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The Growing of Wildflowers . . .

This is the theme of the whole volume starting with Issue No. 69.

The Growing of Wildflowers In Good Garden Conditions . . .

It is the last three words that are the concern of this issue.

However! A very important zone is the top layer of soil and this is the target of this issue. Just as we have provided ideal growing conditions for our plants, we have also provided ideal living conditions for the teeming populations of micro organisms that grow in association with our plants. These often get out of balance; or we destroy their ecological balance. Possibly the old English gardener controlled this area by his habit of shallow cultivation. As described later, we cannot do this as many of our plants have feeder roots near the surface. Anyway, if you are as lazy as I am you will not want to be bothered with weeding and cultivating.

The solution? Mulch heavily with gravel or coarse sand all over the garden to a depth of 5 cm. This will provide a neutral zone, reduce weed growth and preserve moisture. Gravel is the best and more permanent solution and if you cannot get enough, just have gravel mounded around the base of the plant to the extent of its main leaf canopy. If you use coarse sand you may have to replace it periodically around the plant, or in the area where a new plant is planted.

Select Suitable Species

There are hundreds of wildflowers suitable for your garden. Later issues will be more specific as to the species' names especially suited for your area. Meanwhile the issues of this volume have presented families of plants that are found throughout our continent.

The family of plants known as Myrtaceae:

Callistemon (Bottlebrushes) and *Melaleuca* — See issue No. 69.

The five-petalled Myrtaceae, some a little harder — See issue No. 70.

Eucalyptus — Our magnificent "gum" trees — All issues.

The family of plants known as Proteaceae:

Banksia and *Dryandra* — magnificent foliage plants — See issue No. 71.

Hakea, *Lambertia*, *Isopogon*, etc. — See issue No. 72.

Grevillea — some would say the easiest and best of all—See issue No. 73.

Herbaceous Plants — Reports needed for a future issue.

Plants for Dry Areas and the Desert — Reports needed.

COVER PLATE

Photography by P. Althofer

Grevillea johnsonii is a slender to spreading shrub 2-4 metres tall with narrow divisions of the leaves as shown in the photograph. It is closely related to *Grevillea longistyla* that has fewer, wider, leaflets. *Grevillea longistyla* is shown in colour on the cover of our No. 45 issue. It is more spectacular in flower, with larger and more numerous flowers, but *Grevillea johnsonii* is a more attractive shrub when not in flower. The typical flower of the *Grevillea* is shown in the colour plate, grouped in an inflorescence or head of flower which in this case stands up proudly. In a good plant these flowers are shown full size but they are more usually a little smaller.

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For details of the Society, membership of the Society see the inside rear cover.

Growing Wildflowers



"The growing of wildflowers is easy in good garden conditions if you select suitable species".

— The Editor. Some experienced horticulturalists would say that this statement was ill-advised and misleading. As all those who have had much experience with the cultivation of our wildflowers in their gardens know quite well, many are not easy and seem to die without obvious cause.

Good Garden Conditions

Even some experienced horticulturalists have asked what I mean by this. Over the 70 issues in the past we have concentrated mainly on above ground conditions of temperature, exposure, frost, etc., and only briefly on below ground conditions. The much worn statement of "a well drained soil" has been used for all but the hardiest of plants, except for plants that revel in bog conditions.

Ask an old English gardener what good garden conditions are. No doubt you will get a jumble of preferred conditions for the growing of his poppies, pansies or sweetpeas. This would include — an open, friable, rich, loamy soil — good drainage — good depth — constant moisture — plenty of available fertilizer — abundant large fat worms — protection from bleak conditions but plenty of sunlight.

These are good garden conditions?

For most plants, they are ideal garden conditions. No doubt the old English gardener will then start to qualify it for certain plants, such as: for roses the soil needs to be heavier than normal, for Rhododendron it needs . . .

I include a qualification in my statement by the term ". . . if you select suitable species. Quite obviously plants found in Darwin will not prosper in Melbourne. Further, plants that live in a bog or those that live in beach sand may not be suitable for 'good garden conditions', although there may be some surprises here.

However the "experts" have been hiding behind vague references of special conditions for each species of plant for too long. The objective of this series is to show that a very wide range of plants can in fact be grown in "good garden conditions".

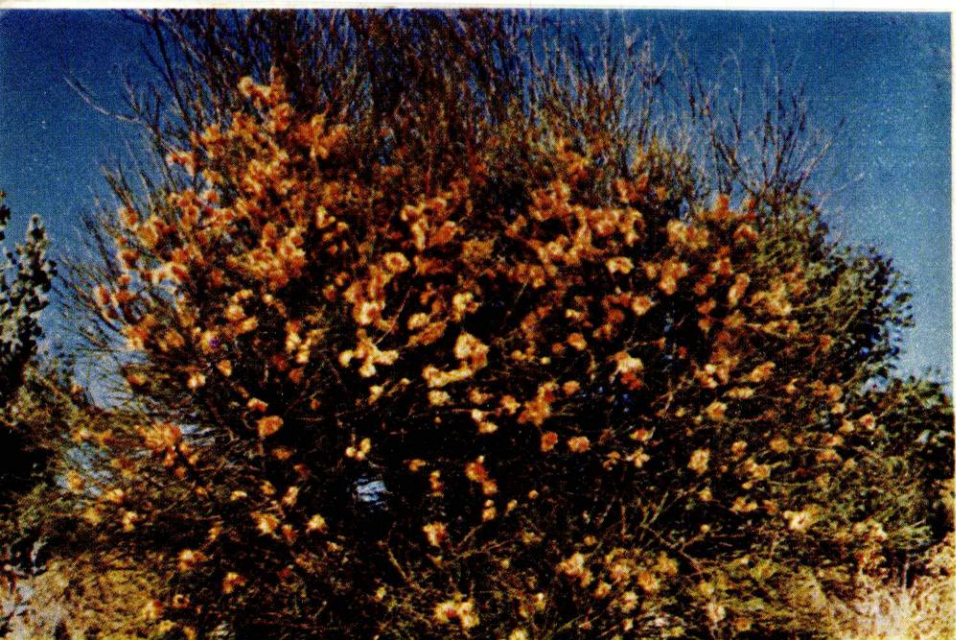
Given good garden conditions the floral display in your garden will be spectacular using a huge range of our Australian plants.

So Why Do They Die?

All plants die. Many only have a short life of productive abundance and then go back. If the plant has given you pleasure for three seasons then it could be all you should expect. Nature's way is often to remove old tired growth by fire, returning the nutrients to the soil as ash. You can "stand in" for nature by heavily pruning after flowering, encouraging new vigorous growth next season. Remember a good gardener is ruthless with the pruning shears or by wholesale replacement of plants after they have given of their best.

But! Our wildflowers in the garden do die unexpectedly without apparent reason. A major reason is that they get waterlogged, the roots get sodden, cannot breathe and die back. But we are talking about good garden conditions here so I cannot hide behind this excuse either.

Another reason is the health of the living space for the plant roots below ground level. This is the subject of our next issue.



Colour photography by Peter Althofer.

HAKEA PYCNONEURA

This large shrub is suitable for background planting in your garden, or as a feature specimen. There is a pink and a white flowered form as shown in the photographs above.



Colour photography by Peter Althofer.

ISOPOGON HETEROPHYLLUS

A beautiful small shrub for your garden typical of the many beautiful species of *Iso pogon* available. See page 150 for propagation.

Shrubbery Is Also Important — Select Suitable Species

This issue, as well as the one before it and the next one to follow, features plants in the family *Proteaceae*. These are ideal shrubbery plants even when not in flower. One member asked me — "Should we rename this periodical *Australian Flowers* and not *Australian Plants*. You show many beautiful flowers but what of the use of shrubbery, plant form, foliage and colour which are such an important aspect of any garden?"

It is true I have neglected to bring to notice the incredible range of foliage shapes and colours available. Go back to the last issue and see the foliage of the *Banksia* and *Dryandra* illustrated. The plants illustrated here will also grace your garden. What we really need is someone to record plant shapes and styles so we can plan a garden on plant form, foliage and colour alone. Who will offer to do this for us?

Healthy Living Space For Plants Beneath The Surface

One article in this issue examines aspects of root structures in the *Proteaceae*. It summarises the latest findings in this field and makes the following significant points (it is hoped that the author will forgive me for pre-empting his excellent article but I want to highlight certain aspects and encourage every reader to study it. Do not be discouraged by the apparent technical presentation. In this respect Byron Lamont has done a very fine job in presenting highly scientific research in such a readable, straight forward manner):

- (a) The previously recommended practice of adding soil from beneath adult *Banksias* to *Banksia* seedlings is not necessary — any organic matter will do. Previous claims of an essential fungal association called *mycorrhiza* whereby micro-organisms live sympathetically in the roots of *Proteaceae* such as *Telopea* (the Waratah) are not correct. The root structures being observed were, in fact, proteoid roots. Proteoid roots are dense bunches of small roots almost universally present in this family.
- (b) Research on proteoid roots does indicate that most species can adapt to regions with a different growing season from that to which they are native.
- (c) Fertilizing a garden containing plants that have adapted to the low nutrient levels of the garden soil may cause the plants to die. The proteoid root system may take up nutrients to toxic levels. Alternatively, a plant already growing in a high nutrient level soil will have short laterals and no proteoid roots but will not cope with dry periods.
- (d) Most *Proteaceae* will not tolerate soil disturbances beneath their canopy mainly because this is where most of the root system is located. The provision of a litter of leaves, bark and the like, on the soil and the absence of soil cultivation is the best method for the growing of Australian plants in general.
- (e) Seedlings should be propagated under similar water and nutrient conditions into which the plant is to be transferred.
- (f) A high nutrient status in soils and plants will greatly reduce flowering in the plants.

Wildflowers And Their Natural Growing Conditions

It has been my contention that the old adage "to grow wildflowers, observe their growing conditions in the wild and emulate these conditions in the garden" is misleading and usually leads to quite incorrect growing conditions. For a start how can an untrained observer evaluate growing conditions, especially those below ground?

This does not mean that I do not support the natural way to grow plants. I do not advocate the use of sprays against pests, preferring nature's way with birds and with their natural predators. However man has interfered with nature's cycle to such an extent that we need to give it a hand by adopting selective chemical and physical controls. See below.

I also support nature's way below ground. In the next issue, a leading authority on this aspect will present "growing plants in soils, nature's way".

Entomologists, Photographers and Pest Control

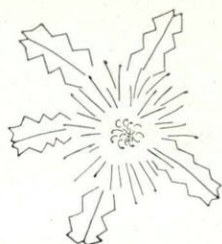
A series of articles concerning the life cycles of animals, pests??, and various creatures that live in association with plants is proposed. We shall ignore the major giant pests such as cats and humans and concentrate on the "wogs" that love and need our plants. In most cases we shall find that our plants need them.

Will any person with knowledge of these creatures and with facilities to take good colour photographs please start a photographic study of the life cycle of anything that moves. Advise the Editor if you wish to partake in this exciting study. There are no doubt many people who have already made a start and have good photographs. Let us all see them, published in full colour.

Help us all to live in harmony with the world around us.

I Grow Proteaceae

by Hazel Cole



As I have been quite successful in the growing of plants from seed, especially the *Proteaceae* which previously gave me trouble, my experiences will be of interest; also will be my methods of propagation by cuttings at the end of this article.

I no longer use bush sand in my potting mixture, as described in my article in Issue No. 46 of "Australian Plants". For sowing of seed I use three parts coarse river sand collected from an old stock pile on the banks of the Swan River, two parts of garden compost, and one part of a German peat. For a pricking mixture, i.e. a mixture for placing the small seedlings in, I use these materials in the ratio of 2:1:1 and for a potting-on mixture I use them in the ratio of 1:4:1, except that I use a sandy loam instead of peat for potting out. The sandy loam is from the granite soil of the Darling Range.

My garden compost would be 3 or 4 months old before using and I add no lime to the compost, only poultry manure. It is partially sterilised by pouring boiling water through earthenware pots full of the compost. The sand for making the compost is yellow sand from the subsoil in the garden. I have four heaps of compost, one in use, two maturing and one that I add material to. Each heap is turned over 2 or 3 times as it is moved along the line.

For the final potting-on mixture I sieve the compost through chicken wire. I have given up adding blood and bone to the mixtures, as the plants are fed with Osmocote at three-monthly intervals, the amount depending on the size of the plant.

I have no trouble growing *Banksia* now. I generally sow in April putting 2 or 3 seeds to each 7 cm square pot. The point of the seed is inserted into an angled slit in the potting mixture with the wing above surface. The pots are kept in a shallow plastic lined pool, which can be drained, under a sarlon shade cloth over the top and at the sides. They are protected from rain by covering with 2 sheets of P.V.C. They are watered by bottom irrigation until it is cooler and we have regular rain when they are moved into the open, unless they are still too small. I water by a hand held hose when necessary.

Water By Trickle Irrigation

Young banksias and especially dryandras 5-6 months old can be put out in the garden at the beginning of summer. They do well with trickle irrigation. My trickle irrigation system consists of 300 feet of 1/2 in. P.V.C. hose which surrounds the house (where the eaves prevent some of the rain from reaching the plants) and also covers a newly planted area. There are about 130 capillaries, one to each native plant, but some of these are in a section of garden where exotics grow and some of these plants have 2 capillaries each. The system is run direct from one tap with no pressure reducing valve, but with a filter. Young plants require 2 gallons a week in 2 applications of 1 gallon each. I calibrated the flow of water from the capillaries and thus know how many hours to leave the system operating per day. It has only been installed for one year and some of the plants doing well are *Boronia heterophylla*, *B. megastigma*, *Chamelaucium* sp., *Anigosanthus viridis*, *Dryandra praemorsa*, *Banksia media* and *Macropodia fuliginosa*.

