

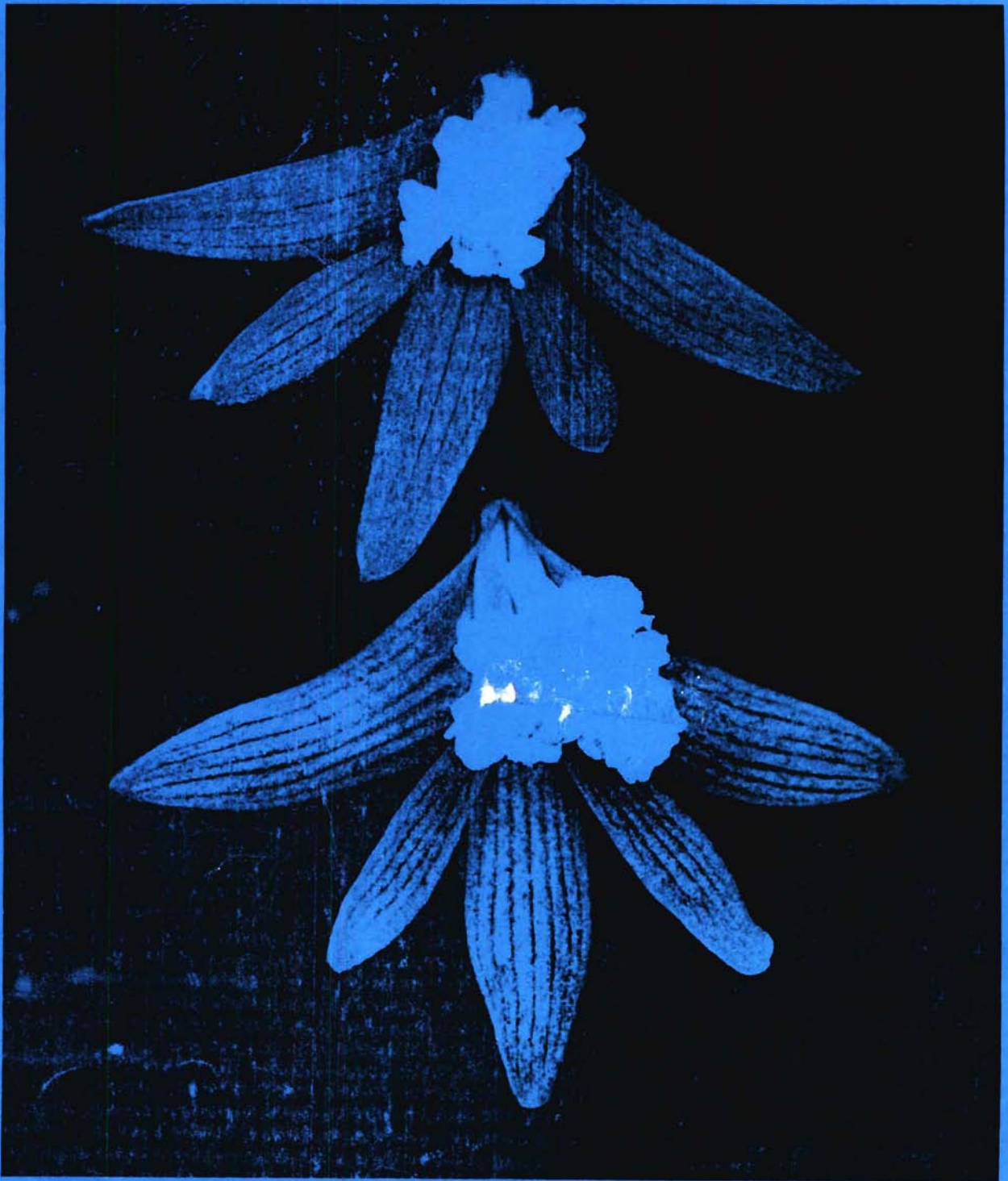
The Orchadian

Volume 13, Number 8

www.anos.org.au

June 2001

Official Journal of the Australasian Native Orchid Society



Grower, Hills District Orchids

D.P. Banks

***Dockrillia striolata* subsp. *chrysantha* from Bicheno, Tas. (top)
& *Dockrillia* sp. aff. *striolata* from Watagan Mountains, NSW**

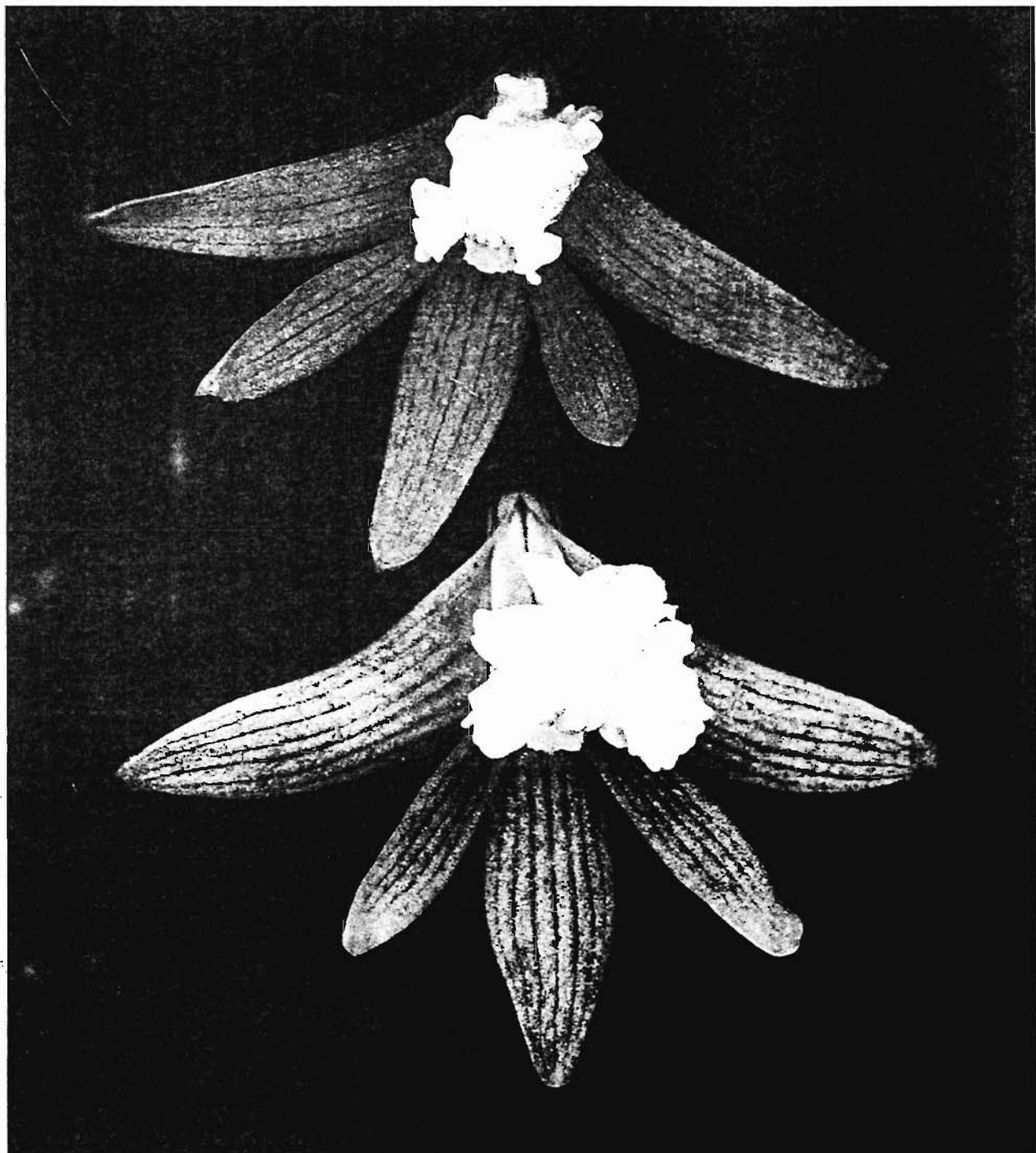
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& *Dockrillia* sp. aff. *striolata* from Watagan Mountains, NSW**

Notice of Annual General Meeting of ANOS Council, Election of Council (2001-2002) & Advisory Committee Meeting.

The above meetings of the Society will be held at the new venue of **Campbelltown R.S.L. Club, Carberry Lane, Campbelltown** (venue for next ANOS Conference and Show) at **10am on Sunday, 26th August 2001**. Hosted by ANOS Macarthur & District Group. Morning tea will be served from 10am and lunch will be available at the club.

The Annual General Meeting (AGM) will be declared open at 10.30am and the Election of Council for 2001-2002 will take place.

The ANOS Advisory Committee Meeting will be held in conjunction with the above, commencing after closure of the AGM.

ANOS Groups and Associated Native Orchid Societies are requested to advise the Secretary the names of their delegates or to nominate representatives to the Advisory Committee Meeting before 19th August 2001.

Nominations For Election To Council

Nominations for election of ANOS Council are called for. These should be signed by a member of the Society, countersigned by the Nominee accepting nomination and lodged with the Secretary no later than 19th August 2001.

The positions to be filled are President, Vice-President, Secretary, Treasurer, Editor, Conservation Officer plus seven Councilors. Proxy Forms for the Election must follow the format set out in Appendix 1 the Society's Rules.



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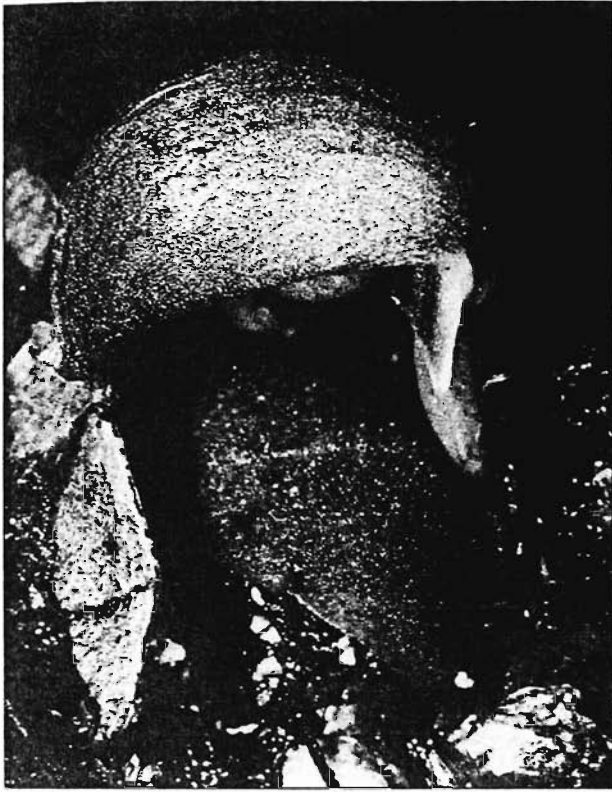
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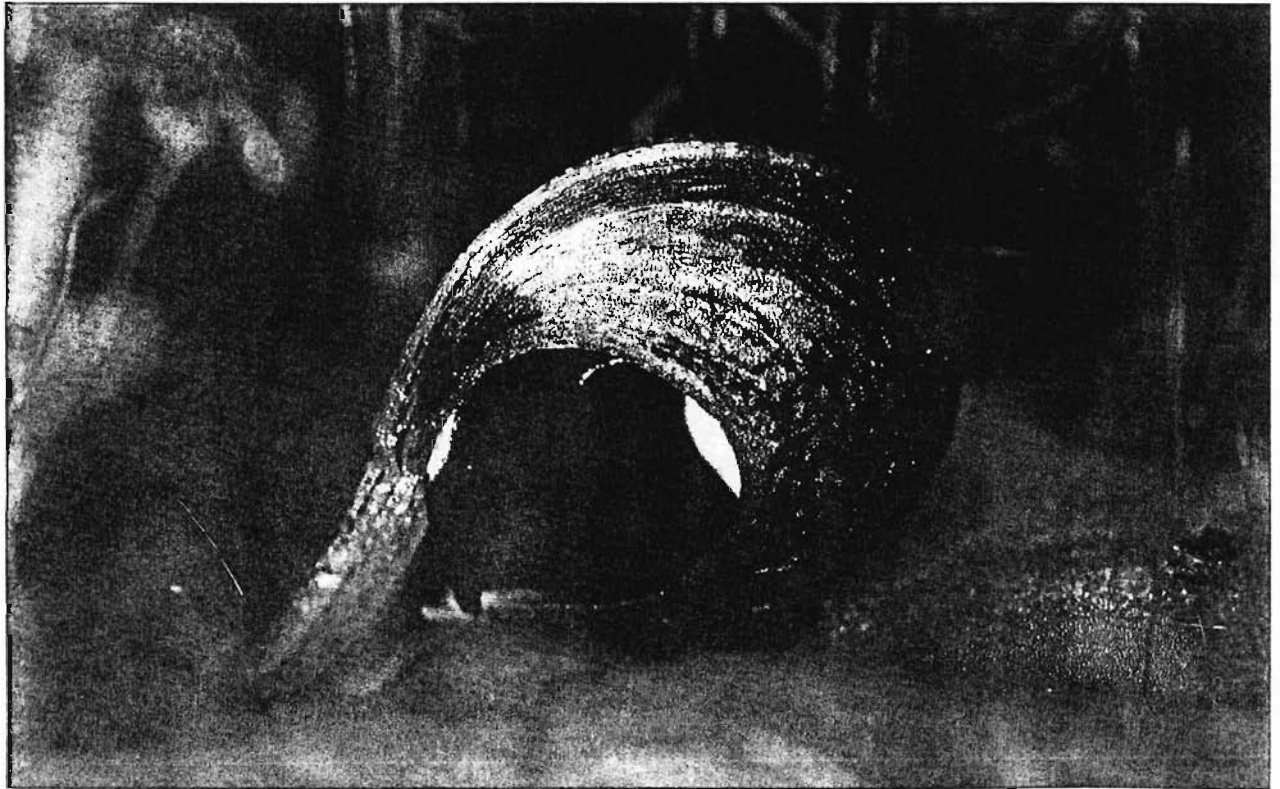
M.A. Clements

Corybas aconitiflorus
from Batehaven, New South Wales



M.A. Clements

Corybas cerasinus
from Shipton's Flat, Queensland



M.A. Clements

Corybas neocaledonicus
from Mt. Mou, New Caledonia

Corybas cerasinus (Orchidaceae), a New Species from North-eastern Queensland.

David L. Jones* and Bruce Gray#

* Centre for Plant Biodiversity Research, Australian GPO Box 1600, Canberra, A.C.T., 2601, Australia.

Tropical Research Unit, CSIRO, Maunds Rd, Atherton, Queensland, 4883, Australia.

Abstract

Corybas cerasinus from open forests of north-eastern Queensland is described as new and compared with *C. neocaledonicus* from New Caledonia and *C. barbarae* and *C. aconitiflorus* from Australia. Notes on habitat and ecology are included.

Key Words

Orchidaceae, *Corybas cerasinus*, new species, Australian flora, Queensland.

Introduction

The identity of *Corybas neocaledonicus* Schltr., which is endemic to New Caledonia, was recently established (Jones 1997) and shown to be distinct from an Australian taxon previously confused with it (Gray & Jones 1985). The opportunity is taken here to describe that Australian species as new.

Taxonomy

Corybas cerasinus D.L.Jones & B.Gray, sp. nov.

C. neocaledonico Schltr. affinis, sed floribus minores super ovario erecto insidens, sepalo dorsali vade curvo, et labello apicali latissimo cum marsupio profundo, differt.

