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Mt Lesueur Under Threat

An appeal from the
Western Australian
Wildflower Society

Mt Lesueur is a spectacular wilderness area located just 200 km north of Perth and 20 km from Jurien, Western Australia. It is one of the most significant areas yet to be conserved in the State with many rare species of flora.

A careful study by a very competent fact finding committee has identified some 800 plant species, more than 200 of which have special conservation status. The shrublands of Mt Lesueur and its surrounds have more species per unit than any other vegetation type in the State. The flora is unique and cannot be seen in this form anywhere else in Western Australia.

Two private companies plan to establish a power station and an open cut coal mine that will desecrate the area. The motivation is profit with a complete disregard for the environment and the future of our world. Expert opinion has established, without doubt, that there are more suitable, more economical and more environmentally safe sites for power generation.

When is this crazy exploitation of the rapidly diminishing natural wonders of the world going to stop? Many projects are arguably necessary to maintain our standard of living and the issue is often clouded by biased supporting statements on one side and claims by ill-informed radical conservationists on the other, but this is a clear case of exploitation for profit. You can help with a brief letter to the Premier of Western Australia, Perth 6000, beseeching her to stay the execution of this beautiful area and to adopt any of the more economically viable alternatives available to her.

Editor's Note: I have prepared the above statement based on considerable detailed data supplied to me by our Western Australian Society. I have been to this area and please believe me, this is a unique, fragile wildflower area unsurpassed in the world. We do not get directly involved in local conservation issues as there are so many throughout Australia it would fill each issue of our journal. Our conservation policy is stated quite clearly in No. 120 issue of the journal where we are actively involved in the preservation of our unique flora on a national level based on competent scientific research, and on the local level by encouraging members to active participation on local action committees such as that at Mt Lesueur. However, in this case, I am asking all responsible readers to take a few minutes to write a letter as above. ■

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COVER PLATE — *Helichrysum bracteatum*

Photography by W. H. Payne

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Golden Everlasting

by John Knight

Helichrysum bracteatum, Golden Everlasting, or Paper Daisy is named from the Greek, *Helios* (Sun) and *Chrysos* (Gold) which refers to the bright golden yellow flowers; *bracteatum* refers to the prominent and numerous, dry, papery bracts, which are often incorrectly referred to as petals.

Helichrysum bracteatum is a most variable and widespread plant, found on the margins of dry rainforest in north Queensland, through to coastal areas of Western Australia, and seemingly every imaginable habitat in between, except wet or heavily shaded areas. They generally flower from spring to autumn, although those varieties which occur in arid inland areas flower in the cooler months.

Plants may be either annual, or woody perennials.

In the early 19th century, noted East German horticulturist Herren Ebrisch, at Arnstadt, developed many unusual colour forms by intensive breeding of the annual varieties, and these were widely distributed in European gardens in the 1850's. These varieties known as Strawflowers, have globular heads, the bracts of which are coloured maroon through to bronze. The bracts remain cupped around the flowers rather than opening out flat to the perfect flower-head of Golden Everlasting. Seed of the Strawflowers is still commonly available, distributed by seed companies such as Hortico. Variability of wild populations of *Helichrysum bracteatum* is seen in vigour, foliage and flower.

The annual varieties may grow from 30 cm to 1.5 m high, usually well branched but more or less erect. Foliage may be 20 mm long, but only 1 mm wide, or up to 100 mm long and 25 mm wide, whilst the flowers vary from 20 mm to 50 mm across.

Plants are easy to establish from seed sown following autumn rains, and flowering can be expected to commence about October/November in Melbourne conditions. For best results, choose a situation with full sun, and well worked soil into which some complete fertilizer has been incorporated. Place plants at 30 cm centres, and keep well watered during establishment period. Light feeding each month with Thrive or Aquasol, will produce healthy and bushy plants which reward the grower with heavy flowering for six months or more, depending on the severity of the season.

Plants may also grow well in dappled shade, but, depending on available light, may grow taller and produce smaller or fewer flowers. To overcome this, prune lightly but regularly to promote bushiness, and use a low nitrogen fertilizer when preparing the ground.

Picking flowers for decoration or drying will encourage further flower production, but be sure to leave some flowers to produce seed for next year. Seed may be collected and stored for sowing in autumn, or be allowed to disperse naturally, where it will pop up in the most delightful places. It is unlikely to germinate in areas where the soil is heavily compacted or heavily mulched with organic material. However, it germinates well in gravelled areas.



△ *Helichrysum bracteatum* 'Golden Bowerbird' Photo N. Marriott

▽ *Helichrysum bracteatum* 'Diamond Head' Photo Australian National Botanic Gardens





△ *Helichrysum bracteatum* 'Diamond Head' Photo N. Marriott

▽ *Helichrysum bracteatum* 'Dargan Hill Monarch' Photo M. Hodge



Seed is ready to collect when the bracts have reflexed slightly and the centre of the flower becomes downy, like a dandelion. It should come away from the flowerhead with no effort. When storing, be sure the seed is dry and free from insects. Store in paper bags or envelopes in a dry area. Seed is likely to be available from various distributors of Australian plant seed (e.g., Harpers, Nindethana) and various SGAP groups.

Plants are readily propagated from cuttings of firm young wood taken during spring to autumn. Wood produced during a flush of growth is most successful.

Most people are happy to grow the various perennial varieties, which are readily available from nurseries throughout Australia. Such is their popularity that even those nurseries that don't stock Australian plants will offer varieties of *Helichrysum bracteatum*. Again, plants are extremely varied in their habit and habitat. There are tightly matted ground covers to robust rounded shrubs which may grow over 1 m high and, in some instances, up to 2 m wide.

The leaves are bright green to grey-green, somewhat hairy and velvety to the touch. Size varies from 30 mm to 125 mm long, and 5 mm to 30 mm wide. Depending on the season, foliage may be sparse to dense, and it has been noted, in cultivation, that extra watering during summer will resurrect a limp, tired plant in a short time.

Given good conditions, that is plenty of sun, and an open friable soil that is not allowed to dry out in summer, the perennial forms of *Helichrysum bracteatum* are most attractive, free flowering shrubs, which may flower continually throughout the year. Regular light pruning is recommended to maintain bushiness, and cutting flowers for decoration is the ideal way to prune. Plants, including the forms described below, benefit from a regular light feeding during active growth.

Fresh flowers last a long time in water. If one wishes to dry the flowers, it is important to pick them when the first bracts have commenced to open, remove any foliage, and hang the flowers upside down in a dry, airy situation. Treated thus, the bracts will continue to open till all are arranged in perfect symmetry, displaying their true beauty for years.

The perennial forms of *Helichrysum bracteatum* have been popular in cultivation for many years, but it seems those grown originally which included plants with orange, yellow, lemon and white flowers, have given way to the many named cultivars now propagated.

***Helichrysum bracteatum* 'Dargan Hill Monarch'** was the first of these. It is a robust and large flowered selection from Cunningham's Gap, in the McPherson range on the SE Queensland/north New South Wales border. Growing as a dense rounded shrub to 0.8 m x 1-1.5 m, it has woolly grey foliage 70-120 mm x 20-30 mm. Very large, well displayed flowers, about 90 mm across, are held high above the foliage. Row upon row of shiny, bright yellow bracts surround up to 80 tiny orange florets. Plants may flower all the year if spent flowerheads are removed, but in cooler climates is generally restricted to the warmer months, October to April.

This cultivar is most hardy in cultivation, adapting to any well drained soil, in full sun or dappled shade. Plants respond to light feeding during vigorous growing periods, and pruning is beneficial. Heavy pruning should be avoided if possible, however, experience with plants in cultivation shows that plants will grow away well from hard pruning provided it is carried out early in the growing season, before the weather gets too hot.

***Helichrysum bracteatum* 'Diamond Head'** is another well established cultivar. It was registered in 1977 by John Wrigley, then curator of the National Botanic Gardens, Canberra. This compact, prostrate plant is common on the coastal cliffs and bluffs around Diamond Head on the north New South Wales coast. This selection is quite different from all other perennial cultivars, growing as a dense mat, about 0.1-0.2 m high and 0.5 m across. The bright green oblong leaves are soft and fleshy, but covered with short bristly hairs, giving them a slightly rough texture. Flower heads, with bright yellow bracts and orange florets, are about 30 mm across and held high above the foliage on stalks up to 100 mm long. Flowers during the warmer months, October to April.

Plants may become less thrifty and untidy if not pruned correctly. Strong, new growth commences about mid-winter, and at this time most of the old foliage should be cut away to allow the new growth to come through. As is common with many coastal plants, *Helichrysum bracteatum* 'Diamond Head' will not tolerate poor drainage, and performs best in full sun. It makes an excellent rockery plant. In areas where heavy frosts are experienced, cutting away the old growth should be delayed to afford protection to the new growth.

***Helichrysum bracteatum* 'Princess of Wales'** is a more recent introduction by the National Botanic Gardens. Named in honour of Her Royal Highness on the occasion of her visit to the garden in November 1985, this cultivar is a spontaneous hybrid between *Helichrysum bracteatum* 'Dargan Hill Monarch' and a coloured annual cultivar. Selected as having special merit, it is a bushy, free flowering plant growing about 0.6 m x 0.6 m, with bright green foliage.

Rich golden yellow flowers are about 60 mm across, and borne in profusion from September to April. Whilst of a more compact habit than other cultivars, *Helichrysum bracteatum* 'Princess of Wales' still benefits from light pruning during the growing season to encourage still more flowers. An ideal size for a small rockery, it would also make an excellent border plant, adapting to most aspects and soils. Again, full sun for heavy flowering.

***Helichrysum bracteatum* 'Cockatoo'** is similar to *Helichrysum bracteatum* 'Dargan Hill Monarch', in size and foliage, but the flower heads, to about 70 mm across have light lemon bracts surrounding up to 200 orange florets. *Helichrysum bracteatum* 'Dargan Hill Monarch' is one parent, the other parent being a white flowered perennial plant. A well drained sunny spot will ensure a compact habit, with the plant growing to about 1 m x 1 m. Flowers may be produced throughout the year with light pruning.

Other cultivars include: *Helichrysum bracteatum* 'Lemon Monarch'; *Helichrysum bracteatum* 'White Monarch'; *Helichrysum bracteatum* 'Golden Bowerbird'; *Helichrysum bracteatum* 'Barleythorpe'; *Helichrysum bracteatum* 'Hastings Gold'. As I have not tried these, I cannot comment on their suitability for garden cultivation. However, any *Helichrysum bracteatum* cultivar is likely to be successful if treated as for those described. ■

***Helichrysum bracteatum* 'Princess of Wales'**

Photograph by R. Hotchkiss by courtesy of Australian National Botanic Gardens.

(next page top)

***Helichrysum bracteatum* 'Cockatoo'**

Photograph by courtesy of Australian National Botanic Gardens.

(next page bottom)



REGISTERED CULTIVARS

The Australian Cultivar Registration Authority

***Helichrysum bracteatum* 'Barleythorpe'**

heel-ee-CRIS-um

This cultivar is a seedling of *Helichrysum bracteatum* 'Dargan Hill Monarch' and was selected by Somerville Nurseries, Somerville, Victoria. It grows into a dense shrub ± 60 cms tall by up to 1 m wide. The leaves (136C)* are similar in size and shape to *Helichrysum bracteatum* 'Dargan Hill Monarch' but lack the dense tomentum of that cultivar. The inflorescence is also much the same size being some 7-9 cms in diameter with ray florets that are narrower and more numerous, yellow (14A)* and disc florets yellow (23A)*. Flowering season from spring to autumn. Said to be frost hardy and drought hardy, it does not appear to show any merit above *H. bracteatum* 'Dargan Hill Monarch'.

***Helichrysum bracteatum* 'Cockatoo'**

heel-ee-CRIS-um

This cultivar is a spontaneous hybrid between *Helichrysum bracteatum* 'Dargan Hill Monarch' and a white flowered perennial form of *Helichrysum bracteatum* which arose in Mr D. M. McKenzie's garden at 3 Pearl St, Ocean Grove, Victoria 3226. It forms a bush that is compact and very dense and grows to ± 1 m tall $\times \pm 1$ m wide. The leaves are covered with fine hairs which gives them a greyish bloom. They are oblanceolate in shape and vary from 6-12 cms in length. The stems are also covered in fine hairs. The inflorescence is large, averaging 7 cms in diameter. The ray florets are very numerous and are ± 2.5 cms long, a light lemon yellow in colour, with odd flowers showing mottled ray florets of a deeper yellow colour (1D). The disc florets are a golden orange (23A). The flowers are displayed well on long stems held some 12-15 cms above the foliage. The flowering period is spread over spring, summer and autumn but some flowers are found all year round. The cultivar differs from its parents in the colour of its inflorescence and the size and shape of the shrub. Its perennial habit is the same as for both parents. It has been grown for many years and tried in most situations. It performs best in a full sun situation. Propagation is quick (2-4 weeks) from cuttings of new growth. The bush tolerates regular pruning which helps to improve its form and flowering potential. The name 'Cockatoo' was selected as the shape and colour of the ray florets resemble the wing feathers of the sulphur-crested cockatoo.

