

Canberra Botanic Gardens

GROWING NATIVE PLANTS

Vol. 2, 1972





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Goodenia hederacea:
Goodenia — in honour of
Dr. Goodenough, a Bishop of Carlyle,
1743-1827;
hederacea — resembling ivy, ie trailing

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PROPAGATION OF NATIVE PLANTS

There are three simple ways by which the home gardener may increase his collection of native plants—

1. By purchasing plants from a native plant nurseryman.
2. From cuttings.
3. From seed.

The first method is by far the quickest provided one can find the nurseryman who stocks the plants required. However, what greater thrill is there for the keen gardener, displaying a rare flowering gem, than to say, 'I grew that from a cutting (or seed)?' Propagation from both cuttings and seed is generally not difficult, but before setting out methods for both these techniques certain important points should be brought to the reader's notice—

1. There are laws in the ACT and the States prohibiting the removal of any protected plants (or parts of plants, including seed). In the ACT all native plants are protected; in the States lists of protected plants may be obtained from the relevant State authority.
2. Collection in National Parks and Reserves is prohibited, except where special permits are held. These permits are rigidly controlled by the State authorities.
3. Permission must be sought from the owner of private land before collections are made thereon.
4. The question then arises, 'Where can cutting material or seed be obtained?' Seeds of many Western Australian plants are available from the Director, King's Park and Botanic Gardens, Perth, WA (catalogue is available). Some seed is also available from commercial suppliers in NSW and WA specialising in natives. Friends' gardens are another source of both cuttings and seed, and in most cases gardeners are flattered if you wish to grow something that they have already successfully cultivated.
5. Finally, anyone who wants to grow native plants would be well advised to join their local branch of the Society for Growing Australian Plants (SGAP). It is at society meetings that problems are discussed and cuttings

and seed are exchanged. A full-colour quarterly journal ('Australian Plants'), as well as regional newsletters, are available to all members.

The State secretaries are:

ACT—Mrs D. Robinson,
29 Hawker Street, Torrens,
ACT, 2607

NSW—Mr J. Frost,
6 Solander Close, Turramurra,
NSW, 2074

VICTORIA—Miss E. R. Bowman,
4 Homebush Crescent,
Hawthorn East, Vic, 3123

QUEENSLAND—Mrs H. R. Park,
755 Bumford Road, Brisbane,
Qld, 4054

SOUTH AUSTRALIA—
Mr C. J. Winn,
Coromandel Valley, SA, 5051

WESTERN AUSTRALIA—
Mrs G. A. Oxnam,
PO Box 64, Nedlands, WA, 6009

PROPAGATION FROM CUTTINGS

Collection of cuttings

It is only necessary to remove 5-6in from the tip of a shrub to obtain material for a cutting. On removal the offcut should be kept fresh by wrapping it in damp newspaper and keeping it in a cool place (the lower part of a refrigerator or an ice box is ideal). Cutting material will deteriorate if it is stored too long, so the best results are obtained if cuttings are prepared as soon as possible after collection.

Preparation of cuttings

Native plants are generally best propagated from half-hardened wood, ie, new season's growth which has had some two to four months to mature. This means cuttings are best taken from December to February for spring flowering species. It may not always be possible to take cuttings at the ideal time of the year, but cuttings may be taken at other times if necessary, although the percentage strike may not be as high.

Tip cuttings about 2-3in long make the best material. The lower cut should be made just below a leaf node and the leaves should be carefully removed from the lower two-thirds of the cutting. For species with large leaves it is advisable to reduce the remaining leaf area by about a third by

cutting off leaf tips with scissors or sharp secateurs. The cutting is then ready to place in the striking medium.

Cutting medium

Four-inch-square plastic pots make ideal containers for striking cuttings, but almost any pot will suffice provided there are drainage holes in the bottom. The medium should be open and well drained but able to retain some moisture. A mixture of two parts (by volume) of coarse sand to one part peat moss is suitable.

The pot is filled with this medium and watered down well. Holes are then made in the medium with a dibber (or sharp stick) to house at least the lower half of the cutting. Care should be taken **not** to **push** the cutting into the medium without first making a hole, as damage to the cutting will almost certainly ensue. Ensure, however, that the end of the cutting is touching the bottom of the hole and then press the medium firmly around it. The pot should then be saturated by watering from overhead.

Propagation frame

A simple propagation box may be made by taking a wooden fruit case about 12-15in deep and filling to about 4-5in with peat moss. A polythene cover may be constructed with a wooden frame that fits tightly over the box. The pots containing the cuttings are then buried in the peat and the propagation box placed in a semi-shaded position in the garden. (Fig. 1).

