery, greyish white. *Inflorescences* terminal, arising

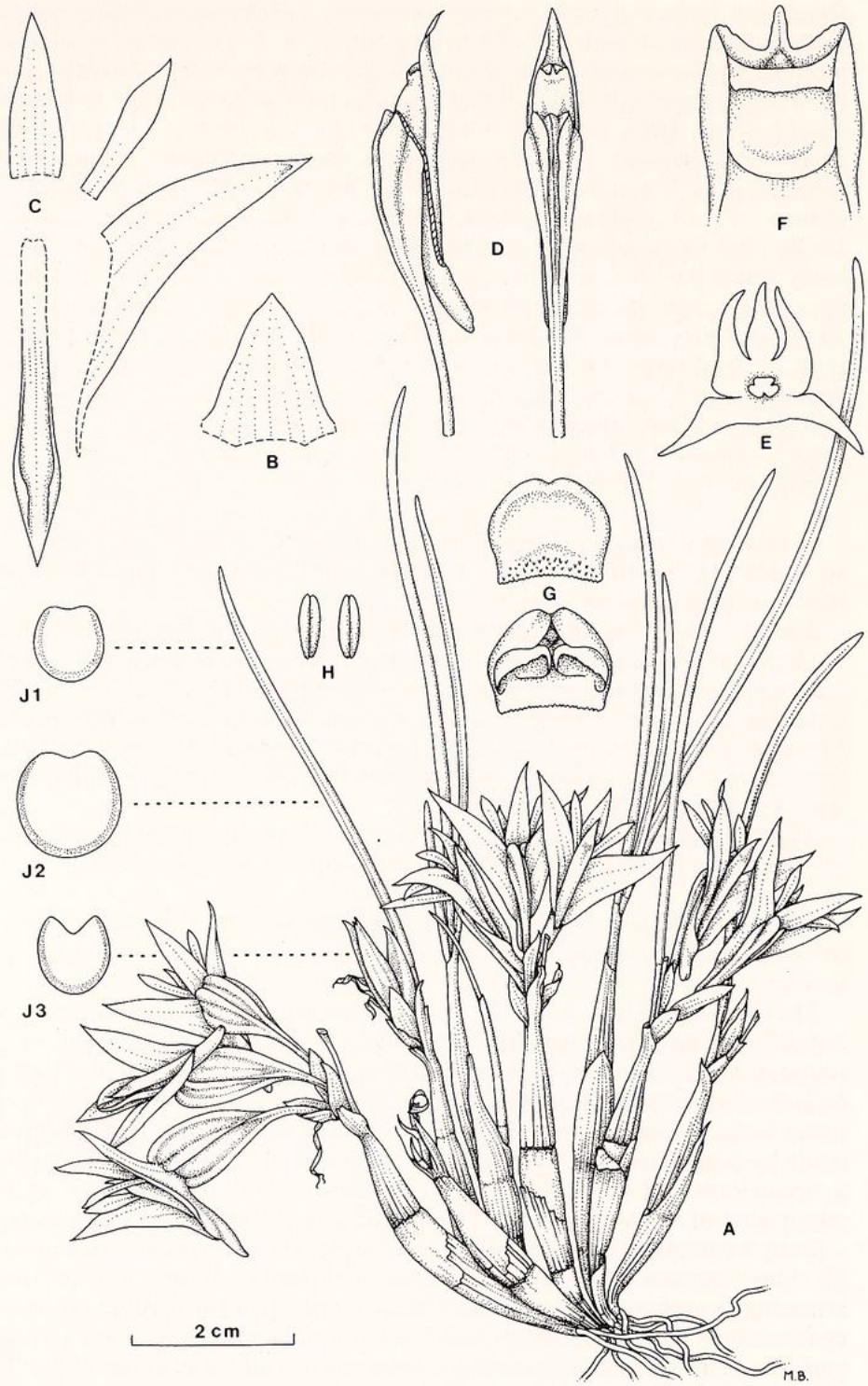


FIG. 25. *Dendrobium hellwigianum*. A, habit; B, bract × 2; C, sepals, petal & labellum × 2; D, labellum, ovary & column × 2; E, ovary cross-section × 8; F, column tip × 8; G, anther cap × 8; H, pollinia × 8; J1, J2, J3, leaf cross-sections × 6. All drawn from *Woods* 1142, RBGE 68.0933.

from both leafy and leafless stems, subsessile, 1–3-flowered; bracts regular, ovate acuminate. *Flowers* 1.7–3.2cm long, usually widely opening, lasting c.4–6 months; sepals and petals pink to purple, greyish white to blue (with purplish mentum) or creamy-yellow, labellum apex bright orange to orange-red. *Dorsal sepal* 7–13 × 2–4mm, narrowly ovate, acute. *Lateral sepals* 17–31 × 3–6.5mm, narrowly triangular, acute to acuminate; basal fused part cylindrical to subconical, 3–12mm long; mentum total length 10–22mm, tip bilobed or obtuse. *Petals* 6–11 × 1.5–3mm, linear to obovate, acute. *Labellum* 14–28 × 2–3.5mm, subtrilobate, linear-oblanceolate, adnate to column foot at base, apical part free with margins slightly incurved, without a cross-ridge, apex not recurved, acute to subacuminate. *Column* c.2.5mm long; foot 10–22mm long; anther 1.5–2mm broad; pollinia c.1mm long. *Ovary* purplish pink, 5-winged with 3 dorsal wings close together and occasionally undulate; pedicel-ovary 15–28mm long. *Fruit* 14 × 8mm, ovoid.
Distribution: New Guinea (Map 15); 52 collections examined.
EAST NEW GUINEA. Most of the mainland provinces of Papua New Guinea.
Epiphyte, rarely terrestrial, 1400–2700m.

D. hellwigianum is one of the most common and most widespread *Oxyglossum* species in the eastern half of New Guinea, but rather surprisingly it has never been collected in the western half of the island.

This species was the second member of the section to be recorded from New Guinea, and was named in honour of its discoverer, Franz Hellwig (1861–1889), a botanist with the German New Guinea Company. He was one of the first botanists to venture into the montane regions, but died shortly afterwards at Finschafen, having been in the colony for only 14 months. His specimens were forwarded to Berlin where many novelties, including several orchid species, were described by Fritz Kränzlin.

Almost a century later, in 1980, this species was recollected in the same area of the Finisterre Mountains—*Reeve* 503, which has been selected as the neotype.

When not in flower, *D. hellwigianum* is readily recognized by the fleshy terete or subterete leaves which superficially resemble *Allium schoenoprasum*, the garden chives.

The flowers are similar to those of *D. violaceum* in colour and general shape, but differ in the smaller size, the proportionately narrower tepals, and in the shape of the ovary cross-section. The three upper wings on the ovary of *D. hellwigianum* are close together and can give the superficial appearance of the ovary being 3-winged when in fact it is 5-winged (see Fig. 25). This error was made by Kränzlin in his original description, but subsequently (1910) he had a closer look and corrected it after Schlechter had drawn attention to the importance of ovary wings and ribs in classification of the *Oxyglossum* species.

Both the greyish blue and the pinkish purple colour forms are widespread. The blue-flowered forms, as well as those with creamy yellow flowers are quite attractive, and this species deserves more attention from growers of miniature dendrobiums although establishment requires care (Warren, 1986a), In the past the blue form has sometimes been known in cultivation under the incorrect name *D. coerulescens* (Northen, 1980).

A natural hybrid between *D. hellwigianum* and *D. violaceum* is recorded (see p. 173 and Plate 13B).

19. Dendrobium pentapterum Schlechter in Schumann & Lauterbach, Nachträge zur Flora der deutschen Schutzgebeite in der Südsee 161 (1905); in Beih. Repert. Spec. Nov. Regni Veg. 1: 539 (1912) & 21, t.182, fig. 683 (1928)–Engl. transl 574, 703–fig. (1982); Warren in Brazilian Orchids Newsletter 3: 22 (1986). **Fig. 26; Plate 14C.**

Syntypes: East New Guinea, Madang Province, Bismarck Mountains, c.1500m, ii 1902, *Schlechter* 13983 (lecto. K; iso. BM, BO, BR, P); West Sepik Province, Torricelli Mountains, c.900m, iv 1902, *Schlechter* 14434 (B†).

Syn.: *Pedilonum pentapterum* (Schltr) Rauschert in Feddes Repert. 94: 462 (1983).

Erect tufted epiphyte 6–20cm high, usually with ascending habit of growth. *Roots* 0.5–1mm diameter, white with green tips. *Rhizomes* usually short, sometimes new pseudobulbs arising 1–2 nodes up from the base of older stems. *Pseudobulbs* 1.5–6 × 0.3–0.8cm, fusiform to ovoid, ± constricted at nodes, with 1–4 leaves at apex. *Leaves* 2–9.5 × 0.3–1.1cm, erect to suberect, linear-elliptic, apex obtuse, ± mucronate, sometimes slightly unequally bilobed; sheaths smooth, pale green, old sheaths persistent, greyish. *Inflorescences* terminal, arising from both leafy and leafless stems, 1(–3)-flowered; bracts ovate, apiculate to acuminate. *Flowers* 2–3.5cm long, widely opening, lasting several months; sepals and petals pale greenish white to creamy-yellow, labellum greenish with bright orange to orange-red apex. *Dorsal sepal* 8–16 × 4–7mm, ovate-elliptic, obtuse to subacute, mucronate. *Lateral sepals* 15–30 × 6–10mm, obliquely ovate, obtuse mucronate to acuminate; basal fused part 2–7mm long, cylindrical to subconical; mentum total length 10–18mm, tip truncate to obtuse or bilobed. *Petals* 7–15 × 3–5.5mm, subspathulate, apiculate. *Labellum* 15–24 × 2.5–4.5mm, subtrilobate, oblanceolate, adnate to column foot at base, apical part free, margins incurved, without a cross-ridge, apex not recurved, acute to subacuminate. *Column* 3–4mm long; foot 10–18mm long; anther 2–2.5mm broad; pollinia 1–1.5mm long. *Ovary* greenish, with 5 main wings and usually several other smaller wings, dorsal wings ± undulate; pedicel-ovary 17–34mm long. *Fruit* (immature) 18 × 7mm, ovoid.

Distribution: New Guinea (Map 14); 10 collections examined.

EAST NEW GUINEA. West Sepik, Western Highlands, Madang and Morobe Provinces.

Epiphyte, 800–2000m.

D. pentapterum has a rather limited distribution in NE New Guinea and is a species of the lower montane zone. Schlechter was the orchid collector *par excellence* of the zone between 500 and 1500m in East New Guinea and made more collections of this species than any subsequent botanist. One of his original specimens (*Schlechter* 13983) was well distributed and remains as the only syntype. Van Royen's (1980) selection of *Schlechter* 16531 as lectotype is invalid as it was not one of the specimens cited with the original description.

Claims have been made by Mansfeld (1929) and van Royen (1980) that this species occurs in the alpine zone, but these are almost certainly based on misidentifications. To the superficial observer the colour and size of the flowers approach *D. vexillarius* subsp. *vexillarius*, a true alpine orchid, but this latter species is readily distinguished by its triangular ovary and its narrow leaves. *Keysser* 92 (cited by Mansfeld) is now not available, but *Brass* 10529 (cited by van Royen) from near Lake Habbema in West New Guinea, has been examined and is a typical specimen of *D. vexillarius*.

FIG. 26. *Dendrobium pentapterum*. A, habit; B, bract × 1.3; C, sepals, petal & labellum × 1.3; D, labellum, ovary & column × 1.3; E, ovary cross-section × 6; F, column tip × 6; G, anther cap × 6; H, pollinia × 6; I, fruit × 1.3. A–H drawn from *Reeve* 472, RBGE 82.1005; I from *Reeve* 271.

D. pentapterum is most closely allied to *D. nebularum* and the differences between these two are noted under that species.

Despite its limited distribution *D. pentapterum* is often locally abundant. Schlechter (1912) records that 'on a single tree a hundred or more specimens may be seen together'. This feature is also reported for parts of the Jimmi Valley in the Western Highland Province (Kaul Dorum, pers. comm.).

As far as we know the colour of this species is constant. The flowers are a pale greenish white becoming more creamy-yellow with age, and the labellum apex is bright orange. Of all the larger-flowered tufted *Oxyglossum* species *D. pentapterum* is the only one commonly with single-flowered inflorescences. The flowers are widely opening, long lasting, and at the Highland Orchid Collection, Laiagam, some cultivated plants of this species are constantly in flower. Being from a lower altitude it is a warmer growing species. All of these features make it very worthy of introduction into cultivation (Warren, 1986b). A fine form has already won a Certificate of Cultural Merit from the American Orchid Society and is illustrated in the *American Orchid Society Bulletin* 58: 145 (1989).

20. Dendrobium nebularum Schlechter in Beih. Repert. Spec. Nov. Regni Veg. 1: 540 (1912) & 21: tab. 183, fig. 684 (1928)—Engl. transl. 574, 703–fig. (1982). **Fig. 27; Plate 14D.**

Type: East New Guinea, Madang Province, Bismarck Mountains, c.2400m, ii 1908, *Schlechter* 18752 (B†). Neotype (designated here): East New Guinea, Enga Province, Porgera District, Paiela, near Waimeram village, 2300m x 1979, *Reeve* 476 (E., iso. LAE).

Syn.: ?*D. keysseri* Schltr in Repert. Spec. Nov. Regni Veg. 16: 217 (1919). Type: East New Guinea, Morobe Province, two days walk west of Sattelberg, c.1400–1500m, iv 1913, *Keysser* s.n. (B†).

D. tumidulum Schltr in Bot. Jahrb. 58: 110 (1923). Type: East New Guinea, East Sepik Province, Angoram District, Mt Schrader, 2070m, v 1913, *Ledermann* 11714 (B†).

D. murkelense J. J. Smith in Bull. Jard. Bot. Buitenz. sér 3, 10: 149 (1928). Type: Moluccas, Seram Island, summit of Goenoeng Moerkele, 2000–2500m, i vii 1918, *Kornasi* in herb. Rutten 1493 (iso. L).

D. palustre L. O. Williams in Bot. Mus. Leafl. Harvard 12: 160 (1946). Type: East New Guinea, Morobe Province, Amieng on Yaneng River (tributary of Busu River), 1500–1800m, 25 iii 1941, *Clemens* 12056c. (holo. MICH, iso. AMES).

Pedilonum keysseri (Schltr) Rauschert in Feddes Repert. 94: 460 (1983).

P. murkelense (J. J. Smith) Rauschert op. cit. 461.

P. tumidulum (Schltr) Rauschert op. cit. 464.

Erect tufted epiphyte, 8–20(–30)cm high, usually with ascending habit of growth. *Roots* 0.5–1.5mm diameter, white with orange tips. *Rhizomes* short. *Pseudobulbs* 1.5–15(–20) × 0.3–1.6cm; very variable in shape, slender cylindrical-fusiform to obclavate (sometimes quite swollen at the base as in *Reeve* 538, see Fig. 27A), apex 1–3(–4)-leaved. *Leaves* 1.5–14 × 0.3–2.3cm, subpetiolate, linear-lanceolate to elliptic, apex subacute, often mucronate; sheaths slightly ribbed, pale green usually striated purplish red, persistent. *Inflorescences* arising from the upper nodes of both leafless and leafy stems,

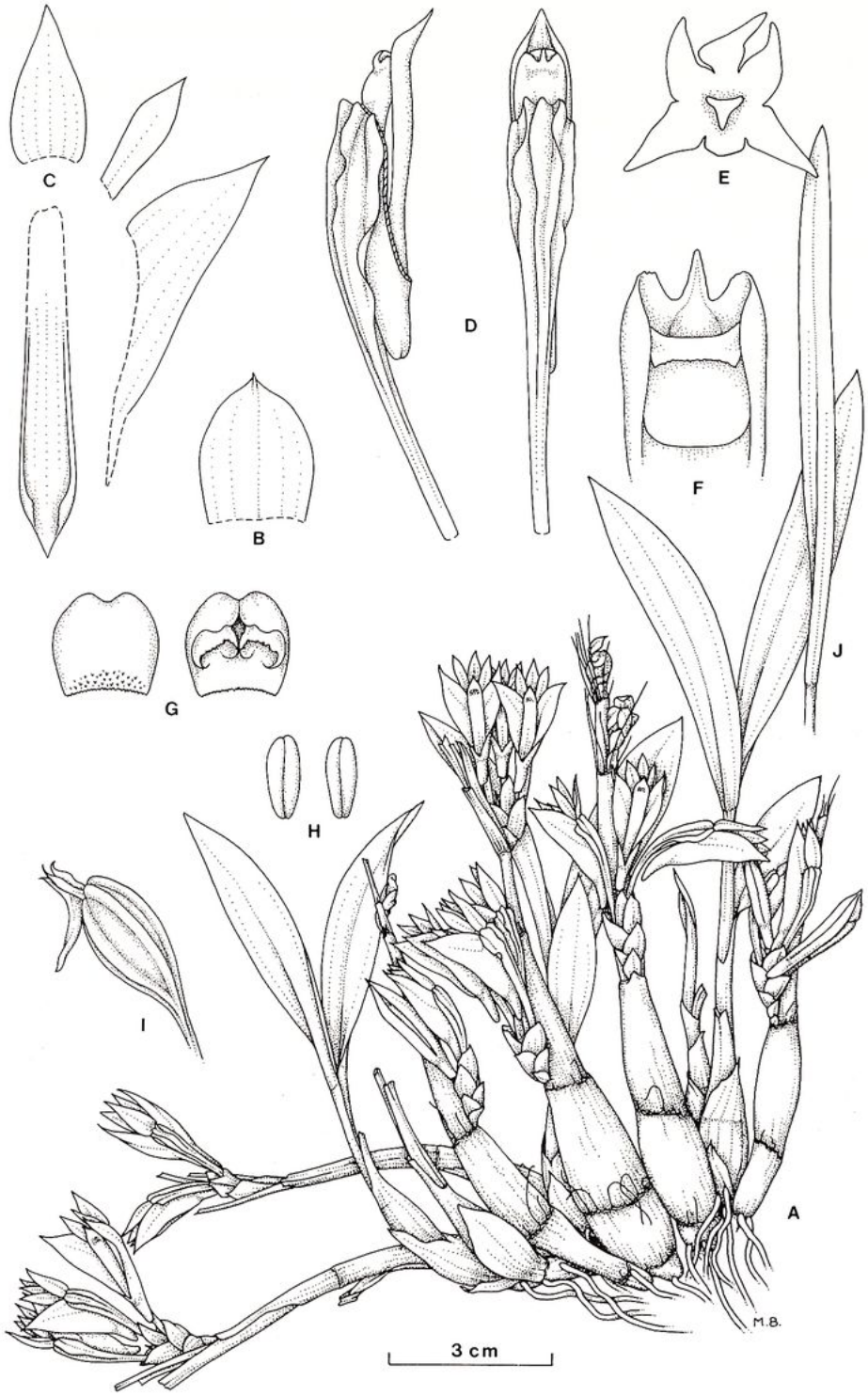


FIG. 27. *Dendrobium nebularum*. A, habit; B, bract × 2; C, sepals, petal & labellum × 2; D, labellum, ovary & column × 2; E, ovary cross-section × 6; F, column tip × 6; G, anther cap × 6; H, pollinia × 6; I, fruit × 0.7; J, leaf × 0.7. A–I drawn from *Reeve* 538, RBGE 82.1007; J from *Reeve* 476.

2–5-flowered, subsessile; bracts ovate to suborbicular, apiculate to shortly acuminate. *Flowers* 2–3.2cm long, not widely opening, long lasting, greenish white to yellow (veins sometimes purple-red) or dark red to purplish red, labellum apex rarely coloured differently. *Dorsal sepal* 8–15 × 3–5mm, ovate to ovate-lanceolate, acute to acuminate. *Lateral sepals* 19–31 × 4–7mm, somewhat oblique, ovate-lanceolate, acuminate; basal fused part 5–10mm long, conical; mentum total length 11–19mm tip incurved, subacute to obtuse, ± bilobed. *Petals* 7–13 × 2–4mm, narrowly oblong to subrhombic, acute to subacuminate. *Labellum* 17–26 × 3–3.5mm (expanded width to 5mm), subtrilobate, linear-oblanceolate, adnate to column foot at base, margins of free part incurved, apex triangular to acuminate, margins erose. *Column* 3–3.5mm long; foot 11–19mm long; anther 2–2.5mm broad; pollinia c.1.5mm long. *Ovary* 5-winged, usually with smaller 6th wing on ventral surface, wings undulate, sometimes very markedly; pedicel-ovary 16–30mm long. *Fruit* 28 × 14mm, ovoid.

Distribution: Moluccas, East New Guinea (Map 16); 11 collections examined.

MOLUCCAS. Seram Island.

EAST NEW GUINEA. East Sepik, Enga, Southern Highlands, Western Highlands, Madang and Morobe Provinces.

Epiphyte, commonly in montane *Nothofagus* forests; rarely terrestrial, 1400–2800m.

D. nebularum is a widely distributed species but it is not common. In any one locality often only a single plant is collected and therefore herbarium material is scanty.

Kornasi, an assistant working with the Dutch geologist Dr Louis Rutten, collected a single plant in Seram, Moluccas in 1918 and it was subsequently described as a new species (*D. murkelense*) by J. J. Smith. This specimen has been carefully examined and is identical in all respects with the East New Guinea material and therefore it is included in synonymy here. Although it has not been discovered there yet, *D. nebularum* undoubtedly also occurs in West New Guinea.

D. nebularum is most closely allied to *D. pentapterum* and it is sometimes difficult to distinguish dried specimens. *D. nebularum* may be recognized by its orange root tips, the striated sheaths and bracts, the usually longer stems and subpetiolate leaves (not always seen on young plants), the 2–5 (not single)-flowered inflorescences with the flowers not opening widely, the narrower lateral sepals, the margins of the labellum being incurved for most of its length, the different colour of the flowers (labellum apex not bright orange) and the more widely undulate wings on the ovary.

This species is one of the few *Oxyglossum* orchids with orange root tips, a feature noted with several New Guinea montane dendrobiums which are commonly epiphytic on *Nothofagus* (Southern Beech) trees. *D. nebularum* was probably named by Schlechter to commemorate the misty and cloudy mountain habitat in which these miniature orchids thrive.

The flowers of this species are not widely opening so horticulturally it is not very noteworthy. The purplish red forms are usually more attractive than the pale greenish white to yellow colour forms.

21. Dendrobium vexillarius J. J. Smith in Bull. Dep. Agr. Ind. Neerl. 39: 12 (1910) & Nova Guinea 8: 575, tab. 96A (1911), 14: 424 (1929); Kränzlin in

Engl., Pflanzenr. 45: 362 (1910); van Royen in The Alpine Flora of New Guinea 2: 375, fig. 129 (1979); Reeve & Woods in The Orchadian 6: 204 (1980); Warren in Brazilian Orchids Newsletter 3: 24 (1986).

Figs 28–30; Plates 15 & 16 A & B.

Erect to suberect, occasionally pendulous, tufted epiphyte or terrestrial, 3–25(–40)cm high. *Roots* 0.5–2mm diameter, white with green tips. *Rhizomes* short. *Pseudobulbs* 0.5–30 × 0.2–1.5cm, ovoid, obclavate to cylindrical, tapered gradually towards apex, few to many noded (up to 20), upper half with 2–10 leaves. *Leaves* 1–16(–24) × 0.2–1.8cm, erect to spreading (to pendulous), linear, linear-lanceolate to elliptic, acute to obtuse, usually mucronate, green to dark purplish, occasionally red (underside more often coloured), sheaths becoming greyish white, usually persistent, sheaths and leaves sometimes finely purple-spotted (var. *uncinatum*). *Inflorescences* arising terminally or laterally from both leafy and leafless stems, often several arising together from the same node, (1–)2–5(–7)-flowered, peduncle to 1cm long, rhachis to 2cm long; bracts large, to 3.5cm long, ovate-triangular, keeled and laterally compressed, apex acute to acuminate-subulate. *Flowers* 2.2–5cm long, usually widely opening, to 4.25cm broad, long lasting (c.6 months), red, orange, yellow, whitish, greenish, blue-green, blue, bluish-grey, grey, violet, purple, purple-red or pink, labellum green to almost black, apex usually red or orange or bi–tri-coloured with orange to yellow band below tip, ovary green to purplish or violet. *Dorsal sepal* 7–20 × 3.5–9mm, ovate to oblong-elliptic, obtuse to subacute, ± mucronate, ± keeled. *Lateral sepals* 19–45 × 5–13mm, obliquely triangular to ovate-triangular, obtuse to abruptly acuminate, mid-vein often strongly crested on outside, keels to 2.5mm high towards pointed apex; basal fused part 3–8mm long, conical to subconical; mentum total length 14–30mm, tip usually bilobed. *Petals* 7–20 × 2.5–9mm, obliquely oblong-obovate to subspathulate, sometimes subrhombic, obtuse to acute or apiculate. *Labellum* 18–39 × 3–7mm, subtrilobate, sublinear, adnate to column foot at base, upper margins incurved, without a cross-ridge, small side lobes rounded, apex triangular, acute to subacuminate, usually recurved, sometimes rolled under. *Column* 2.5–5.5mm long; foot 14–30mm long, nectary near base indistinct; anther 2.5–4.5mm broad; pollinia 1.5–2mm long. *Ovary* 3-winged, sometimes with small lateral ribs, dorsal wing usually projecting up behind dorsal sepal, apex ± pointed; pedicel-ovary 16–40mm long. *Fruit* c.30 × 14mm, ovoid.

Distribution: Moluccas, New Guinea, Bismarck Archipelago (Maps 17, 18); 172 collections examined.

Epiphyte or terrestrial in montane and alpine forests, shrubberies and grasslands, (?850–)1200–3500(–4000)m.

D. vexillarius is the most common of all the *Oxyglossum* species in New Guinea and has a wide range of habitats and colour forms. We have included a total of 12 species in synonymy here. The only doubtful one is *D. brachyphyta* Schlechter from a much lower altitude (850m) and for which no type is available.

D. vexillarius is allied to the other larger-stemmed species *D. nebularum* and *D. pentapterum* but is readily distinguished from both of them by its 3-winged ovary.

Various entities are recognized within this complex species, some more clearly defined than others, and we have been able to distinguish six varieties

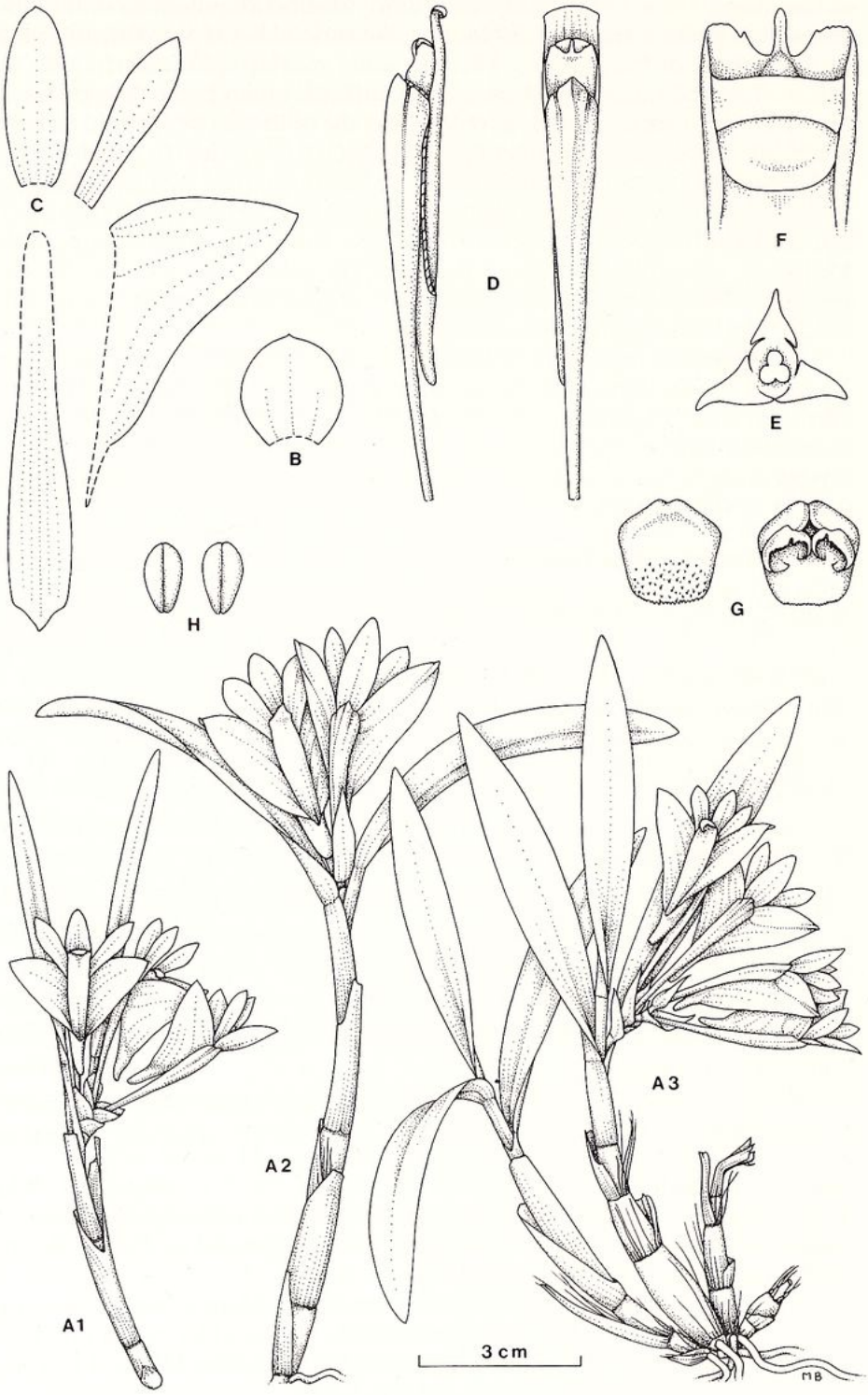


FIG. 28. *Dendrobium vexillarius*. A1 var. *vexillarius*, habit; A2, var. *albiviride*, habit; A3, var. *uncinatum*, habit. Dissection of var. *vexillarius*: B, bract × 2; C, sepals, petal & labellum × 2; D, labellum, ovary & column × 2; E, ovary cross-section × 6; F, column tip × 6; G, anther cap × 6; H, pollinia × 6. A1, & B–F drawn from *von Romer* 1294; A2 from *Woods* 2493; A3 from *Hoogland & Pullen* 5440; G & H from *von Romer* 1297 (syntype).

at this stage. These varieties represent fairly distinct populations in the wild, and although there are other differences, the varietal key is conveniently based on the colour of the flowers. There is some overlap, particularly with the yellow-flowered forms and there may be difficulty with preserved specimens for which there are no records of colour, but the following key should be fairly workable for the large majority of plants collected in the field or in cultivation.