*Editor's Note — It is reports such as these that we need. Here is a lady we can all be proud of. She has thought about what she is doing and come up with some original practical solutions. What is more, she is growing plants better than the experts. Why don't you read what she has done and join the fun?



HAKEA CUCULLATA

THE BUSH

An erect linear shrub up to 2 m. This plant grows on laterite soils in the Stirling Range of W.A. Leaves hug the stem and display the delicate pink flowers.

Photography by Peter Althofer

Hakea — Propagation and Cultivation

The seed is germinated in a similar manner to *Banksia* above. *Hakea* have proved quite successful over quite a range of species that include *H. laurina*, *H. ferruginea*, *H. circumalata*, *H. myrtoides*, *H. lehmanniana*, *H. invaginata*, *H. orthorrhyncha* and *H. multilineata*. For gardens in Perth I would recommend *H. laurina*, it grows quickly into a small tree 3.5 metres high, often with weeping branches, and is covered in red and cream pin-cushion flowers in May (see the colour plate in our last issue). *H. orthorrhyncha* is a more straggling shrub to 2.5 metres high, but is very showy when its bright red flowers cover the branches. *H. circumalata* is a spreading dense shrub about 0.6 metres high and has pink grevillea type flowers. I lost one plant (before it flowered) but have others started. Some hakeas that are germinating well this season (April-May, 1977) are *H. cucullata*, *H. scoparia*, *H. incrassata*, *H. obtusa* and *H. cinerea*. With *Hakea* it seems important not to pot on too soon, about 5-6 months.

Growing Dryandra

I still find *Dryandra* difficult. The only ones I have succeeded with are *D. praemorsa*, *D. pteridifolia*, *D. fraseri* and *D. nivea*. *D. praemorsa* is a shrub to 2½ metres. It flowers well in the Perth sand, but my plant is only a very young one. *D. pteridifolia* is a small shrub to 0.6 metres. It hides

HAKEA

CUCULLATA

THE FLOWER

Photography by
Peter Althofer



its flowers a little, but its value in the garden is the foliage. I planted in sandy loam from the Darling Ranges at the beginning of summer, but lost it towards the end of the summer (a very dry year). It would probably do better planted out in such a harsh environment at the beginning of winter, or else at the same time of year in the garden on trickle irrigation. *D. fraseri* makes a good ground cover. It flowers in Perth, but does not set seed. *D. nivea* is an attractive foliage ground cover plant, but I have had no flowers on the plant in the garden. It occurs in the heavier hills soil.

Grevillea — Propagation and Cultivation

Grevillea have proved difficult. I am now removing a small portion of the testa (the outer covering of the seed) from all *Grevillea* seed. Using a small knife with a scalloped edge, I remove a small portion of the testa halfway down the side of the seed, on the side ridge or just above it. They are then soaked in TMTD/80, a fungicidal drench, for at least one hour. I do not know the optimum time for soaking.

I did a rough germination experiment with *Grevillea drummondii* during the April, 1976 sowing season, sowing some seed that was not nicked as a control. I am measuring the percentage germination of an unidentified

Grevillea from the Hill River, both nicked and un-nicked seed. The nicked seed germinated quicker (in 4 weeks), but the experiment wants doing properly with a measurement of percentage germination. I hope to do this over the 1977 season. This method has also been successful with seed of *Agrostocrinum* and *Scaevola striata*, also *Dianella revoluta*.

Isopogon and Petrophile

Other proteaceae which are germinating are *Isopogon scabriusculus*, *I. teretifolius*, *Petrophile longifolia* and *P. ericifolia*. *Isopogon* and *Petrophile* have given good germination and include *Isopogon dubius*, *I. divergens* and *I. tripartitus* and *Petrophile anceps*. However, I have failed to keep them growing as soon as the hot weather comes. All were sown with a few seeds to a pot eliminating pricking out. The seed is sown direct without any prior treatment, pressed into the surface and covered with the same soil to a depth equal to the diameter of the seed.

Myrtaceae

I am having the same trouble with certain *Myrtaceae*, notably *Actinodium cunninghamii*, *Calytrix glutinosa*, *C. angulata*, *Beaufortia macrostemon*, *Eremaea beaufortioide* and *E. violaceae*. I do not know what the answer is to getting these plants through the summer in pots. Some ideas I shall try are to put them in a cooler spot such as in the house, water only from the bottom, feed with a solution I am using for cuttings (mentioned later) or spray regularly with a fungicide such as Benlate, Captan or Zineb.

Verticordia do not give me much trouble using fresh seed from plants in the garden. At the moment I have seven species baking in the hot summer sun, covered only with road metal. This is the method used by Bob Dixon of the Perth Zoological Gardens for *Verticordia grandis* and *Macropodia fuliginosa*. The pots are nearly filled with my normal potting medium, the fluffy *Verticordia* seed placed on top and then covered with a centimetre of road metal chips about 1/2 cm across.

Propagation By Cuttings

I no longer use plastic bags for cuttings but have the mixture, 3-4 parts of river sand to 1 part of peat, in a plastic container with holes in the bottom. I use 15 cm square ice-cream containers. These hold a lot more cuttings placed 2 cm apart. A plastic bag with a ventilation hole, is placed over the top supported by 2 wire loops, the ends being thrust into the container, one in each corner. The whole is stood in a shallow tray of water which can be replenished when necessary.

The position of the "boxes" is according to the season; in the bush house or with other shade in summer, and for cooler weather they are placed to receive morning sun.

The cuttings are soaked overnight in a mixture of Captan, Formula 20 and Maxicrop made up according to directions. I prefer to take cuttings from plants that have already been propagated by this method as these root comparatively easily. These include *Verticordia picta*, *Melaleuca fulgens*, *Rhagodia nutans* (grey form), *Correa reflexa*, prostrate *Eremophila* sp., *Grevillea obtusifolia*, *Hibbertia cunieformis*, *Brachysema latifolium*.

Even so I do have trouble with some species after potting up. The potted plant should be returned to a humid atmosphere and gradually acclimatised to normal conditions. If one is in too much of a hurry, the rooted cutting fails to grow. Where I know there is a high rate of strike, I often put one cutting per small container, 7 cm deep, 4 1/2 cm square at top, tapering to a small base, so that there is no disturbance during potting up when the roots form. The small plastic tubes are placed in the larger container, surrounded by some damp peat and covered as before.

I use the solution the cuttings have soaked in for watering them in after placing the cuttings in the medium.

Hakeas of Sydney

and the East Coastal Region

by Hugh P. Stacy

*"But we never know the worth of a thing
Until we have thrown it away".*

(Lines from "A Voice from the Bush", credited to Adam Lindsay Gordon.)

Introduction

The eastern hakeas described below represent a fine range of shrubs and small trees suitable for diverse purposes. Although their widespread presence across hillsides, gullies and heaths contributes much of that distinctive texture which characterises the east coast bushland, comparatively little effort has yet been made to cultivate them.

For many urban dwellers now no longer are these plants familiar, nor is the bush nearby. As some measure of care and concern for the seldom seen slowly replaces contempt for the plants once common, so the bush receding attracts far more attention, sometimes nostalgic from older people, often eager from the young. There is a growing interest in preservation which is seeking to hold what is left and awakening desires to re-establish what has gone. The wish need not be entirely forlorn: the bush can come back.

Those who would direct their efforts towards this objective should seek out the many indigenous plants and shrubs in their own region, observing their particular features and using them to advantage. Think form and foliage first, let flowers be a seasonal bonus. These hakeas are part of Australia's east coastal heritage; as such they can all help considerably in recreating an eastern bushland setting.

Awareness is the first necessity, catalysing a process by which observations can lead to knowledge and then to understanding. Hopefully the descriptions of these plants and their occurrence in the wild may facilitate a readier recognition of them, in order to foster a greater appreciation of their worth and usefulness in any bush garden. For plants well known can make plants well grown.

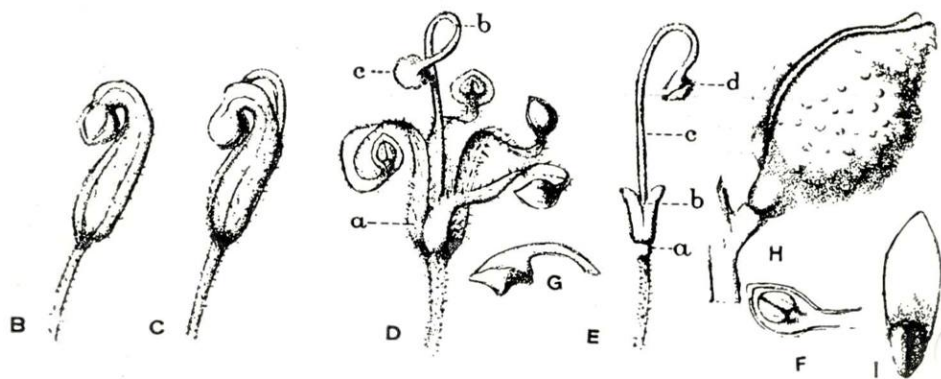
Propagation

As a rule it is unwise to pick last season's fruits when gathering seed. Those between two and four years old assure maturity yet avoid deterioration by rot or insect attack. Seed raising by means of a capillary bed has proved a reliable method for hakeas and other proteaceous species. Vermiculite or clean river sand about 25 mm deep is kept damp in a suitable tray, forming a bed on which seed punnets 50 mm deep are laid. Seed is placed with pointed end (from which the radicle grows) inclined down in a sterile medium such as vermiculite so that the kernel is covered, leaving the wing exposed. Warm surroundings and moisture rising by capillary action from the bed through holes in the bottom of the punnet is sufficient to germinate most eastern species within three or four weeks, although large seeds like *H. bakerana* or *H. constablei* may easily take twice as long.

Propagation from cuttings may well become more common should commercial demand exceed the supply of seed.



Colour photography by Hugh P. Stacy



HAKEA MACRAEANA

- B. Bud.
 C. Unopened flower.
 D. Opened flower showing—
 (a) four-lobed perianth, with sessile
 anthers in the concave tepals;
 (b) style;
 (c) stigma.
 E. Portion of flower (perianth removed),
 showing —
 (a) hypogynous gland;
 (b) ovary;
 (c) style;
 (d) pollen presenter;
 F. Anther.
 G. Stigma at centre of disc.
 H. Rugose fruit.
 I. Seed.

A shrub of attractive open habit to 3 or 4 m tall. This species is confined to scattered occurrences in the open forests on the far south coast of N.S.W. following the eastern slopes of the Divide from Bega northward to the Budawang Range.

For description of this plant see page 154.



Colour photography by Hugh P. Stacy

HAKEA PROPINQUA— A localised form from the Blue Mountains

***Hakea propinqua* species with needle leaves**

This is a plant of sandstone hillsides on the Woronora and Hornsby Plateaus and ridges of the Blue Mountains in the Sydney region. Within this area there are several diverse forms, while still more variation occurs along coast and Divide from the northern tablelands south to the Budawang Range. Marked differences show in growth habit, flowering time, flower colour and size of fruit. Where specific characteristics are quite consistent within a population of plants in a given locality, their seedlings may also show the same characters in cultivation. To what extent this is true is the subject of continuing experimentation.

Quite distinctive features typify two fine forms of *H. propinqua*. That south of Sydney becomes a shapely small tree to 3 m high x 3 m wide, with spreading limbs, smooth trunk, rich green pine-like foliage firm but hardly rigid, small off-white flowers in May and June and large near spherical follicles up to 5 cm diameter with rough surface swellings. High on the mountains this species is typically a bush up to 2 m tall with short rigid pungent foliage, having smaller fruits only 2.5 cm in diameter. Axillary flower clusters in early October are bright yellow, making the bushes appear as though sprinkled with gold dust. In mountain forms generally the young branches turn deep red.

Tiny flowers in numerous clusters of 6 to 10 along the leaf axils of the previous year's growth are subtended by villous pedicels about 3 mm long. Unopened a perianth measures 2 mm long, its curved tepals terminating in a globular limb bent over like a head bowed. These segments unroll free to one side before falling, the style then still remaining hooked and 3 mm long (about 4.5 mm if straightened); the carpel is glabrous, ovary sessile and pollen presenter straight (i.e., square to the axis of the style) and shaped as a flattened cone.

Seedlings of this species have proved very sensitive to damping off in humid conditions, particularly those of the yellow flowered mountain form. In Sydney late summer sowing is therefore recommended, together with a coarse sandy medium for potting up. While this propensity may be a factor in confining the species to open or sandy soils in the bush, cultivated plants are growing well in clay with good drainage.

Hakea macraeana— "Macrae's Hakea"

First collected by William Baeuerlen (whose name is given to the Chef's Cap Correa), this species was named after George Macrae of Braidwood, in recognition of assistance given to the original collector in his botanical travels. Although described by F. von Mueller in 1886 *H. macraeana* has remained virtually unknown, simply because circumstances have combined to cause its omission from the general botanical references currently available. It was included by Moore and Betche in "A Handbook of the Flora of New South Wales", published in 1893, and later well described and illustrated in Maiden's "Forest Flora of New South Wales". But its limited distribution misses the range of any of the recent books of Australian regional flora.

Yet *H. macraeana* certainly deserves attention. One of the finest of all the needle leaved hakeas, this handsome tree is confined to scattered occurrences in the open forests on the far south coast of N.S.W., following the eastern slopes of the Divide from Bega northward to the Budawang Range. It appears to thrive in poor soil in well drained situations at elevations up to about 500 m. Though seldom abundant, it can sometimes be found in woodland dominated by Spotted Gum (*Eucalyptus maculata*) and Burrawang (*Macrozamia communis*).