Typus

Queensland: Cook District; Mt Walker, 2 June 1994, L.J. Roberts (D.L. Jones 13022) (holo CANB; iso BRI).

Terrestrial tuberous herb growing in colonies. *Leaf* cordate to orbicular, 12-25 mm long, 10-14 mm wide, bluish green adaxially, reddish or purplish abaxially, apex apiculate. *Peduncle* c. 1 mm long. *Floral bract* closely sheathing, narrowly ovate, 3-4 mm long, 2-2.5 mm wide, acuminate. *Ovary* erect, straight or incurved, 4-5 mm long, c. 2 mm wide. *Flower* solitary, erect with a porrect dorsal sepal, 9-13 mm long, 5-7 mm wide, dark maroon. *Dorsal sepal* concave, curved throughout, ovate-oblong when flattened, 15-23 mm long, 6-10 mm wide, dark maroon with 6-8 longitudinal striae, narrowed at base, apex apiculate, often upcurved. *Lateral sepals* linear-

tapered, 1.5-1.8 mm long, c. 0.3 mm wide, acuminate, porrect or projected upwards against the base of the labellum. *Petals* linear-tapered, c. 1 mm long, c. 0.3 mm wide, acute, falcate, obtuse, hidden behind the labellum spurs. *Labellum* much shorter than, and mostly hidden by, the dorsal sepal, maroon and white; labellum tube c. 3 mm long, erect then recurved sharply and expanded into a lamina; lamina obovate to cordate when viewed from the front, 5-7 mm long, 5-7 mm wide, white with conspicuous striae, with a prominent, deep anterior pocket, the outer margins folded back, the inner surface papillate, the outer surface and margins denticulate and hispid; callus thickened, strongly folded medially. *Labellum* spurs c. 1.3 mm long, deflexed, hollow, tapered. *Column* c. 2.5 mm long, semi-erect, broadest at the base (c. 1.4 mm across), minutely winged, with a thick, prominent, fleshy, red pseudo column-foot. *Anther* c. 1 mm long, c. 0.7 mm wide, with a very short, blunt rostrum. *Stigma* elliptic, c. 0.6 mm diam., c. 0.5 mm high, sunken. *Pollinarium* c. 0.8 mm long, c. 0.4 mm wide, consisting of four pollinia in two pairs, attached directly to an oblong viscidium c. 0.5 mm long. *Pollinia* oblong, cream to yellowish, mealy. *Capsule* not seen.

Fig. 1.

Distribution and Ecology

Endemic to eastern Queensland between Cooktown and the Herbert River, including Dunk Island. Grows in a range of habitats, particularly on exposed ridges in moist to wet sclerophyll forest (Gray & Jones 1985), with an upper canopy dominated by *Allocasuarina littoralis* and *Banksia dentata* and a ground cover of *Xanthorrhoea* sp. Also found growing on moist sheltered slopes in open forest dominated by *Eucalyptus* spp. and *Allocasuarina littoralis*, with

a relatively sparse shrubby understorey.
Soils are sands, sandy loams and gravelly loams.
Altitude: c. 10-600 m.
Flowering period: June to August.

Recognition

Corybas cerasinus can be recognised by relatively small (9-13 mm long, 5-7 mm wide) maroon flowers borne on an erect ovary; porrect, shallowly curved dorsal sepal; open labellum lamina which is broadest towards the apex (5-7 mm wide) and lacks any longitudinal pleats or folds and with a prominent deep anterior pocket; and, a strongly folded labellum callus.

Similar Species

Corybas neocaledonicus, which is endemic to New Caledonia, can be immediately distinguished from *C. cerasinus* by its significantly larger flowers (13-18 mm long, 10-15 mm wide), borne on a leaning ovary; strongly nodding, sharply curved dorsal sepal with three pale longitudinal ridges; widely open labellum lamina which is broadest towards the base (c. 10 mm wide) and a superficial, very shallow anterior pocket; and, a flat labellum callus.

Corybas barbarae D.L.Jones, which overlaps with the new species in northern Queensland, has much larger pale pink to white flowers and *C. aconitiflorus* Salisb. from localities much further south has flowers of a similar size but

much paler colouration.

Notes

Corybas cerasinus may sometimes grow in extensive colonies but always has a very low proportion of flowering plants. Additionally its flowers are apparently rarely pollinated (L. Roberts, pers. comm.).

Pollination biology

The flowers of *C. cerasinus* are entomophilous.

Etymology

From the Latin *cerasinus*, cherry red, in reference to the flower colour.

Specimens Examined

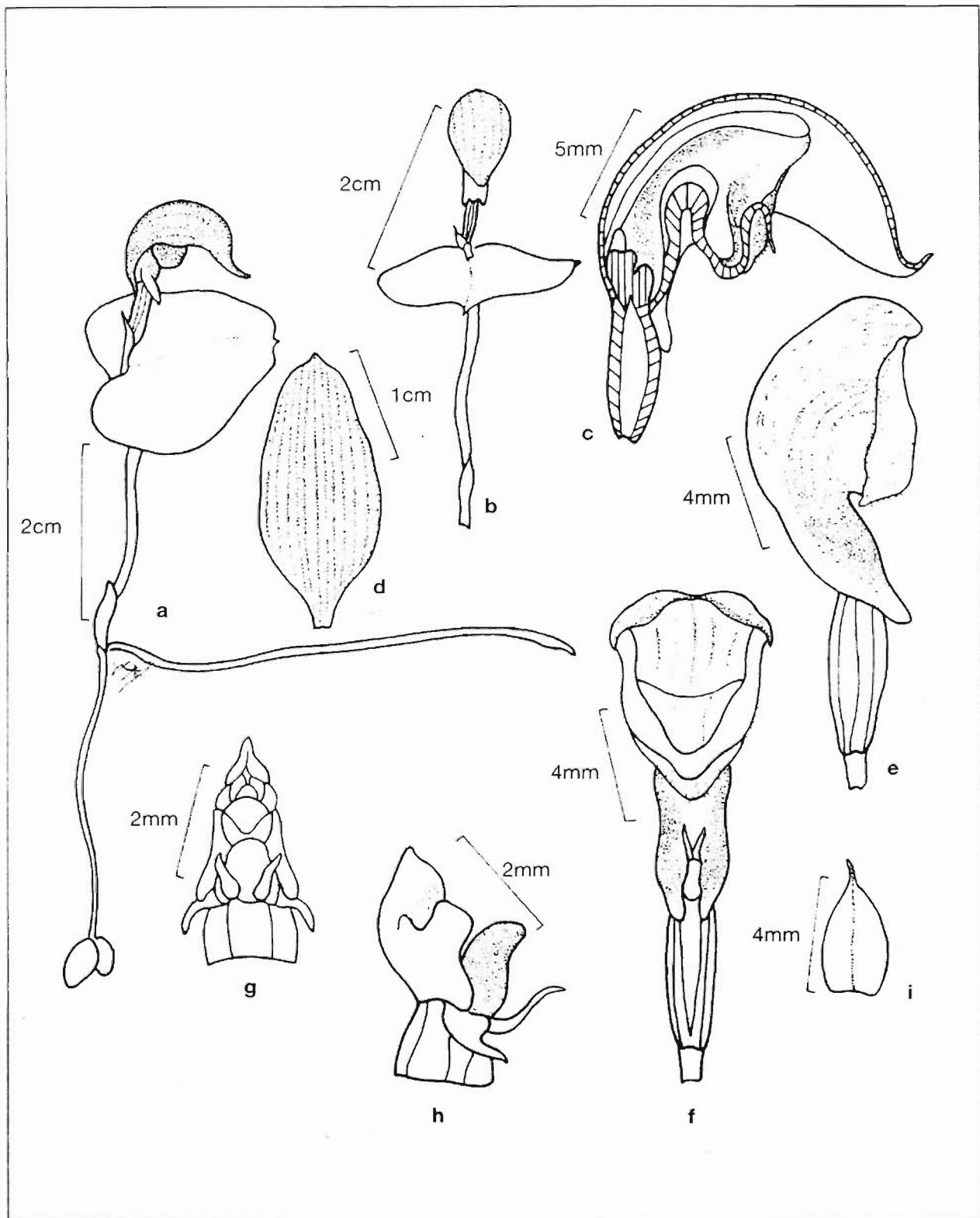
Queensland: Mt Leswell, c. 30 km S. of Cooktown, 7 Sep. 1982, *Gray 3092* (CANB, QRS); *ibid*, 17 June 1984, *Gray 3377* (QRS); Herbert River Gorge, above Blencoe Ck, 4 June 1989, *Gray 5052* (QRS); TR 176, Monkhouse, Mt Leswell, 31 Aug. 1982, *Hyland 11907* (QRS); Gillies Hwy, c. 3 km below Heales Lookout, 21 May 1989, *Jones 4174 & Clements* (CANB); Wallaman Falls, 1 June 1988, *Lavarack* (CANB);

Acknowledgements

We thank Marion Garratt and Karina FitzGerald for technical assistance, Mark Clements, Laurie Adams and Lyn Craven for commenting on the manuscript and the Directors of the following herbaria for access to specimens; B, BM, K, L, MEL, NOU, P, QRS. Laurie Adams provided the Latin diagnosis.

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- Gray, B. & Jones, D.L. (1985). Miscellaneous Notes on the Orchids of North-eastern Queensland. *Orchadian* 8(5), 108-111.
- Jones, D.L. (1997). Miscellaneous Notes on *Corybas neocaledonicus* (Orchidaceae). *Muelleria* 10: 69-73.



***Corybas cerasinus*, Mt. Walker, Queensland.**

L.J.Roberts (D.L.Jones 13022) – drawn from the type collection Fig. 1.

a. flowering plant, side view; **b.** flowering plant, front view; **c.** longitudinal section of flower; **d.** dorsal sepal flattened out; **e.** labellum and ovary, side view; **f.** labellum and ovary, front view; **g.** column, front view; **h.** column, side view; **i.** fertile bract.

Drawing 21/5/1996 by D.L. Jones. ©

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First International Orchid Conservation Congress

The interest, energies and influence of several venerable bodies – the IUCN in the form of its Orchid Specialist Group, Botanic Gardens Conservation International, the Australian Network for Plant Conservation, the American Orchid Society, and Kings Park and Botanic Gardens, Perth - have combined to spawn the first world gathering to cogitate upon a matter of central concern to all of us interested in orchids, plant conservation and a sustainable environment on this planet we inhabit.

The Congress will bring together a wide variety of interested, experienced and knowledgeable people in an attempt to develop a better understanding of the state of conservation of the world's orchids. Needs and challenges, discoveries, failures and successes in orchid conservation will be identified and analysed from which new ideas, approaches and techniques can be developed to better enable the maintenance of orchid species, their populations, natural environments and total gene pool.

Three major segments are planned. The main event, four days of presentations, discussion and summary will cover such topics as:

- Orchid populations, how do breeding, genetics and adaptation work
- Pollination and its relevance to conservation
- Mycorrhiza and their role in conservation – Clements and European terrestrials
- Threats to orchid populations
- Recovery and population restructure
- Orchid taxonomy – its relevance – inventory – what are we conserving?
- Australian orchid conservation – needs, and case studies
- In vitro technology

The Orchid Conservation Techniques Course will precede the congress itself. It will be an intensive hands-on learning experience over three days just prior to the congress, and will cover such things as micropropagation including seed germination and storage, care of seedlings, mycorrhizal fungi, use of microscopes, population recovery methods, pollination and genetics.

There will be a mid-congress one day trip into the field to look at orchids in their natural habitats, in and near Perth.

Immediately after the main event will be the post congress tour which alone promises to be worth going to Western Australia for. It will be over ten days and will tour through many areas looking at a large number of WA's incredible native orchids, (as well as the other incredible WA flora) by those familiar with the local scene.

The vexed matter of the Convention on International Trade in Endangered Species (CITES) will also come to the fore. Trade in wild-collected orchids is still happening; international exchange for scientific and conservation purposes is strongly hindered by unnecessarily involved, cumbersome and unco-ordinated regulations.

Commercial nursery people find legitimate export and import difficult indeed, going through the 'proper channels'. What about the countless millions of orchids left to rot or be burned after logging and land clearing operations, because they are not allowed to be rescued and exported or imported etc? Is ex situ conservation a real option, or just a forlorn excuse by fanciers? Remember *Epidendrum ilense*, now only known to exist in cultivation?

Habitat conservation is a related, fundamentally important issue. How else can local, national, and world biodiversity – the total gene pool - be conserved for the future of the planet? Population reduction or removal reduces or blocks potential for natural selection and the potential for adaptation of the species to an ever-changing environment. It also reduces availability of gene variety for the purposes of line breeding and hybridisation in the cultivation arena.

The website can be found at:

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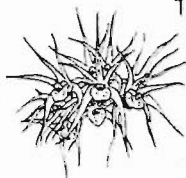
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The Genus *Dockrillia*, and its use in hybrids

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Friedrich Gustav Brieger established the name *Dockrillia* back in 1981, which he used to loosely accommodate the so-called "terete-leaved" *Dendrobium* species. This treatment featured a large number of errors and omissions, and was basically ignored by the botanical community.

The name, which commemorates the respected author and naturalist Alick William Dockrill, was resurrected in 1996 in the first issue of the ephemeral journal, *Lasianthera*. However, this time it has been widely accepted in botanical and horticultural circles. As at 2000, there are 28 named species plus a subspecies (Table 1).

It is predominantly an Australian and New Guinean genus, with outlying populations of taxa throughout parts of the Pacific Islands. There are still other taxa awaiting formal recognition, both in Australia and Papua New Guinea. The type species for the genus is *Dockrillia linguiformis*.

Table 1. Accepted *Dockrillia* Species and their Country of Origin

Species and Author	Distribution
<i>Dockrillia bowmanii</i> (Benth.) M.A. Clem. et D.L. Jones	Australia (NSW, Qld.), New Caledonia
<i>Dockrillia brevicauda</i> (D.L. Jones et M.A. Clem.) M.A. Clem. et D.L. Jones	Australia (north Qld.)
<i>Dockrillia calamiformis</i> (Loddiges) M.A. Clem. et D.L. Jones	Australia (north Qld.)
<i>Dockrillia casuarinae</i> (Schltr.) M.A. Clem. et D.L. Jones	New Caledonia
<i>Dockrillia caudiculata</i> M.A. Clem. et D.L. Jones	Papua New Guinea
<i>Dockrillia chordiformis</i> (Kraenzl.) Rauschert	Papua New Guinea
<i>Dockrillia convoluta</i> M.A. Clem. et D.L. Jones	Papua New Guinea
<i>Dockrillia crispata</i> (G. Forst.) Rauschert	Tahiti
<i>Dockrillia cucumerina</i> (MacLeay ex Lindley) Brieger	Australia (NSW, Qld.)
<i>Dockrillia delicata</i> M.A. Clem. et D.L. Jones	Papua New Guinea
<i>Dockrillia desmotrichoides</i> (J.J. Smith) Brieger	Irian Jaya
<i>Dockrillia dolichophylla</i> (D.L. Jones et M.A. Clem.) M.A. Clem. et D.L. Jones	Australia (NSW, Qld.)
<i>Dockrillia fairfaxii</i> (F. Muell. et Fitzg.) Rauschert	Australia (NSW)
<i>Dockrillia flagellum</i> (Schltr.) Rauschert	Papua New Guinea
<i>Dockrillia fuliginosa</i> M.A. Clem. et D.L. Jones	Papua New Guinea
<i>Dockrillia hepatica</i> M.A. Clem. et D.L. Jones	Papua New Guinea
<i>Dockrillia linguiformis</i> (Sw.) Brieger	Australia (NSW, Qld.)
<i>Dockrillia mortii</i> (F. Muell.) Rauschert	Australia (NSW, Qld.)
<i>Dockrillia nothofageti</i> M.A. Clem. et D.L. Jones	Papua New Guinea
<i>Dockrillia nugentii</i> (F.M. Bailey) M.A. Clem. et D.L. Jones	Australia (Qld.)
<i>Dockrillia pugioniformis</i> (A. Cunn.) Rauschert	Australia (NSW, Qld.)
<i>Dockrillia racemosa</i> (Nicholls) Rauschert	Australia (north Qld.)
<i>Dockrillia rigida</i> (R. Br.) Rauschert	Australia (north Qld.), PNG
<i>Dockrillia schoenina</i> (Lindley) M.A. Clem. et D.L. Jones	Australia (NSW, Qld.)
<i>Dockrillia striolata</i> (Reichb.f.) Rauschert	Australia (Vic., NSW)
<i>Dockrillia striolata</i> subsp. <i>chrysantha</i> D.L. Jones	Australia (Tasmania)
<i>Dockrillia teretifolia</i> (R. Br.) Brieger	Australia (NSW, Qld.)
<i>Dockrillia vagans</i> (Schltr.) Rauschert	Vanuatu, Fiji & Samoa
<i>Dockrillia wassellii</i> (S.T. Blake) Brieger	Australia (north Qld.)