***Helichrysum bracteatum* 'Dargan Hill Monarch'**

heel-ee-CRIS-um

This cultivar is a herbaceous form of the well known Everlasting or Straw Flower which was found growing about one mile inland from Cunningham's Gap in southern Queensland in May 1961. It is a low-growing, rounded, soft-wooded evergreen shrub growing to a height of 0.6-0.8 m and about 1.5 m in diameter. The leaves are grey and woolly and are 100-120 mm in length and 20-25 mm at their widest point which is beyond the mid-point. The mid-rib is prominent although depressed whilst the margins are slightly recurved. The flower heads are lustrous golden-yellow, between 70-90 mm in diameter and borne above the foliage on long stems about 300 mm in length. The ray florets (yellow-orange 14A) are papery and remain on the plant for some months. The inner florets are yellow-orange (23A), the foliage green (136C). This cultivar is different from other known forms of *Helichrysum bracteatum* in that of the grey foliage and flower size. The typical *Helichrysum bracteatum* has green foliage and flower heads about 50 mm in diameter.

*Royal Horticultural Society colour code.

***Helichrysum bracteatum* 'Diamond Head'**

heel-ee-CRIS-um

This cultivar is a natural form of *Helichrysum bracteatum* which was found at Diamond Head, New South Wales. Owing to the exposed position this plant grows in, it has developed a stable prostrate habit which reduces its height to approximately 8 cm. Flower heads are held above the level of the plants adding about 8 cm to its height during the flowering season which begins in early November and continues through to mid-February. Overall height, therefore, is approximately 16 cm. Individual plants will grow to approximately 60 cm across and are perennial. The leaves are green, approximately 7 cm long and about 5 mm wide. They are rough to the touch due to a covering on both upper and lower surfaces of short stout hairs. The flowers are bright yellow, approximately 3 cm across. The ray florets (yellow 13A) are papery and remain on the plant for some months. The centre of each flower head is orange (21A).

***Helichrysum bracteatum* 'Golden Bowerbird'**

heel-ee-CRIS-um

This cultivar is the result of a manipulated backcross between *Helichrysum bracteatum* 'Cockatoo' to one of its parents, *Helichrysum bracteatum* 'Dargan Hill Monarch'. The cross was performed by Mr Doug McKenzie of Ocean Grove, Victoria 3226. It forms a shrub $\pm$ 40 cms tall by 70 cms wide and has foliage very similar to both parents. The foliage is grey in appearance due to the heavy tomentum covering the leaves. The inflorescences, 9-10 cms across, are carried 9-10 cms above the foliage. They are larger than the inflorescences of both the parents. The ray florets are numerous, averaging 300 per inflorescence, compared with 80 in *Helichrysum bracteatum* 'Dargan Hill Monarch' and 200 in *Helichrysum bracteatum* 'Cockatoo'. This gives a "doubled" appearance to the inflorescence. The buds are brown in colour and open to reveal clear yellow ray florets (5A) and golden orange disc florets (23A). The florets are $\pm$ 2.5 cms in diameter. *Helichrysum bracteatum* 'Golden Bowerbird' is easily distinguished from both the parent forms by its much larger and brighter gold inflorescences, the far more numerous ray florets, and the bush is smaller and more compact than either of the parents. This cultivar strikes readily from cuttings. This method must be used to preserve this cultivar form. It has proved hardy in a variety of situations in Ocean Grove.

***Helichrysum bracteatum* 'Hastings Gold'**

heel-ee-CRIS-um

This cultivar is a naturally occurring form of the species found growing at Hastings Point which is on the coast east of Murwillumbah, northern New South Wales. It is a perennial herb growing to a height of about 250 mm being shorter than the usual form that can reach 600 mm. When in flower another 200 mm is added to the height as the flowers are held above the foliage. Individual plants reach 700 mm across. The leaves are green on the upper surface and grey-green underneath due to a covering of stiff silvery hairs. The leaves are up to 140 mm long by up to 30 mm wide. The papery flowers are bright yellow (13B) with a darker centre (23B) and measure 50 mm across. They are borne on stems about 200 mm long. It is reported that it flowers most of the year in Brisbane with a peak during spring and summer. It differs from *Helichrysum bracteatum* 'Diamond Head' which grows to 160 mm and has smaller flower heads to 30 mm. It differs from *Helichrysum bracteatum* 'Dargan Hill Monarch' which grows to a height of 600-800 mm and has flowers with a diameter of 70-90 mm.

This cultivar is a presumed hybrid between two forms of *Helichrysum bracteatum*, the annual multicoloured form and the perennial form known as *Helichrysum bracteatum* 'Dargan Hill Monarch'. The cultivar arose in cultivation at the Australian National Botanic Gardens in Canberra and was selected by Mr P. Ollerenshaw in summer 1983. It grows into a compact, dense shrub 0.6 m tall by 0.6 m wide. The leaves are mostly glabrous though the midrib is covered with a fine mantle of silky hairs. Some scattered silky hairs occur also along the leaf margins. The younger stems are covered in a dense coat of similar silky hairs which diminish as the stems become older. The leaves average between 5-9 cms in length. The flower heads average 5-6 cm across. The outer involucral bracts are about 2 cm long while the rays of the inner bracts average 1-1.5 cm long. Both are a rich gold in colour, yellow-orange (14A). The stigmas are orange colour (23A) when they emerge. The flowers are on long stems that emerge well above the foliage. The flowering season in Canberra is from October to April but occasional flowers may be found all year round. It should not be markedly different in other parts of Australia. The cultivar has the perennial habit of *Helichrysum bracteatum* 'Dargan Hill Monarch' but lacks the greyish appearance provided by the fine silky hairs. The main distinguishing characteristic is in the cultivar's flowering habit. As flowers die the stem withers and the whole flower stem and dead flowerheads disappear into the lower foliage of the plant. At the same time new growth emerges from lower on the plant and extends above the foliage again. These new stems then bear new inflorescences. The cultivar is named in honour of Her Royal Highness the Princess of Wales. The cultivar is frost hardy and moderately drought hardy. Cuttings may be obtained from plants at almost any time of the year. ■

Our Favourite Everlastings

by Tony Foster and Neil Kirby*

I like *Helichrysum bracteatum* 'Princess of Wales' most of all the cultivars as it does not grow too tall, rarely above half a metre high and produces such an abundance of large flowers. This is provided you cut the fresh flowers; it just keeps producing more flowers, seemingly, most of the year. Of course it needs full sunshine.

Helichrysum bracteatum 'Golden Bowerbird' has equally as large yellow flowers, with longer flower stems but does not produce as many flowers.

Helichrysum bracteatum 'Cockatoo' is the next favoured, the soft warm-lemon bracts surrounding the yellow flower centre, again produced on a long stem, are very decorative.

Helichrysum bracteatum 'Lemon Monarch' is very similar to the cultivar above except that the surrounding lemon coloured paper bracts are fewer and less crowded. *Helichrysum bracteatum* 'White Monarch' is similar except that the papery bracts surrounding the yellow centre are pure white providing a stark contrast. The leaves are a fleshy grey.

*Operating the Yellow Rock Native Nursery in the Blue Mountains west of Sydney, these experienced growers supply huge quantities of plants to the trade, wholesale. Their plants are widely available. They know which are the best, most rewarding and the hardiest selections. —Editor.

***Helichrysum bracteatum* Forms**

by Esma Salkin, Australian Daisy Study Group

The Australian Daisy Study Group has collected seed of this variable species from many locations throughout Australia. Most have been annuals and are ideal to use for massed display or as "fillers" in the garden. Four forms popular with the group from the eastern states, range in height from 2.3 m to low compact shrubs 20–30 cm.

A form from Guyra, New South Wales is an open, upright, very floriferous plant 1.5–2.3 m high. Flowering stems are long, making it ideal for cut flowers. Flowerheads, 4 cm across are saucer-shaped and bright yellow. Outer bracts are fawn to mid-brown and in some cases, yellow striped with brown giving the flowerhead a multi-coloured effect. Buds frequently show a marbling pattern seen to advantage in floral art. Leaves are long and narrow and grey-green. It blooms continuously throughout summer to autumn. A Cobar form has similar characters, but leaves are bright green.

A form from the Grampians, Victoria, is a more compact bush of 0.5 m. Leaves are broader and golden flowerheads on short stems cover the bush. Flowering commences early summer, some plants blooming into winter.

A form from the alpine regions of Victoria and New South Wales is unusual and has affinities with *Helichrysum acuminatum*. Its bracts are narrow and acute, but outer bracts are shining, not dull as for *H. acuminatum*. Outer bracts are deep yellow to brown, intermediate ones deep yellow and the narrow acute bracts give the flowerhead a star-like appearance. Flowerheads are terminal on branching stems, bloom in the alpine spring. Leaves are narrow, 1 cm wide and dark green. The habitat is sunny, sheltered rocky outcrops above the snowline in Gippsland alps and Kosciusko National Park.

The form from South West Rocks and similar coastal locations in northern New South Wales is a very attractive low compact shrub covered with golden flowerheads 5 cm or more in diameter. ■

Sturt's Desert Pea

Research by Dr Greg Kirby
Flinders University, Bedford Park, SA

The Sturt's Desert Pea, *Clianthus formosus*, is one of the world's most spectacular flowering plants and a potentially enormous horticultural asset. In years to come it will be sought after throughout the world. You are invited to assist my research, being supported by The Australian Flora Foundation.

Plant breeding is market orientated. One market is for exports overseas of cut runners about 60 cm long with two or three bunches of open flowers. These plants will need to have strong vertical runners with long internodes and shortish stems on the flowers. Another market is for pot and hanging basket plants which will have to be prostrate with short internodes and longer flower stems. Cut flowers for florists will need to have stems that are very long. A range of flower colours will be desired by different consumers. Fortunately, the natural populations contain plenty of colour variants besides the classic red flower with a black centre. It also needs to be emphasized that selection for health and vigour will need to be practised in order to eliminate the bad habit that many plants have of suddenly wilting and dying.

Research at Flinders University is as follows:

- (a) the collection and study of a germplasm collection based on seed;
- (b) the development of isozyme electrophoresis methods for the identification of genetic loci that can be used in further studies on the breeding system and genetic structure of natural populations;
- (c) the isolation of microbial symbionts (*Rhizobia* bacteria and mycorrhizal fungi) and study of their role in aiding the growth of plants;
- (d) studies on the breeding system and inbreeding depression of Sturt Pea.

A pilot germplasm trial in the 1989/90 summer with seedlings from WA and SA populations revealed an extraordinary amount of variation in all of the characteristics evaluated on the plants grown in the glasshouse and an outside area. Flower colour and shape, stem length and thickness, number of flowers per stem, plant growth habit (ranging from one or two vertical runners to many prostrate runners on different plants), time from planting to flowering, susceptibility to wilt and mildew are all examples of characters that vary greatly.

Making crosses between plants is quite straightforward because the large flowers are easy to manipulate: the anthers should be removed just before the flower opens to prevent them dropping pollen over the stigma, the flower is left for four to seven days depending on temperatures, then pollen from an opened flower on the chosen male parent is rubbed onto the now receptive stigma and after a few days the petals collapse and a pod forms. The pod takes from six to 14 weeks to ripen depending upon temperatures and a good pod will contain more than 50 seeds. Plants can also be self-pollinated by tripping the stigma on a flower that is at least a week old and rubbing its own pollen on the stigma. Most plants seem to be self-fertile but there is evidence of inbreeding depression in the seedlings derived from self-pollination.

The Seed Bank and How You Can Assist

In order to supply the genetic variation required for plant breeding, a large germplasm collection must be built up of seeds from all over the species range and from any strains that have succeeded in cultivation. I am proposing to establish a germplasm collection for Sturt Peas so that material can be supplied to anyone interested in growing and breeding this wonderful native. Practically any Sturt Pea seed is likely to be useful to the collection. It could be collected from wild plants or from plants already in cultivation. Whilst seeds from plants with obvious variations such as unusual flower colours are keenly sought after, plants that look ordinary may turn out to carry less conspicuous and equally valuable characteristics such as disease and pest resistance genes. If you have seed still in pods, please leave it in the pod so that the relationship between the seeds is known. If anyone has the opportunity to collect ripe pods from natural populations, please do not collect more than one pod per plant and try to keep separate the pods from different plants. Details such as locality and any interesting plant features should be recorded if possible (but, please do not let the lack of details discourage you from sending seed or pods).

People wishing to obtain seeds from the germplasm collection should contact me. At present the collection contains relatively few well documented accessions. In 1990, naturally pollinated pods were obtained in abundance from a handful of plants that survived an epidemic of wilt (root-rot) disease in an outdoor garden plot. These pods are available either for exchange with people who have seeds that they can donate to the germplasm collection or for supply to others. Those who do not have seed to exchange should donate \$5.00 (or more) to support research on Sturt Peas and cover costs. ■

Sturt Pea

A Dramatic Native Flower For Your Garden

by Frank Bridgeman, B.Sc (Agric)

One of the most striking and brilliant of native flowers — indeed comparing favourably with the most beautiful flowers of the world — the Sturt Pea can be cultivated without any great trouble. Note the words, “without any great trouble”. It is, indeed, one of the best natives for a novice to start with — nearly as easy as zinnias — as it blooms within several months of sowing with results your neighbours will envy. You will need to grow from seed.

Seed Treatment or Scarification — The seed usually contains a high percentage of so-called “hard” seeds which because of an impervious coating cannot absorb water necessary for germination. To break this coat the seed is rubbed lightly between two sheets of medium sand paper. Another rather more tedious but excellent method is to lightly file with one or two rasps (a nail file will do) each individual seed without penetration beyond the outside coat. This should be done away from the scar on the seed where it was originally attached to the pod. Seed properly treated in cold water overnight will swell when soaked. I prefer these methods to the soaking in hot water as this is likely to kill any nitrogen fixing bacteria that may be adhering on dust on the seed. Also the seed is more liable to damping off and other fungus troubles. To prevent fungal attack, the seed should be dusted with a fungicide before sowing.

