

PUBLISHED BY THE SOCIETY FOR GROWING AUSTRALIAN PLANTS IN 13,000 COPIES

Australian Plants

Registered for posting as a periodical—
Category A

MARCH, 1973

VOL. 7, No. 54

Volume 7 will comprise Issues 53-60

Recommended Price: 30c



Photography by R. Paynter

PETROPHILE LINEARIS R.Br. PIXIE MOPS (see page 53)

GROWING WILDFLOWERS AND NATIVE ORCHIDS

CONTENTS OF THIS ISSUE

- There are three major themes related to the cultivation of wildflowers:
1. PROTEACEAE—pages 47-56 & 66-68. Ecology study of the family which includes *Grevillea* (A report from Qld. below), *Banksia*, *Dryandra*, *Hakea*, etc.
 2. MELALEUCA—pages 72-92. A report on the cultivation of the "pom-pom" flowered species with a reference to the whole genus and frost hardiness.
 3. TERRESTRIAL ORCHIDS—The propagation of ground orchids—pages 57-65 and the cultivation of the genus *Diuris*, the "Donkey Orchids".

Grevilleas in Toowoomba

by N. K. McCarthy, 68 Holberton Street, Toowoomba, Qld. 4350

The following *Grevillea* are growing successfully in my Toowoomba garden: *G. longifolia*, *G. barklyana*, *G. baueri*, *G. biternata*, *G. buxifolia*, *G. crithmifolia*, *G. floribunda*, *G. glabrata*, *G. hookeriana*, *G. juniperina*, *G. lanigera*, *G. longistyla*, *G. pteridifolia*, *G. punicea*, *G. sericea*, *G. stenomera*, *G. tridentifera* and hybrids *G. "Audrey"*, *G. "Porinda Constance"*, *G. "Ivanhoe"*.

There would appear to be a deficiency in local soil which can be overcome by several applications of iron chelates. This soil deficiency appears to affect the plants in their early stages of growth, and once overcome it does not recur. Strong new growth follows, replacing yellowed, burnt foliage. Some of the plants have been a little slow to establish, but in due course have rewarded patience with abundant blooms.

The situation has an easterly aspect, and an altitude of 2200 feet, being on top of the Great Dividing Range 80 miles west of Brisbane, thus having a relatively cool climate for this latitude. The soil is red-black, fine, extremely deep, volcanic in origin, and well drained.

Two varieties in exposed positions, *G. stenomera* and *G. glabrata*, were badly cut by repeated late frosts, but are once again growing strongly.

As it is apparent that the maturing and flowering of these plants have brought about a substantial increase in the number of birds frequenting my garden, I intend to add more grevilleas.

PAST ISSUES OF "AUSTRALIAN PLANTS" AVAILABLE

Because of the vast wealth of our flora there is very little repetition.

VOLUME No. 1 issues 1-12, no longer available bound but issues 5, 6, 7 & 9 are available at 45c each, \$1.85 incl. postage. However it is proposed to reprint Volume 1 as a fully bound book at a date in the future not yet decided upon.

VOLUME No. 2, issues 13-20, all available only fully bound at \$6.00 plus 20c postage. Including "A Descriptive Catalogue of Western Australian Plants".

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VOLUME No. 5, issues 37-44 all available only fully bound at \$6.00 plus 20c postage. Including "The Language of Botany", a valuable reference to words and terms.

VOLUME No. 6, issues 45-52. Available fully bound at \$6.00 plus 20c postage including "Western Australian Plants for Horticulture—Part II" valued at \$3.00. Available August 1973.

Other Books published by the Society

Available from Editor, 860 Henry Lawson Drive, Picnic Point, 2213; by mail only.

"A REFERENCE TO THE AUSTRALIAN FLORA"—"Genera"—"A Complete Index to *Australian Plants*" Vols. 1-6 inclusive. It seems that this work will have to be deferred. You will be advised in a future issue probably with reprint of Vol. 1 early in 1974.

WEST AUSTRALIAN PLANTS FOR HORTICULTURE Part 1, is a book by the Society available from the editor for \$3.00 plus 20c postage. The format of the book generally is to have simple but adequate descriptions (using simple features that anyone can distinguish) of three species in one genus with a full colour plate of one of them on the opposite page. Directions as to cultivation are given for each species. Price \$3.00 + 20c postage.

WEST AUSTRALIAN PLANTS FOR HORTICULTURE Part 2. This has many features that make it even better than Part 1 especially those sections dealing with cultivation. All the colour plates are new and spectacular. They have not appeared in past issues of "Australian Plants" or any of our publications and they alone make this book good value at \$3.00 plus 20c postage. Available August, 1973.

LATE ISSUES: This issue is late as was the last one. This has also held up Volume No. 6 binding and W.A. Plants for Hort., Pt. 2. What is worse the colour work on the last issue was poor. We shall do our best to get back on time and return to our previous high standard of printing—Editor.

PROTEACEAE

THE ECOLOGY OF THE AUSTRALIAN PROTEACEAE WITH IMPLICATIONS FOR THEIR CULTIVATION

by Byron Lamont

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The family Proteaceae contains sixty two genera, thirty seven of which occur in Australia. It is also well represented in South Africa by quite distinct genera, with a few representatives in Madagascar, South America, South-East Asia (as far north as Japan), New Zealand and New Caledonia. The distinctive open yet shapely habit, leathery to harsh foliage, massed heads of white, orange, scarlet or sky blue flowers and ornate woody fruits are responsible for the outstanding horticultural potential of the family. Most species are easy to propagate, and adapt to a wide range of growing conditions. Recommendations are made in this account for cultivating proteaceous species following a consideration of their ecology in six botanical districts in Australia. This does not mean that these are the only conditions under which the Proteaceae will grow. But it does mean that if these conditions do occur, one or more proteaceous species exist which will grow satisfactorily there. The observations should apply to many species of *Banksia* and *Hakea*, in particular, and also *Adenanthos*, *Conospermum*, *Dryandra*, *Grevillea*, *Isopogon*, *Lambertia*, *Persoonia*, *Petrophile*, *Synaphea* and *Xylomelum*, and any *Lomatia*, *Macadamia*, *Telopea*, *Symphionema* and *Stenocarpus* species which are not restricted to dense forests in their natural habitats. I make no apology for taking most examples from the flora of the south-west of Western Australia: with more than twice as many proteaceous species as the remainder of the continent combined, this region can be regarded as the real home of the Australian Proteaceae. However, it is worth noting that this family probably evolved initially under tropical conditions (Johnson and Briggs 1963).

Natural habitats of the Proteaceae

Proteaceous species are most prolific in eastern, southern and south-western Australia, within fifty to one hundred and fifty miles of the coast. The family is well represented at Mt. Lesueur, the Fitzgerald River, Lake Grace, Stirling Range-Kalgan River and Perth Coastal Plain in Western Australia. Eyre Peninsula, Kangaroo Island and the Ninety Mile Plain are major habitats in South Australia, as is Wilson's Promontory in Victoria. Proteaceae are abundant in parts of northern Tasmania, the northern coastal lowlands and Hawkesbury Sandstone District in New South Wales and the coastal lowlands of Queensland, including the Wallum and Cape York Peninsula. Comparing a sample of these environments, described in Tables 1 and 2, it is seen that they have in common temperate climates with long, hot summers and mild winters. The soils, which are invariably sandy and deficient in most plant nutrients, are some of the most infertile in Australia.

More striking, however, is the wide variation in environmental factors to which this family is adapted. The rainfall ranges from 40 cm per year (the semi-arid climates east of Mt. Lesueur in W.A. and Ninety Mile Plain in S.A.) to over 165 cm (sub-tropical climate of the Qld. Wallum). Rain may fall only in the winter (W.A. and S.A.), throughout the year (Vic. and N.S.W.), or mainly in the summer (Qld.) On the whole the rainfall is unreliable by world standards with the average yearly total not being reached four out of ten years in the Stirling-Kalgan District in W.A. and up to six out of ten years in the Hawkesbury district in N.S.W. and Wallum in Qld. Whilst the mean maximum for January is uniformly high in these areas (27-32°), the minimum varies from 13°C in the Ninety Mile Plain to up to 24°C in the Wallum. The mean temperature for July is around 16°C throughout, though it may rise to 21°C in the Wallum.

The next 6 pages carry colour plates of typical Proteaceae and tables listing some genera in the family with details of the areas on which this study has been based. The article is continued on page 54.

DRYANDRA

Hardy Proteaceae closely related to the *Banksia*.



Photography by R. Paynter

DRYANDRA NOBILIS Lindl. GOLDEN DRYANDRA

A much-branched shrub to 4 m tall, the branches densely leaved, with flowerheads 5-7 cm across. Grows in lateritic soil in woodlands between Moora and Katanning and flowers in spring.

Other *Dryandra* featured in colour in our previous publications are: *D. arborea* W.A. H2 ("West Australian Plants for Horticulture—Part 2) see page 46; *D. cirsioides* W.A. H1; *D. formosa* Vol. 1, No. 7:1; *D. kippistiana* W.A. H2; *D. polycephala* W.A. H2; *D. sessilis* Vol. 1, No. 7:13; *D. speciosa* Vol. 1, No. 8:28; *D. tenuifolia* W.A. H2. Many past issues advise on propagation and cultivation.

BANKSIA

Closely related to *Dryandra* are the well known *Banksia* mentioned frequently in the article. Those featured in full colour in our previous publications are: *Banksia audax* W.A. H1; *B. ashbyii* 5:321; *B. burdettii* 5:336; *B. caleyii* 5:201; *B. collina* 5:240; *B. ericifolia* 1:12:32, 5:372; *B. goodii* 5:200; *B. grandis* W.A. H1; *B. loricata* 5:204; *B. occidentalis* 5:205; *B. ornata* 5:289; *B. sphaerocarpa* 1:7:13; *B. sceptrum* 5:193.

HAKEA

Hardy Proteaceae widely distributed often with pointed leaves.



Photography by R. Paynter

HAKEA SCOPARIA Meissn.

A spreading shrub to 2 m with needle-like, channelled leaves. The flowers, in dense racemes 4 cm across, have a sickly perfume, while the fruits are woody, about 2 cm long. It grows on sandheaths from Geraldton to Narrogin and east to Southern Cross, flowering in late winter. Other *Hakea* featured in colour in our previous publications are: *H. bucculenta* W.A. H2; *H. cucullata* 5:344; *H. falcata* W.A. H2; *H. francisiana* W.A. H2; *H. lissocarpa* 5:373; *H. muellerana* 5:345; *H. myrtoides* 5:376; *H. preissii* 5:341; *H. prostrata* W.A. H2; *H. purpurea* 5:340; *H. ruscifolia* W.A. H2; *H. sericea* 5:352; *H. suberea* W.A. H2; *H. sulcata* W.A. H2; *H. verrucosa* 5:377; *H. victorlae* 5:185. Many issues deal with their cultivation and propagation.

TABLE 1: Selected areas in Western Australia where Proteaceae are abundant

Location	Perth Coastal Plain	Mt. Lesueur District 125 m north of Perth	Kalgan River District, 225 m S-E of Perth
Occurrence of Proteaceae	77 species 4 species	115 species 6 species	57 species 2 species
<i>Adenanthos</i>	11	11	7
<i>Banksia</i>	10	10	3
<i>Conospermum</i>	2	9	9
<i>Dryandra</i>	0	0	2
<i>Franklandia</i>	12	18	2
<i>Grevillea</i>	13	26	14
<i>Hakea</i>	8	11	7
<i>Isopogon</i>	1	1	2
<i>Lambertia</i>	2	5	1
<i>Persoonia</i>	8	14	5
<i>Petrophile</i>	2	1	2
<i>Stirlingia</i>	1	0	0
<i>Strangaea</i>	2	2	2
<i>Synaphea</i>	1	1	2
<i>Xylomelum</i>	1	1	2
Vegetation type	heath, scrub open-forest	heath woodland	heath scrub
Climate (after Specht 1970)	Mediterranean; long, hot su., mild winter	Med.; long, hot su., mild winter	Med.; long, warm su., mild winter
Temperature (Tierney 1969)	50-100 °C	40-65, wi. maximum 29-32/13-18 °C	50-75; wi. maximum 27-29/13-16 °C
Rainfall in cm/year	29-32 °C/16-18 °C	18/7-10 °C	16/4-10 °C
Mean max./min. temp. (Anon. '59)	16-18 °C/7-10 °C	0-5	0-5
Frost (0 °C or below)	0-10 days/year	10-5	8
Sunshine (Anon. 1954)	10-5 hours/day	5-5-6-5	5
Rel. humidity (Gentilli 1971)	5-5-5 hours/day	40-50	60
Wind speeds	40-50% 60-70% e.g. Perth: 11 knots 15 knots	65 no records	70 e.g. Albany
Length growing season	7-10 months	5	7
Physiography	sandplain & dunes west of Darling Scarp	low laterised plateaux, wide valleys	sandplain south of Stirling Range
Drainage	wel-drained; seasonal & permanent swamps common	wel-drained—by Hill River	well-drained; few permanent swamps
Soil	shallow, calcareous or deep leached sand, meadow podsol	sand & lateritic gravel	fine sand, clay & lateritic gravel
Nutrient deficiencies	P, N, K, Ca, Cu, Zn, Mo, Mn, S, Co	P, N, K, Cu, Zn, Mo	P, N, K, Ca, Mg (trace elements?)
Soil reaction	alkaline to acid	acid	very acid
References	Beard (1970), Bettenay etc (1960) Lamont (1972a), McComb etc (1967) Speck (1958)	Burvill (1965), Speck (1958), Lamont (1972a)	George (1969), Lamont (1972a), author's records

