

Australian Plants

Registered for posting as a periodical —
Category B

June, 1976—Vol. 8, No. 67
Volume 8 will comprise Issues 61-68

75c



Photography by Eric Gordon

GREVILLEA BAUERII

GROW AUSTRALIAN WILDFLOWERS

GROWING WILDFLOWERS

This publication is dedicated to the presentation of articles on the cultivation of the Australian flora and the development of its horticultural potential. Every effort is made to include as many articles as possible.¹ They are presented in a clear and simple manner so that every one, from the young person who is just beginning to appreciate the beauty of the world around him, to the home gardener, may join in this exciting hobby.

Why not grow a few wildflowers in your garden?

There are many who are convinced that the pressures of civilisation and population will increase to the extent that most natural habitats will be invaded and alienated so that wildlife, creatures or plants, will need to be nurtured for the species to survive.

Those who have had some experience with the cultivation of much of our Australian flora will readily acknowledge that there is much to learn. We do not pretend that we can preserve the flora in our home gardens but we are learning how to propagate, cultivate, develop the best forms and have fun in the frontier of horticulture. Rather than be impatient² if some of the articles appear too technical, be grateful to writers such as Dr. Byron Lamont, of the Western Australian Institute of Technology,³ and Dr. Laurie Johnson, Director of the Botanic Gardens, Sydney,⁴ for their offer to help us to a wider understanding.

NOTES:

1. All articles of a simple nature directly related to growing wildflowers in the garden are published. I am the first to acknowledge that we do not publish enough of them so, experienced growers, or even the not so experienced, please send me an article on your triumphs and failures at growing wildflowers.

2. I am well aware that some readers want more of the simple articles on cultivation. You get all I receive so if you want more of this type then it is up to you to do your part and send some notes. I wonder sometimes how well the ones that are printed are read. For instance, in our No. 65 issue on *Boronia*, the bulk of the issue could be described as technical (although from the correspondence received it is a most popular issue), but the article by Max Hewett on the cultivation of *Boronia* was outstanding and the issue was good value for this authoritative and well-presented article on its own. If you are having trouble growing the more difficult small plants then I suggest you re-read it carefully. In the present issue there are a number of articles, each containing as much information on growing wildflowers as appears in each issue of "Your Garden" where the type is spread out to complete a page. "Your Garden", I hasten to add, is an excellent gardening magazine and those who purchase it regularly will be treasuring the many articles by Roger Elliott and others. Articles in each issue are excellent, such as those in the May, 1976, issue on "Propagating Banksias From Cuttings" and "Landscaping of Steep Slopes".

3. See "The *Hakea Sulcata* Group"—page 298.

4. An official release of results of recent research in simple terms serves as a valuable bridge between professional botanist and the interested public. Articles in this issue reporting on work by research botanists at the Royal Botanic Gardens, Sydney, will help to resolve many problems that existed in the past over the correct naming of plants.

PROTEACEAE — The Principal Contents of This Issue

As the Australian flora is so vast and the large family of *Proteaceae* so diverse, any attempt to present other than a small segment adequately would fail. Our approach is that the articles in the previous 66 issues, supplemented by the information in this issue, and in future issues as our knowledge broadens, will give the reader the most comprehensive report available.

Propagation—Two excellent articles here supplement others published.

Cultivation—Two reports here supplement others previously published.

Research—See notes 3 and 4 above.

BEGINNERS' GUIDE

If you are new to wildflowers, that is to their recognition and cultivation, then it is suggested that you might start from the back of this issue and work forward.

"Our Pretty Bushland Spiders"—page 335—will open up a new world of interest by examining our spider flowers.

"Isopogons"—page 331—will introduce you to propagation.

"Grevillea From Seed"—page 330—describes a very interesting method.

"New Australian Wildflower Cultivars"—page 325—officially registers a number of beautiful garden plants.

Now start reading from the beginning with the article opposite.

PROTEACEAE FOR GARDENS

by Anthony Cavanagh

The *Proteaceae* family contains some of the most spectacular and desirable species of the whole plant kingdom. Most of us are familiar with *Banksia*, *Dryandra*, *Grevillea*, *Hakea*, *Isopogon* and South African *Protea*. Yet there are many more groups such as *Petrophile*, *Adenanthos*, *Persoonia*, *Sterlingia*, *Franklandia* and others which, in their own way, are attractive and desirable for the garden. Victoria is fortunate in having a climate roughly similar to that of south-west Western Australia, in particular with a mainly winter rainfall*.

In endeavouring to grow *Proteaceae* I believe it is important not to be over ambitious in the initial selection of plants. Some of the most spectacularly flowered species, such as *Banksia coccinea*, require rather special conditions for success and can prove a disappointment. Yet, there are a number of hardy types with both attractive foliage and flowers, e.g., *Banksia ericifolia*, *B. collina*, *B. spinulosa*, *B. robur*, *B. serrata*, *B. serratifolia*, *Dryandra formosa*, *D. praemorsa*, *D. calophylla*, *D. pteridifolia*, *Isopogon formosus*, *I. dawsonii*, *I. anemonifolius*, *I. anethifolius*, many *Hakea* and of course the hardy floriferous *Grevillea*. Once experience has been gained with these the more difficult types can be attempted.

Both the garden area available and the size of the plants to be grown must be considered. There is a very wide choice of species, with plants ranging from prostrate to large trees, so the final selection will be governed by size considerations—spread as well as final height. A suburban block could not accommodate more than, say, 10-15 of the larger species, together with a selection of smaller shrubs. Plants from the different genera can be mixed together to give foliage contrast and a spread of flowering times. With some species, such as *Banksia coccinea* and a number of the *Dryandras*, close planting is helpful in minimising wind damage and blowing over, as the entanglement of branches gives mutual support. In general, however, it is better to space plants adequately to allow them to grow naturally. The *Isopogon* and *Petrophile* can tolerate semi-shade and, on account of their small size, can be used as undershrubs.

Mulches are important in dry areas, or where watering is not practical. They help conserve moisture and maintain a cool root run. However, mulching involves a lot of work if the garden area is large, and most *Proteaceae* seem to grow just as well without any. I have employed both wood shavings (to a depth of about 15 cms.) and leaf litter and soil from under *Banksia marginata* trees on my garden, and both appear to be effective. When using mulches, such as wood shavings, a space approximately 20-25 cms. in diameter should be left around the trunk to minimise the possibility of collar rot.

Whether *Proteaceae* should be watered in the summer months is always a contentious point. Most certainly young plants require regular heavy waterings through their first summer. I believe that, in well drained soils at least, there are fewer losses when summer watering is carried out. The best time is early morning and each plant should receive a thorough soaking, the regularity of the watering being determined by the frequency of rainfall. A number of western *Banksias* flower in summer, and watering will improve flowering.

A final comment might be made on soil types and how they affect some of the *Proteaceae* family. These are of necessity very general and there are probably many exceptions. Both *Hakea* and *Grevillea* appear to be relatively tolerant of most soil types in Victoria, though probably western sand plain species would not succeed in heavy clay soils which exist in so many areas.

*For other areas of Australia see page 294.

GREVILLEA ARE PROTEACEAE

Photography by F. W. Humphreys

GREVILLEA OBTUSIFOLIA

Grevillea obtusifolia is a procumbent shrub from Western Australia. Its branches often lie along the ground but occasional branches will become upright and perhaps reach 1.5 metres in height. Flowers are a soft red and are borne in spring and summer. The plant requires good drainage and may be propagated from cuttings. This plant is quite different from *Grevillea obtusiflora* from N.S.W. which is a parent of the garden cultivar *Grevillea* "Poorinda Belinda" described and officially registered on page 327.



Photography by Andy McWhirter, Canberra Botanic Gardens

THE RED SPIDER FLOWER — GREVILLEA SPECIOSA

"The Red Spider" flower is so well known that we have chosen to picture an unusual variety you may not know. Grow this beauty in your garden.

MORE PROTEACEAE FOR GARDENS

The species has for years been known as *Grevillea punicea*. Announcement of the name change is made on page 319. The change in the scientific name is most unfortunate, but to thousands of bush ramblers in the Eastern States it has been, and always will be, "The Red Spider Flower". If you want a simple description of the spider flower-heads, turn to page 335. *Banksias* mostly require fair to good drainage, though some species, e.g., *B. robur* and *B. occidentalis*, can tolerate poorly drained soils. Western Australian *Banksia* have proved difficult on heavy clay soils in contrast to the eastern species, which are more tolerant. Western species prefer deep sandy soil, usually in a sunny position. *Dryandra* are relatively unknown in gardens, apart from a few well known plants. They must have a well drained spot and can stand more shade than *Banksia*. The natural soil for many of them is laterite, so they should tolerate heavier soils better than *Banksia*. *Isopogon* and *Petrophile* are mostly small shrubs and able to do quite well in lightly shaded areas. In fact, for some species, a certain amount of shade is essential. Again, good drainage is important and light or heavy soil seems to give equally good results.

PROTEACEAE AND THEIR CULTIVATION

Most people can readily recognise plants in the large plant family of *Proteaceae*; *Banksia*, *Telopea* (Waratah), *Grevillea* (which includes the spider flowers), *Hakea* (which includes the needle bushes), *Isopogon* (drumsticks), etc. What is not so obvious is why they are all in the same plant family. The botanists have grouped them together because of some common characters of the small flowers, many of which grouped together make up the head of flower. With the individual flowers varying in each genus and grouped together in different arrangements, we have the many genera that make up the family.

Another common character appears to be the conditions preferred by them for healthy growth. The previous article was written for gardeners in Victoria but may be applied generally. It may appear a little vague and non-specific, but in fact is to the point. Do not be too ambitious in your choice of plants when first starting, sticking first to species that are proven and hence readily available from most nurseries.

The soil type does not appear to be as important as some seem to think, a good garden soil being best with a reduction in results as you get heavier or lighter. As with most garden plants, many do not like wet feet, so that depth of soil or good drainage appear to be the most critical factors.

They need a regular watering and feeding. There is evidence that some at least also require a fungus-type growth, in association with their roots, that breaks down nutrients in the soil to a form more readily taken up by the roots. For this reason rotting leaves and a little soil from underneath an old *Banksia* tree may give you a good start. Unfortunately, they also suffer with fungal diseases, so that there is also a risk of introducing it to your garden with this method. Keep the area around the trunk higher than the surrounding ground and as dry as possible.

All these factors have been considered in previous articles:

Telopea—Growing Waratahs, Vol. 2: page 259; Vol. 3: 15.

Banksia—Vol. 2: page 11; Vol. 5: 194, 202, 321, 336, 356, 373.

Hakea—Vol. 5: pages 337, 342, 347, 352, 361, 373; Vol. 7: 310.

Grevillea—Vol. 2: pages 92, 93; Vol. 3: 3, 9, 11; Vol. 6: 6, 23, 169.

Isopogon—Vol. 3: pages 62, 135, 287; Vol. 7: 146, 318.

Petrophile—Vol. 5: pages 348, 349; Vol. 7: 45, 50.

Macadamia (Queensland Nuts)—Vol. 5: page 29.

HAKEA BAKERANA

A Species in Need of Preservation? — by Hugh P. Stacy

Found only in a few places between Sydney and Newcastle, north of Sydney, this hakea is surely one of the region's outstanding wildflowers. With flowers in mid-winter to rival the finest of its family and fruits amongst the largest of its genus, *Hakea bakerana* deserves to be better known.

It occurs naturally on sandy or gravelly loam as a low-spreading bush, often only about 60 cm in height on windswept heathlands and hillsides facing the Pacific Ocean. Whereas many other proteaceous plants found in these areas grow much larger in better conditions, *H. bakerana* is apparently not so inclined. Elsewhere even as an undershrub in open eucalypt forest, it remains a small bush barely 1.5 m tall, with multiple stems arising from a common rootstock.

Characterised by a mallee habit, this species grows quite slowly, its compact form freshened by bright green hairless new shoots and needle leaves to 7 cm long. Since flowers come only on old wood, several seasons pass before the various stems are sufficiently mature. The large glabrous inflorescences open between May and July, each with numerous flowers upstanding on short pedicels (about 5 mm long), massed together in axillary clusters nestling against the stems, often low on the plant. These clusters measure easily 10 cm across. Individual styles are typically deep reddish pink in colour, gently curving, up to 5 cm long and usually at least four times the length of the perianth tube which generally measures 8-10 mm. The perianth itself varies in shading, being carmine red at the base with cream-coloured lobes.

Although recently (July 1975) a single plant with white flowers was reported growing amongst pink ones, and while other observations suggest that in some areas flowers may be coloured more vividly than in others, there also tends to be an overall deepening of the hues as the flowering season progresses, or as individual flowers darken with age. Plants in community provide an outstanding display of rich colour in June.

Remarkable too is the formation of woody fruit so large in proportion to the size of the plant itself. Considering the growth effort necessary, it is as well that fruits form singly rather than in clusters. Stems carrying mature fruit are always noticeably thicker below than parts immediately above which have carried only flowers. The follicles measure to 6.5 cm from base to tip x 5 cm wide x 4 cm thick, with very rough deeply wrinkled surfaces. The rounded shape suddenly reduces to a short beak on each side of which there is, near the tip, a small conical protuberance 3 mm high.

While knowledge of its actual distribution remains uncertain, the few known habitats of *H. bakerana* lie between the cities of Sydney and Newcastle. Fortunately, so far, some of these areas have escaped the ravages of land development, although few lie within permanent parklands or reserves. The accompanying photo was taken within a mile of recent industrial subdivisions. These places, near settlement, are subject to bushfire, and even to burning off. Despite the apparent protection of its seed within such massive fruits, very few seedlings of this species were observed the year after a fire. However, many old plants which had been burnt to the ground were again growing strongly from the base. This mode of regeneration may be an important factor in the fight for survival, since new growth does not flower for several years, after which the fruits may take up to two seasons to mature.

More information is needed of this species in cultivation. Germination from seed is slow but sure, but in the first season particularly, seedlings are sensitive to drying out and require regular watering. Although wild plants are found in various soils, establishment on heavier clay loams appears more reliable. The few known specimens on clay soils west and south-west of Sydney are growing slowly and appear to be tolerant of wet conditions. Some success has been achieved in propagation from cuttings, but as yet no records are available of plants so grown. It will be interesting to observe whether such specimens tend to grow with single stems, perhaps becoming taller than plants grown from seed.



Photography by Hugh Stacy

HAKEA BAKERANA

GROWING EASTERN PROTEACEAE

Other eastern plants in this issue are the species of *Conospermum*, page 317, *Isopogon* and *Petrophile*, pages 320 and 331, and *Grevillea*, *Grevillea baueri*, on the front cover as well as pages 318 and 335. We need greater member participation in this periodical. Please send notes to the Editor on how successfully you are growing eastern Proteaceae in your garden.

HAKEA OF WESTERN AUSTRALIA

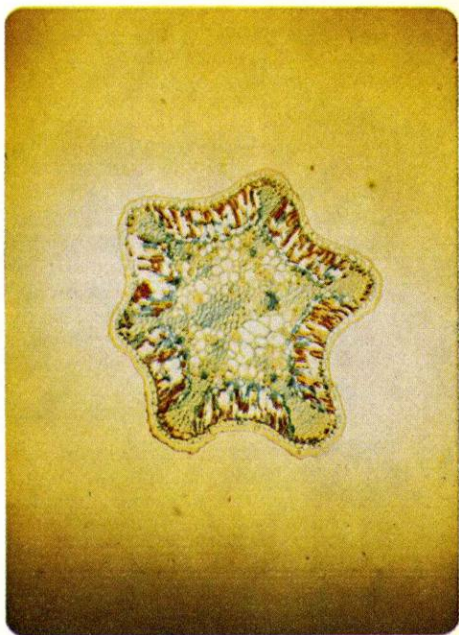
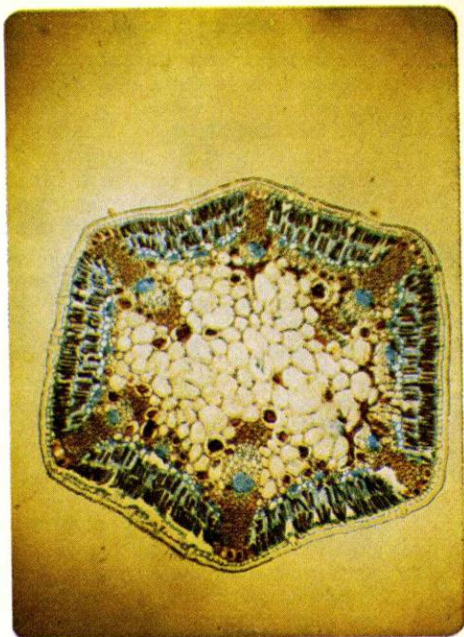


PLATE 1.—Upper, flowering branch of *Hakea sulcata* plus cross-section of typical upper leaf, widest diameter 1.25 mm. Lower, *Hakea gilbertii*, diameter 0.88 mm.