Soil — The main requirement is that the soil be deep without a sticky clay subsoil within about 30 cm of the surface; without rocks or hardpan or other obstructions anywhere close underneath, to give the plants a free roof run. Drainage must be good. The situation should be sunny. Given these requisites an ordinary garden bed is preferable, in my opinion, to rockeries (where I have had little success with Sturt Peas) pots or specially built up beds — unless these happen to be unavoidable to obtain the basic requirements.

Time of Planting — In most coastal areas, sow as a summer annual like zinnias — the hotter the weather, the better for sowing and growing. In Western Australia, September to January are suitable months — November being one of the best. Similar times would apply in the east with a few weeks later in the south. Remember not so early as to place the seed in cold soil where germination is likely to be slow and disease ridden; but not so late that the plants have only a limited flowering season before cold autumn weather retards them.

Planting — I prefer sowing Sturt Peas where they are to grow, in open beds. They do better without transplanting. Make rows about 1–20 cm deep, about 30 cm apart and scatter the treated seed fairly thickly in the rows — 2–3 cm apart at the most. Water well and keep just moist until germination which in warm weather only takes a few days. When the plants are established, thin out to about 20–30 cm apart. The thicker the final stand, the more the plants will tend to grow upward. Sowing can also be done in large deep pots — similar to the size of a kerosene drum or in wide pipes, but in these cases the soil may dry out badly and I would suggest some peat in the mixture. Sow up to six seeds per container and thin to two or three final plants.

Transplanting, I avoid it but, if necessary, sow several seeds in paper cups or small plywood cylinders, thin out to one and move without disturbance when the first compound leaves develop.

Though Sturt Peas are a desert plant, they often do better when suitably watered, and where grown during hot dry summer, some watering is essential. Less moisture is needed after germination than before, but a good watering can be given about once a week on light soils, and about once a fortnight on heavy soils in dry hot conditions. Watering can be done by sprinkler if desired. Overwatering should be avoided. Where summer rains occur as in Sydney or as in Melbourne, watering may not be necessary.

Subsequent Fertilizer Treatment — If desired, fertilizer can be given after the plants are germinated rather than before. Keep the fertilizer about 5 cm away from the base of all plants and water after application. If the plants do not make fast growth, and the weather is warm, check on the colour of the leaves. They should be deep green and healthy. If not, check for red spider and if not this, dig a few plants up to examine the roots — don't pull, dig up carefully and wash the soil away. If there are no nitrogen fixing bacterial nodules on the roots which are otherwise healthy, the trouble is probably lack of nitrogen, apply sulphate of ammonia at no more than 1.5 grams per metre² or urea at 1.0 grams per metre² at monthly intervals. A top dressing with a mixed fertilizer at no more than 2.5 grams per metre² at the beginning of flowering can also be made. Always wash fertilizer in with a good watering.

Nitrogen Fixing Bacteria and Sturt Pea — Like all legumes, native and exotic, Sturt Peas have an association or symbiotic relationship with Rhizobium bacteria that form nodules on the roots and can supply the plant with nitrogen fixed from the air, thus improving the growth of the plant. This nitrogen fixing occurs under both natural and cultivated conditions with the legumes I have investigated — even in soils well supplied with nitrogen fertilizer, I have seen nodules well developed on native plants. The bacteria can supply a steady and large source of nitrogen in a suitable form without it being leached out by excessive watering or rain, especially in light soils; whether nitrogen fertilizer is used or not I strongly consider it wise to encourage such nitrogen fixing bacteria for more sustained health of the plant. If nitrogen fertilizer only has to be relied upon, it has to be provided in small quantities at frequent intervals or otherwise yellowing will occur.

Pests and Diseases — Sometimes Sturt Peas can turn yellow or wither or wilt due to damping off or root rot. Drench with a fungicide 1.5 gm per litre applied at 5 litres per square metre. Do not water for several days afterwards. This will not save plants already damaged but should stop the spread to others. ■

Will You Grow Sturt's Desert Pea?

You can assist a vital research project and enjoy the product of your labour. Obtain seed of Sturt's Desert Pea, either by writing to Dr Greg Kirby and donating \$5.00 for the seed or sending to the Western Australian Wildflower Society, P.O. Box 64, Nedlands, WA 6009, enclosing a stamp/addressed envelope for return and \$1.00 per packet of seed. Then sow the seed as directed below. When the plants bloom and set seed send one pod to Greg Kirby with a comment on the features of the flowers and plants you grew.

Sturt's Desert Pea —

A Flowering Pot Plant

by G. E. Barth, Ornamental Horticulture,
Department of Agriculture, SA

In our research programme at Northfield Research Laboratories aimed at assessing Sturt's Desert Pea as a cut flower crop, we found that the seedlings could be grown as attractive pot plant specimens with either manual pinching or the use of growth retarding chemicals*. There are several constraints in producing Sturt's Pea as a cut flower crop and it is felt that the commercialization of this species may be more favourable as a flowering pot plant line. With selection of varieties for uniformity, compactness and colour variations, Australian producers could produce patented plant material for overseas sales.

The methods used for growing Sturt's Pea successfully in pots from seedling material may be of interest. Seeds are scarified (seed coats nicked with a scalpel or use drum scarifier) and sown in seedling trays containing suitable seedling mix or in Jiffy® pots. After true leaves emerge, seedlings are transplanted into 150-175 mm pots in a pasteurized 3:1 pine-bark/coarse sand media supplemented with: Dolomite: 2 kg/m³, Lime: 1.5 kg/m³, Single Super P: 0.5 kg/m³, Iron sulphate: 750 g/m³, Micromax®: 300 g/m³, 8-9 mg Osmocote®: 2.5 kg/m³. Plants should receive supplemental liquid feeds until first flowers appear. Suitable formulations are full-strength Top® hydroponic solution twice weekly supplemented with Sequestrene® (0.5 g/l) or Aquasol® weekly.

Plants need good light conditions for flowering but will not tolerate high temperatures in an unshaded greenhouse without damage. In South Australia with high winter light levels, plants are best produced in the period April-November. In this period, greenhouse cooling can be kept to a minimum, and night temperatures can be adjusted to influence plant height. By maintaining night temperatures near day temperatures, plant height is controlled and the use of growth retardants is minimized. Plants grown in houses where there is a wide fluctuation in day/night temperatures will produce elongated plants which are unsuitable as flowering pot plants.

Mechanical pinching can be used but care must be taken in timing. The upright central stem should develop to 15 cm prior to pinching. Many seed lines will stop vegetative growth and initiate flowers at this height and will not require pinching. Laterals, in comparison, should be pinched at approx. 10 cm of growth, to encourage branching close to the centre of the plant. A combination of growth retardants and pinching can be used for dense growth.

High standards of nursery sanitation must be maintained during production of Sturt's Pea plants because of their high susceptibility to *Fusarium moniliforme*, a systemic wilt disease which produces spores that are air-dispersed and easily spread once established. Treatments with the fungicides Fongarid®, Alliette®, Rovral®, Prochloraz®, and Benlate® have not caused any damage to young plants. Major insect pest of Sturt's Pea in greenhouses are two-spotted mite, aphids, mealy bugs and thrips. ■

*Growth retardants, when used, are applied two weeks after potting on seedlings. Paclobutrazol (Bonzi®) drenches (100-200 ml) at rates of 2-4 mg a.i. per pot would be recommended to reduce height and elongation of laterals 30-40% over control plants. Chlormequat (Cyclocel®) sprays and drenches had no effect over controls in our trialwork.



Young Sturt's Pea seedlings are planted into pots when roots were clearly visible at the bottom of the peat pots (Jiffy Pots) and there were 1-2 true leaf pairs. Plants are 8-12 weeks old when marketable, i.e., bloom with well balanced shoot growth. These have been treated with growth retardants only. Pinching would result in a more uniform bushy plant but it takes longer to come into bloom.



Research on our Wildflowers

The Australian Flora Foundation

W. H. Payne, Director

The article "Sturt's Desert Pea" by Greg Kirby, nominates as its objectives, what could be described as the principle objective of this periodical and the Society, if applied to a whole range of our wildflowers.

1. As cut flowers — for the export market, cut runners 60 cm long with 2–3 bunches of open flowers on shortish stems. What a spectacle this would make in our homes, or in the garden, cut flowers on long stout stems.

2. For pots in hanging baskets — just as many people purchase a pot of daisy or Cyclamen with the flowers just bursting into bloom, blooms that they will hold for a long period in a sunny position in the home, so he is researching to market a pot or a hanging basket crowded with Sturt's Desert Pea bursting into flower. For this the plants will have to be prostrate with short internodes and long flower stems. With mass production from tissue culture, a vigorous grower from the desert adapted to germinate, prosper and flower, and set seed after a rare heavy shower, is ideal. What a spectacular hanging basket.

3. For horticulture — The emphasis is the reliable production of plants with a range of flower colours. What flower in the world can out dazzle the classic brilliant red flower with its black centre. Particular emphasis is on "selection for health and vigour".

I will repeat my statement above slightly differently. Is this not what all readers want with a whole range of wildflowers, particularly the last sentence of objective 3. To achieve this we need competent advice and research from Australia's scientists and horticulturists. Along with research aimed at the preservation of the Australian flora, this a preferred objective of the Australian Flora Foundation. The work by Dr Greg Kirby is one of the many research projects on the Australian flora being supported by the Foundation.

Quite reasonably, questions have been asked — "We have created The Australian Flora Foundation and given it support in the past, what is it doing and is the money being spent wisely?" In future issues you will learn of the work of the Foundation. It is similar to that above, conservation orientated, horticulturally productive. The funding is not lavish but related to direct expenses incurred by competent scientists who have given freely with their time, their available resources and their expertise.

The work is limited only by the available funds. With a donation of \$2 000 you could support a whole project on your own such as Greg Kirby's study of mycorrhizal fungi association with the roots of the Sturt's Pea. This may be the horticultural breakthrough desperately needed and for just \$2 000 you, personally, would fund a complete scientific research project of great importance. Do not just think about the need for development of our flora, now is the chance to do something significant. For others it is the many donations of \$100 we hope to receive from readers concerned about the conservation of Australia's unique flora that is enabling vital research work to continue. Did you send \$100 for 1990? Send to: Australian Flora Foundation, G.P.O. Box 205, Sydney 2001. ■

Banksia

by Trevor Blake,
Banksia Study Group Leader¹

A spectacular group from Western Australia

A group of banksias that for a long time was lumped together under the one name of *Banksia sphaerocarpa* made its own mark on the botanical world during the decade of the eighties. Growers, wildflower enthusiasts and botanists for years had recognized that there were many distinct "forms" within this group. Most had flowers in the cream/yellow to golden brown range and generally with fine linear leaves with well displayed ball to shortly conical flowers. Early in the 1980's, the banksias were revised by a Western Australian botanist, Alex George², and most were given distinct species status.

Banksia sphaerocarpa

Banksia sphaerocarpa was named by Robert Brown in 1810 from collections made on Flinder's voyage and refers to the spherical shape of the fruiting cone. It is one of the group which grows to around 2 m from an underground stem known as a lignotuber. This species flowers in its natural habitat from January to July and will recover from fire by shooting from the lignotuber. The foliage is a uniform dark green colour with bright green, new shoots. The leaves are narrow, linear with revolute margins. Spherical purplish-brown flower heads are borne terminally or on short lateral branches. The follicles are smooth and shiny and the habit is smaller than var. *caesia*. It is distinguished from *B. micrantha* by having larger flower spikes and less sharply ending leaves. It occurs naturally from west of Nannup to Jerramungup in the east with a spread to the northern sand plains near Eneabba. It is widely cultivated and tends to be a slow grower, and it requires well-drained, light soils with plenty of sun. It could prove to be tolerant of a range of soil types.

Banksia sphaerocarpa var. *caesia*, a closely related form, was named because of the pale, glaucous leaves. It is generally found in a lower rainfall area of the southern wheatbelt which averages up to 450 mm per annum. It differs from the true species with its larger habit (to 4 metres), glaucous leaves, smaller golden flowers, smaller follicle size and greater number of follicles per cone. It is found in the Newdegate-Piawanning area but also as far south as Kojonup and east to Hyden. It grows in laterite or sand over laterite.

Banksia sphaerocarpa var. *dolichostyla* is another recently named variety that can be found in a restricted area east of Hyden near Mts. Ironcap and Holland. It was so named because of its longer flower parts (perianth and pistil). The leaves are similar to var. *caesia* in that they are also glaucous, the flowers golden and the follicles small. The flowering period is more restricted and it inhabits lateritic soils in a 300 mm rainfall area. The "Banksia Atlas" confirms the rarity of this species.

1. The Banksia Study Group — See page 358 for details.

2. "The Banksia Book" by Alex George. The most complete reference to Australian *Banksia* is a book sponsored by the Society, "The Banksia Book" by Alex George. It may be obtained from your bookseller or by mail as indicated inside the rear cover of this issue. The book gives many interesting notes on these unusual plants with advice on seed collection, germination and the cultivation of plants. Each of the 75 species is described and illustrated with clear sketches and large, beautiful colour plates. An essential reference and an ideal gift. We are indebted to Alex for his comments on this article and the use of sketches from the book.



***Banksia scabrella* (above)**

Photography by Trevor Blake

The flower buds are pale. The often purplish and long, tapered brown, hair-like bracts that are below each flower (see sketch on page 359) are hidden in the photograph. The cluster of brown bracts that cup the flower head are visible. The mature flower displays the purplish flowers at the upper end of the flower head, the lower ones being cream to yellow. From what leaves are shown it will be noted that they are fine, short and crowded.