All the New Guinea specimens which we have examined have been assigned to one of the six varieties but plants from the Moluccas and New Ireland are not sufficiently known to place at this stage. *Eyma* s.n., from Seram, in the Moluccas, was collected with no record of the colour. It appears to be very similar to var. *uncinatum*, but the population does have a smaller ovary with the 2 lateral ribs slightly larger than usual.

The specimens from New Ireland were all collected in the Hans Meyer Range by Sands, Pattison & Wood on an expedition from the Royal Botanic Gardens, Kew, England in 1975 (*Sands* 1985, 1986, 2349, 2374 & 2399). This population is quite variable, especially in the colour of the flowers, and requires further study before deciding on its varietal status. At present the plants appear nearest to var. *uncinatum*.

KEY TO VARIETIES (New Guinea)

1. Mature plants small, pseudobulbs less than 2.5cm long [flowers orange to orange-red] .....**21f.** var. **elworthyi**

\+ Mature plants with pseudobulbs over 2.5cm long 2

2. Flowers orange, orange-red or orange-yellow .**21d.** var. **microblepharum**

\+ Flower colour otherwise 3

3. Flowers greenish blue, blue, bluish-grey or grey, often suffused with violet **21b.** var. **retroflexum**

\+ Flower colour otherwise 4

4. Leaves linear to linear-lanceolate, mostly less than 6mm broad [flowers yellow or greenish yellow].....**21a.** var. **vexillarius**

\+ Leaves linear-lanceolate, to elliptic, mostly over 6mm broad 5

5. Flowers whitish green to primrose yellow, mostly over 3.5cm long [high-altitude variety from Owen Stanley Range, SE New Guinea, 2600–3400m] **21e.** var. **albiviride**

\+ Flower colour otherwise [or if yellow, then from below 2500m and flowers mostly less than 3.5cm long] .....**21c.** var. **uncinatum**

21a. var. **vexillarius.** **Fig. 28A1, B–H.**

Type: West New Guinea, Mt Wilhelmina complex, Mt Agathodaemons, 2580m, xi 1909, *Von Roemer* 1294 (lecto. BO, designated by P. van Royen, 1979); *Von Roemer* 1297 (syntype BO).

Syn.: ?*D. semeion* van Royen in The Alpine Flora of New Guinea 2: 384, fig. 132 (1979). Type: East New Guinea, Western Highlands Province, Minj District, Kubor Range, Minj-Nona Divide, 3270m, 4 vii 1963, *Vink* 16010 (holo. L; iso. CANB, LAE).

Pedilonum vexillarius (J. J. Smith) Rauschert in Feddes Repert. 94: 465 (1983).

Var. *vexillarius* is recognized by its narrower linear to linear-lanceolate leaves, usually all less than 7mm wide, and by its yellow to greenish yellow flowers 2.5–4.2cm long.

Distribution: New Guinea. (Map 17); 40 collections examined.

WEST NEW GUINEA. Mt Carstenz, Mt Doorman, Mt Wilhelmina, Lake Habbema.

EAST NEW GUINEA. West Sepik, Enga, Southern Highlands, Western Highlands, Chimbu, Eastern Highlands, Madang, Morobe, Central and Milne Bay Provinces.

Epiphyte in montane and alpine forest, often on small branches and twigs high up on *Nothofagus*, rarely terrestrial (in Wau area recorded as low epiphyte and terrestrial), 2000–3500m.

Var. *vexillarius* is mainly confined to the alpine zone, above 3000m, and is quite common in some localities. However it does extend lower than this, usually to about 2500m, but in the Wau area, on the Edie Creek road, there is a colony at 2000–2200m.

As noted above, the narrow leaves are the most distinctive feature of this variety, together with the colour of the flowers which is always yellow to greenish yellow.

J. J. Smith labelled *Lam* 1591 & 1655 from Mt Doorman as var. 'purpureoviride' but later changed his mind and did not publish this name. These particular specimens were collected at 3500m and the purple colouration in the leaves indicates that it grew in an exposed position. Reeve has often observed leaves on this variety tinged dark purple during his collecting patrols in Papua New Guinea.

Vink 16010, which is the type of *D. semeion* van Royen, is a very large plant with wider leaves. It seems best to place it in synonymy here although it may possibly represent the uncommon yellow colour variation of var. *retroflexum*.

Var. *vexillarius* is particularly common as a high epiphyte on *Nothofagus* in Enga Province above 2800m: Reeve has counted well over a hundred plants on the small branches and twigs of a fallen tree. On Mt Giluwe in the Southern Highlands Province this variety is also common on *Papuacedrus papuana*, the so-called 'New Guinea Pine'.

At the Highland Orchid Collection at Laiagam, Papua New Guinea, this variety grows well in elevated, more exposed positions. Small plants which are thinner stemmed than some of the other varieties are difficult to establish in cultivation.

21b. var. **retroflexum** (J. J. Smith) T. M. Reeve & P. Woods, **comb. et stat. nov.** **Fig. 29 A1, K; Plate 15A.**

Syn.: *D. retroflexum* J. J. Smith in Bull. Jard. Bot. Buitenz. sér. 2, 2: 14 (1911) and in Nova Guinea 12: 71, tab. 19, fig. 56 (1913); P. van Royen in The Alpine Flora of New Guinea 2: 388, fig. 134 (1979). Lectotype (designated by P. van Royen, 1979): West New Guinea, Mt Goliath, 3250–3450m, iii 1911, *de Kock* 103 (BO n.v.).

D. caenosicallainum P. van Royen in The Alpine Flora of New Guinea 2: 390, fig. 135, plate 88 (1979). Type: West New Guinea, Star Mountains, Mt Antares, c.3000m, 23 vii 1959, *Kalkman* 4494 (holo. L).

Pedilonum retroflexum (J. J. Smith) Rausch. in Feddes Repert. 94: 463 (1983).

D. pentagonum sensu J. J. Smith in Nova Guinea 8: 574 (1911), non Kränzlin.

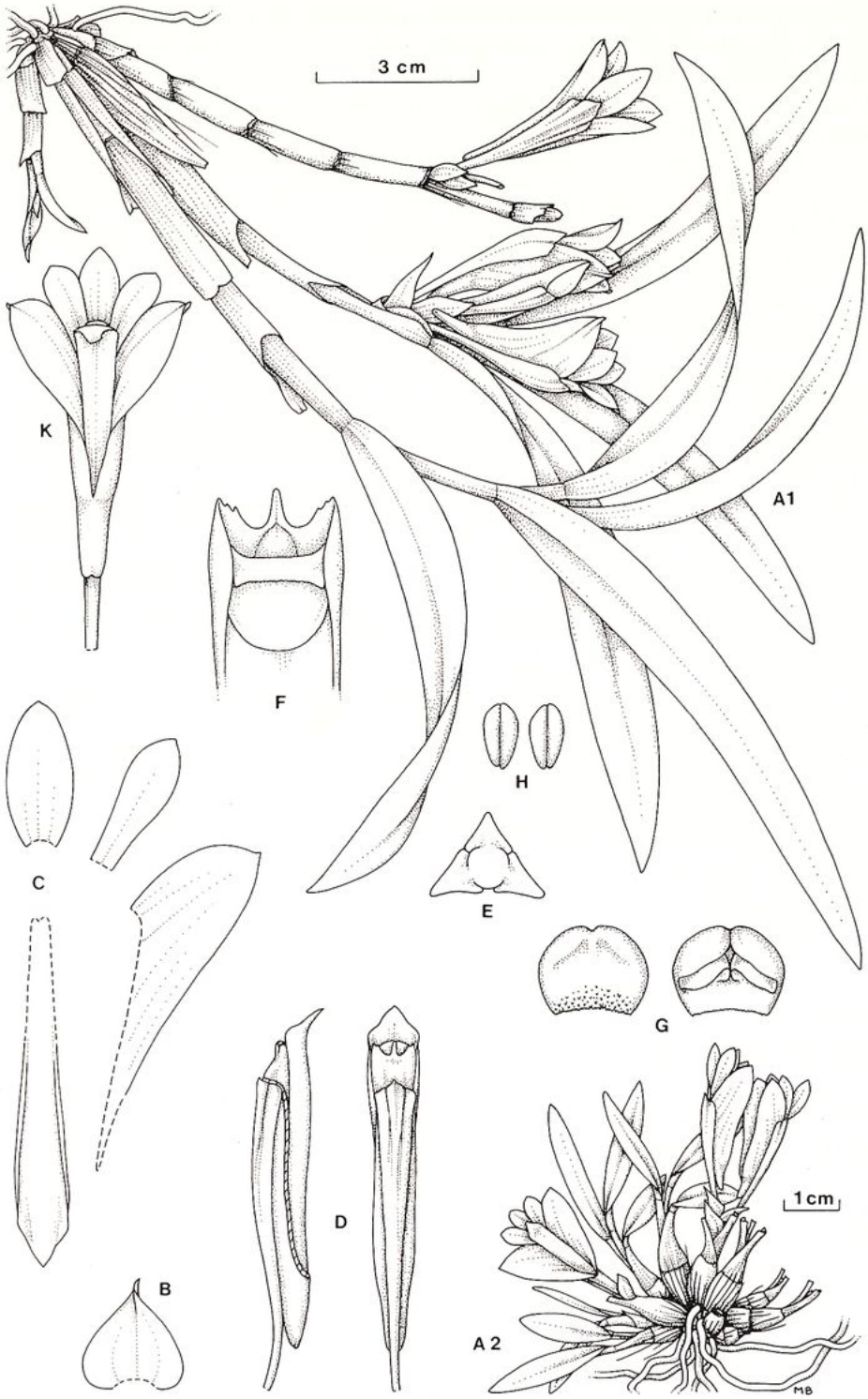


FIG. 29. *Dendrobium vexillarius*. A1, var. *retroflexum*, habit; A2, var. *elworthyi*, habit. Dissection of var. *elworthyi*: B, bract × 2; C, sepals, petal & labellum × 2; D, labellum, ovary & column × 2; E, ovary cross-section × 6; F, column tip × 6; G, anther cap × 6; H, pollinia × 6; K, flower of var. *retroflexum* × 1. A2–H drawn from *Woods* 318; A1 and K from *Reeve* 273.

D. brevicaule sensu Ridley in Trans. Linn. Soc. Bot. 9: 175 (1916), non Rolfe.

Var. *retroflexum* is recognized by its green, blue, bluish grey, or steel-grey flowers which are often tinged with violet, especially at mentum tip, ovary and tips of tepals, 2.5–4.5cm long. Unlike other varieties, plants found in the wild in shaded habitats often have a semi-pendulous habit.

Distribution: New Guinea (Map 18); 17 collections examined.

WEST NEW GUINEA. Mt Carstenz, Mt Wilhelmina, Lake Habbema, Star Mountains.

EAST NEW GUINEA. (So far only collected west of Laiagam, 143°30'E): West Sepik, Enga and Southern Highlands Provinces.

Low epiphyte embedded in clumps of moss in alpine shrubberies, often with semi-pendulous habit in forest, 2700–3450m.

The first specimens of this interesting high-altitude variety were collected by van Nouhuys in 1909 from the Mt Wilhelmina area of West New Guinea at 2800–3000m. The colour of the flowers was given as 'transparent grape-blue with a deep blue lip, blood red at the tip'. They were rather poor specimens and were tentatively identified as *D. pentagonum* by J. J. Smith (1911a). However the next collections of this variety (*de Kock* 100 & 103) from Mt Goliath at 3250 to 3450m were recognized as new and described under the name *D. retroflexum* J. J. Smith in the same year (1911b).

A little later, in 1913, Boden Kloss collected var. *retroflexum* from Mt Carstenz, much further west, at 3200m and the colour of the flowers was given as 'pale silvery grey, tinged with violet at the tips; outer base violet; inner lip tipped scarlet'. Unfortunately Ridley (1916) incorrectly identified it as *D. brevicaule* Rolfe and it was subsequently mounted onto the holotype sheet of Rolfe's species at Kew. To add further to the confusion over its correct identity, Dr van Royen (1979) identified this Kloss specimen as *D. rupestre* J. J. Smith!

This variety is only common in a few localities along the Central Range of mountains in New Guinea, from Mt Carstenz in the west to near Laiagam in the east, a distance of approximately 650km.

The unusual colour of var. *retroflexum* attracts much attention when first encountered in nature or seen in cultivation. The colour of the flowers varies from a sea-green or bluish green to full blue, bluish grey to light silvery grey. The flowers are often tinged with violet, especially at the tips of the sepals and petals and on the mentum and ovary. The lip is very dark violet, almost black, with an orange-red to scarlet apex which is usually rolled over but occasionally is unbent (in which case it is often lighter in colour). It is well illustrated in Andreé Millar's *Orchids of Papua New Guinea* (Millar, 1978: 35).

Very occasionally, a yellow form is seen amongst a large population, e.g. *Reeve* nos 121 & 1131, both from Enga Province. Unless detailed notes are recorded this uncommon form is very difficult to key out from some of the other varieties.

Cultivation of this variety, like so many other New Guinea alpine orchids, has so far proved difficult.

21c. var. **uncinatum** (Schlechter) T. M. Reeve & P. Woods, **comb. et stat. nov.** **Fig. 28 A3; Plate 15 B & C.**

Syn.: *D. uncinatum* Schltr in Beih. Repert. Spec. Nov. Regni Veg. 1: 538 (1912) and in Beih. Repert. Spec. Nov. Regni Veg. 21: t. 182, fig. 682 (1928); Karasawa, Orchid Atlas 4: 106 t. 124, 249 (1986). Type: East

New Guinea, Madang Province, Finisterre Range, c.1200m, ix 1908, *Schlechter* 18223 (B†). Neotype (designated here): East New Guinea, Eastern Highlands Province, Goroka District, Daulo, c.2400m, 23 vi 1956, *Hoogland & Pullen* 5440 (LAE; iso. AMES, BM, CANB, L, US).

D. trialatum Schltr in Beih. Repert. Spec. Nov. Regni Veg. 1: 540 (1912) and in Beih. Repert. Spec. Nov. Regni Veg. 21: t, 183, fig. 685 (1928). Type: East New Guinea, Madang Province, Ramu District, Bismarck Range, c.1800m, xi 1908, *Schlechter* 18785 (B†).

D. trifolium J. J. Smith in Gibbs, L. S., Contr. Phytog. Fl. Arfak Mtns., p. 119 (1917). Type: West New Guinea, Vogelkop Peninsula, Angi Lakes, 2100m, xii 1913, *Gibbs* 5907 (holo. BM).

? *D. brachyphyta* Schltr in Bot. Jahrb. 58: 107 (1923). Type: East New Guinea, East Sepik Province, c. 850m, ix 1912, *Ledermann* 8875 (B†).

D. bilamellatum R. S. Rogers in Trans. Roy. Soc. South Australia 49: 264 (1925). Type: East New Guinea, Central Province, Owen Stanley Range, 2400m, ii 1923, *Lane-Poole* 408 (holo. AD, iso. BRI).

D. tenens J. J. Smith in Nova Guinea 14: 425, tab. 66, fig. 75 (1929). Syntypes: West New Guinea, 70km north of Mt Carstenz, 1800m, vii 1914, *Doorman* 14 & 15 (BO n.v.).

D. xiphiphorum P. van Royen in The Alpine Flora of New Guinea 2: 377, fig. 130 (1979). Type: East New Guinea, Milne Bay Province, Mt Dayman, 2250m, 27 v 1953, *Brass* 22586 (holo. L; iso. AMES, K, LAE, US).

Pedilonum uncinatum (Schltr) Rausch. in Feddes Repert. 94: 464 (1983).

Pedilonum trialatum (Schltr) Rausch. *loc. cit.*

Pedilonum brachyphyta (Schltr) Rausch. *op. cit.* 457.

Var. *uncinatum* is recognized by its erect robust habit, wider lanceolate leaves over 7mm broad, and its carmine or crimson through purplish-red to pinkish-purple (cerise), occasionally yellow or greenish yellow, rarely white, flowers 2.5–4.5cm long. Purple spotting is often present on the leaves, new sheaths and occasionally the flowers.

Distribution: New Guinea and possibly Moluccas (Map 18); 84 collections examined.

? MOLUCCAS. Seram, *Eyma* s.n. (K, L)—colour not known but habit and form of plants identical to var. *uncinatum* which is the only variety recorded for the nearby Vogelkop Peninsula in West New Guinea.

WEST NEW GUINEA. Vogelkop Peninsula, Mt Doorman, Idenburg River.

EAST NEW GUINEA. Western, Enga, Southern Highlands, Western Highlands, Chimbu, Eastern Highlands, Madang, Morobe, Central and Milne Bay Provinces.

Epiphyte in margins of primary forest, in secondary forest, on *Cyathea* in sub-alpine grasslands etc, occasionally terrestrial. (? 850–1200–)1600–2800 (–3000)m.

Var. *uncinatum* is the most common of the six varieties of *D. vexillarius* and has the widest distribution throughout mainland New Guinea. It is particularly common in many parts of the Highlands Region of Papua New Guinea, from about 1800m to 2800m.

The most common colour form is pinkish purple (sometimes described as cerise) which corresponds to *Spiraea* red on the Royal Horticultural Society's colour chart no. 25. It is a difficult colour to define exactly and the shade does vary. Plants growing in direct sunlight have brighter flowers. It is illustrated, incorrectly as *D. quinquecostatum*, by Andreé Millar (1978, p. 37).

There is a crimson form in Milne Bay Province recorded variously as bright crimson, raspberry-red or deep wine-red (*Cruttwell* 731, 772, 932 & 1242). Schlechter's colour descriptions for the types of *D. uncinatum* and *D. trialatum*, both from Madang Province, are given as 'pale carmine-red'.

Yellow flowered forms have been collected from time to time and are represented by *Gibbs* 5907, *Doorman* 14 & 15 and *Brass* 11883 from West New Guinea as well as *Argent s.n.* from Mt Shungol in Morobe Province of East New Guinea. These have also been reported from Western Highlands Province (P. Sausman, pers. comm.) as well as Enga Province. Reeve has also collected a whitish form from the Yonggamugl area of Chimbu Province.

The name *D. uncinatum* has been correctly applied to cultivated specimens of this variety for a long time. Previously the orange-red variety was exported from Papua New Guinea under this name, but it is now treated under var. *microblepharum* (q.v.).

In suitable habitats in the wild, e.g. when epiphytic on *Cyathea* in subalpine grasslands, var. *uncinatum* occasionally grows into very large clumps, over 20cm across. Also at 2800m in Enga Province, Reeve observed that this orchid sometimes survived the severe frosts of 1972 whilst other epiphytes, and occasionally the host tree were killed.

In cultivation at Laiagam, Papua New Guinea, it has been observed that this variety thrives and flowers best when exposed to plenty of light and air movement.

21d. var. **microblepharum** (Schlechter) T. M. Reeve & P. Woods, **comb. et stat. nov.** **Fig. 30.**

Syn.: *D. microblepharum* Schltr in Bot. Jahrb. 58: 109 (1923). Type: East New Guinea, East Sepik Province, Mt Schrader, 2070m, v 1913, *Ledermann* 11676 (B†). Neotype (designated here): East New Guinea, Enga Province, Porgera District, Paiela Census Division, Ingalepe (5°25'S, 143°00'E), 2100m, xi 1977, *Reeve* 80 (E; iso. CBG, K, L, LAE).

Pedilonum microblepharum (Schltr) Rauschert in Feddes Repert. 94: 461 (1983).

D. vexillarius sensu Cribb , Reeve & Woods in Kew Mag. 2(3): 300, t.39 (1985).

Var. *microblepharum* is recognized by its usually more slender stems, greater than 2.5cm long on mature plants, and by its orange to orange-red or occasionally orange-yellow flowers 2.5–4cm long.

Distribution: New Guinea (Map 17); 17 collections examined.

WEST NEW GUINEA. Lake Habbema.

EAST NEW GUINEA. West Sepik, Enga, East Sepik and Southern Highlands Provinces.

Epiphyte, usually low, in montane shrubberies and forest, sometimes on cultivated *Cordyline*, 1800–2900m.

Var. *microblepharum* is a very attractive orchid with bright clusters of sizeable orange to orange-red flowers, and is used for arm and hair adornment by natives of Enga Province, Papua New Guinea. This variety occurs in a small part of East New Guinea—mainly from Telefomin to Laiagam along the tributaries which form the upper catchment of the Strickland River.

Reeve has observed small populations separated from the main 'belt' and suspects that, because of its horticultural merit, natives have transported this

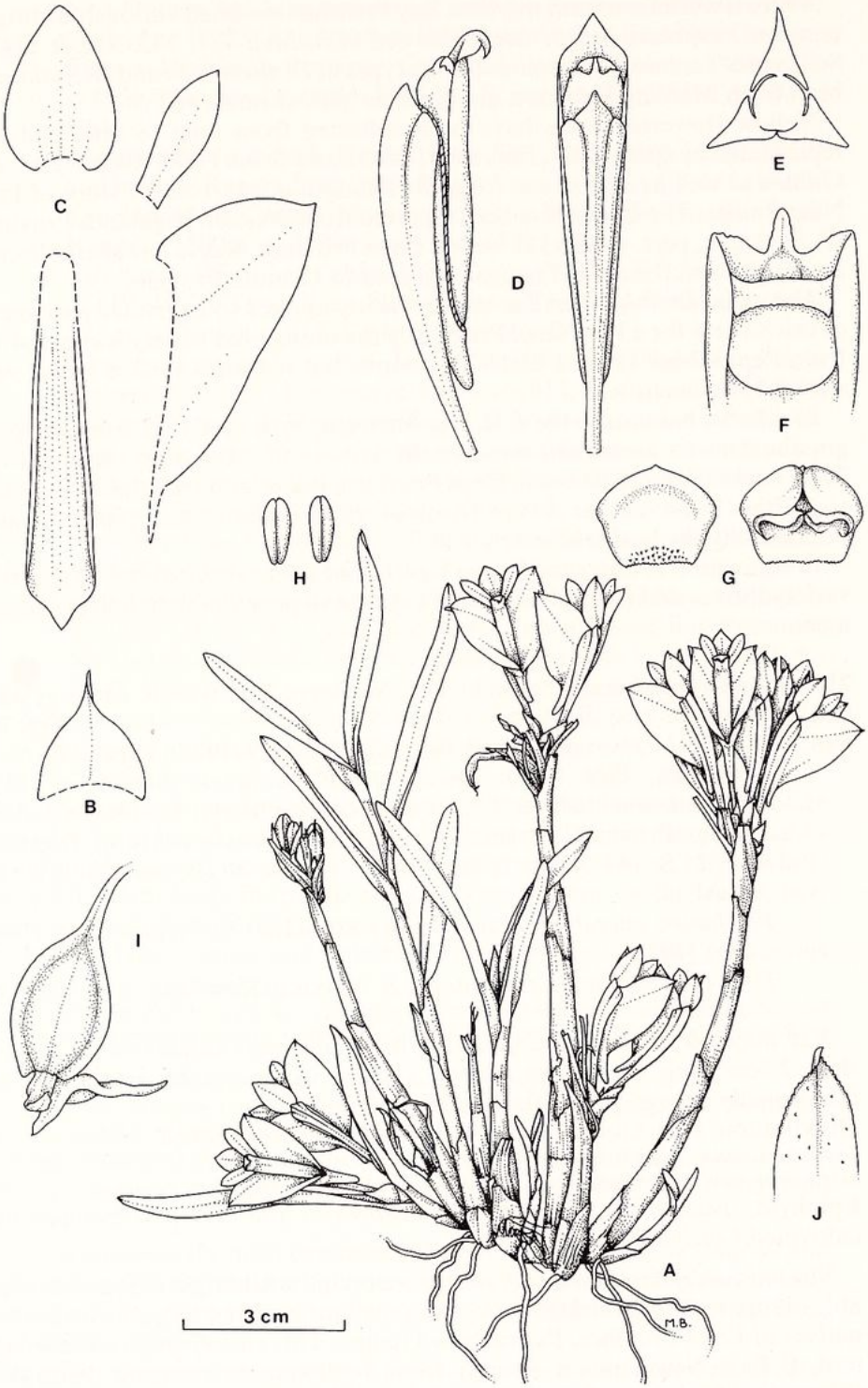


FIG. 30. *Dendrobium vexillarius* var. *microblepharum*. A, habit; B, bract × 2; C, sepals, petal & labellum × 2; D, labellum, ovary & column × 2; E, ovary cross-section × 6; F, column tip × 6; G, anther cap × 6; H, pollinia × 6; I, fruit × 1; J, leaf tip × 6. All drawn from *Reeve* 80, RBGE 82.1010.

A

B

PLATE 9 A, *D*: *cyanocentrum* (*Reeve* 381). B, *D. cyanocentrum* (*Reeve* 1132).

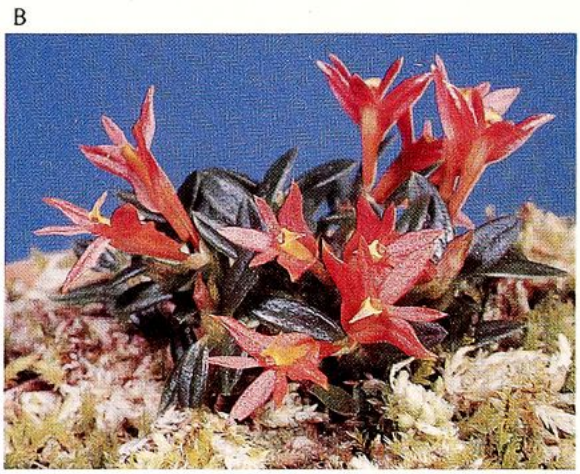
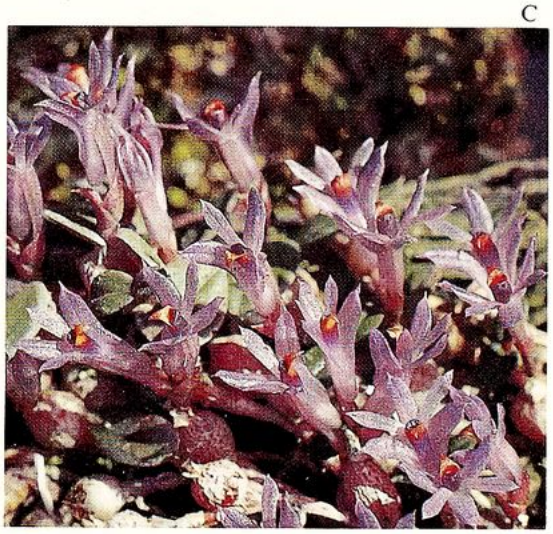


PLATE 10 A, *D. subacaule* (*Jermy* s.n.). B, *D. subacaule* (*Woods* 296, cult. RBGE 63.0338). C, *D. pachythrix* (*Reeve* 552); centre flowers: *D. subacaule* to left and right. D, *D. rupestre* (*Reeve* 466).

A

B

C



D

PLATE 11 A, *D. putnamii* (*Reeve* 299, cult. RBGE 82.0995). B, *D. delicatulum* subsp. *huliorum* (*Reeve* 306), Tani, Southern Highlands Province, Papua New Guinea. C, *D. delicatulum* subsp. *delicatulum*, blue form (*Reeve* 84). D, *D. delicatulum* subsp. *delicatulum*, purple form (*Reeve* 297, cult. RBGE 82.0997).

A

B

C

PLATE 12 A, *D. puniceum* (*Reeve* 566). B, *D. violaceum* subsp. *violaceum* (*Woods* 274, cult. RBGE 63.0335). C, *D. violaceum* subsp. *cyperifolium* (*Reeve* 521).

A

B

PLATE 13 A, *D. brassii* (*Reeve* 673). B, *D. hellwigianum* × *D. violaceum*, natural hybrid (*Reeve* 159).