Dendrobium* versus *Dockrillia

Many people are still reluctant to accept that the huge genus *Dendrobium* will be dissected into a number of smaller genera. I feel this is largely because we are familiar with them as dendrobiums. You must admit that it is hard to believe that *Dendrobium toressae* and *Dendrobium bigibbum* are in the same genus, either in or out of flower!

Dendrobium moniliforme from Japan and China is the type species for the genus. In broad terms, the "true" dendrobiums are the "softcane" species, which include the popular exotics *D. nobile*, *D. findlayanum*, *D. signatum* etc. In Australia we therefore only have one true *Dendrobium*, being *D. stuartii* from north Queensland.

There is just so much diversity within *Dendrobium* that this segregation was bound to happen. Basically some of the Sections we have

previously recognised are in the process of 'upgrading' to generic rank. Apart from *Dockrillia*, this has already happened in the past to create the genera *Cadetia*, *Diplocaulobium*, *Epigeneium* and *Flickingeria*. In recent times we have seen the introduction and/or resurrection of *Cannaeorchis*, *Dichopus*, *Eriopexis*, *Grastidium*, *Inobulbum*, *Kinetochilus*, *Tetrodon* and *Winika*. In time, a similar thing will happen to other large genera such as *Bulbophyllum*, *Eria* and *Pterostylis*.

The main characteristics, which separate *Dockrillia* from *Dendrobium* include:

- succulent leaves, which are often terete and cylindrical in cross-section
- pseudobulbs absent
- predominantly pendant growth habit, particularly on older plants
- flowers one to few on an inflorescence, off the previous seasons mature growth
- flowers generally non-resupinate, with the labellum uppermost

Table 2. Abridged Taxonomy of *Dockrillia*

Old Name	New Name
<i>Dendrobium beckleri</i>	<i>Dockrillia schoenina</i>
<i>Dendrobium bowmanii</i>	<i>Dockrillia bowmanii</i>
<i>Dendrobium brevicaudum</i>	<i>Dockrillia brevicauda</i>
<i>Dendrobium calamiforme</i>	<i>Dockrillia calamiformis</i>
<i>Dendrobium casuarinae</i>	<i>Dockrillia casuarinae</i>
<i>Dendrobium cucumerinum</i>	<i>Dockrillia cucumerina</i>
<i>Dendrobium dolichophyllum</i>	<i>Dockrillia dolichophylla</i>
<i>Dendrobium fairfaxii</i>	<i>Dockrillia fairfaxii</i>
<i>Dendrobium fuliginosum</i>	<i>Dockrillia fuliginosa</i>
<i>Dendrobium linguiforme</i>	<i>Dockrillia linguiformis</i>
<i>Dendrobium linguiforme</i> var. <i>nugentii</i>	<i>Dockrillia nugentii</i>
<i>Dendrobium mortii</i>	<i>Dockrillia bowmanii</i>
<i>Dendrobium pugioniforme</i>	<i>Dockrillia pugioniformis</i>
<i>Dendrobium racemosum</i>	<i>Dockrillia racemosa</i>
<i>Dendrobium rigidum</i>	<i>Dockrillia rigida</i>
<i>Dendrobium schoeninum</i>	<i>Dockrillia schoenina</i>
<i>Dendrobium striolatum</i>	<i>Dockrillia striolata</i>
<i>Dendrobium striolatum</i> (Tasmanian "yellow form")	<i>Dockrillia striolata</i> subsp. <i>chrysantha</i>
<i>Dendrobium tenuissimum</i>	<i>Dockrillia mortii</i>
<i>Dendrobium teretifolium</i>	<i>Dockrillia teretifolia</i>
<i>Dendrobium teretifolium</i> var. <i>aureum</i>	<i>Dockrillia dolichophylla</i>
<i>Dendrobium teretifolium</i> var. <i>fairfaxii</i>	<i>Dockrillia fairfaxii</i>
<i>Dendrobium teretifolium</i> var. <i>fasciculatum</i>	<i>Dockrillia calamiformis</i>
<i>Dendrobium teretifolium</i> 'Black Pam'	<i>Dockrillia fuliginosa</i>
<i>Dendrobium teretifolium</i> 'Fiery Glow'	<i>Dockrillia convoluta</i>
<i>Dendrobium wassellii</i>	<i>Dockrillia wassellii</i>



Grower, Darryl Smedley

Dockrillia fuliginosa

Seed raised ex Kaisipi Swamp, PNG

D.P. Banks

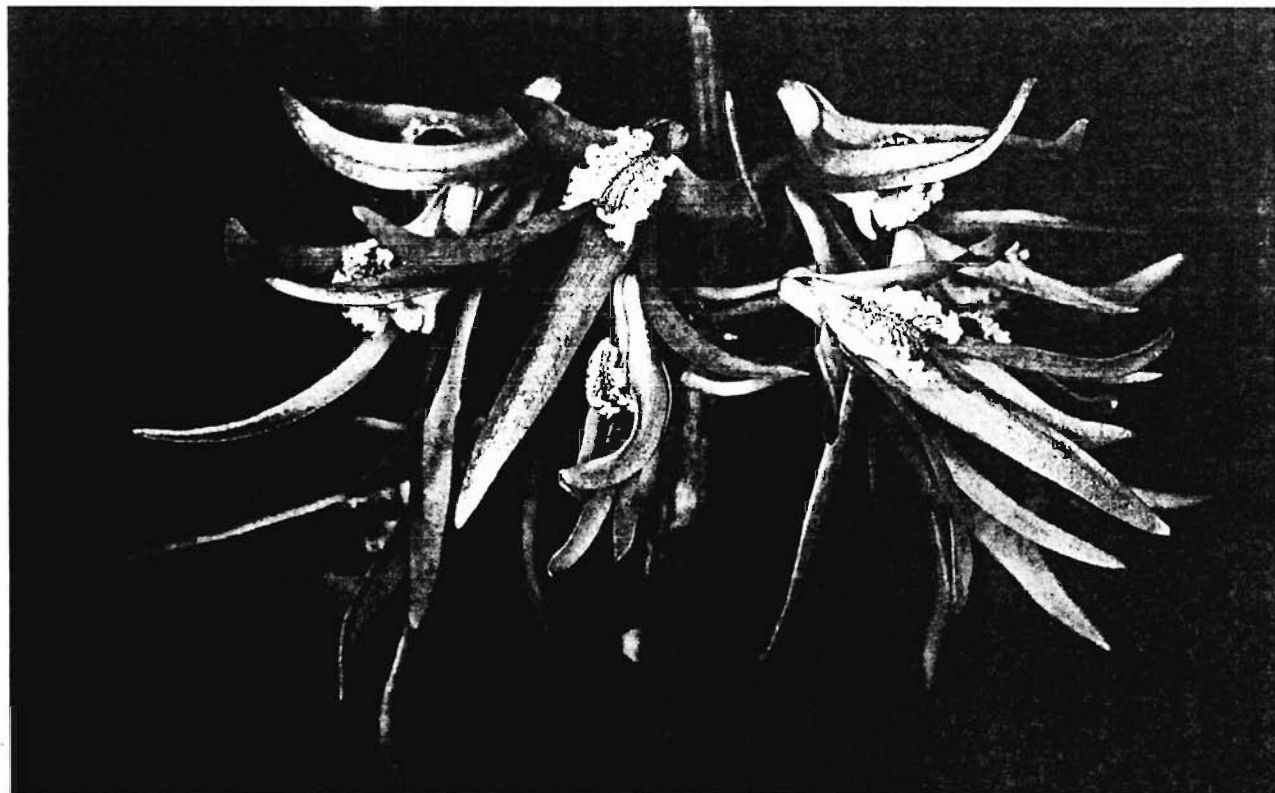


Grower, Darryl Smedley

Dockrillia dolichophylla

from southeast Queensland

D.P. Banks



Grower, Hills District Orchids

Dockrillia brevicauda

from Mt. Finnigan, North Queensland

D.P. Banks

The taxonomy of *Dockrillia* has been confusing. Many taxa were misidentified at the time they were known as dendrobiums, leading to a number of conflicting but necessary name changes in the late 1980's. Perhaps their transfer to *Dockrillia* compounded this confusion in the minds of many native orchid enthusiasts. Even today, there are several incorrect interpretations and incorrect names on plants. An effort is made here (Table 2) to help correct these problems.

At present the Royal Horticultural Society (RHS) in London accepts *Dockrillia* as a valid genus for botanical purposes. However, for hybridisation purposes, it continues to lump any such combinations within *Dendrobium*. In an unusual twist, the Registrar even created the combination of *Dendrobium fuliginosum* simply to accommodate *Dockrillia fuliginosa* for registration purposes. I am not sure what will happen when a registration is eventually submitted involving *Dockrillia convoluta*, as we know there is already a *Dendrobium convolutum* from Section *Latouria*.

Australian and Australasian hybrids

A number of growers have plants of (or hybrids with) an orchid that was loosely known as *Dendrobium teretifolium* 'Black Pam'. Despite the name, this taxon is not even close to the true *Dendrobium teretifolium*. Yet, this was the name that was promoted (and still is by some) and numerous hybrids have been made (and subsequently registered) with this taxon, now correctly known as *Dockrillia fuliginosa*. Similarly the plant known as 'Fiery Glow' has been named *Dockrillia convoluta*. Another problem, an "outcross" was made several years ago, being a hybrid of *Dendrobium teretifolium* 'Fiery Glow' and *Dendrobium teretifolium* 'Black Pam' – thereby *Dockrillia* (*convoluta* x *fuliginosa*). They are certainly not straight *Dendrobium teretifolium*, as the progeny are hybrids. This hybrid has yet to be registered.

Many hybrids derived from *Dockrillia fuliginosa* and/or *Dockrillia convoluta* (or the hybrid between the two) invariably are benched as Australian hybrids. How can this be the case when it is well known that our infamous 'Black Pam' and 'Fiery Glow' came from Papua New Guinea? They should be benched in the Australasian class (or appropriate exotic class). Only a single injection of any of the PNG, or Pacific Island species would obviously (by

definition) exclude the progeny from Australian orchid hybrid classes. Perhaps a section for pure "*Dockrillia* hybrids" may work.

Taxonomic Problems with "*Dendrobium teretifolium*" Hybrids

A number of hybrids have been registered with the RHS quoting "*Dendrobium teretifolium*" as the parent – in some cases this has been misleading (Table 3).

Personally, I believe there are three registered hybrids (plus a number unregistered) which cite "*Dendrobium teretifolium*" as the parent, when in fact *Dockrillia fuliginosa* was used. *D. fuliginosa* is dominant in throwing pinkish-red tones, often with fine pepper spotting, to its progeny. The three in question are *D. Gillieston Glow*, *D. Gillieston's Pepper Pot* and *D. Wesley Pink*. The first two hybrids were made by the late Bill Skillicorn, who used *Dockrillia fuliginosa* extensively as a parent, certainly before it was formally named. The flower colour is typical of *D. fuliginosa* hybrids. Ironically, true *D. Gillieston Glow* (Stephen x *teretifolia*) may not exist, but a plant from the same seed capsule was later (and correctly) registered as *D. Catherine* (Stephen x *fuliginosa*). Wal Upton made and registered *D. Wesley Pink*, and a colour photo (plate 196) appears in his *Dendrobium Orchids of Australia*. There is no doubt that *D. fuliginosa* was also used in this hybrid. In the hybridists' defence, there was no alternative name at the time these hybrids were made.

Before 1997 (when *D. fairfaxii* was accepted at specific rank for hybrids), all varieties of *Dockrillia teretifolia* (as *Dendrobium teretifolium*) were lumped together for registration purposes. Unless we can verify the details with the hybridist, we cannot be 100% sure of which taxon was actually used. The possibilities include *Dockrillia calamiformis* (as *Dendrobium teretifolium* var. *fasciculatum*), *Dockrillia dolichophylla* (as *Dendrobium teretifolium* var. *aureum*), *Dockrillia fairfaxii* (as *Dendrobium teretifolium* var. *fairfaxii*) and of course true *Dockrillia teretifolia*. To date, only *Dendrobium teretifolium* and *Dendrobium fairfaxii* have been accepted by the RHS.