PROTEACEAE — ITS TAXONOMY, ECOLOGY, ANATOMY AND HORTICULTURE

THE HAKEA SULCATA GROUP

by Dr. Byron Lamont, Biology Department, Western Australian Institute of Technology, Bentley, 6102

INTRODUCTION

The general ecology and horticultural requirements of the Australian Proteaceae were considered in a previous article (Lamont 1973). More recently, the topic has been reviewed by two New Zealand horticulturalists (Hocking and Thomas 1974). This article examines in detail a number of *Hakea* species which have caused much confusion to both botanists and horticulturalists alike — the so-called *Hakea sulcata* group. The species concerned are *Hakea sulcata* R. Br., *H. gilbertii* Kipp. ex Meisn., *H. invaginata* B. L. Burtt, *H. scoparia* Meisn., *H. pycnoneura* Meisn., *H. subsulcata* Meisn., *H. meisnerana* Kipp. ex Meisn. and *H. lehmanniana* Meisn. At various stages, *H. gilbertii*, *H. scoparia* and *H. invaginata* have been regarded as varieties of *H. sulcata* (var. *gilbertii* Benth., *scoparia* Benth. and *intermedia* Ewart and White respectively — as in Blackall and Grieve 1954), but it took a Scotsman (Burtt 1943) to realise that they were distinct. Up till now there has been no key to separate these four species and *H. subsulcata* and *H. meisnerana* cannot be distinguished readily using Bentham's key (Bentham 1870). Much new data has been gathered for this article to show that, though they form a natural group, these species are different not only in their taxonomy, but also in their growth characteristics, leaf anatomy, ecology and climatic tolerances. A natural key to the eight species has been devised and notes are given on their horticultural potential.

Though it is the only broad-leaved species, *H. pycnoneura* has been included in the group because it is otherwise very similar to *H. scoparia*. This indicates the groupings under section *Conogynoides* of *Hakea* (Bentham 1870) are artificial, because *H. pycnoneura* is placed in a separate series to *H. sulcata* (*H. scoparia*).

HABIT

Table 1 gives morphological and ornamental details on each species. All are shrubs, with *H. gilbertii* (at an average height of 60 cm) easily the shortest, followed by *H. sulcata* and *H. lehmanniana* (100 cm) with *H. subsulcata* reaching up to 250 cm. Though there is much branching of the stems, the canopies are usually open due to the small surface area of their narrow leaves (Figs. 1 and 2). Many stems of equal importance arise from near ground-level, the outer ones curving away from the base before ascending, to give a shapely compact plant, especially *H. subsulcata*. The exceptions are: *H. gilbertii* which tends to spread horizontally from one or two main stems, tall specimens becoming straggly, *H. lehmanniana* which tends to spread horizontally from a few main stems, like a short toffee apple, and *H. pycnoneura* whose outer branches may collapse with age.

FLOWERS

All flowers are produced in clusters spread along stems produced the previous growing season (plates 1-4). The exceptions are *H. subsulcata* whose isolated inflorescences are produced on the old bare wood, and sometimes *H. gilbertii* with a few clusters at the tips of the previous year's growth. The clusters of *H. invaginata*, *H. scoparia*, *H. pycnoneura* and *H. subsulcata* are globular (like *H. laurina*) and of various shades of pink, with the purple stalks arising along a short hairy support (raceme). The clusters of *H. sulcata*, *H. gilbertii*, *H. meisnerana* and *H. lehmanniana* with fewer flowers are parachute-shaped and cream-coloured (except *H. lehmanniana* which is unique among the Proteaceae in having distinctly blue flowers) with the flowers also

arising along a short hairy support (of negligible length in *H. sulcata*). Little is known about the pollination vectors of this group, except to note that *H. gilbertii* is visited by at least five species of native bee, the honey bee and flies, while those with conspicuous inflorescences, especially *H. invaginata*, *H. scoparia* and *H. pycnoneura*, are sure to be bird-pollinated as well (Greg Keighery, King's Park and Botanic Garden, pers. comm.). The group is typically spring-flowering, though the winter-flowering of *H. pycnoneura* (like *H. petiolaris*) and early summer-flowering of *H. meisnerana* increase their horticultural appeal.

TABLE 1.—The habit, colour of foliage and flowers, flowering time, and dimensions of leaves and fruits of eight species in the *Hakea sulcata* group. Information is based on personal observations (field, King's Park) and all specimens in the herbaria of the Agriculture Department (WA), University of W.A. (UWA), and W.A. Institute of Technology. 20 ± 1 specimens from different collecting sites were available for all species, except *H. scoparia* (49), *H. meisnerana* (26) and *H. pycnoneura* (13). Figures are means $\pm$ standard deviations. Open = can see through canopy.

SPECIES	HABIT (sym. = symmetrical)	HEIGHT (m)	FLOWER COLOUR
<i>H. sulcata</i>	open, erect, sym., many stems from base, a few rising above rest	1.0 ± 0.4	cream
<i>H. gilbertii</i>	open, spreading from 1 or 2 stems, branches clumped around fruits	0.6 ± 0.1	cream, rarely suffused pink
<i>H. invaginata</i>	open, erect, sym., many stems from base	1.3 ± 0.4	deep pink, rarely cream
<i>H. scoparia</i>	open, erect, sym., many stems from base	1.5 ± 0.4	pale yellow to deep pink, stalk purple
<i>H. pycnoneura</i>	open, erect, spreading with age, 6 to many stems from base	1.6 ± 0.6	mauve, rarely cream, stalk purple
<i>H. subsulcata</i>	closed (mature)—open (old), erect, sym., many stems from base	2.0 ± 0.5	cream to mauve, stalk purple
<i>H. meisnerana</i>	open, erect, sym., several stems from base	1.4 ± 0.5	cream, rarely pink, stalk green
<i>H. lehmanniana</i>	partly open, fairly sym., spreading from 1 or 2 stems	1.0 ± 0.4	pale blue, rarely cream

Species	Flower period	Leaf colour	Leaf length (cm)		Fruit length (cm)
			Shortest	Longest	
<i>H. sulcata</i>	Sept.	pale grey-green	1.5 ± 0.4	9.0 ± 4.1	0.7 ± 0.1
<i>H. gilbertii</i>	Aug.-Sept.	pale grey-yellow	1.5 ± 0.5	5.5 ± 2.5	1.3 ± 0.2
<i>H. invaginata</i>	Aug.-Sept.	pale grey-green	6.4 ± 2.9	18.8 ± 3.6	2.1 ± 0.3
<i>H. scoparia</i>	Aug.-Sept.	pale grey-green	5.6 ± 2.9	17.6 ± 5.4	2.2 ± 0.3
<i>H. pycnoneura</i>	May-June	pale grey-green	5.8 ± 2.2	17.8 ± 4.5	2.6 ± 0.3
<i>H. subsulcata</i>	Sept.-Oct.	grey-olive green	2.6 ± 1.1	9.5 ± 2.1	1.9 ± 0.4
<i>H. meisnerana</i>	Sept.-Nov.	green	3.2 ± 1.1	9.5 ± 1.7	1.5 ± 0.1
<i>H. lehmanniana</i>	July-Sept.	dark blue-green	1.2 ± 0.4	5.4 ± 1.5	2.5 ± 0.5

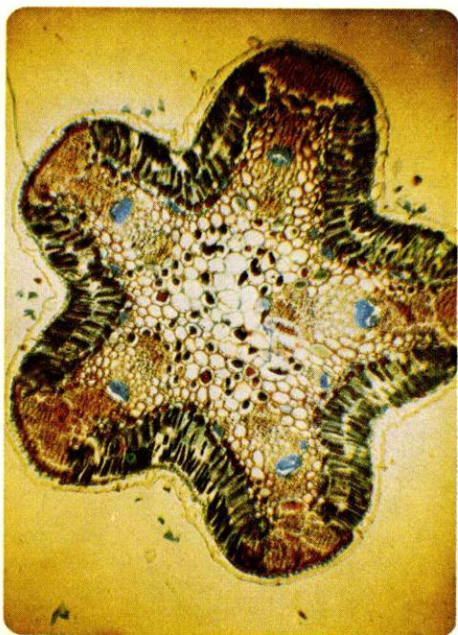
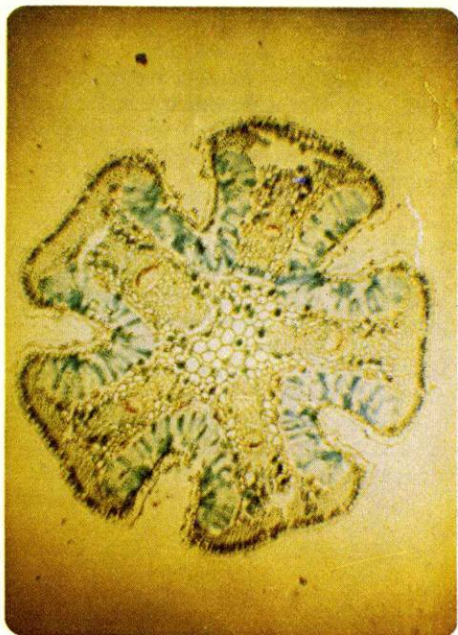


PLATE 2.—Upper, flowering branch of *Hakea invaginata* plus cross-section of typical leaf, widest diameter 1.25 mm. Lower, *Hakea scoparia*, diameter 1.50 mm.

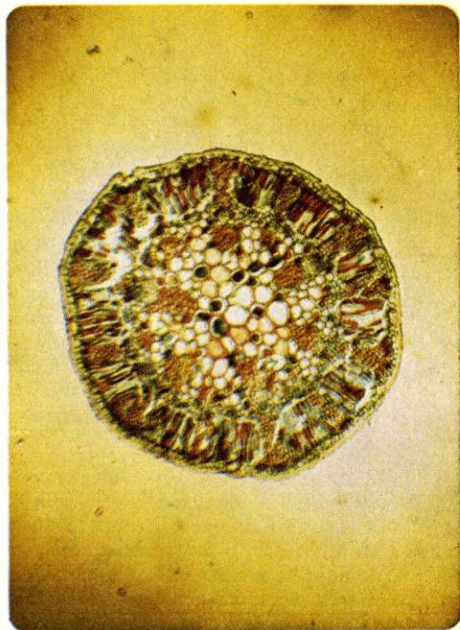
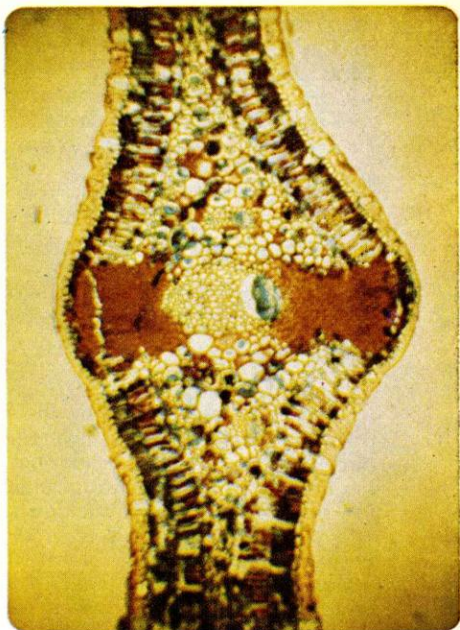


PLATE 3.—Upper, flowering branch of *Hakea pycnoneura* plus cross-section of typical leaf, widest diameter 5.75 mm. Lower, *Hakea subsulcata*, diameter 1.0 mm.

LEAVES

Even without their seasonal masses of flowers, the leaves and fruits of these species are a continuous source of interest (Figs. 1 and 2). Their foliage gives an overall impression of greyness or dark green, providing a contrast with other greens in the garden. The new leaves are silky due to white or orange T-shaped hairs which form a cover of "scales" over the leaf and stem surfaces. The leaves of *H. invaginata*, *H. scoparia*, *H. pycnoneura*, *H. subsulcata* and *H. meisnerana* curve out from the node and then ascend vertically, independent of the angle of the stem. The leaves of *H. gilbertii* are typically at right angles to the stem (sometimes bent forwards or backwards—recurved) independent of the position of the stem, while those of *H. lehmanniana* form an angle of 30° – 80° to the stem, though are sometimes recurved. The lower (vegetative) leaves of *H. sulcata* are vertical whereas the upper (floral) leaves are often horizontal or recurved. Twisting and coiling of leaves is common in *H. invaginata*, *H. scoparia* and *H. pycnoneura*, while the curving of leaves in the same direction on a given branchlet of *H. subsulcata* gives the canopy a swirled appearance.

All species have broad (oblongate) juvenile leaves which are replaced by needle (terete) leaves by the end of the first growing season. The plant reverts to juvenile foliage temporarily following severe damage to the canopy (fire, drought, grazing, bulldozing). The whole area of leaf polymorphism in the Proteaceae as an environmental adaptation would provide an exciting topic for research by eco-physiologists. In addition, all species show a severe reduction in length of leaves produced towards the end of the growing period, especially *H. lehmanniana*. In addition, *H. sulcata* produces basal mature leaves which are much longer and closer together than the terminal mature leaves, independent of growing conditions.

Despite the conspicuous within-plant differences, there are clearly differences in typical leaf length between species. At up to over 20 cm, the leaves of *H. invaginata*, *H. scoparia* and *H. pycnoneura* are by far the longest in the group, with their shortest leaves on average equal to the length of the longest leaves in *H. gilbertii* and *H. lehmanniana* (Table 1). *H. sulcata*, *H. subsulcata* and *H. meisnerana* are in between with their longest leaves around 10 cm. The large variation in length of the longest leaves of *H. sulcata* is due to some specimens including basal leaves (long), others only upper leaves (short). The reduction of leaf length by seasonal conditions to under 1.5 cm in *H. sulcata*, *H. gilbertii* and *H. lehmanniana* indicates the high level of leaf plasticity (as defined by Beadle 1968) in this group. Leaf width varies little seasonally once juvenile leaves are no longer produced. Those of *H. subsulcata* and *H. gilbertii* are rarely more than 1 mm wide, *H. scoparia* has the widest needle leaf — up to 2.2 mm, with the rest from 1.0 to 1.8 mm. The broad leaves of *H. pycnoneura* vary from 4 to 8 mm in width. The leaves of all species taper to a point (mucron) — except *H. meisnerana* and *H. pycnoneura* which come to a point abruptly — coloured black or brown with a yellow base. The mucron of *H. gilbertii* is probably the finest (and sharpest!) of all species in the Proteaceae.

ANATOMY

Provided mature adult leaves are used, leaf structure provides the best clue to the identity and relationship of the eight species (plates 1-4). These cross-sections were cut at $8\mu\text{m}$ with a rotary microtome and stained with safranin (red) and fast green to highlight the various tissues (except *H. invaginata* which was stained with toluidine blue O). However, a safety razor blade and hand lens are sufficient to show the taxonomically-important features. Every species has a group of thick-walled fibres (red) at each corner of the leaf. These fibres are responsible for the "nerves" or striations running along the leaf surface. There is a groove (or sulcation — hence the sulcate group) running between each pair of fibre groups. Water loss from the leaves is limited to pores (stomates) in these grooves. Apart from their rounded

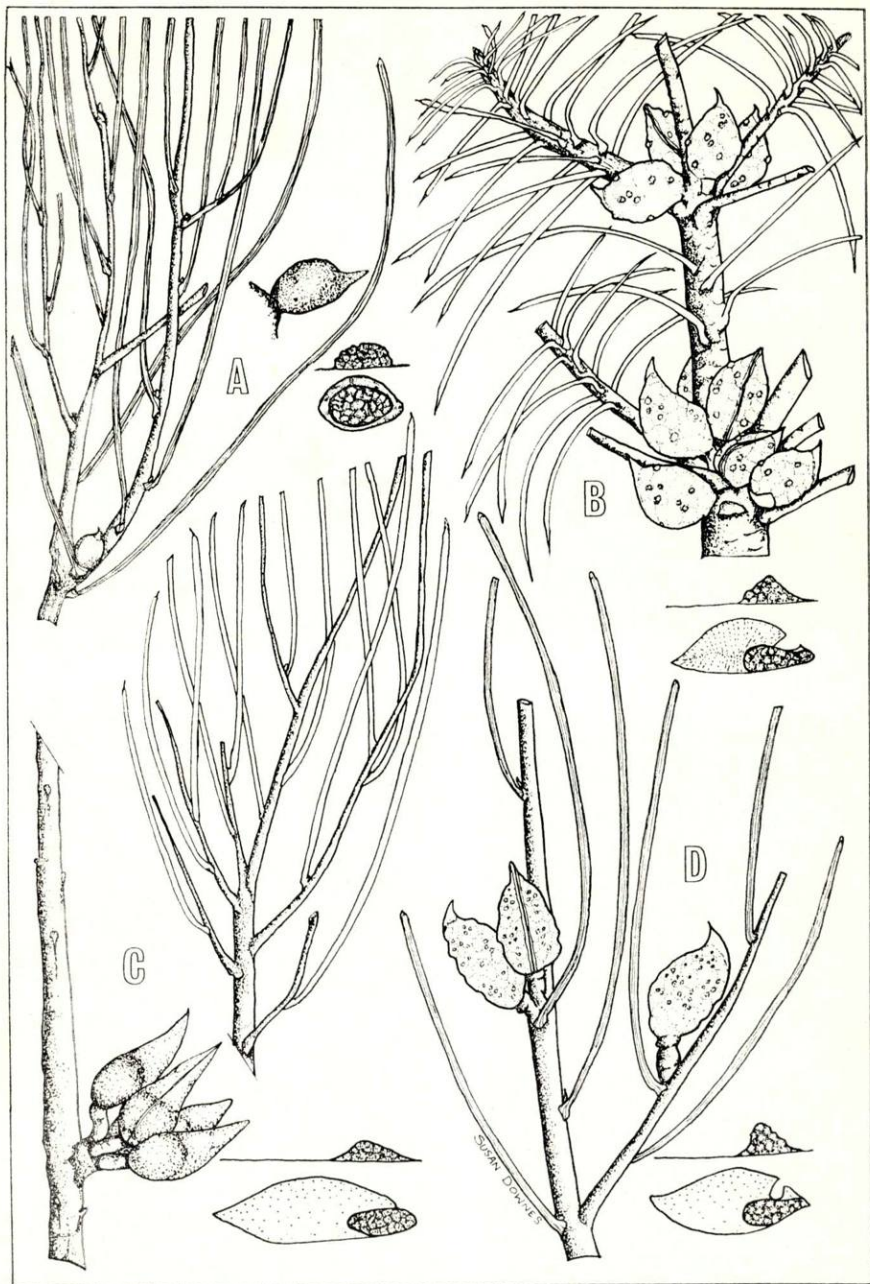


FIGURE 1.—A, *Hakea sulcata*; B, *Hakea gilbertii*; C, *Hakea subsulcata*; D, *Hakea meisnerana*. Branches natural size, seeds (and fruit of *H. sulcata*) $\times 2$.