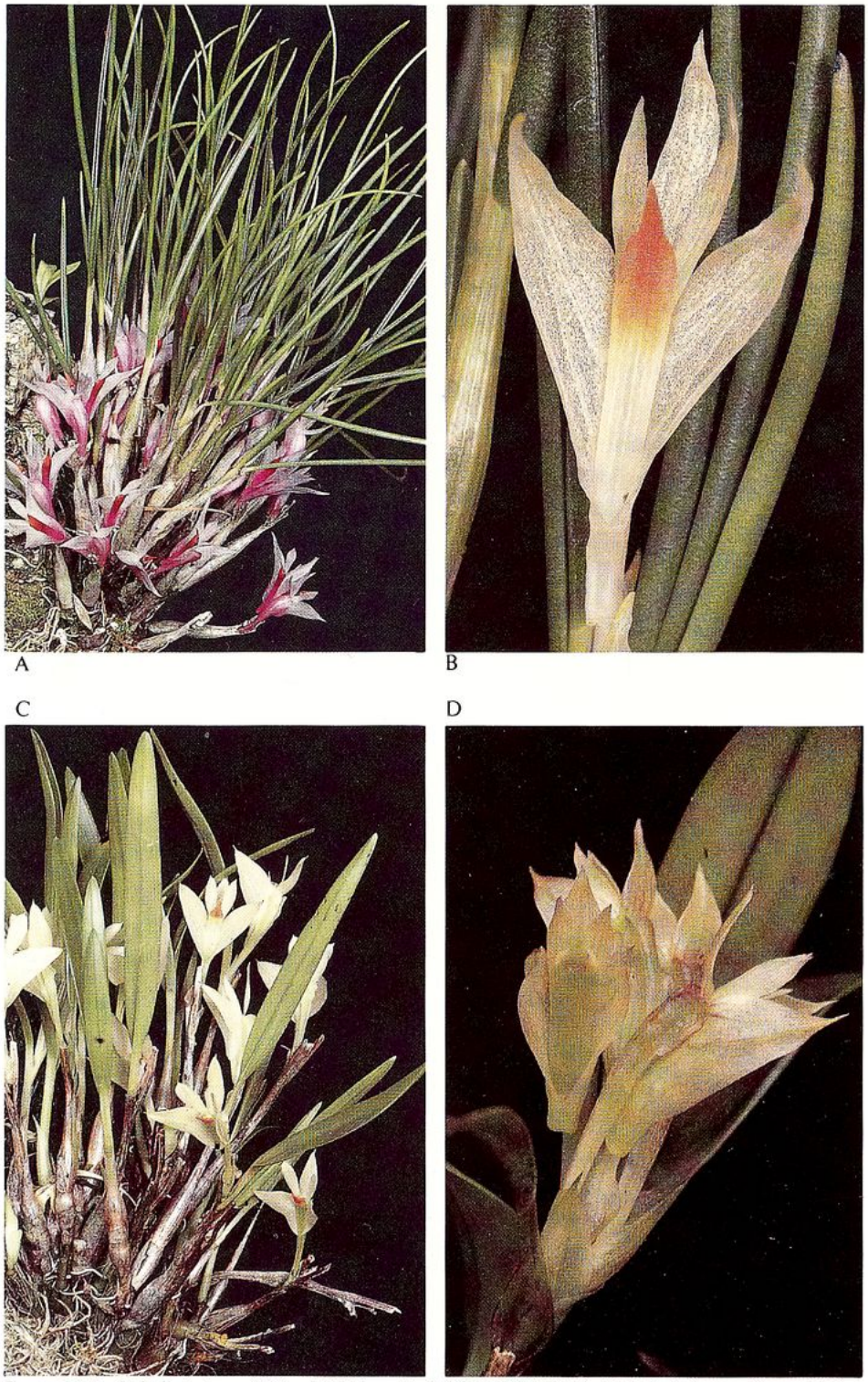
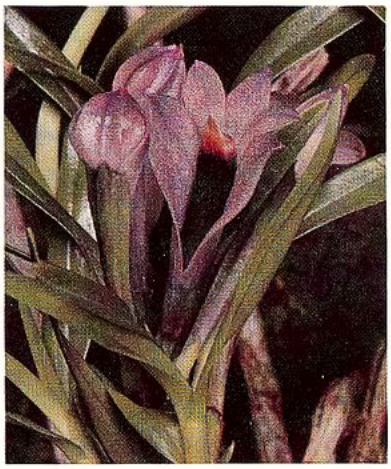


PLATE 14 A, *D. hellwigianum*(*Woods* 2925, cult. RBGE 68.2447). B, *D. hellwigianum* (*Reeve* 629, cult. RBGE 82.1018). C, *D. pentapterum* (*Reeve* 472, cult. RBGE 82.1005). D, *D. nebularum* (*Reeve* 3538, cult. RBGE 82.1007).

A



B

C

PLATE 15 A, *D. vexillarius* var. *retroflexum* (*Reeve* 82, cult. RBGE 82.1009). B, *D. vexillarius* var. *uncinatum* (*Cruttwell* s.n.). C, *D. vexillarius* var. *uncinatum* (*Reeve* 128).

A

B

C

PLATE 16 A, *D. vexillarius* var. *albiviride* (*Woods* 2493, cult. RBGE 68.2067). B, *D. vexillarius* var. *elworthyi* (*Woods* 318). C, *D. petiolatum* (*Reeve* 112), Yuyango, Enga Province, Western Highlands District, Papua New Guinea.

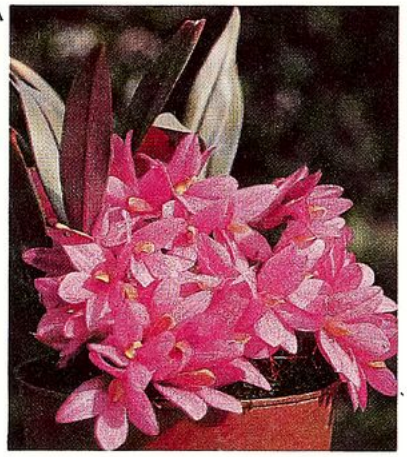
A

B

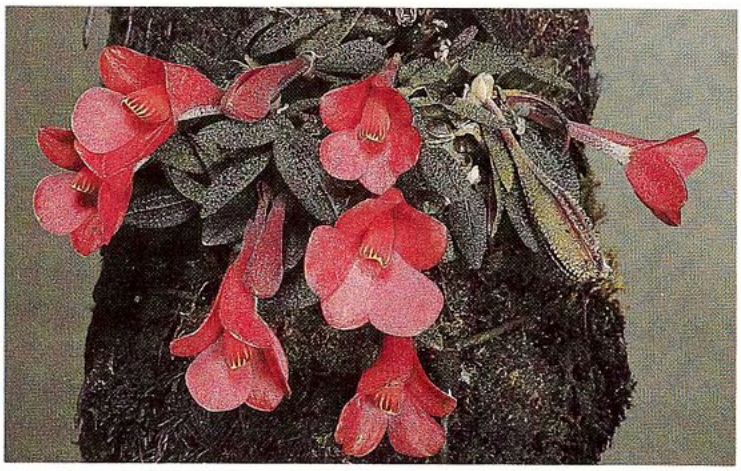
C

PLATE 17 A, *D. habbemense* (*Cruttwell* s.n.). B, *D. prasinum* (*Murray*, cult. RBGE 82.2620). C, *D. prasinum* (*Murray*, cult. RBGE 82.2623).

A



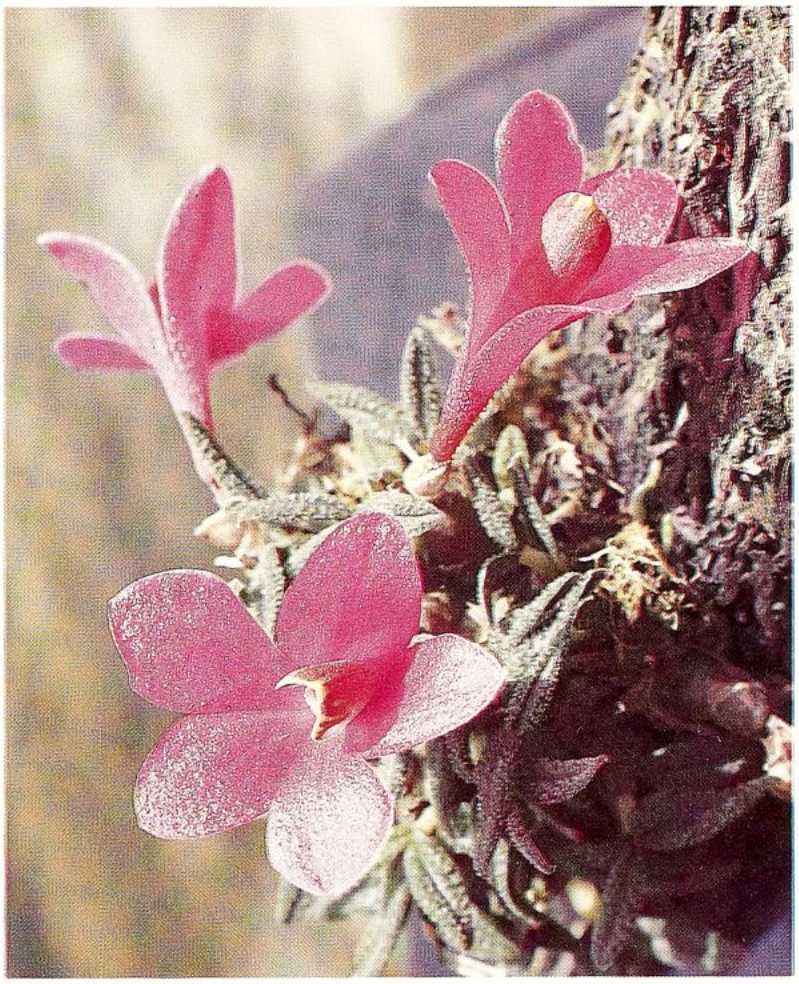
B



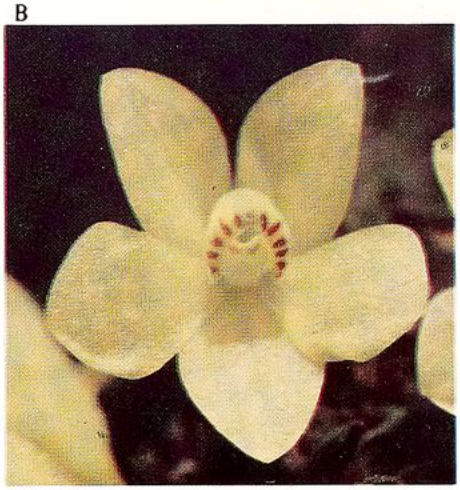
C

PLATE 18 A, *D. laevifolium* (*Stocker* s.n.). B, *D. cuthbertsonii* (*Elworthy*, cult. RBGE 75.2458). C, *D. cuthbertsonii* on *Cyathea* (*Reeve* s.n.), Tari Gap, Southern Highlands Province, Papua New Guinea.

A



B



C

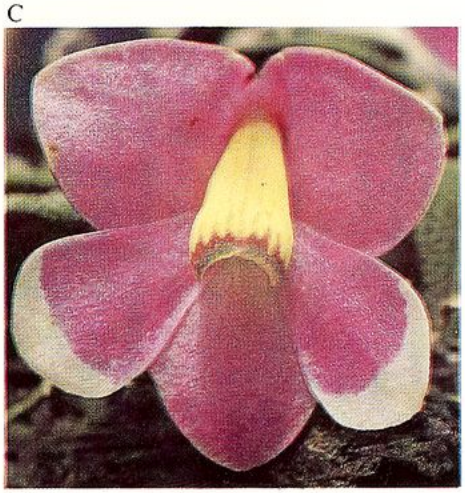


PLATE 19 A, *D. cuthbertsonii* (*Reeve* s. n.). B, *D. cuthbertsonii* (*Reeve* s.n.). C, *D. cuthbertsonii* (*Reeve* s.n.).

A

B

C

PLATE 20 A, *D. cuthbertsonii* (*Elworthy*, cult. RBGE 75.2458). B, *D. cuthbertsonii* (*Woods* 1529, cult. RBGE 68.1127). C, *D. cuthbertsonii* (*Elworthy*, cult. RBGE 75.2458).

variety to their own areas in the past. This could also account for its presence in the Tari District. There is a single recording from West New Guinea and further exploration is necessary before commenting on the extent of its western distribution.

The colour of the flowers shows some variation and occasionally noteworthy darker (redder) forms are seen in the wild. One was illustrated in the *Australian Orchid Review* (Reeve, 1981) and interestingly, some of the bright red pigment was also in the leaves. Once near Laiagam, Reeve collected plants with mixed orange and purple flowers which were probably the result of crosses between var. *microblepharum* and var. *uncinatum*. Also there is a record of a putative hybrid between this variety and *D. violaceum* Kränzl. (*Reeve* 58—see p. 174). In addition a larger plant with aberrant sterile flowers was once collected in Enga Province and is represented by *Reeve* 115 & 269. The Plant illustrated as *D. uncinatum* in Andreé Millar's *Orchids of Papua New Guinea* (Millar, 1978: 36) is referable to var. *microblepharum*.

Plants of this variety rarely grow into large clumps and they are usually slender-stemmed which makes small plants difficult to establish in cultivation. Larger plants produce flowers regularly in the wild, and with the flowers lasting 6 months this means that they are in bloom for most of the year. This is one of the outstanding *Oxyglossum* orchids which has great horticultural potential if easy-to-grow forms can be bred.

21e. var. **albiviride** (P. van Royen) T. M. Reeve & P. Woods, **comb. et stat. nov.** **Fig. 28 A2; Plate 16A.**

Syn.: *D. albiviride* P. van Royen in The Alpine Flora of New Guinea 2: 381, fig. 131 (1979). Type: East New Guinea, Central Province, Goilala District, Mt Albert Edward, 3350m, 22 i 1965, *van Royen* NGF 30076 (holo. L; iso. LAE).

D. albiviride P. van Royen var. *minor* P. van Royen *op. cit.* 384, fig. 132 (1979). Type: East New Guinea, Central Province, Goilala District, Murray Pass, 3000m, 23 vii 1969, *Foreman & Wardle* NGF 45520 (holo. K, iso. LAE).

Var. *albiviride* is a high altitude variety recognized by its leaves over 7mm broad and its large whitish green to primrose-yellow flowers (3–)3.5–5cm long.
Distribution: New Guinea (Map 17); 12 collections examined.
EAST NEW GUINEA. Central and Milne Bay Provinces.
Low epiphyte in alpine shrubberies etc., (2600–)2800–3400m.

Var. *albiviride* is closely related to var. *uncinatum,* but grows at higher altitudes on the Owen Stanley range. In the Murray Pass area of Mt Albert Edward it is a rather common low epiphyte from 2800 to 3400m. Its stems are usually quite thick and it has larger flowers which are whitish green to yellow. In our opinion these features warrant recognition only at varietal level.

In the past this variety has sometimes been known incorrectly as *D. 'pseudofrigidum'*. A colour photograph under that name appeared in Andrée Millar's *Orchids of Papua New Guinea* (Millar, 1978: 37).

In 1968 Woods collected a superior form with very large flowers (up to 4.8 × 4.25cm) on Mt Simpson at the eastern end of its distribution (*Woods* 2251), and several plants have been cultivated successfully at the Royal Botanic Garden, Edinburgh. In 1985 Buckingham Palace granted permission for a particularly outstanding selection of this to be named in honour of Her

Majesty Queen Elizabeth to mark the occasion of her visit to the Garden on 3 July 1985 (see also Pottinger, 1987). A formal description follows:

Dendrobium vexillarius var. **albiviride** 'Queen Elizabeth', **cultivar nov.**
Stems to 20cm high. *Leaves* 6–8 per stem, green (sometimes purplish when exposed to high illumination). *Flowers* lasting about six months, 4.8cm long by 4.25cm wide, pale primrose-yellow (2C*) sometimes suffused pale purple on outer surfaces, sometimes more prominently on median ridge of lateral sepals. *Lip* olive-green, apical half darker (147A–B*), apex bright orange-scarlet (34A*), tip downward curved. *Ovary* green sometimes suffused purplish.

This cultivar is represented by a herbarium specimen which includes a water-colour drawing by Mary Bates of *Woods* 2251, cult. in hort. bot. reg. Edin., 681944, Papua New Guinea, Milne Bay Province, Rabaraba subdistrict, Daga area, Matawan (Mt Simpson). In montane grassland above Idop Camp. 1980–2130m. Collected with N. E. G. Cruttwell, M. Galore & Mary Ogira, 15 vii 1968.

21f. var. **elworthyi** T. M. Reeve & P. Woods **var. nov.** differt a varietate typica pseudobulbis maturis omnibus minus quam 2.5cm longis et floribus parvis aurantiacus vel miniatus. **Fig 29A2, B–H; Plate 16B.**
Type: East New Guinea, Central Province, Kupiano District, Musa Mountains, Obaka Range (SE of Doma village in the Northern Province), c.1200m, 11 xi 1962, *Woods* 318 (holo. E; iso. AMES, K, L, LAE, NSW).

Erect to suberect epiphytic herb, 2–5cm high. *Pseudobulbs* 0.5–2(–2.4) × 0.2–0.6cm, ovoid, fusiform, to cylindrical, apex 2–3-leaved. *Leaves* 1–5 × 0.2–0.6cm, linear-lanceolate to elliptic, mucronate. *Inflorescences* 1–2-flowered. *Flowers* (2–)2.2–3(–3.3)cm long, orange or reddish-orange; labellum usually purple or black with apex orange, not recurved; ovary blackish.
Distribution: New Guinea (Map 18); 2 collections examined.
EAST NEW GUINEA. Eastern Highlands Province: Mt Michael, 2900m, *Reeve* 282 (E, LAE).
Epiphyte in elfin woodland amongst a rich epiphytic flora, 1100–2900m.

Var. *elworthyi* has so far only been recorded twice from well-separated localities (650km apart), and from widely differing altitudes. However both were collected from the same type of elfin woodland vegetation so often seen on exposed ridge tops in New Guinea. It is worth noting here again that plants growing in the south-eastern part of New Guinea (the 'tail of the bird') are often found at significantly lower altitudes than the same species in the central part of the island (see p. 212).

Both of the collections exhibited the same shortened pseudobulbs, mostly less than 2cm long (occasionally to 2.4cm), and the same orange or orange-red flowers).

On Mt Michael in the Eastern Highlands Province, at 2900m, only two plants were collected on the NW side of the mountain. The flowers were up to 3.3cm long, slightly larger than in *Woods* 318, but in all other respects they are identical to the type.

In the Musa Mountains area, on the border of the Central and Northern Provinces, Woods found var. *elworthyi* to be plentiful at c.1100–1300m.

The new variety is named in honour of Mr Geoffrey C. Elworthy whose

* Colours according to Royal Horticultural Society Colour Chart (1966, 2nd ed.).

influence, and interest in the orchids of the Central Province, initiated and supported the 1962 expedition to the Musa Mountains area by one of us (Woods). Mr Elworthy was a long-time resident of Papua and forwarded many plant specimens, mainly living, to the botanic gardens at Lae, Edinburgh and Kew.

Cultivation of this variety has so far proved difficult. It requires excellent aeration and drainage.

22. Dendrobium petiolatum Schlechter in Beih. Repert. Spec. Nov. Regni Veg. 1: 541 (1912) & 21: t.183, fig 686 (1928)—Engl. transl. 575, 704–fig. (1982); Karasawa, Orchid Atlas 4: 106 t.123, 249 (1986). **Fig. 31; Plate 16C.**
Type: East New Guinea, Madang Province, Ramu District, Bismarck Mountains, c.1800–2400m, 13 xi 1908, *Schlechter* 18710 (iso. AMES, BO, E, K, L, NSW).

Syn.: *D. unifoliatum* Schltr in Repert. Spec. Nov. Regni Veg. 17: 375 (1921). Type: East New Guinea, West Sepik Province, inland from Angriffshafen [Vanimo Harbour], *Kempter* s.n. (B†).

Pedilonum petiolatum (Schltr) Rauschert in Feddes Repert. 94: 462 (1983).

Erect to suberect tufted epiphyte, to 25cm high. *Roots* 0.5–1mm diameter. *Rhizomes* short. *Pseudobulbs* 0.5–4.5 × 0.5–1.6cm, obclavate to shortly subfusiform, usually constricted at nodes and surrounded by fibres from decayed sheaths, apex 1-leaved (occasionally 2-leaved on small cultivated plants). *Leaves* 3–16 × 1.0–3.5cm, erect to spreading, distinctly petiolate, oblong-elliptic to subovate, apex subacute, mucronate; sheaths petioliform, to 4.5cm long. *Inflorescences* arising terminally or laterally from defoliated pseudobulbs, 4–20-flowered in dense racemes (occasionally 1–2-flowered racemes are observed on small cultivated plants); peduncle distinct, 0.5–4cm long (usually elongated when plant is embedded deep in moss); bracts ovate, acuminate. *Flowers* 1.4–2.1cm long, long-lasting, bright purple with orange labellum apex. *Dorsal sepal* 6–13 × 2–3.5mm, oblong-lanceolate, carinate, acuminate. *Lateral sepals* 14–21 × 3–4mm, carinate, strongly acuminate; basal fused part 2.5–4mm long, cylindrical to subconical; mentum total length 6–10mm, tip obtuse to truncate or bilobed. *Petals* 4–9 × 1–2mm, linear-lanceolate, acute to acuminate. *Labellum* 11–16 × 2–2.5mm, subtrilobate, linear, adnate to column foot at base, with central U- or V-shaped cross-ridge, apex narrowly triangular, acute. *Column* c.2mm long; foot 6–10mm long; anther c.1.25mm broad; pollinia c.1mm long. *Ovary* 5(–6)-winged, pedicel-ovary 9–17mm long. *Fruit* not observed.

Distribution: New Guinea, New Britain, Solomon Islands (Map 12); 19 collections examined.

EAST NEW GUINEA. Enga, Southern Highlands, Western Highlands, Madang, Morobe and Milne Bay Provinces.

NEW BRITAIN.

SOLOMON ISLANDS. Guadalcanal.

Epiphyte in montane forest, usually in association with mosses in shade, 800–2400m.

D. petiolatum has a reasonably wide distribution in East New Guinea, and is one of three *Oxyglossum* species so far recorded from New Britain. However, it is not common although it sometimes occurs abundantly in very restricted

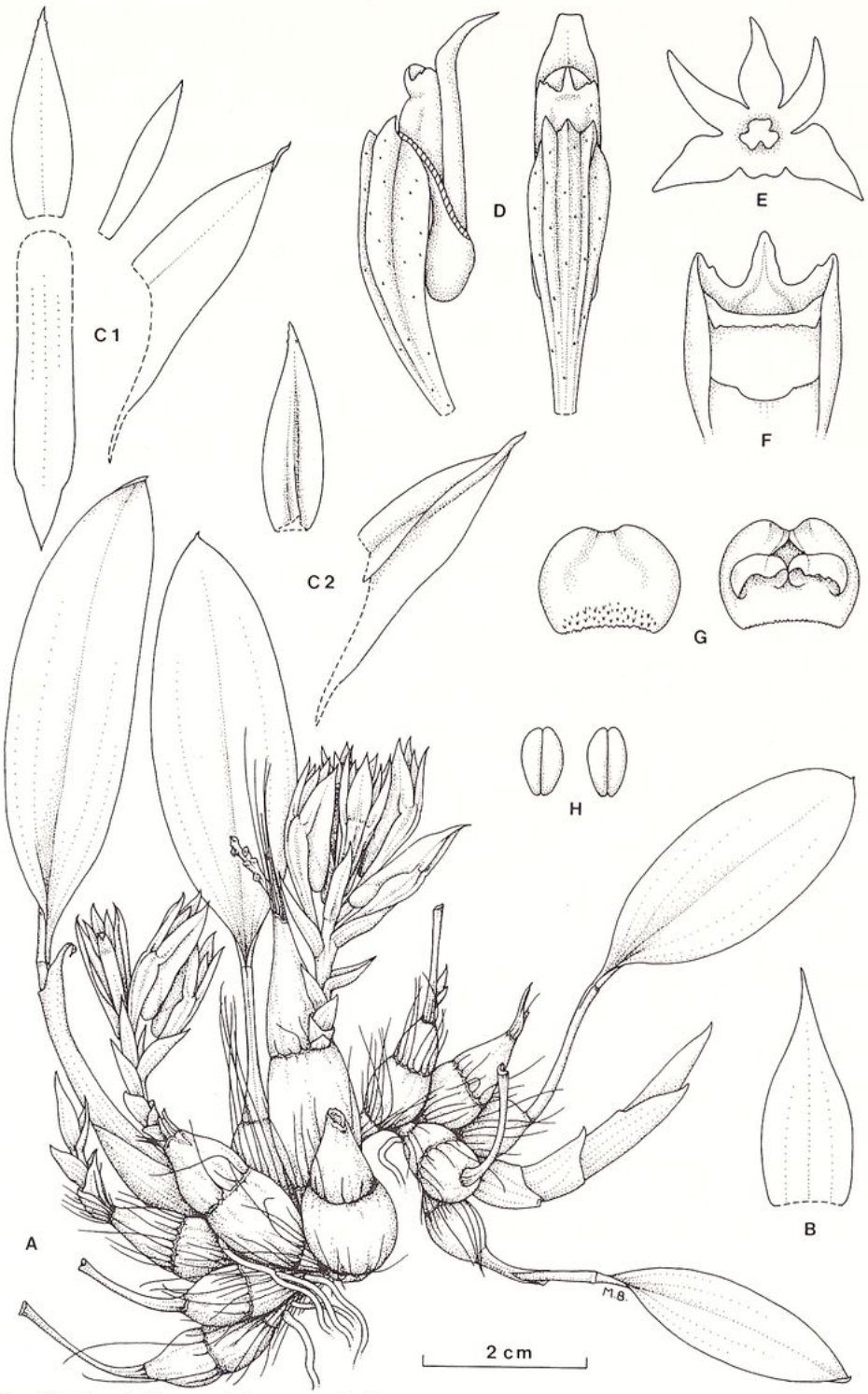


FIG. 31. *Dendrobium petiolatum*. A, habit; B, bract × 3; C, sepals, petal & labellum × 3; D, labellum, ovary & column × 3; E, ovary cross-section × 8; F, column tip × 8; G, anther cap × 8; H, pollinia × 8. All drawn from *Reeve* 288, RBGE 82.1014.

localities. Reeve has observed that it is fairly common on two separate ridges separated by 40km in the Paiela and Hewa areas of the Enga Province, but so far it has not been seen elsewhere in the Province.

This species often grows in large clumps of epiphytic mosses in deep shade on steep ridges where there is direct exposure to air movement. This appears to be a very delicate moisture/humidity/drainage balance.

D. petiolatum with its dense racemes of up to 20 flowers has many features in common with sect. *Pedilonum*, but the acuminate tepals, acute labellum and angled ovary warrant its inclusion within sect. *Oxyglossum*. The lateral sepals on this species are probably the most acuminate in the section. Other characteristics are the large petiolate leaves, the persistent fibres (from decayed sheaths) around the pseudobulbs, the long peduncles, the carinate sepals and the cross-ridge on the labellum.

Colour photographs of *D. petiolatum* appeared in the *Journal of the Orchid Society of Great Britain* 31 (4): 111 (1982), and also in Andreé Millar's *Orchids of Papua New Guinea*, (1978: 36). The latter photograph is under the incorrect name of *D. 'dryadum'*, and the habitat note about its occurring on *Casuarina* trees is highly doubtful.

The flowers, which last several months, are bright magenta purple and the lip apex is orange to yellow.

23. Dendrobium undatialatum Schlechter in Beih. Repert. Spec. Nov. Regni Veg. 1: 542 (1912) & 21: tab. 183, fig. 687 (1928)—Engl. transl. 576, 704–fig. (1982); Reeve & Woods in The Orchadian 6: 206 (1980). **Fig. 32.**
Type: East New Guinea, Madang Province, Finisterre Mountains, c.1000m, 13 vii 1908, *Schlechter* 17960 (iso. AMES (2 sheets), BO, E, K, L).

Syn.: *D. maboroense* Schltr in Beih. Repert. Spec. Nov. Regni Veg. 1: 543 (1912) & 21: tab. 184, fig. 688 (1928)—Engl. transl. 576, 704–fig. (1982). Type: East New Guinea, Morobe Province, Waria district, Maboro Mountains, c.1300m, v 1909, *Schlechter* 19509 (B†).

Pedilonum maboroense (Schltr) Rauschert in Feddes Repert. 94: 461 (1983).