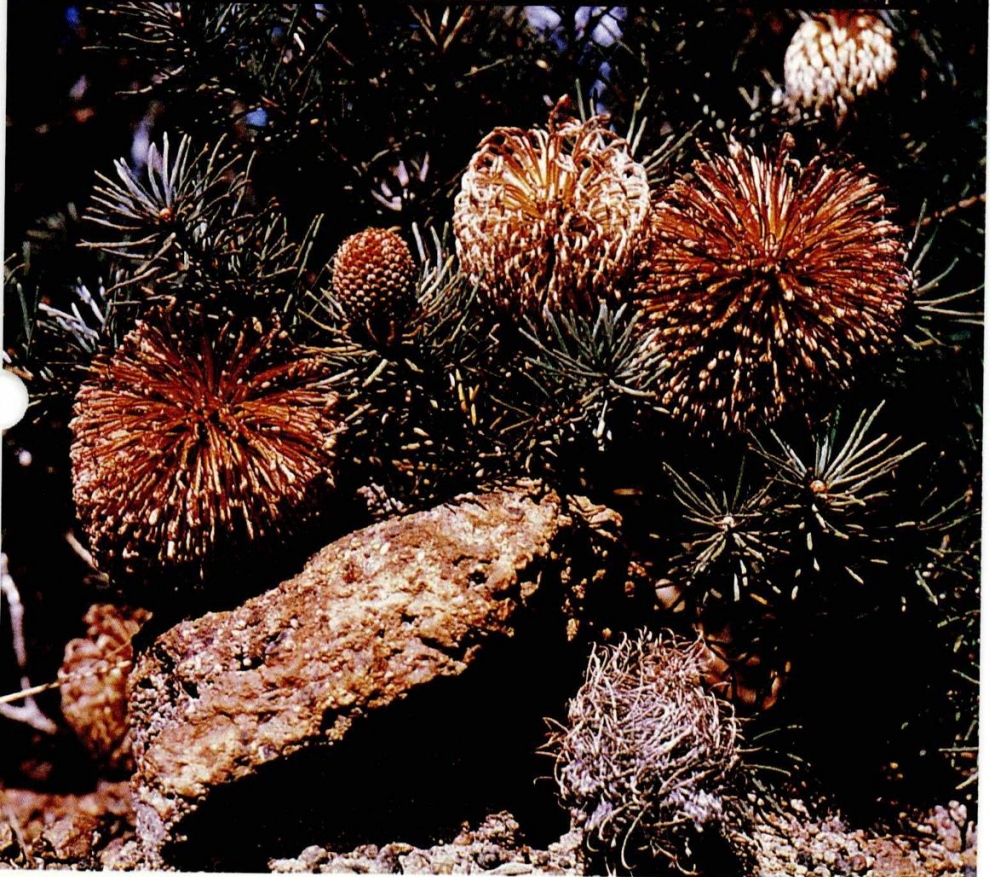
***Banksia sphaerocarpa* — the type variety *sphaerocarpa* (opposite top)** Photo by Trevor Blake

This small shrub, rarely to two metres high, has purple-brown flowers to 10 cm diameter in a large characteristic ball. The flowers are shown here in all stages from the small cylindrical head of flowers in bud, to the stage at the lower left where the flowers are fully formed but the style ends are still held in the ends of the petals (see page 359 for sketch of a flower). In the half mature flower on the centre right the styles of the lower half of the flowers have popped out whereas those in the upper half still being held in a loop. Mature large pom-pom ball type heads of flower where all styles have popped out like bristles are characteristic of this group of *Banksia*. The leaves are about 5 cm long and 2 mm wide.

***Banksia sphaerocarpa* var. *caesia* (opposite bottom)**

Photography by Trevor Blake

The young flower heads appear to have a silvery sheen on the backs of the looped styles but the larger mature flowers with bristling styles are a deep golden orb. The leaves are glabrous (without hairs — almost shiny). The seed head at the bottom shows how the dead flowers have persisted.



Banksia lanata

Banksia lanata received species status in the 1981 revision. The specific name refers to white, woolly, floral bracts. Its spreading habit keeps it low to the ground and it is a useful groundcover. The dense, fine leaves are crowded on stems and the pink new growth provides an interesting addition. Flowerheads are borne on short lateral branches. The species can be easily distinguished by the bracts below each flower being covered with white, woolly hairs, a detail which is different from all of the other species within this group. The old floral parts give the seed cone a shaggy appearance. It can be found growing on the lower slopes of undulating hills in deep, white sand or, occasionally, in sands over laterite. It inhabits heathlands to the north of Perth from the Arrow-smith Lake to Coomallo Creek, and it is well represented in Tathra National Park. A few reports indicate success in deep well-drained sands in full sun.

Banksia scabrella

Banksia scabrella is a spreading shrub that can reach 3 m across with the lowest branches resting on the ground. The name refers to the roughened leaves. Generally, easily distinguishable by the fine, short, crowded, hair-covered leaves that become quite roughened or scabrid. The flower buds are pale purple and have long, tapered, brown, hairlike bracts below each flower. The flowers are well displayed terminally or on short, lateral branches. It can be found on deep sands in a restricted area to the east and south-east of Walkaway, a township near Geraldton, and to the east of Mt. Adams. It regenerates after fire from seed as it has no lignotuber. It is interesting to note that this species was originally collected by Baron von Mueller in 1877. The "Banksia Atlas" records this species as being on the verge of being rare and at risk. To date, there are encouraging reports on plants growing in well-drained sandy soils in sunny situations.

Banksia telmatiaea

Banksia telmatiaea: The specific name refers to its swampy habitat. A more upright shrub with very short, crowded leaves. The flower buds are covered in rich, rusty-brown hairs and the elongated flowers open to a gold brown colour. It can be found growing in deep, grey sandy loam that is frequently wet in winter. It occurs in coastal areas south of Perth to Badgingarra and was first collected in 1830/40's by Preiss and Drummond and included under *B. sphaerocarpa* but not given species status until 1981. Little is known of its cultivation habits, but moist well-drained sandy loams in sunny or partially shaded situations should be successful.

Banksia micrantha

Banksia micrantha, the name referring to the small flowers, can be found on the northern sandplains between Eneabba and Cervantes, and is quite common in the threatened area of Mt. Lesueur. It is a low, spreading shrub that reaches 1.5 m across with fine leaves that terminate in a point and are hairless above. The flowers are generally pale yellow with occasional purplish tinges, and are the smallest in this group of species. It was separated from *Banksia sphaerocarpa* because it has smaller flowers and larger follicles. The follicles are broad and flattened, becoming quite glabrous with age. It also has underground, lateral branches which is a characteristic quite unique in the group. This species grows in white sands and laterite gravels.

Table of distinctive features to this group of *Banksia*. Leaf — Margins of all species are revolute. Flowers — All flowers are persistent on the fruiting heads except for *Banksia incana*. Lignotubers occur on *Banksia sphaerocarpa*, *B. micrantha*, *B. grossa*, *B. incana* and occasionally on *B. violacea*.

Species	Height × Width in metres	Leaf Length in cm	Leaf Width in mm	Flower colour	Flowering time	Follicles	Follicle Numbers
<i>Banksia</i>							
<i>sphaerocarpa</i>	0.5-2	2.5-10	1.5-2	purple/ brown	Jan-July	elliptical, glabrous with age 15-30 mm long × 10-25 wide	60
var. <i>sphaerocarpa</i>	×						
	1.0						
<i>sphaerocarpa</i>	1.5-4	"	"	golden	Mar-July	smaller than above	"
var. <i>caesia</i>	×					8-17 mm long × 10-12 wide	
	1.5						
<i>sphaerocarpa</i>	2-3	"	"	golden	Mar-May	Similar to v. <i>caesia</i>	"
var. <i>dolichostyla</i>	×					longer floral parts	
	1.0						
<i>micrantha</i>	0.60	1-3	1-1.15	pale yellow	Dec-May	ovate-elliptic glabrous with age. 23-27 mm long × 20-23 wide	25
var. <i>micrantha</i>	×						
	1.2						
<i>grossa</i>	1.0	4-12	2.3	golden	Mar/May/Dec	elliptical 25-35 mm long × 10-18 wide	15+
var. <i>grossa</i>	×			brown to rusty brown			
	1.5						
<i>leptophylla</i>	2.0	4-12	1-15	pale yellow	Nov-Dec	elliptical 15-30 mm long × 8-10 wide	80+
var. <i>leptophylla</i>	×			to pale brown			
	3.0						
<i>leptophylla</i>	2.0	4-12	1-15	to golden	March-July	"	80+
var. <i>melleitica</i>	×			brown			
	1.0						
<i>lanata</i>	1.0	3-10	to 1	upper pinkish lower ones pale cream	Sept-Oct	elliptical 12-30 mm long × 6-12 wide	50
var. <i>lanata</i>	×						
	1.0						
<i>scabrella</i>	2.0	0.8-3	1	upper purple lower cream to yellow	Sept-Jan	Narrow elliptical 8-28 mm long × 6-8 wide	80
var. <i>scabrella</i>	×						
	3.0						
<i>telmatiaea</i>	2.0	3-4	1+	golden to pale brown	May-Aug	Narrow elliptical 12-20 mm long × 4-7 wide	65
var. <i>telmatiaea</i>	×						
	1.0						
<i>incana</i>	0.70	1-6	1.5-2	bright yellow occasionally purple	Nov-Mar	elliptical to rhomboid 8-33 mm long × 10-30 wide	36
var. <i>incana</i>	×						
	1.0						
<i>violacea</i>	1-1.5	1-2	1.5		Nov-April	elliptic, flattened 10-25 mm long × 8-22 wide	10-36
var. <i>violacea</i>	×						
	1.0						

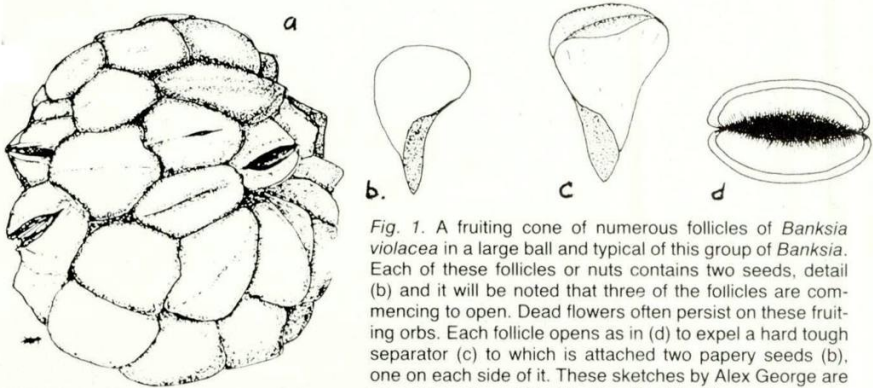


Fig. 1. A fruiting cone of numerous follicles of *Banksia violacea* in a large ball and typical of this group of *Banksia*. Each of these follicles or nuts contains two seeds, detail (b) and it will be noted that three of the follicles are commencing to open. Dead flowers often persist on these fruiting orbs. Each follicle opens as in (d) to expel a hard tough separator (c) to which is attached two papery seeds (b), one on each side of it. These sketches by Alex George are reproduced from "The Banksia Book" with permission.





***Banksia incana* (above)**

Photography by Trevor Blake

The flowers are usually a bright yellow but occasionally they are purple as shown above. Both flowers are mature, with extended styles. The short leaves, in this case about 2 cm long, are often a little greyish and these appear a greyish green.

***Banksia leptophylla* (opposite top)**

Photography by Trevor Blake

The flowers of this *Banksia* vary from pale yellow to pale brown. The flower on the top right has not fully matured as most of the styles still being loop-attached to the "petals". The mature flower on the top left is a large golden orb with the styles straightening out like bristles. The lower dark brown object is the head of fruit with maturing seed. A typical orb of fruit for this group of *Banksia* is shown on page 355 and in the photograph above the dead flower styles have stayed attached.

Other *Banksia* with narrow leaves

There are eight other species of *Banksia* with narrow leaves similar to these described in this article. They have flowers and fruiting cones in the familiar cylindrical/bottlebrush type heads as shown for *Banksia occidentalis* opposite bottom. To complete the reference, bottlebrush flowers are the subject of the next issue.

Banksia grossa

Banksia grossa is one of the most easily recognizable species in the group with its broad linear leaves and velvety brown new growth. The flower is not spherical but more cylindrical, being up to 7 cm long and 9 cm wide. The bracts below the flower cone are covered in rusty hairs and the large follicles are hirsute. Again, this species can be found in sandy soils which cover laterite in an area on the northern sand plains between Eneabba and Regan's Ford to the north of Perth. The flowers are usually hidden in the foliage in this species. The bark is flaky which is unusual. Reports indicate that this does well in well-drained, light soils in sunny situations and can reach 1 m high.

Banksia leptophylla

The type form var. *leptophylla* is a large, robust shrub with a wide spread of 3 m with soft long foliage that is rusty brown when new. The flowers can be within the foliage during the long flowering period and can vary from pale yellow to golden brown. Brown floral bracts can be found at the base of each flower. It is without a lignotuber and so the species is susceptible to fire and must regenerate from seed. It naturally occurs on deep, white sands or sandy clays in depressions where there is greater moisture. It is rarely found associated with lateritic soils, and it grows naturally from Tathra National Park to Mogumber. Under cultivation, it can become straggly and needs to be cut back by tip pruning to keep it vigorous. This species was named in the revision and refers to the fine leaves. At one stage, it was called *B. pinifolia*. It has been grown in cultivation for some time and requires very well-drained soils with plenty of sun.