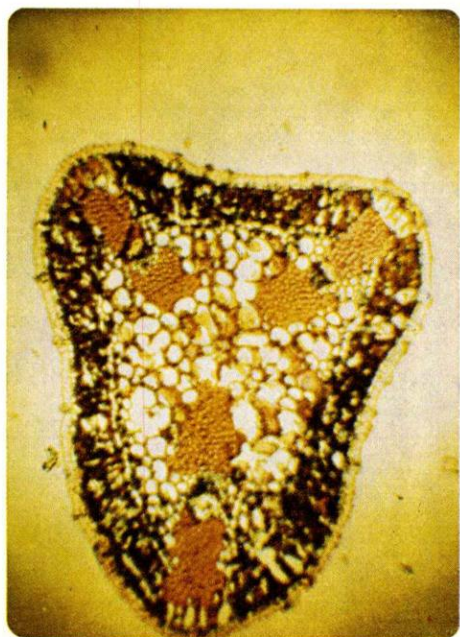
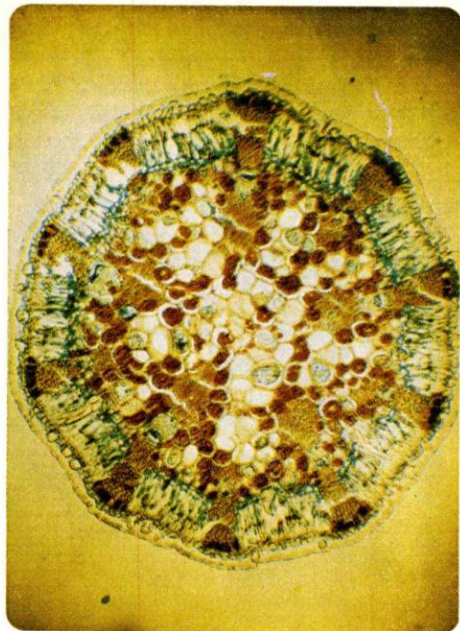


PLATE 4.—Upper, flowering branch of *Hakea melsnerana* plus cross-section of typical leaf, widest diameter 1.25 mm. Lower, *Hakea lehmanniana*, diameter 1.35 mm.

shape, other features of the leaves which are considered to reduce water loss (important for survival of the summer drought — see under Climatic Tolerances) are their thick cuticles (1.3 times width of the epidermis) and sunken stomates.

H. sulcata generally has 6 fibre groups (5 in basal adult leaves) and is very shallowly grooved, if at all. *H. gilbertii* also has 6 groups, but is not hexagonal because its grooves are deeper and vary in width, and is also distinguished by the uniting of two diametrically opposite fibre groups. *H. invaginata* is characterised by 5 very broad fibre groups (which correspond to the surface actually exposed to the elements) and deep sunken grooves (hence invaginate). With hairs and stomates restricted to these grooves such leaves are remarkably similar to the cladodes of *Casuarina*. *H. scoparia* has 5 fibre groups intermediate in thickness between *H. sulcata* and *H. invaginata*. The moderately deep grooves of *H. scoparia* (similar to those of *H. gilbertii*) give the cross-section a starfish appearance, whose anatomy is otherwise identical to that of *H. invaginata*. The thick broad leaves of *H. pycnoneura* at first appear unrelated to the previous species. Closer study of the section shows, however, that it is based on the same pattern, with 6 fibre groups at the corners and shallow grooves. Contraction of the leaf and loss of one fibre group would give a structure not unlike that of *H. scoparia*.

The three remaining species are just as distinctive. *H. subsulcata*, with 12 small fibre groups, is almost circular. Shallow grooves exist between the 10 fibre groups of *H. meisnerana* (polyhedral), which is otherwise very similar to *H. subsulcata*. *H. lehmanniana* has only three groups, with a rounded triangular or broadly V-shaped outline.

FRUITS AND SEEDS

Typical of other Hakeas, this group has attractive woody fruits (follicles) which are retained on the plant unopened indefinitely. On picking, the fruits open to release two winged seeds. At an average length of 0.7 cm, the fruits of *H. sulcata* are among the smallest of all Hakeas (I have not seen the eastern species *H. microcarpa*). The stalk is so small that it is embedded in the branch by the time the fruit reaches maturity. All other species clearly have stalks. The follicles of *H. invaginata*, *H. scoparia*, *H. pycnoneura* and *H. lehmanniana* are generally 2-3 cm long, while *H. gilbertii* and *H. meisnerana* are 1-2 cm long (Table 1). Only one fruit arises from an inflorescence in *H. sulcata* and *H. lehmanniana*, one or two develop in *H. gilbertii* and *H. meisnerana*, and handfuls of five or more often develop in *H. subsulcata*, *H. scoparia*, *H. pycnoneura* and *H. invaginata*. A fascinating feature of *H. sulcata* and *H. gilbertii* is the development of the new season's branchlets from the base of a fruit or old inflorescence. They come off in pairs, though one branch tends to dominate in *H. sulcata*. Because the inflorescences are clumped in *H. gilbertii*, the branches are also clumped, giving a most unusual growth pattern.

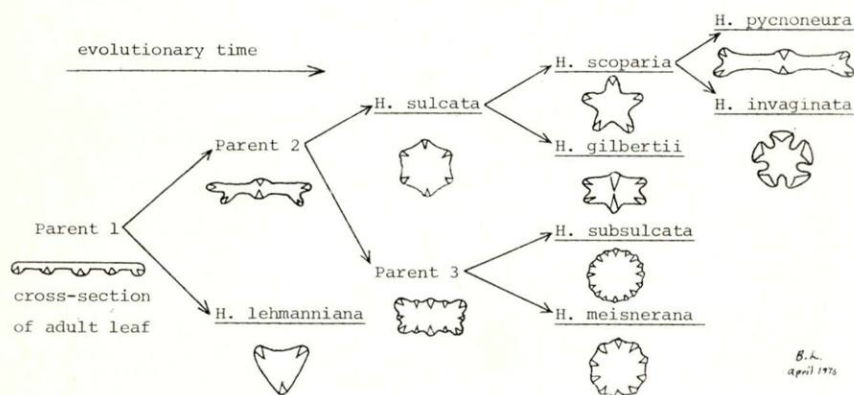
All species have rounded, ovoid fruits which taper to a point (beak). The fruits of *H. sulcata*, *H. subsulcata*, *H. meisnerana* and *H. invaginata* are smooth, though "shot-holes" may be common in their surface. The surface of *H. gilbertii* fruit is covered in smooth or broken "warts", while its beak is "snub-nosed", like that of *H. meisnerana*. While the fruits of *H. subsulcata* taper gradually to a point, those of *H. invaginata*, *H. scoparia* and *H. pycnoneura* have long constricted beaks which readily break off. The fruits of *H. scoparia* and *H. pycnoneura* are identical in shape and presence of many black, corky warts (Fig. 2), though the fruits of *H. scoparia* tend to be larger than those of *H. pycnoneura*. The small beak of *H. lehmanniana* is almost lost among the many multiple-branching prickles of its bizarre, hedgehog fruit.

The seed of *H. sulcata* has a minute wing which surrounds the embryo-bearing centre (nucleus) like the rim of a hat. All the other seeds are spear-shaped, with only the wings of *H. invaginata*, *H. scoparia*, and *H. pycnoneura*

clearly passing right around the nucleus. Only in *H. subsulcata*, which has a very elongated nucleus, does the wing not pass right down at least one side of the nucleus. Inspection of the impression left by the seed in the fruit shows that, even in this species, the wing technically passes down both sides of the nucleus. Not much weight should be given to the nick in the wings (caused by their incomplete formation) seen in Figs. 1 and 2: they may be present or absent in different specimens of the same species, though at least *H. meisnerana* appears to consistently have the nick.

RELATIONSHIPS

In the absence of genetic studies, it is difficult to form a complete picture of evolutionary relationships in this group. On the basis of the foregoing, however, and on the assumption that changes have occurred from moist-adapted to drought-adapted (Johnson and Briggs 1975) — though their actual physiological limits are not yet known (see under Climatic Tolerances) — the following tentative scheme is proposed:



It is at least clear that the natural groupings are *H. sulcata* and *H. gilbertii*; *H. scoparia*, *H. pycnoneura* and *H. invaginata*; *H. subsulcata* and *H. meisnerana*; and *H. lehmanniana*. In view of this, a natural key has been devised based entirely on features that are always present in *Hakea* specimens, leaves and fruits (Fig. 3).

FIGURE 3. Key to separate species in the *Hakea sulcata* group based on leaves and fruits. Species are grouped according to their conjectured relationships such that the most closely related species are separated out last. "Leaves" refers to typical, adult leaves.

- A. Leaves 3 nerved, fruits with ornate prickles *H. lehmanniana*
- A. Leaves 5 or 6 nerved, fruits smooth or warty
 - B. new branches arise from base of inflorescences, fruits under 1.6 cm long
 - C. fruits under 1 cm long and appear to lack stalks *H. sulcata*
 - C. fruits over 1 cm long and stalks clearly present *H. gilbertii*
 - B. new branches arise independently of inflorescences, fruits over 1.6 cm long
 - C. leaves with sunken grooves, fruits smooth *H. invaginata*
 - C. leaves with open grooves, fruits very warty
 - D. leaves needle-like *H. scoparia*
 - D. leaves strap-like *H. pycnoneura*
- A. Leaves 10 or 12 nerved, fruits smooth
 - B. fruits narrow with tapering tip, leaves in bunches *H. subsulcata*
 - B. fruit rounded with short bent tip, leaves spaced out *H. meisnerana*



FIGURE 2.—A, *Hakea scoparia*; B, *Hakea pycnoneura*; C, *Hakea invaginata*; D, *Hakea lehmanniana*. Branches natural size, seeds x 2.

DISTRIBUTION AND ECOLOGY

From the distribution maps in Fig. 4 it is seen that only *H. subsulcata*, *H. scoparia* and *H. invaginata* venture outside the South-West Botanical Province into the dry Eremaean Province. On the other hand, all but *H. sulcata*, which is typically coastal, avoid the wet, forested south-west corner. *H. gilbertii*, *H. pycnoneura* and *H. lehmanniana* reach coastal areas, but *H. meisnerana*, *H. scoparia* and *H. invaginata* are strictly inland. The apparent wide range of *H. subsulcata* is dependent on confirmation of the specimen supposedly from the Darling Range near Perth. The isolated occurrences of *H. subsulcata* in the pastoral district of Leonora suggest more searching is required between it and the main area centred on Pingrup. *H. scoparia* appears to cover the greatest area and its distribution overlaps (sympatry) those of *H. meisnerana*, *H. subsulcata*, *H. invaginata* and possibly *H. pycnoneura*. The isolated occurrence of *H. pycnoneura* at Mt. Ragged, 193 km east of Esperance, is a form with thin leaves and deserves closer study.

From Table 2 it is seen that generally these species occur on sandy or lateritic soils. *H. sulcata* is atypical in that it usually occurs in winter-water-logged soils, though it may spread to deep, dry sands (Lamont 1976). *H. sulcata*, *H. scoparia* and *H. subsulcata* may also occur on "better" soils — loams of higher nutrient content and water availability. *H. invaginata* may also be found on red sands typical of mulga country. Most soils are only able to support heath or scrub, and occasionally woodland. All species have been reported to possess relatively small, specialised surface (proteoid) roots (Lamont 1972) which no doubt assist in the absorption of nutrients from such deficient soils (Lamont 1975). For the *H. sulcata* study mentioned above, it was found root growth occurred over the range of 1% water availability (dry) to 22% water availability (flooded). The proteoid roots were larger in dry soils, but there were more of them under moderately water-logged conditions (2 x field capacity). This seemed to provide a balance so that nutrient uptake was maintained under all conditions.

TABLE 2.—The physiography, soils and vegetation types occupied by species in the *Hakea sulcata* group. Information as in Table 1.

Species	Physiography	Soil Type	Vegetation Type
<i>H. sulcata</i>	Swamp to sandy rise	White sand, clay-laterite, loam, sand over clay or laterite	Mallee scrub, open woodland—marri, jarrah, <i>Nuytsia</i>
<i>H. gilbertii</i>	Sandplain	White sand	Heath, open woodland—jarrah
<i>H. invaginata</i>	Sandplain	Yellow or red sand	Mallee or mulga scrub, <i>Codono-carpus</i>
<i>H. scoparia</i>	Lateritic or sandy rise, sandplain, granite outcrop	White/yellow sand, sand over laterite, clay-laterite, loam	Heath or scrub—mallee, <i>Banksia</i> , other Hakeas
<i>H. pycnoneura</i>	Lateritic rise or sandplain	White sand, clay-laterite, sand over laterite	Heath or scrub
<i>H. subsulcata</i>	Lateritic rise, mallee flat	Sand over laterite, laterite, clay-loam	Scrub or mallee, woodland
<i>H. meisnerana</i>	Undulating sandplain	White/yellow sand, plus laterite, loamy sand	Heath or scrub—mallee, other Hakeas
<i>H. lehmanniana</i>	Lateritic rise or sandplain	White sand, sand over laterite, clay-laterite	Heath or scrub with mallee, open woodland—wandoo

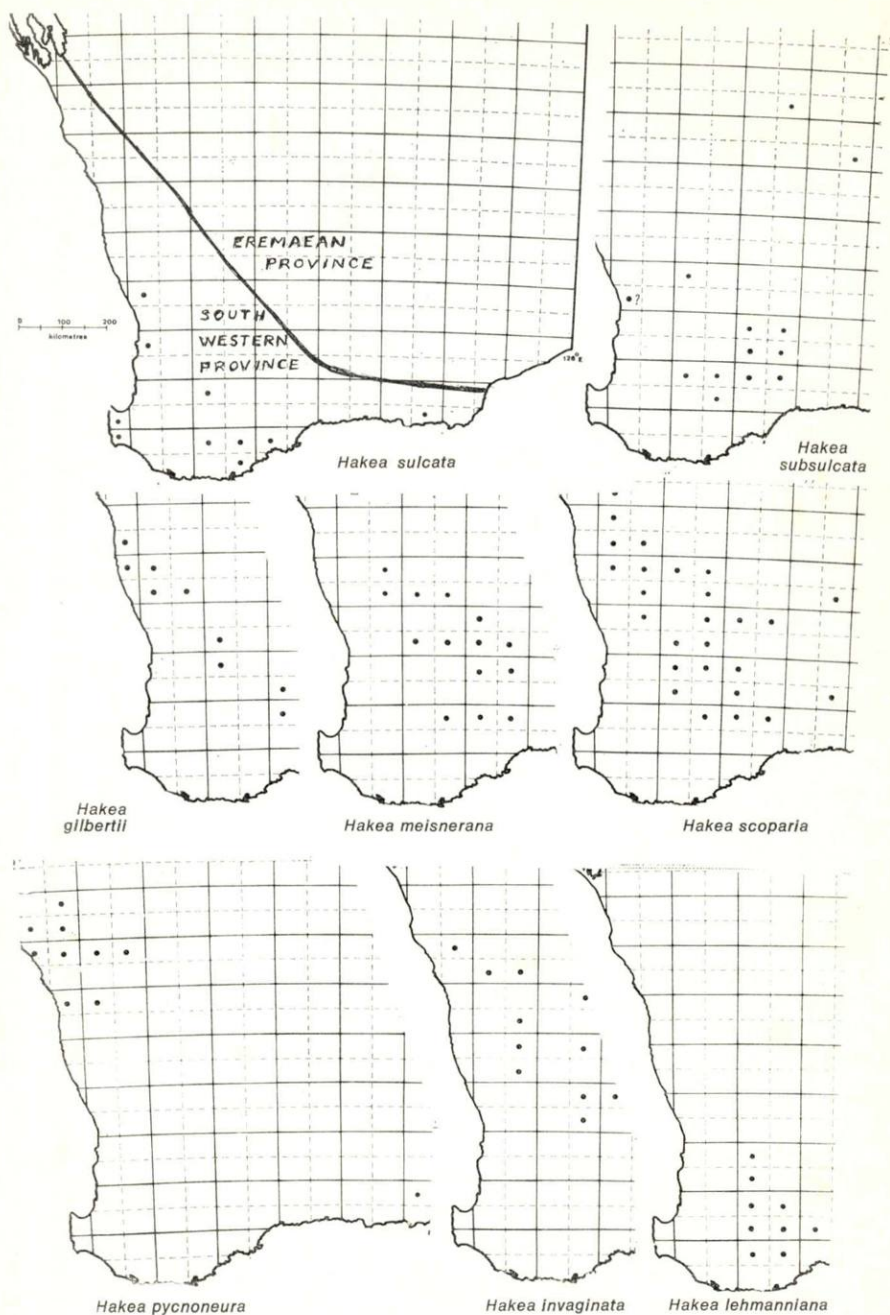


FIGURE 4.—Distribution of species in the *Hakea sulcata* group. The map is based on the 1:2.5 million projection of the W.A. Dept. of Mines (1969) with the grid squares subdivided into four. Any quarter in which a herbarium specimen was collected is indicated by a dot in its centre.