TABLE 2: Selected areas in eastern Australia where Proteaceae are abundant

Location	Ninety Mile Plain S-E South Aust.	Hawkesbury District, from Sydney to Newcastle	Wallum Coastal Lowlands, S-E Qld.
Occurrence of Proteaceae	14 species	50 species	29 species
<i>Adenanthos</i>	1	0	0
<i>Banksia</i>	2	6	5
<i>Conospermum</i>	1	5	1
<i>Grevillea</i>	3	11	4
<i>Hakea</i>	5	6	3
<i>Isopogon</i>	1	2	0
<i>Lambertia</i>	0	1	0
<i>Lomatia</i>	0	2	1
<i>Macademlia</i>	0	0	1
<i>Peucephylla</i>	1	11	7
<i>Strangaea</i>	0	2	3
<i>Symphionema</i>	0	0	1
<i>Teloepa</i>	0	2	1
<i>Xylomelum</i>	0	1	1
Vegetation type	heath, scrub	heath, scrub open forest	heath, scrub, woodland, forest
Climate	Mcd.: long, warm su., mild winter 40-50; wI. max.	Maritime: warm su., mild winter 70-130; no dry season	Sub-tropical: hot su., mild winter 115-165; su. max. 27-32/18-24
Reinfall in cm/year	29-32°C/13°C	27-29/16-18	18-20/7-16
Mean max./min. temp.	13-16°C/4°C	16-18/2-7	0-5
Frosts	0-5 days/year	5-20	7-5-8
Sunshine	10 hours/day	6-6.5	7-8
Rel. humidity	5-6.5 hours/day	60-70	60-70
Wind speeds	40% e.g. Mt. Gambler: 13 knots 14 knots	65 e.g. Sydney	60 e.g. Rockhampton:
Length growing season	9 am 3 pm	6 8	5 6
Physiography	7-8 months sandplain derived from old Murray delta	9-12 dissected sandstone/shale plateaux; steep vales	9-12 rolling sandplain & dunes E of Great Divide
Drainage	well-drained	well-drained; swamps & creeks common	low depressions poorly drained
Soil	deep sand; clay sub-soll	shallow, fine sand & gravel	deep, fine sand; clay hard pan
Nutrient deficiencies	P, N, K, Cu, Zn, Mo	P, N, Ca (trace elements?)	P, N, K, Ca, Cu, Zn, Mo, S, B
Soil reaction	neutral to acid	acid	often very acid
References	Litchfield (1956), Specht & Rayson (1957a)	Beadle (1968), Beadle etc. (1962), Hannon (1956)	Bailey (1901), Coaldrake (1961), Grundon (1972)

More Proteaceae, this time with long racemes of flowers.



Photography by F. W. Humphreys

XYLOMELUM ANGUSTIFOLIUM Kippist.—Sandplain Pear

Found in sandplain areas in the northern and eastern parts of the agricultural area of Western Australia. *Xylomelum occidentale* R.Br. closely resembles the above species in flower although the individual flowers are longer and the spikes are twice as broad. It occurs in the forest areas of the south-west of W.A. and hence its common name is "Forest Pear". Because of its habitat, it is more upright, taller, less widely branched and with a compact habit of growth. The leaves are ovate or oblong in shape and not more than twice as long as wide. The fruit of the two species is identical.

More Proteaceae—"Drum Sticks"—"Cone Sticks"



Photography by R. Paynter

ISOPOGON DIVERGENS R.Br.—Spreading Coneflower

This spreading shrub up to 1.5 m tall has leaves 6-10 cm long with terete lobes. The flowers are in spikes 4-5 cm across. It is common in gravelly soil between the Murchison River, Perth and Lake Grace, W.A.

Known locally as "Drumsticks" in wide areas, other *Isopogon* featured in colour are *I. anemonifolius* 5:153; *I. dubius* W.A. H1; *I. cuneatus* 3:388.

Cover Plate—PETROPHILE LINEARIS R.Br. Pixie Mops

A shrub with several stems up to 50 cm high with curved leaves 3-8 cm long and flowerheads 4-5 cm across, the flowers woolly. Grows in sand on the coastal plain from Perth to the Hill River, W.A., and flowers in late spring. Other *Petrophile* featured in colour are *P. biloba* 5:348; *P. divaricata* W.A. H1; *P. drummondii* 5:349.

Continued from page 47—

The minimum is around 7°C, though it may be as low as 2°C in the Hawkesbury, or up to 16°C in the Wallum. Because of the differences in rainfall effectiveness the growing season varies from five months at Mt. Lesueur to the whole year in the Hawkesbury and Wallum districts. Generally, frosts are rare (less than five times a year on average), though there may be up to ten frosts a year in parts of the Perth Coastal Plain and twenty in the Hawkesbury. A few species of Proteaceae even thrive in the Mt. Kosciusko highlands, where temperatures fall to a mean minimum of 1-4°C in July with frosts or now likely for more than 150 days of the year.

Sunlight is abundant in summer (10 hours per day) in the south-west of W.A. and Ninety Mile Plain but restricted in winter (5-6 hours per day). This seasonality is absent from the Wallum with 7-8 hours per day throughout the year. However all show a marked reduction in the actual solar energy received for growth in winter (from 550-675 calories/cm²/day in January to 200-325 calories/cm²/day in July—Gentillii 1971). The mean relative humidity for January ranges from 40% on the west coast and Ninety Mile Plain to 70% on the east coast. The July mean is about 65% for all these areas. The areas subject to onshore westerlies (11-15 knots) receive much higher winds throughout the day and year than those subject to onshore trade winds (5-8 knots). Many habitats are exposed to strong prevailing winds and gusts up to 85 knots have been recorded (coastlines, sandplain heaths), while others are protected by mountains, valleys or tree species.

The landscape varies from lowlands (sandplains) to uplands (plateaux, mountain ridges) with proteaceous plants growing on laterite, limestone, granite or sandstone outcrops or flat plains and sand-dunes (e.g. Perth Coastal Plain) or steep valleys and cliff faces (e.g. Hawkesbury sandstones). Consequently the soil varies from very deep sands to almost bare rock. The site may be well-drained (e.g. the sand heath of Mt. Lesueur) to seasonally or permanently waterlogged (e.g. the wet heath of Queensland), with both poor and good drainage existing in the Perth Coastal Plain and Wilson's Promontory (Groves and Specht 1965). Waterlogging often results in the build up of an impenetrable claypan at a depth of one metre or less. Whilst the low levels of the nutrients phosphorus, nitrogen and potassium in all areas listed in Tables 1 and 2 prevent the establishment of introduced horticultural plants, they are not always deficient in manganese, sulphur, magnesium, boron, calcium, cobalt and iron. As a consequence of their infertility, the soils are often acid, though they may be neutral, or even alkaline in the coastal limestone of the Perth Coastal Plain. The poorly drained sites are generally very acid, especially the Wallum.

The plants in community

Vegetation in which the family Proteaceae is prominent is always sclerophyllous: i.e. the leaves are leathery or brittle, and wilting is prevented by a well-developed cuticle and thick-walled cells, called sclereids. The plants are evergreen, with the relatively small leaves often reduced to needles (surface area under four square inches—though there are exceptions, e.g. *Hakea victoriae*, *Banksia robur*, *Dryandra drummondii*). The vegetation is able to withstand long annual droughts and occasional fires and waterlogging. Many species retain their fruits until the plants are killed by excesses of any of these factors, when the seeds are released. Following severe foliage damage many species regenerate from rootstocks (lignotubers) or the old stem (by epicormic buds). Another feature of the vegetation is its open canopy—direct sunlight reaches the soil surface, even when there are a number of tree and shrub layers. The leaves of proteaceous species are either concentrated at the tips of the branches or scattered along their full length, and directed away from the stem so that the plants often appear open and woody. Except for some tropical representatives, proteaceous plants are rarely trees, and are generally restricted to the shrub layer even in the forests and woodlands noted in Tables 1 and 2. However, *Banksia menziesii*, *B. attenuata*,

B. prionotes and *B. littoralis* in the Perth Coastal Plain and *B. serratifolia* and *B. integrifolia* along the east coast are sometimes the dominant species in these vegetation types. As a rule of thumb, the lower the vegetation the greater the contribution of proteaceous species to the flora, so that they invariably dominate scrub (0 to 8 metres) and heath (0 to 2 metres) vegetation. It follows that the lower the vegetation, the greater the exposure of the component plants to sunlight, soil heat and winds. The large tracts of low prickly shrubs embraced by this article constitute some of Australia's best wildflower country, and in these habitats abound many species of *Banksia*, *Conospermum*, *Dryandra*, *Grevillea*, *Hakea*, *Isopogon*, *Persoonia* and *Petrophile*.

When Tables 1 and 2 are compared (omitting the information for South Australia) it is seen that, floristically, there are both similarities and differences between the eastern and western districts included in this study. Five genera (*Adenanthos*, *Dryandra*, *Franklandia*, *Stirlingia* and *Synaphea*) present in the south-west are absent from corresponding habitats in the eastern region, with four genera (*Lomatia*, *Macadamia*, *Symphionema* and *Telopea*) present in the east but absent from the south-west. The numbers of species of *Banksia*, *Conospermum*, *Hakea*, *Isopogon* and *Petrophile* are much greater in the south-west, with the number of species of *Persoonia* much greater in the east. The low numbers of species of *Grevillea*, *Lambertia*, *Strangea* and *Xylomelum* is comparable in both regions. But note that nothing can be implied about the environmental preferences of genera from these observations.

The fact that scores of *Banksia*, *Hakea* and *Dryandra* species are restricted to the south-west does not mean that they will not grow well, or even better, in other localities. For example, when introduced into South Africa, *Hakea suaveolens* (endemic to a narrow strip of the south coast of Western Australia) soon reached weed proportions. The ancestors of many species in the south-west were separated from their eastern relatives at least fifty million years ago by an inland sea. This separation was maintained when this sea was replaced by the Great Australian desert (Gardner 1944, Burbidge 1960). The floras evolved independently in response to different levels of plant competition and opportunities to migrate and colonise new habitats, rather than disparate changes in physiography and climate. In fact, the Proteaceae probably succeeded in the establishment battle throughout Australia by default—faster growing species in the families Myrtaceae, Fabaceae and Mimosaceae were less tolerant of the increasing depletion of nutrients from the already infertile sands and increasing aridity of the continent (Grieve 1956, Beadle 1962, Grudon 1972).

Returning to the areas under consideration, it is seen that the plant communities vary from open shrublands to closed forest. The vegetation may be very open, with individual plants fully exposed to heat from the sun and soil surface, e.g. the open heath of Mt. Lesueur, or impenetrable because the individuals overlap, e.g. the closed heath of the Stirling Range foothills. Some proteaceous species are restricted to one habitat, e.g. *Persoonia longifolia* only occurs in Jarrah forests, *Banksia prostrata* only in sand heaths. Others have a wide range of tolerance, e.g. *Banksia grandis* is a 16 metre tree in Jarrah and Tuart forests, but a one metre shrub in heaths; *Hakea nitida* is a 3 metre shrub in the woodlands of the Stirling Range but a woody creeper on the dunes of the south coast. Species in the Proteaceae may either dominate scrub or heath vegetation, e.g. *Conospermum stoechadis* in the valleys of Mt. Lesueur and *Dryandra sessilis* on the Perth coastal limestone, or form a minor component of the scrub layer in eucalypt forest, e.g. *Telopea speciosissima* in the Hawkesbury sandstone. Often the low eucalypt forests contain essentially the same proteaceous species in the shrub layer as the heath and scrub communities nearby. At a given site there may be comparatively few species of a genus, but many individuals per unit area, e.g. *Stirlingia latifolia* in the Perth Coastal Plain, or many species of a genus with few individuals e.g. *Hakea* at Mt. Lesueur.



Photography by J. Glass

GREVILLEA WICKHAMII Meissn.

This erect, rather open shrub grows to 5 m tall and has greyish leaves 3-8 cm long. The racemes of flowers each only 4-5 mm long are often produced for many months of the year. Widespread in the north-west of W.A., the Kimberleys and across the Northern Territory to Queensland it often grows in harsh rocky soil.