Table 3. Pure *Dockrillia* Hybrids (registered with RHS under *Dendrobium*)

Registered Name	Parentage
Aussie Cascade	<i>pugioniformis</i> x <i>schoenina</i>
Beverly Anne	<i>rigida</i> x <i>cucumerina</i>
Bronze Belle	<i>fuliginosa</i> x Julie Skillicorn
Burly	<i>cucumerina</i> x <i>schoenina</i>
Catherine	Stephen x <i>fuliginosa</i>
Comboyne	<i>pugioniformis</i> x <i>fairfaxii</i>
Dainty Cascades	<i>pugioniformis</i> x <i>mortii</i>
Duffy	<i>striolata</i> x <i>pugioniformis</i>
Fay Moore	Rosemary Jupp x <i>teretifolia</i>
X <i>foederata</i> (natural hybrid)	<i>calamiformis</i> x <i>rigida</i>
Green Gem	Aussie Cascade x <i>striolata</i>
Gillieston Glow	Stephen x <i>teretifolia</i>
Gillieston's Pepper Pot	Limestone x <i>teretifolia</i>
Glenn Wall	<i>bowmanii</i> x <i>linguiformis</i>
Goose Bumps	<i>teretifolia</i> x <i>cucumerina</i>
Green Cascades	Dainty Cascades x <i>pugioniformis</i>
X <i>grimesii</i> (natural hybrid)	<i>calamiformis</i> x <i>nugentii</i>
Ida Mary	<i>schoenina</i> x <i>mortii</i>
Jiggi	<i>schoenina</i> x <i>teretifolia</i>
Julie Skillicorn	<i>mortii</i> x <i>striolata</i>
Limestone	<i>bowmanii</i> x <i>cucumerina</i>
Maddison	<i>racemosa</i> x <i>rigida</i>
Memoria Merv Ditchmen	<i>racemosa</i> x <i>fairfaxii</i>
Michael Jupp	<i>schoenina</i> x <i>linguiformis</i>
Numbat	<i>linguiformis</i> x <i>rigida</i>
Rigidigge	<i>rigida</i> x <i>bowmanii</i>
Rosemary Jupp	<i>striolata</i> x <i>teretifolia</i>
Stephen	<i>schoenina</i> x <i>striolata</i>
Striolling	<i>striolata</i> x <i>linguiformis</i>
Super Ruffles	Rosemary Jupp x <i>mortii</i>
Virginia Jupp	<i>linguiformis</i> x <i>teretifolia</i>
Wesley Pink	Virginia Jupp x <i>teretifolia</i>
Zucchini	<i>wassellii</i> x <i>cucumerina</i>

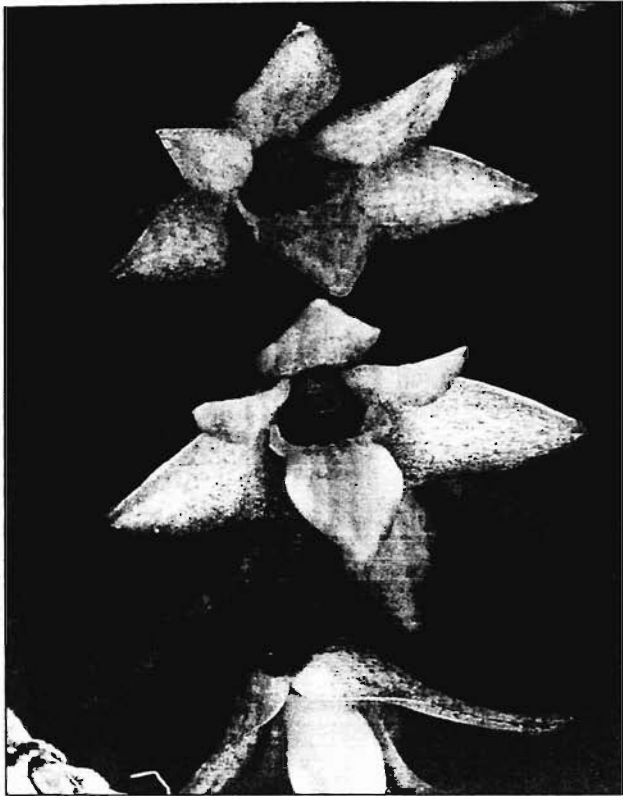
"Intergeneric" hybrids using *Dockrillia*

A number of experimental hybrids have been registered which link *Dockrillia* to other Sections within *Dendrobium* (Table 4). I have referred to these as "Dockrobium", as they are still registered under *Dendrobium*. The term "Dockrobium" has no botanical or taxonomic standing whatsoever (at present anyway!), but is simply used in this paper to distinguish hybrids between *Dockrillia* and *Dendrobium*.

There does not appear to be a sustained future for this style of hybrid, as many are very slow

growing and reluctant to flower. This is generally because of the distorted growth habit this type of breeding often produces.

There are still many combinations that have yet to bloom (or may never), and some of these are well over ten years old. Having said that, one of the nicest examples of this style of breeding is exhibited in Darryl Smedley's unregistered hybrid of *Dendrobium tetragonum* crossed with *Dockrillia fuliginosa*.



Grower, Michael Harrison
Dockrillia rigida
"yellow form" ex. North Queensland

D.P. Banks



Grower, Darryl Smedley
Dockrillia casuarinae
from New Caledonia

D.P. Banks



Dockrillia striolata* subsp. *chrysantha
Growing on granite at Bicheno, Tasmania

D.P. Banks

Table 4. "Intergeneric" *Dockrillia* Hybrids (registered under *Dendrobium*)

Registered Name	Parentage
Amaroo	<i>Dockrillia mortii</i> x <i>Dendrobium falcorostrum</i>
Ayr Queensland	<i>Dendrobium canaliculatum</i> x <i>Dockrillia teretifolia</i>
Beulah	<i>Dendrobium speciosum</i> x <i>Dockrillia cucumerina</i>
Elfin	<i>Dockrillia Dainty Cascades</i> x <i>Dendrobium kingianum</i>
Fred Steenbeeke	<i>Dockrillia striolata</i> x <i>Dendrobium monophyllum</i>
Lemon Lace	<i>Dendrobium Xgracillimum</i> x <i>Dockrillia mortii</i>
Pink Pencil	<i>Dendrobium kingianum</i> x <i>Dockrillia teretifolia</i>
Striking	<i>Dendrobium kingianum</i> x <i>Dockrillia striolata</i>
Warrego	<i>Dockrillia linguiformis</i> x <i>Dendrobium lichenastrum</i>
Wesley Rose	"Dockrobium" Pink Pencil x <i>Dendrobium speciosum</i>
Yondi Harvest	"Dockrobium" Wesley Rose x <i>Dendrobium falcorostrum</i>

Poorly known taxa within the *Dockrillia teretifolia* Complex

Despite the fact that Australia's epiphytic orchid flora is well documented, there are still some taxonomic problems with "species complexes". In the past, many of these have been simply lumped together under one name. However, over recent years, there has been a trend to segregate significantly different populations from related taxa. This is a result of scientific study of numerous plants from known localities, plus the renewed interest by a growing number of enthusiasts who have recognised differences in habitat, ecology, reproductive biology, as well as floral and vegetative features.

The *Dockrillia teretifolia* "complex" is one that is undergoing revision. I know of at least six "forms" which don't quite fit the parameters of the accepted species. I am not suggesting that all of these deserve recognition at specific rank, but their status needs to be investigated.

***D. sp. aff. calamiformis* "Cape York"**

This form appears to be restricted to lowland Cape York Peninsula, in far north Queensland. It is found from the Iron Range area and north of Bamaga to the tip of Cape York. It has greenish-cream flowers, with an untidy arrangement on the inflorescence. It blooms in late spring to early summer and, like *D. calamiformis*, can also have occasional stray flowerings throughout the warmer months.

***D. sp. aff. calamiformis* "Atherton"**

This is a high altitude form, found in many parts of the Atherton Tableland in north Queensland. It has a more slender leaf form and its habit is

not as robust. This taxon has white blooms and may in fact be what was previously named *Dendrobium teretifolium* var. *album* and/or *Dendrobium baseyanum*. A lack of herbarium material (particularly from the original recordings) has hindered research.

***D. sp. aff. dolichophylla* "Kroombit"**

This form from the Calliope Range in central-eastern Queensland, has significantly smaller flowers (25-35mm across) than plants of *Dockrillia dolichophylla* from the NSW/Qld Border Ranges, which can be up to 100mm in diameter.

***D. sp. aff. teretifolia* "Ballina"**

This coastal form from northern New South Wales has larger blooms than its southern counterparts but is sparsely flowered, with only a couple of inflorescences per growth.

***D. sp. aff. teretifolia* "Inland Form"**

Dockrillia teretifolia is generally a coastal species. This form can grow up to 200km away from the coast. It is recorded in mountainous areas from the Granite Belt, on the NSW/Qld border near Stanthorpe, Toowoomba, and the Calliope Range. The growth habit is very sparse and somewhat weedy, and they are certainly not strong plants (when compared to clones from the Gosford area, NSW). It grows as an epiphyte and a lithophyte. The flowers however, are basically identical to the coastal forms.

***D. sp. aff. teretifolia* "Western Sydney"**

This is a most distinctive form, more so in plant habit than in floral structure. Whereas the typical form of the species grows in a pendant

manner, the "Western Sydney" form grows outwards from the host tree, but not downwards, forming a compact, dense mass of stems and leaves which do not develop the normal pendulous habit. Apparently this form was once common on the western edge of the Cumberland Plain, with confirmed recordings from near Kellyville, Prospect and south of Penrith. Most of its former habitat has been transformed into urban development or cleared for agriculture. Numerous searches by enthusiasts, in a range of potential habitats, have failed to locate this unique taxon in recent years. It seems unlikely this form is now extinct in nature, but the fact remains that it has not been seen for over a decade

***Dockrillia* Species and their Potential in Hybrids**

Obviously the scarcer species should be raised from seed and spread around to collections before the secondary thoughts of creating hybrids. This has already happened with *Dockrillia fuliginosa*, which is now part of most specialist collections. Priority should be given to the species from New Guinea and the Pacific Islands, as well as the very rare *D. brevicauda* from north Queensland.

Most of these plants have been used in hybrids and we know something of their dominant and recessive breeding characteristics. A number are popular in hybrids for three main reasons – being flower colour, overall floral display and vegetative features. The flower colour of the Australian species basically ranges from white to green through yellow and brown tones. Labellums are generally white, some with varying degrees of purple and green markings. I will now discuss some of the species we have in cultivation and, where appropriate, examine the potential (and drawbacks) in their role of creating hybrids.

Dockrillia bowmanii

This is a unique green flowered species with a white labellum. Has the potential to produce a range of green flowered hybrids, which may bloom in a number of "bursts" throughout the year. It is tolerant of a wide range of climatic conditions. Should be crossed with *D. teretifolia* and the albinistic forms of *D. striolata*.

Dockrillia brevicauda

Lewis Roberts discovered this very rare species in cloud forest on Mt. Finnigan in north Queensland in 1993. *Dockrillia brevicauda* appears to have an extremely restricted distribution and is one of the most significant new additions to the Australian epiphytic orchid flora since the discovery of *Dendrobium tozerensis* (now *Grastidium tozerense*) in 1977. Plant habit is similar to *Dockrillia calamiformis*, and plants may have been confused with this taxon when not in bloom. Florally, it is unlike any other *Dockrillia* species. Between four and ten caramel-brown to greenish yellow fragrant blooms are produced in mid summer. At present, very few plants would be in cultivation. It is a cool growing species, with most growth produced between autumn and spring. To date, I have been unsuccessful in attempts to produce viable seed by "selfing" my plant.

Dockrillia calamiformis

This is generally a warm growing, lowland species. *D. calamiformis* is very widespread and common over much of north Queensland. Could be used to give warmth tolerance to hybrids grown in tropical climates.

Dockrillia casuarinae

This is a species endemic to New Caledonia, which is similar to the Australian *Dockrillia racemosa*, but the flowers are white. A slow growing plant with unimpressive blooms.

Dockrillia convoluta

A new colourful species (1996) described from Papua New Guinea. Hybrids been seen in a few specialist collections labelled as *Dendrobium teretifolium* 'Fiery Glow'.

Dockrillia cucumerina

Can be somewhat difficult to grow. Has been used more for its foliage than its flowers, however hybrids only have small bumps on the leaves. Not a profuse bloomer.

Dockrillia delicata

A rare white flowered species from Papua New Guinea. It has wider segments than most *Dockrillia* species, with the blooms sparsely arranged on the inflorescence.

Dockrillia dolichophylla

This predominantly golden coloured species has the potential to expand the range of yellow flowered hybrids. Like *Dockrillia fairfaxii*, the leaves can grow up to 100cm long. Hybrids from *Dockrillia dolichophylla* are very slow to mature but worth the wait. The most horticulturally attractive clones occur around the NSW/Qld border region.

Dockrillia fairfaxii

This rainforest species grows into a large plant, botanically it is very close to *Dockrillia dolichophylla*. Hybrids from *Dockrillia fairfaxii* are also very slow to mature, but may be used for their large well marked flowers. This taxon is endemic to New South Wales, where it is found from the Kanangra Boyd region, at the southern end of the upper Blue Mountains, north to Dorrigo and the Upper Clarence River area.

Dockrillia fuliginosa

Selfings and hybrids of this species from Papua New Guinea have been marketed for many years as *Dendrobium teretifolium* 'Black Pam'. A most successful parent in hybrids, this species has opened the door to new range of colours, unavailable in the Australian species. Has been the parent in a number of desirable unregistered hybrids, including combinations with *Dockrillia mortii*, *Dockrillia schoenina* and *Dockrillia striolata*.

Dockrillia hepatica

Another new species recently described from Papua New Guinea. Rare in cultivation, *D. hepatica* could also bring some new colours to hybrids, in the reddish tones, similar to progeny from *D. fuliginosa*, but with more flowers.

Dockrillia linguiformis

A great hardy foliage plant, this species now becomes the type for *Dockrillia*. May be used to increase the flower count in hybrids. Has larger, but thinner blooms than the related *Dockrillia nugentii*.

Dockrillia mortii

This dainty species has been a parent in a number of natural hybrids, generally passing on its olive green blooms with a well-marked purple labellum. Takes more shade and moisture than most *Dockrillia* species.

Dockrillia nugentii

This may have featured in a number of

registered hybrids under the name of *Dendrobium linguiforme*. Segments are shorter and broader than *Dockrillia linguiformis*, and it is somewhat more warmth tolerant in cultivation.

Dockrillia pugioniformis

Very distinctive foliage makes this an attractive plant even when not in bloom. There is an albino form with apple-green segments and pure white labellum. Produces some nice growth forms in hybrids. Can be difficult to bloom in warmer climates.

Dockrillia racemosa

This is not a strong growing species and the hybrids appear to lack vigour. Flower colour is a dirty cream. This has never been a popular species in cultivation.

Dockrillia rigida

Dockrillia rigida is a warm growing Australian lowland species that also extends into Papua New Guinea. The variation in labellum colour is one of the most outstanding features of this species. Tends to flower spasmodically, with a flush of blooms in the warmer months.

Dockrillia schoenina

This is a very fragrant species, with a particularly untidy growth habit. Larger plants can produce a "cloud" of blooms. Each new leaf is progressively smaller than the last (apart from new basal growths), with the terminal leaf quite small on old stems.

Dockrillia striolata

This is a very popular species in cultivation, which has also been used extensively in hybrids. These often are grown in slatted baskets and produce an outstanding floral display in spring. Unfortunately, it has proved difficult to bloom in sub-tropical and tropical climates. There are two distinct "forms" on mainland Australia, whilst the Tasmanian plants have now been assigned to *Dockrillia striolata* subsp. *chrysantha*. The form from eastern Victoria to the Blue Mountains in New South Wales is closer to the Tasmanian subspecies, with a clumping but compact growth habit. The blooms are similar, but with more distinct striation on the back of the flowers. The most popular variety in cultivation is often known as the "Watagan" form. These are the plants to the northern end of this species' distribution. This taxon is primarily from the Watagan Mountains (and surrounding ranges), and other populations

occur at the northern limits of the Blue Mountains near Newnes and Putty. Blooms are significantly larger than typical *D. striolata*, with an outstanding large frilled white labellum. Flowers range from a mushroom pink to deep reddish browns, with darker striations on the back of the blooms. The growth habit is also more pendant. This "form" may occur in other places, such as the Wollemi National Park and obviously requires further investigation. In the broad sense, *D. striolata* is the most cold tolerant species, with plants in some locations (eg. Mt. York, Jenolan Caves) being dusted with snow in winter.

Dockrillia striolata* subsp. *chrysantha

This bright yellow flowered subspecies (described in 1998) is endemic to rocky outcrops near the east and northeast coast of Tasmania. Plants often flower profusely. Very compact growth habit, and cold tolerance are characteristics that may pass onto hybrids.

Acknowledgements

I wish to thank Michael Harrison, David Jones, John Riley and Mark Clements for information on *Dockrillia* species, and in particular the discussion on the *Dockrillia teretifolia* complex. Wal Upton and Darryl Smedley also assisted by providing data on a number of *Dockrillia* hybrids.

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New Caledonia and its Dendrobiums (Part 2)

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Comparison of development of Dendrobiinae on New Caledonia and New Guinea

New Caledonia and New Guinea, the only islands with endemic sections of *Dendrobium*, have biogeographical similarities and also notable differences. For instance, each has received its dendrobiums from two main sources: New Guinea from Malesia and Australia, New Caledonia from Vanuatu and Australia. New Guinea is the "crossroads" for northern and southern dendrobiums, but New Caledonia is at or near the subtribe's periphery.