CLIMATIC TOLERANCES

Table 3 has been compiled by comparing the distribution of each species against the best isoline maps available for each climatic factor (Anon. 1940, Anon. 1959, Anon. 1968, Anon. 1970, Gentili 1971, Bartlett 1975, K. Newbey, pers. comm.). The isolines of smallest or highest values which fell closest to the middle of a quarter-grid were used to derive the range of tolerance. The Darling Range locality of *H. subsulcata* and Mt. Ragged locality of *H. pycnoneura* were omitted from calculations. All species typically are found under mediterranean conditions with limited occurrence in semi-arid areas. The wettest six months of the year are generally from May to October, with the extreme range of *H. subsulcata* from February to July. *H. sulcata* and *H. lehmanniana* are restricted to the wetter areas of the south-west (40-120 cm annual rainfall), with the others, except *H. gilbertii*, in much drier areas (20-50 cm). The irregularity of the rainfall is indicated by the fact that, on average, for one year in ten (10 percentile) some specimens of *H. invaginata*, *H. scoparia*, *H. pycnoneura* and *H. meisnerana* must survive an annual rainfall of less than 15 cm (6 in), and less than 10 cm for *H. subsulcata*. At the other end of the scale, some specimens of all these species may receive more than 60 cm (24 in) one year in ten (90 percentile).

TABLE 3.—Climatic data for species in the *H. sulcata* group. Distribution maps were compared against isoline maps (from various sources) for each climatic factor.

Species	Mean rainfall in cm/year	10 percentile for year	90 percentile for year	Growing season in months	Mean sunshine in hr./day
<i>H. sulcata</i>	45-120	36-102	69-140	6 -8.5	6 -8.3
<i>H. gilbertii</i>	30-60	25-41	41-79	4.5-5.5	8 -8.5
<i>H. invaginata</i>	25-35	15-30	41-58	2 -4.5	8.3-9
<i>H. scoparia</i>	25-50	13-25	36-61	1.5-5.5	7.5-9
<i>H. pycnoneura</i>	23-50	13-36	41-61	2 -4.5	8.5-9
<i>H. subsulcata</i>	20-45	10-30	36-61	0 -6	7 -9.5
<i>H. meisnerana</i>	25-50	13-30	41-61	3 -5.5	7.5-8.7
<i>H. lehmanniana</i>	40-70	30-41	56-91	5 -8	6.5-8.3
	Mean min. temp./mth. (°C)	Mean max. temp./mth. (°C)	Frost-free days p.a. (>0°C)	Relative humidity Jan. 3 p.m.	Relative humidity July 9 a.m.
<i>H. sulcata</i>	5 -10.6 (-2.2)*	24.4-30 (44.4)†	200-365	40-70	75-85
<i>H. gilbertii</i>	5 - 8.9 (-2.8)	30 -34.4 (46.7)	200-350	35-65	70-80
<i>H. invaginata</i>	3.9- 6.7 (-3.3)	33.9-36.1 (47.8)	200-365	25-50	70-80
<i>H. scoparia</i>	3.9- 6.7 (-3.9)	30 -36.7 (47.2)	180-300	25-50	70-85
<i>H. pycnoneura</i>	5.6-10 (-1.7)	31.7-37.2 (47.8)	300-365	30-60	65-70
<i>H. subsulcata</i>	3.9- 5-6 (-3.9)	2.94-37.5 (50)	200-300	25-40	60-85
<i>H. meisnerana</i>	3.9- 5.6 (-3.3)	30 -35.6 (47.2)	200-250	30-50	80-85
<i>H. lehmanniana</i>	4.4- 6.7 (-3.9)	26.7-32.8 (47.2)	150-300	35-55	80-85

* Lowest temperature recorded.

† Highest temperature recorded.

Of more importance is the rainfall in relation to evaporation. Taking this into account using the Prescott formula (Gentilli 1971), the species can be ranked from the greatest to least mean growing period favoured as follows: *H. sulcata* (>7 months), *H. lehmanniana*, *H. gilbertii*, *H. meisnerana*, *H. scoparia*, *H. pycnoneura*, *H. invaginata* and *H. subsulcata* (3 months). In fact, *H. invaginata*, *H. scoparia*, *H. pycnoneura* and *H. subsulcata* can grow in areas with a theoretical growing season of nought (!) to two months. It is more likely, however, that, through their ability to absorb water at depth, these species grow over a much longer period. Consider, for example, *H. lehmanniana* growing in gravelly clay loam over laterite (Lamont 1976):

	Jan. 30	Mar. 29	May 18	May 28	Aug. 30	Sept. 10	Oct. 28	Dec. 18
New shoots	o	o	xx	xxx	xx	xx	xx	o
New roots	o	o	x	xx	xx	xx	o	o
Available soil water*	o	o	xx	xx	xx	xxx	o	o

* In uppermost 15 cm of soil

o — nil; x — restricted; xx — moderate; xxx — high

It is seen shoot growth continued into early summer, even though surface water availability had long since dropped to zero and root growth ceased.

The more northerly and easterly the distribution of a species, the greater the daily sunshine (Table 3). A figure of 9.5 hours/day is as high as any in Australia, while a figure as low as 6 hours/day is rarely met. Only specimens of *H. invaginata*, *H. scoparia*, *H. subsulcata* and *H. meisnerana* may be found growing at a minimum monthly temperature for the coldest month of less than 4°C, though there is little difference in mean low temperature tolerance between any of the eight species. Temperatures rarely drop below 0°C, and the lowest temperature recorded (-3.9°C) has been met by *H. scoparia*, *H. subsulcata* and *H. lehmanniana*. Frosts are not sufficiently frequent or severe to affect plant growth, and only *H. scoparia* and *H. lehmanniana* occur in areas with less than 200 consecutive frost-free days during the year. Since most of the populated areas of Australia receive 200 or more frost-free days, only *H. pycnoneura* would need to be treated with caution in areas with less than 300 frost-free days. If frosts are a problem, then *H. lehmanniana* appears to be the most tolerant.

Ranking of the species from lowest to the highest average mean maximum temperature experienced for the hottest month gives: *H. sulcata* (30°C), *H. lehmanniana*, *H. gilbertii*, *H. meisnerana*, *H. invaginata*, *H. scoparia*, *H. pycnoneura* and *H. subsulcata* (37.5°C). This sequence is the same as that for decreasing growing season requirements (except *H. pycnoneura* appears in a lower position) and, in the absence of eco-physiological experiments, these two criteria give the best clues to the relative drought-tolerance (xerophytism) of these species. The species which experienced the highest temperature recorded (50°C) was *H. subsulcata*. There is little difference in the highest relative humidity (July, 9 a.m.) present between and within the range of all species. However, the lowest relative humidity (January, 3 p.m.) varies from 40-70 per cent for *H. sulcata* to 25-50 per cent for *H. invaginata*, *H. scoparia* and *H. subsulcata*.

The presence of broad juvenile leaves in these otherwise narrow-leaved species is puzzling. They could simply be a hangover from their tropical ancestors which presumably would have produced only broad leaves. On the other hand, the broad juvenile leaves could give the seedling a better chance of establishing — the large leaf area enhancing sugar production for further growth at a time of year when soil water was abundant.

HORTICULTURE

The members of the *Hakea sulcata* group are virtually unknown to nurserymen or home gardeners, though fine specimens of all but *H. meisnerana* and *H. sulcata* have been raised in the botanic gardens of King's Park, Perth. Two 30 cm high plants of *H. sulcata* I removed from the edge of a swamp in winter (dormant) have thrived in my garden. When sown just beneath the surface of clean, fine, freely-drained sand from April to August almost 100 per cent germination is assured by 3-4 weeks. If drying out is a problem, the tray containing moistened soil can be placed in a new plastic bag till emergence has occurred. The seedlings should be transplanted into a friable soil mix low in nutrients as soon as the cotyledons have spread horizontally. The seedlings can be transferred to the garden the following late autumn, or after a few years — provided the root systems have not been confined.

For information on the implications for cultivation of their adaptation to very infertile soils and moderate to low rainfall see the section "Growth requirements for the Proteaceae" in Lamont (1973). In particular, these species thrive in full sunlight and soils with surface humus. They respond very well to the slow-release fertilisers now on the market. Their hardiness (drought-tolerance) in increasing order seems to be: *H. sulcata* (cool mediterranean), *H. lehmanniana*, *H. gilbertii*, *H. meisnerana*, *H. scoparia* = *H. pycnoneura* = *H. invaginata*, *H. subsulcata* (semi-arid). Even so, all species can grow under moister conditions, probably including all-year-round watering. They should not be watered overhead during the day. Regarding pests, caterpillars will severely damage soft new leaves, while adult leaves are understandably quite immune. Leaf "galls" (swellings bearing a 0.3 cm long slit) are almost universally present on field specimens of *H. scoparia*, and to a lesser extent *H. invaginata* (Plate 2), though whether they also disfigure garden specimens is not known. Parrots will bite off fruits and the tops of mature stems. Apart from this, they are "not susceptible to fungal disease or pests" (E. Wittwer, pers. comm.).

Generally, these eight species make handsome shrubs with stiff, erect leaves, and compact, symmetrical shape. Their light grey to dark green foliage contrasts with other greens in the garden. Their leaves, fruits and flowers are rewarding subjects for study. Their beautiful clusters of flowers at intervals along the stem are highly suitable for vases, bouquets and ikebana floral art. Because of their ornate woody fruits and firm leaves these species are ideal for dried art. More specifically, *H. sulcata* has the special virtue of tolerance of winter-waterlogging, but otherwise, because of its minute fruit and leaf polymorphism, has mainly novelty value in its favour. Because of its low height (for a *Hakea*) and compact habit in full sun, *H. gilbertii* has been recommended for rockeries; its spiny leaves make it a formidable barrier to human or animal traffic, should such a need arise. Otherwise, the spiny leaves, straggly habit and unexciting flowers severely limit its horticultural potential. *H. scoparia* and *H. invaginata* are most attractive when in flower, at a time when many spring-flowering species are still in bud. Their high drought-resistance, as already described, makes them suitable for sites with little or no irrigation: freeways, car parks, bush gardens, mine dumps. Their open density enables them to withstand high winds and yet offer some shelter. Ken Newbey of Ongerup has had some establishment problems with *H. invaginata* (pers. comm.). While *H. invaginata* retains its symmetry, *H. scoparia* tends to ramble with age. Its close relative, *H. pycnoneura*, may also ramble, but it has the virtues of charming mauve inflorescences, broad leaves and winter-flowering.

H. subsulcata appears to be the most drought-tolerant in the *H. sulcata* group. In addition, it is the tallest and densest (wind-break). Its twisting dark foliage is highly attractive, though its delicate inflorescences are hidden on the old wood in the centre of the cylinder-like canopy. Old plants, in the

field at least, become "twiggy" due to loss of leaves. ". . . A very hardy species which requires good drainage and makes moderate growth" (Newbey 1970). Little is known about *H. meisnerana* except to note that, though the inflorescences are not striking, they are produced in late spring-early summer when many species have finished flowering. It has a pleasing form and not the width of the other species, but otherwise its horticultural potential is limited. Though the arrangement of the spiny leaves makes *H. lehmanniana* painful to touch, its blue-green foliage, pale blue flowers and prickly fruits give it unique appeal. Full sun and exposure ensure the plants have a compact shape, otherwise they tend to spread. It has considerable potential for rockeries, pebble gardens, planter boxes and Bonsai.

ACKNOWLEDGMENTS

The excellent line drawings were prepared by Susan Downes of Roleystone. Rick Ryan of Biology prepared the maps and took most measurements. Lynne Brighton, formerly of Biology, and Kevin Kennelly, formerly of the Botany Department, University of W.A., prepared most of the leaf sections. Ernie Wittwer, Superintendent, King's Park and Botanic Garden, and Ken Newbey, of Murdoch University and Ongerup, generously provided notes on the horticultural potential of the *Hakea sulcata* group.

REFERENCES

- Anon. (1940).—"Climatological Atlas of Australia". Bur. Meteorol.: Melbourne.
 Anon. (1959).—"Climatological Survey: Region 13 — Geraldton Western Australia". Also Regions 8, 11, 12, 14, 16 and Esperance in the same series. Bur. Meteorol.: Melbourne.
 Anon. (1968).—Review of Australia's Water Resources. Monthly Rainfall and Evaporation. Bur. Meteorol.: Melbourne.
 Anon. (1970).—Atlas of Australian Resources. Rainfall. Geography Section, Dept. Nat. Develop.: Canberra.
 Bartlett, W. M. (Ed.) (1975).—Western Australian Year Book. Aust. Bureau Statistics, W.A. Office: Perth.
 Beadle, N. C. W. (1968).—Some aspects of the ecology and physiology of Australian xeromorphic plants. *Aust. J. Sci.* 30, 348-55.
 Beard, J. S. (1970).—"A Descriptive Catalogue of West Australian Plants". 40-42. S.G.A.P.
 Benthall, G. (1870).—"Flora Australiensis". Vol. 5, p. 495. Reeve & Co.: London.
 Blackall, W. E. and Grieve, B. J. (1954).—"How to Know Western Australian Wildflowers". Vol. 1, p. 119. Univ. of W.A. Press: Nedlands.
 Burt, B. L. (1943).—Tabula 3437. *Hakea sulcata* R. Br., Tabula 3438. *Hakea invaginata*. Hooker's *Icones Plantarum*.
 Gentili, J. (Ed.) (1971).—Climates of Australia and New Zealand. Vol. 13 In "World Survey of Climatology". Elsevier Pub. Cpy.: Amsterdam.
 Hocking, P. J. and Thomas, M. B. (1974).—Evolution of the Proteaceae and cultural implications. *Ann. J. roy. N.Z. Inst. Hort.* 2, 18-25.
 Lamont, B. (1972).—The morphology and anatomy of proteoid roots in the genus *Hakea*. *Aust. J. Bot.* 20, 155-74.
 Lamont, B. (1973).—The ecology of the Australian Proteaceae with implications for their cultivation. *Aust. Plants* 7, 47-56, 66-68.
 Lamont, B. (1975).—Some current research on Australian plants. *Aust. Plants* 8, 159-63.
 Lamont, B. (1976).—The effects of seasonality and waterlogging on the root systems of a number of *Hakea* species. *Aust. J. Bot.* 24 (in press).
 Newbey, K. (1970).—"West Australian Plants for Horticulture". II. Society Growing Aust. Plants: Sydney.

CORRIGENDUM: LAMONT, B. (1975) — "SOME CURRENT RESEARCH ON AUSTRALIAN PLANTS." *AUST. PLANTS* 8, p. 159, INTRODUCTION

The Australian flora contains about 15,000 species of flowering and spore-bearing plants, of which 85% are probably restricted to this continent. Following clearing for agriculture, settlement, forestry and mining, and invasion by numerous exotic species, however, the stability and diversity of the flora has diminished. For example, six species in Western Australia alone have become extinct since European settlement, 100 are considered endangered or rare by the Western Australian Herbarium, and 300 have been collected only once (Specht, Roe and Boughton, 1974). In addition, variation at the subspecies level is important in biological and horticultural research, but the existence and safe-keeping of any biotypes and ecotypes, apart from some Eucalypts, is virtually unknown (Boden). For example, ecotypes of *Boobialla* (*Myoporum insulare*) were revealed when specimens from inland Australia grew poorly on saline coastal soils compared with specimens of the same species propagated from parent plants indigenous to the coast (Aitken). The strongest argument for the prevention of further loss of this genetic diversity is the outstanding potential of the flora for use in ornamental horticulture.