Grevillea particularly have a wide range of habitat and this is reflected in the wide variance in leaf form that has evolved. The colour plate above was chosen as the species is widely distributed across harsh dry areas and the leaves are hard, tough, spiky, often half dead looking. In cultivation they become an attractive greyish green.

Other Grevillea featured in colour in our previous publications are: *G. acanthifolia* 4:337; *G. aquifolium* 4:336; *G. annulifera* 4:9; *G. aspera* 4:4; *G. biformis* 4:12, 5:252; *G. brownii* 4:4; *G. capitellata* 4:4; *G. dielsiana* W.A. H2; *G. eriostachya* 3:1.

Cultivation of the Genus *Diuris*

By David L. Jones

The genus *Diuris* contains some of the showiest terrestrial orchids in Australia. The exact number of species present is hard to assess since the genus is a very complex one botanically, however we can estimate it at about forty species.



Photography by John Fanin

DIURIS PEDUNCULATA

The flowering period, distribution and other details have been adequately dealt with in previous issues. I will mention a few details of interest in each species but will not deal with them fully. The underground system is extremely variable with some tubers attaining a very large size. Some species increase vegetatively and all respond to propagation techniques.

I have had experience with about thirteen species in cultivation plus various forms and varieties. As a general rule all species are very easy to grow and many are excellent pot subjects lending themselves readily to massed displays. A few offer problems that are not yet overcome but these are of manipulation rather than basic culture, and mainly relate to the flowering of plants in pots.

I find that many of the species like plenty of root room so use 6" pots or larger. Before potting I ensure that the drainage hole is covered and running free. Use an open compost that will also drain free and ensure that some good leaf mould is present. I use a mixture of 1/3rd bush loam, 1/3rd coarse sand and 1/3rd of the mould from under the Coastal Tea-tree (*Leptospermum laevigatum*). The loam I use entirely now for this genus is mountain soil—a heavy but well structured and well drained loam from some of the highland areas to the east of Melbourne. The response of *Diuris* in general to this soil type is very encouraging. The top layer of a good Granite soil would give similar results.

As previously mentioned the tubers of some species are very large and need plenty of root room. As well those which have tall flowering spikes should be planted deeply—the top of the tuber 1½-2" below the soil surface. This is done to reduce the chance of the spike toppling over and perhaps damaging the tuber. For the same reason protect flowering plants from the wind.

The various species respond well to liquid fertilizer applied fortnightly during the warmer months. I have very little trouble with pests, however slugs and snails do relish them and should be kept away with baits. Aphids are occasionally a problem on the leaves of the finer-leaved species just after emergence, and also on the flower spikes. These can be controlled with a contact spray of pyrethrum and should be hit when first noticed otherwise they build up quickly in numbers. Some species are attacked by a rust fungus (*Uromyces thelymitrae*). This fungus is a native parasite, which forms clusters of yellow pustules on the leaves. It stunts the plants growth and disfigures the leaves but otherwise is not a virulent pathogen. It doesn't seem to spread very rapidly and affected plants recover the following season after re-potting.

Diuris aurea Sm.

An extremely handsome species from N.S.W. and Queensland that is an ideal pot subject. It grows vigorously, increases slowly but surely, and is very easy to flower. It prefers a large pot and as the spikes are very tall the tubers should be buried about 1½" down. The tubers themselves are not large but are lobed. The species characteristically produces a single channelled leaf that increases in length up till flowering time. It is a good plant for producing a massed pot display and the lovely golden-yellow flowers always attract attention.

Diuris brevissima R. D. FitzG.

A very controversial but nevertheless beautiful species which makes a good pot plant. It is very close to *D. maculata* but my plants in cultivation are more robust and always flower later than for this species. It produces a pair of thin channelled leaves and tubers that grow to about 1½" long and are roughly pear-shaped. It does not seem to increase vegetatively but responds readily to propagation. Unfortunately it only seems to flower well every second year.

Diuris carinata Lindl.

A slender species from W.A. that is easy to grow but is very shy of flowering. It produces thin leaves singly or in pairs, that are easily mistaken for onion-grass. The tubers are small and so far the plant has shown no tendency to increase vegetatively. It grows well in a 5" pot of mountain-soil compost.

Diuris emarginata R.Br.

I have only had one season's experience with this species but it seems to be growing well. In W.A. it grows in very moist situations.

Diuris longifolia R.Br.

An extremely beautiful species that grows easily but is a very shy flowerer. In the bush it forms colonies that may be quite dense but few plants flower. However after a bushfire the plants flower in their hundreds making an impressive massed display. In cultivation only an odd plant will produce a flower and it is obvious that the species needs some stimulation. This I haven't yet been able to discover. The species produces a very unique and unmistakeable tuber which is long and slender. It may grow up to 6" long and be only ¼" in diameter. At repotting time these are found curved around the edge of the pot. It increases prolifically by three or four times a season and soon builds up in numbers. It prefers a mountain soil mixture and a large pot.

The species is extremely variable and because it multiplies vegetatively lends itself well to selection of various clones. Besides the common wall-flower coloured form the two most noteworthy I have selected are a pure golden yellow form with a green callus, and a highly coloured form with rich burgundy markings from W.A.

Diuris maculata Sm.

An extremely variable orchid that makes an ideal pot plant. It grows vigorously and flowers easily although it does have a tendency to flower best every second year. It prefers a large pot and grows well in a mountain soil mix. The various forms only reproduce slowly if at all.

Once again its variable nature allows the selection of forms. These are mostly colour variations from almost pure yellow with few spots to an orange colour which is heavily blotched. I have one very attractive form which is a pure glistening white with black blotches. Unfortunately as with most albinos this form is not very vigorous.

Diuris palachila R. S. Rogers

A very vigorous species that grows and flowers easily. It is a natural hybrid between *D. maculata* and *D. pedunculata*, and because of this is extremely variable. It produces a tuft of three to five erect leaves. The tubers are roughly conical about 1" long and the species increases slowly. It prefers a large pot (about 6") and a mountain soil compost.

Diuris palustris Lindl.

A delightful little species that makes an ideal pot subject. It grows well, reproduces slowly, and flowers easily. It produces a neat tuft of ten or twelve slender, upright, twisted leaves with a reddish base. It is one of the first species to flower, the spikes appearing in July and the flowers opening in August. The flowers give off a delightful spicy scent that on a warm day pervades the whole glasshouse. The flowering stems are generally only 6-8" tall and a potful in flower is very attractive. The tubers are small but the species prefers a large pot.

Diuris pedunculata R.Br.

This *Diuris* is probably the best species for pot culture. I have on occasions had a 6" pot with twenty spikes of flower in full bloom simultaneously. This is quite an impressive display. The species does best in a large pot and thrives in mountain soil. It reproduces slowly but grows easily. Some forms produce huge tubers 1½-2" long and ½-¾" through. It produces a neat tuft of five or six upright leaves. Overall it is extremely



Photography by John Fannin

DIURIS SULPHUREA R.Br.

The northern species of *Diuris* are described and illustrated in the book AUSTRALIAN INDIGENOUS ORCHIDS by A. W. Dockrill—Price \$18.00 plus \$1.00 postage.

AUSTRALIA LOSES A FAMOUS BOTANIST

Those who were fortunate enough to have known Dr. Stan Blake will have lost a respected colleague and friend. With his death Australia has lost an irreplaceable taxonomist, world famous for his scientific research. In extending condolences to his widow and family we advise that he will always be remembered for his dedication to our wildflowers.

variable and lends itself well to the selection of clones. Apart from the common form I have selected the following.

- (1) A very early form flowering in August.
- (2) A large flowered very handsome form. It is vigorous with flowers about 2" across and huge tubers. It increases freely.
- (3) A short squat form with highly coloured flowers. The labellum is a deep orange colour.
- (4) An alpine form which flowers late in November. It has clear yellow small flowers with very rounded segments.

An albino form unfortunately died out.

Diuris platichila R. D. FitzG.

A very attractive species from inland N.S.W. In cultivation it grows vigorously increasing freely but flowering well only every second season. It produces big tubers and does best in a 6" pot. The flowering spikes are very tall and quickly become top heavy. To avoid tuber damage they should be staked. It does very well in a mountain soil compost.

Diuris punctata Sm.

This is easily the most beautiful species in the genus. The spikes are tall and bear large flowers in various shades of lilac and purple. It is an extremely variable species and many varieties and forms have been named. All those I have tried, grow quite easily doing well in the mountain soil mix. Some forms increase vegetatively in cultivation while others show no sign of this method of reproduction. The species produces very large triangular, characteristically palmate tubers which need plenty of root room and do best in a large pot. Most forms flower quite easily but the spikes may become top heavy and need to be staked.

Diuris punctata forma blakneyae

An extremely variable form that makes a handsome pot plant. I have selected out a range of colour forms to grow, including blotched and spotted combinations. One deep purple form from Mornington increases quite steadily in cultivation. Some forms are scented.

Diuris punctata var. *alba*

A very handsome form from northern N.S.W. and Qld. that grows and flowers easily. It reproduces slowly.

Diuris punctata var. *albo-violacea*

A very rare form confined to Victoria. In cultivation it does well but increases slowly. The tubers sometimes get huge—up to 3" across and deeply palmate. It has a squat thick flowering stem and the flowers have a delightful spicy scent. It likes a large pot and a mountain soil compost.

Diuris punctata var. *longissima*

A very attractive form with long slender sepals. The flowers are white blotched with purple and are faintly scented. This form takes readily to culture, growing vigorously, flowering well and increasing steadily.

Diuris sulphurea R.Br.

A handsome species that in cultivation behaves similar to *D. longifolia*. That is, it increases freely and tends to produce many tubers too small to flower. As with *D. longifolia* it forms colonies in the bush, few members of which flower. It seems to need the stimulation of a bushfire to produce a massed display. The tubers are variable in shape and are produced from the tips of long fleshy roots. It is very easy to grow, doing best in a large pot.

Diuris venosa H. M. R. Rupp

A very dainty species confined to a few northern highland areas of N.S.W. In cultivation it is slow and lacks vigour but grows quite easily. It likes plenty of water particularly late in the season as it flowers in December. It has a very short dormant season only dying down for about a month. For cultivation it grows best in mountain soil and a plastic pot for added moisture. It does not increase vegetatively and only produces small tubers $\frac{3}{4}$ -1" long.

Australian Terrestrial Orchids From Seed

II—IMPROVEMENTS IN TECHNIQUES AND FURTHER SUCCESSES

by D. K. McIntyre, G. J. Veitch and J. W. Wrigley

The methods used to successfully raise Australian terrestrial orchids from seed (McIntyre et al 1972) have been changed with some success.

The medium has been changed to a coconut milk medium, which is Knudsons C plus 15% coconut milk (Veitch and McIntyre 1972). The addition of coconut milk has led to the increased growth of both epiphytes and terrestrials, particularly in tuber growth in terrestrials and more vigorous root growth in epiphytes.

In the past all seedlings were placed in a western window in the laboratory and they received daylight plus some light from the laboratory lighting.

Growth rates of terrestrials and epiphytes improved greatly when two rows of 40 watt fluorescent lights were installed 20" above the bench to provide supplementary lighting. The lights are left on for 20 hours per day and controlled by a time clock.

Table I summarises the further successes with terrestrials from seed.

Species germinated	Canberra Botanic Gardens Number	Date Sown	Age at trans to soil (mths.)	Dormant (D)	Awaken from dormancy (A)	Months in non sterile soil at 24.10.72
<i>Acianthus reniformis</i>	711775	20. 9.71	—			
<i>Acianthus reniformis</i>	72307	21. 9.71	—			
<i>Caladenia carnea</i>	72314	27.10.71	—			
<i>Caladenia latifolia</i>	72313	27.10.71	—			
<i>Caladenia menziesii</i>	72312	27.10.71	—			
<i>Caladenia sp.</i>	711750	5. 7.70	15	D	A	12
<i>Calochilus robertsonii</i>	711751	24.11.70	—			
<i>Calochilus robertsonii</i>	711752	8. 1.71	11	D	A	10
<i>Chiloglottis gunnii</i>	72335	3.12.71	—			
<i>Cryptostylis erecta</i>	711778	22. 2.71	—			
<i>Dipodium punctatum</i>	72367	7. 2.72	—			
<i>Diuris punctata</i>	72344	6. 1.72	—			
<i>Diuris sp.</i>	711753	5. 7.70	20*	D		7
<i>Eriochilus cucullatus</i>	721310	4. 5.72	—			
<i>Glossodia major</i>	711755	21. 9.71	—			
<i>Microtis bipulvinaris</i>	72323	5.11.71	8			4
<i>Microtis oblonga</i>	72322	5.11.71	8			4
<i>Microtis unifolia</i>	72326	5.11.71	11			4
<i>Microtis sp.</i>	711895	13.12.71	9			1
<i>Microtis sp.</i>	711896	13.12.71	9			1
<i>Pterostylis acuminata</i>	711756	25. 5.71	—			
<i>Pterostylis concinna</i>	711757	29. 7.71	—			
<i>Pterostylis curta</i>	711758	8. 1.71	—			
<i>Pterostylis curta</i>	711759	20. 8.71	—			
<i>Pterostylis curta</i>	711760	21. 9.71	—			
<i>Pterostylis nutans</i>	711761	29. 7.71	—			
<i>Pterostylis obtusa</i>	711776	6. 4.71	—			
<i>Pterostylis parviflora</i>	711777	6. 4.71	—			
<i>Pterostylis pedunculata</i>	711762	20. 8.71	—			
<i>Thelymitra aristata</i>	711763	5. 7.70	15	D	A	12
<i>Thelymitra aristata</i>	711764	8. 1.71	8.9	D	A	13
<i>Thelymitra carnea</i>	711765	24.11.70	8	D	A	15
<i>Thelymitra carnea</i>	711766	24.11.70	18*			5
<i>Thelymitra chasmogama</i>	711768	5. 7.70	15*	D		12
<i>Thelymitra carnea</i>	711767	24.11.70	22*			1
<i>Thelymitra ixioides</i>	72317	29.10.71	11			1
<i>Thelymitra nuda</i>	711769	5. 7.70	15	D		12
<i>Thelymitra pauciflora</i>	711770	24.11.70	18*			5
<i>Thelymitra pauciflora</i>	711771	24.11.70	18*			5
<i>Thelymitra pauciflora</i>	711772	8. 1.71	11			10
<i>Thelymitra pauciflora</i>	711773	20. 9.71	12			1
<i>Thelymitra sp.</i>	711774	5. 7.70	22*			5
<i>Thelymitra sp.</i>	72329	16.11.71	18*			4

* Dormancy in tube, prior to transplanting.