Recently (1987), a form has been recognized as *Banksia leptophylla* var. *melletica* which amusingly refers to the long time taken in recognizing this variety. It is found naturally occurring near coastal areas (within 30 km) south of the Murchison River to Guilderton and is similar in most respects to the true species, but differs because the flowers are smaller. The flowering period too is restricted to winter. The soils it prefers are deep sands, or sands over limestone and sometimes it is found in depressions. It is scarcely known in cultivation.

Banksia incana

Banksia incana is a low spreading shrub that may reach 2 m wide. The specific name means hoary and it refers to the short, grey hairs on the follicles. The leaves are short and can be a little greyish in appearance. The small bright yellow flowers are generally well displayed on lateral branches. The fruit sheds all floral parts and exposes very large valved follicles that are crowded and covered in grey hairs. Regeneration after fire takes place from a lignotuber. Found in deep sand or sand over laterite in association with other heathland species, it is distributed from Mogumber to 35 km north of Eneabba. Meissner named this species as a variety of *sphaerocarpa* which he called var. *glabrescens* in 1856. With its striking flowers, this should prove an attractive plant in a sunny, well-drained situation.

The Banksia Study Group is an information disseminating group and appreciates the assistance of any member who can provide data on any of the new species. Failures as well as successes are worth reporting as gradually a picture of the requirements can be built up. If we are to learn and to understand a little more about the fascinating group described here, then let's hear of your efforts. Data sheets are available singly or are printed in the back of the latest Banksia Report No. 8 (1988). Articles are eagerly sought for inclusion in Report No. 9 which is currently being prepared. Reports No. 7 (\$4.00) and No. 8 (\$5.50) plus \$1.00 postage for each are still available. ■

The *Banksia* Flower

by W. H. Payne et al.*

Banksia flowers are produced in dense spikes of scores of individual flowers supported on a central woody spike. A section through a head of flowers is shown below in detail (a), except that, for clarity, all but one flower has been removed. The individual flowers occur in pairs, the dots in detail (d), each enclosed at the base by a floral bract, shown as the small ovals adjacent to each flower dot on detail (d) and about normal size in detail (c). A larger common bract, detail (b) is associated with each pair of flowers, the larger oval in detail (d). The pairs are arranged in a double spiral pattern and often in vertical rows as well.

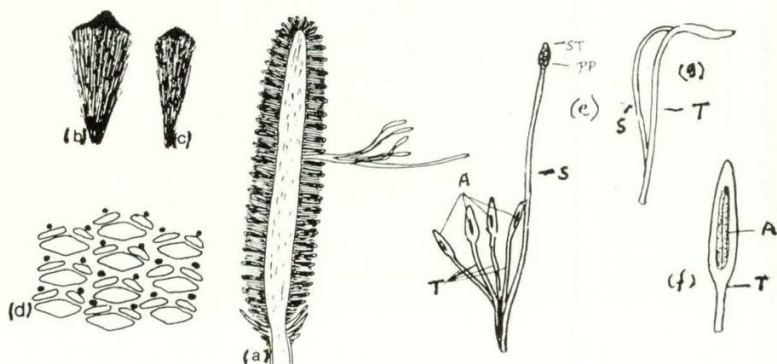


Fig. 2. The *Banksia* Flowers: (a) A section through a head of flowers showing a common central woody axis with crowded bracts, arranged in a pattern as in detail (d). All but one of the many individual flowers have been removed for clarity. Each flower, when mature, detail (e) comprises four tepals, T, (petals?), and an erect style giving it a bottlebrush-like appearance.

Each individual flower, detail (e) has four tepals (T) (modified petals? and collectively known as the perianth) each broadening out, boat-like, to accommodate an anther (A), detail (f), which sheds pollen just before the flower opens. The single style (S) with the stigma on the end, is stiff and wiry. When in bud this stigma is enclosed in the back of the "boat" (limb) on the end of the tepal and as the style elongates it forms a characteristic arch on the back of the tepals, detail (g). On maturity the ends of the tepals relax, freeing the stigma and the showy styles straighten, protruding well beyond the tepals giving the mature flower head, the bottlebrush-like appearance.

Just a few flowers in the head are pollinated to produce seed. The seeds form in hard woody follicles that expand and become the fruiting head as shown in Figure 1. There are about 40 follicles in this rounded woody head. With many species the dried flowers persist providing the "Banksia Man" character of children's stories. On maturity, and often after fire or extreme heat, the follicles open to eject the seed. Three follicles in Figure 1 are beginning to split open.

*These notes were prepared based on sketches (a)-(d) by Alex George from "the Banksia Book", and sketches by Peter Weston in No. 114 issue of *Australian Plants*. Their assistance is gratefully acknowledged. Their indulgence in allowing me to reproduce their work in a simple form is appreciated. Hopefully, this will encourage readers, especially the young, to study the wonders of nature.



△ *Banksia violacea*, the usual form

Photography by Trevor Blake

▽ *Banksia violacea*, a rare prostrate form found east of Wickesin, Western Australia

Photography by Alex George





△ *Pandorea pandorana*
▽ *Pandorea jasminoides*

Photography by N. Marriott



The Australian Species of *Pandorea*

by E. James
Horticultural Research Institute
Department of Agriculture, Victoria

The genus *Pandorea* belongs to the family Bignoniaceae*, a widespread family occurring in North and South America, Asia and the Pacific region. The family consists of approximately 113 genera and 800 species (Gentry 1977) and is confined mainly to tropical and subtropical regions. Most species are found in Central and South America where they are conspicuous components of tropical forests. Many of the exotic species of Bignoniaceae introduced into Australia within the past 200 years have become popular horticultural plants. For example, *Jacaranda mimosifolia*, *Tecomaria capensis* (Cape Honey-suckle), *Campsis radicans* (Trumpet Creeper) and *Podranea ricasoliana*.

Pandorea is one of five genera of Bignoniaceae* which occur naturally in Australia. The most recent review of the genus was done by van Steenis in 1977. He considers the genus to contain only six species of which four occur in Australia. Three of these are endemic with restricted ranges. Probably the most familiar species is *Pandorea jasminoides* (Bower of Beauty), a popular garden climber with a showy floral display typical of the family. This species occurs from northern Queensland to southern New South Wales. Although it has been found in Victoria, the plant was thought to be beyond its natural range and was quite likely to be a "garden escape" (Willis 1972). A second species, *Pandorea pandorana* which includes *P. doratoxylon* (van Steenis 1977) is the only Australian species whose range extends beyond the Australian continent. It is found in habitats ranging from the wet, tropical rainforests of northern Queensland and New Guinea to the arid centre of Australia. It is found throughout the continent and is also the most variable of the Australian species. A third species, *Pandorea nervosa*, occurs in the Atherton region of Queensland whilst the fourth species, *Pandorea baileyana*, is restricted to a small area around the southeastern border of Queensland and New South Wales (Thomas and McDonald 1987).

Inflorescence

All *Pandorea* species are lianes with flowers consisting of terminal inflorescences. *Pandorea baileyana* has flowers borne on a long raceme or spike (Maiden and Baker 1895). The remaining species have branched inflorescences with determinate main axes and indeterminate axillary axes forming a pyramidal cluster.

Flower Morphology

The individual flowers of *Pandorea* species vary in size and shape depending on the species (Fig. 1). However, all are tubular and attached to the peduncle by an obvious pedicel. The flower consists of a cup-shaped fused calyx which usually splits into five. The corolla is also fused and inserted within the calyx; the length of the fused section varying with species. The corolla divides into five lobes with the upper two usually slightly smaller than the lower three, which recurve to varying degrees as the flower ages. The four stamens are arranged in two pairs with a staminode (vestigial stamen) between them (Fig. 2). The stamen filaments are fused to the base of the corolla and the anthers each consist of two lobes which dehisce longitudinally from slits.

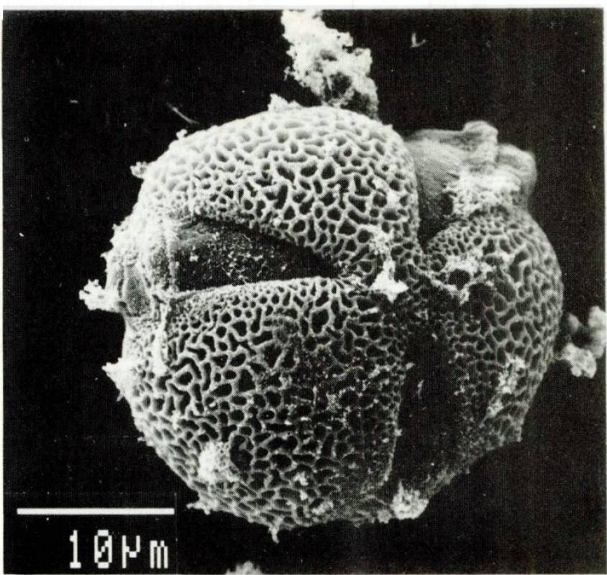
*Australian species in the other four genera will be described shortly.

Fig. 1. Flower shapes and sizes of *Pandorea* species.

Fig. 2. Cut-away flower of *Pandorea jasminoides* from the side.

Fig. 3. Half-flower of *Pandorea jasminoides* (lower petals removed).

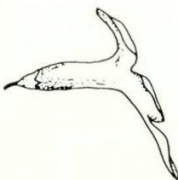
Fig. 4. Pollen grain of *Pandorea jasminoides* showing reticulate exine and 3 colpi. The scale is 10 microns, 10 millionths of a metre.



P. baileyana



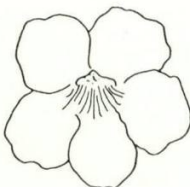
P. pandorana



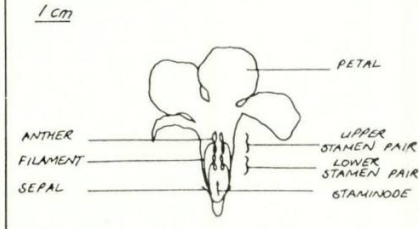
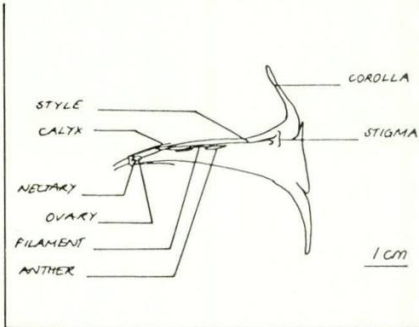
P. jasminoides



P. nervosa



1cm



Pollen of *Pandorea* species has been studied along with other members of Bignoniaceae in an attempt to clarify the taxonomy of the family. Only *Pandorea jasminoides* and *P. pandorana* have been described (Buurman 1977; Suryakanta 1973) and both have pollen grains with finely reticulated exine (outer coat) divided by three colpi (slits) (Fig. 4). The pollen tube emerges from the germinating grain through one of the colpi and grows down into the female part of the flower. This type of grain is considered to be one of the less specialized types from which have developed the more advanced pollen types in the Bignoniaceae (Gentry and Tomb 1979).



Pandorea nervosa △

▽ *Pandorea pandorana* 'Golden Showers'



The female part of the flower consists of a superior ovary surrounded by an annular nectary, an elongated style and a stigma comprising two lobes which are covered in papillae (Fig. 3). The stigma lobes are usually closed when the corolla opens but separate soon after. The lower lobe in particular recurves as the flower ages (Fig. 6). The stigma lobes are sensitive to touch and if a flower is pollinated, the lobes close permanently, often within 30 seconds. The ovary is divided into two locules and contains numerous ovules (Fig. 5a, 5b).

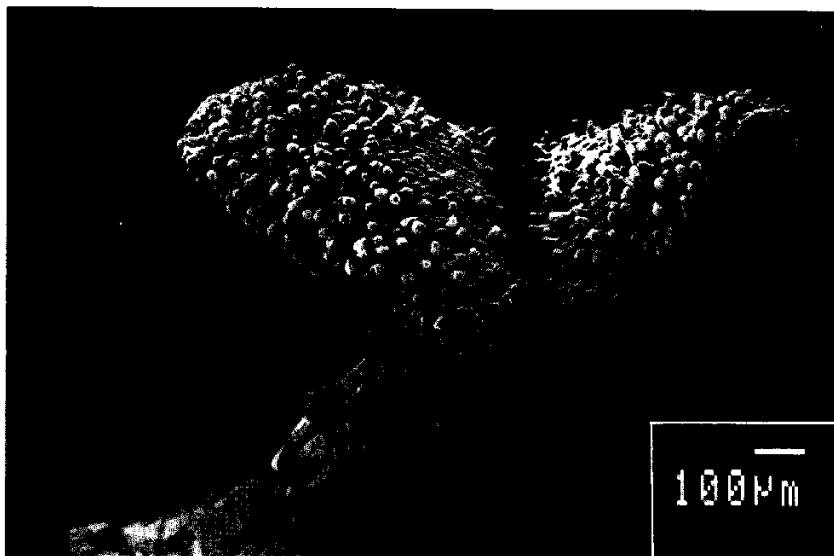
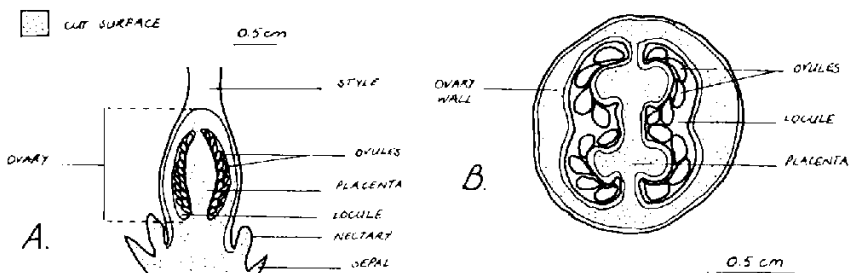


Fig. 5a,b. A section through ovary of *P. jasminoides* showing the two locules and arrangement of ovules on the placenta. A. Longitudinal section. B. Transverse section.