Let us compare the histories of these islands and their "spectra" of Dendrobiinae. New Caledonia is geologically old, and conditions there have changed little for 40 my except for erosion of the ophiolite. I have proposed that its original dendrobiums (notably ancestors of sections *Macrocladium* and *Kinetochilus*) made an early adjustment to the arrival of the ophiolite; speciated in the process probably aided by fragmentation of the serpentine areas; and persisted with minor new developments in this special protected environment. These species remain isolated on the island. As the area of normal soil increased, the dendrobium flora received immigrants from Australia: early, e.g. precursors of section *Eleutheroglossum*; later, e.g. *D. (Dendrocoryne) odontochilum*, and recent, e.g. *D. (Rhizobium) bowmanii*. Many other recent arrivals came from New Guinea over the island chain of the Solomons and Vanuatu, e.g. *D. (Latouria) psyche*. Except for *D. (Brevisaccatum) finetianum*, the latecomers have not adapted to the ophiolite. Some have spread, via Fiji, to islands farther east.

New Guinea, in contrast, is much larger; it is young (perhaps 10 my old) in its present form; and its nearly 500 species in the Dendrobiinae have developed relatively rapidly. Its strongest environmental challenge, which fostered ecological niches where new sections of *Dendrobium* could evolve, was not the imposition of toxic soil, but the rapid rise of extensive high mountains. The resulting steeply dissected terrain provided multiple ecosystems at different altitudes. Cool-growing, poorly dispersing (with heavy seeds) primitive plants, such as *Nothofagus* and *Araucaria*, arrived early (probably over dry land during a cool period)

from Australia and survived at altitude, rather than on ophiolite. There they avoided equatorial conditions and the flood of competing species immigrating from tropical Sundaland. Some of the Dendrobiinae (most notably Asia-derived *Dendrobium* section *Pedilonum*) exploited successfully the developing high-altitude habitats that contained phorophyte trees of Australian origin. Thus they produced new species, even new sections, there (e.g. section *Oxyglossum*).

Dendrobium section *Pedilonum* and its progeny, most of them montane species, depend on Sahullan nectar-eating birds, the Meliphagidae, common in Australia, as pollinators. Birds tolerate cold and altitude better than bees and, unlike insects, fly in wet weather. Large-flowered section *Latouria*, which may be most closely related to sections *Spatulata* (the "antelopes") and *Phalaenanthe*, rather than *Dendrocoryne* and *Monophyllaea*, evidently adapted to big bees at (usually) moderate altitudes. We have a mystery here, however: it is not clear why this large section, *Latouria*, with most species having "generic," *Cattleya*-type flowers, is almost endemic to New Guinea, the exceptions being *D. bifalce* and the far-travelled *D. macrophyllum* complex. We know almost nothing, unfortunately, about pollinators of New Caledonian dendrobiums, but the prevalent trumpet-like flower with short mentum suggests an adaptation to bees. *D. (Oxyglossum) masarangense* is, however, probably bird-pollinated.

As noted above, two endemic *Dendrobium* sections, *Macrocladium* and *Kinetochilus*, seem to be old and serpentine-bound; the other two,

Inobulbum and *Tetrodon*, appear more recent and tolerate both substrates, but so far are non-migratory. A fifth section, *Eleutheroglossum*, has a single species endemic to Australia. Remarkably, New Guinea, despite its size, partitioned terrain, and number and variety of sections (25, about 15 native), has fewer (3) endemic sections than New Caledonia. New Guinea is "leakier" because of its normal ecology and central geographical position. This dispersion has occurred although all the native sections developed comparatively recently. A number of the near-endemic, small sections have established a species or two on nearby islands, Moluccan as well as Melanesian. This did not occur with New Caledonia because of its greater isolation and the chemical barrier of the ophiolite.

New Caledonia was long ago a part of a much larger Tasmantis, connected to Australia. It has had no land connections with other islands since it took its present form about 40 mya. Before that time, a smaller, lower New Guinea was another outpost of Australia. Separated intermittently by the Torres Strait, New Guinea was temporarily reconnected, during relatively recent glacial times of lower sea level (within the past 2 my), by the exposed Sahul plain. This "corridor" allowed migration of flora and fauna. Recent New Guinea migrants into Queensland include several species of *Dendrobium* section *Spatulata*, the "antelopes". Conversely, species of Australian origin have migrated to New Guinea recently. Probably less recent was the migration of New Guinea dendrobiums southeast, across the Melanesian islands to New Caledonia and eastward as far as Tahiti. On both New Guinea and New Caledonia, species of animals and possibly plants may have become concentrated when extensive contiguous areas subsided underseas.

As we have seen, the old native dendrobiums of New Caledonia have remained tied to the island, presumably because they or their host trees developed special edaphic (soil-related) requirements and/or are poor competitors on normal soils. Only one widespread immigrant species, *D. (Dendrocoryne)*, seems to have travelled directly from New Caledonia to other

islands in Oceania: northeast to Vanuatu and, possibly, also southeast to the Kermadec Islands north of New Zealand. It is not reported from intervening Tonga.

On the other hand, New Guinea has been a prodigious generator of exported species. As we have noted, a minority of the nearly 500 New Guinea members of the Dendrobiinae, being very diverse and adapted to a range of habitats, spread to the nearby Moluccas, tropical northeastern Australia, and especially Oceania via Bougainville. In the eastern Moluccas, Micronesia, Melanesia, and Polynesia, native New Guinean sections supply most of the resident Dendrobiinae (except in New Caledonia). My calculation is that 50 New Guinean species in the subtribe have colonised the nearby Solomons, 19 Australia, and 10 Micronesia and the Moluccas. Their pollinators, the avian Meliphagidae and a variety of bees, also extend out from Sabulland, in diminishing numbers, far across the Pacific. Some mesic (intermediate) and cool-growing cloud-forest dendrobiums of New Guinean derivation have found suitable habitats on smaller islands, such as Viti Levu in Fiji, at relatively low altitudes, where the ocean cools the climate. Examples are *D. (Oxyglossum) prasinum* and *D. (Calyptrochilus) mohlianum*.

Human history and *Dendrobium* study

An Englishman, Captain James Cook, "discovered" and named New Caledonia for Scotland on his second voyage in 1774. It was the French, however, who settled the island as a penal colony in 1789. In the mid-1800's, after France abandoned the penal project, immigrants from Pitcairn Island, descendants of the *HMS Bounty* mutineers, moved in. France finally annexed New Caledonia, just ahead of the British, in 1853, and it remains part of France. Since the 1860s, mining has been the chief industry, attracting foreign labour and ultimately threatening the flora of the ultramafics. New Caledonia is one of the world's largest exporters of nickel. During World War II New Caledonia was a key base for American operations. Nouméa, the capital, at the southeastern tip, holds half the total population of about 150,000; the most populous groups are, in order, native Melanesians, Europeans,

Polynesians, and Asians. Air transport to New Caledonia has overcome its isolation. With a variety of cultures, splendid beaches, and mild climate, La Grande Terre and several other islands have developed an important new industry, tourism. The word, kanak (Polynesian) or canaque (French), is accepted as an adjective for New Caledonia or a name for its people.

Study of the native dendrobiums and other orchids was haphazard in the nineteenth century, with European taxonomists working up the meager collections of returning explorers. Rudolf Schlechter visited the island in 1902-1903, after his first New Guinea expedition, and produced the first monograph (Schlechter 1906) on New Caledonian orchids, reporting 11 new *Dendrobium* species as well as 9 new sections, of which 4 survive: *Eleutheroglossum*, *Inobulbum*, *Kinetochilus*, and *Macrocladium*.

Meanwhile French taxonomists moved into the field. Finet (1903) described 5 new species, and Guillaumin (1948) provided a checklist and key, now outmoded. The definitive work is Nicolas Hallé's orchid volume (1977) for the *Flore de la Nouvelle Calédonie*, to which he made several short additions (Hallé 1978, 1981a, 1981b, 1986). During this period Jaquet (1980) wrote a popular review including probably the first colour photos of 5 endemic *Dendrobium* species.

Hallé's works include detailed drawings of every species, which remain invaluable. His system of groups within *Dendrobium*, though idiosyncratic, translates generally, but not always, into Schlechter's sections. Thus Hallé, although not an orchid specialist, provided until the 1990s the only modern scientific literature on New Caledonian dendrobiums. He acknowledged his debt to plant physiologist and explorer H. S. MacKee. MacKee, along with his wife, who predeceased him, collected from 1958 to 1988 New Caledonian plants for the Museum d'Histoire Naturelle in Paris. His specimens also went to other herbaria; I have seen a number of them at AMES. MacKee was Hallé's guide in the field and the source of most of his specimens. Despite deteriorating health, he kindly supplied me with much valuable information (pers. comms. 1993 and 1994). A preliminary version

of this paper, which I sent to him in early 1995, was returned with the notation that he had died.

Mark Clements and other botanists at the Australian National Botanic Gardens, having visited La Grande Terre in 1989, mounted two field expeditions in 1992 to investigate New Caledonian orchids. With support from officials and orchidists on the island, they obtained specimens, including most of the resident dendrobiums, from both ultramafic and "normal" substrates, and established a living collection of them in Canberra. In their report, Clements, Walker, and Ziesing (1994) presented observations of many dendrobiums and other orchids in their habitats. As a result of this experience, Clements and Jones are producing a series of taxonomic papers on New Caledonian Dendrobiinae (Clements and Jones 1998a, 1998b). For their results to date see Taxonomic Revisions below.

In 1995, sadly too late for the MacKees, the national orchid group, the Société Néo-Calédonienne d'Orchidophilie, founded in 1976, published *Native Orchids of New Caledonia*. This long-awaited popular volume (Bégaud et al 1995) complements Hallé's monograph. With Jacques Bégaud's text presented in French, English, and Japanese, it gives brief accounts of a majority of the species, including cultural information, along with excellent colour photographs of plants and habitats. Among the 150 species included are 28 *Dendrobium*, 2 *Diplocaulobium*, and 1 *Flickingeria* (as *Ephemerantha*). *Dendrobium* sections are not specified.

A proliferation of biogeographic and ecological studies of New Caledonia in the past 20 years has had support from the mining industry, which helped Holloway (1979). The French government supported the work of Morat, Jaffré, et al., noted above, as well as the collecting activities of the MacKees. Most of the island habitat apparently remains pristine, partly because the ultramafic areas are poor farm land and grow little timber. Nevertheless, serious long-term threats to the ecosystems and their orchids remain, particularly brushfires and surface mining. The serpentine biota recovers

very slowly (Wallace pers. comm. 1999). We have reason to hope, nevertheless, that with the help of the Société and other groups, the remarkable flora of New Caledonia, including the Dendrobiinae, will have a secure future.

Taxonomic revisions

In recent years Clements and Jones have pursued the taxonomic study of orchids native to Australia and adjacent islands, notably New Guinea and New Caledonia. The main subject of their joint research has been the Dendrobiinae. Although I have referred to many of their changes above, a summary is in order. They have clarified the status of several previously known taxa. On the other hand, their checklist embodying several changes (Clements and Jones 1999) gives no supporting information. Their species-level changes involving New Caledonian taxa follow, along with my comments. I support them except as noted.

1. Including an unknown *Diplocaulobium* species in Bégaud et al (1995) under the Guadalcanal taxon, *D. mekynosepalum*, sens. lat. (Clements and Jones 1999)

2. Reassigning *Dendrobium* (*Macrocladium*) *finetianum* to section *Trachyrhizum* (Clements, Walker, and Ziesing 1994). The sectional name should be corrected to *Brevisaccata*.

3. Reassigning *Bulbophyllum layardii* Kraenzlin to replace *Dendrobium* (*Inobulbum*) *munificum*, in restored genus *Inobulbon*, as *I. layardii* (Clements and Jones 1998a). Ormerod (pers. comms. 1999, 2000) finds this to be a misinterpretation of the type material of *B. layardii*: he reports that the description applies to a true *Bulbophyllum*, although Mueller evidently mislabelled the type specimen. *Inobulbon*, correctly *Inobulbum*, was the changed spelling, now illegitimate (Greuter et al 1994), which Schlechter and Kraenzlin adopted for the genus (Kraenzlin 1910).

4. Reassigning *Dendrobium oppositifolium* to a new genus, *Tetrodon*, as *T. oppositifolius* (Clements and Jones 1998a). The *Tetrodon* concept seems sound, but I balk at making it a genus.

5. Reassigning previously obscure *Dendrobium petrophilum* to genus *Tetrodon* as *T. petrophilus* (Clements and Jones 1998a). This is a sound assignment, perhaps more appropriate at sectional level.

6. Supporting *Dendrobium* (*Dendrocoryne*) *comptonii* as a Pacific island species separate from Australian *D. gracilicaule* (Clements, Walker, and Ziesing 1994). I have heard other support for this, but the type drawing is uninformative, and my own plant received from Fiji is undistinguishable from the Australian form.

7. Adding three species to the new genus *Cannaeorchis* (see below): *C. atractoglossum*, described by Hallé as a variety of *Dendrobium polycladium*; *C. delumbe*, by Hallé considered synonymous with *D. polycladium*; and *C. megalorhizum*, reduced by Hallé to a variety of *D. sarcochilus* (Clements and Jones 1997b). Judging from photographs, I find the species changes justified but in feminine gender, as *atractoglossa*, *delumbis*, and *megalorhiza* (see below).

8. Removing the controversial New Zealand endemic, *Dendrobium cunninghamii*, from current sections where different students had placed it, including *Macrocladium*, thus making section *Macrocladium* endemic to New Caledonia (Clements et al 1997). This species does not belong in any current section, but making it a new monotypic genus, *Winika*, is in my opinion questionable (see below).

9. Reestablishing *Dendrobium psyche* Kraenzlin of Vanuatu and New Caledonia as a species separate from *D. macrophyllum* (Clements, Walker, and Ziesing 1994; Clements 1999). Cribb (1983) reduced to synonymy many names in this widespread complex, which are receiving reanalysis (Clements 1999; Spence 2000). I fear that this effort may open a taxonomic "can of worms." A thorough restudy of the complex is in order.

13. Similarly separating *Dockrillia* (or *Dendrobium*) *seemannii* L.O. Williams from the broad *D. vagans* (Clements and Jones 1999). As in the last case, this is a large complex, and I'd like to see clearer distinctions drawn before accepting this change.

A major feature of Clements and Jones's studies has been splitting off new or revived genera from *Dendrobium*. Several such changes, some of which are new, appear in their Checklist of New Caledonian Orchidaceae (Clements and Jones 1999). Their genus level taxonomic changes in addition to *Winika*, noted above, include:

1. Reviving Brieger's genus *Dockrillia* to replace *Dendrobium* section *Rhizobium* (Brieger 1981; Clements and Jones 1996). It is ironic that Dockrill himself (1992) opposes this.
2. Returning *Dendrobium* section *Grastidium* to generic level, where Blume initially placed it (Blume 1825; Clements and Jones 1997).
3. Returning *Dendrobium* section *Inobulbum* to genus level, which Schlechter and Kraenzlin had elevated it as *Inobulbon* (Kraenzlin 1910; Clements and Jones 1998a).
4. Raising recently defined *Dendrobium* section *Tetrodon* (Ormerod 1995) to genus level (Clements and Jones 1998a).
5. Raising *Dendrobium* section *Macrocladium* to genus *Cannaeorchis* (Clements and Jones 1998b). The authors changed the name to avoid confusion with the fern genus *Macrocladus*.
6. Supporting Brieger's elevation of *Dendrobium* section *Kinetochilus* to genus level (Brieger 1981; Clements and Jones 1999).