These improvements have speeded up the growth rate of terrestrials, and in some cases there has been no need to transplant seedlings, to ensure continued growth. The seedlings being produced appear to be stronger and more vigorous.

The success of raising terrestrial orchids from seed must be judged when the seedling has been planted from the sterile medium into non sterile soil, grows successfully, goes dormant, wakes from that dormancy and continues to grow. In other words completes its full natural growth cycle.

McIntyre, Veitch and Wrigley (1972) reported that several species had been planted out into non sterile medium and had survived for a few months but none had gone dormant.

It would appear that the major obstacles in raising terrestrials from seed have been overcome, and future work will now be aimed at perfecting techniques.

It has been found that slugs have a particular liking for young terrestrial seedlings and it has therefore been necessary to construct a moat around these hard earned gems to prevent such avoidable losses.

Two galvanised iron trays were made one inside the other, the inner one being about 1" smaller all round. This 1" was filled with water, to form a moat and the inner tray filled with sterile sand. The pots were placed on this sand. The slugs will not cross the water, and the seedlings have remained protected by this means.

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A New Medium for Raising Australian Terrestrial Orchids from Seed

by G. J. Veitch and D. K. McIntyre

Following the successful raising of Australian terrestrial orchids from seed in sterile conditions (McIntyre, Veitch and Wrigley 1972) many species of terrestrials placed onto Knudson's C agar at the protocorm stage have shown little development past this stage for very long periods of time.

Species which showed very poor growth rate were *Pterostylis parviflora*, *Microtis bipulvinaris*, *Microtis unifolia*, and *Thelymitra ixioides*.

To overcome this apparent deficiency in the medium, it was decided to try coconut milk. Coconut milk has been used in media for growing epiphytes for many years (Withner 1959).

Fresh coconuts, each containing about 150-200 mls of milk were used. Knudson's C media was used (Knudson 1946), but instead of 1000 mls of water, 850 mls of water and 150 mls of coconut milk were used. The media was autoclaved and no pH adjustment was made. The pH however was usually about 5.1 to 5.2 which was considered reasonable.

Pterostylis parviflora plants which had produced only two very small leaves and no tubers in 12 months on Knudson's C agar were transferred to the coconut medium. Within 10 days "root" growth had commenced and tuber formation followed shortly thereafter. There was also an associated increase in shoot growth.

This medium seems particularly suited to *Pterostylis* spp. as *P. pedunculata*, *P. curta*, *P. concinna*, *P. nutans*, *P. acuminata*, and *P. obtusa* are now all growing well. These species did not perform at all well on Knudson's C alone.

Microtis unifolia seedlings transferred onto coconut milk media showed greatly increased growth, particularly tuber growth, which was prolific (Plate 1).

The tuber growth in B was much greater than tuber growth on the new batch of Knudson's C medium.

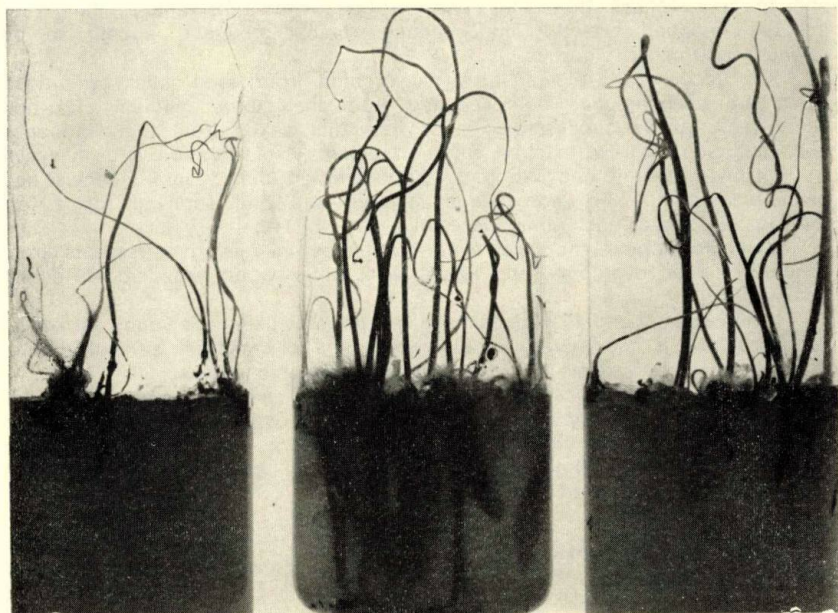


PLATE 1

Microtis unifolia plants transferred from the tube A, at left (Knudsons C) to tube B, in centre (coconut milk medium) and to tube C at right (Knudsons C) 7 weeks before.

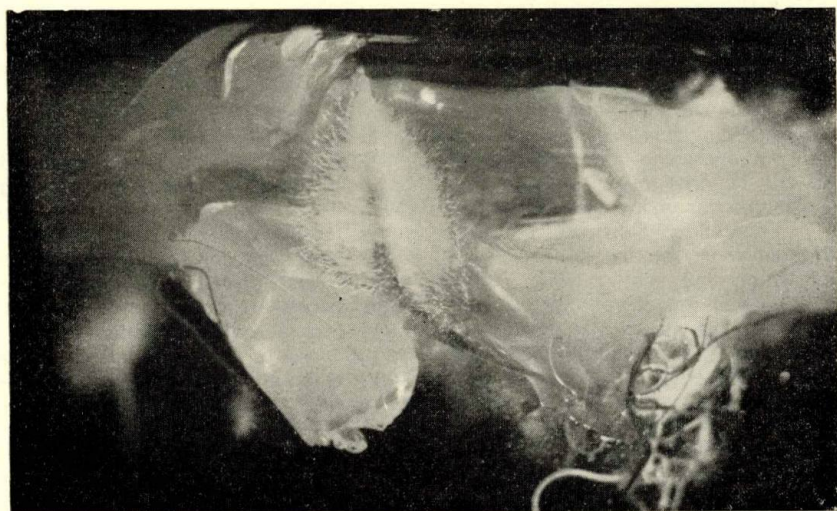


PLATE 2

Shows the mass of rhizoids which appear fungus like on *Microtis bipulvinaris*

Note that the rapid growth of tubers has split and lifted the agar in the flask. The whole slab of agar was lifted off the bottom of the flask—10 days

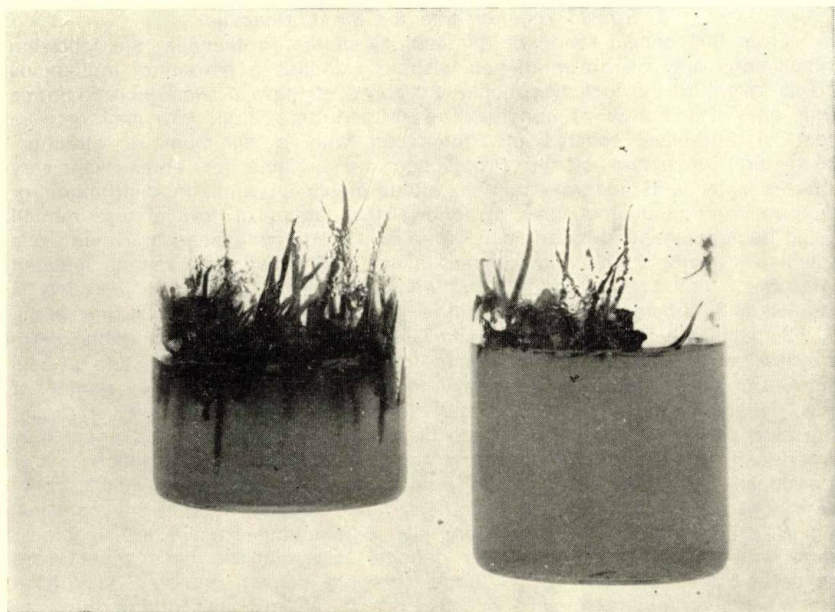


PLATE 3

Thelymitra ixioides, seedlings on Coconut milk medium (left), showing superior growth to those on Knudson's C, right.

previously the agar was not even split and only 2 tubers had reached the bottom.

Microtis bipulvinaris plants placed on Coconut milk media also showed very marked tuber growth, and as well masses of rhizoids or root hair like structures (their anatomical structure has not been checked) were formed and these did not occur on Knudson's C.

All terrestrial Orchids are now being placed on the coconut milk medium at the protocorm stage as a routine procedure. This appears to have resulted in an overall improvement in growth of all species although no precise measurements are being kept.

The rapid growth and development occurring on this medium will probably allow protocorms placed on it to grow to the potting on stage without further transplanting.

ACKNOWLEDGEMENTS

Thanks are given to Mrs. J. Simpson, C.S.I.R.O. Plant Industry, Canberra, for photographing the plants in Plates 1 and 2.

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PROTEACEAE—AN ECOLOGY STUDY—continued from page 55

Growth requirements for the Proteaceae

From this consideration of the ecology of the Proteaceae, the following conclusions may be drawn. If you wish to establish a garden of indigenous plants in any of the localities mentioned above, or have a site which conforms with any of the sets of conditions described here, then you may grow a host of attractive species of Proteaceae with a minimum of attention. In general, members of the Proteaceae are suitable for areas with very infertile soils and moderate rainfall, either highly seasonal in distribution or uniform throughout the year. It follows that areas of low annual rainfall could be supplemented by artificial watering in the growing season. Proteaceous species normally dormant in summer in the south-west can even be induced to grow at this time by artificial watering. However, unless this watering is regular and substantial it may reduce the drought tolerance of the plant.

About eighty percent of Australia is semi-arid or arid. Hence, while there are few areas wetter or more humid than those considered in this article, there are many with a greater daily temperature range, a lower rainfall of less reliability, lower humidity and somewhat greater number of hours sunshine per year. While Proteaceae do occur in these more arid areas they are rare in comparison with the occurrence of members of this family nearer the coast. Some apparently avoid heat damage by possessing thick corky bark e.g. *Hakea suberea*, while others have special internal mechanisms, e.g. *H. preissii* (Hellmuth 1971). Generally, proteaceous species are unable to store water or tolerate large water deficits, so as far as these aspects are concerned they are not really "good" drought plants. However, they have the fascinating ability to start or stop growth at any time during the year according to whether or not conditions are suitable. In effect, proteaceous species avoid drought by possessing an extensive root system, with the surface fibrous roots active in the wet season, and the deep lateral roots active throughout the year (Specht and Rayson 1957b). While the surface soil need only be moist for part of the year, the sub-soil must be moist throughout. Thus, following an unusually dry summer, proteaceous plants growing in deep sands, shallow clay or the crevices of rock outcrops may die because the amount of water available at depth has fallen below a critical level. With additional water at these times members of the Proteaceae should grow well on such sites. Wide spacing between plants is another method of reducing competition for soil moisture.

Many species of Proteaceae are suitable for the damp edges of creeks, swamps and lakes. Species such as *Hakea sulcata* (Lamont 1972b) tolerate seasonal, but not permanent, flooding. Many species occurring on uplands and dune and cliff faces are quite intolerant of waterlogging, especially if it occurs when the plant is growing, and prefer well-drained sites, such as most *Dryandra* species. The main problem with poor drainage is the build up of disease organisms, to which this family is particularly susceptible. It is a useful rule of thumb that plants growing naturally in waterlogged soils will grow in well-drained soils, but generally not vice versa. However, there may be surprises: I grew seedlings of *H. francisiana*, normally found in semi-arid climates of W.A. and S.A., under water-logged conditions for five months without harmful effects. The point is not that this species should be grown in poorly drained soils but that a given species can grow under a variety of conditions in the garden. While some Proteaceae grow near the ocean, e.g. *Banksia integrifolia* (Baglin and Mullins 1970), there is no evidence that this family colonises or tolerates saline soils.