Fig. 6. A scanning electron micrograph of aged stigma of *Pandorea pandorana* showing stigmatic papillae and recurved lobes. The papillae on the stigma would be visible with a strong magnifying glass or a hand lens in conjunction with good eyesight. The lobes on a fresh stigma have not recurved to the extent shown in the micrograph. The scale is 100 microns or 100 millionths of a metre.

Reproductive Biology

Little work has been done on the reproductive biology of Bignoniaceae. Most research has been on the taxonomy although some of this has included examination of the breeding systems of various species in their natural habitats. However, no Australian species have been included in breeding system studies.

The chromosome number of *Pandorea jasminoides* was recorded as $n = 19$ (Nakajima 1936) and it is probable that the other species have a haploid number of 19. The most common chromosome number in the family is $n = 20$ and it has been concluded that there is a fairly close relationship between all of the tribes of Bignoniaceae, and that the species have arisen from a common ancestry in a single evolutionary line (Goldblatt and Gentry 1979).

Successful pollination is followed by the development of fruit capsules containing a central septum to which winged seeds are attached. However, a mechanism known as a "self-incompatibility" system is present in the family. It minimizes inbreeding in a population by blocking fertilization between plants of similar genotype. It was first mentioned for Bignoniaceae by Duggar (1879) who found that self-pollinated flowers of *Bignonia venusta* never set fruit. Since then a number of species in Bignoniaceae has been found to be self-incompatible. It is probable that self-incompatibility is widespread in the family as it is common in the few species whose breeding systems have been studied. The exception so far, *Tecomanthe speciosa*, has been found to set fruit after self-pollination (Hunter 1967). This is supported by work at the Horticultural Research Institute, Knoxfield, in which fruit set has been obtained from self-pollinated flowers of the Australian species, *Tecomanthe hillii*.

Experiments with *Pandorea jasminoides*, conducted in an insect-proof glasshouse to prevent pollination from an unknown source, have shown that a particularly well-defined self-incompatibility system operates.

♀ \ ♂	1	2	3
1	0*	35	30
2	23	0*	26
3	35	19	0*

Experiment A — Using three genotypes of *Pandorea jasminoides* 1, 2 and 3, self-pollinated (*) and cross pollinated flowers as shown, the percentage fruit set varied 15% to 35%.

♀ \ ♂	1	2	UNTREATED
Genotype 1	0*	93	0

Experiment B — To check that fruit set could not occur in unpollinated flowers, self-pollinated (*) flowers and untreated flowers did not set fruit but genotypes crossed with type 2 set fruit in 93%.

The lower fruit set in the first experiment may have been due to the abortion of fruit before two weeks of age due to the high fruit loads on individual plants. Plants in the second experiment each had a maximum fruit load of five. Poor fruit set and low numbers of fruit reaching maturity appear to be common occurrences in the family Bignoniaceae and although they have been studied to some extent, the reasons for such phenomena are far from clear. It is expected that the other species of *Pandorea* would have self-incompatibility mechanisms similar to that found for *P. jasminoides*.

However, experiments with plants removed from their natural habitats may not take into account the influence of biotic factors present in natural communities on the operation of incompatibility mechanisms. For instance,

Campsis radicans, previously thought to be self-incompatible (Bertin 1982a, 1982b, 1985) has recently been shown to set fruit containing considerable numbers of selfed seeds if pollination occurs with a mixture of pollen from plants of the same and different genotype (Bertin and Sullivan 1988).

If fertilization in *Pandorea* species is successful, the developing fruit hangs vertically and matures to a dry capsule which splits longitudinally to release seed. As the plants are frequently found growing at the tops of large trees and the seeds are conspicuously winged, wind would be the most probable seed dispersal agent. However, this idea has been queried for some members of other genera such as *Tecomanthe speciosa* (Cranwell 1962). Seedlings of *Pandorea* species are rarely found far from the parent plant and unless the seeds are released high in the plant canopy, the wind movement may be minimal.

The Australian Species of *Pandorea*

The species can be readily separated on floral characteristics as shown in Fig. 1, but leaf differences also occur.

Pandorea pandorana

This species was first described as *Bignonia pandorana* by Andrews in 1801, then as *Tecoma australis* in 1810 by Robert Brown. In 1839, Endlicher described *Pandorea* as a section of the genus *Tecoma*. Spach renamed the species *Pandorea australis* raising the section to generic rank in 1840. It was finally renamed *P. pandorana* by van Steenis in 1929, the specific epithet of Andrews having precedence over that of Robert Brown.

Tall, glabrous, woody climber. Leaves usually three to nine-jugate. Leaflets ovate to ovate-lanceolate, or almost linear in arid zone variants, entire or less often coarsely crenate, 2.5-7.5 cm long, glabrous, venation not prominent. Flowers 1-2 cm long in loose, terminal panicles. Calyx smooth, 2-3 mm long. Corolla colour variable, white, yellow, orange, often streaked inside with purple or red. Corolla tube 1-2 cm long, slightly curved and dilated upwards, lobes not one-third as long as the tube, the throat bearded inside on the lower lip, no hair-ring inside near insertion of stamens. Capsule 3-7 cm long, usually acute at both ends, the valves hard and very concave. Seeds very flat, obovate, surrounded by a broad, papery wing.

Pandorea jasminoides

This species was described as *Tecoma jasminoides* in 1838, firstly with an illustration by John Lindley and then a botanical description by G. Don. It remained unchanged until 1894 when Schumann assigned it to the genus *Pandorea*.

Tall, glabrous woody climber. Leaves two-jugate. leaflets entire, ovate to lanceolate, blunt at apex, nerves and veins not prominent above, dark glossy green. Calyx campanulate, truncate or obscurely toothed, 6 mm long. Corolla 4-5 cm long, white to pink with crimson throat. Corolla tube >2.5 cm, much more dilated upwards than in *P. pandorana*, the lobes very broad, more than half as long as the tube, the throat scarcely bearded inside. Fruit as for *P. pandorana*, may be larger, but seeds broader, the wing either entirely surrounding them or chiefly on the two sides.

Pandorea nervosa

First described by van Steenis in 1931, it is allied to *P. jasminoides*.

Vine with slender, ribbed, purple stems. Leaves with five leaflets, dark green, ovate to ovate oblong, 2.5-6 cm long and 1.5-4 cm broad. Flowers odourless, showy. Calyx glabrous, campanulate, 6-7 mm long, splitting irregularly into lobes up to 2.5 mm. Corolla white, the tube yellow inside, funnel-shaped, slightly curved, 3.5 cm (excluding lobes). Fruit and seeds not recorded.

Pandorea baileyana

Maiden and Baker (1895) first described *Tecoma baileyana* in honour of Mr Fred Manson Bailey, the contemporary government botanist. Van Steenis renamed it *P. baileyana* following his revision.

Tall, glabrous, woody climber. Leaves three-jugate. Leaflets usually seven, elliptic-oblong or obovate, 6×12.5 cm, coriaceous, pale beneath, reticulations very prominent below but less marked above, margins slightly recurved. Flowers in a long raceme or spike. Calyx glabrous, 5-toothed. Corolla tubular, 1.5 cm long with five very short lobes, not dilated upwards, cream with pink throat. Fruit and seeds not recorded.

Horticultural Aspects

Pandorea plants are easily grown from fresh seed which germinates in 10-14 days if the temperature is kept at about 20°C. A lower temperature results in slower and more sporadic germination. Plants can also be propagated readily from cuttings of one or two nodes. A successful propagation method used routinely at the Horticultural Research Institute, Knoxfield, with hardwood and semi-hardwood material is to dip the bottom 1 cm of the cutting in a solution of 2 000 ppm IBA for five seconds. Cuttings are then placed in a mixture of 1 part peat:2 parts coarse washed sand in a mistbed with bottom heat. Roots form within 3 to 6 weeks.

The popularity of *Pandorea jasminoides* and *P. pandorana* has led to the selection of horticulturally desirable forms which may have a different flower from the usual form or perhaps are more floriferous than normal. *Pandorea jasminoides* is available in the standard pink form ('Bower of Beauty'), a white form ('alba' or 'Lady Di') and a variegated leaf form ('Charisma'). *Pandorea pandorana* is available in many forms often depending on the characteristics of the local plants. Two commercially available forms are 'alba' or 'Snow Bells' with white flowers and 'Golden Showers' with small, bright yellow flowers. Another variant with highly dissected leaves can be obtained but is often sold under its old name of *P. doratoxylon*. *Pandorea pandorana* is occasionally found as an upright shrub in arid habitats but no selection appears to have been done on plants of upright habit. The very limited ranges of *P. nervosa* and *P. baileyana* have restricted their availability and so they have yet to be tried under a range of environmental conditions. They may well prove to be as adaptable as other species and certainly have features of horticultural merit.

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Grafting Native Plants

by Merv. Hodge¹
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¹As a preface to this article I would like to pay tribute to the late Harvey Shaw who first interested me in grafting Australian native plants. He gave assistance and encouragement to a number of people interested in developing this skill.

Why do we need to graft plants? The main reason is to provide a reliable and vigorous root system not susceptible to root diseases and able to perform satisfactorily in local conditions. In addition, the scion material will produce a plant with identical flowering and fruiting habits to the parent. In rare cases it could be used to prevent undesirable suckering habits of the parent plant. It may also be used where a plant is too difficult to propagate by other means. It is a more labour-intensive and costly means of producing plants, so the end product is necessarily more expensive. This cost may vary from plant to plant, depending on the degree of difficulty.

Grafting of Australian native plants is not new, some having been successful at least early this century – e.g. grafting *Correa* on *C. alba* and *Clianthus formosus* onto *C. puniceus* (a New Zealand species).

Selection of Plant Material

Rootstocks need to be closely related to the scion, i.e. they need to be in the same family and preferably in the same genus. This is no guarantee of compatibility and ultimately it comes to actually trying them and observing the results over a long period. It is probable that different combinations of scion and rootstocks will be necessary in different climatic regions.

A critical assessment of the rootstock available will soon eliminate all but a few, perhaps leaving only one. The points to consider are compatibility, reliability, longevity and availability. It might be better to select a reliable, easily propagated hybrid rootstock over an equally compatible species which may be difficult to propagate or available only seasonally. Rootstocks should be healthy and vigorous, both before and after grafting. Any stress placed on the rootstock can cause it to abort the graft even though the rootstock might survive and look quite healthy. This can be caused by something as simple as overlooking the watering of a plant on one occasion. Good potting mixes and fertilizers are important to maintain vigour. A significant factor in my success rate is vigorous tubed plants of *Grevillea robusta* from Fairhill Nursery.

Scion material is best taken from a clean disease-free, vigorous plant, in the same manner as when selecting cutting material. Better results are achieved using scions taken from healthy potted plants, rather than those collected from garden plants or from wild sources. Harvey Shaw preferred soft green tips for scion and rootstock for his grafts. I prefer firm but green material. Both work equally well, but I find the latter easier to work for my method.

Grafting Methods

There are a number of different methods of grafting. The methods most commonly used are top wedge, whip and approach grafts. The latter was that which Harvey Shaw mostly used until he perfected his technique with top wedge grafts. I have only used approach grafts on a few occasions and will not describe it here. I used top wedge grafts for some time, but later switched to whip grafts.

The Top Wedge Graft

For the top wedge method, select scion material and cut to lengths of 25 to 75 mm long. Compare the scion to the rootstock to determine a section of equal diameter where the graft will be made on the rootstock. Remove the top of the rootstock, cutting directly below a node on green wood. I prefer to do this to remove any possibility of the rootstock producing laterals at the node. I find no disadvantages in doing this, despite predictions of die-back that others have quoted.

The scalpel is then placed along the diameter of the stem (the other hand may have to hold the rootstock steady). The blade is then pushed firmly and carefully vertically to form a slit down the stem, effectively dividing it into two equal portions, to a depth of 18 to 25 mm. Care should be taken not to allow the blade to wander off course. To do so could cause a disaster to the graft and to the hand holding the rootstock. I must admit that it is this part of the operation which first caused me to seriously consider using the whip graft.



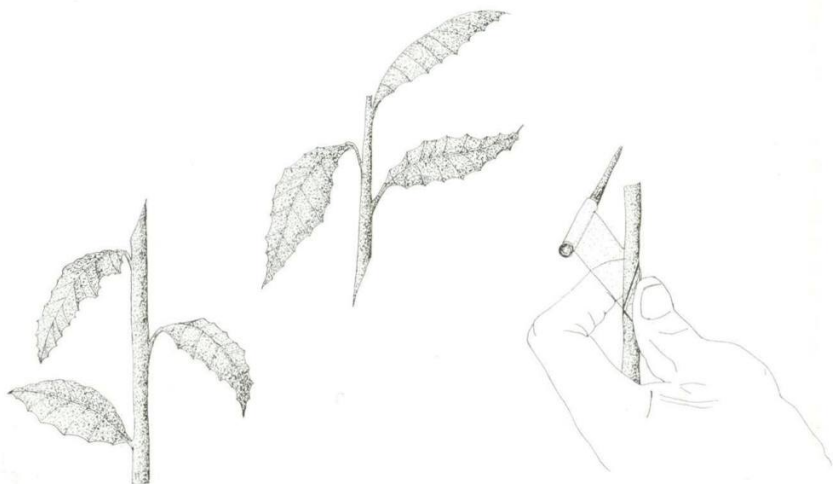
Now a wedge is cut on the end of the scion, approximately the same length as the slit made in the rootstock. The wedge should be made by making an angled cut on each side of the scion to meet at the original diameter. Firmly, but carefully, insert the wedge into the slit made in the rootstock until the tip of the wedge has penetrated to the full depth of the cut. Care should be taken that the two stems line up so that the cambium layers are making as much contact as possible. In most cases there is enough force exerted by the graft to hold the scion in place whilst hands are moved to attach the tape. The tape should be bound firmly over the graft in two layers, firmly stretching the tape so that it holds the graft together and seals it against the outside air and moisture.