Typically a graceful shrub of attractive open habit growing to 3 or 4 m tall, in age occasionally becoming a rough barked tree with 30 cm bole reaching to a height of 7-8 m, this species always commands attention. A grove of them makes a magnificent sight as long leaves softly moving, shimmering slightly against the afternoon sun, send ripples of warmth across a deep green leafy sea . . .

Branches ascending from a single stem carry very long thin needle leaves (to 13 cm x 1 mm diameter) set at 45° to the branch. The mature dark green leaves are pungent, smooth, hairless and quite pliant, pointed tips 2.5 mm long being bent slightly downward. Numerous flowers in September are off-white, carried in groups up to 6 per axillary cluster. The flower parts are glabrous, pedicel measuring 7 mm, perianth 4 mm, style 9 mm (extended) but remaining curved and 6 mm long. Distinctive follicles are reddish-brown in colour, 4 cm long x 3 cm wide x 2.5 cm deep, having jowls prominently warty and nose reduced to a flat area 7 mm long x 5 mm thick with a small horn-like conical protuberance 2 mm high on each half of the fruit pointing at right angles to the suture. The flat area continues into a keel at the suture and is free of warty swellings.

As knowledge of this species in cultivation is negligible, the author's limited experience so far is reported here. Of a small batch of seed sown in Spring 1974 some germinated in a matter of days, more rapidly than any other hakeas under the same conditions, but the majority took three to four weeks. The young plants have proved quite hardy in Sydney's climate; small seedlings have not been prone to fungal attack in humid conditions, while potted plants are not over sensitive to drying out. From this batch four plants now three years old (September, 1977) are growing less than a mile apart, but in different situations. One has just flowered for the first time. Watered weekly twice after planting, they have since received a little supplementary water only during dry spells exceeding two months. Further details of these specimens are noted below.

EXAMPLES OF EARLY GROWTH OF *HAKEA MACRAEANA* IN SYDNEY

From seed sown In September, 1974

PLANT (1)

At planting 6 months old, 20 cm high, Autumn.
At 3 years 55 cm high x 50 cm wide. Healthy, with 2 stems.
Aspect Faces E, sheltered by tree to W. Open flat dry position.
Soil Shallow clay over sandstone rock.

PLANT (2)

At planting 12 months old, 30 cm high, Spring.
At 3 years 140 cm high x 60 cm wide. Balanced growth, single stem.
Aspect Sheltered, open to SW. Afternoon sun, less in Winter. Well drained slope to E.
Soil Coarse grey bush sand enriched with humus. Clay subsoil.

PLANT (3)

At planting 12 months old, 30 cm high, Spring.
At 3 years 165 cm high x 125 cm wide. Balanced growth, strong laterals from main and secondary stems. Flowered first in August, 1977.
Aspect Faces NW, $\frac{3}{4}$ sun. Sheltered for first year, now open. Bed raised 30 cm, fairly dry.
Soil Fine sand 60 cm deep over clay.

PLANT (4)

At planting 27 months old, 40 cm high, Midsummer.
At 3 years 75 cm high x 60 cm wide. Rapid new growth on main stem and laterals.
Aspect Raised bed; open position; full sun.
Soil Friable sandy loam 150 cm deep over clay.

Hakea teretifolia (synonym *H. pugioniformis*) "Dagger Hakea"

Why is it that, of the many terete leafed hakeas, this one is so named? The answer is not really that this was the first pin-leaf hakea discovered, but rather it was supposedly the first such banksia! As an unfortunate consequence of this apparent confusion, a far more distinctive name has perforce been abandoned after being accepted for over a century.

The story began in 1796, before the genus *Hakea* was separately defined in 1797, when the British botanist Salisbury named this species *Banksia teretifolia*. In accepting the many characteristics common to these related genera, the cylindrical leaf shape must have seemed to him the salient feature of this plant compared with the broad leaves of the several true banksias then known. He continued a process of seeking similarities rather than differences, for as early as 1788 the Finger Hakea too was first described as *Banksia dactyloides*.

In 1800 the Spanish botanist Cavanilles partly corrected this situation by reclaiming *Hakea dactyloides* from the banksias; then, unaware that the Dagger Hakea too had strayed, he quite independently called this species *H. pugioniformis*, referring to the dagger shaped folicle. Although the same publication included a description of *H. gibbosa*, showing that Cavanilles was familiar with both flat and needle leafed hakeas, he still chose names characterising the woody fruit, which had by then become recognised as typifying the genus. Not until 1916 were *Banksia teretifolia* and *Hakea pugioniformis* shown to be the same plant; the present name *H. teretifolia* was then adopted automatically.

An angular bush seldom exceeding 2 m in height, it seems to favour damp depressions, shallow heath or verges of marshland. Smooth grey-green leaves may be up to 10 cm long, consistently much shorter in some forms. New growth in Spring produces yellowish stems with white axillary flowers in profusion during December, each cluster emerging from an involucre of prominent brown deciduous bracts. Long narrow fruits 3 cm x 0.5 cm, sharply pointed and hilted, closely resemble a dagger.

Abundant on the east coast of Victoria and along coast and mountains of N.S.W., the species is adaptable to wet or dry conditions. Despite its natural preference for damp places, it has proved extremely hardy in Sydney, growing sturdily to 2 m in five years in shallow sand over a dry sandstone shelf.

H. teretifolia is a reliable shrub with open foliage, its shape and flowering being improved by consistent tip-pruning while young. Also useful for background planting in competition, it can generally be relied upon for Christmas flowers after the third season.



Colour photography by Hugh P. Stacy

HAKEA GIBBOSA

Hakea gibbosa (synonym *H. pubescens*) "Hairy Hakea"

This dense compact bush to 2 m high is a haven for small nesting birds. Young needle leaves and stems are thickly covered by long silky hairs. Flowers in clusters of no more than four occur profusely in June along the previous year's growth, with styles 10 mm long, perianths 5-6 mm, both yellowish cream. Axillary pedicels 3-5 mm long are dressed with soft grey downy pubescence. Beaked fruits to 3 cm diameter split open sideways like a book, whereas other hakea fruits open lengthwise from the base.

Plants grow naturally on coastal heaths and adjacent plateaus, whether sandstone or heavy soil, favouring damp conditions. Young plants in cultivation require regular watering, gradually becoming more tolerant of dry periods. With mature foliage of unusual grey-green appearance due to hairiness, this species is particularly attractive in late Spring when soft new shoots carry hues of pale grey and pink.

In cultivation interstate it remains well known by the former name *H. pubescens*, which was perhaps more descriptive of its general appearance than the specific name now accepted (Latin *gibbus* = a hump, whence *gibbosus* = humped, hunchbacked; presumably referring to the shape of the follicle which is greatly swollen on one side of the seed cavity, this side becoming a hinge as the valves split open).

This species is quite consistent in form throughout its coastal range in the Sydney region. Specimens from northern N.S.W. and Queensland at present called *H. gibbosa* show marked differences and deserve further study.

Hakea sericea "Needle Bush", "Silky Hakea", "Bushy Needlewood"

This hardy small tree, usually no more than 3 m tall, with divergent leaves and angular branches, is common on coastal areas of N.S.W. and

the most widely distributed species of hakea in Victoria. Flowers massed in leaf axils of previous year's growth appear regularly in early Spring (mid August in Sydney), up to 1 cm long, usually white. A population of pink flowered plants from the far south coast of N.S.W. has so far provided seedlings with the same characteristics for two generations in Sydney. Fruits 2.5 cm dia. x 3 cm long are generally rough with pronounced jowls and sharply pointed beak, and, when open, show two more-or-less equal layers of wood (the outer one paler) opposite the seed cavity. Bushes can be improved in shape by tip pruning when young and may flower in the third season.

As flowers come only once annually and generally keep closely to season, hybridisation among wild hakeas does not often occur. Sometimes the flowering period of *H. sericea* may overlap a few late flowers of *H. gibbosa*, or very early ones of *H. teretifolia*. Since these species often grow together, natural hybrids may occasionally be found.

Hakea constablei

This interesting species bears the name of E. Constable, botanical collector for Sydney's Botanic Gardens at the time, who brought it to the attention of botanists there in 1950. (It is interesting to note that these Botanic Gardens did not become "Royal" until the visit of Queen Elizabeth II in 1953.) Constable's type specimen was described by Dr. L. A. S. Johnson in 1962, although an earlier example of this species, gathered by Maiden in 1899, was found amongst a collection of *H. propinqua*.

Found naturally in only a few places in the Blue Mountains, these plants grow to 3 m high in rocky exposed conditions at 1000 m elevation, apparently relying on mountain mists for much of their moisture requirement. Terete leaves are up to 10 cm long, smooth, thick, deep green. Young stems, covered with fine hairs, burst forth new shoots as rich cream flowers (unopened perianths tinged green) open in clusters in early October on previous year's growth. Fruits, which take up to two years to mature, finally measuring 5 cm wide x 5 cm long from base to tip x 3 cm deep, are blunt, black and very rough.

In cultivation at lower altitudes a well drained sunny position is desirable, with supplementary watering through the summer months; taller shrubs than in the wild are likely. This is a fine bush of robust appearance which grows easily, though more reliably in a mountain climate.

Observations suggest that this species may not readily regenerate after fire, which could account for its very limited distribution. Apparent failure of seed to germinate after burning has been noticed too with *H. bakerana*, which suggests the possibility that species with very large fruits may be particularly sensitive in this regard.

Hakea bakerana

This beautiful small shrub was featured in a previous article (q.v. Australian Plants, Vol. 8: 67, pp. 295-6). See page 167 for propagation. Its foliage provides useful low cover, the fresh bright green appearance thoroughly enjoyable in its own right until large pink flowers reward the patient grower after seven years or so.

Hakea microcarpa "Small Fruit Hakea"

A small shrub growing in wet places in highland to subalpine areas, this species follows the Divide from eastern Victoria into southern N.S.W., misses the Blue Mountains and recurs in Northern N.S.W. and Queensland.

The leaves are pungent pointed and dull green, varying from quite flat and linear to terete, sometimes on the same plant. Tiny fruits typically 5 mm wide x 10 mm long, are carried on pedicels 5 mm long, and open in early spring. Flowers appear in November-December.

SPECIES WITH FLAT LEAVES

Hakea dactyloides "Finger Hakea"

Although capable of becoming a sparse tree to 6 m tall in competition on sandstone hillsides, this adaptable species grows more compactly in the open. Brilliant golden bronze new foliage in late Spring is particularly outstanding on plants growing in heavier soil under full sun. Profuse flower clusters in September are usually white, though sometimes one tree in a group may have flowers clearly tinged pale pink. Perianths are glabrous, pedicels pubescent. Fruits vary in shape from ovate to almost globular, 12-25 mm diameter to 35 mm long, smooth or slightly rough. Leaves are flat, dull, pale green with three (or more) prominent longitudinal veins.

This plant adapts to dry conditions by developing several xeromorphic characteristics to limit water loss. Understanding these changes is necessary before a fair assessment can be made of the plant's potential in cultivation. As *H. dactyloides* occurs widespread across the Sydney region from coast to mountains, often surviving in very tough terrain, many specimens show signs of deprivation. Yet too often it is by their appearance alone that the species is judged. To know a little of how these plants survive is to appreciate them better, sufficient to wonder at the boundless energy of Nature; the will to live is not peculiar to man alone, nor is the ability to live within available means.

In difficult circumstances, as in hard times, frugal living is a matter of necessity. These plants economise on their water requirements by producing fewer leaves, arranged spirally around the stem to minimise air resistance and with edges presented vertically to the light. Remarkable changes occur in cellular structures in the leaf laminae which all help to control transpiration. Older leaves become tougher, quite leathery in texture as sclerification spreads across the mid region under the influence of wind and sun. These thick-walled cells slow down transpiration by reducing the very intercellular spaces within the leaf which are concerned with this process. At the same time the stomates, or perforations through which the leaf breathes, become less effective as they sink deeply below the surface. By contrast, no such cellular thickening is found at all in young leaves up to the stage of maturity, while it is rare in plants growing in shade.

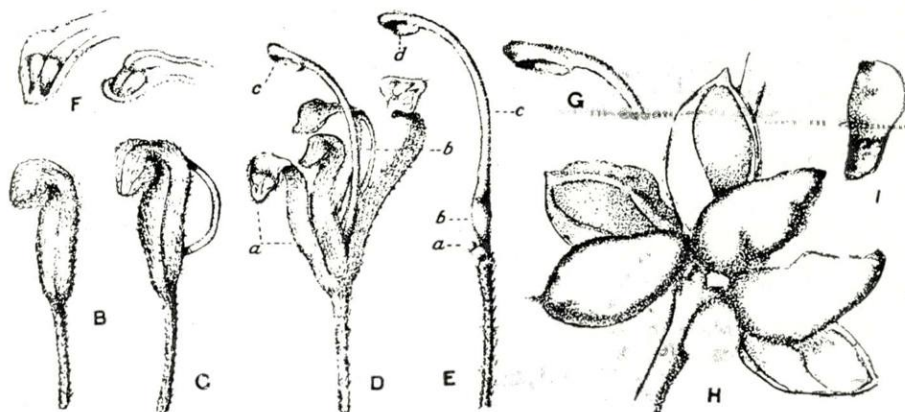
H. dactyloides makes a handsome shrub in a well drained position, responding duly to good soil and adequate moisture. While it can readily be pruned to shape, this is seldom necessary in open sunny conditions which are conducive to better form and heavy flowering. Although it can be one of the most reliable hakeas, suitable for almost any situation other than a bog, its hardiness should not be taken for granted. Hakeas generally are not naturally good drought resistant plants, nor is this one an exception. Any ability to endure dry spells (let alone drought) is slowly developed by each individual within its environment; it is quite unrealistic to expect, for example, nursery grown stock to adapt overnight.