P. undatialatum (Schltr) Rauschert *op. cit.* 465.

Tufted epiphyte, 5–10cm high. *Roots* slender 0.3–0.8mm diameter. *Rhizomes* very short, indistinct. *Pseudobulbs* 1.0–3.5 × 0.3–1cm, crowded, ovoid, 2–4-noded, basal internode usually surrounded by remains of sheath-fibres, apex 1- rarely 2-leaved. *Leaves* 1–9 × 0.6–2.7cm, sessile, elliptic to ovate or ovate-lanceolate, usually broadest below middle, many veined, 3–5 veins prominent, base usually rounded to somewhat cuneate and slightly folded, apex acute sometimes shortly acuminate, apiculate; sheaths smooth or ± ribbed, with age becoming fibrous. *Inflorescence* terminal, c.3.5cm long, pedunculate, scape c.1.5cm long, 1–8-flowered; bracts 4–7mm long, about half length of pedicel and ovary, ovate acuminate. *Flowers* 11–16mm long, not widely spreading, white sometimes pale green, labellum towards apex orange-yellow, tip white, or labellum flecked orange-yellow or sometimes purple or with 5 reddish nerves, column sometimes with a yellow spot. *Dorsal sepal* 8–10 × 2–2.5mm, oblong to lanceolate, mid-nerve distinctly keeled, apex acute. *Lateral sepals* 8–15 × c.3.5mm, narrowly triangular, mid-nerve distinctly keeled, apex acute, ± apiculate; basal fused part 2.5–3mm long, cylindrical; mentum total length 3–4mm long, tip obtuse, bilobed. *Petals* 8–9 × 2.5–3mm, oblanceolate

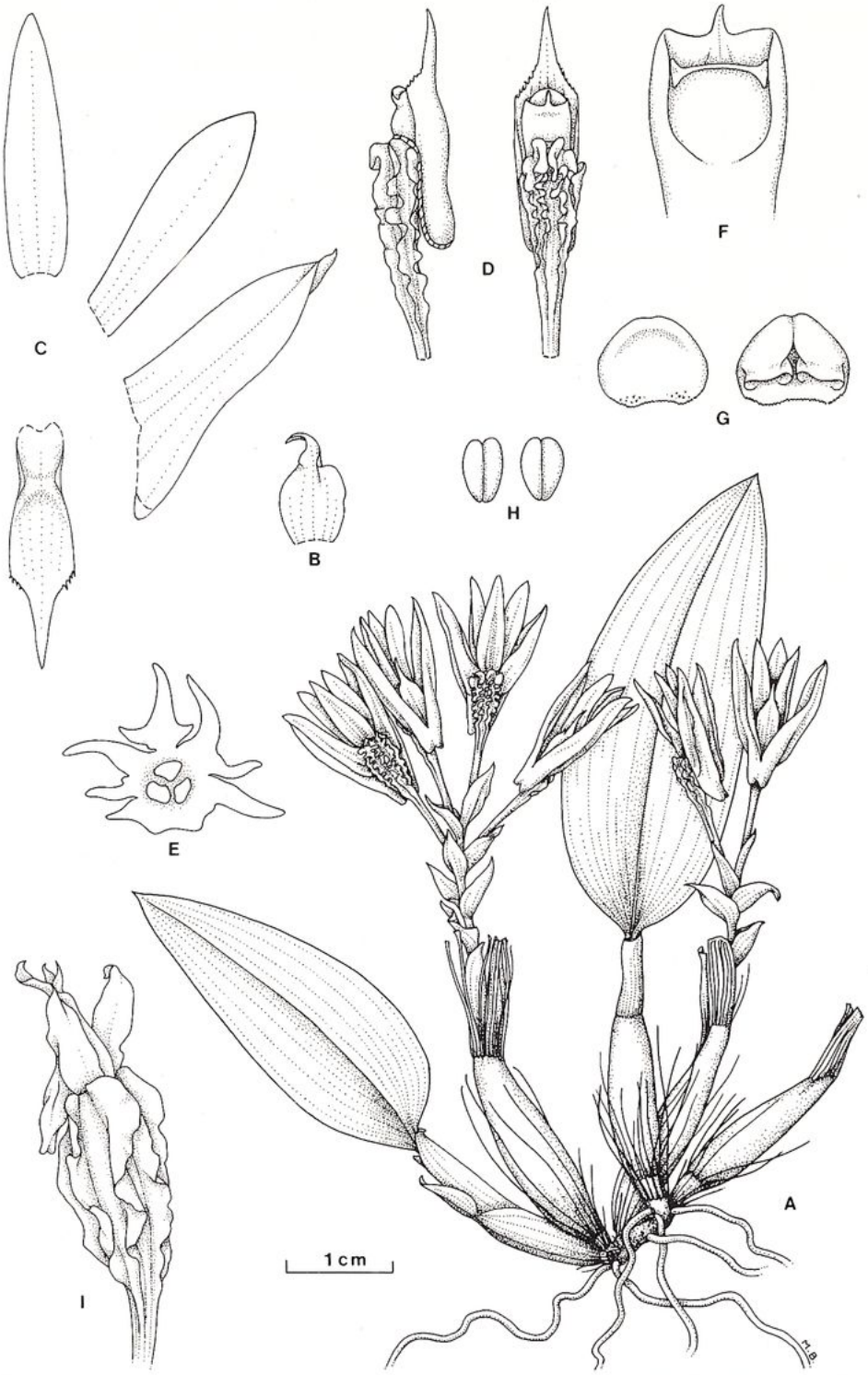


FIG. 32. *Dendrobium undatialatum*. A, habit; B, bract × 3; C, sepals, petal & labellum × 3; D, labellum, ovary & column × 3; E, ovary cross-section × 8; F, column tip × 8; G, anther cap × 8; H, pollinia × 8; I, fruit × 4. A drawn from *Schlechter* 17960 (type) with flowers from *Schlechter* 17960 and *Cruttwell* 498; B–H from *Schlechter* 17960; I from *Schlechter* 16092.

shortly acuminate. *Labellum* 8–9 × 2–3mm, subtrilobate, oblong, adnate to column foot at base, usually somewhat constricted towards middle, with [or without?] a transverse callus, margins ± incurved, apex not recurved, abruptly acuminate, acumen 1.5–3mm long with a finely denticulate-ciliate basal margin. *Column* c.2mm long; foot 3–4mm long; anther c.1.75mm broad; pollinia c.1mm long. *Ovary* with 6 (sometimes 5 or 7) distinctly undulate wings; pedicel-ovary 9–13mm long. *Fruit* 7 × 3.5mm, narrowly ovoid.

Distribution: New Guinea, Solomon Islands (Map 9); 4 collections examined.

EAST NEW GUINEA. West Sepik province: Torricelli mountains, c.900m, ix 1909, *Schlechter* 20147 (B†). Madang province: Finisterre mountains, c.1000m, 13 vii 1908, *Schlechter* 17960 (AMES, BO, E, K, L). Southern Highlands province: Erave, 1100m, iv 1983, *Reeve* 1084 (E). Morobe province: Waria district, Maboro mountains, 1300m, v 1909, *Schlechter* 19509 (B†). Milne Bay province: Bonenau, 4200ft, 2 vi 1964, *Cruttwell* 498 (K).

SOLOMON ISLANDS. Kolombangara: 2500ft, 4 ix 1965, *Hunt* 2534 (K).

Forest epiphyte, 900–1300m.

Schlechter regarded this species (originally called *undialatum* on his field labels) as somewhat aberrant within the section. Certainly the several-flowered raceme, short mentum, ± ciliate lip, strongly undulate ovary-wings and one-leaved pseudobulbs together make this species quite distinct from the others of the section.

Examination of the flower from a living plant collected at Erave, Enga Province, showed a slight cross-ridge on the lip. This ridge is not always easy to observe and can be difficult to see in dried specimens. This could account for the discrepancies in Schlechter's observations in his descriptions and drawings of *D. undatialatum* and *D. maboroense*.

A herbarium specimen at Kew of *Dendrobium purpureum* Roxburgh (sect. *Pedilonum*) from Minjemtor, Madang Province collected at c.100m in May 1909 (probably 1907, see Blaxell, 1982: 552 & 1179) by Schlechter (no. 16092) also includes a good flowering specimen of *D. undatialatum*. It seems unlikely that the latter species could have been collected at such a low altitude and the misplaced specimen is more likely to have originated from one of the other Schlechter collections cited above.

D. undatialatum seems an unusually uncommon species. Its sparse and evenly scattered distribution, as presently known, over the eastern half of New Guinea to Kolombangara at the western end of the Solomon Islands may be due to its being a somewhat insignificant species and therefore perhaps easily overlooked.

Two plants have been cultivated at 1600m in the Highlands of Papua New Guinea (at Nondugl), and grew reasonably well there on tree fern slabs. However, as far as we know no plants have yet been introduced to glasshouse cultivation.

24. Dendrobium lancilabium J. J. Smith in Bot. Jahrb. 66: 198 (1934); Reeve & Woods in The Orchadian 6: 206 (1980). **Fig. 33.**

Type: West New Guinea, Wandamen, Mount Wondiwoi, 1980m, 16 vii 1928, *E. Mayr* 370 (holo. L).

Syn.: *Pedilonum lancilabium* (J. J. Smith) Rauschert in Feddes Repert. 94: 460 (1983).

Erect to pendulous stemmed epiphyte. *Roots* 0.8–1.2mm diameter. *Rhizomes* short. *Stems* to 30 × 0.2–0.4cm, of ± uniform thickness, 5–22-noded, internodes 0.4–3.5cm long, slightly fractiflex (zig-zag), recorded as blackish, older stems

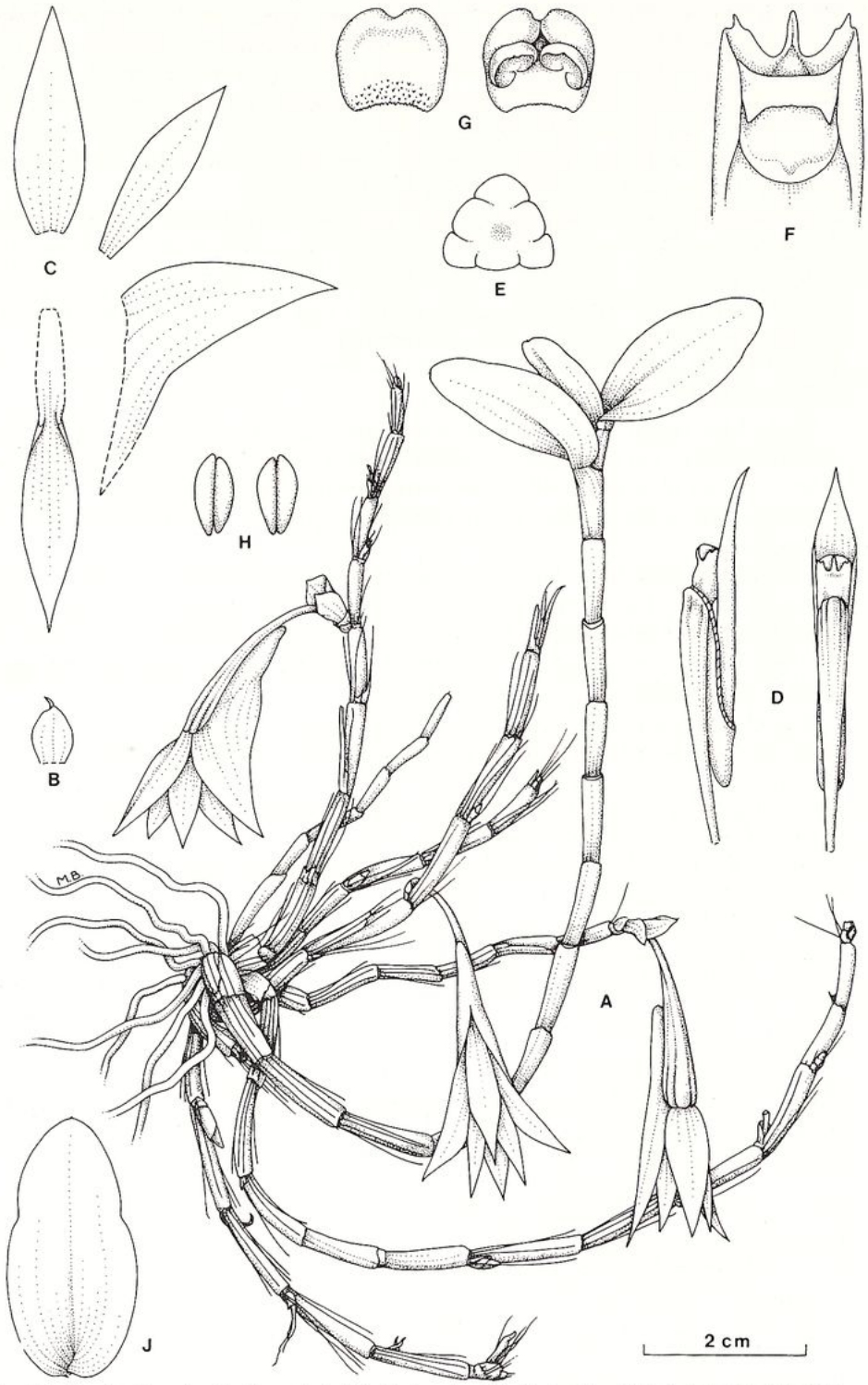


FIG. 33. *Dendrobium lancilabium*. A, habit; B, bract × 1.3; C, sepals, petal & labellum × 1.3; D, labellum, ovary & column × 1.3; E, ovary cross-section × 5; F, column tip × 5; G, anther cap × 5; H, pollinia × 5; J, leaf × 1. A drawn from *van Royen & Sleumer* 7290; B–J from *Mayr* 370 (type).

usually with several coarse fibres at nodes, with up to 5 leaves borne at upper nodes. *Leaves* 1.2–3.2 × 0.4–1.6cm, broadly elliptic, ovate or oblong, apparently always slightly but distinctly constricted above middle, many nerved with 3–5 more prominent than others, margins smooth or minutely crenulate, apex obtuse, mucronate, base rounded sessile; sheaths ± ribbed, persistent for some way down stem, becoming more fibrous with age. *Inflorescence* 1(–2)-flowered, sessile, terminal or from upper nodes of leafless stems; bracts 3–6mm long, ovate-acuminate, sheathing, membranous with rhaphids present. *Flowers* (27–)30–35(–38)mm long, blood-red to orange-red. *Dorsal sepal* 12–21 × 3–6.5mm, elliptic-lanceolate, acute to acuminate. *Lateral sepals* (17–)21–29 × 5–8.5mm, narrowly triangular, oblique, tips spreading, the apical free part curving outwards almost at right angles, apex acuminate; basal fused part 4–7mm, narrowly conical, mentum total length 15–18mm, tip obtuse. *Petals* 10–19.5 × 3–5mm, obliquely elliptic-lanceolate, apex acuminate. *Labellum* 15–30 × 2.5–5.5mm, ± subtrilobate, linear-lanceolate, margins adnate to column foot for c.7mm at base, transverse callus absent, margins of free part slightly incurved and indistinctly contracted in the upper $\frac{1}{3}$–$\frac{1}{4}$, apex acute, apiculate. *Column* c.3.5mm long; foot 14.5–18mm long, slightly curved; anther c.2.6mm broad; pollinia c.1.8mm long. *Ovary* triangular in cross section, narrowly clavate, 6-grooved and scurfy punctate, pedicel-ovary to 24mm long. *Fruit* not observed.

Distribution: New Guinea (Map 16); 3 collections examined.

WEST NEW GUINEA. Wandammen: *Mayr* 370. Vogelkop Peninsula: Aifat river valley, Tohkiri Mts East, summit area, opposite Waumi river, rather common, 1550m, 7–8 xi 1961, *van Royen & Sleumer* 7290 (L); *ibidem*, Nettoti Range, south slope of Mt Nettoti, path Andjai-Wekari river, 1650m, 27 xi 1961, *van Royen & Sleumer* 7347 (L).

Epiphyte in mossy forest; on trunk of *Nothofagus*, 1550–1980m.

Dendrobium lancilabium has two features which seem to be consistent: the abrupt narrowing of the apical $\frac{1}{2}$–$\frac{1}{4}$ of the ovate-oblong leaf-blade and the distinctive sweep of the tips of the lateral sepals at almost right angles to the ovary. Smith's description describes the inflorescence as 2-flowered but we have only observed 1-flowered inflorescences.

Although recorded in 1961 by van Royen and Sleumer as common in the Tohkiri mountains we have only seen three collections of this species represented in herbaria. It and the following species, *D. habbemense,* demonstrate the extreme range within this section. The long usually pendent stems and disposition of the flowers are more typical of section *Calyptrochilus* and some members of section *Pedilonum*. The triangular ovary of *D. lancilabium* and the shape of the flower is however sufficiently typical to justify Smith's inclusion of it in sect. *Oxyglossum*.

It is not in cultivation.

25. Dendrobium habbemense P. van Royen, The Alpine Flora of New Guinea, 2: 424, fig. 147 (1979). **Fig. 34; Plate 17A.**

Type: West New Guinea, Mt Wilhelmina, near Lake Habbema, 3225m, viii 1938, *Brass* 9022 A (holo. L, iso. AMES).

Syn.: *D. spathulatilabratum* P. van Royen *op. cit.*: 427, fig. 148. Type: East New Guinea, Chimbu Province, Mt Wilhelm, 3350m, 20 ix 1962, *van Royen* NGF 15125 (holo. L, iso. LAE).

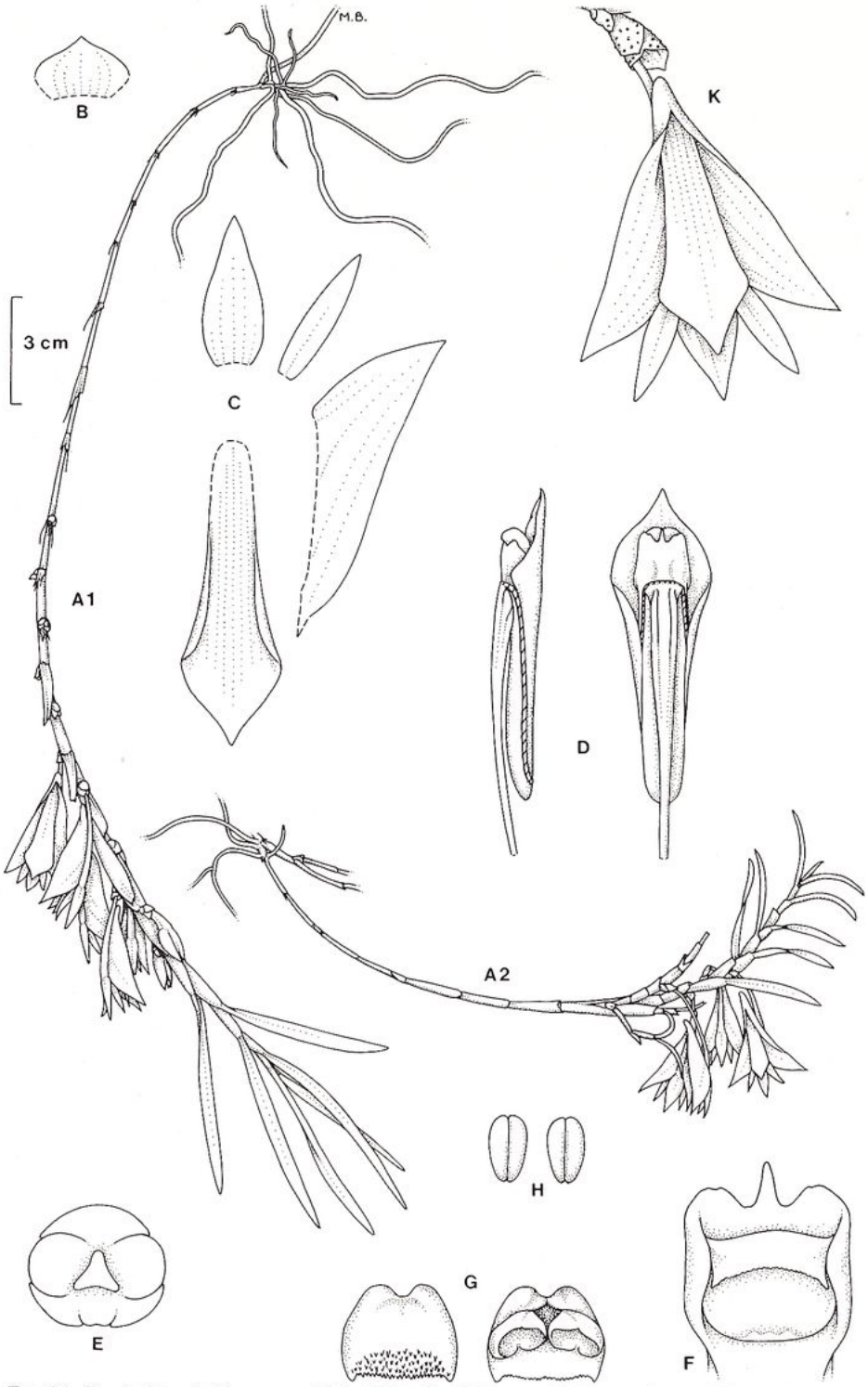


FIG. 34. *Dendrobium habbemense*. A1 & A2, habit; B, bract × 1.3; C, sepals, petal & labellum × 1.3; D, labellum, ovary & column × 1.3; E, ovary cross-section × 6.6; F, column tip × 4; G, anther cap × 4; H, pollinia × 4; K, flower × 1.3. A1 and B–K drawn from *Brass* 30538; A2 from *Brass* 9022A.

Pendulous, epiphyte up to 100cm long. *Roots* 1–2.5mm diameter, white. *Stem(s)* 10–100 × 0.2–0.7cm, pendent, curving, usually only a single slender stem at base, branching above and often thickening towards apex, nodes 0.3–3cm apart, leafy towards apex. *Leaves* 1–10 × 0.2–0.8cm, pendent to slightly spreading (more spreading and becoming plicate when exposed), linear, usually falcate, acute; sheaths warty (papillate), usually purplish. *Inflorescences* 1–10, single flowered (very rarely 2-flowered), spaced along apical part of stem just behind the leafy section, sessile; bracts cup-like with longer side apiculate, warty (resembling the bracts of *D. cuthbertsonii*), old bracts very persistent. *Flowers* 2.2–4.2cm long, usually widely opening (to 3.6cm broad), bright orange to orange-red (usually mentum is reddish to maroon). *Dorsal sepal* 9–17 × 4–8mm, subrhombic-elliptic to ovate-elliptic, acute. *Lateral sepals* 18–36 × 6–12mm, obliquely triangular, acute; basal fused part 2–7mm long (proportionately short for section), conical in sideview; mentum total length 13–24mm, ± falcate, tip obtuse. *Petals* 8–16 × 2–5mm, narrowly oblong-elliptic, subacute. *Labellum* 19–35 × 6–12mm, simple, spathulate-rhombic, obtuse to acute, adnate to column foot at base, not fused to lateral sepals, central margins up to widest part of labellum incurved. *Column* 4–6mm long; foot 13–24mm long; anther 2–4mm broad; pollinia 1–2mm long. *Ovary* regular, slightly 6-ribbed; pedicel–ovary 15–33mm long. *Fruit* not observed.

Distribution: New Guinea (Map 7); 43 collections examined.

WEST NEW GUINEA. Mt Carstenz and Mt Wilhelmina.

EAST NEW GUINEA. Enga, Southern Highlands, Western Highlands, Chimbu, Eastern Highlands, Madang, Morobe and Central Provinces.

Low pendulous epiphyte in montane and alpine forest and shrubberies, 2100–3500m.

D. habbemense is a distinctive species, with no close allies, and does not fit well into any of the established sections of this group. It has the single-flowered inflorescences and warty cup-like floral bracts of *D. cuthbertsonii*, and its long branched canes resemble some members of sect. *Calyptrochilus*. Possibly *D. habbemense* is best placed near to *D. juncoideum* and *D. womersleyi* in sect. *Pedilonum* which in New Guinea currently contains many disparate entities. However, we have decided to follow van Royen (1979) and to keep this species within sect. *Oxyglossum* because of its widely opened flowers which have acute perianth segments. Also, because of the bright orange coloured flowers, the pendulous habit, as well as its alpine habitat, *D. habbemense* is likely to be confused with some forms of *D. brevicaule* so it seems logical to keep it in this group for the present. When a fuller study is made of the subgenus, this species may be better accommodated elsewhere, perhaps in a new section or subsection (although unnecessary multiplication of small sections is not a practice we endorse).

Characteristics of this species to be noted are its pendulous curving habit, the very slender stem at the base becoming thicker apically, the persistent warty cup-like floral bracts and single-flowered inflorescences, the usually widely-opening flowers and the spathulate-rhombic labellum. The flowers are bright orange to orange-red in colour, with the mentum usually more reddish or maroon.

This species almost always grows in shaded habitats as a low epiphyte. The type (*Brass* 9022A) was collected from an exposed alpine position, and is

therefore much shortened with the leaves becoming plicate. However, all the other features are identical with the type of *D. spathulatilabratum* P. van Royen. When the two descriptions were published together in 1979, Dr van Royen commented as follows on *D. habbemense,* 'A species close to *Dendrobium spathulatilabratum* van Royen but differing in the plicate and shorter leaves'. Since we regard these differences as due solely to environmental causes we united the two species in our preliminary paper (1980), and chose the shorter name, *D. habbemense*, even though the type is slightly unusual.

This species has a wide distribution in New Guinea, its most westerly record being from Mt Carstenz in 1973 (*Raynal* 17687). Although widespread it is not common except in a few localities such as Mt Giluwe and Mt Wilhelm.

D. habbemense, being suspended by a single slender stem, and rooting only at the base is a very difficult species to establish and cultivate. Experience at Laiagam in Papua New Guinea has shown that it is best to take a small piece of twig or branch with the plant, and attach it to the tree-fern to avoid disturbing the roots unduly.

An interesting feature of this species is that flower size, as a general rule, is observed to be larger at higher altitudes.

26. Dendrobium prasinum Lindley in Journ. Linn. Soc. Bot. 3: 11 (1858); Reichenbach f. in Seeman, Flora Vitiensis 304 (1868); Drake del Castillo, Ill. Fl. Ins. Pacific 307 (1892); Rolfe apud Gibbs in Journ. Linn. Soc. Bot. 39; 174 (1909) & Gibbs *op. cit.*: 205; Williams in Bot. Mus. Leafl. Harvard 5: 123 (1938); B. E. V. Parham in Trans. Proc. Fiji Soc. Sci. Ind. 2: 32, pl. 3 (1953); J. W. Parham, Plants of the Fiji Islands 287 (1964), ed. 2: 382 (1972); Murray in Orchid Review 88: 116 (1980); Reeve & Woods in The Orchadian 6: 25 (1980); Warren in Brazilian Orchids Newsletter 2: 4 (1985); Blumhardt in Orchids in New Zealand 12: 160–161 photo., 196–197 (1986). **Fig. 35; Plate 17B & C.** Type: Fiji Islands, 2000ft, US Expl. Exped., drawing by Agati (Alfred T. Agate) (AMES).

Syn.: *Sarcopodium prasinum* (Lindley) Kränzlin in Engl. Pflanzenr. 45: 322 (1910).

Tufted epiphyte 8–18cm high, forming clumps to 15cm across. *Roots* c.1mm diameter. *Rhizomes* short, to c.10mm. *Pseudobulbs* 1–5 × 0.5–2cm, 1–4-noded, crowded, ovoid to fusiform or cylindrical, narrowing to the apex, at first covered with pale greyish sheaths, in herbarium specimens usually drying yellow or orange, the nodes sometimes marked with a blackish line usually banded above with orange, narrow apical part consisting of leaf-sheath remains, clothed and often overtopped by numerous bristle-like nerve fibres from old sheaths, apex 1–3(–4)-leaved. *Leaves* c.2.5–14 × 0.5–1.7cm, oblong to lanceolate, sometimes narrowly elliptic, rarely linear, main nerves often prominent, to 10, apex obtuse or acute, indistinctly mucronate, narrowed towards base and there laterally folded; sheaths smooth, mid-green, ± persistent. *Inflorescences* terminal, occasionally lateral, 1 or 2 arising from leafless, rarely leafy stems, (1–)2-flowered, subsessile; bracts to 9mm, ovate to orbicular, apiculate, membranous, greyish, many-nerved, sometimes sparsely brown-scurfy. *Flowers* 20–33mm long, widely opening to 4cm, lip usually, but not always, held uppermost, white to cream or pale yellow often tinged green, column bright green, mentum and ovary often pale green. *Dorsal sepal* 14–23 × 5–9mm,

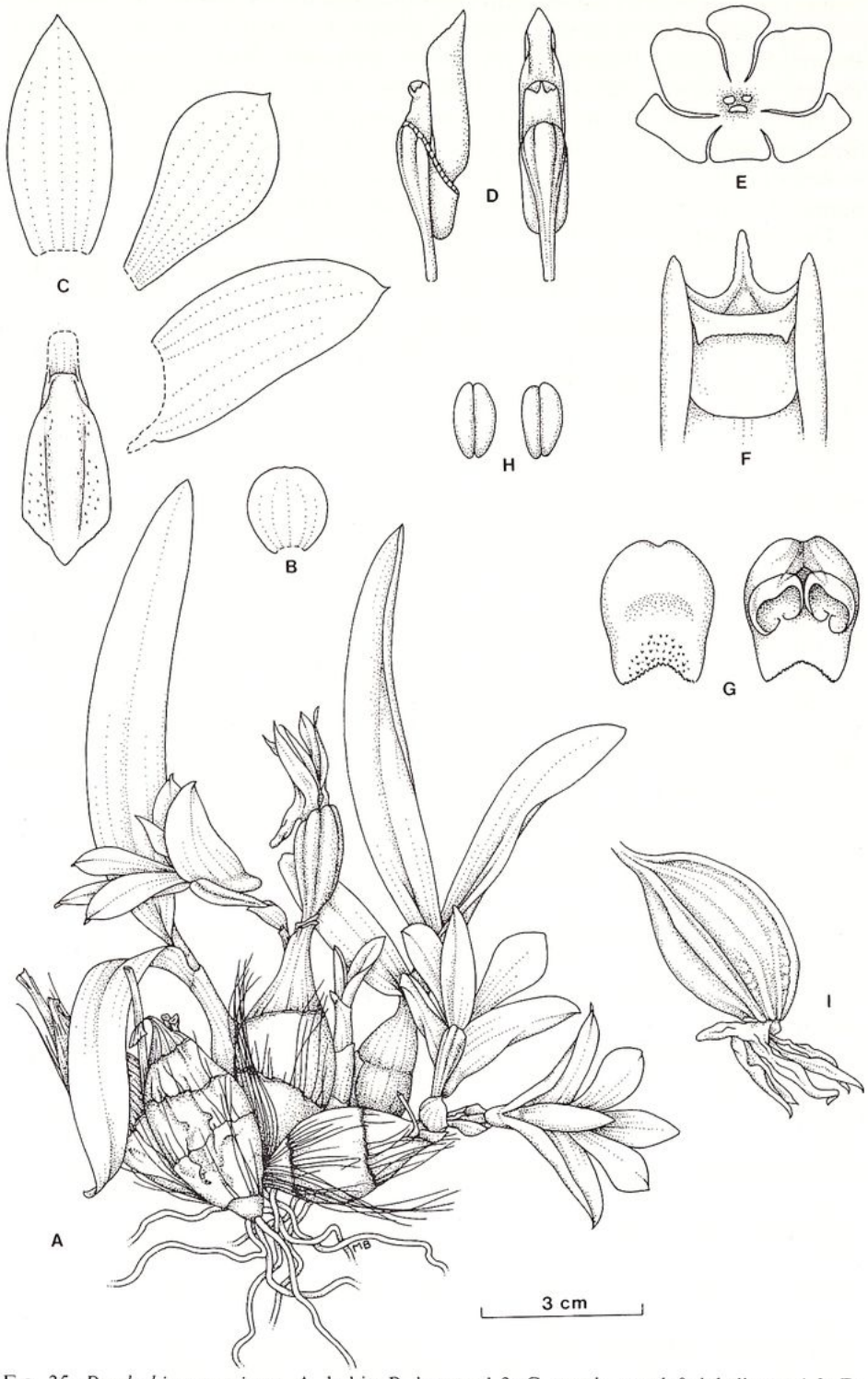


FIG. 35. *Dendrobium prasinum*. A, habit; B, bract × 1.3; C, sepals, petal & labellum × 1.3; D, labellum, ovary & column × 1.3; E, ovary cross-section × 6; F, column tip × 6; G, anther cap × 6; H, pollinia × 6; I, fruit × 1. All drawn from *Murray*, RBGE 82.2623.

oblong-elliptic, shortly acuminate. *Lateral sepals* 14–30 × 5–10mm, obliquely oblong, upper margin curved, lower margin ± straight, shortly and abruptly acuminate, slightly ridged on reverse; basal fused part 2–3mm, greenish, broadly cylindrical; mentum total length (5–)6–9mm, tip obtuse. *Petals* (13–)15–23 × 4–11mm, obovate to oblanceolate, apex apiculate. *Labellum* 18–23 × 4–6mm, greenish, strongly boat-shaped, papillose, margins up-curved to 4mm at highest point, floor flat, with a slight concavity towards base, obovate to oblanceolate when flattened, basal $\frac{1}{4}$ adnate to column foot, apical part free with margins curved slightly around column, apex somewhat cucullate, acute. *Column* c.4 × 2–4mm, green; foot 6–9mm long; anther 3mm broad, white; pollinia c.1.75mm long; *Ovary* obscurely triangular to rounded with 5 obtuse ribs; pedicel-ovary 12–18mm long. *Fruit* 26 × 15mm, ovoid.