TELOPEA, A NEW JOURNAL FROM THE N.S.W. NATIONAL HERBARIUM

by Rhonda Barry

Telopea is a new journal from the National Herbarium of New South Wales, Sydney. It replaces *Contributions from the New South Wales National Herbarium* with a journal of one-word title and new format. The title derives from the generic name of the Waratah, the State floral emblem of New South Wales, *Telopea speciosissima*. *Telopea*, from the Greek *tēlopōs*, meaning seen from afar, as the crimson flowers of these tall shrubs are visible at a distance. The first part of *Telopea* was issued in July 1975. Summaries of the papers from this first issue are given below.

Telopea is not on sale but is available from the National Herbarium of New South Wales, Royal Botanic Gardens, Sydney, 2000. Because of its technical nature, it is of value chiefly to those with a considerable degree of botanical expertise. Copies are available in municipal libraries in New South Wales and if, after perusing a copy, readers consider that it would be of interest and value to them, they may write to the Director of the Royal Botanic Gardens indicating their interest.

NOTES ON AUSTRALIAN TAXA OF ACACIA

Recent research has enabled the description of the following five new species of *Acacia*:

Acacia torringtonensis is a multi-stemmed shrub 1-1.5 m high with smooth grey bark and deep-yellow, round flower-heads. It occurs in dry sclerophyll forests on acid granite in the Darling Downs district of Queensland and around Torrington on the Northern Tablelands of New South Wales. This species is closely related to *A. ruppii* but differs from it in its smaller phyllodes, reduced inflorescences and undulate, flexuose, more densely hairy fruit.

Acacia barringtonensis is distributed over the eastern side of the Northern Tablelands, southwards from the Gibraltar Range National Park and on Barrington and Gloucester Tops, N.S.W., in moist situations in dry sclerophyll forest or woodland. It is a shrub or small tree about 1-7 m high, usually of mallee habit with grey bark. The phyllodes are obliquely elliptical with short, appressed, white hairs on both surfaces. The flower-heads are round and arranged in racemes. It is related to *Acacia clunies-rossiae*, *A. dorothea* and *A. caesiella*. A key is given to distinguish *A. barringtonensis* from its allies.

Acacia gracillima is a shrub or small tree up to 4 m high, with the old bark dark red and peeling off readily into curling grey strips (i.e. "minni-ritchie" bark). It is found in the Kimberleys of Western Australia and has often been confused with *A. linarioides*. The specific epithet "*gracillima*" refers to the very slender phyllodes of this species. The flower-heads are bright yellow and spike-like.

Acacia dacrydioides is also found in Western Australia, but in mixed woodlands of the King Edward River district. It is a graceful, arching, spreading shrub up to 2.5 m high with fawn to red-brown branchlets and yellow, spicate flower-heads. It is closely allied to *A. kelleri* and derives its name from its superficial resemblance to members of the Gymnosperm genus *Dacrydium*.

Also a new species, *Acacia diphylla* is 6-11 m high with dark grey, rough, hard, fissured bark, as well as fragrant, pale-yellow, spicate inflorescences and black, glossy seeds. It is distributed over the Northern Tablelands and North Coast of New South Wales and occurs on slate or shale in woodland fringing the rims of gorges. Its name "*diphylla*" refers to the two types of foliage (intermediate stage and mature phyllodes) occurring in the species. It is related to *A. cheelii*.

Other notes in the same article include a new name for *A. pallida*, now *A. pallidifolia*, as the name *A. pallida* is a later homonym (that is, the name has been published previously for a different species). Several other species are discussed: specimens of *A. linarioides* are compared with the holotype at the Royal Botanic Gardens, Kew; the legumes of *A. macnuttiana* are described since they were unavailable to Maiden and Blakely at the time of original publication; further notes are given on the little-known *A. kelleri* and on *A. ruppii*.

Three new records for New South Wales are published. *A. austfeldii*, thought previously to be endemic to the Bendigo-Eaglehawk region of Victoria, has been collected along the Mudgee-Cassilis road and in the Gulgong district of New South Wales. Collections of *A. clivivola* have been cited for the Far-Western Plains of New South Wales. A specimen of *A. curranii* has been collected from Shepherds Hill, Western Plains, the first record since the original, and doubted, collection at Cobar in 1887.

The name *A. terminalis* has been re-established following studies of original descriptions which show that this species was the plant known as *A. botrycephala* in Eastern Australia. This species is a member of the Botryocephaleae, a group of bipinnate wattles with round flower-heads.

BILLARDIERA and RHYTIDOSPORUM

A re-examination of the New South Wales species of *Billardiera* (Pittosporaceae) and related taxa, in which *Rhytidosporum* F. Muell. is re-instated and two new species of this genus are described. *Rhytidosporum* now contains three species: *R. procumbens* (formerly *Marianthus procumbens*); *R. alpinum*, a rhizomatous plant about 10 cm high, occurring in acid soils on the Southern Tablelands of N.S.W. and in the A.C.T. at altitudes above 1250 metres; and *R. prostratum*, a sparingly branched shrub occurring in moist sandy sites on the Central Tablelands near Robertson and at Currockbilly on the Southern Tablelands. This paper also includes, for New South Wales only, keys to *Billardiera* and *Rhytidosporum*, and a key to the genera of Pittosporaceae which may be of interest as a guide to these plants:

KEY TO GENERA OF PITTOSPORACEAE IN NEW SOUTH WALES

1. Fruit dry, dehiscent.
 2. Anthers shorter than filaments, opening by longitudinal slits. Petals white, cream, yellow or reddish.
 3. Fruits with thick leathery valves, usually more than 1 cm long.
 4. Seeds not winged, viscous. Petals less than 2 cm long. *Pittosporum*
 - 4.* Seeds winged, not viscous. Petals 3-4 cm long *Hymenosporum*
 - 3.* Fruits with thinly leathery to crustaceous valves, less than 1 cm long.
 5. Shrubs usually more than 50 cm high. Branches usually spiny. Inflorescence paniculate *Bursaria*
 - 5.* Shrubs less than 50 cm high. Branches never spiny. Inflorescence 1-2 flowered or corymbose *Rhytidosporum*
 - 2.* Anthers longer than filaments, opening by terminal pores. Petals blue *Cheiranthra*
- 1.* Fruits succulent, indehiscent.
 6. Shrubs with twining or flexuose, non-spiny branches. Fruits oblong-cylindrical to globose *Billardiera*
 - 6.* Shrubs with spiny branches. Fruits globose *Citriobatus*

ORCHIDACEAE

An article in tabulated form of the Type status of various orchid specimens collected by Rudolf Schlechter in New Caledonia, Celebes, Borneo and Sumatra. If a specimen is believed to have a relationship to the original specimen on which the specific name is based, it is given a Type status. A *Holotype*, for example, is the specimen chosen and cited in the original description of the species. An *Isotype* is a specimen collected from the same plant as the *Holotype*, at the same time and bearing the same collection number. Many of the specimens listed in this article are *Isotypes*. This is the second of two such papers, the first dealing with New Guinea.

CELASTRUS

A discussion of two species of climbing shrub in the genus. They are found on a variety of soils in the rainforests of eastern Australia and the only native representatives are *Celastrus subspicatus* and *C. australis*.

The botanist Ding Hou, who works at Leiden, in the Netherlands, has sought to synonymise both these species under the Asian species *C. paniculatus*. The authors, however, conclude that the three species are quite distinct, and the article puts forward their reasons for this judgment. Specific differences lie in the leaf-shape and lateral vein system; in the compounding of the inflorescences, and in the fruit colour. The species also differ in their distribution. *C. paniculatus* has a wide range in eastern Asia and Malaysia, *C. australis* is confined to southern-eastern Australia (from eastern Victoria to the Bunya Mountains of Queensland; while *C. subspicatus* is found on the east coast from North Queensland to the Illawarra District of New South Wales.

GRASSES

A description of two new species of Australian grasses and one new variety. *Paspalidium breviflorum* is a very slender, ascending perennial and derives its specific name from the short (Latin: *brevis*) spikelets (florum—flowers) which are only 1.8-2 mm long. The new species occurs on the North Coast and New England District of New South Wales and in Queensland but, as yet, it has not been widely collected. It is similar to *P. aversum*, *P. radiatum* and *P. scabrifolium* but the main differences occur in size and shape of spikelets and the shape of leaves.

Setaria paspalidioides also has been scarcely collected. Two specimens have been cited: from Gulargambone on the Western Plains and from Emerald in the Leichhardt District of Queensland. This plant is a tufted perennial up to 70 cm high with flat, linear leaf-blades and spikelets elliptical-obovate (roughly oval-shaped) in outline.

The new variety is *Microlaena stipoides* var. *brevisetia*, found on sandstone soils in the Central Tablelands of New South Wales. It differs from the type variety mainly in the shorter awn of the lower sterile lemma of the grass flower.

A discussion of two new species and a new combination in the grass genus *Echinochloa*. The new combination is *Echinochloa lacunaria* which was originally named *Panicum lacunarum*.

Both the two new species are found in watery habitats. *Echinochloa telmatophila* is an erect, often robust annual up to 180 cm high. The aerial stems (culms) are stout, glabrous, smooth and shining. The inflorescence is purplish or greenish, usually large and dense and around 20-35 cm long. This species occurs in mud at margins of streams and ponds along the Central Coast, northward to southern Queensland and occasionally near Perth. Its name derives from the Greek *telmatos*—pool or mud, and *phileo*—I love. *Echinochloa inundata* derives its name from being found in or near watercourses; it grows on the Western and Far-Western Plains of New South Wales; in the Leichhardt, Burnett, Darling Downs and Warrego districts of Queensland and in South Australia, along the Diamantina River. It is a tall, green, hairless annual up to 120 cm high. The inflorescence is 7-20 cm long.

DODONAEA

A new species and a new name in the genus (Family Sapindaceae). *Dodonaea serratifolia* is a new species occurring in several localities on the Northern Tablelands of N.S.W. It has narrowly elliptical leaves with serrulate margins which distinguishes it from all other species of *Dodonaea*. The species prefers granitic soils in moist situations. The plant from Central Australia (N.T. and W.A.) known as *D. peduncularis* var. *coriacea* is shown to be a distinct species now named *D. coriacea*. In addition *D. polyandra* from New Guinea is now recorded from northern Queensland. It has been known in Australia as *D. viscosa* var. *laurina*, even though it is very closely related to *D. triquetra*.

CONOSPERMUM

A revision of the eastern Australian species (Proteaceae) in which a new species, *Conospermum burgessiorum*, is described, and *C. ericifolium*, *C. ellipticum* and the variable *C. taxifolium* are united under the name *C. taxifolium*, of which a number of intergrading forms are now indicated by informal names (e.g. "broad-leaved form", "Blue Mountains form"). *C. burgessiorum*, named in honour of the Rev. Colin Burgess and his son, Peter Burgess, grows on "acid granite" soils on the Gibraltar Range (Northern Tablelands of N.S.W.) and the Stanthorpe-Wallangarra region of southern Queensland. It is a robust shrub 1.5-3 metres tall with leaves 12-25 cm long and 4-10 mm wide. *C. mitchellii*, from The Grampians of western Victoria, is closely related to it. The eastern species of *Conospermum* are: *C. burgessiorum*, *C. mitchellii*, *C. patens*, *C. taxifolium*, *C. longifolium*, *C. sphacelatum* and *C. tenuifolium*.

KEY TO SPECIES

1. Erect or spreading shrubs with flat leaves, apices of tepals divergent at anthesis.
 2. Perianth limb and perianth tube almost equal in length. Shrubs with several to many spreading branches.
 3. Leaves 12-25 cm long, 4-10 mm wide, lateral veins visible on both surfaces 1. *C. burgessiorum* Johnson et McGillivray
 - 3.* Leaves 6-12 cm long, 1-4 mm wide, lateral veins inconspicuous or evident on the lower surface only 2. *C. mitchellii* Meisn.
 - 2.* Perianth limb noticeably shorter than the perianth tube. Shrubs with few to many branches (commonly erect or ascending).
 4. Leaves less than 5 cm long, perianth commonly 8 mm or less in length.
 5. Leaves spreading arcuate; peduncles erect, almost parallel, longer than the branches of the inflorescence; flowers usually blue 3. *C. patens* Schlecht.
 - 5.* Leaves ascending to spreading, not arcuate; peduncles erect to ascending and rarely parallel, usually not conspicuously longer than the branches of the inflorescence; flowers cream to white 4. *C. taxifolium* Sm.
 - 4.* Leaves more than 5 cm long, perianth often more than 8 mm long.
 6. Leaves glabrous, oblanceolate to linear, inflorescence more than 15 cm long, coma of hairs on ovary and fruit 2-2.5 mm long 5. *C. longifolium* Sm.
 - 6.* Leaves finely hairy, linear, inflorescence less than 15 cm long, coma of hairs on ovary and fruit 2.8-4 mm long 6. *C. sphacelatum* Hook.
 - 1.* Procumbent shrub, mature leaves sub-terete, apices of tepals convergent at anthesis 7. *C. tenuifolium* R. Br.

AUSTRALIAN PROTEACEAE: NEW TAXA AND NOTES

(This summary prepared by A. C. Cornish.)

The paper includes descriptions of five new species of *Grevillea* and a new species of *Isopogon*, together with four new names in *Grevillea*, *Hakea* and *Isopogon*; general discussion covers various species of *Grevillea*, *Hakea* and *Petrophile*.

Grevillea coriacea

From the eastern part of the Cook district of northern Queensland, is a small slender tree, or tall single-stemmed shrub, 4-15 metres tall, with linear leaves 12-30 cm long, 4-10 mm wide, of a somewhat leathery (coriaceous) texture. This new species is closely related to *G. parallela* from which it differs in its slender habit, more leathery leaves and sparingly branched or unbranched inflorescences with fewer and larger flowers. *G. coriacea* flowers from June to August, whereas in the same region *G. parallela* commences flowering in September.

Grevillea glossadenia

A shrub 1-2 metres high with elliptical to obovate leaves 5-12 cm long and 2-3.5 cm wide. Inflorescences are terminal with 6-12 reddish-coloured flowers. It is related to *G. decora*, a larger shrub. This new species is known only from Irvinebank and near Bakerville in the Cook district of Queensland. The tongue-like floral gland is the basis for the specific epithet (Gk. *glossa*—tongue, *adenos*—gland).

Grevillea cyranostigma

A shrub with oblong, obtuse leaves and terminal inflorescences on short axillary branches. It is restricted to the Leichhardt district of Queensland, and to date is recorded only from "Mt. Playfair" Station and Moolyamba, near the Carnarvon Range. The style-end of this new species and the profile of Cyrano de Bergerac, noted for his prominent nose, show a particular similarity, hence the specific epithet. It is closely related to *G. juniperina* which has pungent, more slender leaves.

Grevillea johnsonii

Usually grows in sheltered sites in dry sclerophyll woodland. It occurs in the Gungal-Kerrabee-Widden area of the Upper Goulburn River Valley, New South Wales, and Mt. Gundargarco in the Capertee Valley. *G. johnsonii* is a slender to spreading shrub 2-4.5 metres tall with narrowly pinnatisect leaves. It is closely related to *G. longistyla* from Queensland but differs in its narrower and more numerous pinnae, smaller inflorescences and hairy styles. It flowers from September to November. When cultivated, it is a handsome shrub which usually has a denser habit than its wild counterpart. This new species is named in honour of Dr. L. A. S. Johnson, Director of the Royal Botanic Gardens, Sydney, "in recognition of his considerable contributions to our knowledge of the Australian flora".

Grevillea rivularis

A shrub up to 2 metres high, with pungently pointed, deeply divided leaves 3-6 cm long and of about the same width, with terminal, one-sided inflorescences and glabrous flowers. This new species is restricted to the Carrington Falls area near Robertson on the Central Tablelands of N.S.W., where it is found in sandy soil or alluvium in and near the small streams above the falls. In cultivation in the Royal Botanic Gardens, Sydney, it has grown to a dense shrub 2 metres high and about 5 metres across within a few years.

Grevillea acanthifolia* ssp. *stenomera

This plant was originally known as *G. acanthifolia* var. *stenomera* but is now recognised as a geographically isolated subspecies. It strongly resembles the type subspecies in the structure of its flowers and fruits and in the

pattern of leaf division, but is distinguished from it by its longer and narrower leaf segments, shorter inflorescences and less conspicuous indumentum. These differences, however, are considered insufficient basis for its separation at specific rank. It occurs in moist situations on peaty to sandy soils and has been collected at Gibraltar Range, ENE of Glen Innes, and in the vicinity of Point Lookout, E of Armidale.