The common name is intriguing, as there is nothing about the plant at all resembling a finger, either in shape or behaviour. J. H. Maiden suggested that the name *dactyloides* is derived from two Greek words: *dactylis* = a long grape like a finger, and *oidos* = like. As it seems unlikely that Gaertner would have mixed Greek and Latin roots when naming the species, the usual assumption that the name derives from the Latin word *dactylus* (a poetical term for a metrical foot having one long and two short syllables, like the bones of a finger, itself arising from the Greek word *daktulos* = a finger) may not be correct. Maiden also noted that Gaertner's original description contains an illustration showing fruits which are "... clustered together like grapes, and are somewhat elongated." Since the habit of forming fruit in bunches is more common with this species than most, the specific name may be a classical paraphrase of the grape variety known as "Lady's Finger". Perhaps it might be called, with more meaning, the "Finger Grape Hakea".

Hakea eriantha "Tree Hakea"

H. eriantha, like *H. dactyloides*, grows tall in the forest, but forms a well shaped bush in the open, seldom exceeding a height of 3 m anywhere in New South Wales. Although in eastern Victoria sturdy specimens to 7 m sometimes are found, Maiden claimed that he had "... never seen it more than 10 feet, with 3" to 4" trunk." In N.S.W. at least the common name Tree Hakea is quite misleading; generally for cultivation it is a shrub, not a tree.

To call it "Woolly Flowered Hakea" would be more appropriate, in that the white flowers are unusually fleecy. The specific name is derived from two Greek words: *erion* = wool and *anthos* = a flower. Perianth, limb and pedicel are all dressed with silky hairs, formed in very short racemes or virtually sessile clusters. During September the flowers open, showing a pollen presenter almost lateral to the style. Rather elongated fruits measure 3 cm long x 2 cm wide, with smooth dull-brown surface covering a slightly bulbous base, waisted middle and upturned pointed nose becoming blunt.



B. Bud.

C. Unopened flower.

D. Opened flower showing —

(a) four-lobed perianth, the tepals with acute recurved points, with sessile anthers in the concave tepals;

(b) style;

(c) pollen presenter.

E. Portion of flower (perianth removed), showing —

(a) Hypogynous gland;

(b) stipe; ovary;

(c) style;

(d) stigma.

F. Anther.

G. Lateral pollen presenter.

H. Fruits.

I. Seed.

Typical coastal forms have narrow lanceolate leaves fresh to dark green in colour, 8-14 cm x 1 cm, pointed but not pungent, flat, with only the mid vein faintly visible. The foliage is a feature of these bushes, neither dense nor sparse, but open enough to allow light to penetrate easily. Leaf surfaces semi lustrous both sides readily reflect in ever changing patterns the play of sun and shadow, wind and rain.

Ranging from south east Queensland across the northern tablelands of N.S.W., following the coast southwards to be widespread in north eastern Victoria, this species completely bypasses the Sydney region. (Was it drowned perhaps by the rising seas some 13,000 years ago?) Wild plants generally favour cold and exposed conditions, whether near sea front or on mountain side, often growing in poor soil or rocky places. Whereas some widely distributed species have evolved local forms well suited to particular conditions which may not succeed elsewhere, generally the very fact of existence over a wide range is of itself a fair indication of adaptability. Certainly *H. eriantha* is a hardy plant which has proved reliable and rewarding in most conditions and soils.

Hakea salicifolia (synonym *H. saligna*) "Willow Leaf Hakea"

This handsome small tree 3-4 m tall frequents the moist slopes and valleys of the Blue Mountains and watercourses of the coastal region. Leaves are smooth, flat, dark green, 5-12 cm long, broad and spreading on mountain forms, narrow and upright on coastal creeks where plants spill seed regularly in summer. Beaked fruits are relatively smooth surfaced with very thin valves where summer conditions are dry, otherwise prominently warty and larger throughout, 2.5 cm long and up to 2 cm broad. As young plants grown from seed of narrow leaved coastal specimens do not seem distinguishable from others (the leaves being broader and set wider apart), these differences appear to be due to environmental response when the species must adapt to harsher than normal conditions.

In September greenish cream flowers open, the clusters 2 cm diameter having 16 or so flowers in each. Slender glabrous pedicels are greenish yellow, 7 mm long, emanating from a tiny hairy rachis. The perianth too is glabrous, 4 mm long, very revolute under the limb. Styles 7 mm (extended) remain curved, 4 mm long, topped by a large convex pollen presenter laterally placed (parallel to the axis of the style). The sessile ovary is red-brown.

Although this splendid ornamental shrub prefers full sun with a rich or heavy soil and reliable moisture, its ability to tolerate dry periods greatly extends its usefulness in cultivation.

Hakea ulicina "Furze Hakea"

This shrub, seldom reaching 3 m tall, grows as far west as the Mt. Lofty Range near Adelaide, is widespread on sandy heaths across southern Victoria and occurs on the far south coast of N.S.W. Leaf shape varies considerably, being triangular in section and measuring only about 1 mm wide in the Mt. Lofty form; growing up to 14 mm broad in the Ninety Mile Desert; becoming narrow linear, 2 mm wide up to 20 cm long in forests east of Melbourne; then broadening to 3 mm x 7 cm long near Eden. In most forms the leaves are gently curved, set at right angles to the stem and tapered gradually to pungent tips. Particularly noticeable in broader leaved forms is that the petioles are twisted so that the leaf laminae lie parallel, a mechanism to reduce water loss by turning the leaves edge on to the sun.

Short divaricate branches from a single stem give good cover, interweaving to provide mutual support for plants growing together in thickets on windy heathlands. In the open forest *H. ulicina* grows bushy, with its fresh foliage a brilliant emerald green. Small white flowers form dense axillary clusters late in Spring, both perianth and pedicel being glabrous, the former 2 to 2.5 mm long with style twice that length. Pale grey-brown fruits are often found clustered together, virtually sessile in the axils, measuring to 2 cm long x 12 mm broad. These fruits are characterised by a relatively smooth external surface which is generally rather lustrous (particularly in forest forms), and which tapers to a slightly upturned point.

In cultivation the Victorian forest form grows slowly in a light sandy loam with good drainage, but may need extra water during extended dry periods. While this form has most attractive foliage, the South Australian form is proving hardier, and may adapt better in heavier soils.

Cultivation Of Hakea

All these hakeas are sun-loving and reasonably hardy once established, while some grow well as forest understorey. Most are shallow rooted, depending on mutual protection and support from neighbouring plants. For this reason hakeas are better suited for group plantings than as specimen shrubs. Yet those growing in open conditions tend to be bushier than their taller counterparts in competition. Shape is improved by tip pruning (particularly where height limitation will resist wind damage, or where bushy growth is preferred), before seedlings are 30 cm high, and then again early in each growing season.



Proteoid Roots

Root Systems in the Family Proteaceae and their relevance to Horticulture

by Dr. Byron Lamont, Department of Biology, W.A. Institute of Technology 6102

Summary

Most of the Australian members of the *Proteaceae* produce dense bunches of rootlets called proteoid roots. Their production is dependent on soil micro-organisms, low levels of inorganic nutrients and moist soil. They are ephemeral, new proteoid roots forming throughout the growing season, especially just beneath the soil surface. In highly impoverished soils these roots enhance uptake of water and nutrients available from the decomposing litter. In fertile soils they probably increase drought tolerance on the one hand, but may cause the plant to take up nutrients to toxic levels on the other. The absence of proteoid roots on a plant indicates that it is young, or has been grown under high nutrient conditions for that species, suggesting that it may not thrive in the garden.

Introduction

Without doubt the family *Proteaceae*, along with the *Myrtaceae*, *Mimosaceae* and *Fabaceae*, dominate the Australian flora, especially on the poorer soils in areas with a moderate rainfall, often having a hot, dry summer. In trying to understand how members of this family cope with highly impoverished soils and long summer droughts, researchers have shown that many species have an unusually high capacity to (a) absorb water and nutrients from soils deficient in them, (b) utilize and reuse nutrients once inside the plant, and (c) prevent loss of water and nutrients from the plant to the surrounding air and soil.

Interest in the possible mechanism of water and nutrient absorption by members of the *Proteaceae* was stimulated in 1960 when Helen Purnell of Victoria reported the existence of dense clusters of rootlets, which she termed 'proteoid' roots, in eleven genera of this family. The list has now been extended to 203 species in 30 genera (Table 1). Note, however, that no species in *Persoonia* (and its close relatives *Acidonia* and *Pycnonia*), *Agastachys* and *Symphionema* has yet been found to bear proteoid roots.

Structure of Proteoid Roots

Proteoid roots may be less than a cm long and 0.5 cm wide up to 20 cm long and over 5 cm wide. Each proteoid root is made up of hundreds, even thousands, of rootlets. Each rootlet in turn is covered with hundreds of root hairs, often right up to the tip of the rootlet. As a consequence, proteoid roots cling tightly to soil and litter particles, and their surface area is much greater than the normal (non-proteoid) roots on an equal weight basis.

In the *Proteaceae*, new season's roots arise adventitiously from old roots, the root stock or base of stems, rather than as resumed growth from the tips of roots formed in the previous growing season. Proteoid roots of such genera as *Hakea* and *Telopea* are produced at intervals along the

AUSTRALIAN MEMBERS OF THE PROTEACEAE WHICH PRODUCE PROTEOID ROOTS — TABLE 1

GENUS	TRIBE*	HABITAT	NUMBER OF SPECIES EXAMINED	SPECIES PRESENT	REFERENCES
<i>Acridonia</i>	Persoonieae	Heath → woodland	2	0	A
<i>Adenanthos</i>	Conospermeae	Scrub → woodland	1	5	A, B
<i>Agastachys</i>	Conospermeae	Forest	1	0	Q
<i>Banksia</i>	Banksiae	Heath → forest	16	16	A, B, D, E, F, G, H, I, J
<i>Bellenden</i>	Bellendeneae	Subalpine heath	1	1	K
<i>Buckinghamia</i>	Embothrieae	Rain forest	1	1	F
<i>Cenarrhenes</i>	Conospermeae	Forest	1	1	Q
<i>Conospermum</i>	Conospermeae	Heath → woodland	9	9	A, B, F
<i>Darlingia</i>	Knightrieae	Rain forest	1	1	F
<i>Dryandra</i>	Banksiae	Heath → forest	6	6	A
<i>Franklandia</i>	Franklandieae	Scrub	1	1	A
<i>Grevillea</i>	Grevilleae	Heath → rain forest	41	41	A, B, F, R
<i>Hakea</i>	Grevilleae	Heath → forest	80	80	A, B, D, E, L, M, N, O, P
<i>Hellcia</i>	Hellcleae	Forest	1	1	*
<i>Hicksbeachia</i>	Brableae	Rain forest	1	1	F
<i>Isopogon</i>	Conospermeae	Heath → forest	9	9	A, B, E, F
<i>Lambertia</i>	Macadamieae	Scrub	2	2	A, E
<i>Lomatia</i>	Embothrieae	Heath → forest	5	5	B, F
<i>Macadamia</i>	Macadamieae	Rain forest	2	2	F
<i>Neorites</i>	Orliteae	Rain forest	1	1	*
<i>Oreocallis</i>	Embothrieae	Rain forest	1	1	F
<i>Orlites</i>	Orliteae	Heath → rain forest	3	3	B, F, K
<i>Persoonia</i>	Persoonieae	Scrub → forest	9	0	A, B, F
<i>Petrophile</i>	Conospermeae	Heath → forest	3	3	A, B, E
<i>Pycnonia</i>	Persoonieae	Scrub → forest	4	0	A
<i>Sphalmium</i>	Sphamieae	Rain forest	1	1	F, *
<i>Stenocarpus</i>	Embothrieae	Rain forest	2	2	F
<i>Stirlingia</i>	Conospermeae	Woodland	1	1	A
<i>Strangia</i>	Embothrieae	Scrub → forest	2	2	A, Q
<i>Symphonema</i>	Conospermeae	Forest	1	0	F
<i>Synaphea</i>	Conospermeae	Heath → forest	1	1	A
<i>Telopea</i>	Embothrieae	Forest	3	3	B, F
<i>Xylomelum</i>	Hellcleae	Scrub → forest	3	3	A, F, Q

*Johnson and Briggs (1975)

A — Lamont, 1974; B — Purnell, 1960; C — Lamont, unpub.; D — Grudon, 1972; E — Siddiqui, 1971; F — Pathmaranee, 1974; G — Lamont, 1973b; H — Malajczuk and Bowen, 1974; I — Groves, 1964; J — Jeffrey, 1967; K — Rao, 1971; L — Lamont, 1972a; M — Beadle, 1968; N — Bayliss, 1972; O — Hocking and Thomas, 1974; P — Bradhurst, 1954; Q — Lee (nee Purnell), pers. comm.; R — Moore and Keralitis, 1966.

new roots, with most of the root remaining non-proteoid. On the other hand, in *Banksia* and *Dryandra*, many of the new root branches may be almost entirely proteoid, giving a very dense mat of roots and rootlets near the soil surface which can be mistaken for a continuation of the litter layer. The proteoid rootlets begin to dry up after two or three months, new proteoid roots forming elsewhere in the soil during the same or the next growing season.

Relationship with Soil Micro-organisms

Despite much early speculation that proteoid roots were a type of fungal symbiosis, called mycorrhizas, it is now clear that this is not so. In fact, *Proteaceae* is one of the few families for which there is no record of micro-organisms living symbiotically in the roots of any of its members. On the other hand, proteoid roots do not form under sterile conditions. Recent evidence suggests bacteria living near (but not in) a growing root provide it with a particular growth factor necessary for the initiation of proteoid rootlets. While the bacteria responsible have not yet been isolated, they are unlikely to be specific for certain species nor restricted to certain soils. For this reason it is hard to justify the common practice of adding soil from beneath adult *Banksia* to *Banksia* seedlings, except as a source of humus — you can be sure the necessary micro-organisms are already present in the soil mix, unless you are using pure sand, when addition of any organic matter (provided it is not high in nutrients) would do.