Distribution: Fiji Islands (Map 8); 19 collections examined.

VITI LEVU. Mba: Mt Koroyanitu, Mt Evans, Mt Koromba, Nadarivatu, Mt Tomanivi. Nandronga and Navoso: Rairamatuku Plateau between Nandrau and Nanga, Monasuva.

KANDAVU. Mbuke Levu.

VANUA LEVU. Mathuato: Mt Ndelaikoro. Thakaundrove: Mt Ndikeva.

TAVEUNI. Near Somosomo.

NORTHERN LAU GROUP. Yathata: Navakathura.

Epiphyte on trunks, forks or horizontal branches of trees (e.g. *Metrosideros*) sometimes above streams in dense sometimes open mossy forest, 600–1150m.

We have here the unusual situation where an illustration of a plant represents the type of the species. Alfred T. Agate was one of two artists who accompanied the United States Exploring Expedition to Fiji under Captain Charles Wilkes in 1840 (Bartlett, 1940: 628) and it is Agate's water colour drawing in the Oakes Ames orchid herbarium at Harvard which represents the holotype of *Dendrobium prasinum*. Of this, Lindley (loc. cit) states, 'A very distinct plant of which I only know a drawing by Agati [sic], in the possession of my learned friend Prof. Asa Gray. The flowers are sea-green, nearly two inches in diameter. The sepals about $\frac{3}{8}$ of an inch wide.'

Lindley's 'sea-green' is misleading until the Agate water-colour is studied. Here a green wash has been used to convey the pale colour of the flowers, painted on a creamy white paper. No notes on flower colour accompany the painting. The type sheet at Harvard also includes a letter sent by Lindley to Asa Gray when returning the painting in which he relates *D. prasinum* to *D. muscicola* (*Eria muscicola* Lindl., a small greenish-white, not dissimilar plant from continental Asia) and to his own *D. subacaule* at that time not yet described. Curiously the type description carries no reference to even this latter affinity.

Also on the sheet is a fragmented but adequate specimen collected during the Wilkes expedition labelled 'Mudthwata Mts' and possibly from which Agate drew his dissectional drawings. However as it was all that Lindley saw, Agate's work remains the type.

Nothing more was known of this plant until 20 years later when it was collected by Berthold Seemann, the botanist selected by W. J. Hooker, director of Kew, to join the British Government Commission to Fiji. During the six months which Seemann spent there he worked with great energy amassing a large collection of dried specimens of which 35 numbers were orchids; two thirds of these were described as new by Reichenbach who worked up the results of that family for Seemann.

The first set of Seemann's collections is at Kew, the only sheet of *D. prasinum* being number 597. This was originally labelled (presumably by Seemann) '*Eria* near *E. braccata* [sphalm *baccata*] Lindley' a not unreasonable guess, but that superficially similar orchid only occurs in Ceylon and Southern India and interestingly is very close to *E. muscicola* to which Lindley, in litt., had likened the type. This number (*Seemann* 597) agrees with his list in *Bonplandia* 9: 260 (1861) and also with Kränzlin's citation. On the other hand Reichenbach in his account and Drake del Castillo and Williams in theirs all cite '596' under *D. prasinum*. In *Bonplandia* (loc. cit.) Seemann lists this number as *Eulophia macrostachya* Lindley?, a name which does not appear in his later *Flora Vitiensis*. Without further search we are inclined to think that both the Reichenbach and the Williams references to *Seemann* 596 as *Dendrobium prasinum* are in error.

The islands of Fiji represent, with *Dendrobium prasinum, D. delicatulum* and *D. masarangense*, the most easterly station for the section. Both geographically and taxonomically *D. prasinum* is closest to *D. laevifolium* and the relationship is discussed under that species. Pale coloured forms of *D. laevifolium* can be distinguished by their longer mentum.

Several references to *D. prasinum* are made by Blumhardt (loc. cit.) and the observation recorded of a plant growing for at least a couple of years on a clay bank where it must have been blown by a storm; it had by far the best root system of any other plant of this species which had been found, the roots penetrating into the clay by several inches. The bank was near vertical and would have had perfect drainage. Attention is also drawn to the fact that it 'seems very like *D. sophronites* but white'.

The herbarium specimens which we have had at our disposal all display a fair degree of homogeneity as does living material which has been part of the study collection at Edinburgh since September 1982. We are especially grateful both to the late Mrs Jean Murray, for arranging to obtain these plants for us and to Mr Don Burness who with Mr Saula Vodonaivalu made the expedition to Mt Nadarivatu, Viti Levu, to collect them. Mrs Murray (pers. comm.) grew a plant of *D. prasinum*, though not with ease, for seven years in her garden at Suva, which is at sea level. Blumhardt (pers. comm.) has successfully grown five plants at Whangarei, New Zealand. Pot-grown plants have grown better than those on tree-fern slabs probably because they do not dry out as excessively under his conditions as do the plants on the slabs.

Plants at Edinburgh appear to grow equally well in either 'cool' or 'intermediate' conditions but seem to be more floriferous in the 'intermediate' house; a longer trial under these regimes will be necessary before these observations can be confirmed. In nature plants are recorded as flowering during July and from February to October; in cultivation the Edinburgh plants bloom between July and April. The flowers last three months at most.

The field label of *Smith* 5232 records the native name as 'Kambaleka'. A good illustration of *D. prasinum* was featured as 'white orchid' on a two shilling Fiji stamp several years ago.

27. Dendrobium laevifolium Stapf in Curtis' Botanical Magazine tab. 9011 (1924); Wilson (ed) in The Orchid Review 32: 251 & 280 (1924); J. S. Womersley in Australian Orchid Review 32: 131–132 (1967). **Fig. 36; Plate 18A.**
Type: 28 ii & 1 iii 1923, illustrations; 25 v 1923, hort. *Colman*; 20 viii 1923, hort.

Kew (K–all on one sheet grown from material collected S E New Guinea, Louisiade Archipelago, Rossel Island, *J. C. Frost*).

Syn.: *D. occultum* Ames in Journ. Arn. Arb. 14: 108 (1933). Type: New Hebrides, Santa Cruz group, Vanikoro, 800m, 11 xi 1928, *Kajewski* 604 (holo. AMES).

Pedilonum occultum (Ames) Rauschert in Feddes Repert. 94: 462 (1983).

Tufted epiphyte, 2.5–18cm high. *Roots* to c.2mm diameter. *Rhizomes* short, to c.0.5cm. *Pseudobulbs* 0.7–4.5 × 0.2–1cm, to c.6-noded, cylindrical, fusiform, flask-shaped or ovoid, crowded, apex 2-, occasionally 3-leaved (the third leaf then very small). *Leaves* (1.5–)5.5–14.5 × 0.5–2.5cm, linear, oblong-lanceolate or elliptic, moderately thick, green or deep green, sometimes suffused purple below and at margin and mid-nerve, apex acute or subacute, mucronate, subpetiolate; sheaths ± tubular to c.2cm or more long, smooth, mid-green, separating with age into loose spreading fibres. *Inflorescences* 1–2(–4)-flowered, mostly from leafless stems, terminal or from upper nodes, subsessile; bracts to 8 × 8mm rotundate to ovate-triangular, shortly acuminate or apiculate. *Flowers* 2–4.5cm long, to 4.5cm wide, colour variable, cream, cream suffused pink, red, reddish purple or purple-pink, labellum similarly coloured or paler, sometimes orange, margin yellow, pink or orange, column pale green or pink. *Dorsal sepal* 12–25 × 5–11mm, elliptic-oblong to ovate-oblong, slightly keeled towards apiculate apex. *Lateral sepals* 20–30 × 5–10mm, oblong to ovate, gradually tapering towards acute or apiculate apex; basal fused part 4–7mm long, tubular to narrow conical; mentum total length 8–20mm, tip obtuse. *Petals* 12–19 × 6–11mm, obovate, rotundate or oblanceolate, apex obtuse apiculate. *Labellum* to 21 × 3mm (c.6mm when expanded), oblanceolate, boat-shaped, papillose, margins upcurved, apex apiculate, with a ± crescent-shaped, shallow transverse callus c.6mm above the base. *Column* 4.5–5 × c.2.5mm; foot 8–20mm long, with a minute angular flap c.2.5mm from base; anther 1.5–2mm wide; pollinia 1–1.5mm long. *Ovary* obscurely triangular, angles rounded, shallowly 6-grooved; pedicel-ovary (8–)10–28mm long. *Fruit*. 28 × 10mm, oblong-ovoid.

Distribution: New Guinea, Bougainville, Solomon Islands, Santa Cruz Islands (Map 8); 15 collections examined.

EAST NEW GUINEA. Louisiade Archipelago: Tagula (Sudest) Island, Rossel Island.
BOUGAINVILLE. Mt Chonopau.
SOLOMON ISLANDS. Santa Ysabel: Mt Sasari. Guadalcanal: Mt Popamanatseu, Mt Jonapau.
SANTA CRUZ ISLANDS. Vanikoro Island.
VANUATU. Espiritu-Santo.

Epiphyte in moss forest, often growing in thick moss near the base of trees or moss covered saplings, 360–2135m.

The type sheet at Kew comprises three separately collected pieces: two from Sir Jeremiah Colman's plant at Gatton Park, one dated 25 v 1923, and one from a plant grown at Kew collected 20 viii 1923 (this bears the 'type specimen' label). Also included on the sheet is a very rough dissectional sketch dated 28 ii 1923 and a good, partly coloured drawing of 1 iii 1923. There is no reason to doubt that these all derive from the original collection.

Before describing this species as new, Otto Stapf submitted a small flowering specimen to J. J. Smith for comment. Smith suggested that it was a variety of *D. asperifolium* (= *D. cuthbertsonii*) but the absence of wart-like protuberances on the leaves was sufficient to convince Stapf that he was dealing with a distinct

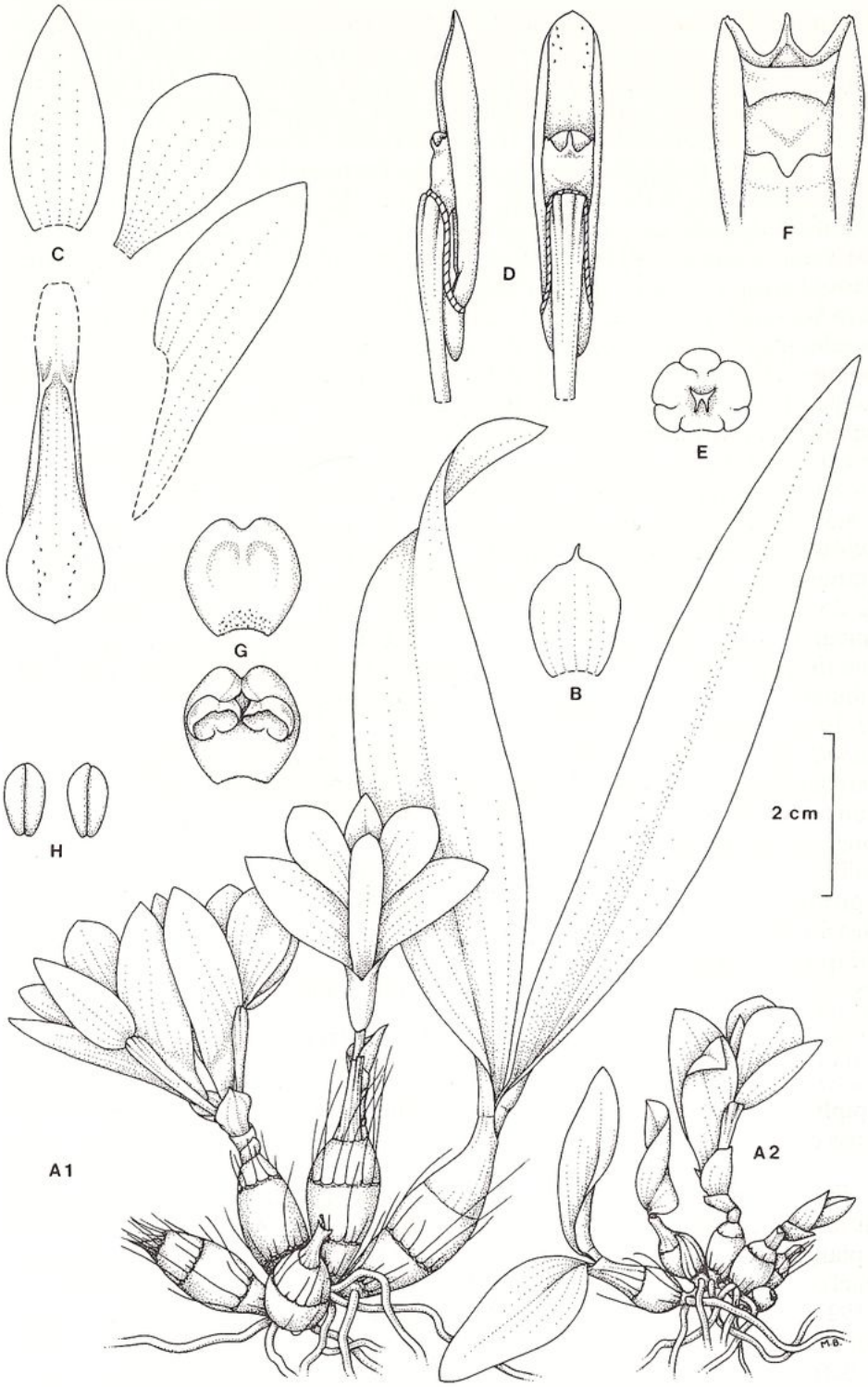


FIG. 36. *Dendrobium laevifolium*. A1 & A2, habit; B, bract × 2; C, sepals, petal & labellum × 2; D, labellum, ovary & column × 2; E, ovary cross-section × 6; F, column tip × 6; G, anther cap × 6; H, pollinia × 6. A1 drawn from *Brass* 27856; A2 from *Brass* 3271; B–H from *Frost* (type).

species with at most an affinity to *D. asperifolium*. Small plants of *D. laevifolium*, for example *Brass* 3271 (AMES) from Mt Sasari on Santa Ysabel, *Hunt* 2960 (K, L) & 2981 (K) from Mt Popamanatseu on Guadalcanal and indeed the plant rather poorly portrayed in the Botanical Magazine could, at first glance, be mistaken for *D. cuthbertsonii*. Hunt (1969) in fact misidentified his collections as *D. sophronites* and this mistake is further perpetuated as *D. cuthbertsonii* by Thorne & Cribb in the introduction (but not the check list) to *Orchids of the Solomon Islands and Bougainville* (1984: 2). Close examination for the differences as indicated by Stapf, i.e. the absence of warts on leaves and ovaries, should ensure accurate identification.

Almost 10 years after Stapf, Oakes Ames gave the same affinity when describing *D. occultum* but also drew attention to the similarities in habit to *D. pentapterum* and *D. cuthbertsonii*. In addition he later annotated the type sheet at AMES (*Kajewski* 604) 'in Bernice P. Bishop Museum herbarium is a specimen of this species [*D. occultum*]. Its data are: Fiji, Vanua Levu . . . June 5–6 1934, *A. C. Smith* 1901 . . .'. Although we have not seen Smith's specimen it has been determined as *D. prasinum* (Paul Kores, pers. comm.). There is undoubtedly an overall similarity between *D. laevifolium* and *D. prasinum* and in fact one of us (Woods) initially included *D. occultum* with *D. prasinum* although its correct placement later became clear. The relationship between *D. prasinum* and *D. laevifolium* will be more fully understood when further collections and field observations, particularly from the Santa Cruz and New Hebridean (Vanuatu) islands, are available for study. A collection at NSW (*Quaife* 348, New Hebrides, from Santo Island) appears to be intermediate between the two species.

The main differences between the two species are in the mentum length (6–9mm long in *D. prasinum* and 8–20mm in *D. laevifolium*) and in the flower colour (cream-coloured or whitish in the former and predominantly reddish or purplish in the latter).

We did not include *D. laevifolium* in our preliminary key (1980) nor did we comment on its exclusion which, despite Stapf describing it as an *Oxyglossum* dendrobium was due to our thoughts that it was more closely related to *D. cuthbertsonii* and must therefore belong to section *Cuthbertsonia*. As explained in the Introduction (p. 163) there seems no justification at the moment for keeping the sections separate.

The species is found in deep moss. Of *D. occultum* Ames states that the specific name alludes to the tendency of the flowers to be hidden by the moss in which the plants are growing. J. S. Womersley (*loc. cit.*), writing about the rediscovery of *D. laevifolium* on Rossel Island by Henty & Slade in the 1960's quotes Henty's vivid description of the habitat which is consistent with that described by G. Dennis of Honiara, Solomon Islands, to whom we are indebted for the many detailed notes from his field observations which from time to time he has sent us. The following note accompanied a plant of *D. laevifolium* which he presented to the Royal Botanic Garden Edinburgh in 1981. '. . . collected on the cold, mist-shrouded, mossy summit of Mt Chonopau at 4200ft 1980, deteriorating after 10 months [cultivation] at sea level at Honiara where the climate is hot and desiccating. In nature *D. laevifolium* occurs in deep growths of lichen and moss on the trunks or slightly sloping branches of treelets a few feet above the mossy elfin forest bed almost constantly saturated with cold mist or light rain with brief bursts of very hot sunshine'.

Although the plant received from Mr Dennis did not survive it did produce in December 1984 one small cream-coloured flower with very faintly lilac-flushed sepal tips, and a cream anther with a pale, but distinct lilac flush. The leaves were short, 3.1cm long and the margins, mid nerves and petioles were purplish.

J. C. Frost's collection of *D. laevifolium* from Rossel Island in the Louisiade Archipelago must have been the first introduction of an *Oxyglossum* dendrobium into cultivation and for a while, at least, was successfully grown. Mr Collier, grower to Sir Jeremiah Colman (of mustard fame), Gatton Park, Reigate, Surrey had grown the plant of this in a shallow pan suspended high up near the glass roof of a house with intermediate temperature and a rather moist atmosphere and never allowed to go very dry. Colman's plant was awarded a Botanical Certificate by the Royal Horticultural Society on 24 June 1924 and was described in *The Orchid Review* as 'a singular species of densely tufted habit and bearing about forty spikes each having from two to four flowers of deep rose colour'. As already indicated the Gatton Park plant (or plants) had flowered during February, March, May and August of 1923.

Seedlings kindly grown on by R. C. Warren (Edinburgh) from protocorms generously presented to the Royal Botanic Garden by Mr G. C. Stocker (Malanda, Queensland) in 1982 and since distributed elsewhere have flowered well in cultivation: a plant grown by Mr Z. Urdzins of Warwick won third prize in the 1986 Orchid Review 'Orchid of the Year' award (see *Orchid Review* 94: 130–131, fig. 113, 1986) and one grown by Dr C. Maunder, Sheffield was exhibited at the Orchid Conference and Show held in Glasgow in September 1988.

Mr Stocker (1983) describes *D. laevifolium* as a vigorous species which is easy to grow, the flowers only varying a shade or two from the typical mauve colour. The source of Stocker's plants is Rossel Island.

28. Dendrobium cuthbertsonii F. von Mueller in Trans. Roy. Soc. Vict. 24: 175 (1888); Kränzlin in Engl. Pflanzenr. 45: 256 (1910); Schlechter in Beih. Repert. Spec. Nov. Regni Veg. 1: 524 (1912)–Engl. transl. 564 (1982); Reeve in the Australian Orchid Review 46: 105–colour photo, 109 (1981); Woods & Cullen in Walters *et al.* (eds) The European Garden Flora 2: 216 (1984); Cribb, Reeve & Woods in The Kew Magazine 2(3): t.37 (1985); Warren in Brazilian Orchids Newsletter 2: 4 (1985); McGraith in the Australian Orchid Review 51(2): 15–16 (1986) and in Orchid Review 94: 406–408 (1986); Rentoul, The Specialist Orchid Grower 56 (1987); Northen in Orchid Digest 52: 4 (1988).

Fig. 37; Plates 18–20.

Type: East New Guinea, Mt Obree, 6000–8000ft, *Cuthbertson & Sayer* s.n. (holo. MEL; iso. BRI, K).

Syn.: *D. agathodaemonis* J. J. Smith in Bull. Dep. Agr. Ind. Neerl. 39: 7 (1910); Kränzlin *op. cit.* 360; J. J. Smith in Nova Guinea 8: 576 tab. 96B (1911) & 12: 73–74 (1913), 335 (1916) and in Gibbs, Contrib. Phytogeog. and Flora Arfak Mts 120 (1917); Mansfeld in Bot. Jahrb. 62: 472 (1929); Reeve in The Orchadian 6: 36–39 (1978); van Royen, The Alpine Flora of New Guinea 2: 395–397, fig. 136 (1979). Syntypes: West New Guinea, Alkmar to Hellwig Mts, *von Roemer* 710 (BO–n.v.), Agathodämons Mt, *von Roemer* 1296 (BO). Note: The lectotype chosen by van Royer (*op. cit.* 397) is invalid as it is not one of the original syntypes.

D. asperifolium J. J. Smith in Bull. Jard. Bot. Buitenz. sér. 2, 2: 13 (1911) and in Nova Guinea 12: 72, tab. 19 fig. 57 (1913) and 14: 424 (1929). Type: West New Guinea, Mt Goliath, 900m, *de Kock* 15 (BO n.v.).

D. sophronites Schltr in Beih. Repert. Spec. Nov. Regni Veg. 1: 524 (1912) & 21: tab. 177, fig. 663 (1928)–Engl. transl. 564, 698–fig. (1982); Reeve in The Orchadian 6: 36–39 figs. p. 37–38 (1978); Millar, Orchids of Papua New Guinea 14–15, colour photos (1978); Northen, Miniature Orchids 66, pl.C–25 (1980); Bechtel, Cribb & Launert, Manual of Cultivated Orchids 124, 202–colour photo (1981); Dressler, The Orchids 106, 231, t. 11 f. 65 (1981); Schelpe in South African Orchid Journal 12: 81 (1981); Karasawa, Orchid Atlas 4: 106 t. 122, 249 (1986). Type: East New Guinea, Bismarck Mts, c.2200m, xi 1908, *Schlechter* 18800 (B†).

D. trachyphyllum Schltr in Beih. Repert. Spec. Nov. Regni Veg. 1: 525 (1912) & 21: tab. 178, fig. 664 (1928)–Engl. transl. 565, 698–fig. (1982). Type: East New Guinea, Dischore Mts, c.1300m, vi 1909, *Schlechter* 19678 (B†).

D. coccinellum Ridley in Trans. Linn. Soc. Bot. ser. 2, 9: 174 (1916). Type: West New Guinea, Mt Carstenz, Camp III, 2500ft, *Kloss* s.n. (holo. BM, iso. K).

D. euphues Ridley *loc. cit.* Type: West New Guinea, Mt Carstenz, Camp VIc, c.5500ft, *Kloss* s.n. (holo. BM, iso. K).

D. fulgidum Ridley *op. cit.* 173 non Schltr (1912). Type: West New Guinea, Mt Carstenz, Camps X to XI, 6700–8300ft, *Kloss* s.n. (holo. BM; iso. K).

D. fulgidum var. *purpureum* Ridley *op. cit.* 174. Type: *ibid.* (holo. BM, iso. K).

D. laetum Schltr in Bot. Jahrb. 58: 107 (1923)–nom. nov. for *D. fulgidum* Ridley non Schlechter.

D. atromarginatum J. J. Smith in Nova Guinea 14: 422, tab. 66 fig. 73 (1929). Syntypes: West New Guinea, Mt Carstenz, bivouac B, 1330m, viii 1914, *Doorman* 16, 17 (BO n.v.).

D. lichenicola J. J. Smith *op. cit.* 423 f. 74. Type: West New Guinea, Mt Carstenz, bivouac C, 1800m, vii–viii 1914, *Doorman* 18 (BO n.v.).

D. carstenziense J. J. Smith *op. cit.* 425–nom. nov. for *D. fulgidum* Ridley non Schltr.

Pedilonum cuthbertsonii (F. von Mueller) Brieger in Schltr, Die Orchideen ed. 3, 1(11/12): 682 (1981).