Potting on

When the cuttings have rooted (this may take from two weeks to six months or longer for some species), the contents of the pot are carefully upended. Extreme care must be taken at this stage to avoid damaging roots. Some species, particularly members of the family *Epacridaceae*, develop very fine roots which break easily. The plantlets may be separated safely by carefully immersing the contents of the pot in a basin of water. The cutting medium will fall away from the roots and the plant is then lifted away for potting-on.

For the first potting, plants may be trans-

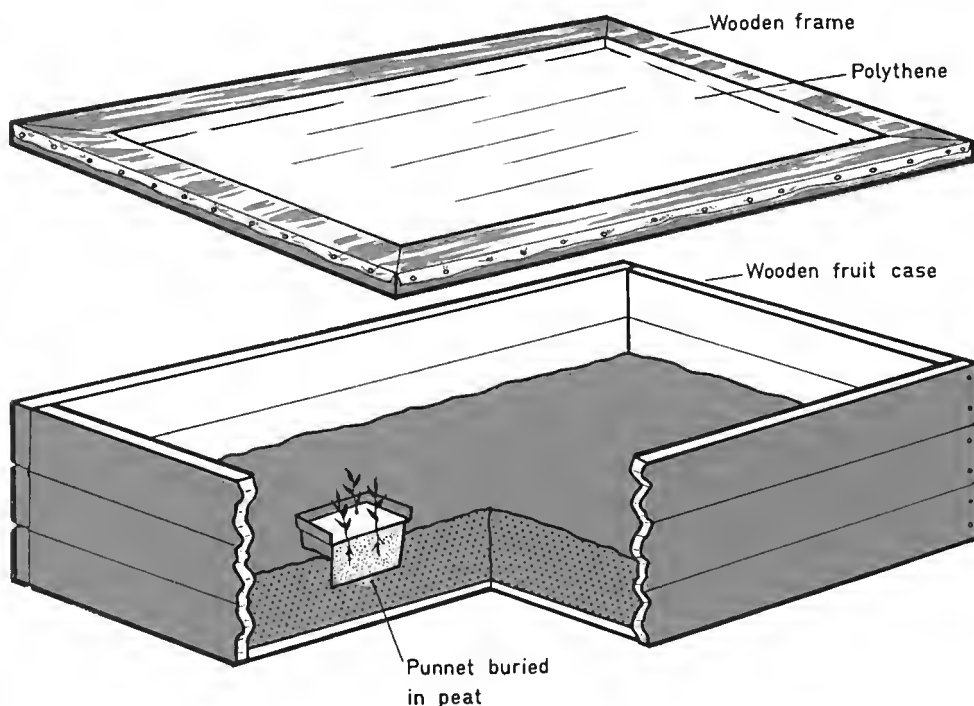


Fig.1

Propagation frame

ferred to 3in high plastic tubes or 3in pots. The potting mix should be well drained and comprised of a mixture of sandy loam and leaf mould or peat moss with about a teaspoonful of blood and bone per pot.

The rooted cutting should be planted at the same depth in the pot as it was in the cutting mix. Care should be taken to place the roots evenly in a hole in the soil mix and not to damage or bend them in an unnatural way. A deep root system may be encouraged even at this early stage.

The soil should be gently firmed down with the fingers after planting and then watered well. Pots should be kept in a bush house or sheltered spot.

A second potting-on is required when the root system is well developed. This may be tested by gently tapping out the contents of the pot and looking at the root development. On no account should the plant be left long enough in a 3in pot for the roots to develop a 'curl'. The second potting is best done into 9in x 9in black plastic bags (about prune-tin size). The soil-mix should be similar to the first stage, although a little coarse sand added will assist drainage over the winter months.

The contents of the 3in pot should be transferred to the plastic bag with as little disturbance as possible. If roots have developed curl, an attempt can be made at this stage to straighten them to encourage a deep root system.