Water and Proteoid Root Formation

Proteoid roots may contribute over half the weight of the root system, depending on the species and certain environmental factors. Because of the high nutrient content of most seeds in the *Proteaceae*, the seedlings do not rely on external supplies of nutrients in the first few months, and it is interesting to note that the root systems also lack proteoid roots at this stage. Under mediterranean conditions, proteoid roots only form following substantial autumn rains and cease formation by late spring, as with the rest of the root system. However, if the plants are watered regularly during the dry summer they will often form new proteoid roots (though this practice may encourage build-up of pathogenic soil micro-organisms which attack the roots). It does mean, however, that most species can adapt to regions with a different growing season from that to which they are native. It should be added that the soil need not be well-aerated to promote proteoid root formation, their concentration often being higher in mildly waterlogged soil than in barely moist soil. But, of course, sensitivity to water status varies between species: for example, in New South Wales, Yaeesh Siddiqi found sand that was very moist fostered root growth of *Banksia ericifolia*, but suppressed root growth of *Banksia serratifolia*.

Nutrients and Proteoid Root Formation

Plants growing in sands and laterites lacking humus generally have *less* proteoid roots than those in sandy loams, which in turn have *more* proteoid roots than those in humus-rich loams and clay-loams. This is because proteoid root production reaches its peak at much lower levels of nutrients (especially nitrogen, phosphorus and sulphur) than the peak for normal roots. In fact, for nutrient levels at which plant growth is a maximum (which is generally at a concentration far below that in other families anyway), proteoid roots may be absent altogether. You can be sure absence of proteoid roots on plants which are more than nine months old indicates they have been grown under excessively high nutrient levels (or nutrient imbalance) for that species. Further, you can anticipate that the plant will have short, weak laterals and not cope very well with dry periods. On the other hand, the plant will be 'pre-adapted' to nutrient-rich soils, in that it will not take up nutrients to toxic levels as it would if proteoid roots were abundant — a major reason for the death of adult plants, which already have proteoid roots, when the garden is fertilized.

Distribution Through the Soil

Generally, proteoid roots are concentrated in the uppermost soil horizon of decomposing litter, while non-proteoid roots are concentrated just beneath, in the humus layer. Since the upper 15 cm of soil therefore accounts for the 'feeder' part of the root system it is understandable why most members of the *Proteaceae* cannot tolerate any soil disturbance beneath their canopies. However, proteoid roots have been found down to depths of 70 cm. Both root types are most abundant within the plant canopy, such that its own litter is a major source of nutrients for the plant's roots. Small pockets of humus-rich soil anywhere in the soil profile (but usually at the surface) stimulate production of proteoid roots more than normal roots. This effect is probably due to the higher nitrogen availability and microbial activity of such regions.

Function of Proteoid Roots

That proteoid roots give the plants bearing them a competitive advantage for water and nutrients in nature has appealed to researchers on the following grounds: (a) their very large absorptive surface compared with normal roots, (b) their abundance only under conditions of extreme nitrogen and/or phosphorus deficiency and their absence altogether at quite moderate nutrient levels, and (c) their virtual restriction to the surface soil horizons where nutrient accumulation and release is greatest. Because drier soils

stimulate the formation of root hairs more than wet soils, it has been suggested that proteoid roots may be more efficient in many situations than mycorrhizas* which only form slowly and on roots with few root hairs. In fact, a number of studies have now shown that proteoid roots may absorb up to more than five times the amount of phosphate, perhaps the most deficient nutrient in Australia, as normal roots.

It is true that in very deficient soils, seedlings with proteoid roots may be much larger than those without them. However, as indicated earlier, most proteaceous species do not have a high demand for nutrients. This means that even in moderately-fertile soils, normal roots can generally take up more than sufficient nutrients to produce optimum growth. In other words, there can be no guarantee that a plant will grow better because it has many, rather than few, proteoid roots — it may simply be a 'symptom' of its having grown in nutrient-deficient soil or random variation between plants. Ideally, seedlings should be propagated under similar water and nutrient conditions into which the plant is to be transferred — a high nutrient plant in a sandy soil increases the risk of death through inadequate water uptake, a low nutrient plant in a rich soil increases the risk of death through involuntary nutrient uptake to toxic levels. It is also worth noting that high nutrient status plants do not flower well. One of the safest and most beneficial additions to plants in the Proteaceae is a surface mulch of such organic matter as shavings, sawdust, humus, litter, peat and bark into which both proteoid and normal roots will grow vigorously. Light fertilizing of the mulch, *especially if the fertilizer is low in, or lacks, phosphates* (to which proteoid roots are particularly sensitive) will have to be considered in relation to the existing nutrient status of the soil and the plant, and how much artificial watering is available.

* Symbiotic fungal associations with roots.

References to Proteaceae in Australian Plants

The Ecology of the Australian Proteaceae With Implications For Their Cultivation, by Byron Lamont — Vol. 7, Page 47.

Proteaceae — The *Hakea sulcata* group by Byron Lamont — Vol. 8, Page 297.



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Grow from Seed — 3

A Review of Propagating Methods by the Editor

The direct planting method is the best for large seed, i.e. one seed per small container. There are available small 3 cm plastic pots that do not take up much room. This applies especially to *Proteaceae* (Vol. 3:252). Their roots are very brittle and if you use "Jiffy Potts", or some other fibrous pot that will let the root go through the bottom, you can plant direct into larger pots after germination. A simple method is to use the wells in some types of egg-cartons, with a hole in the bottom to be sure the root goes straight down. These cartons will need to be supported in a tray of sand, as repeated watering makes them very weak.

Flat seed, such as *Banksia*, *Dryandra*, *Hakea*, etc., may be stood up with the embryo below the surface and the wing sticking out from the sand. They germinate quite well lying down (Vol. 3:25, Vol. 5:156).

With pointed grass-like seed, such as *Calytrix*, one of the difficult *Myrtaceae* mentioned last issue, put them point down with the fluffy tails hanging out.

Watering the Seed

I use the method described last issue, with the plastic pots standing in a tray of water. The level is kept down, so that the surface is just moist. Probably the best method is to fill the water-tray once a day for a period of five minutes only, leaving it dry for the rest of the time.

A method of keeping seed-pots moist automatically, that has been quite successful, is described in Vol. 5:260.

With *Proteaceae*, be careful not to get the surface too moist, "just moist almost to the point of dryness" (Vol. 5:356).

Watering from above seems to be confined to boxes (Vol. 7:96).

I use water direct from a tap. Boiling water will reduce algae infestation.

The Seedlings

The main enemy is fungi attacking the stem where it enters the ground. Spray with a fungicide such as Captan fortnightly. The drier the soil or sand is at this point the better. When they are planted out I top my pots up with sun-bleached sand. The practice of using gravel is a good one (Vol. 6:309, Vol. 7:96).

Losses also occur when the seedlings are planted out, or if germinated in pots individually, when they have four leaves and need sustenance from the outside. Spraying with a mixture of a foliage-ingesting fertilizer, such as Aquasol, and a fungicide will reduce losses.

Potting On

The previous recommendations apply. Sanitisation of the soil would be necessary commercially, but rarely by the home gardener (Vol. 1, 1:3, Vol. 6:309). The potting-on technique is well described in Vol 7:96.

The soil mixture is not critical for most plants, provided it is well drained and open. However, a little trouble will give the plant a much better start, which usually produces a good plant. Various mixtures are given in Vol. 2:181-2, Vol. 6:309, and in various other articles. Generally a mix of $\frac{1}{2}$ sand, $\frac{1}{4}$ peat moss and $\frac{1}{4}$ gravel, supplemented with animal manure, would be a good mix. A sandy soil would be a good substitute for the sand, compost for the peat moss and a good soil for the gravel.

For *Proteaceae* the addition of decaying leaves, or a little soil from under another vigorously growing plant of *Banksia* or Waratah, could be

essential. There is ample evidence that a fungus that would be attached to this would assist the roots of the new plant to take up the nourishment it needs.

If you do not have a vigorous Proteaceous plant then you will fail to get a good bush. This applies especially with Waratah. Most plants prefer to be planted out when small, especially if they are to be looked after in a good position. This applies especially with *Eucalyptus* and N.S.W. Christmas Bush. On the other hand, *Proteaceae* should be well grown first, especially *Teleopea*, that should have two years of vigorous growth on it.

A report (Vol. 6:23) indicates that seedlings must not be potted-on too deeply. It is important to see the taproot will go straight down, but that the fibrous roots are near the top of the soil, even to the extent of placing them near the top and mounting around the stem with sterile sand or gravel to hold the seedling plant up.

After the first watering or two the seedling may fall over, and this applies especially to Kangaroo Paws, Christmas Bells, etc., but just stand it up again, using a small mound of sand, and it will quickly find its own support.

Fertilizer

A plant supplied with abundant nutrition as a seedling is more likely to respond favourably to additional fertilizers than one which does not receive the same applications until it is mature (Vol. 7:67).

Animal manures and blood-and-bone are recommended (Vol. 1, 5:3, Vol. 7:67). The presence of organic matter deep in the soil is stressed (Vol. 2:181), together with a soil with a slight acid content (pl. 6:5).

Nursery supplied plants are often forced along with a soluble fertilizer such as Aquasol (Vol. 7:198).

Proteaceae: "*Banksia* do not take kindly to very much phosphorus, so a lot of commercial complete fertilizers are out. They do like small quantities of nitrogen in slow release, and potash. I use a fertilizer mixture of nitrogen, potash and trace elements, plus peat and humus" (Vol. 5:356).

"Species are particularly susceptible to phosphorus toxicity, and inorganic fertilizers should be avoided. Growth may be much improved by the use of animal manure and blood-and-bone" (Vol. 7:67).

STUDY GROUPS

ACACIA — Leader: Mr. John Arnold, P.O. Box 89, Armidale 2350, N.S.W.

BANKSIA — Leader: Mr. Trevor Blake, 12 Little John Court, Vermont 3133, Victoria.

BEAUFORTIA — Leader: Mr. Brian Walters, 19 Hurley Street, Toongabbie 2146, N.S.W.

CALLISTEMON — Leader: Mrs. D. Phelps, Loxton North, S.A. 5333.

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DRYANDRA — Leader: Mr. Tony Cavanagh, 2 Wilkinston Street, Ocean Grove 3226, Victoria.

EREMAEA — Leader: Mrs. Lyn Parry, "Floralands", Karlong 2251, N.S.W.

EREMOPHILA — Leader: Mr. G. Needham, 2 Stuckey Ave., Underdale 5032, S.A.

EUCALYPTUS — Leader: Mr. L. J. Daniels, Research Station, P.O. Box 201, Biloela 4715, Qld.

FERN — Leader: Mr. Steven Clemesha, c/- Post Office, Moonee Beach 2450, N.S.W.

MELALEUCA — Leader: Mr. Ralph Campbell, 58 Lee-Steere Crescent, Kambah, A.C.T. 2902.

RUTACEAE — Leader: Dr. Mervyn L. Turner, 14 Rose Avenue, Boronia, Victoria, 3155.

Study groups comprise a number of members, usually without any prior experience, who undertake to grow plants in their gardens and report results. They usually operate by mail through a leader, who supplies seed, advice and, in some cases, plants. The objective is to grow and develop better forms of species, or to determine the best growing conditions of species already available.

To become a member send \$1.00, with a stamped, addressed envelope, to one of the leaders above. No more members for the fern group at present.

GOOD NEWS! We have four more study groups, *Grevillea*, *Hakea*, *Hibbertia* and *Stylidium*.

GREVILLEA — Mr. M. Hodge, 25 Barford Street, Moorooka, Q. 4105.

HAKEA — Dr. M. M. Barratt, Lot 33 Cranebrook Rd., Cranebrook, N.S.W. 2750.

HIBBERTIA — Leader: Mr. Bernard Dixon, 82 Gilbertson Rd., Kardinya, W.A. 6163.

STYLIDIUM — Leader: Mr. Richard Davidson, 16 Toolera St., Melton Sth., Vict. 3338.

Grow from Cuttings — 1

A Review of Methods

The propagation of plants from cuttings is usually not difficult and really quite pleasant. Before describing my own crude methods, I wish to emphasise that it is a case of "doing your own thing". You will quickly develop your own method that will suit your facilities, time, and circumstances. May I suggest that you first read through reports of other people in past issues. Then read the report by Hazel Cole on page 147 of this issue.

As this issue is about *Proteaceae* and an excellent method of propagating these plants is by cuttings, I have included the reports by the two expert propagators below. Have a try yourself and in a later issue I shall give you my method.—Editor.

Propagation of *Bellendena* — Mountain Rocket

Experiences In Propagation of *Bellendena montana* R.Br. by A. M. Gray

This lovely little endemic alpine shrub from Tasmania has already been featured in a past issue of the Journal, Vol. 3, no. 23, p. 105. There is, however, no good account of its successful propagation and I have had many previous failures both with seed and cuttings.

In March, 1974, cutting material was collected, under permit, from Wombat Moor (1066 m) in Mt. Field National Park. The slips were summer-hardened shoots between 6 and 10 cm long, some cut to a node, others left with a cleanly trimmed heel; most leaves apart from 4-6 at the apex were removed.

The medium was prepared and used in a 20 cm terra-cotta pot in the following way. Cocks 2.5 cm deep—peat moss 5.0 cm on top of cocks, 10 cm of a medium comprising equal parts of shredded peat moss and coarse sand—2 cm of peat moss topped with 0.5 cm of sand.

Nineteen cuttings were prepared and the cut surfaces were dipped into "Seradix" rooting powder ("hardwood" strength) and the excess shaken off, then into "Benlate" fungicide powder and the excess shaken off.