It has been shown that proteaceous plants cope with hot summers, cool winters and some frost. Specht and Rayson (1957a) found *Banksia ornata* and *B. marginata* in the Ninety Mile Plain only commenced growth once the mean temperature exceeded 18°C (November to April), which, it should be noted, is out of phase with the wet season. The genera discussed here prefer full sunlight, though they tolerate filtered light. Hence sites beneath

dense trees, on the south side of or inside buildings, would not be suitable. A number of species withstand salt spray and strong winds and are ideal as windbreaks and subjects for seaside gardens (Newbey 1968). In fact, moderate air movement and low humidity seem to encourage the development of sturdy plants. Under strong prevailing winds many normally upright species assume a squat, compact habit. In addition, they are not really colonising species, as they are too slow-growing to stabilise mobile dunes or steep slopes with soil movement.

While very low nutrient levels are favourable for growth of proteaceous species, quite moderate levels may be toxic. Scrub and heath species are particularly susceptible to phosphorus toxicity, and inorganic fertilisers should be avoided (Specht 1963). Growth may be much improved however by the use of animal manure and blood and bone at one tenth the rate of application for other species, and leaf litter and wood shavings. Many roots of proteaceous plants are very close to the surface, and these additives should never be dug in. The addition of iron chelates may be necessary to combat chlorosis in calcareous soils. It is worth noting that a plant supplied with abundant nutrients as a seedling is more likely to respond favourably to additional fertilisers than one which does not receive the same application till mature. This is possibly the basis of the alarming death rate of *Banksia* species left as specimen plants following house construction. It is unlikely that there are natural soils that are too fertile for the growth of Proteaceae. However, the chances of their being outgrown by neighbouring plants would be high and proteaceous species might be limited to specimen plants or grown in a special part of the garden in these soils. Planting in lawns should be avoided as these receive heavy fertilising and do not allow the accumulation of leaf litter.

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Victorian Wildflowers

Victorians particularly will be pleased to know that the following book is at last available. Mail orders through Editor with 60c postage.

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Series V—*Spiciflorae* Benth.

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Series VI—*Capitatae* Benth. Sub-series I—*Oppositifoliae*

M. calycina R.Br., *M. cymbifolia* Benth., *M. sparsiflora* Turcz.

Series VI—*Capitatae* Benth.—Sub-series II—*Nervosae* Benth.

M. cordata Turcz., *M. globifera* R.Br., *M. oldfieldii* F. Muell.

Series VI—*Capitatae* Benth.—Sub-series III—*Longifoliae*

M. concreta F. Muell., *M. hakeoides* F. Muell., *M. glomerata* F. Muell.

Series VI—*Capitatae* Benth.—Sub-series IV—*Erythrocephalae*

M. eriantha Benth. (This sp. and *M. seriata* are possibly conspecific). *M. erubescens* (Benth.) Otto, *M. holosericea* Schau., *M. leptospermoides* Schau., *M. polycephala* Diels, *M. pentagona* Labill., *M. sclerophylla* Diels, *M. seriata* Lindl., *M. subtrigona* Schau. (A sp. of the *M. scabra* complex), *M. trichophylla* Lindl. (A sp. of the *M. scabra* complex). *M. ciliosa* Turcz.

Series VI—*Capitatae* Benth.—Sub-series V—*Pallidiflorae* Benth.

M. depressa Diels, *M. thymoides* Labill, *M. striata* Labill.

Series VI—*Capitatae* Benth.—Sub-series VI—*Pauciflorae* Benth.

M. acerosa Schau., *M. aspalathoides* Schau., *M. leiocarpa* F. Muell., *M. leiopyxis* F. Muell., *M. pauperiflora* F. Muell., *M. sheathiana* W. V. Fitzg. (Reduced to synonymy under *M. pauperiflora* by J. M. Black in Flora S. Australia).

Sub-series VII—*Peltatae* Benth.

M. deltoidea F. Muell., *M. minutifolia* F. Muell., *M. tamariscina* Hook, *M. thyoides* Turcz.

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MELALEUCA

Melaleuca Species at Canberra Botanic Gardens by D. Verdon

The genus *Melaleuca* has many species that are very suitable for garden cultivation and is used extensively in landscaping. The previous issue described species from the series I-V of the genus and commencing on page 76 many species of the *Capitatae* group, series VI with "pom-pom" type flowers are described. Recognised species not described are listed opposite.

The article is a competent report of experiences in cultivation at the Canberra Botanic Gardens and will give a guide to the cultivation of these hardy plants elsewhere. Of special interest are the following tables that record frost tolerance of the species grown.

TABLE SHOWING FROST TOLERANCE OF MELALEUCA SPECIES AT C.B.G.

Ratings are given in relation to a minimum terrestrial temperature (Screen Temperatures are not recorded at C.B.G.) of -7°C (20 deg. F.) L. = Low Frost Tolerance; M. = Moderate Frost Tolerance; H. = High Frost Tolerance. Species are listed alphabetically within series.

I *Callistemoneae* (Species resembling *Callistemon*)

Species	Frost Tolerance	Remarks
<i>M. diosmifolia</i>	L	Specimen in very sheltered position near building badly frosted. Has been pruned but growth in summer 1972 only fair.
<i>M. elliptica</i>	H	Mature plants may tolerate lower terrestrial temperatures than -7°C . but young plants need protection.
<i>M. fulgens</i>	M	All surviving specimens in sheltered situations.
<i>M. hypericifolia</i>	M to H	This sp., although having some sensitivity, recovers well.
<i>M. lateritia</i>	M to H	No specimens in fully exposed situations at C.B.G.
<i>M. macronychia</i>	H	May tolerate slightly lower terrestrial temperatures, but caution advised at this stage.
<i>M. steedmanii</i>	M to H	Specimens under tree shelter; frost tolerance not certain.
<i>M. steedmanii</i> cultivar (known as "Payne's Hybrid")	L to M	Plants surviving in tree shelter but some losses in open situations.

II *Decussatae* (Opposite leaves at right angles to pair above and below)

Species	Frost Tolerance	Remarks
<i>M. acuminata</i>	M to H	Frosted tips of plants in open suggests caution at terrestrial temperatures below -7°C (20°F .)
<i>M. decussata</i>	H	May grow in cooler areas if special care is taken.
<i>M. gibbosa</i>	H	May grow in cooler areas if special care is taken.
<i>M. leptoclada</i>	H	May grow in cool areas if given some shelter, care advised until further assessments.
<i>M. platycalyx</i>	?	This species has only been grown under tree shelter.
<i>M. thymifolia</i>	H	Care needed with young plants.
<i>M. violacea</i>	H	Will probably tolerate lower terrestrial temperatures than -7°C (20°F .)
<i>M. wilsonii</i>	H	Young plants need special care, but mature plants may tolerate slightly lower terrestrial temperatures.

III *Laterales* (Flowers lateral—mainly on old wood)

Species	Frost Tolerance	Remarks
<i>M. cardiophylla</i>	L	Many losses of young plants. No mature specimens yet at Gardens.
<i>M. depauperata</i>	?	No specimens without overhead cover.
<i>M. neglecta</i> (including <i>M. ororia</i>)	M	This species has not been grown in completely exposed positions; tolerance may be higher but caution needed.

IV *Circumscissae*

No species of this series at C.B.G.

V *Spiciflorae* (Flowers in spikes)

Species	Frost Tolerance	Remarks
<i>M. adnata</i> var. <i>intermedia</i>	L	Specimens frosted in sheltered situation.
<i>M. armillaris</i>	M to H	Several plants damaged by persistent extreme frosts. Some losses among mainly young plants in cool areas of Canberra. Little or no reaction in milder previous winters. Many have recovered in Canberra.
<i>M. alternifolia</i>	M	Caution exercised because species not yet grown in exposed position.
<i>M. cheelii</i>	M	As for <i>M. alternifolia</i> .
<i>M. decora</i>	M to H	Young plants apparently have low-tolerance; several losses have occurred.
<i>M. hamulosa</i>	M	No plants in exposed positions at C.B.G. Tolerance may be higher but caution needed.
<i>M. huegelii</i>	M	Only specimen here is in sheltered situation.
<i>M. lanceolata</i>	M to H	Adverse reaction to spring sun in the presence of frost suggests caution.
<i>M. laxiflora</i>	M to H	Tips damaged by persistent frosts; recovery good.
<i>M. linariifolia</i>	M to H	Some specimens sustained tip damage and leaf discoloration, but plants recovered.
<i>M. pulchella</i>	H	Young plants need overhead frost protection.
<i>M. radula</i>	L to M	Some losses in open situations at C.B.G.
<i>M. raphiophylla</i>	H	May tolerate lower terrestrial temperatures than 20°F. but caution is necessary at this stage.
<i>M. sieberi</i>	H	Care needed—some individuals may be less tolerant than others.
<i>M. sp. aff. spicigera</i>	H	Not to be confused with the true <i>M. spicigera</i> which has not yet been cultivated at C.B.G.
<i>M. squarrosa</i>	H	This species may tolerate lower terrestrial temperatures than 20°F. but caution is advised.
<i>M. subfalcata</i>	M to H	Our specimen of this species is atypical. The typical <i>M. subfalcata</i> has not yet been cultivated at C.B.G.

Editor's Note: What Species Is That? Previous issues have described many species. To identify a species, please refer to the series by C. N. Debenham, "The Genus *Melaleuca*", Vol. 1 No. 10, page 23—Vol. 2, pages 23, 156, 197 and 290. This presents sketches and keys for species in Series I to V above and describes why the species are grouped in this fashion.

VI *Capitatae* (Flowers in terminal heads)

Species	Frost Tolerance	Remarks
i <i>Oppositifoliae</i>		(Leaves opposite)
<i>M. cuticularis</i>	H	Slight discolouration of young shoots suggests caution at terrestrial temperatures below 20°F.
<i>M. halmaturorum</i>	M?	One specimen in sheltered situation.
ii <i>Nervosae</i>		(Leaves 3-7 nerved)
<i>M. cordata</i>	L	No specimens have survived here but reason not certain.
<i>M. megacephala</i>	L to M	Shrubs near sheltered westerly side of building thriving but losses have occurred in less sheltered situations.
<i>M. nesophila</i>	L to M	Shrubs surviving in tree sheltered position but all shrubs in open situations were lost in extreme winter of 1971.
iii <i>Longifoliae</i>		(Leaves linear or terete mostly above 7.5 cm long)
<i>M. nematophylla</i>	M?	Growing tips frosted in semi-open situation but plants recovered well.
<i>M. uncinata</i>	H	Young plants need extra care.
iv <i>Erythrocephalae</i>		(Red headed)
<i>M. erubescens</i>	L to M?	Needs some tree shelter especially when young.
<i>M. pentagona</i>	?	No specimens planted out in Garden. Tub specimen in shadehouse.
<i>M. scabra</i>	H	Caution needed at terrestrial temperatures below -7°C (20°F.)
<i>M. psammophila</i>	H	Caution needed as for <i>M. scabra</i> .
<i>M. spathulata</i>	H	Leaves colour slightly in exposed situations. Caution advised in cool areas.
<i>M. squamea</i>	H	May tolerate lower terrestrial temperatures than 20°F.
v. <i>Pallidiflorae</i>		(pale flowers yellow to white).
<i>M. capitata</i>	H	Will probably tolerate lower terrestrial temperatures than -7°C (20°F.)
<i>M. densa</i>	H	May tolerate lower terrestrial temperatures than 20°F.
<i>M. ericifolia</i>	H	Will probably tolerate lower terrestrial temperatures than 20°F.
<i>M. incana</i>	M to H?	Some frost damage in 1971 winter-care needed at lower terrestrial temperatures.
<i>M. microphylla</i>	H	May tolerate lower terrestrial temperatures than -7°C (20°F.)
<i>M. nodosa</i>	H	As for <i>M. microphylla</i>
<i>M. polygaloides</i>	H	Caution needed where terrestrial temperatures are lower than -7°C (20°F.)
<i>M. viminea</i>	M to H	Adverse reaction to spring sun in presence of frost suggests caution.
vii <i>peltate</i>		(Leaf attachment dorsal—shield like).
<i>M. micromera</i>	M to H?	No plants in exposed positions.

Editor's Note: Cultivation—As mentioned in the Introduction to this article (page 3) "Few *Melaleuca* species need special treatment in cultivation; most are extremely adaptable." Previous issues report good results over a wide range of climates "In garden conditions". They are less successful in light soil unless well watered and occasionally fed, but are rewarding in good to heavy soil. As repeatedly pointed out in this article, pruning is essential for pleasing growth and good flowering.

Series VI—*Capitatae* Benth.