Notes on the Top Wedge Graft — All plants are a little different. The thickness of material indicated would be as for *Oreocallis*. It is thicker than I would generally use for say *Grevillea*. The length of most scions (upper plant) that I have done recently have been 5-13 cms long, again a little longer than those indicated. The most important condition was to ensure that they had at least a few good, potential growing points, i.e., at least three terminal and/or lateral buds. Suggestions as to the tools and tape to use are at the end of the article.

The Whip Graft

The whip graft is the method which I now prefer and I now do all grafts that way. I find it simpler and faster and just as effective as wedge grafts. Whilst it is claimed that wedge grafts are stronger, I have not found any significant difference between the two once the grafts have taken. Both have their share of mechanical failures and both exhibit good strength if the graft is well done. I find that I can do whip grafts faster, but it requires more dexterity to hold the graft together whilst starting the tape. I do not find it necessary to add a tongue as in the "whip and tongue" method. That would slow up the process and make matching of cambiums more difficult.

Firstly, ensure that you have tape wound on two nails (see page 374). The end of the tape should be left with about 10 mm unwound. Then begin the whip graft by cutting the top off the rootstock below a node. This type of graft requires an acute angled cut across the entire thickness of the scion and rootstock, starting at a point on each where their stem diameters are about equal. The cut should be made at the same angle for both and continued until it completely severs the unwanted portions of the scion and the rootstock. Ideally, it should be completed with one cut 20 to 30 mm long, and should end in a fine tip. If this is done correctly, the cambium layers should appear identical.



The scion and rootstock should be placed together so that their cambiums match and held firmly with the left hand towards the bottom of the graft. The right hand should then pick up the nail with the tape already wound on it. Place the unwound section of the tape in a position where a slight movement of the left thumb will allow it to press the tape against the rootstock side of the graft.

Notes on the Whip Graft to this point: Perhaps it may help to comment on a few aspects to this point. The beautiful sketches above provide the key to success. The scion or upper plant may be longer, possibly with more potential growing points. As shown over page, the top cutting may even have the terminal leaves. The material used is often thinner making the job a little more difficult. The grip on the whip graft is not quite right (even though it was made from a photograph of myself in action). The index finger should be a little lower to allow the tape to be initially wrapped around the top of the graft, but high enough to hold the graft together. The tape is initially clamped against the stem by the thumb as shown.

Using a nail, now wind the tape onto the top part of the graft, pulling firmly to hold the graft in place. Gradually slide the left hand down to hold the bottom of the graft. Quickly check to see that the cambiums are still aligned and continue to wind the tape downwards around the graft. Continue the process until the tape fully covers the graft then wind another layer of tape back up the graft, ensuring that the tape does not twist. The tape may be pulled tight at the end of the graft where it will seal itself and break off. This is the most difficult part of the method and it does require some practice. If you are unable to master this, it may be necessary to do wedge grafts. Left-handed persons would have to adapt the description to their own needs.

Once the graft is completed it is necessary to prevent the scion from dehydrating. This can be achieved in a number of ways. You may devise your own method, but the following methods have been well tried and do work.

Dehydration prevention, Method 1: I followed the method used by Harvey Shaw. Some small lateral growths and foliage can be left on the scion, but it is wise not to overdo this. Purchase self-sealing bags about 120 mm x 74 mm with a built-in zipper-like device. Place the bag over the scion and seal it on or below the graft. I make a slight kink in the zipper where it contacts the stem to reduce its potential to open itself. Once the graft has taken the bag must be gradually opened over a number of days to allow the scion to harden off. Grafts can be lost at this stage. I still use this method when the scion has dense, fine foliage which would take too long to remove, or where the scion has no dormant buds and has already produced lateral growths.

Dehydration prevention, Method 2: If the scion has dormant buds, particularly when they appear to be about to grow, and if the plant has easily removable foliage, then I use the following method. Remove all foliage except for small tip leaves. Make the graft as previously described, but do not break the tape once the graft is fully bound. Now continue the tape right up, binding over the entire scion except for the very tip. If the growing tip has previously been removed, then the entire scion can be bound. This should be done with one layer of tape only, stretching it as you bind. Overlap the tape slightly as you bind to ensure that the scion is fully sealed except for the tip. If the tip is very soft it might be best to remove it.

In two to four weeks the buds should become active. They normally break through the tape and continue to grow. As they grow they acclimatize themselves. The tape will eventually decompose and normally does not need to be removed.

I first conceived this idea in 1986 when I noticed that when tape was bound over buds in the scion and rootstock near the graft, they occasionally burst through the tape and continued to grow. I reasoned that if it happened at the graft, it could also occur on the scion. But it would require going against advice from others, i.e. to leave some foliage on the scion. I carried out trials with a number of plants and they were successful.

The photographs opposite illustrate the splice graft and recommended treatment for after care. Photos A, B and C from the bottom up the left hand side show progressive stages of wrapping the scion as for the dehydration method 2. Currently I would not waste time binding the lateral growth on the left but would remove it. The photograph on the top right hand corner shows the two methods of dehydration described here. Currently I would remove the large leaf on the top of the wrapped specimen, allowing only the tip exposed. Leaving the tip does not appear critical if there are good active lateral buds. The two photographs on the bottom right are completed wrapped grafts that have subsequently grown to vigorous plants.



In March, 1988 I tried this method on a seedling *Grevillea banksii* growing in full sun in the field, using a *G. bipinnatifida* scion. No further assistance was given to the plant. The weather was hot but conditions were favourable to promoting active growth. The scion started to break through the tape in two weeks and continued active growth. On the same day I grafted *Grevillea bipinnatifida* onto two healthy potted *G. robusta* seedlings. These were watered regularly and fertilized and kept under shadecloth. There was a tremendous contrast in the growth rates between the field plant and those in the shadehouse. The field graft was three times the size of the other two in a short time and continued to out-perform them for some time.

After recently having been shown a fogging system in operation, I feel that it would be worth experimenting with grafts in that controlled environment. It would most likely eliminate the need for bags or wrapping. These systems are expensive so the enthusiastic amateur or the small commercial producer may be content to try the methods I have described.

Tools:

Experienced grafters, particularly professionals, have their own preferences. I have tried to improvise with a number of implements, but I eventually followed Harvey Shaw's lead and now use a scalpel with a number 11 blade. It appears to be the optimum for this type of grafting. It is necessary to use a very sharp implement so a good supply of replacement blades is necessary. When the blade starts to pull or tear it is necessary to replace it. The blade should be kept as clean as possible. I pour boiling water over the handle and blade before commencing. I normally dip the blade in Methylated Spirits frequently when grafting. I also use scissors and two nails, see page 374.

Tape:

I prefer to use "Nescofilm" tape, a self-sealing, opalescent, thermo-plastic film. It may be purchased in a 10 cm x 40 metre roll from which I cut strips 10 cm long x 10-13 mm wide. Peel off the paper backing first. This roll will do thousands of grafts. Nescofilm is normally used in laboratories so it should be sought out from medical or scientific suppliers. The scalpel handle and blades can be obtained at the same time. This tape has the advantage of breaking down in sunlight, making it normally unnecessary to remove it after the graft has taken. It remains intact long enough for the graft to take. The tape has a fair amount of elasticity and will give a little with plant growth. It is self sealing and eliminates the need for sealing the finished graft with sealing wax or vaseline.

The tape can be difficult to handle, particularly when grafting small plants. It is inclined to twist and stick together so a method of control is necessary. I found that I could best achieve this by winding the tape onto one end of a match. I later changed to a 65 mm nail after breaking numerous matches. It is advisable to have a second nail on hand with the tape already wound onto it. Inevitably, the tape will break at an inconvenient time when one hand is holding the graft together and the tape has stuck on the nail without a free end. When winding on, the tape should be lightly tensioned and kept flat. If it is allowed to twist and form into a cord-like condition it will tend to strangle the plant, particularly when it is considered that it takes longer to break down in that condition. Too many layers will also increase breakdown time.

Grafting That Has Been Successful

The following are the successful grafts, most of these by Harvey Shaw. All of them are still alive but it may be some time before we can assess their complete success. In most cases there are only small numbers and in some cases only one plant is still surviving. Others are so popular that over a hundred have been grafted and distributed. There are other plants not included which showed initial success and then collapsed months later. These include *Verticordia grandis* onto *Kunzea flavescens* and *Baeckea* 'Winter Pink' onto *Kunzea flavescens*.

Grevillea have been favoured and about 200 forms grafted. Not all have been completely successful, e.g. *G. quercifolia* grafts easily but frequently fails later because it is too brittle at the graft and breaks off. Most have been grafted onto *Grevillea robusta* but a few have been grafted onto *G. banksii*, *G. 'Ivanhoe'*, and *G. 'Royal Mantle'*. Some of the hairy-leaved *Grevillea* responded poorly using the above methods. They appear to be adversely affected by the humid conditions created. I managed to graft a couple without wrapping the scion or using the bag method.

Banksia have proved to be difficult and we have only been successful with a small handful, all onto *B. integrifolia* rootstock.

Hibbertia, including *H. stellaris*, have been grafted onto *H. scandens*. Considering the stem thickness of this plant, grafting it onto anything is astounding. *H. miniata* was successful initially but was lost later.

Eremophila species (14) have been grafted onto the more reliable *Myoporum* species. They grafted well but did not perform well in Brisbane because of the effect of our summer humidity on their foliage.

Prostanthera were grafted onto *Westringia fruticosa*. One notable success was *Prostanthera magnifica*. Most of the *Prostanthera* were found to flower poorly in our conditions so Harvey lost interest in them.

Eucalyptus have been a frustrating challenge. At the time of his death in May, 1989, Harvey was producing promising results grafting good colour forms of *Eucalyptus ptychocarpa* back onto seedlings of the same species. I have been informed that one gentleman has grafted *Eucalyptus ptychocarpa* onto *Angophora costata* in south-east Queensland and that it has been growing well in the ground for some time. He has also successfully grafted *E. ptychocarpa* onto *E. citriodora* and *E. viminalis*, and grafted *E. ficifolia* onto *E. tessilaris*, *E. citriodora* and *E. maculata*. The latter is about 20 years old and still doing well. He has several other combinations of *Eucalypt* scions and rootstocks.

The Geraldton Wax, *Chamelaucium uncinatum* was grafted onto *Kunzea flavescens* and *Bakea virgata* but they were difficult and not always reliable.

Hakea salicifolia has been the recommended rootstock for other *Hakea* species. Whilst many *Hakea* graft readily to that species, it is not reliable enough here in south-east Queensland to be the ideal rootstock. I decided to try grafting *Hakea* onto *Grevillea robusta*. Many have grafted readily to it and, at this stage, it appears to be the best rootstock. The long-term reliability of these is yet to be proved. Another person has grafted a *Grevillea* onto *Hakea salicifolia* because he had no other rootstock on hand. It is still alive.

If you wish to try any of these methods I caution that trials should be carried out to ensure that you perfect the technique for your conditions before committing large numbers of plants to the project.

Brachychiton have proved to be the easiest genus to graft and are a good beginner's plant to gain confidence. The Flame Tree, *Brachychiton acerifolius* and *B. bidwillii* the rootstocks I have used for better forms of the species. ■



Above: A completed splice graft of *Oreocallis pinnata* onto *Oreocallis wickhamii* showing how well the union is made with this type of simple graft. This, and many other grafts have survived wind storms that have severely damaged the upper growth.

Below: *Grevillea formosa* on *Grevillea robusta*. This is the plant being wrapped in photographs A, B and C on page 372. This growth has burst through the tape when grafting two months previously.





Above: A field graft of *Grevillea pinnatifida* on to *Grevillea banksii* just three weeks after grafting as described in the article. The new growth bursts out of the tape without assistance. To this point the tape has held it snug from attack and from the elements.

Below: *Grevillea patentiloba* on to *Grevillea robusta* 17 days after the graft was made.



Western Australia's Endangered Flora

Produced by the Department of Conservation and Land Management of Western Australia and available from them, 50 Hayman Avenue, Como, Western Australia 6152, for \$24.95 plus \$5.00 postage, this 140-page book illustrates and describes 238 plants declared as Endangered Flora. Most of these are illustrated in colour while the remaining plants for which a suitable colour slide was no longer available are identified by clear sketches.

What has alarmed me is the range of magnificent plants in our care that may shortly disappear for ever because of our greed/indifference. What causes me even greater concern is that, if we go on the way we are, many thousands more species will be added to this list. Refer to page 334 and the Mt Lesuer crisis. One can only hope that the Department of Conservation and Land Management and the Western Australian Government are prepared to take a responsible attitude and have not published the above book with "tongue in cheek". Responsible government!!

Wildflower Nurseries in Queensland

Fairhill Plants and Botanic Gardens — Fairhill Rd., Yandina, 4561. Tel. (071) 46-7193. Large range of trees, shrubs, ground covers, climbers, ferns, palms and orchids for the sub-tropical and tropical east coast. Extensive display gardens open 8.30 a.m. to 5 p.m. any day. New comprehensive catalogue \$3.50 posted.