Grevillea speciosa

An unfortunate but necessary change of name for *G. punicea*. This plant was originally described by Knight in 1809 as *Lysanthe speciosa*. It has been universally known as *G. punicea*, a name published by Robert Brown in 1810, but the International Code of Botanical Nomenclature requires the epithet from the earlier name to be used. See page 293 for colour photograph.

Grevillea longifolia* and *G. aspleniifolia

Species which have been confused. *G. aspleniifolia* grows on the lower ridges and slopes of the catchments of the Nattai, Wollondilly, Kowmung, Cox's and Shoalhaven Rivers. It usually occurs in woodland and tends to be in open rocky places. The plant has rounded, densely tomentose branches, and linear, entire or deeply divided leaves with a dense indumentum of curled hairs on the undersurface. *G. longifolia* occurs in forest and woodland, usually beside streams, in the Lawson to Springwood area of the Blue Mountains, Georges River, Woronora River and as far south as Appin and the Lower Cataract River. It has angular silky branchlets, serrate or rarely entire, linear to narrowly ovate-elliptical leaves with a smooth, silky indumentum on the undersurface. The plant is widely cultivated, usually under the incorrect name *G. aspleniifolia*. *G. longifolia* flowers from about July to November, as does *G. aspleniifolia*, but the former occasionally flowers also in late summer and autumn.

Grevillea glabella

Now recognised as a distinct species. The plant is characterised by a much-branched habit with relatively stiff branches, and slender linear leaves 1.2 cm long and less than 1 mm wide. It occurs in mallee country in the Central Western Slopes and Western Plains of New South Wales in the Barellan-Taleeban-Rankins Springs-Merriwagga region, and in the Little Desert of Victoria. Within the native plants nursery trade it has been known as *Grevillea* "Rankinsii".

Grevillea pityophylla

This species was described by Mueller in 1868 from a specimen in Drummond's personal herbarium which is now incorporated in the National Herbarium of Victoria. In 1936 Gardner gave to the same species the name *G. blackallii* which must be replaced by the earlier name. *G. pityophylla* appears to be restricted to the Austin dist. W.A. and to the vicinity of Lat. 29° 30' S., Long. 147° 30' E. It flowers mainly from July to August, but has been in flower as late as October.

Grevillea rosmarinifolia

Allan Cunningham collected this species in 1822 near the site of the military depot located by the Cox's River on the first road to Bathurst. It was described by him in 1825, and introduced into cultivation in England. There is no known record of collections since 1822, although several searches for it have been made in recent years, but "forms" attributed to the species are found in the Southern Tablelands of New South Wales and in Victoria. In August 1969 the plant was rediscovered, growing beside a building in the Edinburgh Botanic Garden in Scotland. Cuttings were sent to the Royal Botanic Gardens, Sydney, and specimens have been established in a number of gardens and some nurseries in New South Wales and Victoria. Its leaves, about 2.5-4 cm long and 2-3 mm wide, are longer and broader than other forms which have been referred to the species. Colour plate, page 336.

Hakea eyreana

This species was originally described in 1917 as *Hakea intermedia* by Ewart and Davies. However, it was observed that another plant already held this name so it was renamed *H. divaricata* by L. A. S. Johnson in 1963. Recently it was found that a plant named in 1920 as *Grevillea eyreana* was the same as *H. divaricata*. In accordance with the rules of botanical nomenclature the species is now known as *Hakea eyreana*.

Hakea pulvinifera

Was first collected in 1949, and it is possibly now extinct. The latest collection was made in 1966, 1.5 km SSE of the wall of Keepit Dam, about 30 km ENE of Gunnedah, New South Wales. It was very localised to the crest and western side of a very dry, conglomerate hillside, with scattered *Callitris columellaris* and *Alstonia constricta*. This locality was later searched in 1971, and again in 1975, but no trace of the plant could be found. The slope has been partly cleared and a portion of the top of the ridge flattened to form a car parking area. It is possible, although perhaps unlikely, that the species may occur in other places.

Isopogon mnoraifolius

This newly described species is endemic to the North Coast of New South Wales. It grows 40-80 cm high in open heath or on the edge of woodland on clay loam near Coaldale, NNW of Grafton, and on the coast E of Grafton from Angourie to Minnie Water. This plant has a superficial resemblance to *Isopogon anemonifolius* which, on the coast, is not recorded N of Smokey Cape. It is closely related to *I. dawsonii* from which it differs mainly in its shorter leaf lobes, its broader and flatter petiole, and its fewer more acute cone scales. The shape of its leaves is reminiscent of the menorah, the Jewish candelabra, hence the specific epithet which is pronounced "mnoraifolius".

Isopogon prostratus

This plant, originally known as *I. anemonifolius* var. *tenuifolius*, is now described as a distinct species. It differs from *I. anemonifolius* in its prostrate habit, more slender leaf segments, and slightly more conspicuous terminal tuft of hairs on the end of the perianth. *I. prostratus* occurs on the Central Tablelands (S from Clarence), Southern Tablelands, and South Coast of New South Wales, and is rare in Victoria.

Petrophile pulchella

Reaffirmed as the correct name for the species incorrectly known as *P. fucifolia*. Both epithets were originally published under the generic name *Protea*; by Schrader in March 1975 as *Protea pulchella* and by Salisbury in November-December 1975 as *Protea fucifolia*.

A NEW AUSTRALIAN SPECIES OF OLEARIA (COMPOSITAE)

Surprisingly close to Sydney, a new species of *Olearia* has recently been discovered which has been named *Olearia cordata*. As yet, it has been found only on the Central Coast, in small populations around Wiseman's Ferry, St. Albans Common and Wollombi.

Olearia cordata is an ascending branched shrub to 2 metres tall and strongly aromatic. The stems, peduncles and both surfaces of the leaves are densely covered with hairs. The leaves are linear and have a broad cordate (or heart-shaped) base. This is the distinguishing characteristic which gives the new species its name. The flower-heads are solitary, about 2-3 cm in diameter, with attractive deep blue to mauve ray florets and yellow disc florets.

Olearia tenuifolia seems to be the closest relative of the new species. However, the former is much more widely distributed on the Tablelands and Slopes. Other differences between the two are that *O. tenuifolia* has a narrow leaf-base and is not as hairy as *O. cordata*. The fruit are also distinguishable: those of *O. cordata* having prominent ribs while those of *O. tenuifolia* do not.

A NEW SPECIES OF OLEARIA



Photography by A. Rodd

OLEARIA CORDATA

Found only on the Central Coast of N.S.W. in small populations around Wiseman's Ferry, this small shrub will probably only grow to one metre in the garden. The flower-heads are solitary, about 2-3 cm in diameter, with attractive deep blue to mauve ray florets and yellow disc florets. With quite a long flowering period the obvious potential for horticulture has not been developed.

The flowering period appears quite extended as specimens collected in November, March and April were all flowering.

WE NEED YOUR HELP

We are trying to unravel and prepare for registration, the extensive range of "Poorinda" and "Clearview" cultivars. Grevillea cultivars in particular, though the others are needed also. While they are in flower, will growers and nurserymen send fresh flowering specimens they are growing to The Secretary, Australian Cultivar Registration Authority, Canberra Botanic Gardens.

Photographers — please get out those cameras this season and send slides or photographs to The Editor, Australian Plants.

ERICIFOLIA NATIVE PLANT NURSERY

6 Game Street, Blackburn, Vic. 3130

Telephone 878-3889

Open 9-5.30 Daily. Closed Wed. only.

NATIVE PLANT NURSERY

Extensive range of native plants, including many rare or difficult to obtain species. Native bird feeders available.

Mt. Martha Shopping Centre,
Morningside Peninsula, Victoria.
Phone Mt. Martha (STD 059) 74-1792
weekdays. (Open weekends only.)

**Austrafloora Nursery**

W. & J. MOLYNEUX NURSERIES
PTY. LTD.,

BELFAST ROAD, MONTROSE, VIC. 3765

The largest range in Australia from which to select. Mail orders within Australia and Overseas. Retail only.

Open 9-5.30 Mon.-Sat.; 12-5.30 Sun.
during spring and autumn.

Agency in Canberra, A.C.T.

1975 catalogue — 60c at Nursery,
\$1.00 posted.

ALEXANDER PLANT FARM

(Doug Twaits, Prop.)

2 Winifred Street, ESSENDON, VIC. 3040

Phone: 379-5163

EVERYTHING FOR THE GARDEN

Specialising in Australian Native Plants

Nindethana Native Plant Seeds

By Packet, Ounce or Pound

Large selection. Send for free list.

NINDETHANA

Box 129, Wellington, N.S.W. 2820

BELBRA NURSERY

In the heart of the Grampians
LARGE RANGE OF AUSTRALIAN
NATIVES

Closed Wednesday only

BOX 12, HALL'S GAP, VIC. 3381

WIRIMBIRRA

Hume Highway, between Tahmoor and
Bargo, N.S.W.

AUSTRALIAN PLANTS

Wide Range — Phone: Bargo 84-1112
OPEN SEVEN DAYS A WEEK

Greenbriar Drive-In Nursery

AUSTRALIAN NATIVE PLANTS

Large and Varied Selection

195-7 MOUNTAIN VIEW ROAD,

BRIAR HILL, VIC. 3088

Phone: 43-1468 — Open Weekends

MICHIE'S KENTLYN NATIVE PLANT NURSERY

Specialising in Australian Plants

Beth & Bob Michie invite you to call

96c George's River Road, Kentlyn, 2560

Phone: Campbelltown 25-1583

Closed Tuesday and Wednesday only

NAROOMA NATIVE NURSERY

(H. & N. RYAN, Proprietors)

15 TILBA STREET, NAROOMA, N.S.W.

2546 — Phone 132

Good variety of native plants

Catalogue available 10 cents

CHIVERS' NATIVE PLANT NURSERY

26 Cowper Road, Black Forest, S.A.

5035 — Phone: 93-7808

Open April-May

Catalogue available — Send 18c stamp

No Interstate Orders



FLORA TERRA Australis

COLLECTORS NURSERIES NATIVE PLANT SPECIALIST
KEVIN REED

Cnr. BELLEVUE CRES. and SEAFORD RD. SEAFORD Vic. 3198

Huge selection from ground
cover to trees, rare and the
common, sizes large or small

Open Saturday and Sunday

(Closed Mon. and Tues.)

PRESERVATION BY CULTIVATION

Closed Tuesdays

FLORALANDS

KARIONG, via GOSFORD, N.S.W. 2250 — Prop. Brian & Lyn Parry

A large variety of the most popular native plants at nursery

PHONE: Gosford 25-1142

Send self-addressed envelope for plant list

WHALAN'S NURSERIES

175 GRINSELL STREET, KOTARA, 2288.

Phone: Newcastle 57-1225

Situated right next to the famous Blackbutt Reserve in Newcastle

All types of native plants, advanced and small, including Crowea, Correa, Eriostemon, Boronia, Callistemon, Melaleucas, Dampierii, Hypocalyma, and numerous others.

Many new and exciting types

WHALAN'S NURSERIES — KOTARA

Lakkari Native Plant Nursery

Russell & Sharon Costin

*Wide range of all common varieties, many interesting and hard-to-get plants, new introductions from North Queensland and other tropical areas.*477 REDLAND BAY ROAD,
CAPALBA, QLD. 4157 — 206-4119
(Closed Thursdays)**PARSONS NATIVE PLANT****NURSERY**Trees, Shrubs, Ground Cover, Climbers.
Specialising in GrevilleasOpen Thur., Fri., Sat., 9-5; Sun. 9-1
Werrandye Road, Research, Vic. 3095**BUSHFLORA**

46 Swan Street, Eltham, Vic. 3095

Wide range of well-grown plants

INSPECTION INVITED

Hours: 9 a.m.-5 p.m., Thurs., Fri., Sat.
Sunday, 1-5 p.m.**AUSTRALIAN PLANTS CENTRE***(John & Joan Barton)*

Large variety of natives.

Specialising in rockery plants.

Retail only — No mail orders

Pine Ridge Rd., Coombabah, Qld. 4215.

Phone Gold Coast 37-1227

Closed Mondays (except Pub. Hols.)

DEANES ORCHID NURSERY*Specialising in Australian Native Orchids*

Please send for descriptive list. Plants sent anywhere.

Nursery open every weekend — Weekdays phone 86-3446

157 BEECROFT ROAD, BEECROFT, N.S.W. 2119

**FOREST
NATIVE
NURSERY****(02) 450-1785**

NO MAIL ORDERS

9 Namba Road, Duffy's Forest, N.S.W.
(beside Waratah Park, via Terrey Hills)

**MAGAZINES, BOOKS, BROCHURES, PRICE LISTS,
CATALOGUES, OFFICE STATIONERY, LETTERHEADS,
INVOICES, STATEMENTS, ENVELOPES, BUSINESS CARDS**

Consistent quality and unbeatable service together with reasonable
costs remove most of the problems confronting people purchasing
printing at . . .

SURREY BEATTY & SONS

43 RICKARD ROAD, CHIPPING NORTON, N.S.W. 2170

Telephone: (STD 02) 602-7404, 602-3126

PAST ISSUES OF "AUSTRALIAN PLANTS" AVAILABLE

- Because of the vast wealth of our flora there is very little repetition.
- VOLUME No. 1. Issues 1-12 — to be reprinted in 1978. Watch for announcements.
- VOLUME No. 2. Issues 13-20, all available only fully bound at \$9.00 plus \$1.00 postage, including "A Descriptive Catalogue of Western Australian Plants".
- VOLUME No. 3. Issues 21-28, all available only fully bound at \$9.00 plus \$1.00 postage, including also "Catalogue of Cultivated Australian Native Plants" valued at \$6.00.
- VOLUME No. 4. Issues 29-36, all available only fully bound at \$9.00 plus \$1.00 postage, including "Western Australian Plants for Horticulture—Part I" valued at \$6.00.
- VOLUME No. 5. Issues 37-44, all available only fully bound at \$9.00 plus \$1.00 postage, including "The Language of Botany", a valuable reference to words and terms.
- VOLUME No. 6. Issues 45-52, all available only fully bound at \$9.00 plus \$1.00 postage, including "Western Australian Plants for Horticulture—Part II" valued at \$6.00.
- VOLUME No. 7. Issues 53-60, all available only fully bound at \$9.00 plus \$1.00 postage, including "North Australian Plants" valued at \$6.00.
- "Australian Plants" is produced as a continuing series, each issue adding to the information recorded over the past issues. The most valuable and complete reference.

OTHER BOOKS OF THE SOCIETY

West Australian Plants for Horticulture, Parts 1 & 2, each available at \$6.00 plus 80c postage from the Editor. On the right-hand pages of these books there is a full colour plate of a W.A. wildflower and on the page opposite is a description of this plant together with another plant or plants from the same genus. The descriptions are clear and in simple terms with a special section on propagation and horticulture treatment and potential. Part 2 most recently published carries 42 new colour plates.

WEST AUSTRALIAN PLANTS—A Descriptive Catalogue. Price \$6.00 plus 80c postage.

The only complete reference to the flora of Western Australia.

AUSTRALIAN INDIGENEOUS ORCHIDS, by A. W. Dockrill. Price \$24.00 plus \$2.00 postage.

A magnificent large book. The only complete reference to all Australia's epiphytic orchids. Each plant is fully described botanically followed by a description for the layman and each has a large detailed line drawing.

BINDERS FOR ISSUES OF "AUSTRALIAN PLANTS". Price \$3.00 plus 60c postage.

Good quality D-ring binders with gold lettering on the spine. At the moment available only with Vol. 9 or without a number on the spine.

NORTH AUSTRALIAN PLANTS—1, by Jenny Harmer. Price \$6.00 plus 80c postage.

This is the first book giving a reasonable coverage to the flora in the North of Australia and will be an authoritative reference to it. There is a reference to 380 species. While this is a lot of flowering plants it is still a long way short of the Northern Australian flora. As such it is Part 1 of a series and describes those plants of horticultural interest that are to be found in the Darwin area and Arnhem Land, known locally as the "top-end" of the territory.

This book will be of interest to all. On each right-hand page is a large full colour plate of a wildflower usually showing the tree or shrub, and a detail of the flower. Opposite is a description of the genus together with all other species of the same genus occurring in the area followed by a clear description of the plant pictured, its distribution and economic value.

LANGUAGE OF BOTANY, by C. N. Debenham. Price \$3.90 plus 60c postage.

A complete reference to all botanical terms using Australian species as a reference. Clearly written for the layman, it has, however, become a recommended School, College and University reference.

THE SOCIETY FOR GROWING AUSTRALIAN PLANTS

"AUSTRALIAN PLANTS" IS AUSTRALIA'S NATIONAL PRESERVATION JOURNAL

(A non-profit making venture, produced quarterly, dedicated to preservation by cultivation)

This Journal is published by The Publishing Section on behalf of:

SOCIETY FOR GROWING AUSTRALIAN PLANTS—N.S.W. REGION:

President: Mr. W. H. Payne, 860 Henry Lawson Drive, Picnic Point, N.S.W. 2213.

Secretary: Mr. Ray Page, 21 Robb Street, Revesby, N.S.W. 2212.