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Sub Series I—*Oppositifoliae*

Melaleuca halmaturorum F. Muell.

(From the term *Halmaturus*, said to be an obsolete name of the swamp wallaby (of Kangaroo Island?). From Gk. *Halma* = leap. *Halmaturorum* is an adjectival form meaning "of the kangaroos". The type specimen of this species was found on Kangaroo Island).

Glabrous shrub or tree 2 metres high, with white papery deciduous bark; leaves decussate crowded, linear-lanceolate, obtuse thick plano-convex 3.7 mm long 1.2 mm broad nerveless, slightly recurved towards apex; flowers white, few or many in terminal heads. Fruits solitary or few together on old wood, ovoid truncate, 4.5 mm diameter.

A "swamp paperbark" from coastal areas of South Australia, this species is often found near salt or brackish water. It also occurs in Victoria.

Our only mature specimen of the species was planted in 1950. It has developed into a large shrub 4 metres tall and 4 metres broad with several white barked stems. It is not densely branched but has a somewhat open and irregular habit with spreading to ascending sparsely leaved branches. The upper branchlets however, are densely leaved showing that regular pruning would maintain a close leafy cover.

There is no evidence of frost damage; its position however, could not be termed open although it has no overhead cover. Without open position specimens it is difficult to give a positive frost rating.

Flowers are fairly plentiful in summer but are somewhat small.

Without further study of the species it cannot be recommended to Canberra gardeners. In areas with grass temperatures above -7°C however, it would be a useful shrub in fairly sheltered positions especially where soils may be alkaline.

Melaleuca cuticularis Labill

(from L. *cuticulo* = skin. Adjectival form probably referring to the loose papery bark).

A shrub or tree 1.5 metres high with rigid, tortuous branches and white paper bark; leaves opposite, linear-oblong or narrow-lanceolate, obtuse, thick, flat or concave, 6-12 mm long; flowers creamy white, solitary or 2-3 together at the ends of branches and surrounded by decussate imbricate bracts; fruits thick, campanulate 6 mm diameter with persistent lobes.

A paper bark from the Stirling and Warren districts of West Australia that has potential as a horticultural subject.

Several specimens are established at C.B.G., all from a 1962 collection. Some are irregularly shaped shrubs, others tree-like, with short white trunks and they vary in height from 1.5 to 2.5 metres. They all have tortuous divaricate branches and many send out long, vigorous "rogue" branches which give them a misshapen appearance. Despite their untidy form, the strikingly glaucous spreading leaves and white bark make them extremely interesting garden subjects. From November to December the creamy white flowers with their contrasting brown, imbricate bracts add a further pleasing touch. Reaction to frost has been negligible in open situations, consisting of slight discoloration of some young shoots.

This species would add individual charm to any native garden and should grow well where grass temperatures fall no lower than -7°C . It could be grown in the milder elevated areas of Canberra and may also succeed in other areas if placed in warm sheltered positions. Overhead protection on hard frosty nights would be necessary in these areas for young plants.

Pruning to improve form and promote young growth should be carried out after flowering. Many gardeners may prefer to maintain the rugged form.



Photography by K. Thaler

Sub-Series II—*Nervosae* Benth.

MELALEUCA CAPITATA

Melaleuca capitata Cheel

(from *L. capitatus* = with a knob like head—referring to the inflorescence).

Usually densely branched shrub, 1-2 metres high, the young shoots villous; leaves alternate, thick, more or less subulate acute, 25 mm long, 2 mm wide, 3-nerved, the central nerve impressed on both sides of the leaf; flowers white, staminal bundles pale yellow, the axis continuous after flowering; fruits about 6 mm diameter, slightly contracted at the orifice, the valves rather deeply sunken.

This is an interesting species usually found along water courses on the south coast and sub-coastal mountains of New South Wales.

It has been introduced to the Canberra Botanic Gardens within the last four years, and plants are thriving in various positions.

These specimens vary in form, but all are more or less open shrubs 0.5-1 m high. Some have divaricate or low-spreading branches on an upright

central stem. Others with no central stem have more or less upright branches. One plant has all its branches very widely and unevenly spreading, giving it a somewhat untidy form.

During the growing season, the rather unruly appearance of these shrubs is made more interesting by the silvery-white villous young terminal shoots. The true flowers are yellowish, in dense globose heads 18 to 25 mm diameter, and are produced in late spring to summer month.

There has been no adverse reaction to frost by specimens in sheltered or open positions during the recent exceptionally cold winter.

Gardeners in the milder areas of Canberra should have no trouble growing this species if it is given some shelter from the S.W. winds.

In colder areas, a warm sheltered position should be chosen and extra protection provided on frosty nights, especially when young.

Pruning will be necessary to keep the stray vigorous branches in check as the shrub develops. This odd branching habit, however, could lend itself to "wall plant" culture. By removing all the breast wood and encouraging the lateral spreading branches, an interesting form could be achieved.

Melaleuca megacephala F. Muell.

(from Gk. Mega = large and cephalus = headed).

A dense upright shrub to 2 metres high with rigid ascending branches, the young shoots often villous; leaves alternate, obovate-orbicular to oblong, 1-2 cm long, obtuse, 3-5 nerved, flowers pale yellow in large dense terminal globular heads, the axis usually continuous after flowering; fruits globular, villous, and 6 mm diameter (often separating into 3 cocci).

In the *Melaleuca* sub-series *Nervosa* are several of the most outstanding Western Australian species. One of these is *M. megacaphala* which, in its natural habitat on the sand heath of the Irwin district, is a dense, bushy well shaped shrub, 1-2 metres high or more.

Several specimens have been planted at the Gardens since 1962 but so far only two have survived to mature and flower. These are planted in a warm sheltered position on the westerly side of the office/herbarium building, and also have good protection from southerly winds. One is in heavy shade of a vigorous *Acacia rubida* and shows the effect of this in its weak growth and poor flowering. The other, however, has the advantage of shelter from the *Acacia* but is some yards to the north of it and receives ample light. This specimen has developed into a loose but bushy shrub with many ascending slightly flexuose slender branches. It is leafless in the lower part but its sub-whorled secondary branches are well covered with the flaccid broadly obovate leaves typical of the species and give the shrub its bushy appearance. This is certainly an attractive specimen, especially in spring to early summer when it produces its large, globular, pale-yellow heads. A second flowering period often occurs in the autumn, but flower production in this late period is sometimes spasmodic due to cold nights. If the cold is extreme many flowers fail to open and the buds die within the dense bracts. The bracts then persist as unattractive brown globular heads until the spring growth.

This is a difficult species to grow where the terrestrial temperatures fall below -7°C and cannot be recommended for the Canberra area generally. If given a well sheltered position, however, it may be possible to grow the species in mild elevated areas. Overhead protection from frost would be essential for young plants. It must be stressed here that risk of failure is high even with these provisions.

Melaleuca nesophila F. Muell.

(From Gk. nesos = Island and -philos = loving referring to the habitat of the original collection).

A dense shrub 2-2.6 metres high, with slender branches; leaves alternate, obtuse or rarely mucronate, flat often vertical, 3-5 nerved, 12-25 mm long; flowers pink or mauve in dense terminal heads, the axis continuous after flowering; fruits often 6 mm diameter in very dense spikes.

This shrub is considered by many to be one of the most beautiful of Western *Melaleucas*. It grows on the coast of the Eyre district in the South West Province of W.A. in sandy habitats.

Several specimens have been planted at the Gardens and those surviving are part of a 1967 introduction. A number of these were planted in a cold exposed part of the gardens and two others were given a sheltered position but without direct overhead cover. All specimens survived two or three winters and grew on to flower in the summer of 1970-71. In the recent exceptionally cold winter, however, the shrubs in exposed positions were killed by the persistent hard frosts. Those in the sheltered bed sustained some tip damage but not of an extensive nature.

The latter are now dense about 2.5 metres high with ascending to erect branches. Although this species is usually a neat shapely shrub these specimens are showing a tendency to become irregular. Several vigorous stray branches are in evidence, some upright and others somewhat spreading. This could have resulted from the environmental conditions and may be controlled by pruning.

This would be a welcome addition to any garden and should succeed where minimum grass temperatures are above -7°C if given a sheltered position. Young plants would need overhead cover on frosty nights. Where grass temperatures fall below that mentioned, a position with light tree cover should be provided; if temperatures are -8°C or lower, however, the risk of loss would be considerable.

Under certain conditions pruning may be necessary to maintain a neat shape. Stopping or removal of stray branches should be carried out as soon as they are noticed. It is possible to grow this species as a tree by judicious removal of lower branches if it is desired.

M. nesophila is adaptable to most soil types but conditions do affect its form and ultimate height. It would probably grow best in sandy soils as in its natural habitat and would be ideal for coastal gardens.

Sub-Series III—*Longifoliae* Benth.

Melaleuca nematophylla F. Muell. (*M. filifolia* F. Muell.)

(from Gk. comp. *nemato-* = threadlike and *-phyllus* = leaved).

Erect shrub to 2.5 metres, glabrous except the inflorescence; leaves alternate, linear-subulate or terete, obtuse or acute rigid, 19 mm to 37 mm long or longer; flowers purple or pink in globular terminal heads, the axis continuous after flowering; fruits 4 mm diameter, sometimes densely packed in ovoid clusters or few due to abortion.

Another very beautiful *Melaleuca* from the Austin and Irwin Districts in W.A., where it grows in somewhat arid granite rocky areas.

We have only two specimens of this species which were planted in 1969. These are both small weak shrubs with few very slender branches and fine branchlets. Despite this weak slender appearance they are reasonably vigorous and should improve in the next couple of seasons.

There has been some reaction to frost in a semi-open position; consisting of browning of the extreme growing tips. It would be difficult to give a positive frost rating at this stage. Colour plate on page 81.

This should be a very desirable garden subject and for gardens in areas where minimum grass temperatures are above -7°C . It should be placed in a warm sheltered spot facing north where some overhead cover can be provided against frost. The planting area should be well drained with a relatively low water table.

Melaleuca uncinata R.Br.

(L., feminine of *uncinatus* = hooked; referring to the leaf apices of this species).

A tall shrub 1-3 metres high with erect branches, grey bark and pubescent young tips; leaves alternate, terete, with a fine, usually hooked point, 1.5-4 cm long; flowers cream in dense globular or shortly oblong heads, the axis often continuous during flowering; fruits subglobular 2-3 mm diameter, compressed in the lower part due to being densely packed in a $\pm$ globular cluster.

A widespread species over the drier parts of temperate Australia often on sand heath. The fine dense branches were often bundled and tied for use as brush fences by early settlers.

M. uncinata should grow well in the milder areas of Canberra and may grow in the colder areas in warm sheltered positions. Extra protection is necessary on frosty nights especially for young plants.



Photography by F. W. Humphreys

MELALEUCA UNCINATA

Several specimens of the species have been planted since 1960. The earliest plantings are now very densely branched "brushlike" shrubs 2 metres high; the erect primary branches are slender and the numerous secondary branches usually fine as are their branchlets. The unattractive appearance is accentuated by the sparseness of the terete leaves. Some improvement is seen, however, when the cream flower heads are produced in spring.

There has been no frost damage during the recent cold winter in the mature shrubs. Young shrubs 0.5 metres high have sustained very slight curling of young tips.

In its "bushy" state this is not the most attractive shrub but if pruned carefully to reduce older branches and promote young lateral growth its appearance may be improved. This should be carried out after flowering.



Photography by F. W. Humphreys

MELALEUCA NEMATOPHYLLA

Sub-Series IV—Erythrocephalae***Melaleuca erubescens* Otto**

(from the L. verb *erubescere* = to blush in Bot. L. adjectival form = becoming red-reddening referring to the flowers of this species.)

Shrub 1 to 3 metres tall with dense virgate branches; leaves terete, sometimes with recurved tips, 6 to 12 mm long; flowers pale crimson in dense spikes 2-4 cm long; the axis continuous after flowering, fruits sub cylindrical 2 mm diameter and 2 mm deep with $\pm$ persistent calyx lobes, spikes 15-30 mm long.

An attractive shrub with a wide distribution in the Wianamatta shale series and the Pilliga district and along creeks in the Riverina district.

It is represented here by 2 mature shrubs and several young plants. One mature specimen, planted in 1961 in a sheltered woodland situation, has developed into a dense irregularly rounded shrub 1½ metres tall. It is well covered to the ground with densely leaved ascending branches. The many fine spreading branchlets bear pale red flower spikes in summer and at times in autumn. The other mature shrub is in much denser tree shade but it flowers reasonably well despite being sparse and ragged in form.

Some younger plants have been killed by the persistent unusually low temperatures experienced during the recent winter. The degree of frost tolerance of mature plants has not been assessed. The tolerance of young plants is low but this is often the case with other species in which the mature plants have a moderately high tolerance.

For Canberra gardeners it would be advisable to select a warm sheltered position. Overhead cover is necessary during frosty weather, at least for young plants. As this species appears to grow well under tall cover such a position would probably increase the chances of success.