I agree with Yukawa et al (1993, 1996) that further subdivision of the Dendrobiinae at this time is premature, since we have incomplete knowledge of species relationships at generic and sectional levels. We especially need more DNA studies.

Furthermore, higher-order taxonomy, defining the limits of genera and sections, can be even more subjective than species taxonomy. Indeed, the work of Chase and Palmer (1989, 1992) with the Oncidiinae has shown that morphological, and especially floral, dissimilarities can be very misleading if not supported by molecular and other lines of study.

Consequently, in listing the New Caledonian

species below, I have taken a conservative approach, accepting (as noted above) most new or restored species and recording, but not adopting, the genera pending greater clarification of the tree of relationships.

Cannaeorchis atractoglossa has not been described in *Dendrobium*. Despite the comments above, I do not feel it is appropriate to make a new taxonomic assignment for a plant that I have never examined.

Dendrobium kajewskii Ames, a variant of *D. (Spatulata) conanthum* Schlechter, was described from Bougainville (Ames 1932). Cribb (1986) and Lewis and Cribb (1989, 1991) considered them synonymous. Ormerod, however, (pers. comm. 1999) retains *D. kajewskii* Ames for the island form found in New Caledonia and listed in Bégaud (1995) as *D. conanthum*. Reviewing relevant descriptions and illustrations, including my own slides of New Guinea plants, I see much general variation in the lip of *D. conanthum* but do not find enough evidence to support *D. kajewskii*. The Clements and Jones list (1999) does not include this name.

Orthography

Several comments on the spelling of New Caledonian names in the Dendrobiinae seem worthwhile. Hallé's epithet *atractoglossum* seems to me untranslatable. *Atratoglossum*, however, means "dark lip," and is appropriate. Likewise, Schlechter's *cymatoleguum* is meaningless, but *cymatolinguum*, "wavy tongue", describes the plant. The taxonomic rule, nevertheless, is to honour the author's original spelling, which is assumed to be intentional even if technically erroneous (Greuter et al 1994, Art. 60). In the *Dendrobium macrophyllum* complex, Schlechter described *D. palawense*, not *palauense* (Clements 1999) from Palau, in Micronesia, despite the risk of confusion with Palawan, in the Philippines. Nuttall named the now popular horticultural vine, *Wisteria*, after his friend, Caspar Wistar (E. Schuyler pers. comm. 1999).

As noted above under Taxonomic Revisions, *Inobulbum* is Schlechter's original spelling, not *Inobulbon*, used by many authors, including himself!

Diplocaulobium ou-hinnae is Schlechter's original hyphenated spelling, followed by Bégaud et al. Hyphenation is the correct way to unite two words in a name (Greuter et al 1994). The description notes, "bei Ou Hinna" (Schlechter 1906). Hallé has *ouhinnae*; current maps show the town as Ouinné. We should stay with Schlechter.

Gender-adjusted Latin endings, on the other hand, are considered taxonomically trivial compared with the body of the name. I think, nevertheless, that they should be in good order. *Cannaeorchis*, being a compound of *Orchis*, is, surprisingly, feminine. *Dendrobium* is neuter. Hence if the new genus is accepted, feminine endings are indicated, e.g. *C. atractoglossa*. *Kinetoichilus*, however, is masculine. The case of *D. sarcochilus* (masculine) is less clear. According to Finet's description, the flower has a fleshy lip, "lobus carnosus", an adjectival use. This suggests *sarcochilum*; sarco- and carno- both refer to flesh. Finet may have thought that the flower resembled that of *Sarcochilus* (masculine), justifying the appositive form, *D.*

List of Dendrobiinae in New Caledonia:

40 species (including 1 unknown, not including 2 questionable); 27 endemic (70%); in 3 genera.

Diplocaulobium (2): *D. ou-hinnae* (local), *D. mekynosepalum*, sens. lat. (widespread).

Flickingeria (1): *F. comata* (widespread).

Dendrobium (37; 27 endemic; in 15 sections plus 1 unclassified; 4 sections, possibly 5, endemic):

Section *Brevisaccata* (syn. *Trachyrhizum*) (1 endemic): *D. finetianum*.

Section *Dendrocoryne* (2, 1 endemic): *D. odontochilum* (endemic), *D. comptonii* (widespread). (Editor's Comment: True *D. gracilicaule* also occurs in parts of New Caledonia, see photo back cover)

Section *Distichophyllum* (1): *D. austrocaledonicum* (oceanic).

Section *Eleutheroglossum* (3 endemic, 1 with 2 varieties): *D. closterium* var. *closterium* and var. *jocosum*, *D. ngoyense*, *D. poissonianum*.

Section *Grastidium* (2, possibly 3; 2 endemic): *D. biflorum?* (oceanic), *D. camaridiorum* (endemic), *D. crassifolium* (endemic).

Section *Inobulbum* (endemic, 2 species): *D. munificum*, *D. muricatum*.

Section *Kinetoichilus* (endemic, 3 species): *D. cleistogamum*, *D. crassicaule*, *D. pectinatum*.

Section *Latouria* (1): *D. psyche* (also Vanuatu; in widespread *D. macrophyllum* complex).

sarcochilus, as in *D. phalaenopsis* (feminine).

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Classifying species by breadth of distribution

In the list below I have labelled most species as "endemic", "Australian", "local" (limited to neighbouring islands), "oceanic" (limited to Pacific Islands), or "widespread" (extending to New Guinea or beyond).

Section *Macrocladium* (endemic, 11 species): *Cannaeorchis atractoglossa* (see Taxonomic Revisions above), *Dendrobium cymatoleguum*, *D. delumbe*, *D. deplanchei*, *D. fractiflexum*, *D. megalorhizum*, *D. polycladium*, *D. sarcochilus*, *D. steatoglossum*, *D. vandifolium*, *D. verruciferum*.

Section *Biloba* (syn. *Monanthos*)(1): *D. bilobum* (oceanic).

Section *Oxyglossum* (1): *D. masarangense* (widespread).

Section *Platycaulon* (1): *D. platygastrium* (oceanic).

Section *Rhizobium* (3, possibly 4, 1 endemic): *D. bowmanii* (Australian), *D. casuarinae* (endemic), *D. linguiforme?* (Australian), *D. vagans* (oceanic).

Section *Spatulata* (2, neither endemic): *D. conanthum* (widespread elsewhere but only Lifou and Maré islands, syn. *D. kajewskii*), *D. macranthum* (oceanic).

Section *Tetrodon* (endemic, 2 species): *D. oppositifolium*, *D. petrophilum*.

Section "unnamed": (1, endemic): *D. virotii*.

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Pollination of the Elbow Orchid, *Arthrochilus huntianus* (F.Muell.) Blaxell subsp. *huntianus*.

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Abstract

The pollination mechanism of *Arthrochilus huntianus* (F.Muell.) Blaxell subsp. *huntianus* by sexually deceived males of the thynnine wasp, *Arthrothynnus huntianus* G.R. Brown is described and illustrated by photographs.

Key Words

Arthrochilus huntianus, *Arthrothynnus huntianus*, pollination, sexual deception, pseudocopulation, mimicry, orchid

Introduction

Odd, weird and bizarre aptly describe *Arthrochilus huntianus*, the Elbow Orchid of south-eastern Australia. Found mainly on the Tablelands and Alps of New South Wales and Victoria, south from Lithgow and west to the Grampians, it extends to the coast in Victoria and Flinders Island. As saprophytes, the plants lack leaves, instead feeding on vegetable matter in the soil broken down by mycorrhizal fungi in their root-like rhizomes. Consequently, plants are invisible until they flower, but even then are a challenge to find.

Short, spindly stems support one to six or more dull coloured, inconspicuous structures hardly recognisable as flowers. *A.huntianus* flowers are borne on a curved pedicel such that the ovary is held horizontally (Plate 1). Except for the labellum, the petals and sepals are deflexed against the ovary and play no part in pollination. The mobile insect-like labellum hangs straight down, swinging freely about a hinge, the 'elbow', at the end of a long horizontal column foot projecting from the top of the ovary. A pair of shiny black, eye-like calli mimic the head region of a flightless female thynnine wasp, while a diffuse cluster of maroon and whitish hairs represent the abdomen. A narrow neck below the pseudohead region equates to the thin thorax characteristic of thynnine females. Rotation of the labellum aligns the decoy against the column below the ovary. Column wings modified into a pair of straight prongs at the column apex are opposed by curved hooks projecting from below the stigma. Unique among the Drakaeinae is the presence of a viscidium to which all eight pollinia are attached, such that the pollinia are removed as a single unit.

Like all other species of *Arthrochilus* for which the pollinators are known, and most other members of the Drakaeinae, *A.huntianus* flowers are adapted for pollination by sexually attracted male thynnine flower wasps. Rotherham (1967) and Stoutamire (1981) have published the only previous accounts of pollination of *A.huntianus*, and Stoutamire (1985) reported observations on the similar *Spiculaea ciliata* of south-western Western Australia. Both Rotherham's (1967) and Stoutamire's (1981) accounts are fragmentary, telling only part of the story, and Rotherham's illustration, while no doubt an excellent representation of the event he photographed, differs in some details from the typical pollination mechanism.

Sexual deception of male thynnine wasps occurs in up to 150 species of Australian terrestrial orchids in the subtribes Caladeniinae and Drakaeinae. The orchids mimic the shape and/or colour of the wingless female, and most importantly, the scents used to attract males from a distance. Female thynnine wasps, and the orchids mimicking them, emit sexually attractive odours (sex pheromones) from a low height; 5 to 30 or more cm above the ground. The scents waft in the breeze to be detected by males patrolling low over the ground. Attracted males follow the odour trail in a zig zag flight upwind to the source, whereupon they attempt to couple with, and carry off the female or orchid. The first arriving male at a calling female is usually successful, carrying her rapidly upwards to escape competing males and flying with her in copula to a nectar source, such as flowers or scale insects, where he helps her to feed. After feeding the male returns the female to where he found her, dropping her to the

ground from as much as 20 cm above the surface. She then burrows into the soil seeking beetle larvae to parasitise. After a few days the female resurfaces and climbs the vegetation to again call for a male.

This paper reports the results of pollinator collections and observations on the pollination mechanism of *Arthrochilus huntianus* on the Central and Southern Tablelands of New South Wales.

Methods

Pollinators were attracted to *Arthrochilus huntianus* flowers using the baiting methods of Bower (1996). Single inflorescences, with the stem in a vial of water mounted in a wooden block, were placed on the ground at their natural height in bushland areas potentially supporting pollinator populations. At each locality, baiting was carried out for 3 to 5 minutes at few to many sites about 20 to 30m apart on a transect through the habitat. Attracted wasps were captured by rapidly lowering an insect net over the inflorescence when it was clear they were orienting to the bait flowers.

Wasp behaviour was observed through the mesh of the insect net when they remained on a flower and continued to behave normally prior to capture. Details of behaviour were also revealed by close-up photography of translocated bait flowers placed in areas known to support high pollinator populations. Photography was carried out on 15 January 2000 on Mt. Canobolas, 10.5 km south-west of Orange Post Office, New South Wales.

RESULTS

Pollinators

Table 1 summarises the available data on insects attracted to *Arthrochilus huntianus* including those by the author and two Victorian collections by Professor Warren Stoutamire (Brown 1996). Some 19 reliably identified insects so far attracted to *A. huntianus* flowers all belong to the same thynnine wasp species, *Arthrothynnus huntianus*, described in 1996 as a new genus and species by Graham Brown. The wasps were attracted on the Central and Southern Tablelands of New South Wales and in western Victoria (Table 1), thereby sampling much of the geographic range of the orchid. No other insects have been reported to be attracted to *Arthrochilus huntianus* flowers.

Pollination mechanism

The bizarre structure of *A. huntianus* flowers reflects an equally extraordinary pollination mechanism (Plates 2 to 6). Attracted male wasps grasp the labellum decoy from below with their forelegs around the 'thorax' region below the prominent eye-like calli (Plate 2). The other legs hold the rest of the decoy. Positioning of the forelegs around the pseudothorax correctly orientates the wasp for pollination. The male may then attempt to mate by curving its abdomen and probing the decoy with its everted genitalia (Plate 3). Usually the wasp then tries to fly off with the pseudofemale (Plate 4), thereby lifting the labellum, which swings on its hinge towards the column (Plate 5).

The wasp's thorax moves between the hooked column wings, the apical straight prongs slipping below the wasp's wing bases on either side. The wings slide along the prongs and push past the flexible ends of the opposing curved hooks trapping the wasp against the column. Plate 6 shows a male wasp suspended motionless from the column of an *A. huntianus* flower, its hindwings resting on the prongs and the bases of both the fore and hind wings held by the curved hooks. In this position the viscidium is in contact with the rear of the wasp's thorax.

Snared wasps may struggle for many seconds before wriggling free, allowing sufficient time for the viscidium to adhere. After being pulled from the anther, the pollinia fall forward on the thorax into the correct position to pollinate the stigma of another flower. Removal of pollinaria has been observed several times by the author, but only one wasp bearing a pollinarium has been attracted to bait flowers; pollination did not occur on this occasion. The lack of attracted wasps with pollinaria is due to most work being conducted in localities where *Arthrochilus huntianus* was absent.

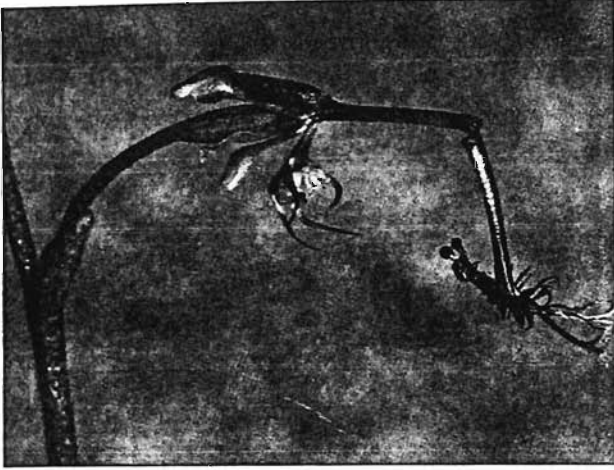
Table 1. Thynnine wasps attracted to *Arthrochilus huntianus* in south-eastern Australia.

Coordinates are the Australian Map Grid system. Final column refers to number of wasps collected.