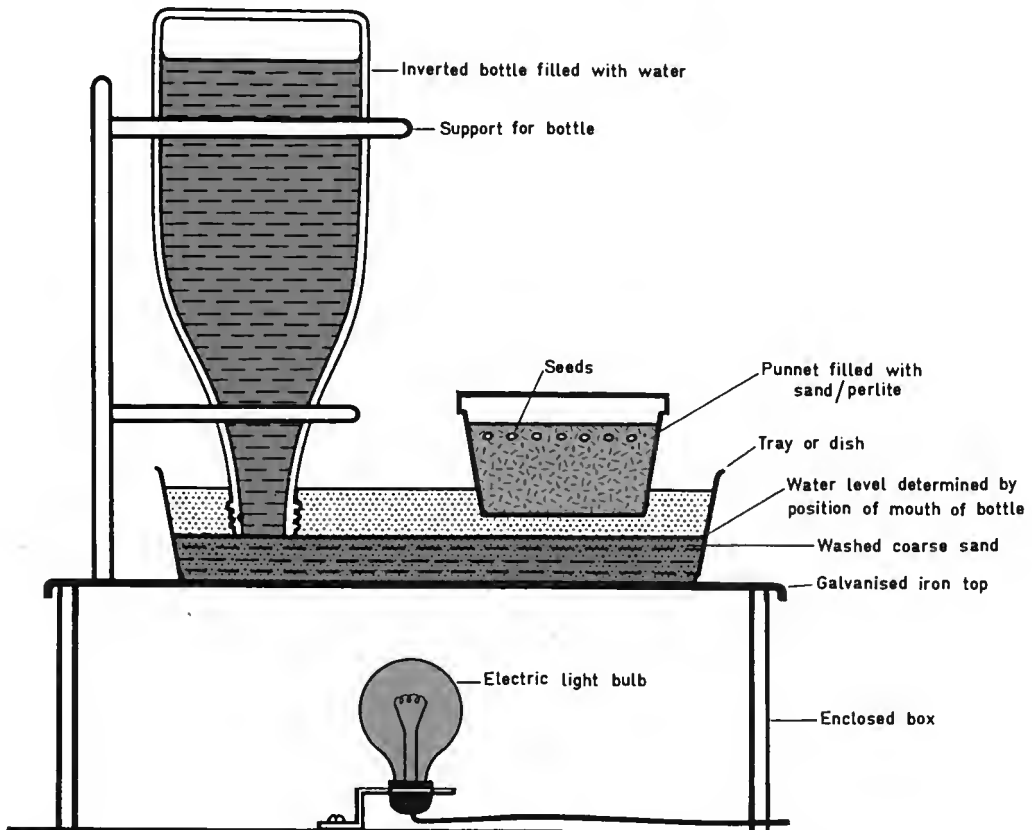
After the second potting, the bags should be kept in the bush house for two or three weeks and then gradually hardened off until ready for planting in the garden. Weekly applications (less frequent in the winter) of a liquid all-purpose fertiliser will greatly improve early growth and help produce healthy vigorous plants for the garden.

The main criterion as to whether a plant is ready for the garden, is its root system. If a plant is growing strongly with a well-developed root system then it may be safely planted out in the open in either autumn or spring.

Propagation from seed

Many native plants will grow readily from seed.

A simple and effective method for sowing seed is to use a capillary seed bed. The



28 Fig.2 Capillary bed for seed germination

following method was first published in the journal 'Australian Plants' (March 1970, pp260-1) by D. K. McIntyre, J. W. Wrigley and C. Green, of Canberra Botanic Gardens. Capillary beds are widely used for seed germination, the principle being that a constant moisture level is maintained in the vicinity of the seed during germination by capillary action of water.

Capillary beds have advantages in the germination of seeds. The seeds are always well aerated and moist (not over- or under-watered). Experience with the large-scale use of this method at Canberra Botanic Gardens has shown that damping off at the young seedling stage has been almost eliminated.

A simple capillary bed can be made by using a small tray, eg, a deep baking dish, filled with washed coarse sand ($\frac{1}{4}$ - $\frac{1}{2}$ in diameter). The dish is then about half-filled with water. Seeds are sown in a punnet filled with a freely draining medium (a 50-50 mixture of washed river sand and perlite is recommended). The punnets should have holes in the bottom to allow the water to enter freely.

The punnets are buried in the coarse sand (but above the water level). Ensure the water rises to the top of the punnet. If the capillary is broken, this is easily noticed because the top will quickly dry out. A constant water level can be maintained by filling a bottle or some other suitable container with water and inverting it with the top of the bottle at the required water level. Supplementary bottom heat can be added as a useful modification by placing the capillary tray on top of a completely enclosed box with a galvanised iron top and heated by one (or more) electric light bulbs. The size and number of light bulbs used will depend on the size of the tray being used. By this means an optimum temperature of 70°-75°F can be maintained in the region of the germinating seeds. The temperature in the sand bed may be up to 10°F higher than this. (Fig. 2).

The heating box is not necessary but it will greatly speed up germination in cold areas and during the winter.

This capillary bed will give excellent results in the germination of most seeds. It should be kept in the light to prevent seedlings etiolating.

Pre-treatment of seed

Some seeds require special treatment prior to germination to allow moisture to penetrate the hard seed coat to start the germination process. In general, these seeds



Correa alba: Correa — after Jose Correa de Serra, a Portuguese botanist; *alba* — white (flowers)

belong to the families *Papilionaceae* (Pea flowers), *Mimosaceae* (Acacias) and *Caesalpinaceae* (Cassias).

The treatment may be carried out in one of three ways—

1. Seeds are placed in a cup and boiling water is poured over them. They are allowed to stand until they swell. For very hard seed, more than one treatment may be necessary. After swelling the seeds are sown normally and germination occurs in two or three days.