Due to its vigorous branching, some pruning will be needed to maintain a neatly rounded form. This will also promote the growth of young wood.

The *Melaleuca scabra* complex including *M. scabra* R.Br., *M. subtrigona* Schau., *M. trichophylla* Lindl. and *M. psammophila* Diels.

Low, diffuse, spreading, prostrate or erect shrubs 0.3-1.5 metres high, branches dense and intricate or virgate, often very slender; leaves terete, semi-terete, slender, clavate or sub-trigonus, sometimes channelled above, tubercular or smooth, obtuse or acute, sometimes mucronate; the young foliage pubescent hirsute or glabrous, 4 to about 25 mm long; flowers various shades of red, purple or pink, in dense terminal globular heads 1-1.5 cm diameter, the axis continuous vegetatively after flowering; fruits sub-globular to urceolate 2-4 mm diameter, few and scattered, or numerous in dense globular heads.

The degree of intergradation between these species is such that their specific limits are virtually impossible to define. Blackall (1953) in an attempt to simplify the situation listed the three latter species as varieties of *M. scabra* but as such they have not been published in accordance with the rules of nomenclature and have no legitimate status. There is certainly need for a broad study of the complex in the field and in herbaria but for the present, it seems advisable to deal with the four species collectively.

Several specimens are established at the Gardens and the oldest of these were introduced in 1962. Two of them, one which can be placed broadly within the specific range of *M. psammophila* and the other closer to the typical *M. scabra*, are planted among dense tall shrubs and trees. Both are loose and branched, sprawling in habit, 0.8 metres high with long weak and widely spreading branches to nearly 1 metre across. The many young branchlets are well covered with leaves almost disguising the looseness of these rather untidy specimens and displaying reasonable vigour, but flowering capacity is not as high as that usually expected from these species.

Two other specimens of the same vintage, both close to *M. psammophila*, are in more open positions but with good shelter on the southern side. These specimens have slightly decumbent, thick main branches from which spring many slender but vigorous ascending branches. In habit they are more compact than the specimens in shaded conditions with close competition but some pruning is required to maintain a reasonably regular shape.

The pink flower heads are produced in late spring to summer.

Reaction to frost of the mature specimens in more or less open positions consisted of slightly discoloured young tips and leaves. It must be stressed, however, that they are not in completely exposed positions.

These beautiful shrubs could be grown in the elevated areas of Canberra if they are provided with a warm sheltered position. In the colder suburbs they may respond to tub culture which would allow them to be moved to advantageous positions. Overhead cover will be essential during very cold nights especially for young plants.

Melaleuca spathulata Schau.

(feminine of *spathulatus* = spatula shaped from classical *L. spatha* = broad sword).

A small spreading shrub, the young shoots silky-pubescent or softly hirsute; leaves scattered, spreading or recurved, obovate-spathulate, obtuse or scarcely mucronate, much narrowed at base 4.6 (-8) mm long, flat, thick smooth obscurely 1 nerved; flowers small, pink-red in dense terminal globular heads, the axis continuous after flowering; fruiting heads globular dense, 8 mm diameter.

This is another outstanding shrub from the South Western Province of W.A. that grows on the sand plains of the Stirling and Eyre districts.

The species is represented at C.B.G. by several specimens from a 1962 collection. All are more or less rounded shrubs 0.5 to 1 metre tall with very dense slender but rigid, upright branches. In the young plant, the branches are densely covered with the small obovate leaves and when topped by the first pink flower heads in mid-November to December, are a wonderful sight. As they mature however, despite the dense branching they become less attractive due to loss of leaves on older wood, the ugliness of old fruiting heads and lowering of flowering capacity. To prevent this, pruning, it seems, is necessary. This should be carried out immediately after flowering. The removal of flowers before fruit production not only prevents ugly fruiting heads but conserves the large amount of energy normally used to produce them. Added to this, the removal of some flowered wood maintains an even balance between the mature and the young wood from which flowers are produced. Colour plate on page 85.

The reaction to frost of our specimens has been slight; consisting of a colour change in the young shoots and in some leaves but no shoot death; recovery in spring is fast and complete as growth speeds up. *M. spathulata*, therefore, can be suggested for the milder areas of Canberra, but care should be exercised especially with young plants. These should be given overhead cover during frosty weather. A compact species such as this may be worth trying as a tub subject by which method it can be moved into frost free areas in winter.

As far as soil is concerned good drainage is probably the most important factor.

Melaleuca squamea Labill.

(*L. feminine of squameus* = scaly, referring possibly, to the floral bracts).

Shrub 1.2 metres high, the young shoots more or less villous; leaves alternate, lanceolate, incurved near the apex, acute or acuminate 6-12 mm long; flowers red, purple, white or yellowish, in terminal spikes 1-2 cm long, the axis continuous after flowering is over; fruits large, urceolate in dense heads.

A species with a wide distribution in N.S.W., Vic., S.A., and Tas., and found in wet situations or on peaty heath, often at high elevations, up to 4,500 ft. in Tasmania.

The earliest introduction of the species to C.B.G. was in 1961 and several specimens are still in cultivation here. The best of these is an irregular open, upright shrub 2 metres high, with ascending, somewhat tortuous branches and few laterals. In general it has a gnarled appearance which, as in *M. capitata*, is made more interesting by distinctive white hairy terminal shoots. Of the other specimens, one that has obviously been physically damaged has shown good rejuvenation powers by throwing out long vigorous regrowths from the base of the old stem, forming a narrow, open shrub 1.5 metres high.



Photography by H. A. Morrison

MELALEUCA SQUAMEA

The species flowers well, though not profusely, here, in late spring and early summer.

As far as frost is concerned, reaction has been negligible during the recent extremely cold winter.

M. squamea can be recommended for gardens in the milder areas of Canberra and should grow in the colder areas if placed in a warm sheltered position. Protection from frost is advisable for the young plants at least.

Pruning after flowering should promote young vigorous growth and prevent fruit production which in turn will conserve energy.

This species seems somewhat sensitive to silty, poor structured soils. It is important therefore to provide a well aerated, open medium. One that has a high peaty humus content would probably be approaching the ideal.



Photography by D. Verdon

MELALEUCA SPATHULATA

CORRECTIONS: No. 53 issue, Part 1 of this article. Page 44, colour plate of *Melaleuca laxiflora*. Add to caption "This polymorphic complex, contains several forms which are actually distinct taxa and the plant portrayed is one of these. Consequently it is better to call this plant *Melaleuca* sp. aff. *M. laxiflora*." Page 39, *M. radula* (from L. verb radere—to scrape).

Sub-Series V—*Pallidiflorae****Melaleuca densa* R.Br.**

(Referring to the often very dense leaves of this species).

A dense, spreading or sometimes sparse and upright shrub with widely spreading, weeping or rigid branches, sometimes tortuous; leaves scattered or in irregular whorls of 3, ovate, concave, spreading or recurved, 3 to 8 mm long, usually 3-nerved; flowers cream in ovoid-oblong or rarely globular heads, the rachis continuous vegetatively during flowering; fruits in dense cylindrical or ovoid spikes 1-2.5 cm long.

Extremely variable in habit and leaf size, this interesting Western Australian species is represented at C.B.G. by a number of diverse forms. It grows naturally in the Stirling and Warren Districts of the South West Province and has proved vigorous and adaptable in cultivation under C.B.G. conditions.

The earliest planting of this species at the Gardens was in 1960. This specimen, a very small leaved form, is now an extremely dense intricate shrub 1.5 metres in height with tortuous reclinate branches curving over older branches to the ground. These older branches are leafless and gnarled with numerous old fruiting clusters, somewhat marring the appearance of the shrub. However, the vigour of several younger branches suggests that pruning would improve this specimen. In fact, if carefully trained, it should make a most interesting and attractive shrub.

Many younger specimens of various forms are established in the Gardens. Several specimens have an attractive spreading form and a number of these, planted in 1960 are now 1.5 metres high and 1-2 metres across. They have intricate, more or less rigid and densely leaved older branches, and slender young branches with weeping tips. These specimens flowered initially in 1969, and have since produced the cream flower spikes in profusion each Spring and early Summer.

Another form widely planted here is sparsely branched and more or less upright attaining a height of 2 or 3 metres. Some specimens are single stemmed while others have several stems. All have slender almost rigid branches that are less densely leaved than those of the spreading forms but have similarly attractive weeping tips when young. This form has potential where a standard specimen is desired if kept to a single stem. For good results, allow the single stem to reach the desired height then prune carefully to encourage lateral growth. This will aid in the formation of a dense head. Flowering has been less profuse in this form than in the spreading form.

Reaction to frost has been slight in all specimens so the species should grow reasonably well in the milder parts of Canberra. If given a warm sheltered position and extra overhead protection on colder winter nights it may be grown in the cooler areas.

***Melaleuca ericifolia* Sm.**

(Irregular L. compound from *Erica* and -folius = with leaves similar to *Erica*).

Variable shrub or tree $\pm$ 3 metres high with slender ascending to upright branches; leaves alternate, narrow linear or semi-terete, $\pm$ obtuse, 6-12 mm long, often recurved; flowers cream/white in ovoid or shortly cylindrical terminal spikes; the axis continuous vegetatively during or after flowering; fruits in $\pm$ dense cylindrical spikes.

A common species of swamps, river banks and sometimes dryer habitats in New South Wales, Victoria, and Tasmania. Its occurrence at Tarago on the N.S.W. southern tablelands is the nearest natural recording of *Melaleuca* species to the A.C.T.

M. ericifolia does not seem to have been popular among Australian horticulturists but it has been cultivated in England for many years. It has been listed in old English garden books as being—"suitable for pots in the green house or for well drained borders in the open at the bases of south walls in the mildest counties".

Taxonomically the species is very close to the Western Australian *M. microphylla* Sm. and *M. viminea* Lindl. One form also displays some affinity

to *M. hamulosa* Turcz. of the series *Spiciflorae*. This form seems to be the *M. gunniana* of Schauer which was reduced to synonymy by Bentham (1866) and later suggested as a distinct taxon by Cheel (1924). C.B.G. specimens of this form are mainly from a Tasmanian collection made by Dr. M. E. Phillips in 1965. They differ from specimens of other forms in their more or less fastigiate habit, the shorter less dense sub-terminal flower spikes and longer staminal bundles, and the sub-globose fruits with more or less persistent calyx lobes. The leaves are also longer, recurved and dense as in *M. viminea*. This form seems to warrant distinct taxonomic status but this and like problems must await the thorough investigation of a full generic revision.

Many of the more typical specimens at the Gardens are broad densely branched shrubs 1-3 metres high and irregularly rounded with a diameter of 2-2.5 metres. Most have long ascending fine branches that appear sparsely leaved due to elongation of the internodes but despite this they are reasonably dense due to the large number of branches produced and the vigour of numerous young branchlets. Some, however, are less dense, their few slender elongated branches giving them a loose open habit.

The flowers of typical forms are cream and are produced in profusion during October and early November. They fade rather quickly but at this stage the often bright red styles become prominent adding a final touch of beauty. The flowers of the atypical form, however, are white and their styles are pale.

No reaction to frost was recorded when assessments were made in 1971 and several specimens are in exposed positions. This suggests that *M. ericifolia* will be suitable at least for the mild elevated areas of Canberra. It may also grow in cooler areas if placed in a suitably sheltered situation. Protection for young plants during the coldest periods should be provided. The adaptability of this species makes it easy to cultivate in most soils. The important needs are ample moisture during periods of high evaporation and provision of a suitable mulch to reduce moisture loss.

Careful pruning after flowering may be needed to maintain a neat habit and to promote vigorous young growth.

Melaleuca incana R.Br.

(Hoary or 'whitish' due to dense short hairs—from *L. incanus* = grey).

A dense, more or less pubescent shrub 2-3 metres high, with spreading or weeping branches; leaves scattered, irregularly opposite or in whorls of three, spreading, often crowded, linear or lanceolate, acute 6-13 mm long; flowers white-cream in dense ovoid or oblong spikes, the axis usually continuous vegetatively after flowering; fruits in very dense cylindrical spikes.

An attractive foliage subject that is well known in horticulture. It grows naturally in wet situations in the Stirling, Warren and Darling districts of the South Western province of W.A. Colour plate Vol. 5, page 293.

The species has been cultivated at C.B.G. since 1961, and many specimens are thriving in various situations. The most outstanding of these is a group of four shrubs planted closely and forming a "shelter hedge" 2.5 metres high and 4 metres broad. Its pendulous branches and grey-green leaves which give dense cover to ground level, make this an unusually handsome hedge. Form and leaf colour are variable in this species; some individuals being relatively unattractive. It is necessary therefore, to select carefully when dealing with seedling material.

During mid-spring to summer, the often attractive form of this species is highlighted by numerous creamy yellow flower spikes.

Frost damage to specimens in the Gardens has not been severe but losses were reported from other parts of Canberra during the 1971 winter. In the mild elevated areas *M. incana* should grow successfully if given a warm sheltered position. Overhead cover should be provided for young plants during frosty weather.