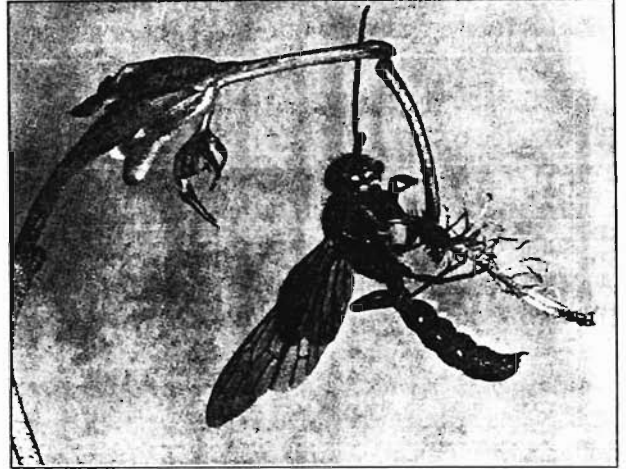
Date	Source of flowers				Baiting location			Thynnine attracted	#
	Locality		Easting	Northing	Locality	Easting	Northing		
14 Dec. 1977	Grampian Ranges, Vic.		unknown	unknown	Grampian Ranges, Vic.	unknown	unknown	<i>Arthrothynnus huntianus</i>	1
9 Jan. 1988	Range Firetrail, 7 km SSE Mt. Werong, NSW		0773413	6216355	Range Firetrail, 7 km SSE Mt. Werong, NSW	0773458	6216523	<i>A. huntianus</i>	4
9 Jan. 1988	As above		As above	As above	Bathurst – Oberon Rd., 1 km NNE Mt. Oberon, NSW ¹	0757900	6277310	<i>A. huntianus</i>	5
9 Jan. 1988	As above		As above	As above	Mullion State Forest, N Orange, NSW	0702476	6333098	<i>A. huntianus</i>	2
9 Jan. 1988	As above		As above	As above	Mid Western Highway, Vittoria, NSW	0720505	6296768	<i>A. huntianus</i>	1
10 Jan. 1988	As above		As above	As above	Towac Way, Mt. Canobolas, S Orange, NSW	0684490	6307060	<i>A. huntianus</i>	2
13 Dec. 1988	Portland, Vic.		unknown	unknown	Portland, Vic.	unknown	unknown	<i>A. huntianus</i>	?
15 Feb. 1989	Bago State Forest, 13 km S Batlow, NSW		0603825	6054562	1 km S Batlow, NSW	0603275	6067175	<i>A. huntianus</i>	2
24 Jan. 1990	Bago State Forest, 13 km S Batlow, NSW		0603825	6054562	7.5 km SW Batlow, NSW	0598590	6061428	<i>A. huntianus</i>	2

¹ This locality incorrectly recorded as Rockley Mountain in Brown (1996).

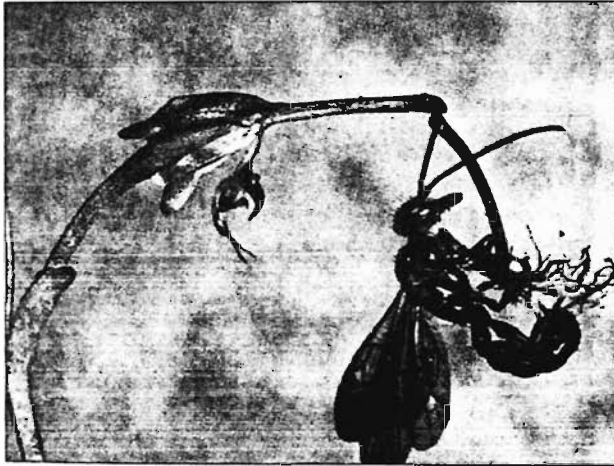
Pollination of *Arthrochilus huntianus*



1. Flower of *Arthrochilus huntianus*. Range Firetrail, 7km SSE Mt. Werong, NSW



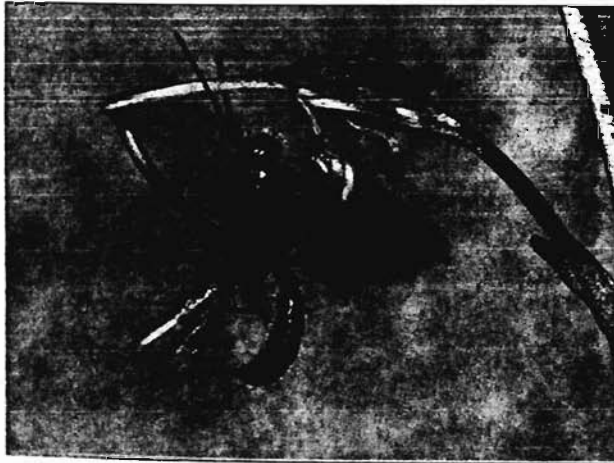
2. Male *Arthrothynnus huntianus* holding the 'thoracic' region of the labellum decoy with its forelegs.



3. *Arthrothynnus huntianus* attempting to mate with the labellum decoy.



4. Blurred wings of *Arthrothynnus huntianus* flying with the decoy.



5. The hinged labellum of *Arthrochilus huntianus* rotates the flying wasp against the column.



Male *Arthrothynnus huntianus* suspended by its wing bases on the hooked column wings of *Arthrochilus huntianus*.

All photographs by Colin Bower

Discussion and Conclusions

The pollination mechanism of *Arthrochilus huntianus* described in this paper expands on the accounts provided by Rotherham (1967) and Stoutamire (1981), and is remarkably similar to that of *Spiculaea ciliata* (Stoutamire 1985). Plates 4 and 5 show clearly that wasps are propelled against the column by their own flight rather than 'the momentum of the insect landing on the hinged labellum' as proposed by Rotherham (1967). Stoutamire (1981) also recognised the importance of wasp flight to the mechanism. In addition, some details of Rotherham's illustration showing the position of the wasp relative to the labellum and column differ from that shown in Plate 2. In particular he shows the forelegs of the wasp holding the basal arm of the labellum rather than the 'thoracic' region of the decoy. While this is possible, it is not typical, since none of the many wasps photographed by the author adopted this position. Also, Rotherham's (1967) illustration shows the straight prong of the column wing above rather than below the wing bases, so that the wings are not as securely snared as in Plate 6. Failure of the wing bases to move between the opposing processes of the column wings on one side was shown several times in the author's photographs indicating incomplete snaring may be common. Nevertheless, Rotherham (1967) reported removal of the pollinarium by the wasp he illustrated. However, it is not known whether the pollinarium in such cases is positioned correctly for pollination of other flowers.

Thynnine females, being wingless, are characterized by a slender neck-like thorax. It seems likely males always secure their grip on females by grappling them around the thorax with their forelegs prior to mating. Males also possess greatly expanded convex, plate-like, basal segments (coxae) on their forelegs that cradle the head of the female. Males may fly off with females held in this way or, after coupling, the female is held in flight by the linked genitalia. The female mimicking labellum decoy of *Arthrochilus huntianus* has a pair of stalked calli basal to a narrowed region that mimic the typical thynnine female head and slim thorax. These structural adaptations appear to be

critical in aligning males to correctly engage the column hooks with their wing bases and contact the stigma and anther with the thorax. Despite the apparent diversity of labellum shapes, all other *Arthrochilus* species feature similar distinct expanded head and narrowed thoracic regions in their decoys. This attribute is also found in the insectiform decoys of other genera including *Drakaea*, *Caleana*, *Chiloglottis*, *Spiculaea*, and some *Caladenia* species. It appears to be a key adaptation for pollination by thynnine males and has probably evolved several times in the Caladeniinae and Drakaeinae.

The data presented in this paper strongly suggest the Elbow Orchid has a single specific pollinator throughout its large geographical range. This is in accord with results obtained for most other orchid species pollinated by sexually deceived male thynnine wasps, though no other species have been tested over their entire ranges. Stoutamire (1974, 1975, 1983, 1985) provided many examples of apparent pollinator specificity in the genera *Caladenia*, *Chiloglottis*, *Drakaea* and *Spiculaea*, but testing was limited to only one or a few sites per species and few wasp specimens were collected for identification (Adams and Lawson 1993).

Similarly, the papers by Peakall (1990), Peakall and Beattie (1996), Peakall and Handel (1993) and Handel and Peakall (1993), while suggesting pollinator specificity, were intensive biological studies based at one site only. Bower (1992, 1996) and Bower and Brown (1997) have used scientifically designed field pollinator choice experiments to demonstrate pollinator specificity and reproductive isolation among closely related sexually deceptive *Chiloglottis* species at multiple sites within the same geographical area. Efforts have been underway for some time to extend this work to entire geographical ranges to gain a better understanding of the degree of pollinator specificity for sexually deceptive orchids as a whole (Bower, unpublished).

The limited available information suggests most *Arthrochilus* species may be pollinated by male wasps of the genus *Arthrothynnus*. Alan Logan

has attracted males of *Arthrothynnus rufiabdominalis* to *Arthrochilus irritabilis* near Hervey Bay in Queensland (Brown 1996) and observed them remove pollinia (A. Logan, personal communication). Graham Brown (personal communication) has attracted an undescribed species of *Arthrothynnus* to *Arthrochilus latipes* in the Northern Territory. It appears that *Arthrochilus* has adapted to, and diversified onto, the genus *Arthrothynnus* for pollination. In apparent contradiction to this is the report by Rotherham (1967) of a species of the thynnine genus *Rhagigaster* as the pollinator of *Arthrochilus huntianus*. This identification was made from a photograph and is incorrect

(Brown 1996), but has been repeated in other publications (Cady and Rotherham 1970, Adams and Lawson 1993).

Acknowledgements

I would like to thank Alan Logan for sharing his observations and insights on the pollination of *Arthrochilus irritabilis* and general discussions on orchid pollination. Thanks also go to Graham Brown for his expertise in thynnine taxonomy and willing collaboration. The Australian Orchid Foundation is thanked for its financial assistance without which my studies on orchid pollination would not be possible.

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P.S. Lavarack

Appendicula australiensis

Plant Habit



P.S. Lavarack

Appendicula australiensis

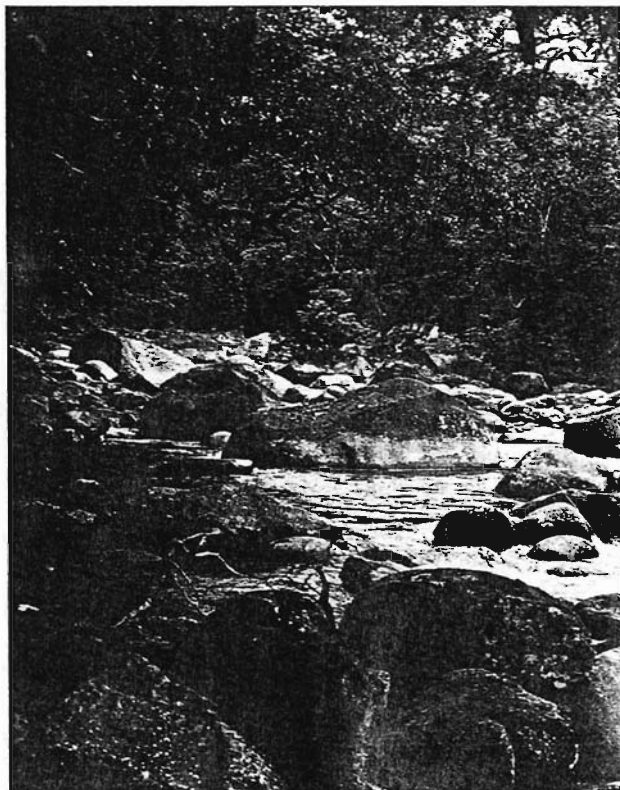
Flower arrangement and detail



M. Harrison

Appendicula australiensis

in situ, Mossman Gorge, Queensland



P.S. Lavarack

Mossman Gorge

Far North Queensland

Appendicula australiensis (F.M. Bailey) M.A. Clem. & D.L. Jones

Bill Lavarack

37 Bay Street Pallarenda, Qld 4810

Appendicula australiensis was first described by F.M. Bailey, the Queensland Government Botanist, as *Eria australiensis* in 1886. Rudolf Schlechter placed it in the genus *Podochilus* in 1907 and there it remained until 1992 when Mark Clements and David Jones noticed that this species has six pollinia, which is consistent with *Appendicula* rather than the four of *Podochilus*. This same fact was also independently noted by Alick Dockrill and published in his revised edition of *Australian Indigenous Orchids* Vol. 1, which appeared a few months later than the paper by Clements and Jones.

The range for *Appendicula australiensis* is from the McIlwraith Range on Cape York Peninsula to the Tully River. Bailey gave the locality as the Johnstone River where T.L. Bancroft collected it. It is sometimes recorded as occurring in New Guinea, but does it? Andrée Millar mentions it in her book *Orchids of Papua New Guinea*, but the photograph does not seem the same as the Australian plants. It is very similar to *A. reflexa* Blume, a common species from Fiji through the Pacific Islands to New Guinea, Indonesia and mainland Asia and, if not conspecific, it is certainly closely related to it.

It grows at low altitudes in rainforest as an epiphyte or on rocks in full to semi-shade, almost always near to streams, often occurring on the branches of penda trees (*Xanthostemon chrysanthus*) that overhang streams. In these areas the habitat is always moist and humid with temperatures that rarely drop below 15 degrees C and rarely rise above 30 degrees C. In this habitat rain is possible at any time of the year and dry periods of more than a week are uncommon. Even when it is dry for several days the roots are protected by the humid environment and by the mosses and delicate ferns that cover the substrate. Another feature of stream bank forests is the air movement, which is much greater than in the forest away from the watercourses.

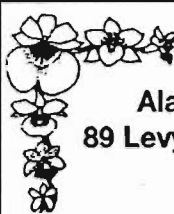
If you want to see this species in the wild, try a visit to the Mossman Gorge in the Daintree River National Park. Here the observant visitor can see plants on trees or on rocks without leaving the walking track, although most of the accessible plants have unfortunately been

stolen. It shares its environment with several other orchids such as *Grastidium cancroides*, *Bulbophyllum baileyi*, *Pholidotia robusta*, *Phreatia micrantha* and *Eria eriaeoides*.

The long slender stems grow up to 70 cm long, although 40 cm is a more common length. The leaves are persistent and arranged in two ranks along the apical two thirds of the stem. They are about two to four cm long and one to two cm wide and dark glossy green. The inflorescences are short and borne in the leaf axils along the leafy part of the stem. There are about three or four to eight flowers about 3 mm across in each inflorescence.

This species has attracted little interest from growers as it has small unspectacular flowers. However the foliage is attractive and it is easy to grow if you can provide it with hot humid conditions year round. I grow it in a small pot of standard bark mixture with a little added sphagnum moss. It hangs high up in a shade house in Townsville and is watered regularly throughout the year. Perhaps the watering is a little less frequent in winter, but I try to keep the humidity high all year. On the few occasions when the temperature drops below 10 degrees C in winter I try to make sure the plants are dry overnight. The plants seem to be attractive to scale and mealy bugs, but these are readily controlled. The blooms appear in late summer and autumn and there are usually two or three bursts of flowering a few weeks apart. The flowers last a few days to a week.





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Ecology of *Calochilus robertsonii* (Orchidaceae) from Rotorua, New Zealand

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Abstract

Calochilus robertsonii is widespread and found in a range of habitats in Australia. In New Zealand, this species is uncommon, occurring mainly in geothermally influenced habitats, although not specific to them. The largest population in New Zealand occurs on heated and hydrothermally altered soils in Rotorua. Active conservation management of its habitat here has helped its survival. The results of monitoring for a number of years shows significant differences in population size between years. Flowering stem height, and the number of flowers per stem also varied during 3 years of monitoring.

Introduction

The genus *Calochilus* (bearded orchids) comprises about 12 species, mostly Australian, but is also recorded from New Caledonia, New Guinea, and New Zealand. The three species that occur in New Zealand are shared with Australia: *C. herbaceus*, *C. paludosus*, and *C. robertsonii* Benth. (red bearded orchid). Although these three species are widespread in Australia, they are uncommon in New Zealand.

Calochilus robertsonii occupies a range of habitats throughout Australia, from the coast to the mountains, but is usually seen on ridges and slopes in open forest, and in heathlands. It has been recorded from swampy habitats in Western Australia (Jones 1988).

Although *C. robertsonii* (Fig. 1 & 2) is the most common of the three species occurring in New Zealand, it is very rare and found at only a small number of sites, mostly in the North Island (Fig. 3). The largest known population occurs at Rotorua, where its habitat is amongst cultivated and mown grassland. Since 1988, the orchid area has been seasonally managed (left unmown during spring and summer), to facilitate flowering and seed set without undue disturbance. This paper describes the habitat, population abundance, plant height, and some aspects of the flowering biology of *Calochilus robertsonii* from Rotorua, New Zealand.