Pedilonum asperifolium (J. J. Smith) Brieger *loc. cit.*

P. coccinellum (Ridley) Rauschert in Feddes Repert. 94: 458 (1983).

P. euphues (Ridley) Rauschert *op. cit.* 459.

P. sophronites (Schltr) Rauschert *op. cit.* 464.

Epiphyte, or occasionally terrestrial, 2–8cm high, usually tufted and clump-forming sometimes to 12cm diameter, or occasionally forming loose, sometimes shortly branched, prostrate or ascending stems. *Roots* 0.5–1.5mm diameter, white, often pinkish to purplish when wet, tips green. *Rhizomes* short, or often elongated if growing in thick moss or in heavy shade. *Pseudobulbs* 0.5–8(–14) × 0.1–0.7cm, spheroid, ovoid or clavate, sometimes stem-like and then sometimes shortly branched, branches 0.6–2.5cm, 2–4 noded (or many-noded on long-stemmed forms); 1–5-leaved, leaves ± terminal, sometimes many

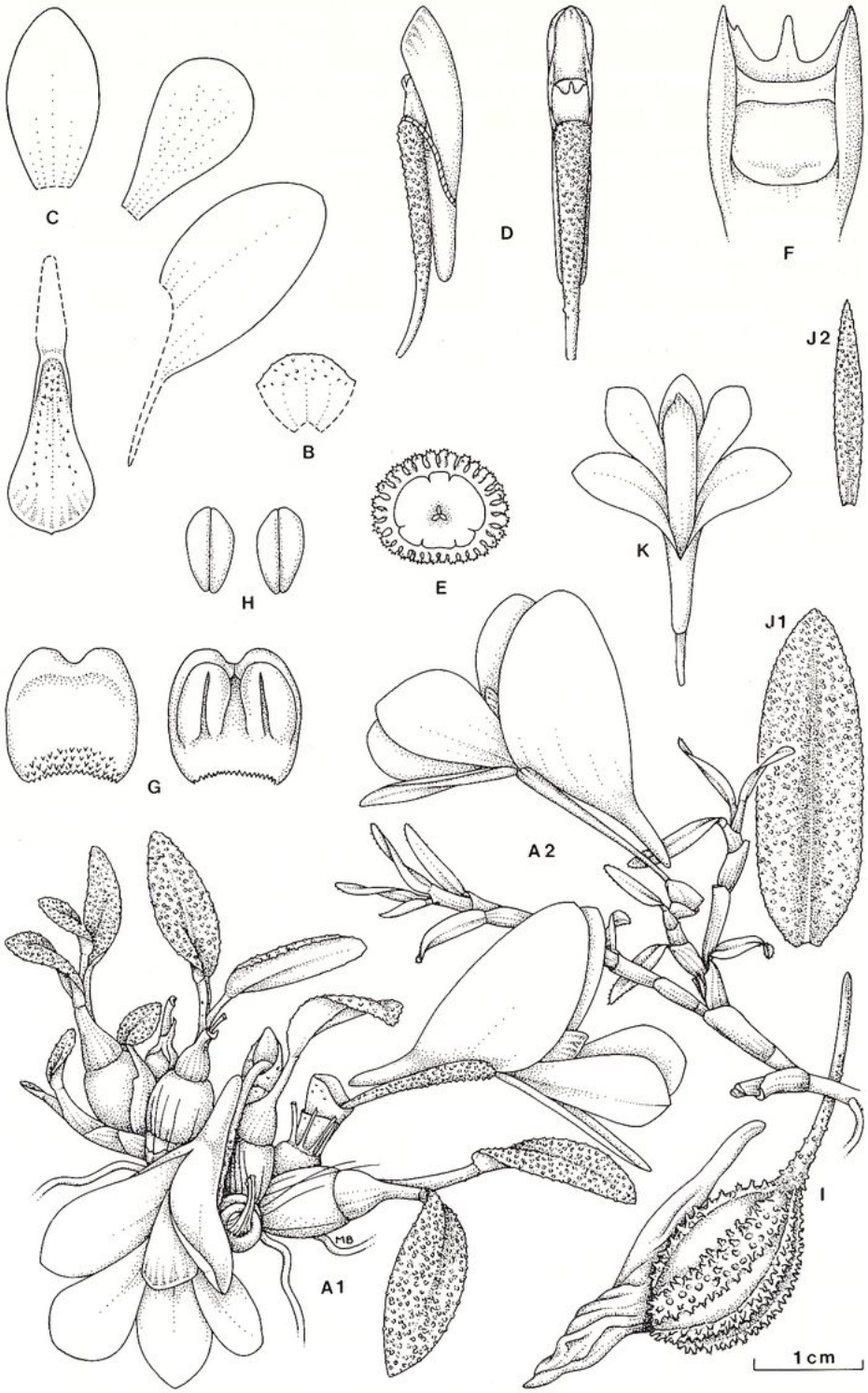


FIG. 37. *Dendrobium cuthbertsonii*. A1 & A2, habit; B, bract × 1.3; C, sepals, petal & labellum × 1.3; D, labellum, ovary & column × 1.3; E, ovary cross-section × 6; F, column tip × 6; G, anther cap × 6; H, pollinia × 6; I, fruit × 1.3; J1 & J2, leaves × 1.3; K, flower × 1.3. A1 and B–H drawn from *Woods* 1821A, RBGE 76.0382; A2 from *Pulle* 880; I from *Henty et al.* 41694; J1 from *Brass* 12890; J2 from *Cuthbertson & Sayer* (type); K from *van Royen & Sleumer* 7873.

and then scattered along elongate stems, erect or spreading or occasionally at almost right-angles to stem. *Leaves* 0.5–4.2 × 0.075–1.5cm, linear to broadly elliptic or, if short sometimes ovate, upper surface glabrous to densely verruculose-papillose, warts or rhaphids sometimes confined to apical part or margins, green to blackish green, lower surface often purplish or purplish-veined, sometimes sparsely warty, apex obtuse or acute, shortly petiolate or not; sheaths membranous, ribbed, verruculose or not, pale green sometimes black towards base, ± persistent, sometimes becoming fibrous. *Inflorescence* 1-flowered, terminal, rarely lateral on plants with elongated stems, bracts (1–)2.5–9mm long, finely verruculose or glabrous, membranous, tubular or cup-shaped, ovate acuminate. *Flowers* 2.2–4(–5)cm long to c.3.3cm wide, pedicel very lax so as to cause the flower to sit horizontally or pendulous with labellum uppermost, rarely sub-erect, commonly red (scarlet to crimson), lip sometimes paler, with darker, reddish brown marks on margin, or flowers purple, pink, orange or less commonly yellow or white, sepals and petals self-coloured or, not infrequently, strikingly bicoloured, the apical parts paler or contrastingly coloured. *Dorsal sepal* 10–21 × 3–12(–15)mm, oblong to broadly elliptic, obtuse. *Lateral sepals* 18–30(–34) × 4–12(–18)mm, oblong to broadly elliptic, sometimes broadly triangular, apex obtuse, rarely acute; fused basal part 4.5–8(–11)mm, narrowly cylindrical; mentum total length 9–18mm, tip obtuse. *Petals* 10–20 × (3.5–)6–16mm, obovate to rotundate, obtuse. *Labellum* 12–30 × 5–15mm (when flattened), obovate adnate to column foot at base, margins strongly upcurved, inside concave, finely or sparsely muriculose or glabrous, floor sometimes thickened fleshy, with or without a transverse V- or U-shaped ridge near base. *Column* 5–7mm long to 5mm wide; foot 9–18mm long; anther c.3.5mm broad; pollinia c.2mm long. *Ovary* indistinctly 6-ribbed, not angled, densely or sparsely papillose-hirsute or verruculose or glabrous; pedicel-ovary 10–32mm long. *Fruit* to 20 × 10mm obliquely ellipsoid with 6 low verruculose or papillose-hirsute longitudinal ribs of unequal width and 6 narrower alternating ± glabrous furrows.

Distribution: New Guinea throughout the main mountain chain, Bismarck Archipelago (Map 19); c.86 collections examined.

WEST NEW GUINEA. Vogelkop Peninsula, Wandamen Peninsula, Cyclop Mts, Idenburg River, Mt Doorman, Wissel Lakes, Mt Carstenz, Habbema Lake, Hellwig range, Mt Goliath.

EAST NEW GUINEA. West Sepik, Enga, Southern Highlands, Western Highlands, Chimbu, Eastern Highlands, Madang, Morobe (including Umboi (Rooke) Island), Northern, Central and Milne Bay (including Goodenough Island) Provinces.

NEW IRELAND.

Epiphyte, occasionally terrestrial or lithophytic, on shrubs, tree ferns, moss forest edges and ridges, *Nothofagus,* mossy rocks of streams, road cuttings, exposed cliff faces, semi-shade or in open areas often exposed to breezes, c.750–3450m.

At various times during the last 25 years, one of the most charming orchids from New Guinea has been introduced into cultivation under the name *Dendrobium sophronites,* aptly named by Schlechter after the equally attractive and superficially similar Brazilian and Paraguayan genus *Sophronitis*. As a result the Schlechter name is now widely, but unfortunately, wrongly used. Reeve (1978), speculating on the relationship of seven species in *Dendrobium* section *Cuthbertsonia*, suggested that the correct name might be *D. agathodaemonis* J. J. Smith, the name applied to a species described in 1910

from Mt Agathodämons in the Hellwig mountains of central West New Guinea. Van Royen (1979) also uses that name in his *Alpine Flora* and includes it within section *Oxyglossum* (Smith had originally refrained from allocating it to any section). Woods & Cullen (1984) in the *European Garden Flora* however use the earliest of the names, von Mueller's *D. cuthbertsonii*. Despite, or perhaps because of these name changes some confusion about the correct name persists and there remains, particularly amongst growers in the United States, a reluctance to change from what must seem the more appropriate epithet *sophronites*.

The conclusion at which we have arrived, after examining the literature on the names involved and the considerable range of herbarium material available for study from throughout New Guinea, is that we are dealing with one variable species where habit and habitat forms in the past have been described and given names often just on the basis of one herbarium specimen. The only applicable name therefore is *D. cuthbertsonii*.

J. J. Smith (1913b: 73) listed at some length the range of variation observed in plants of *D. agathodaemonis* collected by A. C. de Kock and K. Gjellerup occurring between 2300 and 2400m which had thin, randomly branched, non-tufted stems and well-spaced narrow leaves and unbranched, tufted plants found from 2800m to 3000m, which had shorter, compressed swollen stems with broader leaves. It seems unlikely, from the wide range of material examined that anything useful can yet be interpreted from either Smith's groupings or the altitudinal distribution for the purpose of this revision, other than to suggest a research project for an analysis of the ecology of this species in the field. However it is reasonably clear from the field data of the de Kock and Gjellerup specimens which Smith cites, that some plants grew terrestrially while others occurred in moss on trees and presumably therefore in positions of exposure to either high light intensity or deep shade: a paper by Reeve (1978) confirms this view when he observes that it is the degree of illumination to which plants are exposed which seems to govern whether growth is compact or loose. Plants exposed to high light intensity tend to form compact clumps whereas plants in shade produce much longer, thinner stems and this latter condition seems also to be influenced by the amount of competition from mosses and other plants. Reeve also observed that within habitat-influenced forms a range of pseudobulb types may occur on individual plants, whereas leaf shapes usually remain constant. It would be interesting to see if further field studies or experimental work on living collections would confirm this. Plants with the habit of Smith's *D. agathodaemonis* can be found throughout the range of the species. It is curious that despite his earlier assertions that variation was often caused by ecological factors, Smith later was to describe two more species on characters that can now be seen to fall within the overall range.

Schlechter's concept of this group of species, to which he gave the sectional name *Cuthbertsonia*, was based on even fewer collections than those examined by Smith. Kränzlin (1910) had seen the isotype of *D. cuthbertsonii* but whether or not Schlechter also saw von Mueller's type, a duplicate of which was then at Kew, is not clear; certainly he does not cite the Cuthbertson & Sayer specimen, only his own two collections identified as *D. cuthbertsonii* of which we have seen only one (19664) at Harvard, Bogor, Kew and Leiden. Schlechter's descriptions of *D. sophronites* and *D. trachyphyllum* were each based apparently

on unicate collections, specimens of which no longer exist. Under section *Cuthbertsonia* Schlechter also included *D. asperifolium* (described by Smith under section *Oxyglossum*) but excluded *D. agathodaemonis* (not placed by Smith in any section until 1913 when he placed it in section *Oxyglossum*) on the grounds that it differed somewhat in habit from the other members of the section and might belong to section *Pedilonum*.

In his account of *D. agathodaemonis,* van Royen (1979) again quotes the collections cited by Smith (his illustration is from two of them) but infers that there remain two undescribed, though presumably related, species. These are represented by *Gjellerup* 531 and 565 from Anggi Lakes and by *Gjellerup* 1104 and *Eyma* 4969 from Wissel Lakes all in the western half of West New Guinea. The Gjellerup collections had all been discussed by Smith within his circumscription of *D. agathodaemonis* at one time or another (1913b, in Gibbs 1917) albeit with some misgiving: he found it 'very difficult to make a decision' on forms known only from single collections. Van Royen excludes *De Kock* 110d from *D. agathodaemonis* 'as the ovary is covered with the same type of warts as is regularly found in section *Cuthbertsonia*', but from this and Smith's descriptions it must fall within the variation of *D. cuthbertsonii* as does *Eyma* 4969 (L) mentioned above.

Other characters which vary are indumentum and flower size and shape. Leaf papillae vary in quantity from dense to almost glabrous with the warts sometimes confined towards the leaf apices or margins and then with scattered rhaphids rather than papillae; this condition, apparently correlated with a longer linear leaf-shape, seems more prevalent in plants from the southeastern end of New Guinea, eg *Cruttwell* 1090 and *Woods* 2325, 2401, 2483 and 2846 from the Mt Simpson and Mt Dayman areas. The purpose of these small wart-like structures, particularly on the leaves and ovaries is difficult to explain. It may be reasonably assumed that the primary function of these warts is to act as a water trapping and perhaps water absorbing mechanism. We have not attempted to investigate this and are not aware of any comparable leaf epidermis in any other orchid. Further investigation is required. They are clearly illustrated by Michael Bostwick in his account of a journey in Papua New Guinea (Bostwick, 1986: 1016), by John Sullivan (1986: 1226) and by J. N. Rentoul (1987: 56).

Similar types of verrucae also occur on the pedicels and ovaries, as can a longer papillose-hirsute indumentum which gives a mossy appearance similar to that on the calyces of the 'moss rose' *Rosa muscosa*: glabrous ovaries are also found.

It is obvious from the species description that a wide range of flower size occurs; small- and large-flowered forms are found throughout the range.

The presence of a thickened transverse V- or U-shaped ridge inside the labellum near the base was noted and illustrated by Smith when describing *D. asperifolium* and *D. lichenicola* and by Schlechter for *D. trachyphyllum* but not for any of the other synonyms nor the type: as mentioned already (p. 263) this feature is not easy to see in herbarium specimens and is easy to miss in living material, and may indeed not always be present.

Reeve noted (1978) that red-flowered forms of *D. cuthbertsonii* probably predominate throughout the species range: in some localities there may be a greater incidence of other colour variants. Further field observations and genetic studies are necessary to determine whether any pattern of colour inheritance or colour distribution exists.

The occurrence of *D. cuthbertsonii* in the Solomon Islands (Hunt, 1969; Thorne & Cribb, 1984) is based on a misidentification of *D. laevifolium*. This error is perpetuated on a Solomon Island postage stamp.

Whereas the flowers of many species of section *Oxyglossum* hold their flowers more or less erect, the flowers of *D. cuthbertsonii* flop due to the extreme laxness of the pedicel, the weight of the flower causing it to hang or to lie horizontally with the labellum uppermost. Photographs of this species are frequently reproduced upside down (Bechtel *et al.*, 1981: 202 as *D. sophronites*; Braem, 1985: 44; Millar, 1978: 14–15 as *D. sophronites*; Reeve, 1981: 105; Woods, 1989: 140). The charm and variety of colour of this little species appealed both to Smith and Schlechter and prompted the latter to express the wish that these very beautiful plants would soon be introduced into cultivation in Europe: it is doubtful that they ever were, for there is no mention of any *Oxyglossum* species being introduced into cultivation in orchid-growers' literature of that period. *D. cuthbertsonii* has had a slight but unjustified reputation for difficulty in cultivation and some growers who have succeeded with it for a number of years have then been at a loss to give a logical explanation for a plant's eventual demise. One might speculate that perhaps in nature, the life-span of a plant is naturally short, but there is no evidence to support this; it could also be suggested that a plant which blooms so prolifically and for so long may, in cultivation at least, eventually flower itself to death. Perhaps the first flowers from newly imported plants should be removed and the plants allowed to settle down: the old practice of removing flower-buds from a plant in order to allow it to build up strength may be worth trying. Where sufficient plants are available, the effectiveness of this could be investigated by the simple experiment of removing the flowers from half a number of similarly aged and sized plants and measuring the rate of growth against those allowed to flower.

Plants at Edinburgh have grown slowly but successfully on tree-fern slabs or cork-bark for more than 17 years and plants raised from seed and grown by amateurs in Britain are growing vigorously and, have flowered well within five years. Colour photographs of two superbly pot-grown award-winning plants in the United States under the names *Dendrobium sophronites* 'Barbara' and 'Thomas', are illustrated on the back cover of the *American Orchid Society Bulletin* 53(8): August 1984 and again in John Sullivan's comprehensive account of growing the species under lights (Sullivan, 1986). Numerous other forms have been given cultivar names and one, 'Susan', was awarded a cultural commendation certificate by the Royal Horticultural Society in 1988 (Rittershausen, 1988) and illustrated on the front cover of the *Orchid Review* 96, December 1988.

In nature plants are recorded as flowering during every month of the year. At Edinburgh flowering occurs from January to October, the individual flowers lasting up to eight months.

Species Insufficiently Known

Dendrobium sp. nov.?

A plant collected in Seram during the Operation Raleigh expedition of 1987 has recently flowered at Edinburgh. Without better material we are reluctant to describe this although it may represent a new species. It seems close to *D. violaceominiatum* (known from the Caroline Islands and the Solomons) in

having bluish violet flowers and an ovary acutely triangular in cross-section but differs in having much smaller pseudobulbs, somewhat broader leaves, apparently recurved petals and sepals and a green labellum with an orange apex. The species recorded from Seram are *D. seranicum* and *D. nebularum*, both with a five-winged ovary and *D. vexillarius* var. *?uncinatum* (see p. 232, 250).

It was collected in Seram [Petrospoliai, Plot 6, 1300m, legit M. Dickson] as *Edwards* 99 p.p. and flowered in Edinburgh in January 1989 (cult. E 87.1872).

Excluded Species

Dendrobium juncoideum P. van Royen in Alpine Flora of New Guinea 2: 430–433, f. 149 (1979).
Distribution: East New Guinea: Eastern Highlands, Morobe and Central Provinces, 2700–3200m.

This is a striking species with large rich purplish pink flowers which have an orange labellum. The stems may be up to 1 metre long and pendulous if growing in the shade, or short and stunted if exposed to the full sunlight.

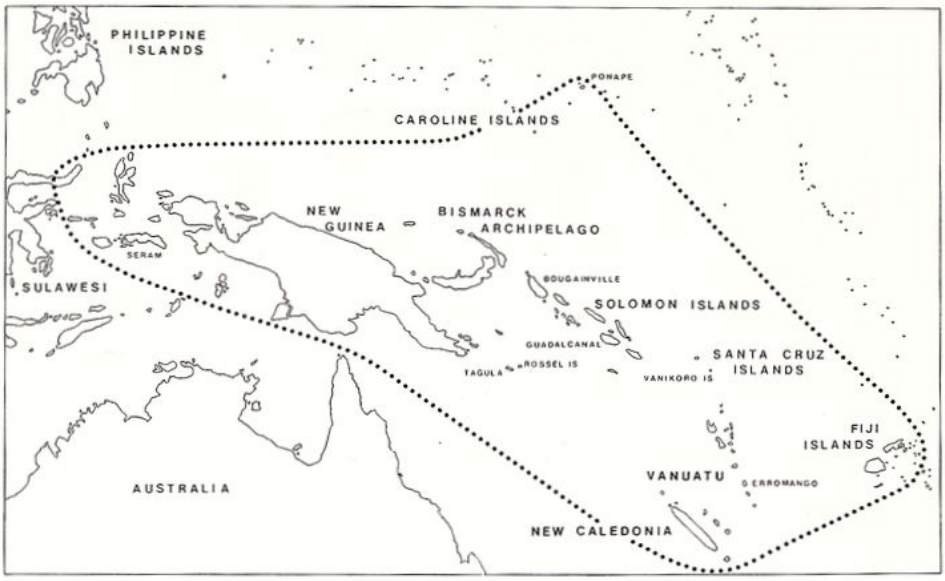
Dr P. van Royen when describing this species placed it in section *Oxyglossum*. However he had earlier labelled some herbarium sheets (e.g. *NGF* 7992 at L) as '*D. blatteo-aurantiacum* van Royen (Sect. *Pedilonum*)'. This name was never published (and is therefore a *nomen nudum*) which might suggest that the author was uncertain where the species should be placed.

D. juncoideum is a borderline species with characteristics of both sections, but as stated previously (Reeve & Woods, 1980), we regard it as best placed in section *Pedilonum*. It is an unusual species with no close allies but is probably nearest to the Maleysian *D. cornutum* Hk. f., *D. hasseltii* (Bl.) Lindl. from Java and *D. crenatifolium* J. J. Smith from West New Guinea, species presently placed in section *Pedilonum*.

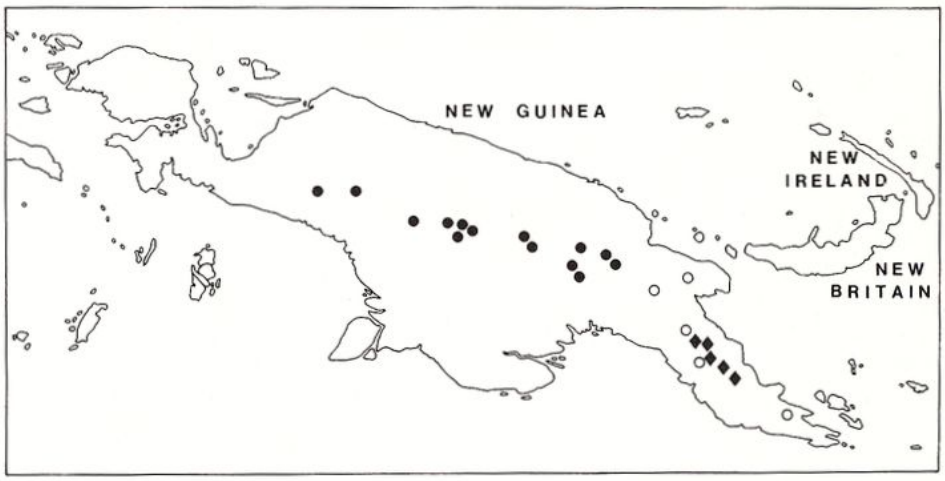
Confusable Species

Sections of *Dendrobium* other than *Oxyglossum* usually have ovary cross sections which are rounded to slightly 6-ribbed but there are exceptions. An uncommon New Guinea species which has a distinctly triangular ovary is *D. vannouhuysii* J. J. Smith. It belongs to sect. *Calyptrochilus* and has the distinctive hooded lip apex. The Fijian *D. catillare* Reichb. f. (section *Pedilonum*) has a distinctly 6-winged ovary.

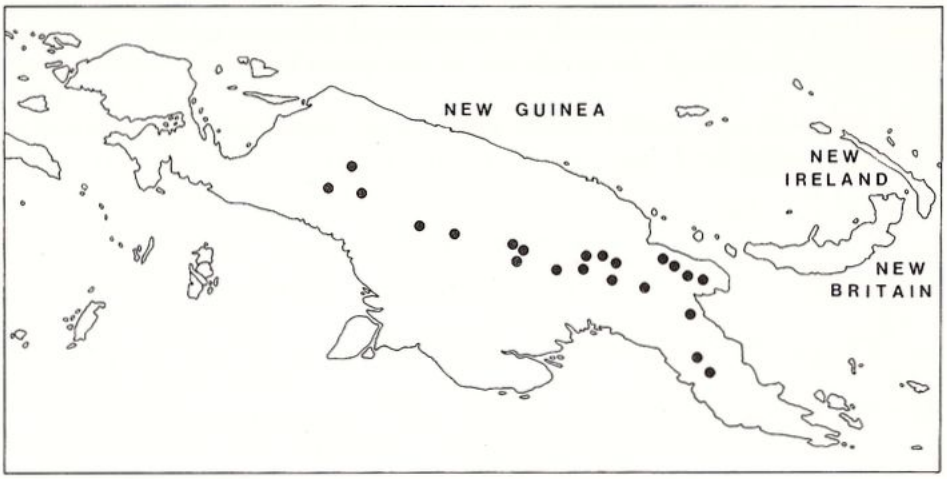
Mature plants of *D. bracteosum* Reichb. f. are rather thick-stemmed with many-flowered inflorescences typical of section *Pedilonum*. However, the petals and sepals are ± acute and small plants with few flowers can be confused with species of section *Oxyglossum*. However, we regard the species as best placed in section *Pedilonum* with small plants being distinguished by having very large floral bracts and ± cylindrical ovaries. The species is found in New Guinea and adjacent islands and in the Bismarck archipelago. Conspecific with *D. bracteosum* are *D. chrysolabium* Rolfe, *D. novae-hiberniae* Kränzl., *D. dixsonii* Bail. and var. *eborinum* Bail., *D. trisaccatum* Kränzl., *D. eitapense* Schltr. and *D. leucochysum* Schltr.



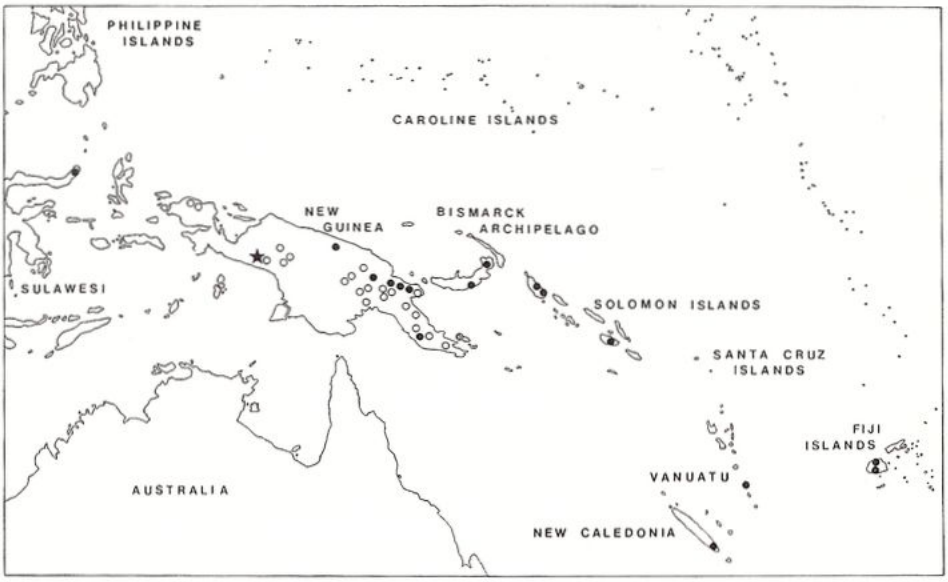
MAP 1. Distribution of *Dendrobium* section *Oxyglossum*



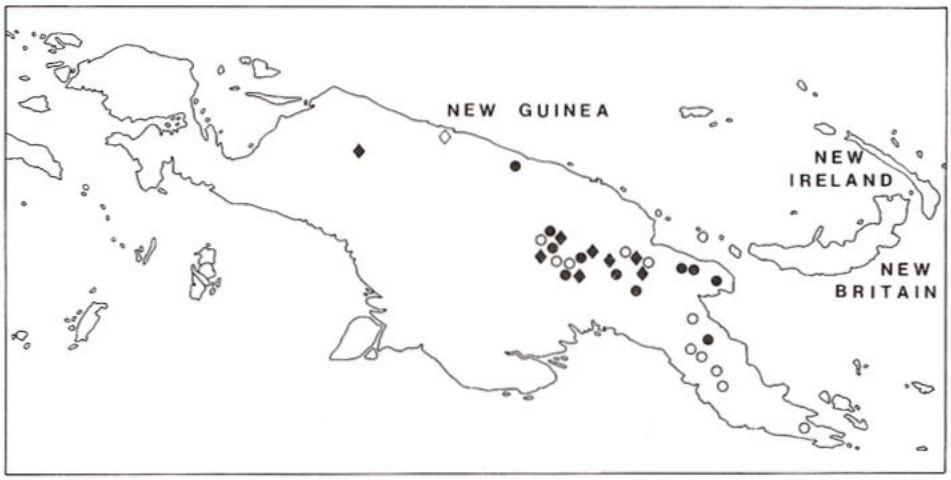
MAP 2. Distribution of *D. brevicaule* subsp. *brevicaule* (◆); subsp. *calcarium* (●) and subsp. *pentagonum* (○).



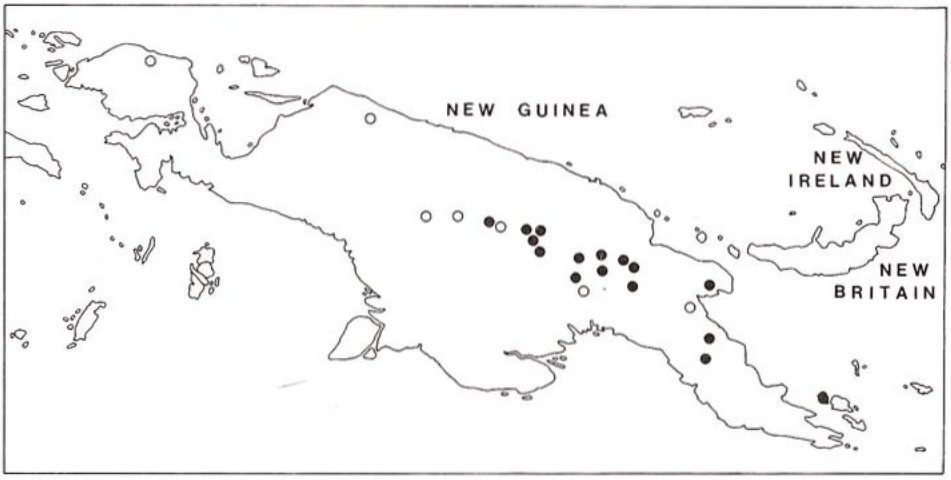
MAP 3. Distribution of *D. dekockii*.



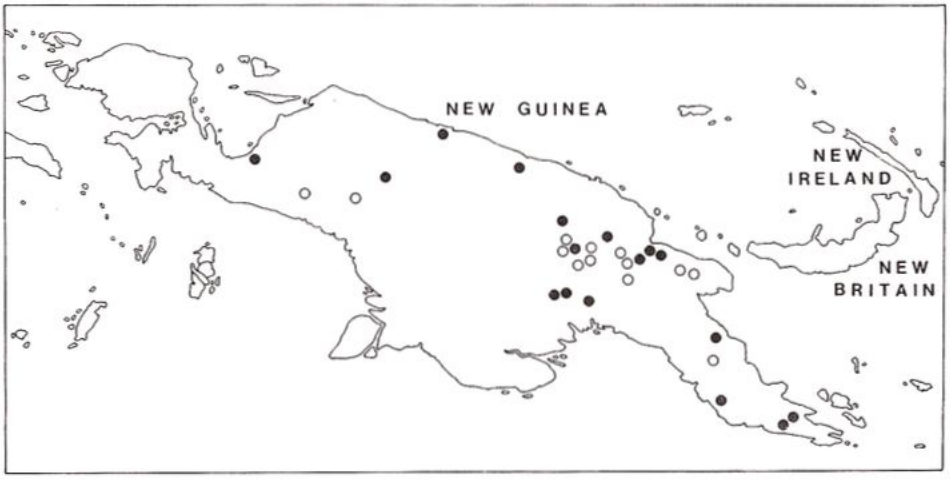
MAP 4. Distribution of *D. masarangense* subsp. *masarangense* (●); subsp. *theionanthum* var. *theionanthum* (○) and subsp. *theionanthum* var. *chlorinum* (★).