The cuttings were inserted into the mix so that the ends were at least 2 cm into the mixture below the layer of peat moss. The pot was then sunk into within 7 cm of the rim in sand, heating cables being positioned near pot base level to maintain 20°C.

Regular watering was maintained and misting apparatus ensured a high humidity.

On 7.5.74 the cuttings were inspected and all were sufficiently well rooted to pot. The nineteen cuttings therefore had sufficiently developed root systems after only 5 weeks from preparation.

Editor's Note: *Bellendena montana* also belongs to the family *Proteaceae* and occurs only in Tasmania. It is a small shrub, seldom more than half a metre high, growing at high altitudes. There is a good article on it on page 105 of Volume No. 3. I am still waiting on a good colour slide of the plant. Who has one? Will readers also send a report on their experiences in its cultivation?

Propagation of *Hakea bakerana*

Experiences by Geoff Butler, Canberra Botanic Gardens

Recently in an article on *Hakea bakerana* in this journal (Vol. 8, pp. 295-296, June, 1976) Hugh Stacy suggested that "some success has been achieved in propagation from cuttings, but as yet no records are available of plants so grown" and queried whether "such specimens tend to grow with single stems perhaps becoming taller than plants from seed". The records of the Canberra Botanic Gardens may be of interest.

Two specimens of *Hakea bakerana* propagated from cuttings in December, 1967 and planted in autumn, 1968 in heavy soil in an open position are now dense domed shrubs 2 m x 2 m. The plants flowered in July/August, 1976 but no fruit has been observed. Even though these specimens were grown from cuttings each has developed a large bole of tissue at ground level from which many stems arise.

Since 1967 four collections of cutting material of this species have been made. Cuttings taken in December, 1967 and January 1968, not treated with rooting hormone, and placed in a plastic propagation frame in a cutting medium of one-third sand, one-third peat moss, one-third perlite gave strike rates of 26% and 60% respectively. More recently, a high strike rate has been obtained for cuttings taken in June, 1976. Half the cuttings were treated with a powdered hormone preparation (Seradix 2) and half with a quick-dip liquid hormone preparation (Indolebutyric acid 1000 ppm : Naphthyl acetic acid 1000 ppm in 50% alcohol). Both lots of cuttings received bottom heat (25°C) and mist (minimal). The percentage strike for the two lots, after ten weeks, was 80% and 100% respectively.

Banksias Grown in Queensland

by Betty Ballingall

When the *Banksia* fancier discovers a bed containing 220 *Banksia* plants growing side by side it is indeed a very memorable experience. Such a sight meets the eye of visitors to Brookvale Park Botanical Gardens on the Darling Downs, Queensland. Why not come and see for yourself. Head west from Toowoomba.

Of the 58 named species of *Banksia* listed for Australia 32 species are growing at Brookvale at present. Many of these are young plants yet to flower; however, 19 species have been successfully flowered since the *Banksia* bed has been established. The *Banksia* bed has been formed in a new area on a gradually sloping site. The soil, a medium loam with some stone, has been well cultivated and then top dressed with gravelly type of soil to assist with drainage and help control weeds and grass. After planting, large rocks at least six inches and more thick have been placed round the plants to give a cooler root run. The response to this treatment has been quite remarkable. Hot dry conditions have contributed to the few failures, most of which were the lesser known West Australian species, in particular from cooler parts. It has been proved without a doubt that autumn planting is far the best.

Several of the Western species have succumbed to fungi problems. Apparently strong, healthy looking plants die off in a few days. This seems to strike when heavy rains follow a hot dry spell. *Banksia ashbyi* and *B. occidentalis* are the worst offenders, but even so some of these are still growing and all have produced masses of bloom. In particular *B. ashbyi* is quick to establish and flowers very readily. It is well worth persevering with. None of the species from the Eastern States have been affected by fungi.

Some of the western banksia that have done exceedingly well are *B. media*, *B. prionotes*, *B. repens*, *B. pilostylis*, *B. dryandroides* and *B. baueri*. Both *B. integrifolia* and *B. ericifolia* from the east flower readily. The fine leaved species of *B. ericifolia* is very attractive and the deep honey coloured blooms are a pleasing colour. *B. dentata* from Northern Territory is the latest addition of the collection.



Growing Tree Ferns

Their Cultivation by David L. Jones

I have successfully grown all Australian species of tree fern in southern Victoria. As a general rule they are quite hardy although a few of the northern members require some overhead protection from severe frosts in the winter. They are very suitable subjects for pot culture but can also be grown in the garden. They do best if planted in raised beds to aid drainage and preferably in a good organic rich soil as they prefer cool root systems. Some species however are hardy enough to tolerate less than perfect conditions and will grow in poor soil; usually however their growth and appearance will be correspondingly worse.

Some species such as *Cyathea australis* will tolerate quite an amount of sun and wind particularly if the roots are damp, but others require more protection. Generally they prefer diffuse sunlight rather than direct, morning sun rather than afternoon sun, and protection from strong winds particularly northerlies. The majority will happily tolerate complete shade, and frosts do not seem to worry most of them once established. Crown growth (fronds) is generally rapid but trunk growth is slow and variable depending on the species and the individual growing conditions. Under ideal conditions fast growers such as *Cyathea cooperi* and *C. robertsiana* may grow as much as 6" per year. Most can be readily transplanted especially when young but remember they are protected plants. As a general rule *Cyathea* species are more difficult to transplant than Dicksonias and a portion of the root system at the bottom of the trunk is required for success. Frond growth in some species occurs in flushes e.g. *Dicksonia antarctica* produces a main flush in late winter or spring and a smaller flush in autumn. The spring flush results in the magnificent spectacle of soft upright uncurling fronds and greatly enhances the plants' beauty. Other species such as *C. celebica* and *C. robertsiana* produce single fronds continually throughout the year. Much of the beauty of tree ferns lies in the young uncurling fronds. As the botany of this genus has been dealt with in an earlier article we will content ourselves with notes on each species in cultivation.

Cyathea australis

Probably the most widely grown tree fern next to *Dicksonia antarctica*. This is deservedly so for it is a very handsome and hardy plant-tolerating quite an amount of sun and dryness. It will also grow quite successfully in clay soil which many ferns do not like. The fronds often have a yellowish appearance especially if grown in sunny positions. Sporelings appear in quite dry situations, especially on clay banks that are wet during the winter, and rapidly develop a nice crown.

C. baileyana

The Wig Tree-fern is very slow growing at least in southern Victoria. It makes a very handsome tub plant with its patterned trunk, green and brown wigs and long arching fronds of a refreshing green. It is fairly frost hardy but does not tolerate dryness or hot sun. It produces underground stolons which form new plants.

C. celebica

This is a beautiful tree fern that is again very slow growing at least in southern Victoria. Unfortunately the trunk and stipes are armed with vicious black brittle spines and one has to exercise care when handling the plant. The trunk is heavily covered with white scales (effectively

concealing the spines) and the fronds are a beautiful whitish green on the underside. The unfurling fronds of this species are the most attractive of any tree fern in Australia. It is quite frost hardy and easy to grow.

C. cooperi

A very attractive and popular species especially in N.S.W. where it is quite fast growing. It is a very spreading tree fern and the fronds may be over 3 metres long and quite broad. It is quite fast growing even in Victoria and is hardy enough to be planted out in most districts. We have plants growing that are native to the coastal strip around Cairns and while they are slower they are hardy enough to survive the Victorian winter.

C. cunninghamii

A tall slender species that is very attractive when young. It will not tolerate dryness or hot sun and is very difficult to transplant. Like *Dicksonia antarctica* it produces its fronds in flushes.

C. leichhardtiana

Another prickly species that makes an excellent tub plant. It is very slow growing with neat compact fronds. It can be damaged by frosts and will not tolerate dryness or sun.

C. marcescens

We have had little experience with this species although it does seem to grow successfully. It is believed by some workers to be a hybrid between *Cyathea australis* and *Cyathea cunninghamii*.

C. rebecca

A very hardy and attractive little species that is an acquisition to any collection. The trunk is very slender and the leaves are always a bright fresh green. It grows very easily in cultivation although fairly slow in southern Victoria. It is frost hardy and will tolerate diffuse sun. It produces new plants by underground stolons in the manner of *C. baileyana*. Young plants are difficult to distinguish from *C. baileyana* but the leaflet venation is different. In an earlier article by Telford the northern limit was stated as Cooktown but in fact it extends at least as far north as the McIlwraith Range of central Cape York.

C. robertsiana

This must be one of our most beautiful ferns with its slender trunk and soft pale green fronds. It is quite easy to grow but will not tolerate hot sun or dryness. It is very difficult to transplant and the soft top of the trunk shrivels and dies very easily. It makes a massive root system and is unsuitable for tub culture because of this. It grows very fast from spores and is one of the first ferns to colonise washaways etc. in nature. It is fairly fast growing and old specimens develop a very attractive lattice like buttress to the base of the trunk.

C. woollsiana

This rare species is slow growing but hardy. It makes a good tub fern or is suitable for ground culture. It is a slender species very reminiscent of *C. leichhardtiana* but with a coarse scaly trunk lacking any spines.

Dicksonia antarctica

Easily the best known and most widely cultivated tree fern in Australia and possibly the world. It is very easy to grow and can be transplanted without any root system, and quickly re-establishes itself. It is impervious to frost or snow but will not tolerate hot sun and wind especially in dry situations.

D. youngiae

A very hardy and easily transplanted species like the former but less tolerant of sun, wind and dryness. It makes an excellent tub plant and grows quite rapidly especially when young. It is quite frost hardy and the trunk is densely covered with long stiff hairs which in healthy specimens are a lovely reddish colour. The species produces small plants from underground stolons.



Eucalyptus leucoxylon

by D. J. Boland,

C.S.I.R.O. Division of Forest Research.

Red- and pink-flowering forms of *Eucalyptus leucoxylon* F. Muell. have considerable horticultural value and have been planted as street and garden trees in many southern areas of Australia. The species also provides good yields of light-amber-coloured honey and its timber is hard, tough, and durable and used for bridge timbers, railway sleepers, piles and posts.

In Victoria *E. leucoxylon* is commonly referred to as yellow gum and in South Australia as blue gum. Its two closest relatives are *E. melliodora* (yellow box) and *E. sideroxylon* (mugga ironbark).

E. leucoxylon was first described by Mueller (1855). Since then the taxonomy of the species has become confused because of the numerous varieties that have been erected viz. vars *rugulosa* F. Muell. ex. Miq., *rostellata* F. Muell. ex Miq., *pruinosa* F. Muell. ex Miq., *erythrostema* F. Muell. ex Miq., *angulata* Benth., *macrocarpa* J. E. Br., and *pauperita* J. E. Br.

The main natural distribution of *E. leucoxylon* is in Victoria and South Australia but several small populations occur in New South Wales close to the Victorian border. The form of the species varies from mallee to tall forest in the wettest, more sheltered parts of its distribution. All forms typically have 1-2 m of rough bark at their base with smooth gum bark above coloured with mottled streaks of white, yellow and blue.

It is now considered that *E. leucoxylon* comprises four main taxonomic groups. The category 'subspecies' is preferred to describe these groupings as trees within each group can be related to geographic origin. The aim of this note is to describe briefly the characteristics of each with some details about their horticultural value.

1. *E. leucoxylon* 'subsp. *leucoxylon*'.

A tree 15-20 m tall; seedling leaves opposite, shortly stalked for 5-7 pairs, subsequent pairs sessile; juvenile leaves opposite, sessile or even connate, cordate to broad lanceolate, green, discolorous; intermediate leaves alternate, stalked, broad lanceolate, green concolorous; adult leaves alternate, stalked, lanceolate, green, concolorous; inflorescence axillary, 3-flowered tending to be pendulous; buds subglobular, smooth-surfaced but if angular usually bicostate; fruit globular truncate, size 15-20 x 8-10 mm.

This form occurs on good quality acidic soils in the higher rainfall subcoastal belt of South Australia and Victoria. Particular areas of occurrence are the Mt. Lofty and Southern Flinders Ranges (near Wirrabara) in South Australia and the Brisbane Ranges of Victoria.

Horticultural Features — The trees are moderately large, have an erect form and green foliage and a smooth, mottled, gum bark. The fruits are globular-truncate in shape and the fruit surface is mostly smooth but sometimes bicostate. The fruits are approximately intermediate in size between the smaller fruits of 'subsp. *pruinosa*' and the larger fruits of the other two subspecies. The juvenile leaves are sometimes connate and this character is especially common and pronounced in progeny of trees from the Brisbane Ranges. Some individuals produce pink or red flowers.

2. *E. leucoxylon* 'subsp. *pruinosa*'.

Of mallee form when growing under poor soil and moisture conditions but usually a tree up to 15 m tall; seedling leaves opposite, shortly stalked for 5-7 pairs, subsequent pairs sessile; juvenile leaves opposite, sessile or

occasionally connate, cordate to orbicular and sometimes with slightly scalloped edges, blue in appearance due to a fine layer of waxy bloom over the leaf surface, discolorous; intermediate leaves alternate, stalked, lanceolate, grey-green, concolorous; adult leaves, stalked, lanceolate, grey-green, concolorous; inflorescence axillary, 3-flowered more or less non-pendulous because of the relatively short peduncles and pedicels; buds pointed-ovoid and usually glaucous, smooth-surfaced; fruit hemispherical, usually glaucous, smooth-surfaced, size 12-14 x 8-10 mm.

This form occurs on good to poor-quality acidic soils mainly in the drier inland areas of Victoria and South Australia. It also occurs in several small disjunct areas in New South Wales near the Victorian border between Barham and Mildura. In Victoria it is common in the Wimmera wheat growing region and also in the goldfield areas near the towns of Rushworth, Bendigo, Castlemaine, Maryborough and St. Arnaud. In South Australia it occurs in the northern more inland parts of the Mt. Lofty and Southern Flinders Ranges and also in the drier inland areas of the southeastern corner of the State.