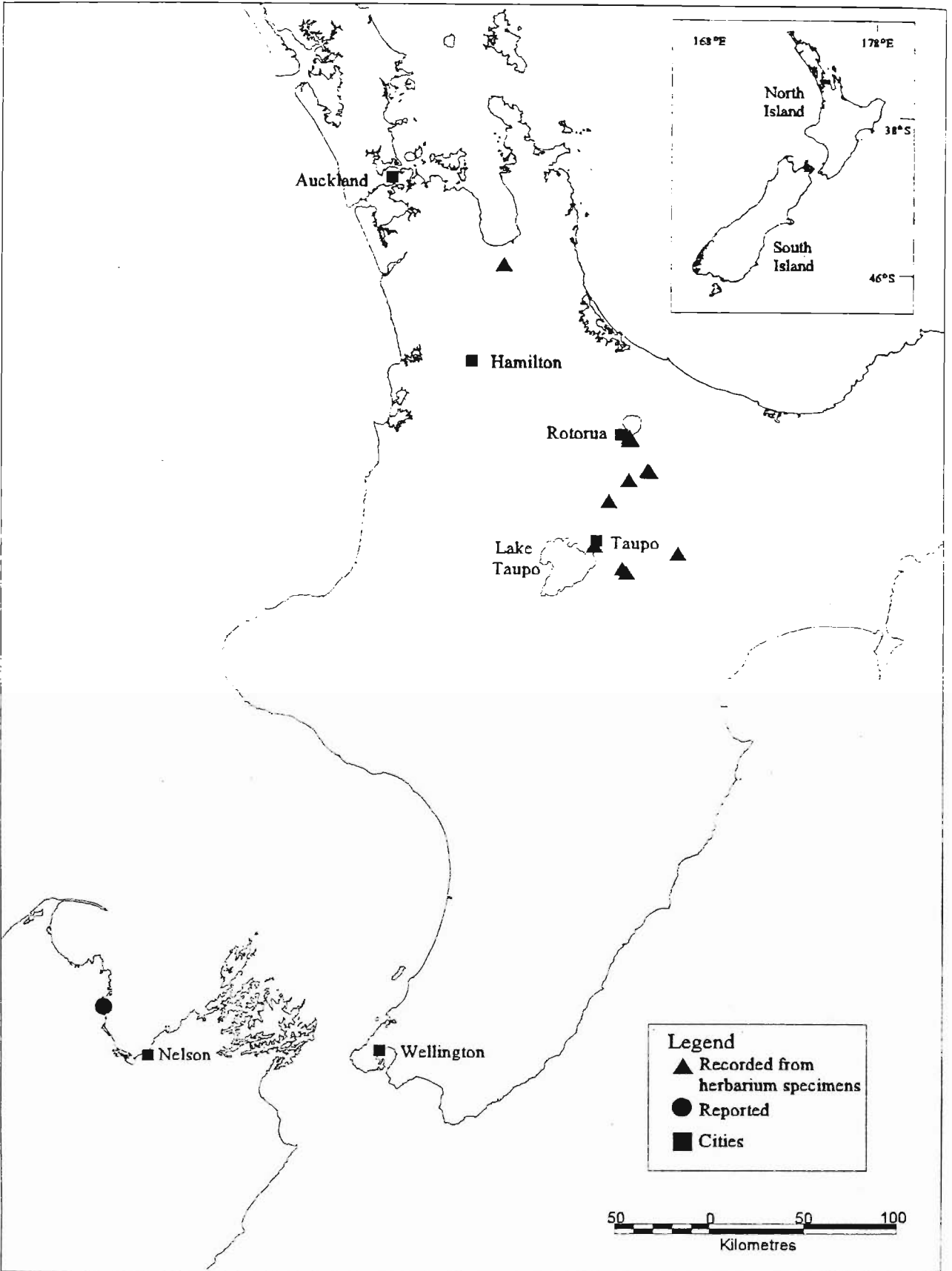
Background

The genus *Calochilus* (in Greek, *calos* beautiful, *cheilos* a lip) was named in 1810 by Robert Brown, a friend and protégé of Sir Joseph Banks (St George & McCrae 1990) with reference to their attractive, hairy labellum (Jones 1988). All *Calochilus* species are terrestrial and deciduous with a solitary, fleshy, erect leaf, dying back to a

fleshy, elongated tuberoid (Jones 1988). New leaf growth is extremely rapid and initiated during autumn. Leaves are fully developed before flowering begins in spring (late September) (Jones 1988). In New Zealand it flowers through to the end of January, and the plants die down in late summer after capsule dehiscence.

Calochilus robertsonii flowers are greenish with red or purplish stripes on the perianth segments and have distinctive, coarse, reddish hairs covering the labellum. In Australia, *Calochilus* pollination is by large, male scollid wasps that remove pollen on their heads while attempting copulation, or by selfing if wasp visitation is infrequent (Jones 1988). In New Zealand, *Calochilus robertsonii* is considered to be predominantly self-pollinating, and although the genus is highly adapted for insect pollination, when this does not occur, the flowers remain open for several days, eventually self-pollinating by default (St George & McCrae 1990). Many angiosperms have obligate relationships with mycorrhizal fungi, usually forming a symbiotic association. Fungal root infection plays a vital role in nutrient uptake for the flowering plant, which in turn provides sugars for the fungus (Raven *et al.* 1992; Salisbury & Ross 1991). All *Calochilus* species are heavily dependent on mycorrhizal fungi (St George & McCrae 1990).

Calochilus robertsonii was first recorded in New Zealand, and described in detail, by Kirk (1892), although under the name *C. campestris* (Moore & Edgar 1970). To add to the confusion, the name *C. campestris* was later used in New Zealand for what is now known as *C. herbaceus*. *Calochilus robertsonii* occurs in scattered



Distribution of *Calochilus robertsonii* in New Zealand

locations in New Zealand (Fig. 3), mainly in the central North Island and more commonly in geothermally heated and/or hydrothermally altered soils. It has also been recorded from disturbed margins of wetlands in the Waikato region, from open sites near Taupo, and reported from Kaitereiteri in the South Island (Johns & Molloy 1983; Wilson & Given 1989). Wilson & Given (1989) classified *C. robertsonii* as vulnerable, whereas it is currently classified as 'naturally uncommon' falling into the 'sparse' sub-group category in the latest list of New Zealand's threatened and uncommon plants (de Lange *et al.* 1999). Taxa in this classification are not considered under any immediate or obvious threat but, for various reasons, have the potential to become threatened (de Lange *et al.* 1999).

The population of *Calochilus robertsonii* investigated is located within the boundaries of the city of Rotorua, in the central North Island of New Zealand (Fig. 3). Rotorua City is located at the edge of a volcanic lake inside an ancient caldera. The city and its surrounding district are renowned for their geothermal activity, including hot springs and streams, boiling mud pools, steaming ground, fumaroles, and geysers. Plant communities that occur in geothermally influenced habitats (e.g., heated soils, hydrothermally altered soils, and steamy atmosphere) of the central North Island support a range of species that normally occur in tropical regions and/or at higher latitudes, e.g., the fern ally *Psilotum nudum* (Given 1989; Merrett & Burns 1998).

Materials and Methods

In November 1998, October 1999, and November 2000, plant height and the number of buds, flowers, and capsules were recorded from randomly selected *Calochilus robertsonii* individuals within the known orchid area. In October 1999, 19 flowering plants were tagged; bud and flower numbers, and the position of open flowers in relation to unopened buds were recorded. Follow-up visits were made regularly at 2-week intervals during the flowering season to monitor flowering progress, and 5-minute

pollinator observations were conducted. Habitat details were noted, soil temperatures at 10 cm depth were recorded using a Digitron temperature probe, and plant species growing in association with *C. robertsonii* were listed. A final visit on 18 February 2000 revealed recent mowing of the study area had taken place, and no *C. robertsonii* were located.

An annual census of the *Calochilus robertsonii* population has been undertaken by the Department of Conservation each year since 1992 (George Pardy pers. comm.), following an earlier census in 1985. During late November or early December, the reasonably well-defined orchid area is demarcated using hip chain cotton, then the entire area divided into transects. Department of Conservation staff and teams of volunteers walk each transect twice, placing a brightly coloured self-adhesive 'dot' beside each red bearded orchid plant (flowering and non-flowering). The number of individual plants is determined by calculating the number of self adhesive 'dots' per metre of backing tape, and measuring the length of backing tape used for each survey.

RESULTS

Habitat

The dominant feature of the vegetation where *Calochilus robertsonii* occurs is low growing (mown) manuka (*Leptospermum scoparium*) with patches of bracken (*Pteridium esculentum*) and exotic grasses. By getting down on one's knees, *C. robertsonii* flowering stems can be seen scattered throughout the area, primarily amongst the manuka. Patches of bare ground are also a feature, compared with the surrounding cultivated grassland, and are indicative of hydrothermally altered soils that inhibit establishment of sown and adventive grasses.

Soil temperatures and pH

Soil temperatures recorded from *C. robertsonii* habitat ranged from 21 to 27°C, with a mean of 23.5°C. Soil temperatures recorded from the grass patches within the study area also ranged from 21 to 27°C. The mean soil temperature

from the surrounding cultivated grassland was 24.5°C, and ranged from 23 to 26°C. Soil bulk density was variable in the study area. For example, there was a noticeable difference in the ease of inserting the temperature probe into the soil within the various habitats. In *C. robertsonii* habitat, the soil was very hard, and inserting the

probe to 10 cm depth was often quite difficult. In comparison, grass patches within the *C. robertsonii* study area were much softer and the probe was easily inserted into the soil.

Three soil samples from locations close to orchid plants were tested and all were pH 4.2.

Year	No.
1985	1392
1993	138 ¹
1994	1473
1995	2037
1996	1132
1997	1996
1998	1820
1999	1005
2000	3268 ²

1 A different method was used for this count.

2 The area was double-checked and an additional 227 plants were counted, giving a total of 3495.

Phenology

Flowering began in October and continued through December, with a few flowers still present in early January. The lowermost buds opened first, with new buds developing at the apex of the stem. Although occasional plants had two flowers open, it was more common for only one flower to be present.

In the monitored group, 89% had only one flower open at any one time. As one flower senesced, it closed and turned brown, remaining attached to the top of the capsule. The green capsule enlarges once the flower had closed, and as it matured it changed colour to become brown, eventually drying and dehiscing to release its seed.

As one flower dies, the bud above begins opening and maturing. It was noted that in some cases, the capsule had withered, suggesting lack of fertilization.

The maximum number of buds and flowers recorded from a single flowering stem over three flowering seasons was 15 in 1998, 9 in 1999, and 7 in 2000 (Table 2). The height of randomly selected flowering stems from three flowering seasons revealed a significant difference ($p=0.00$) between 1998 and 1999, but not significantly different between 1999 and 2000 ($p=0.69$) (Table 2).

In 1998, the maximum height was 38 cm, in 1999, 32 cm, and in 2000, 31 cm, (Table 2). Flower length ranged from 18–21 mm and width ranged from 10–19 mm (Table 3). Five-minute flower observations by three people over a 2-hour period did not reveal visitation by any potential pollinators.

Table 2. Minimum, mean, and maximum plant height, number of flowers per stem, and length and width of flowers in *Calochilus robertsonii* from Rotorua, New Zealand.

<u>Plant height (cm)</u>	<u>1998</u>	<u>1999</u>	<u>2000</u>
<i>n</i>	50	71	58
Minimum	18	13	13
Mean	25	21	21
Maximum	38	32	31
Standard deviation	5.0	3.4	3.7
<u>Number of flowers per stem</u>	<u>1998</u>	<u>1999</u>	<u>2000</u>
<i>n</i>	50	71	58
Minimum	3	2	2
Mean	6.5	4.6	4.5
Maximum	15	9	7
Standard deviation	2.40	1.59	1.40

Table 3. Minimum, mean, and maximum flower length and width of *Calochilus robertsonii* recorded in 1999 from Rotorua, New Zealand.

<u>Flower length and width (mm)</u>	
<i>n</i>	34
Minimum length	18
Mean length	21.7
Maximum length	25
Standard deviation	1.72
Minimum width	10
Mean width	14.8
Maximum width	19
Standard deviation	1.96

Calochilus robertsonii has an interesting distribution in New Zealand. It has been suggested that each distinct site probably represents a separate successful establishment event of wind blown seed from Australia. Although mainly confined to geothermal areas, it is not specific to that habitat. It apparently colonises open disturbed ground where suitable habitat presents itself. There was no discernible difference in soil temperatures between *Calochilus* habitat and non-*Calochilus* habitat at Rotorua. The areas that support *Calochilus* have bare ground available for colonisation and establishment, whereas the areas dominated by pasture grasses effectively exclude *Calochilus* colonisation. *Calochilus robertsonii* cannot compete with pasture grasses.

The number of orchid plants located each year shows that numbers of visible plants fluctuates greatly from year to year (Table 1). The extremely low figure for 1993 is possibly due to

the area being mown just before the counting, thus reducing visibility of the leaves, or to a less effective counting method being used, or to the count being made relatively late in the season by inexperienced observers. The fluctuations from 1005 to 3495 however are too great to be counting errors and must be largely due to natural population fluctuations or at least to the absence of leaves on many plants when counted. Observations of other orchids over many years have shown that plants with no leaves for most of a season can still have live tubers and produce new leaves in the next season.

Over the last 15 years *C. robertsonii* at Rotorua has gradually migrated into formerly bare areas. Unfortunately, areas of relatively open vegetation suitable for this orchid are gradually diminishing and the population will be expected to decline as the dense sward of exotic grasses gradually invades.

Flower size is apparently larger in Australia where flower stems can reach 45cm in height, and bear one to nine flowers (Jones 1988). Variation in plant height from year to year is possibly a reflection of variation in climatic conditions. For example, plentiful rain and/or sunshine during the growth and development phase may influence food storage for use in the following or subsequent flowering year. Individual plants may not flower annually or biennially, which could explain the wide variation in abundance from year to year. Variation in the size of the population from year to year could also be explained by new recruitment and mortality dynamics. In a study of three terrestrial orchids in England, Wells (1981) recorded fluctuations in population, explained by high levels of recruitment in some years. Over the last 15 years *C. robertsonii* at Rotorua has gradually migrated into formerly bare areas. Unfortunately, areas of relatively open vegetation suitable for this orchid are gradually diminishing and the population will be expected to decline as the dense sward of exotic grasses gradually invades.

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The management regime in place at Rotorua allows flowering and seed set of *C. robertsonii* to be completed before mowing, and appears to have been successful in maintaining this population so far. Mowing inhibits taller growing plant species and maintains a sparser vegetation cover more suitable to *C. robertsonii*. A small, previously known population of this species disappeared after its nearby habitat was left unmown.

Additional investigations over several years and would help understand population dynamics and individual plant longevity. For example, by recording the position of individual plants in relation to a permanent marker peg, and recording the state of the plant (flowering or vegetative), would enable the fate of individuals to be followed. Insect visitation observation at various times of the day would also provide more comprehensive information about pollination activity.



Neil Fitzgerald

Calochilus robertsoniiFlowering plants *in situ* from Rotorua, (North Island) New Zealand

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***Dendrobium gracilicaule* from New Caledonia**



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D.P. Banks

***Dendrobium gracilicaule* from O'Sullivan's Gap, NSW.**