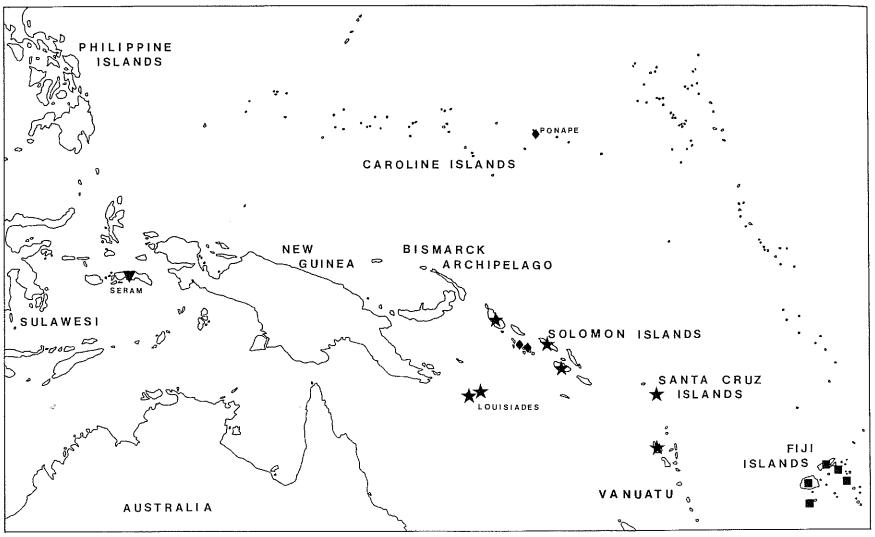
MAP 5. Distribution of *D. sulphureum* var. *sulphureum* (●); var. *rigidifolium* (○); var. *cellulosum* (◆) and sterile (◇).



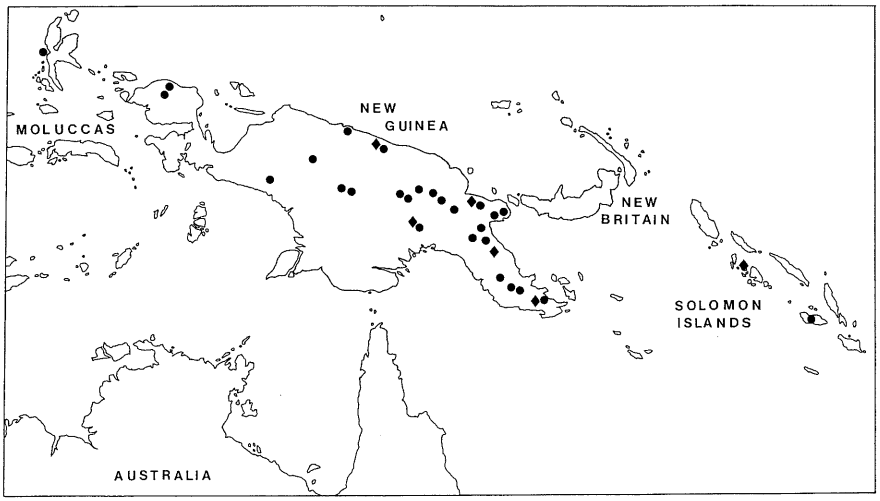
MAP 6. Distribution of *D. nardoides* (●) and *D. subuliferum* (○).



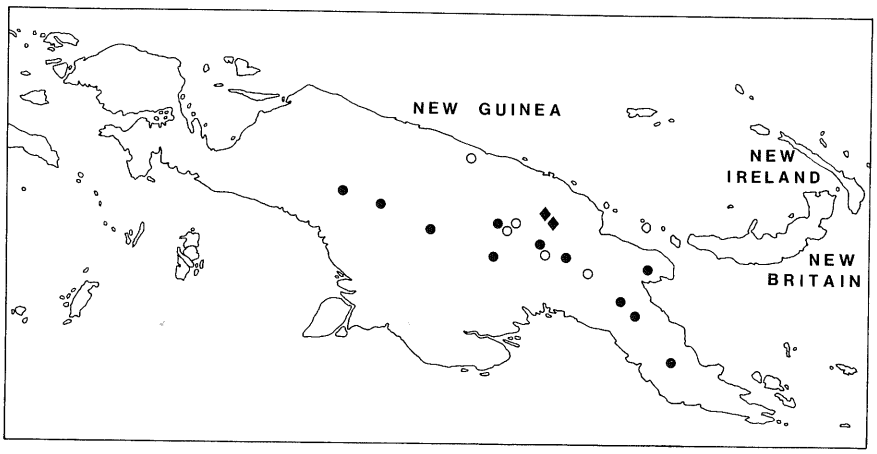
MAP 7. Distribution of *D. cyanocentrum* (●) and *D. habbemense* (○).



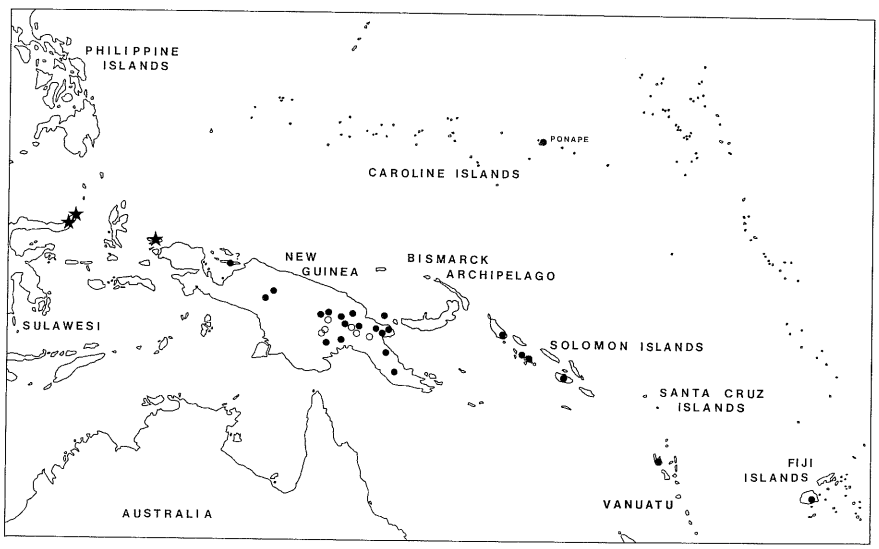
MAP 8. Distribution of *D. violaceominiatum* (◆); *D. seranicum* (▼); *D. prasinum* (■) and *D. laevifolium* (★).



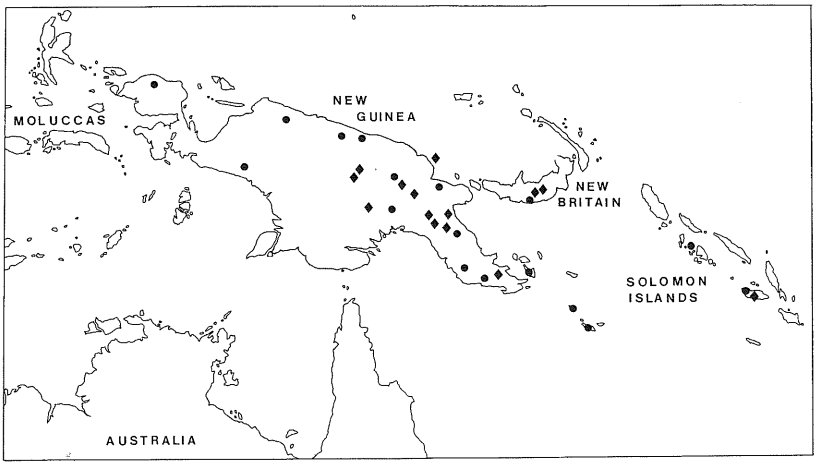
MAP 9. Distribution of *D. subacaule* (●) and *D. undatialatum* (◆).



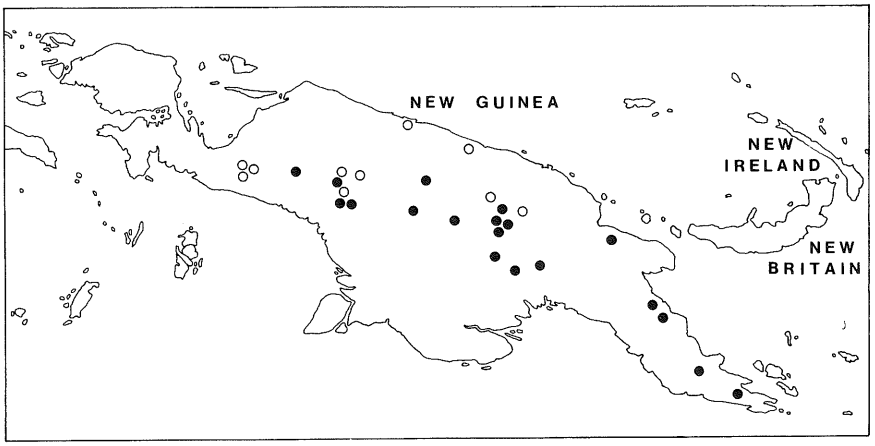
MAP 10. Distribution of *D. pachythrix* (◆); *D. rupestre* (●) and *D. putnamii* (○).



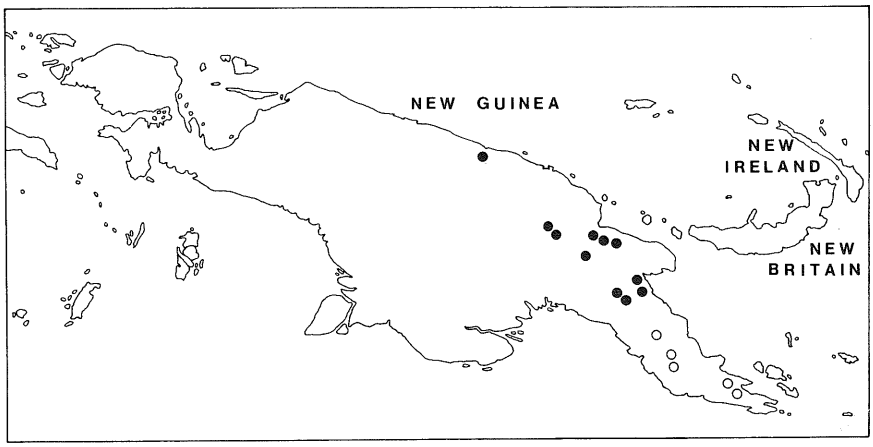
MAP 11. Distribution of *D. delicatulum* subsp. *delicatulum* (●); subsp. *parvulum* (★) and subsp. *huliorum* (○).



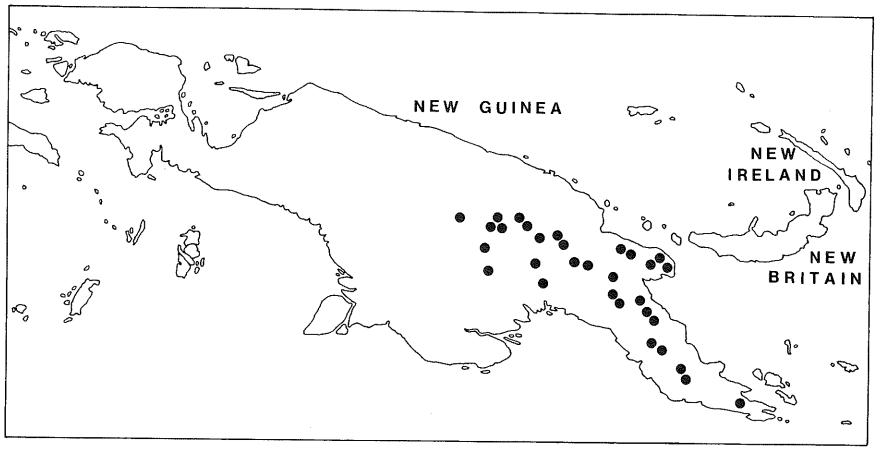
MAP 12. Distribution of *D. puniceum* (●) and *D. petiolatum* (◆).



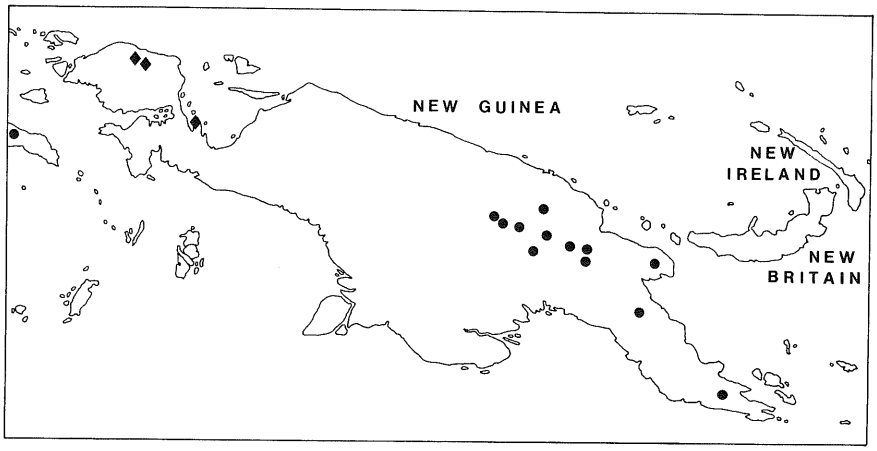
MAP 13. Distribution of *D. violaceum* subsp. *violaceum* (●) and subsp. *cyperifolium* (○).



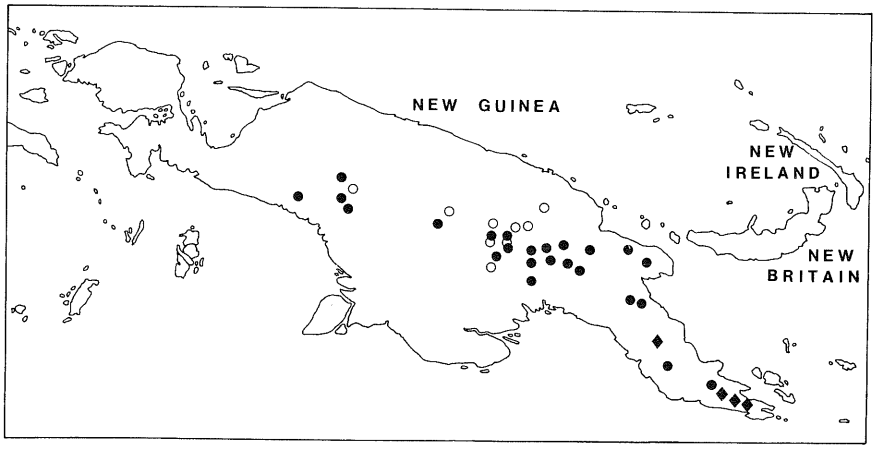
MAP 14. Distribution of *D. brassii* (○) and *D. pentapterum* (●).



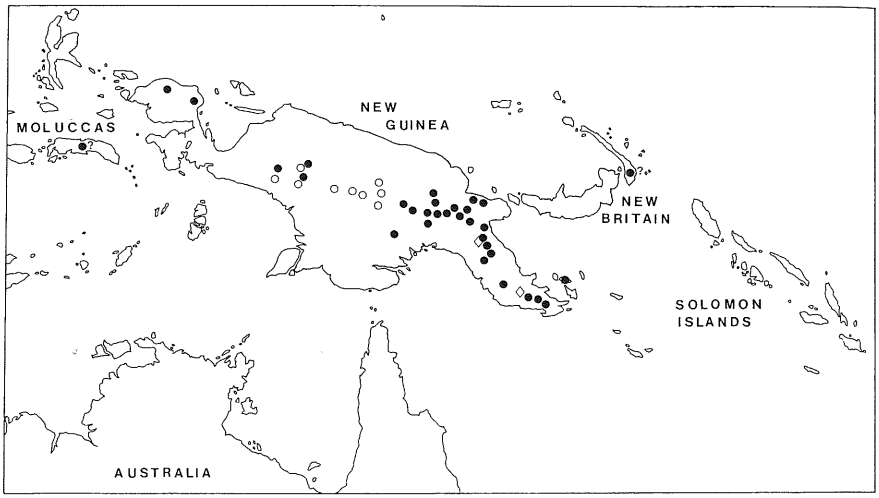
MAP 15. Distribution of *D. hellwigianum*.



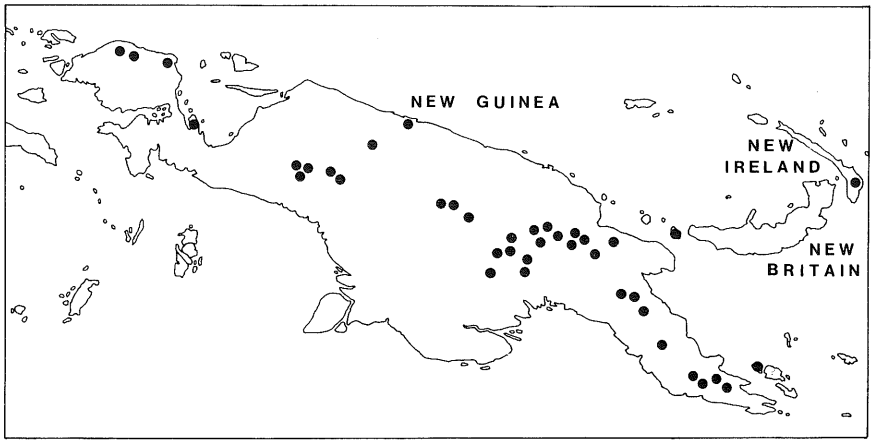
MAP 16. Distribution of *D. nebularum* (●) and *D. lancilabium* (◆).



MAP 17. Distribution of *D. vexillarius* var. *vexillarius* (●); var. *microblepharum* (○) and var. *albiviride* (◆).



MAP 18. Distribution of *D. vexillarius* var. *retroflexum* (○); var. *uncinatum* (●) and var. *elworthyi* (◇).



MAP 19. Distribution of *D. cuthbertsonii*.

List of Exsiccatae

(Numbers preceding abbreviations of herbaria refer to species numbers in the Taxonomic Treatment)

Agate (26: AMES).
Allison NG 136 (1: LAE); AA 281 (21c: LAE).
Ardley s.n. (18: LAE).
Argent NGBF 1213 (5: E); NGBF 1238 (18: E); c.6671 (2: E); c.7241 (1b: E); c.7302 (5: E); c.7455 (21c: E); c.7491 (19: E); c.7886 (25: E); c.7924 (21c: E); c.7925 (21c: E); c.7926 (21c: E); c.8738 (15: E); cult. RBGE 76.1233 (2: E); s.n. (2: E); s.n. (5: E); s.n. (15: E); s.n. (19: E); s.n. (28: E); s.n. (28: E).
Argent & Sandham SAND 64 (21c: E).
Armit s.n. (1c: B†).
Bacchus & Jermy 3 (21c: E, LAE).
Balgooy, van 12 (2: K, LAE); 14 (1b: CANB, K, L, LAE); 190 (4b: CANB, L, LAE); 546 (1b also possibly 1 × 2: CANB, K, L, LAE); 635 (1b: L).
Barker & Croft LAE 66943 (21b: BM, E, K, L, LAE).
Barker & Vinas LAE 67741 (18: LAE).
Barker & Wiakabu LAE 66893 (2: L, LAE).
Barker et al. LAE 67504 (21d: K, LAE).
Barton s.n. (28: BM).
Bergman 62 (16a: L).
Black c.4704 (2: E); c.7610 (18: E).
Bourdy 125 (3a: PORT-VILA).
Bowers 41 (4a: CANB, LAE); 382 (25: LAE).
Brass 3271 (27: AMES); 4294 (1a: AMES, BRI); 4508 (4b: AMES); 9022A (25: L, AMES); 9031 (2: AMES, BM, K, L, LAE); 9348 (3bi: AMES); 9404 (1b: AMES, BM, K, LAE); 9434 (21b: AMES); 10529 (21a: AMES, BM, BRI, L); 10676 (21c: AMES); 10677 (21b: AMES); 10792 (21d: AMES); 10904 (28: L); 10906 (21c: AMES); 10916 (3bi: AMES); 11305 (21c: AMES); 11311 (13a: AMES); 11571 (3bi: AMES, L); 11576 (21c: AMES); 11593 (13a: AMES); 11883 (21c: AMES); 12125 (16b: L, AMES); 12735 (9: L, AMES); 12772 (13a: AMES, L); 12890 (28: AMES); 13456 (7: L, AMES); 22443 (21c: AMES, L, LAE); 22586 (21c: AMES, K, L, LAE, US); 22836 (21c: AMES, L, LAE); 22982 (17: AMES); 23270 (3bi: AMES); 24779 (3bi: AMES); 24823 (3bi: AMES, L); 24850 (3bi: AMES, L); 25760 (14: K, L); 27833 (27: L, LAE); 27856 (27: L); 28498 (27: L); 29739 (28: LAE); 29825 (2: AMES, K, L, LAE); 30426 (25: US); 30538 (25: US); 30604 (25: K, LAE, NY, US); 30701 (2: K, L, LAE); 30822 (21c: K, L, LAE); 30823 (28: K, L, LAE); 30939 (5: LAE, US); 31401 (2: K, L).
Brass & Collins 29901 (1b: L); 31048 (2: K, L, LAE); 31296 (2: K, L, LAE); 31401 (2: K, L, LAE); 32136 (28: K, L, LAE).
Brass & Meijer-Drees 9675 (1b: AMES, L); 9953 (1b: AMES, L).
Bregulla 36 (27: K).
Briggs 3719 (4b: E, NSW).
Bulmer 435 (21c: LAE).
Burness & Vodonaivalu c.7909 (26: E); cult. RBGE 82.2620 (26: E); cult. RBGE 82.2621 (26: E); cult. RBGE 82.2624 (26: E).
Cabalion 2991 (3: PORT-VILA).
Campbell s.n. (22: K).
Carr 10220 (9: AMES, K, L, LAE, NY); 10264 (18: AMES, CANB, K, L); 10287 (9: AMES, K, L, LAE, NY); 10303 (3bi: NY); 10435 (3bi: AMES, CANB, K); 10467 (28: BM, K, L, LAE, NY); 10477 (4b: AMES, BM, K, L, LAE, NY); 10480 (3bi: AMES, CANB, K, L, NY); 10482 (18: AMES, CANB, K, L, NY); 10509a (13a: BM); 10517 (21c: AMES, BM, K, L, LAE); 10555 (11: AMES, BM, K, L); 16687 (3bi: BM); 16776 (4a: BM); 16814 (4a: BM); 16816 (13a: BM); 16820 (13a: BM); 16833 (21c: BM); 16838 (17: BM); 16931 (21c: BM); 16932 (21a: BM); 17254 (3a: BM); 17288 (21a: BM); 101135 (3bi: L).
Chadim 5 (18: K); 10 (28: LAE); 11 (21c: K, LAE); 59 (25: LAE); 72 (18: K, LAE).
Cheesman 1158 (13b: BM); 1336 (13a: BM).
Clemens 4542A (9: Z); 4601 (3bi: AMES); 5406 (18: AMES); 7491A (18: AMES); 11006 (9: AMES, E); 11020 (3a: AMES); 11276A (9: AMES); 11730A. (18: AMES); 11730B. (9: AMES); 12056C (20: AMES, MICH); 12089 (18: AMES); 12094 (13a: AMES); 40917 (9: E); s.n. (18: L).
Clunie LAE 63085 (21c: LAE); LAE 63068 (14: LAE).

Collins 29901 (1b: L).
Coode & Katik NGF 32917 (25: K, LAE); NGF 40213 (2: K, L, LAE).
Corlett 25121 (1c: LAE).
Craig 15 (21c: LAE); 82 (1b: LAE); 133 (21: LAE).
Craven 2958 (2 or 2 × 1: K, L, LAE); 3045 (1a: LAE).
Craven & Schodde c.149 (13a: CANB).
Craven & Lelean 2782 (1a: K, L, LAE).
Cribb & Campbell 5108 (8: K); 5133 (13a: K); 5134 (14: K).
Cribb, Dennis et al. 5043 (3a: K); 5056 (9: K); 5057 (3a: K); 5058 (27: K).
Cribb & Wheatley 109 (13a: K).
Croft & Katik NGF 14959 (22: K, LAE); 15556 (22: K, LAE).
Croft & Lelean NGF 34766 (4b: L, LAE); NGF 34767 (3bi: LAE); NGF 34768 (28: LAE); NGF 34774 (17: K, LAE); NGF 34809 (28: LAE); NGF 34811 (9: K, L, LAE); LAE 65867 (1b: E, L, LAE).
Croft et al. NGF 21460 (2: LAE); LAE 60724 (2: K, LAE); LAE 60725 (1b: K, L, LAE); LAE 60726 (28: LAE); LAE 60947 (21c: LAE); LAE 61395 (1a: K, L, LAE); LAE 65263 (1 × 2: L, LAE); LAE 65998 (2: LAE); LAE 68972 (21c: E, LAE).
Cruttwell 41 (28: K); 42 (28: K); 43 (4b: K); 371 (21c: K); 373 (7: K); 382 (9: K); 498 (23: K); 666 (18: K); 687a (9: K); 731 (21c: K); 772 (21c: K); 773 (21e: K); 814 (16a: K); 842 (3bi: LAE); 843 (9: K); 932 (21c: K); 1085 (3bi: K); 1090 (28: K); 1106 (18: K); 1229 (16a: K, L, LAE); 1242 (21c: K); 1407 (28: K); 1408 (3bi: K); 1425 (5: K); 1639 (3bi: K); 2581 (9: E, K); s.n. (3a: 000).
Cuthbertson & Sayer s.n. (28: BRI, K, MEL).
Damas & Anos LAE 74506 (27: K, L, LAE); 74510 (14: K, L, LAE).
Darbyshire 440 (16b: CANB).
Dennis 2036 (14: K); 2104 (14: K); cult. RBGE 81.2817 (27: E).
Department of Agriculture, Fiji 12867 (26: K).
Dickson s.n. (8: K).
Division of Botany, Lae s.n. (1b: E); s.n. (2: E).
Dockrill NGF 7989 (2: LAE).
Docters van Leeuwen 10974 (16a: L).
Donaldson 0208 ED (21c: E); 0485 ED (9: E).
Doorman 12 (16b: BO-n.v.); 14 (21c: BO-n.v.); 15 (21c: BO-n.v.); 16 (28: BO-n.v.); 17 (28: BO-n.v.).
Edwards 73 cult. RBGE 87.1873 (15: E); 99 cult. RBGE 87.1872 (sp. nov.? see p. 282: E); 202 cult. RBGE 86.1074 (15: E).
Elworthy c.7469 (1c: E); c.7507 (1c: E); c.7521 (28: E); c.7522 (28: E); c.7553 (28: E); c.7561 (28: E); c.7607 (5: E); c.7608 (4a: E); c.7609 (4b: E); c.7611 (21e: E); c.7917 (4b: E); c.7918 (4a: E); c.7919 (4a: E); c.7920 (4b: E); NGF 7991 (1c: L, LAE); NGF 7994 (21e: L, LAE); cult. RBGE 75.2525 (4b: E).
Elworthy & Dockrill NGF 7995 (18: LAE).
Eyma 4588 (16b: AMES, K, L); 4969 (28: L); s.n. (21c?: K, L).
Fisher 66 (16a: CANB, LAE).
Flenley c.4628 (1b: E).
Floyd s.n. (4a: LAE).
Floyd & McKee NGF 6371 (3bi: AMES, LAE).
Floyd & Womersley NGF 6163 (21c: LAE); NGF 6732 (21c: AMES, K, LAE).
Forbes 425 (14: BM); 517 (14: BM); 598 (14: BM).
Foreman NGF 48070 (9: K, L, LAE).
Foreman & Lelean NGF 48377 (21e: LAE); NGF 48380 (1c: LAE).
Foreman & Wardle NGF 45518 (1c: K, L, LAE); NGF 45519 (2: LAE); NGF 45520 (21e: E, K, LAE); NGF 45602 (1a: E, K, L, LAE).
Foreman et al. NGF 48030 (25: LAE).
Frodin NGF 28115 (28: K, L, LAE); NGF 28336 (21a: LAE); NGF 28385 (21d: LAE).
Frost s.n. (27: K).
Gibbs 663 (26: K); 5530 (28: BM); 5596 (28: BM) 5907 (21c: BM).
Gilliard s.n. (1b: LAE); s.n. (2: LAE); s.n. (18: LAE); s.n. (21c: LAE); s.n. (25: LAE).
Gillison 144 (28: LAE); 149 (2: LAE); 150 (1c: LAE).
Giulianetti s.n. (1: K); s.n. (2: K).
Gjellerup 390 (16a: BO-n.v.); 466 (9: BO-n.v.); 827 (6: BO-n.v.); 870 (14: BO-n.v.); s.n. (9: BO-n.v.).
Glassman 2482 (8: E, US).
Greenwood 429 (26: BRI, K).
Grubb & Edwards 7 (25: L, LAE).