Horticultural Features — The trees are medium-sized, having an umbrageous appearance, with grey-green foliage and a smooth, mottled, gum bark. The buds and fruits are small, smooth-surfaced and glaucous. The juvenile leaves are glaucous and sometimes connate, and this character is more common in Victorian than South Australian populations. Some individuals are pink- or red-flowered but in general the smallness of the flowers make it a less suitable form for horticultural use.

3. *E. leucoxydon* 'subsp. *macrocarpa*'.

Of mallee form when exposed to windy coastal conditions but in less exposed sites develops into a tree up to about 14 m tall; seedling leaves opposite, shortly stalked for 5-7 pairs, subsequent pairs sessile; juvenile leaves opposite, sessile, cordate to broad-lanceolate, green, discolorous; intermediate leaves alternate, stalked, broad lanceolate, green, concolorous; adult leaves alternate, stalked, lanceolate, generally broader and thicker than in the other forms, green, concolorous; inflorescence axillary, 3-flowered tending to be pendulous; buds subglobular and sometimes angular; fruits globular-truncate and sometimes bicostate, size 25-32 x 10-13 mm.

This form occurs mainly on poor-quality alkaline soils in the wetter coastal fringe of South Australia and Victoria. It is common along the coast near Mt. Gambier and also on Kangaroo Island.

Horticultural Features — The trees are small to medium-sized. They usually have a spreading umbrageous form and green foliage with a smooth, mottled, gum bark. The buds, flowers and fruits are very large and tend to be pendulous. Pink- and red-flowering individuals of this subspecies are very attractive because of the large flowers. These forms are the ones usually sold by nurserymen under the name '*E. leucoxydon* var. *rosea*'.

4. *E. leucoxydon* 'subsp. *petiolaris*'.

Occasionally of mallee form when growing under poor soil and moisture conditions but usually a tree up to about 12 m tall; seedling leaves opposite, stalked; juvenile leaves alternate, always stalked, broad-lanceolate to ovate, green, discolorous; intermediate leaves alternate, stalked, broad lanceolate, green, discolorous; adult leaves alternate, stalked, lanceolate, green, concolorous; inflorescence axillary, 3-flowered tending to be pendulous; buds green, sub-globular usually very angular with mainly four ribs but occasionally up to seven, ribs often extending from the calyx tube onto the operculum; fruits often distinctly campanulate, usually angular, with an unusual green undulating collar around the base of the style which can be readily observed on fruits shortly before dehiscence, size 25-30 x 12-14 mm.

This form occurs exclusively on Eyre Peninsula of South Australia on soils of intermediate quality. It occurs in two main populations, one near Port Lincoln and the other, lesser known, near Cleve. Because it usually occurs near creeks it is locally referred to as water gum. Populations on



Colour photography by D. J. Kleinig.

EUCALYPTUS LEUCOXYLON— the red form

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Eyre Peninsula had been earlier included under var. *macrocarpa* ('subsp. *macrocarpa*'), but '*petiolaris*' differs in the campanulate fruits and petiolate juvenile leaves.

Horticultural Features — The trees are of considerable horticultural value and are generally small to medium-sized, having an umbrageous form with green foliage and smooth, mottled, gum bark. They have large buds, flowers and fruits which tend to be pendulous and similar in size to those of '*macrocarpa*'. The buds have an attractive angular appearance and the fruits are often bell-shaped.

Individual trees in natural stands near Cleve are locally renowned for their beautiful floral colours. Pink-, red-, yellow- and orange-coloured forms occur. The selection and cultivation of these forms could prove very useful to horticulturists.

General

Only the staminal filaments provide the colour which is noticeable during flowering. In an individual flower there are about six whorls of filaments, the bases of which are attached to a very broad staminal ring. The outer 1-2 whorls are devoid of anthers and the length of the filaments gradually decreases from the outer to the inner whorls. In general, overall filament length is greater in larger than smaller-flowered forms.

Connate leaves, which are very decorative in cut foliage displays and occur in some *leucoxydon* forms, have been recorded for only another 8 of the 500 or more eucalypt species. These are *E. gamophylla* F. Muell., *E. perfoliata* R.Br. ex Benth., *E. perriniana* F. Muell. ex Rodway, *E. risdonii* Hook.f., *E. sturgissiana* L. A. S. Johnson and D. F. Blaxell, *E. tenuiramis* Miq., *E. uncinata* Turcz. and *E. dives* Schau.

Propagation

In *E. leucoxydon* it is very difficult to propagate a true-to-type plant of a selected floral form. Vegetative propagation by means of either cuttings or grafts would be the best way of maintaining a selected line. In practice, however, eucalypts have proved difficult to grow by these methods and *E. leucoxydon* is not likely to be an exception. Usual commercial nursery practice is to grow seedlings from seed collected from open-pollinated select trees. This is the easiest method of raising eucalypts but flower colour is not fixed in first generation plants, as colours range from white to red. Nevertheless, Federick (1976) has suggested that some stabilisation seems to have occurred over several generations of selection. Moreover, since plants flower from about two years onwards, some early selection is possible.

Horticultural Nomenclature

The question of how to refer to red-flowering forms of *E. leucoxydon* requires clarification. Although white or cream is the main flower colour in the species, field evidence has indicated that red-flowering individuals occur in all the proposed subspecies. *E. leucoxydon* var. *erythrostema* (= red flowers) is taxonomically legitimate but was erected to describe forms with large red flowers. Var. '*rosea*' which is commonly used by horticulturists is not recognised formally. As the varietal category is appropriate for describing individual variants it is suggested that this concept ought to be formalised below the proposed subspecific groupings of *E. leucoxydon*.

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Terrestrial Orchids from Seed

by L. T. Nesbitt

My methods of seed raising have evolved over the last 8 or 9 years. In the first year, I attempted to grow *Cymbidium* and *Cattleya* from seed. After a series of failures with various flasking methods I became fed up with all the rigamarole involved. Then a few self-sown seedlings of *Thelymitra* and *Pterostylis* germinated amongst my flowering plants. This seemed very easy, so I began to hand pollinate the flowers of terrestrial species, and harvest the ripe seed. This seed was sprinkled on top of pots containing adult plants and next season several pots were filled with seedlings.

From this point on, I became a devotee of Australian native terrestrial orchids and I madly pollinated every plant which flowered. I have had many disappointments over the years but, with the help of a few local and interstate friends, a reasonably reliable technique has been established.

My original orchid houses were built for *Cymbidium*, *Cattleya* and slipper orchids. My first native terrestrials were grown in the *Cymbidium* flowering area under a glass lean-to roof on one side of the shadehouse.

These pots required hand watering all the year round. The surface layers sometimes dried out on sunny days in winter-spring, killing any small seedlings. I now grow my terrestrials under shadecloth which gives better results and involves less work than growing them in a glasshouse.

For plants in plastic pots under shadecloth, hand watering is unnecessary in winter in Adelaide, but must be resorted to in autumn and spring, and occasionally in summer. Terrestrials are very sensitive to fluctuations in soil moisture content and this fact must be constantly kept in mind. I use 52% shadecloth and all pots are on galvanised weldmesh benches at least 18 in above the ground, to deter slugs and snails.

Most of my non-colony type plants are in 5 in plastic pots, but I am gradually changing to 6 in and 7 in squat plastic pots to reduce watering in spring. Watering must be done gently to prevent erosion of the surface layers of soil where the seedlings may be developing. I have been working on this erosion problem for years. I tried lowering the shadecloth to a foot or so above the pots to prevent erosion from raindrops, but this was no better than a shadecloth roof you could walk under. Some means of binding the surface was needed. A good medium is native moss, but it can take a season to establish and in the third or fourth season the moss gets too thick and smothers the seedlings. This means repotting every three years or so. I now use a thin mulch of chopped needle-like leaves. She-oak leaves are excellent, but are hard to get in quantity, so I make do with radiata pine leaves which are satisfactory.

Watering must be done with a fine spray which is very time-consuming when done by hand. The pots must never be filled so that they overflow, or the seed will float away. I use tap water and sprinkle the pots after sunset so that the plants can soak up moisture over night. Watering during the day in warm weather often leads to damping-off problems.

I mix my own soil to suit each species. The basic ingredient is soil from the Adelaide hills. Orchids will grow in this alone, but as it has a high clay content, water lies on the surface for several hours after rain. To overcome this problem, I add 10-15 per cent sand to the mix to improve drainage. This mixture dries out too fast in spring, so I add peat moss to retain moisture;



**DIURIS
BREVIFOLIA**

A very rare species that is endemic to the lower Mt. Lofty Ranges, S.A.

Colour photograph by
Mark Clements

10 per cent for *Caladenia*, *Diuris* and *Thelymitra*; 25 per cent for *Pterostylis* and *Acianthus*; and up to 50 per cent peat moss for *Corybas*. I have added a very small amount of blood and bone, and complete fertilizer to this mix in recent years. I use $\frac{1}{2}$ in gravel crocking in all pots and then fill with the appropriate soil mix, which is sieved to 316 in size beforehand. This makes repotting easy as the old soil can be tipped into a sieve and it all falls through, leaving the larger tubers and crocking behind.

Pots used for seed raising are topped with a thin layer of rotted gum tree material, sufficiently thick to just cover the soil. I believe this rotted wood, which is obtained from old hollow trees, or rotted stumps, provides food for one, or more fungi, which assist seed germination. I have raised seedlings of 28 South Australian terrestrial species to date. Some species give excellent results, other have so far been unsuccessful, but generally speaking I find if a large plant is growing well, then at least a few seedlings are obtained yearly. It takes only a few minutes to hand pollinate the flowers and later you can sprinkle the seed over the pot, where it eventually washes down into the surface layers. Multi-flowering plants, such as *Thelymitra aristata* should be allowed to bear three or four pods only, otherwise they may not flower the following year.

**CALADENIA
HUEGELII**

One of the more
common spider type
Caladenias from S.W.
Western Australia.

Colour photography by
Mark Clements



Seed may be sown from October to June. I prefer to store my seed in paper envelopes through the summer, and sow in April-May, to minimise loss of seed. Germination takes place in the cool, wet, winter months and protocorms must not dry out during the subsequent two to three months.

The first leaves are generally seen in July. Others appear through the growing seasons, as they make very thin tubers about the size of a pin-head spring months, but as the weather gets hotter in October and November, damping-off becomes a serious problem. It is better to let the pots dry out once the mature plants enter dormancy and sacrifice these late seedlings than to keep watering and have all the plants in the pot rot away.

I prefer not to disturb the seedlings until they have completed one year's growth. A new crop of seedlings can be grown each year in the same pot. Because the larger seedlings form tubers deeper in the pot than small ones, the biggest tubers can be separated by pulling off the lowest inch of soil during the dormant period. The remaining plug of surface soil containing the small tubers can be replaced undisturbed into the pot on top of an inch of fresh soil mix. The larger tubers are then replanted in new pots.

I have flowered seedlings of *Pterostylis nana* in the second year but generally seedlings take three to five years to reach flowering size under my growing conditions.

In my experience it is a waste of time trying to germinate seeds on pots of soil which don't contain at least one living plant, even though the soil, preparation, housing, etc., is identical. I sowed various species on over 200 pots of soil mix, for two consecutive years, and all I got was half a dozen seedlings of *Pterostylis nana* in one pot. The seed and plant do not have to be of the same species or even the same genus. Several species will sometimes germinate around one mother plant. I suspect that the presence of suitable fungi is the key.

The greater the number of pots sown with seed, the better the results. I look after pots which "strike". I can now reliably raise hundreds of seedlings annually of *Diuris maculata* and *Caladenia dilatata*. Others look promising, especially the local *Caladenia* species. The main cause of loss of seedlings are: soil drying out excessively, slugs and snails, and damping-off. These must be continually guarded against. Other less serious problems here are grubs, red spider, thrip, black birds and erosion.

I have concentrated my seed-raising efforts on those species which do not readily form colonies. These include *Diuris*, *Eriochilus*, *Thelymitra*, *Glossodia*, most *Caladenia*, and some *Pterostylis*. The colony types such as *Pterostylis*, *Acianthus* and *Corybas* multiply vegetatively at a satisfactory rate, making seed raising unnecessary, although most of these are easy to raise from seed and reach flowering size comparatively quickly. I have found that approximately 10 per cent of my adult non-colony terrestrials are lost each year from a variety of causes. Propagation from seed seems to be the most practical method for replacing these losses.

Many other species of Australian terrestrials will no doubt respond to these seed raising methods. Tubers and seed of interstate orchids are virtually impossible to obtain here in South Australia, with the exception of the more common Victorian species available through the tuber bank of A.N.O.S. Victorian Group, and a few Queensland species available commercially. There is much work still to be done.

To summarise, in my opinion the main requirements for successful germination of terrestrial orchid seeds under pot culture, in order of importance, are:

1. Fertile seed.
2. Healthy adult plants.
3. The correct fungi and food to nourish it.
4. The soil surface (and hence any protocorms) must remain moist at all times in the growing season (June to September-October).
5. Some form of thin covering to protect the protocorms from rain splash, or watering, must be provided.
6. Plants must be grown in pots which are on benches, clear of the ground, to discourage slugs and snails.
7. A growing area protected from strong winds, hail, birds, cats and dogs, small children etc., and in some cases bright sunlight. A shade cloth shade-house is best.
8. Weeds must be eliminated from pots of terrestrial orchids.
9. Water gently. Never allow water to fill the pot and run over the rim.