SOCIETY FOR GROWING AUSTRALIAN PLANTS—QUEENSLAND REGION:

President: Mr. J. Smith, Roger Street, Birkdale, Qld. 4152.

Secretary: Mrs. D. Brown, 79 Birley Street, off Wickham Terrace, Brisbane, Qld. 4000.

SOCIETY FOR GROWING AUSTRALIAN PLANTS—SOUTH AUSTRALIAN REGION (Inc.):

President: Mr. J. Scarvelles, 19 Wakelin Terrace, O'Sullivan Beach, S.A. 5166.

Secretary: A. Pearl, Box 1592, G.P.O., Adelaide, S.A. 5001.

SOCIETY FOR GROWING AUSTRALIAN PLANTS—TASMANIAN REGION:

President: Mr. R. Wyatt, 7 Cedar Street, Lindisfarne, Tasmania 7015.

Secretary: Mrs. D. H. Gill, Box 1353P, G.P.O., Hobart, Tasmania 7001.

SOCIETY FOR GROWING AUSTRALIAN PLANTS—VICTORIAN REGION:

President: Mr. D. B. Fletcher, 247 Waverley Road, East Malvern, Victoria 3145.

Secretary: (Sister) E. R. Bowman, 4 Homebush Crescent, Hawthorn East, Victoria 3123.

Please do not phone or call at private home—enquiries by mail only.

SOCIETY FOR GROWING AUSTRALIAN PLANTS—CANBERRA REGION:

President: Mrs. Christine Tynan, 42 Bindaga Street, Aranda, A.C.T. 2614.

Secretary: Mrs. J. Benyon, P.O. Box 207, Civic Square, A.C.T. 2608.

WEST AUSTRALIAN WILDFLOWER SOC. (Inc.):

President: Mrs. M. Wittwer, P.O. Box 64, Nedlands, W.A. 6009.

Secretary: Mrs. K. Edmonds, P.O. Box 64, Nedlands, W.A. 6009.

Seed is in very short supply—try the commercial seedsmen, not W.A. Society.

Membership is open to any person who wishes to grow Australian native plants. Contact the

Secretary of the Society for your State for information without obligation.

PUBLISHING SECTION FOR SOCIETIES—Produced as a non-profit venture.

Managing Editor: W. H. Payne, assisted by P. D. Leak; Despatch by E. Hubner, H. Jones.

MAIL—Address mail to the Editor, 860 Henry Lawson Drive, Picnic Point, N.S.W. 2213.

Please do not telephone or call at private home—enquiries by mail only.

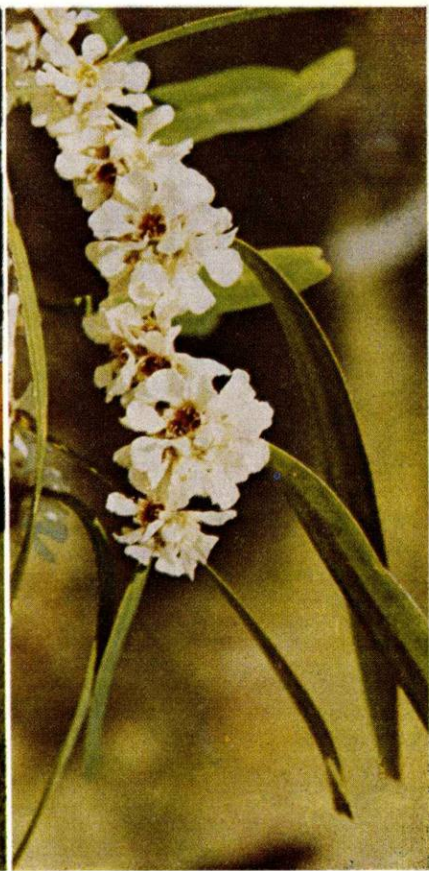
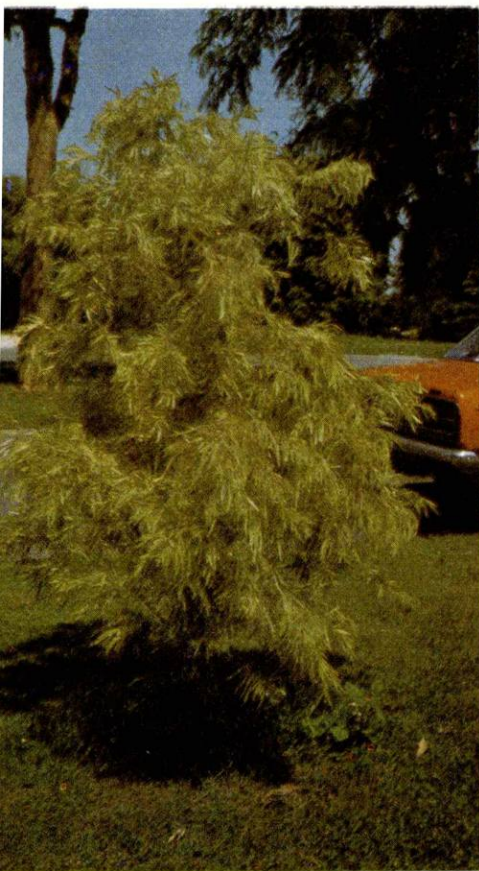
SUBSCRIPTION—Members: Apply to State Secretary above.

NON-MEMBERS: You may receive the next 4 issues direct to your home by forwarding an annual subscription of \$3.00. Overseas subscription \$4.20 Aust., £2.80 in English currency or \$5.50 U.S.

NEW AUSTRALIAN WILDFLOWER CULTIVARS REGISTERED HERE

Agonis flexuosa 'Variegata'

A variegated leaf form of the West Australian peppermint which has been known to the trade for many years. Due to its variegation this plant is not at all vigorous, usually attaining a height of between 3-4 m under good conditions. It requires a sheltered position away from frosts and the hot afternoon sun. Although relatively slow growing and somewhat delicate, this plant is a handsome specimen for the sheltered garden.

**AGONIS FLEXUOSA 'VARIEGATA'**

This splendid horticultural shrub is shown to advantage by the glowing bush above. It is not in flower. The flower is shown on the branch to the right, which illustrates the normal colour of the leaves of the true species.

Propagation is difficult and appears to be only successful by the difficult and tedious method of approach grafting.

N.B.: The above cultivar name is Latinised in accordance with Part b of Article 27 in the International Code of Nomenclature of Cultivated Plants.

Origin:

This cultivar has been grown commercially for many years but its origin is obscure. The specimen submitted for registration is from a plant at Burnley Horticultural College, Burnley, Victoria.

Diagnosis:

Agonis flexuosa 'Variegata' differs from other known forms of this species in its variegated leaves. The variegation consists of a yellow border varying in width from 0.5-1 mm, and a pale green mid portion from 1-2 mm broad with a darker midrib in some leaves. Reversion to normal leaves can occur as is demonstrated on the specimen described here. The green leaves, produced on a lateral branchlet, are in general larger than the variegated leaves. In this specimen the former are 45-80 mm long and 3.5-5 mm broad, the variegated leaves, on the other hand, are 20-50 mm long and 2-4 mm broad. In addition, the green portion of the variegated leaves is paler than the normal leaf colour and seems to emphasise an overall less vigorous appearance.

Colour Coding: Leaf

Inner portion: Green group, 139D; Outer border: Yellow group, 11C (R.H.S. Colour Chart, 1966 edition).

Comparative Specimen:

Agonis flexuosa (Spreng.) Schau.

Torbay Inlet, W.A. (Albany District) on east headland. J. W. Wrigley (C.B.G. 028027).

Anigozanthos 'Pink Joey'

This cultivar belongs to the well-known group of plants commonly referred to as Kangaroo Paws. It is unusual in that it only grows to about 50 cm in height instead of the usual 2 m or so, exhibited by the normal forms of *Anigozanthos flavidus*. The other feature which distinguishes this plant is that its flower colour is a smokey pink instead of the usual green or burgundy tonings.

Plants in the Canberra Botanic Gardens have increased by rhizome multiplication and could easily be divided into new plants by careful division of these rhizomes. A useful plant for inclusion in a rockery.

Origin:

The exact origin of this cultivar is obscure. The specimen presented for registration was raised by Mrs. M. Fisch, of Falcon Court, East Doncaster, Victoria.

The seed was supplied to Mrs. Fisch from the seed bank of the West Australian Wild Flower Society. Seedlings which were presented to Canberra Botanic Gardens on 12th November, 1973, matured and flowered well in the summers of 1974-75 and 1975-76.

Diagnosis:

A. 'Pink Joey' differs from other known forms of this species in its small stature and pale purplish flowers. It attains a height of only 50 cm and has somewhat narrower leaves 16-33 cm long and 4-6 mm broad; the much-branched panicle is $\pm$ 20 cm long and many flowered.

Colour Coding: Flower

Pediceal and perianth tube: greyed purple, 186A (R.H.S. Colour Chart 1966 edition); Inside of perianth: yellow-green, 144A-B; stamens: yellow-orange group, 22C.

Comparative Specimen:

Anigozanthos flavidus DC.

2 miles (Ca. 3 km) from Albany towards Denmark, W.A., along lower coast road, J. W. Wrigley, 12th October, 1968 (C.B.G. 028026).

***Grevillea* 'Golden Sparkle'**

Origin:

According to "Your Garden" (Feb. 1973), this cultivar was developed from cuttings of a variegated branch (sport) found on a plant described as *Grevillea audreyae*. It was found and propagated by Howard and June Sparks at their nursery at Wandiligong, in north-eastern Victoria.

Diagnosis:

The specimen presented for registration appears to be a cultivar of *Grevillea speciosa* (Knight) D. McGillivray. It differs from this species in the leaf variegation which apparently suggested its cultivar name. The variegation consists of an irregular border or blotches of golden yellow on a background of somewhat pale to normal deep green.

Grevillea "Golden Sparkle" was described by H. & J. Sparks ("Your Garden", Feb. 1973) in these terms: "This *Grevillea*, which we have named 'Golden Sparkle', grows 4ft to 5ft (1.3-1.7 m) and has a typical spider flower of orange-red. In spring and autumn the foliage tips turn a striking reddish bronze, which adds to its beauty". The authors also suggested that the cultivar had proved to be frost tolerant and "likes a sunny, open, well-drained position".

Comparative Specimen:

Grevillea speciosa (Knight) D. McGillivray (*G. punicea* R. Br.), Manly Reservoir Reserve, N.S.W. B. Hain, 26/8/70, C.B.G. 035417.

Colour Coding:

Flower: perianth: near red group, 43B; style: red group, 50A; limb: greyed-orange, 172C. Leaves: green-yellow, 1A, and green, 137C.

***Grevillea* 'Poorinda Belinda'**

Origin:

Raised by Mr. L. Hodge at his "Poorinda" property, now at Mt. Lookout Road, near Bairnsdale, Victoria. The parentage of this cultivar is New South Wales *Grevillea juniperina* R. Br. x (yellow *Grevillea obtusiflora* x *Grevillea alpina*). The cross is sterile.

Description:

A spreading shrub with laxly spreading to divaricate branches; leaves 15-25 mm long, 2-4 mm broad, oblong to narrow elliptical, $\pm$ acute with hardened but scarcely pungent points, glabrous glossy and trinerved above, the margins recurved; inflorescence; a short loose raceme, the rachis 7-8 mm long; pubescent; flowers on a slender pubescent pedicel 5-7 mm long; perianth tube 8-10 mm long $\pm$ 1 mm diameter near the recurved limb, dilating to $\pm$ 3 mm diameter below the middle, pubescent, the limb 2.25 mm diameter, more densely pubescent; ovary villous as is the 2 mm long stipe; style $\pm$ 20 mm long villous in the lower part with scattered hairs above, disc surrounding stigma orbicular 2 mm diameter, glabrous.

Diagnosis:

Grevillea "Poorinda Belinda" differs from *G. juniperina* chiefly in its scarcely pungent $\pm$ flat leaves; perianth tube broadly dilated below the middle; ovary and stipe villous, the stipe much less than 4 mm long, and in its hairy style.

Colour Coding: Flower

Perianth tube: orange group, 26C (R.H.S. Colour Chart, 1966 edition). Perianth limb: orange group, 29C. Style: orange group, 29D. Disc surrounding stigma: yellow green group, 145A.

Comparative Specimen:

Grevillea juniperina R. Br. 13 miles (Ca 21 km) from Braidwood-Nerriga, New South Wales, D. W. Shoobridge, 28/10/1962, C.B.G. 013054.

Another attractive addition to the "Poorinda" range of cultivars and one that is similar at least in leaf shape to *G. 'Poorinda Signet'*. It can be distinguished from that cultivar by the innocuous points of its leaves; its shorter inflorescence and the hairy covering of its branches which is not distinctively whitish grey. Differences to be seen with a lens are the densely hairy ovary of *G. 'Poorinda Belinda'*, its much longer, hairy style and its overall flower colour which is a pale orange shade rather than brick red.

***Lechenaultia biloba* 'White Flash'**

A natural colour variant of *Lechenaultia biloba* which differs from other forms in that it has a clear and sharp break between the white central portion of the flower and the deep blue outer area of the petals.

The plant in the wild is an open wiry specimen but with judicious pruning could be shaped into an attractive garden bush doing best in a light gravel or sandy soil.

Diagnosis:

Lechenaultia biloba 'White Flash' differs from most other *Lechenaultia biloba* currently in the C.B.G. Herbarium, by the white corolla tube and lower half of the lobes, contrasting with the shape of the lobe apices; approx: 12 mm white corolla tube, 5 mm blue wings. In other specimens seen the lower part of the corolla was pale, but always blue except in some cases where the whole flower was white.

Colour Coding: Flower

Flower is bi-coloured (R.H.S. Colour Chart 1966 edition); outer half of flower petals: blue group, 100A; inner half of flower petals: white group, 155 between B-D; upper two petals almost entirely blue.

***Melaleuca bracteata* 'Golden Gem'**

Melaleuca bracteata 'Golden Gem' varies from other *Melaleuca bracteata* in that it exhibits an attractive golden colour to the tips of the branchlets. This golden colour is particularly evident during the spring months.

Colour Coding:

(R.H.S. Colour Chart 1966 edition). Leaves (golden tips): yellow-green group, 151A; flower (styles): near white group, 155A.

The name 'Golden Gem' has been trade marked.

This cultivar has previously appeared in print in "Good Gardening" No. 10, Spring/Summer 1972, p. 8 and also in "Bulletin No. 1", Save the Trees Campaign, Qld., September 20, 1971, and "West Australian Gardener", Winter 1975, Vol. 6, No. 2, p. 2.

A voucher specimen has been lodged with the Queensland Herbarium (B.R.I. 120495).

AUSTRALIAN WILDFLOWER CULTIVARS

The Australian Registration Authority announces the official registration of six more cultivars. The first two, *Grevillea juniperina* 'Molonglo' and *Grevillea* 'Robyn Gordon' were registered in No. 59 issue of Australian Plants.

A cultivar is a plant that shows outstanding horticultural potential whether it is the development of a very good form of a true species (or even the growing on of an exceptionally good form found by accident and maintained for our enjoyment) or is a hybrid of different species.

Applications for the registration of cultivars are invited, addressed to the Secretary, Australian Cultivar Registration Authority, Canberra Botanic Gardens, Canberra, A.C.T. It is not essential for applications to contain all detail submitted here; supply as much of the information as you can and trained officers will assist in the final submission.

If you have a plant of exceptional horticultural potential, that will be available for commercial marketing, please submit applications as soon as possible. There is a considerable demand for properly labelled plants with reliable proven characteristics. However, do not submit plants for registration that are not really worthy of maintaining in preference to other valuable forms.



TOP: *Lechenaultia biloba* 'White Flash'.

Photo: Chrls Green

BOTTOM: *Lechenaultia biloba*, a dark blue form of the species. You will note that some white shows on some flowers. Plants offered for sale with the cultivar appendage 'White Flash' will have, reliably, a larger area of white as shown above.

Photo: M. Wittwer

GREVILLEAS FROM SEED

by N. K. McCarthy—Toowoomba, Queensland

How often have you and I heard someone say, "Grevilleas from seed! No, I find them too difficult"?

Yes, we must agree that successful propagation of *Grevillea* from seed does present problems. Many ways have been tried with varying results. Some *Grevillea* are only to be found slow, spasmodic, and all too often disappointing. Recently I tried a method used before me by one of our keenest local members which has proved to be a great success. I feel it should be brought to the notice of other interested members and in particular those who propagate their own plants from seed.

The two species used in this trial were *Grevillea scortechinii* (formerly known as *G. ilicifolia* var. *scortechinii*) and *Grevillea longistyla*. *G. scortechinii* came from the Stanthorpe area of south-east Queensland and *G. longistyla* was my own seed from a plant brought from Gurulmundi near Miles in southern Queensland some three years ago. Both species have large seed and are easy to handle.

The method used was as follows:

Firstly, the seed was individually nicked with a scalpel to facilitate easy entry of moisture through the otherwise impervious seed coating. A quantity of the treated seed was then placed in a clear plastic bag and randomly mixed with a quantity of moist peat moss. The bag was tied, excluding most of the air, and hung in a warm airy room with normal daylight.