Wildflower Nurseries in New South Wales

Cranebrook Native Nursery — R23 Cranebrook Road, Cranebrook, N.S.W. 2750. Tel. (047) 77-4256. Five km north of Penrith, between Tadmore and Taylor Roads. Open 8.00 a.m.-6 p.m. Sunday 1 p.m.-5 p.m. Also at Great Western Highway Warrimoo, N.S.W.

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Wirreanda Nursery — End of Wirreanda Rd., Ingleside, 2101. Tel. (02) 450-1400. Growers of advanced and semi-advanced native trees and shrubs. Open 7 days.

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Les and Kay Nesbitt — 18 Cambridge St., Vale Park, S.A. 5081. Tel. (08) 261-1550. Specialists in the propagation of Australian terrestrial orchids. S.A.E. for list and culture notes.

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Kuranga Native Nursery has the largest range of Australian plants in Melbourne. Decorative flowering plants, hardy varieties, indigenous plants, grasses, etc., advanced grass trees, rainforest plants and more. Kuranga Native Nursery, 393 Maroondah Highway, Ringwood. (03) 879 4076 — open 7 days.

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Westernport Nursery — Specialist growers of Australian plants, 88 Flinders Road, Bittern, 3918. Hours — Monday to Saturday — 9.00 a.m. to 5.00 p.m., Sunday — 10.00 a.m. to 5.00 p.m. Phone: (059) 839 9328 Melway Ref. 164 F.7.

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VOLUME No. 15 INDEX

Comprises Issues Nos. 109–124 of Australian Plants.

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flavescens, *formosa*, *fraseri*, *glaberrima*,

glutinosa, *gracilis*, *gurumundensis*,

gysophylla, *habrantha*, *harvestiana*,

involuta, *islenis*, *leschenaultii*,

leptophylla, *longiflora*, *megaphylla*,

merrelliana, *micrairoides*, *microcoma*,

mimiana, *muricata*, *nematoclada*, *oldfieldii*,

parvivalis, *paucicostata*, *platycheiridia*,

plumulosa, *pulchella*, *praecipua*, *purpurea*,

rupestris, *sapphirina*, *similis*, *simplex*,

Calytrix — cont.

- smeatoniana, stenophylla, strigosa,
stipulosa, sullivanii, surperba,
surdiviperana, sylvana, tetragona,
tenuifolia, tenuiramea, truncatifolia,
variabilis, verruculosa, verticillata,
violacea, warburtonensis,
Other references are:
alpestris 15:209C, 211C
tetragona 15:211C, 263C
Cassia Species being transferred to *Senna*,
hamersleyensis, *helsmii*, *nemophila* 147D
oligophylla 15:147D
Casuarina glauca 15:259D
Ceratopetalum gummiferum 'Christmas Snow',
'Magenta Star', 'White Christmas' **225D**
Chamaelaucium axillare 15:211C, 357X
megalopetalum 15:233P
uncinatum 15:211C, 357X
'Bundara Excelsior', 'Bundara Mystic
Pearl', 'Bundara Supreme White',
'Dowell', 'Mullering Brook', 'Munns',
'Murfit Rose', 'Newmarracarra',
'University', 'Wilson' 15:226D
Cheiranthra alternifolia, *cyanea*, *filifolia*,
preissiana, *volubilis*
15:22D, **23D**, 33P, 44P
Chorizema cordatum 15:49P, 205P, 249C
Citriobatus lancifolius, *linearis*,
pauciflorus, *spinescens* 15:25D
Clerodendrum tomentosum 15:239C, 240C
Clianthus formosus 15:344C, **346CX**, **348CX**
Conospermum All spp. des./cult. 15:69–88CDX
acerosum, *amoenum*, *brachyphyllum*,
bracteosum, *brownii*, *burgessiorum*,
caeruleum, *capitatum*, *crassinervium*,
debile, *densiflorum*, *diffusum*, *distichum*,
dorrienii, *eatoniae*, *ephedroides*, *flexuosum*,
floribundum, *glumaceum*, *huegelii*,
nervosum, *patens*, *petiolare*, *polycephalum*,
scaposum, *sphacelatum*, *stoechadis*,
taxifolium, *tenuifolium*, *teretifolium*,
toddii, *triplinervium*
Conostephium drummondii, *marchantianum*,
pendulum, *preissii*, *roei*, *uncinatum*
15:108–110PD
Correa 'Bett's Red' 15:227D
decumbens 15:218CD
'Dusky Bells' 15:228D
'Fat Fred', 'Mannii' 15:230–228D
pulchella 15:98C, 211C, 212P
reflexa 15:98C, 209C, 211C, **218CD**,
229P
Crowea anqustifolia 15:362C, 364P, 366C
'Cooper's Hybrid' 15:230D
exalta 15:363, 364P, 366
'Australflora Green Cape',
'Bindalong Compact', 'Festival' 15:230D,
232CD, 363
'Poorinda Ecstasy' 15:218CD, **232CD**, 363
saligna 15:361P, 362, 366
Dampiera diversifolia 15:214C, 266C
heterophylla 15:205P
linearis 15:266C
purpurea 15:97P, 266C
rosmarinifolia 15:97P, 263C
Darwinia darwinoides 15:211C
lejostyla 15:98C
taxifolia 15:214C
Dennstaedtia davallioides 15:240C
Dianella revoluta 15:11D
tasmanica 15:239C, 240P

- Dillwynia brunioides* 15:123D
capitata 15:123D
sericea 15:266C
Doryanthes excelsa 15:17CDP
Dryandra drummondii, *formosa* 15:266C
polycephala 15:97CP, 98C
praemorsa 15:209C
proteoides, *quercifolia* 15:97–98CP
Drynaria rigidula 15:257C
Epacris apiculata 15:97P
impressa 15:97C, 98C, 211C
longiflora 15:211C
microphylla 15:11D
reclinata 15:98C, 266C
Eremaea pauciflora 15:266C
Eremophila Species des. 15:143–146, 162–166
arachnoides, *barbata*, *bowmanii*, *carnosa*,
crenulata, *cuneifolia*, *decipiens*, *delisseri*,
denticulata, *drummondii*, *forrestii*, *fraseri*,
freelingii, *gilesii*, *glabra*, *granitica*,
laanii, *latrobei*, *linearis*, *longifolia*,
macdonnellii, *mackinlayi*, *macmillaniana*,
maculata and *X duttonii*, *mailandii*,
margarethae, *nivea*, *obovata*, *oldfieldii*,
oppositifolia, *pachyphylla*, *pantonii*,
platycalyx, *polyclada*, *psilocalyx*,
pterocharpa, *racemosa*, *sargentii*, *scoparia*,
spectabilis, *viscida* 15:143–146, 162–166
Eriostemon buxifolius 15:11D, 98C
difformis 15:218CD
myoporoides 15:211C, **218CD**, 250C
nodiflorus 15:98C, 263C
scaber 15:250C
verrucosus 'J. Semmens' 15:211C
Eucalyptus caesia 'Silver Princess' 15:98C
calophylla, *citrodora* 15:263C, 375X
ficifolia 15:98C
globulus 15:210C
haemastoma 15:12P
maculata 15:210C, 375X
orbifolia X *caesia* 15:36D
platypus 15:210C
ptychocarpa 15:375X
robusta 15:210C
websteriana 15:36CD
Euodia elleryana 15:257C
Eupomatia laurina 15:263C
Ficus coronata 15:239C, 240C
Gastrolobium All spp. listed 15:177D
Gompholobium All spp. 15:93–166, 249C
asperulum, *confertum*, *ecostatum*, *foliolosum*,
glabratum, *gompholobioides*, *grandiflorum*,
hendersonii, *huegelii*, *latifolium*, *minus*,
nitidum, *pinnatum*, *scabrum*, *subulatum*,
uncinatum, *villosum*, *virgatum*
Goodenia varia 15:266C
Grevillea barklyana 15:211C
biformis 15:301P
'Bronze Rambler' 15:214C
'Ivanhoe' 15:375X
johnsonii, *juniperina* 15:211C
laurifolia 15:214C
lavandulacea 15:211C
leucopteris 15:249C
longifolia 15:98C
'Misty Pink' 15:98C
quercifolia, *robusta* 15:375X
'Robyn Gordon' 15:98C
rosmarinifolia 15:211C
'Rosy Posy' 15:9DP
'Royal Mantle' 15:214C, 375X
'Sandra Gordon' 15:98C

- Grevillea* — cont.
sericea, speciosa 15:249C
thelmanniana, willisii 15:211C, 214C
Hakea bucculenta 15:266C
corymbosa, elliptica, francisiana, laurina, macraeana, muellerana 15:211C
multilineata 15:266C
nodosa, orthorrhyncha, salicifolia 211C
sericea 15:11D
verrucosa 15:263C
Halimolobos preissiana 15:266C
Hardenbergia violacea 15:11D, 263C
Helichrysum acuminatum 15:344D
bracteatum and cult. 15:335–344CDPX
'Barleythorpe', 'Cockatoo', 'Dargan Hill Monarch', 'Diamond Head', 'Golden Bower Bird', 'Hastings Gold', 'Lemon Monarch', 'Princess of Wales' 15:339–343DC
Hemiandra pungens 15:266C
Hibbertia microphylla, obtusifolia, pedunculata, stellaris 15:263C, 266C
Hymenosporum flavum 15:26D
Hypocalymma angustifolium 15:205P, 263C
robustum 15:266C
Isopogon, dubius, formosus, petiolaris 15:263C, 266C
Kennedia prostrata 15:211C
rubicunda 15:11D
Kunzea ambigua 15:11D, 211C
baxteri, parvifolia, pomifera, pulchella 15:211C, 263C
Lastreopsis decomposita 15:242C
Lechenaultia acutiloba 15:266C
biloba 15:97CP, 99, 263C
floribunda 15:266C
formosa 15:97CP
Leptospermum petersonii 15:263C
rotundifolium 15:211C
Licuala grandis 15:257C
Livistona australis 15:239C
Lophostemon confertus 'Variegatus' 210C
Lythrum salicaria 15:98C
Macadamia integrifolia 15:210C
Maireana aphylla, georgii, glomerifolia, polypterygia 15:147CD
Marattia salicina 15:257C
Melaleuca armillaria 15:210C
decussata 15:263C
erubescens, incana, thymifolia 15:211C
fulgens 15:98C
linariifolia 15:210C
quinquenervia 15:259C
scabra 15:301P
steedmanii 15:98C
wilsonii 15:211C
Micromyrtus ciliata 15:209CP
Myoporum parvifolium 15:214C
Nemcia ALL Species des. 15:120–125
acuta, axillaris, brownii, capitata, carinata, coriacea, crenulata, dilatata, emarginata, epacridoides, hookeri, illicifolia, leakeana, lehmannii, obovata, pauciflora, plicata, pulchella, punctata, pyramidalis, reticulata, retusa, rubra, spatulata, stipularis, tricuspidata, truncata 15:125D
Normanbya normanbyi 15:257C
Omalanthus populifolius 15:257C
Oxylobium some sp. transferred to *Nemcia* and *Gastrolobium* 15:125D
lanceolatum (now Callistachys) 15:125
scandens 15:121P
Pandorea All spp. 15:362–368CDPX
baileyana, jasminoides, doratoxylon, nervosa 15:362–368CDPX
pandorana 'Golden Showers' 364P, 368D
'Snow Bells' 15:368CD
Patersonia sericea 15:11D
Penisetum alopecuroides 15:112CDP
Petalostylia labicheoides 15:169DP
Phebalium dentatum, elatius 15:47CD, 48P
glandulosum 15:45P, 47CD, 211C
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squamulosum 15:47CD, 48P, 205P, 211C
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Pittosporum All species deac. 15:28–35D
bracteolatum, ferrugineum, melanospermum moluccanum, oreillyanum, phylliraeoides, revolutum, rhombifolium, rubiginosum, tenuifolium, undulatum, venulosum, winnigii
Platycerium bifurcatum 15:240C
Platylobium formosum 15:211C
Platytheca verticillata 15:266C
Poa helmsii 15:239C, 240C
Pratia pedunculata 15:214C
Pronaya fraseri 15:20D, 24D
Prostanthera calycina 15:263C
cuneata, ovalifolia 15:211C
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Pteris umbrosa 15:240C
Ptychosperma elegans 15:257C
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acerosa, adunca, altissima, bauerlenii, blakelyi, brunoides, calycina, cabbagei, capitellata, cunninghamii, daltoni, divaricata, echinula, elachista, empetrifolia, ericifolia, hibbertioides, laxifolia, luehmannii, mollis, neurocalyx, obcordata, radiata, rotundifolia, spinosa, spinulosa, strobilifera, subalpina, subternata, tenella, teretifolia, trichophylla, vestita, verruculosa, williamsoniana 15:133P, 135D
pedunculata 15:208P, 214C
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velutina 15:211C, 263C
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Syzygium australe, oleosum, paniculatum 105D
Telopea oreades, speciosissima 98C, 266C
Templetonia retusa 15:211C
Tetratheca thymifolia 'Bicentennial Bells' 15:8DP
Thelymitra ixioideis 15:188P
Thomasia pygmaea 15:96CP, 98C, 263C
Thryptomene baeckeacea 15:211C
saxicola 15:263C
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Toona australis 15:239C
Tristanopsis laurina 15:210C
Urodon dasphyllus 15:121P
Verticordia drummondii, monadelphae 15:98C
mitchelliana, plumosa 15:266C
Wahlenbergia ceracea 15:284P
communis 15:251CDX, 254
gloriosa, gracilis 15:253P, 255C
Xanthostemon 'Expo Gold' 15:1P, 10CD
Zieria aborescens 15:263C