Gunther 4/81 (10: E).
Hartley 11265 (25: LAE); 11268 (2: AMES); 11719 (9: LAE); 11790 (9: AMES, LAE); 12822 (4a: AMES); 12913 (1a: AMES, CANB, L, LAE).
Hays 343 (2: LAE); 503 (18: LAE).
Hellwig 303 (13a: B†); 323 (18: B†).
Henty NGF 20807 (16a: K, L, LAE); NGF 20885 (6: K, L, LAE); 20919 (16a: LAE); 27073 (27: LAE).
Henty & Carlquist NGF 16528 (22: LAE); NGF 16546 (1c: CANB, L, LAE).
Henty et al. NGF 41649 (18: L, LAE); NGF 41684 (21d: LAE); NGF 41694 (28: K, LAE); NGF 42853 (11: LAE).
Hide 452 (21c: LAE); 505 (3bi: LAE).
Hoogland 9288 (28: LAE); 9314 (5: CANB); 9418 (11: CANB, LAE); 9441 (2: K, L, LAE); 9442 (13a: CANB); 9516 (21a: CANB, LAE); 9581 (21a: CANB, LAE).
Hoogland & Craven 10841 (16b: BRI, CANB, K, L, LAE); 10897 (16b: CANB); 10918 (16b: BRI, CANB, K, L, LAE); 10970 (16b: CANB).
Hoogland & Pullen 5440 (21c: AMES, BM, CANB, L, US); 5527 (4b: AMES, BM, CANB, L); 5527 (4c: CANB [4b and 4c], L, LAE); 5565 (1b: CANB, L, LAE); 5635 (2: L, LAE); 5636 (1b: BM, CANB, L, LAE); 5911 (3bi: AMES, L); 6036 (25: LAE).
Hoogland & Schodde 6812 (18: LAE); 6940 (4a: CANB); 6955 (18: AMES, K, L, LAE, NSW); 7012 (4c: LAE); 7280 (4a: CANB, LAE); 7378 (4a: L, LAE); 7509 (21c: LAE); 7521 (21c: LAE).
Hope ANU 16147 (1b: CANB).
Horne 739 (13: K).
Hosokawa 6003 (13a: TAI-n.v.); 9543 (13a: L).
Howcroft LAE 64098 (17: LAE).
Hunt 2534 (23: K); 2559 (14: K); 2936 (3a: K); 2960 (27: K, L, LAE); 2963 (9: K); 2981 (27: K).
Jacobs 8717 (13a: L, LAE); 8897 (21c: L, LAE); 8902 (28: L, LAE).
Janowsky 88 (7: BO-n.v).
Jermy s.n. (6: E).
Johns & Noble NGF 47031 (25: K, LAE); NGF 47062 (4c: L, LAE); NGF 47064 (5: BRI, L, LAE); 47092 (2: LAE).
Jury s.n. (18: K).
Kairo 388 (28: LAE); 411 (28: LAE).
Kairo & Streimann NGF 35754 (2: LAE).
Kajewski 604 (27: AMES).
Kalkman 4089 (9: L); 4150 (16a: L); 4176 (6); 4494 (21b: L); 4508 (1b: L); 5177 (28: L, LAE); 5186 (21d: CANB, L).
Kalkman & Tissing K4176 (6: L).
Kalkman & Vervoort K4033 (6: L).
Kanai 753487 (21e: LAE).
Katik & Taho NGF 36994 (21c: L, LAE).
Katik et al. LAE 70939 (27: LAE); LAE 70995 (14: LAE).
Kempf s.n. (16a: B†); s.n. (18: B†).
Kempter s.n. (14: B†); s.n. (22: B-†); s.n. (16a: B†).
Kerenga & Croft LAE 77645 (28: LAE).
Kerenga & Umba LAE 74344 (2: LAE).
Keysser s.n. (1c: B†); s.n. (20: B†).
Kloss s.n. (2: BM, K); s.n. (2: K); s.n. (2: K); s.n. (3: BM); s.n. (9: BM); s.n. (14: BM); s.n. (21b: BM, K); s.n. (21c?: BM); s.n. (28: BM); s.n. (28: BM); s.n. (28: BM); s.n. (28: BM); s.n. (28: K); s.n. (28: K); s.n. (28: K).
Kock, de 15 (28: BO-n.v.); 47 (2: BO-n.v.); 103 (21b: BO-n.v.); 110d (28: BO-n.v.); 138 (1b: BO-n.v.); 199 (6: BO-n.v.); 166 (11: BO-n.v.).
Kokori NGF 43581 (28: K, LAE).
Koorders 29565B (13b: K).
Kornasi in herb. Rutten 1449 (15: BO, L); 1493 (20: L).
Koster 6893 (?13: L, E); 13749 (28: L).
Kostermans & Soegeng 648 (16b: L); 734A (16a: L, K); 734B (3b: L); 784 (16); 986 (16a: L).
LAE c.4693 (?4: LAE); 5956 (28: LAE); 6162 (28: LAE); s.n. (2: LAE); s.n. (1a: LAE).
Lam 1430 (16b: L); 1438 (3bi: BO, L); 1591 (21a: BO, K, L); 1603 (2: BO, BZF, L); 1655 (21a: BO, K, L); 1686 (2: L); 1832 (4c: BO, n.v.); 1833 (3bi: L); 1950 (3bi: BO); 1951 (3bi: BO); 7745 (21c: L); 7746 (21a: L); 7751 (28: L).
Lane-Poole 408 (21c: AD, BRI).

Lavarack and Ridsdale NGF 31374 (3a: BRI, K, L, LAE).
Ledermann 1715 (3bi: B†); 8487a (16b: B†); 8875 (21c: B†); 10935a (16b); 11676 (21d: B†); 11714 (20: B†); 13415 (8: B†); 13459b (8: B†).
Lisowski 54096 (25: E, POZ); 54499 (25: E, POZ); 54922 (21c: E, POZ); 66126 (18: E, POZ).
McVean & Wade ANU 7005 (2: L, LAE); ANU 7005A (1b: BRI, CANB); ANU 7294 (25: LAE).
Mason 3 (18: K); 4 (5: K); 7 (2: K).
Mayr 370 (24: L); 596 (16b: L).
McKee 1375 (3bi: K).
Micholitz s.n. (16a: B†).
Millar 1193 (18: LAE, UPNG); 1288 (18: LAE, UPNG); NGF 9220 (9: LAE); NGF 11791 (16a: LAE); NGF 14669 (2: BRI, K, LAE); NGF 14684 (1b: BM, CANB, K, LAE); NGF 15959 (21c: LAE); NGF 22558 (21c: L, LAE); NGF 22610 (19: LAE); NGF 22774 (21a: K, L, LAE); NGF 22831 (18: LAE); NGF 22862 (13a: K, LAE); NGF 22863 (7: LAE); NGF 23151 (4a: L, LAE); NGF 23185 (2: LAE); NGF 23186 (25: LAE); NGF 23191 (4a: L, LAE); NGF 23210 (21c: L, LAE); NGF 23230 (28: LAE); NGF 23231 (2: L, LAE); NGF 23444 (22: LAE); NGF 23673 (25: LAE); NGF 37784 (21c: LAE); NGF 37785 (18: E, LAE); NGF 37788 (25: LAE); NGF 37791 (2: K, L, LAE); NGF 37794 (4b: K, L); NGF 38307 (21e: LAE); NGF 38308 (4b: K, LAE); NGF 38309 (1c: K, L, LAE); NGF 38310 (2: BRI, K, L, LAE); NGF 38313 (18: BRI, E, K, L, LAE); NFG 38366 (28: BRI, K, L, LAE); NGF 40628 (18: K, LAE); NGF 40646 (4a: K, LAE); NGF 40652 (21c: LAE); NGF 40680 (25: K, LAE); NGF 40718 (25: K, L, LAE); NGF 40837 (9: BRI, E, K, L, LAE); NGF 40840 (21e: LAE); NGF 40841 (1c: K, LAE); s.n. (28: E, LAE).
Millar & Garay NGF 18666 (21c: BRI, L, LAE); NGF 18694 (12: LAE).
Millar & Holttum NGF 15748 (21c: LAE); NGF 15753 (28: K, LAE); NGF 18645 (21c: BRI, K, L, LAE).
Millar & Royen, van NGF 14684 (1b, K, L, LAE).
Millar & Sayers NGF 23735 (21c: LAE); NGF 23768 (4b: BRI, L, LAE); NGF 23769 (2: LAE).
Millar & Womersley NGF 7710 (9: BRI, LAE); NGF 7808 (9: AMES, LAE).
Morrison 1690 (9: K).
Mueller, von 488 (28: BRI, K, MEL).
Murray c.7909 (26: E); cult. RBGE 82.2623 (26: E).
NGF 24213 (3a: LAE); 32917 (25: LAE); 40213 (2: LAE).
Nicholls 6 (13: K).
Nicolas 5A (1b: L); 9 (21b: L).
Nouhuys, van 17 (21b: BO); 20 (21b: BO); s.n. (28: BO).
Paijmans 1211 (1b: CANB); 1578 (13a: CANB, LAE).
Philipson W. R. & M. N. 3389 (2: CHR, K, L); 3398 (25: E, K, L); 3403 (25: K, L).
Piottite & Dickson P1 50688 (8: K).
Pratt NG 70 (2: LAE).
Pulle 806 (28: BO); 880 (28: BO, E, K, L); 886 (3bi: K, L); 1066 (11: L, BO); 2408 (1b: BO, K, L).
Pullen 128 (28: L, LAE); 241 (21a: CANB); 5193 (5: CANB, L, LAE); 5268 (2: K, L, LAE); 7999 (16a: CANB, L, LAE).
Quaife 348 (27: NSW).
Rau 10 (21c: K, L, LAE).
Raynal 16601 (3a: P); 17505 (1b: P); 17677 (3bi: P); 17684 (21a: P); 17687 (25: P).
Rees & Reeve 34 (25: K, LAE); 39 (21c: K, LAE); 47 (5: K, LAE); 48 (3bi: K, LAE); 49 (21a: K); 50 (1b: K, LAE); 51 (4c: K, LAE); 52 (28: K, LAE); 53 (4a: K); 115 (28: K, LAE); 165 (13a: K, LAE); 166 (21a: K, LAE); 192 (28: K); 193 (4b: K); 215 (21c: K, LAE); 216 (2: K); 218 (4c: E, K, LAE); 250 (21d: K); 319 (13a: E, K, LAE); 325 (3bi: K, LAE); 334 (16a: K, LAE); 340 (21d: K, LAE); 363 (21b: K, LAE); 372 (22: K, LAE); 373 (9: K, LAE); 376 (11: K, LAE); 383 (28: K, LAE).
Reeve 79 (16a: CBG, E, K, L, LAE); 80 (21d: CBG, E, K, L, LAE); 81 (1b: CBG, E, K, L, LAE); 82 (21b: CBG, E); 83 (11: CBG, E, K, L, LAE); 84 (13a: CBG, E, K, L, LAE); 85 (28: CBG, E, K, L, LAE, SEL); 86 (3bi: CBG, E, K, L, LAE, SEL); 87 (21a: CBG, E, K, L, LAE, SEL); 99 (5: E, K, L, LAE, UPNG); 100 (5: CBG, E, K, L, LAE); 101 (1b: CBG, E, K, L, LAE, SEL); 102 (2: CBG, E, K, L, LAE, SEL, UPNG); 103 (3bi: CBG, E, K, L, LAE, SEL); 104 (21d: E); 112 (22: LAE); 113 (1b: LAE); 114 (21d: LAE); 115 (21d [aberrant]: LAE); 116 (11: LAE); 117 (2: LAE, NSW); 118 (2: LAE); 119 (13a: LAE); 120 (13a: LAE); 121 (21b: LAE); 122 (21b: LAE); 123 (21c: LAE); 124 (21c: LAE); 125 (21a: LAE); 126 (16a: LAE); 127 (18: LAE); 128 (21c: CBG, E, K, L, LAE); 129 (18: CBG, E, K, L, LAE); 130 (4a: CBG, E, K, L, LAE, SEL); 147 (3bi: LAE); 148 (3bi: LAE); 149 (4: LAE); 150 (4c: LAE); 151 (4b: LAE); 152 (20: LAE); 153 (20: LAE); 154 (20: LAE); 155 (9: LAE); 156 (5: LAE); 157 (13c: LAE); 158 (16 × 21c: E, LAE); 159 (16 × 18: E, LAE); 160 (3bi × 2: LAE); 161 (28: LAE); 162 (28: LAE); 207 (25: CBG, E, K, L, LAE); 208 (25: LAE); 245

(16a: K); 246 (13a: K); 247 (3bi: K); 248 (4c: K); 249 (22: K); 250 (18: LAE, K, NSW); 251 (1b: E, LAE); 252 (5: E, K, LAE); 253 (11: K); 254 (21b: K); 255 (9: K); 256 (20: K); 257 (21d: K); 258 (21c: K); 259 (21a: K); 260 (2: K, LAE); 261 (4a: K); 262 (13a: K); 265 (21a: K); 266 (21d: E, K); 268 (3bi: E, K); 269 (21d [aberrant]: K); 270 (21d: E, K); 271 (19: E, K, LAE); 272 (4b: E, LAE); 273 (21b: E, K); 274 (20: CBG, E, K, L, LAE, UPNG); 275 (4a: E, K); 276 (21c: E, K); 277 (4c: E, K); 278 (25: E, K); 279 (25: E); 280 (21a: E); 281 (21a: E); 282 (21f: E, LAE); 283 (2: CBG, E, K, L, LAE, UPNG); 284 (5: K); 287 (13a: E, K); 288 (22: E, K); 289 (11: E, K); 290 (1b: E, K); 291a (16a: E, K); 291b (16a: E); 292 (21a: K); 293 (5: E, K); 294 (3bi: E, K); 295 (18: E, K); 296 (18: K); 297 (13a: AMES, CBG, E, K, L, LAE, UPNG); 298 (13c: E, K); 299 (12: E, K, LAE); 300 (21c: K); 306 (13c: AMES, CBG, E, K, L, LAE, NSW, UPNG); 312 (4c: CBG, E, K, L, LAE, UPNG); 381 (7: AMES, BISH, BO, CBG, E, K, L, LAE, NSW, UPNG); 382 (6: E, K, LAE); 434 (13a: E, LAE); 439 (13a: E, LAE, UPNG); 440 (13c: LAE); 441 (13c: LAE); 449 (21d: AMES, BISH, CBG, E, K, L, LAE, NSW, UPNG); 456 (2: E, LAE, UPNG); 457 (1c: CBG, E, K, L, LAE, UPNG); 458 (3bi: UPNG); 459 (18: UPNG); 460 (28: K, E, LAE); 461 (21a: LAE); 462 (3bi: CBG, E, K, L, LAE, UPNG); 463 (11: AMES, CBG, E, K, L, LAE, UPNG); 464 (21c: UPNG); 466 (11: E, LAE); 467 (18: UPNG); 468 (16a: E, LAE, UPNG); 469 (21d: LAE); 470 (3bi: LAE); 471 (18: LAE); 472 (19: E, K, LAE, UPNG); 473 (21c: UPNG); 474 (4c: E, LAE, NSW); 475 (25: E, UPNG); 476 (20: E, LAE); 477 (9: E, LAE, UPNG); 478 (28: E); 479 (5: E, LAE, UPNG); 480 (4c: LAE); 481 (25: UPNG); 482 (28: UPNG); 483 (4a: AMES, CBG, E, K, L, LAE, UPNG); 484 (3bi: E, LAE); 485 (18: E, LAE); 486 (5: AMES, CBG, E, K, L, LAE); 487 (2: E, LAE); 488 (21a: UPNG); 489 (3bi: UPNG); 490 (6: CBG, E, K, L, LAE); 491 (6: E, LAE); 492 (9: AMES, BISH, BO, CBG, E, K, L, LAE, NSW, UPNG); 493 (28: CBG, E, K, L, LAE, UPNG); 494 (3bi: LAE); 495 (18: E, LAE); 496 (21a: E, LAE); 497 (3bi: AMES, CBG, E, K, L, LAE, UPNG); 498 (4a: CBG, E, K, L, LAE, UPNG); 499 (3: LAE); 500 (25: E, LAE, UPNG); 501 (21c: UPNG); 502 (2: UPNG); 503 (18: E, LAE); 504 (4a: LAE); 505 (2: E, K, L, LAE); 506 (1 × 2?: E, K, L, LAE); 507 (1 × 2?: E, K, L, LAE); 508 (21a: LAE); 509 (3bi: UPNG); 510 (16a: AMES, BISH, CBG, E, K, L, LAE, NSW, UPNG); 511 (21d: UPNG); 512 (13c: E, LAE, UPNG); 513 (4c: UPNG); 514 (3bi: AMES, BISH, CBG, E, K, L, LAE, NSW, UPNG); 515 (28: UPNG); 516 (21b: E, LAE); 517 (28: LAE); 518 (3bi: K, LAE); 519 (7: LAE); 520 (16a: LAE); 521 (16b: AMES, CBG, E, K, L, LAE, UPNG); 522 (3bi: UPNG); 531 (20: LAE); 538 (20: AMES, BISH, CBG, E, K, L, LAE, NSW, UPNG); 552 (10: E, K, LAE); 566 (14: E, K, LAE); 567 (7: LAE); 628 (12: E); 629 (18: CBG, E, K, L, LAE); 633 (2: E); 673 (17: E, LAE); 704 (4c: E, K, LAE); 710 (14: LAE); 711 (21a: LAE); 712 (7: E, LAE); 713 (14: LAE); 831 (18: CBG); 1041 (5: E, LAE, NSW); 1042 (4b: E, LAE); 1084 (23: E); 1087 (14: E, LAE); 1088 (28: E); 1124 (21e: E, K, LAE); 1125 (?3bi: E, LAE); 1126 (28: E, LAE, NSW); 1127 (11: E, LAE); 1128 (9: BISH, BO, CBG, E, K, L, LAE, NSW); 1129 (21a: E, LAE, NSW); 1130 (3bi: E, LAE, NSW); 1131 (21b: E, LAE); 1132 (7: CBG, E, K, L, LAE); 1133 (7: E, LAE); 1134 (16a: LAE); 1135 (16a: LAE); 1136 (?11: E, LAE); 1137 (16a: E, K, LAE); 1142 (9: E, LAE, NSW); 1176 (3a: E); 1181 (9 × 28?: E); 1184 (22: LAE); 1239 (7; LAE, NSW); 1452 (4c: LAE, NSW); s.n. (28: E).

Reinwardt s.n. (9: K, L, W).

Renz s.n. (3a: E).

Ridsdale NGF 30313 (21c: LAE); NGF 36702 (13a: BRI, K, LAE); NGF 36705 (22: LAE); NGF 36743 (22: LAE).

Ridsdale & Galore NGF 33398 (1a: possibly 1 × 2: K, LAE).

Ridsdale & Katik NGF 38046 (3a: K, L, LAE).

Rimer, van 1294 (21: BO); 1294 (21a: BO) 1296 (28: BO).

Robbins 305 (1b: CANB).

Robinson s.n. (22: K).

Romer, von 710 (28: BO-n.v.); 1294 (21a: BO); 1296 (28: BO); 1297 (21a: BO).

Royen, van 3631 (9: L); 3712 (28: L); 3903 (3bi: L); NGF 4369 (28: LAE); 4374 (21c: LAE); 4375 (21a: L); NGF 11073 (1c: LAE); NGF 11311 (21b: LAE); NGF 15125 (25: L, LAE); NGF 15130 (2: L, LAE); NGF 16176 (1c: K, L, LAE); NGF 18095 (4c: LAE); NGF 18109 (21c: LAE); NGF 18120A (28: LAE); NGF 18122 (28: LAE); NGF 18159 (18: L, LAE); NGF 18379 (2: K, L, LAE); NGF 20479 (25, LAE); NGF 20480 (4b: LAE); NGF 30076 (21e: CANB, L, LAE).

Royen, van & Sleumer 5727 (7: L); 5728 (4a: L); 5890 (9: L); 6051 (28: L); 6062 (9: L); 7165 (3bi: L); 7166 (9: L); 7167 (28: L); 7290 (24: L); 7347 (24: L); 7418 (28: L); 7419 (28: L); 7659 (6: L); 7835 (14: L); 7872 (3bi: L); 7873 (28: K, L); 7974 (21c: L); 8002 (3bi: L); 8025 (28: K, L); 8152 (9: L); 8154 (28: L).

Sandham 86/80 (28: E).

Sands et al. S1516 (lc: K); S1557 (2: K); S1625 (2: K); S1667 (1c: K); S1817 (21c: K); S1831 (22: K); S1842 (18: K); S1985 (21c: K); S1986 (21c: K); S2349 (21c: K); S2374 (21c: K) S2399 (21c: K).

Sayer s.n. (9: MEL).
Sayers NGF 21211 (11: CANB, K, LAE); NGF 21293 (4a: BM, LAE); NGF 21460 (2: BM, LAE); NGF 24213 (3a: K, L, LAE).
Schlechter 13930 (7: BM, BR, K, P); 13983 (19: BM, BO, BR, K, P); 16092 (23: K); 16531 (19: K, L); 16545 (3a: BO, E, L, NSW); 16898 (7: BM, BO, K, L); 17960 (23: AMES, BO, E, K, L); 17966 (14: BO, E, K, L, NSW); 17998 (3a: BO, E, K, L, NSW); 18054 (7: B†); 18211 (16a: AD, L, NSW; 18223 (21c: B†); 18710 (22: AMES, BO, E, K, L, NSW); 18723 (3b: B†); 18729 (5: AMES, K, L, NSW); 18752 (20: B†); 18753 (9: E, K, NSW, W); 18754 (13a: AD, BO, E, K, L, NSW); 18785 (21c: B†); 18800 (28: B†); 19011 (19: BO, E, K, L); 19509 (23: B†); 19630 (3bi: BO, E, K, L); 19658 (14: BO, E, K, L); 19664 (28: AMES, BO, K, L); 19743 (16a: B†); 19801 (5: B†); 19882 (7: BM, BO, K, L); 20076 (4a: B†); 20151 (12: B†); 20129 (7: BM, BO, K, L); 20207 (9: B†); 20471 (13b: L, NSW); 20473 (3a: B†).
Schodde 1725 (1b: CANB, K, L, LAE); 2081 (5: CANB); 2430 (16a: CANB).
Schodde & Craven S.4855 (22: CANB).
Shaw-Mayer NGF 27176 (28: LAE); NGF 27177 (18: K, LAE); NGF 27178 (21a: LAE); s.n. (4a: BM); s.n. (21c: L); s.n. (28: BM).
Skingle 2 (1b: LAE); 3 (2: LAE); 5 (21a: LAE).
Slade s.n. (3a: K); s.n. (28: K).
Smith, A. C. 1901 (26: BISH); 4170 (26: AMES, BRI, K, L, P); 4677 (2b: AMES); 5232 (2b: AMES, BRI, K, L, P); 5494 (26: AMES).
Smith, J. M. B. ANU 15104 (2: LAE); ANU 15242 (25: LAE).
Stevens LAE 50303 (21c: K, L, LAE); LAE 54581 (1b: CANB, K, L, LAE).
Stevens & Coode LAE 51398 (1a: E, K, L, LAE).
Stevens & Foreman LAE 55783 (1b: K, L, LAE); LAE 55945 (1b: E, K, L, LAE).
Stevens & Lelean NGF 58217 (22: L, LAE).
Stevens & Veldkamp LAE 55596 (3bi: E, K, L, LAE); LAE 54168 (21e: LAE).
Stocker 10 (26: E); s.n. (26: E); s.n. (28: E).
Stone 5406 (8: L); LAE 53161 (25: LAE); LAE 53246 (1b: LAE).
Streimann 8999 (9: LAE); NGF 27615 (18: L, LAE); NGF 27729 (2: K, LAE); NGF 35929 (28: LAE); LAE 53960 (9: K, LAE).
Streimann & Kairo NGF 27684 (21c: LAE); 27685 (21c: LAE); NGF 35927 (18: LAE); NGF 42467 (19: K, L, LAE); NGF 42469 (21c: LAE); NGF 42470 (22: LAE).
Streimann & Stevens NGF 54851 (18: K, LAE).
Szent-Ivany 7 (1a: LAE).
Takamatsu 689 (13: AMES).
Umba NGF 43469 (2: K, LAE); NGF 43470 (2: BRI, K, L, LAE).
J. H. V. 3213 (26: K).
Vandenberg NGF 35016 (2: K, L, LAE); NGF 35096 (1b: CANB, L, LAE); NGF 39624 (4b: LAE); NGF 39647 (1b: K, L, LAE); NGF 39663 (4c: K, LAE); NGF 39675 (25: K, LAE).
Vandenberg et al. NGF 39732 (25: K, LAE); NGF 39777 (4e: LAE); NGF 39779 (2: K, L, LAE); NGF 39823 (21c: K, L, LAE); NGF 39824 (21a: K, LAE); NGF 39827 (28: K, L, LAE); NGF 39829 (28: K, LAE); NGF 39831 (4a: K, LAE); NGF 39832 (21c: LAE); NGF 39834 (28: LAE); NGF 39851 (25: K, LAE); NGF 39892 (21a: LAE); NGF 39911 (5: K, LAE).
Vaughan 3213 (26: K).
Veldkamp 6547 (1b: K, L, LAE); 6710 (21d: L); 6832 (28: K, L); 6848 (5, LAE).
Veldkamp & Stevens 5690 (21c: L); 5818 (21a: L).
Veldkamp & Vinas 7629 (21a: L).
Versteegh BW3116 (16b: L).
Vinas UPNG 4973 (18: UPNG); LAE 59849 (1: LAE); LAE 67079 (28: K, LAE).
Vinas & Veldkamp LAE 59797 (1b and 2: E, LAE).
Vinas & Wiakabu LAE 59471 (21d: L, LAE); LAE 59521 (21d: L, LAE); LAE 59558 (9: E, L, LAE); LAE 67055 (21a: K, L, LAE); LAE 67071 (2: K, LAE).
Vink 16010 (21a: CANB, L, LAE); 16976 (28: L, LAE); 17016 (21b: L, LAE); 17076 (2: CANB, L, LAE).
Vink & Schram 8643 (16b: L).
Wade ANU 7212 (25: CANB, LAE); ANU 7296 (2: L, LAE); ANU 7322 (4b: CANB, L, LAE); ANU 7327 (21a: CANB, LAE); ANU 7331 (25: CANB, L, LAE); ANU 7573 (3bi: CANB, LAE); ANU 7583 (21c: CANB, K, L, LAE).
Walker ANU 559 (21a: CANB, L, LAE); ANU 822 (4a: CANB); ANU 5149 (2: L, LAE).
Watson 0391 (9: E).
Werner 76 (18: B†).

Wheeler ANU 6117 (1b: L, LAE); ANU 6150 (21a: CANB, LAE).
Whitmore & Womersley BSIP 1031 (27: LAE).
Wiakabu et al. LAE 73439 (9: LAE).
Wickison 8 (8: K); 23 (13: K); 82 (13: K); 150 (3: K).
Womersley NGF 4408 (4a: AMES, BRI, K, L, LAE); NGF 4729 (28: LAE); NGF 4853 (13c: LAE); NGF 4884 (18: LAE); NGF 5180 (2: K, LAE); NGF 5181 (5: BRI, K, L, LAE); NGF 8744 (9: AMES, BRI, K, L, LAE); NGF 8831 (2: AMES, K, L, LAE); NGF 8868 (1b: AMES, LAE); NGF 9385 (16a: LAE); NGF 9392 (16a: AMES, LAE); NGF 9410 (21c: LAE); NGF 11065 (28: K, L, LAE); NGF 11439 (2: AMES, K, L, LAE); NGF 15371 (25: L, LAE); NGF 17952 (1c: L, LAE); NGF 19027 (2: L, LAE); NGF 24729 (21c: K, L, LAE); NGF 24806 (1b: CANB, K, L, LAE); NGF 24807 (2: K, LAE); NGF 43580 (21, LAE); NGF 46435 (28: K, LAE); NGF 46436 (25: LAE); NGF 55300 (25: LAE).
Womersley & Floyd NGF 6162 (28: K, LAE); NGF 6921 (3bi: LAE).
Womersley & Good NGF 9035 (21: LAE); NGF 9039 (18: AMES, BM, K, L, LAE); NGF 9042 (21c: LAE).
Womersley & Millar NGF 7701 (19: AMES, BRI, K, LAE); NGF 7702 (21c: AMES, LAE); NGF 7709 (22: BRI, LAE); NGF 7797 (28: K, L, LAE); NGF 7798 (28: LAE); NGF 7799 (21a: LAE); NGF 8391 (28: LAE); NGF 8406 (18: LAE); NGF 8410 (19: AMES, BRI, K, LAE).
Womersley & van Royen NGF 4369 (28: L, LAE); NGF 5956 (28: BRI, LAE, NSW); NGF 5958 (21c: L, LAE).
Woods 59 (21c: E); 81 (22: E); 154 (16a: E); 155 (14: E); 274 (16a: E); 282 (3bi: E); 296 (9: E); 318 (21f: E); 319 (28: E); 1142 (18: E); 1149 (18: E); 1246 (21c: E); 1267 (21a: E); 1357 (21c: E); 1368 (21c: E); 1411 (4a: E); 1529 (28: E); 1533 (3bi: E); 1575 (21c: E); 1821A (28: E); 2251 (21e: E); 2325 (28: E); 2331 (9: E); 2339 (17: E); 2394 (21c: E); 2401 (28: E); 2483 (28: E); 2490 (4b: E); 2491 (21: E); 2493 (21e: E); 2496 (4b: E); 2599A (17: E); 2599B (21c: E); 2846 (28: E); 2925 (18: E); 2926 (28: E) 2994 (4b: E); 3000 (1c: E); 3028 (4b: E); 3095 (1c: E).

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BISH	Bernice P. Bishop Museum, Honolulu, Hawaii
BM	British Museum (Natural History), London
BO	Herbarium Bogoriense, Bogor
BR	Herbarium, Jardin Botanique National de Belgique, Meise
BRI	Queensland herbarium, Brisbane
CANB	CSIRO, Division of Plant Industry, Canberra, Australia
CBG	The National Botanic Garden, Canberra, Australia
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Index of Epithets

Synonyms are italicized
Species numbers (in bold) precede pagination