Several seeds of both varieties produced radicles 25 mm or longer within two weeks. These were potted into small tubes of light, sandy loam to grow, on which they are doing quite well. The tubed stock was sprayed after planting with a weak solution of Captan to guard against damping off. A further germination of several seeds took place in the plastic bags a week later.

The method of pre-germination of seed has been found to be both quick and satisfactory, not only with *Grevillea* but with other natives as well. This saves the hit-and-miss method of putting seed in pots or tubes and just hoping for the best, as only viable germinated seed is potted up. So if you have seeds which prove difficult to raise, why not give this process a try!

RESULTS

Grevillea scortechinii—42 seeds germinated out of 50.

Grevillea longistyla—45 germinated out of 50.

Germination of species began in 14 days and continued for 62.

POTTING UP

This was done when the radicles were 25 mm long, into 5 cm plastic tubes containing a mixture of sandy bush loam. After first watering well, water was restricted and only carried out when necessary. Over-watering can kill.

A weekly spraying with Captan prevented any loss of plants. Anyone who has tried to germinate *Grevillea* seed will agree that this experiment was very encouraging.

Grevillea longistyla is an upright, spreading, tall shrub. Its multiple and large flowers are held aloft in dazzling red grandeur. Further complemented by its attractive ferny foliage, it flowers for quite a long period, commencing in spring. *G. longistyla* reaches 2 to 3 metres with a similar spread and is a quick grower.

Grevillea scortechinii is a spreading, prostrate shrub with interesting, broad, prickly foliage. New growth is an attractive shade of red-tipped green leaves. The flowers are very dark, almost black, and of great beauty. They are of a toothbrush-type and an admirable contrast to their reddish-green leaves when in full bloom. This plant takes a little time to establish.

ISOPOGONS

A report on seed germination by Anthony Cavanagh

In past issues of "Australian Plants" relatively little has appeared on the genus *Isopogon*. Several species are well known in gardens, notably *Isopogon formosus*, and *I. dubius* and, in eastern States, *I. anethifolius* and *I. anemonifolius*. *I. cuneatus* and *I. latifolius* are looked on with envy by all who see them in flower. There are believed to be some 35 species, 25 endemic to Western Australia and 10 to the eastern States. Apart from the above mentioned species, the majority of the others are not available from even specialist native plant nurseries, an unfortunate situation when one considers their unusual foliage and striking pink or yellow cone flowers. Other features worthy of attention are the small size of most species, typically about one metre high and generally less than two, and the fact that many can grow in semi-shade positions. In their natural habitat a lot of them grow in close association with surrounding vegetation and, on account of their size, they are often the understory. I have lost *Isopogons* in very hot weather in open positions, whereas *I. formosus* and *I. dubius* have both survived the same weather in their semi-shaded spots and will be flowering heavily this year.

I hasten to qualify the above in that a very good article by Ken Stuckey, on page 86 of Issue No. 46, describes 18 of the species most suitable for horticulture and those readers who wish to know more of these beautiful plants should refer to this article.

PROPAGATION BY SEED

Why, then, are *Isopogon* spp. difficult to obtain from nurseries? Part of the answer must lie in difficulty of germination of seed and, more importantly, carrying the seedlings on. Alec Blombery in "A Guide to Native Australian Plants" says: "Germination of seed is slow and often difficult, and some treatment is usually required. Propagation can also be carried out from cuttings, but is also slow." He advocates abrasion of seed with diamond-grit or emery paper followed by soaking in near boiling water. Hazel Cole, writing on "Simple Propagation", in *Australian Plants of March, 1971*, comments that she had had no success at all with *Isopogon* spp. and *Petrophile* spp. and suggests it may be better to sow in situ. A nurseryman to whom I spoke advocated germination in clay, allegedly on the grounds that many *Isopogon* spp. grew in clay soils in Western Australia.

In October of 1973 I planted seeds of the following: *Isopogon asper*, *I. anemonifolius*, *I. cuneatus*, *I. dawsonii*, *I. divergens*, *I. dubius*, *I. formosus*, *I. latifolius*, *I. tridens* and *I. trilobus*. The seed mix was approximately 50 per cent coarse washed sand; remainder sandy loam and peat moss. The seeds were lightly covered with about 5mm. of Yates Seed Raising Mix and about the same depth of coarse gravel. The pots were left in the open and watered about five times a week unless rainfall was adequate; they were given no special protection. The seeds were not treated in any way. All except *I. latifolius* and *I. asper* had germinated within 32 days, the shortest time being 24 days for *I. divergens*, *I. formosus* and *I. dubius*. In most cases the strike was better than 70 per cent.

For interest I left the pot of *I. latifolius* seeds, as I had been told that *Isopogon* spp. sometimes come up after several months. Surprisingly, some seven months later, in late April, a seedling appeared. The pot by this time had a dense, moss-like growth over much of its surface, which I was unwilling to remove in case other seedlings were disturbed; nevertheless, four more appeared and have been potted up into individual tubs. Despite a rather severe and wet winter they have all survived and should be ready for transplanting to larger pots.

With some types of seed a dormancy exists which must be broken before germination will take place. Sometimes the seed requires storing in a cool place such as a refrigerator for about six weeks (stratification); in

nature, such seeds germinate in spring or with autumn rains after going through a winter. I do not know whether *Isopogon* spp. fall into this category, but it seemed rather surprising that the seed germinated in the latter part of a cold autumn and not during the warmer days of spring and summer. To check whether cold weather might have an influence, I sowed 16 more seeds from the same batch on May 18, using this time a sand/peat moss mix. The weather was quite cold, with days of minimum temperatures down to 1 to 3°C. and maxima of 10 to 14°C.; rainfall was scattered but heavy, with some areas of Victoria receiving record June falls. Despite all these highly undesirable conditions, the first seeds came up in seven weeks (51 days) and by mid-July 12 of the 16 had germinated.

On the face of it, these results would appear to indicate the following:—

- If the seed is fertile, many species will germinate freely in 3½ to 4½ weeks when sown in spring.
- For at least the following species, prior treatment does not seem necessary: *I. anemonifolius*, *I. cuneatus*, *I. dawsonii*, *I. divergens*, *I. dubius*, *I. formosus*, *I. tridens*, *I. trilobus*.
- For *I. latifolius* a period of cold weather seems to be necessary for satisfactory germination.

Perhaps the last is not so surprising when it is remembered that *I. latifolius* grows on the slopes of the Stirling Ranges in Western Australia. The Stirlings are up to 1,100 metres high and occasionally receive snowfalls. Seeds from the previous October-November flowering would thus be subjected to a cold winter and would, I assume, germinate in the autumn following good rainfall.

THE SEEDLINGS

While germination of most spp. mentioned seemed satisfactory, carrying the seedlings on was very much a different matter. After being potted on into individual tubes, the seedlings grew on quite strongly, with few losses. After several months they were repotted into 5in. plastic bags. Whatever the cause, the result was a disaster—the plants proceeded to die at a rapid rate. I suspect the potting mix was too wet. By July, 1974, the only ones still growing well were *I. dawsonii*, *I. anemonifolius*, one *I. divergens*, one *I. trilobus* and, surprisingly, *I. cuneatus* and *I. latifolius*. If the above experience is any indication, then this is probably another reason why *Isopogons* are scarce at nurseries. I intend to try again this year, but will pot into a sand/peat moss mixture, with about 10 per cent soil, in the hope that improved drainage is the key.

BOOKS ON WILDLIFE—Available from Editor

REPTILES & AMPHIBIANS OF AUSTRALIA by H. G. Cogger

Price \$23.95 plus \$2.05 post.

Dr. Cogger, a past Honorary Curator of Taronga Zoological Park, Sydney, has set out to provide a means to identify and study the more than 600 species of the Australian herpetofauna — frogs, crocodiles, turtles, lizards and snakes. This he has done with full but simple descriptions, 800 photographs (192 in colour); sketches and keys. The valuable Introduction provides information on naming, location, collection, preservation and care in captivity of these creatures. Large chapters present in turn frogs, crocodiles, turtles, lizards, snakes, each species being described with a map showing where in Australia it may be found. Sketches show in detail the characters of each group of creatures and then the many colour plates together provide a pictorial guide as to the correct name of the species. A magnificent 585-page (25 cm x 18 cm) book. A companion book to "Birds of Australia" and "Australian Shells", each \$19.95 plus \$2.05 post.

AUSTRALIAN BUSH BIRDS IN COLOUR by I. & M. Morcombe

Price \$4.95 plus \$1.05 post.

Australia has one of the richest bird faunas in the world — 734 species including 20 introduced and 125 migratory birds. The 48 species selected for description, study and full-colour photography are the author's selection of interesting birds of the forests and scrublands. 107 pages, 17 cm x 17 cm.

Other books in this series, each costing \$4.95 plus \$1.05 post, are "Australian Butterflies In Colour", "Australian Crustaceans In Colour", "Australian Insects In Colour", "Australian Marine Fishes In Colour", "Australian Reptiles In Colour", "Australian Seashores In Colour", "Australian Spiders In Colour", "Beneath Australian Seas", "Australian Native Orchids In Colour", "Australian Wildflowers In Colour", "Australian Gemstones In Colour", "Australian Opals In Colour".

ISOPOGON FOR THE GARDEN



Photography by O. Hockings

ISOPOGON SCABRIUSCULUS

Though this plant is native to the Avon District of south-west Western Australia, this plant was photographed in Dave Gordon's garden, Myall Park, Queensland. The plant is one metre high, flowering profusely and flourishing on shallow red sandy loam over rock. The lower photograph was taken from above, looking down, as you can see the natural habit is for the flowers to be upright. Some bushes will also have more colour in the flower-heads.

OUR PRETTY BUSHLAND SPIDERS

A series for the young in spirit by Nuri Mass

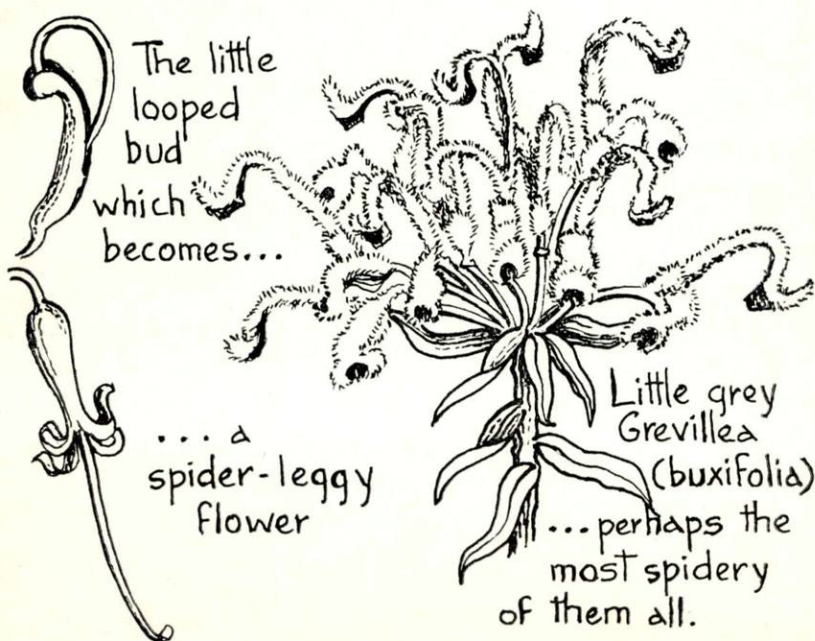
There was once a great philosopher called Baruch Spinoza who loved spiders so much that if his housekeeper ever attempted to clear them or their masses of cobwebs out of his rooms, he got very angry with her. And indeed, if by any unlucky chance all of the spider flowers were to be cleared out of our bushlands, we would lose some of our greatest natural treasures.

Their proper name is, of course, *Grevillea* — and considering their lovely colours and their quaint spidery shapes, it's wonderful that we have so many of them. Also, wherever you go in Australia, and in whatever season, you are almost certain to meet some. You will meet them way up in the Snowy Mountains, and down toward sea-level, in moist places and in dry ones. And they grow on every kind of *plant* level, too.

For instance, our great Silky Oak tree⁽¹⁾ is a *Grevillea*, with masses of beautiful orange-coloured flowers. And there seems to be no end to the numbers and different types of *Grevillea* shrubs. And lastly there are those flat-on-the-ground *Grevillea* ramblers⁽²⁾, covering the earth with a dense leafy carpet — and making it difficult not to tread on their beautiful clusters of flowers.

When you think of the simple parts of a flower (sepals, petals, stamens and pistil), it's remarkable what *some* flowers manage to do with them, what different ideas they express, how they change the shapes, sizes and arrangements of things — how some of them, for instance, can make themselves look more like playful, colourful spiders than like flowers.

To begin with, *Grevilleas* have no sepals at all. Next, their four slender petals are joined together into a tube. Instead of long swaying stamens, they have four tiny ones — attached to the inside tip of each petal, so that you have to look closely to see them at all. Then, when the stamens' pollen is ripe, the tips of the petals roll backwards so as to make sure that bees and honey-eaters get dusted with it when they come visiting in search of nectar.



Also, when the petal-tips roll back, another important thing happens: the long "leggy" pistil straightens out — and it's this that makes *Grevillea* flowers look so spidery, especially those that grow in circular sort of clusters.

When most flowers are in bud, their pistils are tucked away inside them, right at their centres. But not so with *Grevilleas*. The pistils of these Daddy-Long-Legs are far too long for that. They try, but they can't manage it. They hoop out through a slit in the petal-tube, looking like strange little loops, with their tips (or stigmas) caught in at the top of the tube and surrounded by stamens.

Then, of course, when the petal-tips roll back, they let go of the stigma — which soon afterwards becomes sticky enough to catch any pollen that visiting bees and honey-eaters might bring along with them from other flowers — while the loop straightens itself into a very leggy-looking thing indeed.

Pink, red, white, orange, green — *Grevilleas* come in almost every colour except, perhaps, violet and blue. And amongst all of these bright colours, there's a quiet little grey one(?), which might easily be thought the prettiest of all. It's also, perhaps, the most "spider-looking" one, its flowers grouped together in heads, and all of them covered with soft grey hairs.

But the enchantment of *Grevilleas* doesn't finish with their flowers, for their seed-boxes look like elfin boats, mostly tapering off into thin curly ends — the remains of the flowers' pistils.

Finally, when it comes to the leaves of *Grevillea* plants, there's simply no end to their differences. They may be smooth, furry or prickly, short and squat, long and thin, large and oval, daintily ferny, and almost every shape and size in between.

What made you grow the way you are,
You funny little "spider"?
What made you such a spindly-"legged",
Determined stamen-hider?
What made you loop your pistil,
With a petal-tube about you?
And what, I fondly wonder,
Would our bushlands do without you?

(1) *G. robusta*. (2) For example, *G. laurifolia*. (3) *G. buxifolia*.

**New Book—Available from the Editor by mail only from
860 Henry Lawson Drive, Picnic Point, N.S.W., 2213**

How To Know Western Australian Wildflowers—Part IV

Final part in this famous series by W. E. Blackall and B. J. Grievé.

Price \$21.00 plus \$1.50 postage.

This series of books will be recorded in times to come as one of the most important manuscripts ever published. I (Editor) review many books on wildflowers for your information, some really excellent, but this series must surpass all others. As each part has been issued, it has got better and more detailed. This final part meets the peak of perfection for our needs.

Part IV covers the remaining families and revises some already sketchily treated, and includes the families *Solanaceae*, *Myoporaceae* (with the many species of *Eremophila*), *Lobeliaceae*, *Goodeniaceae*, *Stylidiaceae* and the Composites or Daisies *Asteraceae*. In this part the amount of clear, simple sketches assures the amateur who really wishes to know the name of a Western Australian plant in these families of an accurate identification.

But, the magnificent bonus is the section in the front entitled "General Classification and Key to the Families"! The key is prepared with the usual abundance (for this book) of clear sketches to the botanical features of the plant families, which alone makes this book a must for all "keen types". To further enhance the value of this is a section entitled "Aids to Identification" which lists the families with similar general characteristics, such as leaf characteristics, habit and habitat, plants with milky sap, flower colour, flower arrangement, number of stamens, etc. There are also many colour plates to assist identification.

This book is not for the beginner, or rather it is especially produced for the beginner and all others who wish to know more about our wildflowers and are prepared to spend a few hours in careful study. No one who is interested in our wildflowers should be without a copy.

GREVILLEA — BEAUTIFUL GARDEN SHRUBS

There is room in every garden for a *Grevillea*, floriferous easily grown plants. Some species are prostrate, providing valuable ground cover. The shrubs come in all sizes and the trees such as "Silky Oak", *Grevillea robusta*, are magnificent.



Photography by A. Rodd

GREVILLEA ROSMARINIFOLIA

This plant was produced from cuttings taken from a bush growing in Edinburgh, Scotland, that probably derived from the original plant produced from material sent in 1825 by Alan Cunningham when he first found and described the species. Refer to page 319.