Despite its natural habit this species tolerates average garden conditions quite well, but watering during dryer periods will ensure optimum growth.

Melaleuca microphylla Sm.

(Gk. comp., micro- = small and -phylla from phyllus = leaved).

A more or less spreading shrub 2-4 metres high; branches slender, sometimes with weeping tips; leaves alternate, $\pm$ spreading or recurved, crowded, linear to semi-terete, obtuse, about 6 mm long; flowers cream to pale greenish yellow, in ovoid-cylindrical spikes 15-20 mm long, terminal on young shoots or lateral on old wood, the axis continuous vegetatively after flowering or not continuous; fruits, ovoid, 2-3 mm diameter with thickened persistent calyx lobes (sepals), in dense spikes.

This interesting shrub, from the south western province of Western Australia, has some affinity to *M. viminea* Lindl. and even closer affinity to the eastern *M. ericifolia* Sm. with some forms of which it is often confused.

Only one mature specimen of *M. microphylla* is in cultivation at Canberra Botanic Gardens. This specimen was planted in 1963, probably from a 1962 West Australian collection, and has developed into a broad shrub 3 metres high and about 2 metres broad with numerous ascending or spreading branches. It has become slightly irregular due to close proximity of other shrubs and has developed a few untidily spreading branches. Despite this it has a rather attractive habit probably due to many weeping younger branches.

The flowers of this species seem to vary in shade according to the climatic conditions of the flowering season. They are produced in October to November and, though not as numerous as those of other species under C.B.G. conditions, give a reasonable display.

Little or no adverse reaction to frost was recorded during the 1971 winter, a slight discoloration of young tips being the only visible sign.

For the milder areas of Canberra this shrub has good potential. It would require a position sheltered from cold southerly winds and young plants would require overhead protection during frosty periods. Close competition from other large shrubs should be avoided to allow this species develop a broad dense habit.

Widely spreading branches should be controlled by pruning during development and as the shrub matures dead or spent branches and branchlets within the shrub should be removed. Light pruning of outer branches after flowering, and removal of fruiting spikes will promote healthy young growth and conserve energy. Vigorous sucker growths may be produced at the base of this species as is the case with the C.B.G. specimen. These may have no effect on the main body of the shrub but removal of them might be necessary to maintain a neat reasonably compact specimen. It may be possible to use them for propagation material if they have produced adventitious roots. To ascertain this carefully remove the soil from around them, if possible to their initiating point; they, then can be cleanly sliced away with a sharp tool. If this cannot be achieved without excessive damage to the roots of the parent shrub it should not be attempted. In this case removal just below ground level will suffice although this may mean further growth at a later date.

Melaleuca nodosa Sm.

(L. nodosus = knotty—referring to the fruit masses along old stems).

A tall shrub or small tree 1-3 metres high; leaves alternate, linear or subulate, rigid, pungent-pointed, 7-20 mm long; flowers yellow in small dense globular heads, the axis continuous after flowering; fruits 2 mm diameter in dense globular clusters.

Common on the central and north coasts of N.S.W. and the southern coast of Queensland, *M. nodosa* grows mainly in clay soils on Wianamatta shales.

It was first planted at Canberra Botanic Gardens in 1951 and is now well represented by specimens of various ages. The oldest of these is a ragged shrub with one upright and two low spreading stems. Its branches are long, lax and somewhat spreading and are very sparsely leaved except for the uppermost branches. Along most of its branches old fruiting heads are scattered giving them a knotty appearance which illustrates the specific epithet perfectly.

Other specimens are multi-stemmed or shrubby tree forms, the best of which is some 4 metres high. This specimen has many erect to

ascending lax branches all of which are densely leaved and form a loose but leafy oblong head. During spring and early summer this attractive shrub is enhanced by numerous small but distinctive yellowish flowering heads.

One interesting specimen from a 1961 Queensland collection is only 1.8 metres high but 2.5 metres across with numerous slender spreading branches. This atypical form has an irregular almost sprawling habit with a dense leafy cover to ground level. It has $\pm$ terete leaves and its flowers are produced in late autumn and early winter; it would appear therefore to warrant at least varietal rank.

A feature of *M. nodosa* that is worth noting is the virtual absence of fruit on many specimens, the flowers of which appear perfect superficially. Bentham (1866) suggests that "many flowers are male by abortion" on this and other *Melaleuca* species, but this has not been investigated at Canberra Botanic Gardens as yet. For the home gardener, at least, the selection of fruitless forms can be an asset as fertile specimens often become ugly due to old fruit clusters.

Plants in open positions have shown only slight reaction to frost during the recent cold winter. Some leaves and growing tips were discoloured but with spring growth this quickly disappeared.

This species should grow well in the milder areas of Canberra if given a sheltered position. In colder areas it may be more difficult but the smaller shrubby forms could be tried under tree cover. Extra protection would be needed on hard frosty nights especially for young plants.

Pruning would probably be necessary to achieve and maintain a neat form. If the shrub is a form that produces fruit, pruning immediately after flowering will prevent its formation and encourage young lateral growth.

M. nodosa seems to adapt well to conditions here, its main need being ample soil moisture especially during periods of high evaporation.

Melaleuca polygaloides Schau.

(polygala-and Gk. -oides = "resembling Polygala")

A spreading shrub 0.8-1.5 metres high with slender more or less divaricate branches, the young tips $\pm$ weeping; leaves scattered or in whorls of 3, linear or oblong-lanceolate, acute, flat or concave, 6-10 mm long; flowers cream-white, purplish in bud, in $\pm$ dense terminal heads, the axis not continuous; fruiting spikes $\pm$ dense, 10-16 mm long.

Another desirable shrub from the south west province of W.A. where it occurs in swampy habitats, *M. polygaloides* was introduced to C.B.G. in 1962. Only one specimen is at present established here and this has developed into a loosely spreading shrub 1 metre high. Its well-leaved branches are slender, somewhat arching and not dense. A few extra vigorous branches give the shrub a slightly irregular shape but light pruning only would be needed to control them. In spring the purplish buds followed by creamy white flowers enhance this attractive specimen.

Reaction to frost throughout the coldest winter nights consisted of leaf discoloration. In the early spring however, a number of tips were desiccated on the eastern side.

It would not be wise to make positive recommendations on the performance of one plant. This species, however, is at least worth a trial in the milder areas of Canberra. It would need a sheltered position and overhead protection on extra cold nights especially when young. Protection from the sun on frosty spring mornings is important also.

Melaleuca tenella Benth

(from *L. tenellus* = dainty or delicate, referring to the habit of this shrub).

A glabrous, slender, branched and spreading shrub with narrow linear, more or less acute leaves, 5-8 mm long and in whorls of 3; flowers white in dense oblong or shortly cylindrical terminal spikes on short young shoots, the axis continuous vegetatively after flowering; fruits in dense cylindrical spikes about 2.5 mm long.

This attractive shrub from the South West Province of Western Australia displays interesting horticultural potential. It is not well known in the Eastern States where its ease of propagation and early maturity should make it a valuable lawn or border subject.

The three mature specimens at the Gardens were grown from cutting material collected during a 1968 botanical trip to West Australia. They have developed very quickly into spreading shrubs about 1 metre high with very slender weeping branches. They vary in shape, the most interesting being more or less "fountain-like" due to its long branches arching from the centre in an almost regular manner with their tips reaching the ground. More irregular but still interesting, the other two specimens have fewer branches and tend to be rather one sided. The species has some affinity to *M. incana* R.Br. but is completely glabrous, has a lower, more spreading habit and narrower leaves in regular whorls of three. Its flower spikes, which terminate short leafy shoots, are much like those of *M. incana* but are pure white, not creamy-white as in that species, and in bud they display deeper red calyces contrasting well with the pale green bracts.

No frost damage was recorded during the cold winter of 1971, and none of the three specimens has overhead cover, although two are in fairly sheltered positions.

To make firm recommendations, more specimens should be grown over a longer period. This species however, seems to have a reasonable frost tolerance under C.B.G. conditions. It should grow satisfactorily in milder areas of Canberra and if given a warm sheltered position may succeed in other areas. Overhead protection is essential during very cold periods for immature plants.

The long slender branches of *M. tenella* suggest that it may be suitable for trellis work or training as a wall plant, where its weeping habit could be displayed to advantage.

Melaleuca viminea Lindl.

(from *L. vimineus* = having long flexible shoots as in Osier).

A tall glabrous shrub with virgate branches; leaves scattered, erect or recurved, narrow linear, flat or convex underneath, recurved towards the apex, 6-12 mm long; flowers small white, in terminal globular heads and mostly male of perfect flowers in cylindrical spikes, the axis continuous after flowering; fruiting spikes cylindrical, dense or interrupted.

This is a "sandy-swamp" species from the south west province of West Australia. It has been cultivated successfully here since 1963 and has proved to be an attractive foliage subject.

Most specimens are rounded dense shrubs 2-2.5 metres tall and 1-1.5 metres across. They are virgately branched almost to the ground and well clothed with distinctive bright yellowish green leaves. In form they are similar to the eastern *M. ericifolia*. They have, however, a more dense leafy appearance due to the imbricate but recurved leaves and the shorter internodes on the older branches.

The small but attractive flower spikes are produced from November to December adding to an already handsome appearance.

In normal winters frost damage is usually negligible but during the recent unusually cold winter some shrubs have sustained damaged young tips. *Several plants sustained tip damage on the eastern side due to hard frosts in late winter and early spring. This also was observed in other species. For the mild elevated areas of Canberra with a northerly aspect *M. viminea* has potential as a lawn specimen. To grow successfully in colder areas it would require a warm sheltered position and protection from frost on winter nights especially when young. Provision of some form of shelter on the eastern side is needed if late hard frosts occur.

* See introduction

The species does not require extensive pruning to maintain its neat appearance. Light pruning after flowering to avoid development of fruits and promote lateral growth would be sufficient.

Cultivation should present few problems. The most important factor is the provision of ample moisture during periods of high evaporation. Provision of a good mulch will aid in reducing evaporation rate and inhibit growth of competitive weeds.

Series VII—*Peltatae* Benth.

Leaves very small, often almost scale-like, more or less peltately attached, flowers small, in dense heads or spikes.

***Melaleuca micromera* Schau.**

(From Gk. *micro* = small and *merus* = parts. The species has minute leaves and small flower heads).

A tall shrub with very numerous, slender branches, and short branchlets covered with a close white tomentum often almost concealed by the minute leaves; leaves mostly in whorls of 3, $\pm$ closely appressed, ovate, scale-like but thick, peltately attached, rarely above 1 mm long; flowers, at least the male, small in globular terminal heads, the axis soon continuous during flowering; fruit-heads dense, globular; 8-12 mm diameter, the fruits open, 3-4 mm diameter, calyx lobes (sepals) persistent.

Four species belonging to the *Melaleuca* series, *Peltatae* are found in South West Province of Western Australia. One of these is *M. micromera* which occurs in the Stirling and Eyre districts and is the only representative of the series at C.B.G. Colour plate on page 92.

Three specimens of this attractive species are growing under varying degrees of shelter. Two are situated under tall tree cover and the third has a position near larger shrubs but with no overhead cover. All three specimens were introduced in 1962 as cuttings of the same clone.

The specimen in the more open position is now a very broadly spreading shrub 1.5 metres high and over 2 metres across. It is extremely dense with numerous slender branches that are closely covered with the minute more or less appressed, peltate leaves of the species. Many branches twist and curve creating the illusion of green braided cord with here and there a splash of white due to the dense tomentum. During Spring and early Summer, this attractive form has small but numerous yellow flower heads.

In contrast, a specimen in deep shaded conditions consists of a single thickened tortuous and more or less prostrate main stem about 1 metre long with several ascending branches towards its apex. There is no evidence of damage which may have resulted in this poor form and it can be assumed that close competition and shaded conditions are contributing factors.

No frost damage was observed during the winter of 1971 but even the less sheltered specimen is by no means in an exposed position. It would be imprudent, therefore, to recommend *M. micromera* for Canberra gardens in general at this stage. In areas where minimum grass temperatures remain above -7°C , however, it should grow well in a warm sheltered position. Extra overhead cover may be needed on very cold nights especially for young plants, but planting under dense tree cover is not recommended.

CONCLUSION

An attempt has been made to show how, with special care, some *Melaleuca* species can be grown in certain areas of Canberra and comparable areas elsewhere. It is possible that enterprising gardeners have tried these and other species and have found that they will grow successfully in areas considered too cold. Conversely species that have been suggested as suitable for certain areas may have failed. Cases such as this serve to demonstrate the extreme difficulty of assessing the tolerance or susceptibility of plants to climatic conditions of a general area, when many micro-variables are involved. However, it is hoped that this discussion has been of some interest and that it may have created an awareness of this interesting Genus.

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Photography by A. M. McWhirter

MELALEUCA MICROMERA

For a description and advice on cultivation of this attractive plant see page 91.

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