This is a method for raising terrestrial orchid species from seed but, unfortunately, unsuitable for hybrids because of the uncertainty of identification of resulting seedlings. The tiny dust-like seeds can be easily carried from one pot to another by wind or rain. Germination on agar in flasks must be used for seeds of hybrid orchids. The staff of the Canberra Botanic Gardens have written several papers on this subject, which can be consulted by those interested in flasking.

Lowly Plants from W.A.

For Rockeries and Borders

by Alf Gray

By lowly plants I mean prostrate and cushion types especially. Small plants, under half a metre or so, of various shapes that are found on shallow sandy terrain in the west and under exposed conditions for the most part. Such have always been popular among growers with limited space to garden yet possessing enthusiasm for novelty and variety.

Low plants are not confined to W.A. it is true, being typical of the Alpine Plateaus in the Great Divide also. On the western sandplains where great exposure to oceanic winds and where gravelly subsoils at no great depth prevail, the conditions that produce these low plants appear much the same except for temperatures and rainfall. Evidently the latter have little bearing on stature in these circumstances, even though they appear to be dominant influences of environment as a rule. We may express the principle that a stratified environment, both above and below the surface, tends to produce stratified plants. At any rate that is the impression I have gained after residing in desert and sandplain for a number of years.

"But the vegetation on a shallow plain does not always consist entirely of low plants."

Quite true. You may find large shrubs, even trees, growing with prostrate plants on the same site. That is evident almost everywhere. However, especially on shady terrain that has been subject to drift under exposure for a very long period (also inundation in wet periods), plants migrate and the flora becomes interchangeable in forms from other environments. You will see for instance Acacias with phyllodes and others with pinnate foliage growing together. If, as ecologists agree, phyllodes are an adaptation to an arid environment why are the two growing together in a climate suited only to the pinnate species? Obviously they didn't grow together always, for that matter not even recently. After a drought on the sandplain some items of the flora may disappear while neighbouring ones still remain where they have grown perhaps since they evolved.

But what has all this to do with low plants in a growers' journal? If you wish to grow them yourselves it is necessary to consider the conditions that evolved them. Their "background" so to speak. This is my experience (a long one by the way) founded on the acceptance of first principles as these relate to plant propagation and establishment, as it is in any calling. You may get away with gambling or chance success but, particularly where we are dealing with an endemic flora, a study of the conditions that produced it is essential to its successful establishment in culture.

If you wish to grow low plants permanently you must not encourage them to revert to a taller habit by growing them in deeper soils in the shade of buildings or large trees. You would have to treat them like low cacti and certain succulents to make sure you preserve the habit. You have one consolation, however, the longer plants have had to adapt themselves to a set of conditions the longer they should tolerate an altered environment. Our main objective should be to retain what we call the species and its form. You cannot change the genus whatever you do, because it is far more confirmed than the species. Some species do not hybridize as easily as others but they can be changed as we all know; the variety more readily or the form quite easily if you definitely set out to do so. But if the forms of

the plants I will describe are the attraction then like the genera and species they should be retained if at all possible.

Acacia congesta, with its mass of golden bloom on the rich blue grey foliage (but with those leaves there were spines) of the same colour, is a plant I was very pleased with. It probably was the variety *cliftonii*. My good friends next door were not pleased. They had small children who discarded shoes in summer as they all do. One of them tried to walk over that cushion plant against advice, with the inevitable result. His mother promptly chopped out *Acacia congesta*. There were plenty of other low wattles around I could not get names for as it was hard to get them identified. Some might have been new. I didn't plant any of them near the house again for most develop prickles to defend themselves against trespassers. You can't blame them.

Acacia cedroides "Cedar Wattle" also grows prostrate near the Stirlings. A hundred miles east at the foot of the Barrens, I have seen it as a domed shrub about three feet high with a diameter of perhaps four feet. Either form is light yellowish green, but the arrangement of the 2cm phyllodes in regular whorls at intervals along the branchlets (verticillate) is its curiosity. The stipules seem to be present but rudimentary. The peduncles stem from the whorls with flower heads about level with the phyllodes, a rich gold when "out".

Acacia larecina "Larch Wattle" is another unique species which Bentham described as "having the aspect of a short leaved fir". The main difference from *A. cedroides* is in the position of the phyllodes which are alternate for *A. larecina*. They both grow in the same area though I have never seen them together and I think you'd need to look carefully to tell them apart sometimes.

Acacia moirii appears to be named for a member of the Stirling pioneer family keen on the flora and still resident around the range. If it were me I would feel honoured though I have declined on occasion because I believe all specific names should be descriptive to assist determination in the field. "Moirs Wattle" is one of the finest prostrates I know and is fairly widespread north of the range as far as Narrogin I should say. It grows on shallow gravelly sands (a mixture of laterite gravel and white sand) and anchors into the clay below. Very glaucous pinnate leaves about 4cm long x 2.5cm with fluffy flower heads of butter cup yellow up to 1.5cm in diameter (quite large for a mini wattle) on long peduncles so they are doubly conspicuous. They are reddish before maturity and ripen so quickly seed is hard to collect. I fancy wonga pigeons were as keen as I on this species because I seldom found a decent batch of seed. Or maybe the ants; though they can be generous at times and leave a heap of freshly garnered seed alongside the holes. We all have to live.

Acacia nitidula. For years I admired a low deep green mound wattle in the Gairdner River area. It trailed down sandbanks when young, only developing the round variegated habit toward maturity. The phyllodes were approximately 5cm long, fleshy and easily confused with the pods (except they are not numerous) until the latter ripen, when they are hard and woody. In flower this species is not so handsome as the previous one yet its habit and greenness on the sand has an appeal I could not myself resist. I grew it for years. It is a novel item worthy of any collection of the genus especially in the trailing stage on an embankment. And it is tough!

Acacia nitidula has many forms from a sizeable round shrub about one to two metres in diameter to a miniature under half a metre. The latter may be plumb coloured with entwined branchlets carrying parallel nerved phyllodes to 1cm long. A little beauty, the problem is to find it in the region South East of Geraldton toward Morawa and then of course the seed when you do. Recollection of these items is inclined to induce nostalgia for the times when they were more plentiful. One never knows it may still be where I have seen it though there has been great change in the west in recent years.



ACACIA MULTISPICATA

This is not a low growing plant, but a beautiful shrub as shown above. I had difficulty getting photographs of low-growing *Acacia* so decided to use this one to illustrate what beautiful bushes *Acacia* can become in the garden. There are low growing *Acacia* that flower equally as well as the one shown above.

Acacia pulviniformis is a real cushion wattle of confirmed habit, a type quite common north of the Stirlings a decade ago. To one metre in diameter at maturity it is of low mound form. Bright green when young it becomes dusted like a powder puff later. This is due to the bleaching of the tomentum on the linear phyllodes and the fine bristles that protrude, especially over the surface of the cushion. It is the form that is its greatest attraction and it is hard to believe a specimen is probably as old or much older than a large growing wattle. I have seen several species of this type growing near the Pallinup River south of Quowangerup where cultivated fields are now. They may be nearby now but in any case I know the species is in the Katanring area and this one can be grown from cuttings. I believe almost any ground plant can, even a ground wattle.

Goodeniaceae

The family Goodeniaceae is well represented sometimes by several genera and what the botanist calls "parallelism" is, maybe, as evident as it is in the higher vegetation.

It is well known that items in the scrub, especially in semi-arid regions, may resemble each other whilst belonging to different genera, so much so that only in flower or fruit can one be sure of identity.

In *Dampiera*, *Goodenia*, *Scaevola*, etc., where most members are low plants, it is very confusing at times but occasionally species may differ so much they are readily identified.

Scaevola pulvinaris is outstanding in this respect. In the South it may be found in association with *Acacia pulviniformis* and has a similar habit and specific name. This time it means cushion-like, but what a beautiful cushion it is, so carelessly cast down on the white sand. It is powdered by minute white or blue flowers so close together over the surface of the half to one metre diameter plant that the leaves are completely hidden. Seldom growing above 20cm high it is as if being half buried in the sand gives us the clue to its habit. Like many sand plants this *Scaevola* grows mainly from the outer edges thrusting down new roots in the sand after timely rains. Drift sand piles to partly submerge the plant in dry weather in due course stimulating it to form the domed or cushion habit also. A large colony is a sight to behold if only because the two colours mix very evenly, also alternatively. In the garden frequent top dressing with fine sand would be indicated to preserve habit and health of this species.

Some well known members of the Lechenaultias are mound or cushion plants. *L. formosa* var *lobata* and *L. tubiflora* especially. Both respond to culture in a suitable environment. The genus is not deep rooting. Up to 10cm of sand on gravelly clay seems imperative for permanent establishment. Where the shire grader cuts a strip from the road verge in his urge to widen the road the glorious display of rich colour may disappear for the time being. But all is not lost, providing the grader doesn't return for a year or so. Root tips or broken pieces will remain in clay to produce several plants where one grew before during the winter months. One wishes every native plant was so tenacious of life. In the garden however in a foot or so of soil or the local sand they are not at all so happy and languish at best. This is an example of the need to know the background of any subject you desire to grow. Exotic plants have been long inured to the well intentioned habits of mankind in nursery and garden. But the native plant is like the aboriginal in his native state, not easily adaptable to the white man's ways. No wonder, *Lechenaultia* is a very old genus which must have roamed the continent long before man. Species have been recorded from the islands of the Gulf of Carpentaria, Victoria River and Coopers Creek, South Australia, though essentially a genus of the Great Western Plateau.

The Pea-flowered Plants

Brachysema is not so well known. Several species are ground plants; one I regard as the best of its type is *B. latifolium* "Broad leaved *Brachysema*". This one, though seldom seen, is never forgotten providing the specimen is mature and in flower. The habitat ranges from South of the Stirlings to beyond Ravensthorpe. To the east on level patches of white sand you may see a remarkable prostrate dark green plant as round as a cartwheel and about that diameter. In Spring, or early Summer, rich dark red pea flowers about an inch long will add to its beauty the whole plant contrasting so delightfully with the white sand it impresses itself upon the memory for good as it has done with the writer.

Most of the *Kennedy* family are prostrate when there isn't anything handy to climb. I can't remember any I haven't seen doing so except the rare *Kennedy microphylla*. So uncommon I gave it up years ago as a botanist's hallucination. One could pass it by without realizing it was a *Kennedy* because the leaves and flowers were so tiny, smaller by far than any other member of the genus. From memory the leaves are under 1cm each way, the deep maroon pea flowers not much larger amid the dark green leaves. It comes as a shock that it definitely is a *Kennedy* and what a beauty! I grew one from minute seed given a few years ago. It grew to a dense prostrate specimen one metre in diameter flowering in profusion in early Summer.

Editor's Note: Alf Gray has introduced a number of fascinating subjects that are the subject of future Issues. Will readers please contribute with their experiences and observations on low-growing plants suitable for rockeries and garden borders. What plants are you successful with? What species do you especially recommend for gardens in your area? In particular will you supply reports on:

- (a) Dwarf, spreading or prostrate *Acacia*.
- (b) Plants in the family *Violaceae*, especially *Hybanthus*, *Viola*.
- (c) Plants in the family *Goodeniaceae*, especially *Cooperhooia*.
- (d) Monocotyledons especially *Xanthorrhoea*, *Lomandra*, *Anigozanthos*.
- (e) The cultivation of orchids in the garden, i.e. in the ground.
- (f) Dainty ferns that will not take over but add to its character.
- (g) Native grasses that will add interest.
- (h) Any herbaceous plants at all.

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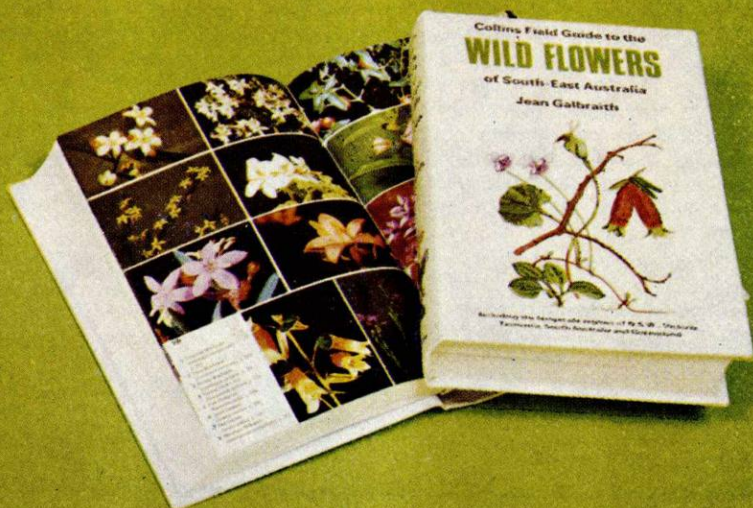
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Australian Climbing Plants

by D. L. Jones and B. Gray — Price \$14.95 plus 55c post. This 168 page (25 x 18 cm) book would rate as one of the most valuable, especially for those seeking a reference to trailing and climbing plants. It does not confine its coverage to only those interesting climbing plants, some of which I have never heard of, but includes those plants that trail along the ground. Those who have seen the work of David Jones and appreciate his easily read, simple, but good descriptive style will be even more impressed by his presentation of this fascinating subject. An exceptional bonus in the book is the 260 beautiful colour plates. While other photographers have contributed, what makes the plates so interesting is the exceptional photography of Bruce Gray who contributed the bulk of the photography.

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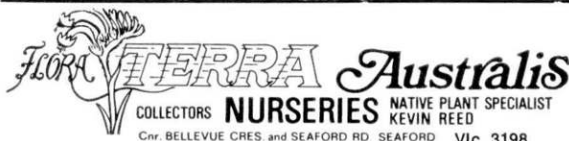
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HAKEA ORTHORRHYNCHA

A bushy shrub with forked sharply pointed leaves. Bright red flowers in mid-winter growing mainly on the old wood.

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