2. For larger seeds it is possible to file through the testa with a sharp triangular section file and thus allow moisture to enter the seed. After filing, the seed is sown by the standard method. Care must be taken with this method so that damage is not caused to the growing point of the seed.

3. The third technique which is really a modification of (2) is that of scarification. Seeds are rubbed between sheets of sand paper until sufficient abrasion has occurred to allow water to penetrate the seed coat.

Potting on

Seedlings are treated in a similar manner to rooted cuttings but two additional points should be noted. Firstly, seedlings should be transferred to the 3in tubes or pots when as small as possible. The first true leaf stage is ideal. If left longer than this extreme care must be taken in ensuring that the roots are placed naturally in the pot. Secondly, the seedling should be placed at the same level in the soil as it was growing in the seed punnet.

A second potting stage is then carried out as for cuttings.

ANIGOZANTHOS SPP.

Anigozanthos rufus: *Anigozanthos* —from two Greek words, *anoigo*, to expand, and *anthos*, flower, alluding to the open branching of the flower stems; *rufus* — one of the Latin words for red

The genus *Anigozanthos* comprises only eight species, all of which make delightful garden subjects. All but one, *Anigozanthos preissii* have been grown in Canberra Botanic Gardens and have flowered successfully. *A. preissii* is difficult to germinate and so far plants have not been established. The common name, Kangaroo Paw, is derived from the shape and woolly exterior of the floral tube. The genus is endemic to south-western Australia and although the species are found in vastly different habitats, they all respond to a well-drained sandy soil in cultivation. All species seem to thrive if kept relatively dry, particularly during the dormant winter season when *A. humilis* sometimes dies down completely. The fan-like clusters of flat iris-like leaves are often marked with unsightly black blotches commonly known as 'ink disease' and for which a cure has not yet been found.

A. flavidus is undoubtedly the hardiest and most vigorous member of the group. Some clumps in Canberra Botanic Gardens are more than 10 years old and flower regularly through the summer months. It is hardy to both frost and drought and responds to a well-balanced general fertiliser. The branched flowering stems may reach 7ft in height. Flower colour varies from uninteresting dull greens to yellow greens, rusty reds and even orange, all with a characteristic turquoise inside the flower.

A. rufus is much smaller than the former species with branched flowering stems to 2-3ft. The striking flowers are clothed with dense maroon hairs and are at their best from November to May. The species requires some protection from the hardest frosts but with care will survive for many years, forming a large clump and producing many flowering heads.

Similar in stature to *A. rufus* is *A. pulcherrimus*, the Gold Kangaroo Paw with its rich, yellow flowers. The two make a delightful rockery contrast, flowering for about the same period. Good drainage and relatively dry conditions are essential.

The best known of the paws is *A. manglesii*,



the Red and Green Kangaroo Paw and floral emblem of Western Australia. It is a common natural plant of King's Park in Perth and thrives in Canberra in built-up sand. The species must be protected from frost and is relatively short lived in cultivation, most plants surviving less than three years. From seed sown in early summer the species will flower the following spring and is at its best in its second season. Flower heads are unbranched and may reach 3ft in height.

A. viridis var. *major* is similar to *A. manglesii* but generally smaller and perhaps less brilliant. It is slightly hardier to frost and less particular about good drainage than *A. manglesii*. Flower heads reach 18in but a dwarf variety with stems less than 6in makes an outstanding pot plant.

A. viridis var. *viridis*, Green Kangaroo Paw, is another small species with narrow rounded leaves and bright green flowers and stems, about 18in long. This species is often longer-lived than *A. manglesii*.

The smallest of the paws is *A. humilis*, the Cat's Paw, a sturdy dwarf less than 1ft high. The hairy flower heads vary in colour from a soft buttercup yellow to orange and salmon and flower for many months in summer and autumn. The species frequently dies down in the winter and should be kept dry over this period of dormancy. A well-grown plant with a dozen or more flower spikes makes an outstanding display. Propagation of *Anigozanthos* is best done from seed sown in spring or summer. Root division is also possible but care should be taken not to over-water the new plantlets. The best time for division is early summer. Plants are available from most nurseries concentrating on native plants.

Some work on hybridisation is being done in Western Australia but results are not generally available.

The rare Black Kangaroo Paw is not an *Anigozanthos* but belongs to a related genus, *Macropidia*. *M. fuliginosa* is difficult to propagate and is not yet available through nurseries.

Anigozanthos pulcherrimus:
pulcherrimus — very handsome





Calytrix alpestris: *Calytrix* — from two Greek words meaning calyx and hair, alluding to the long fine calyx tips; *alpestris* — of the mountains (Gr.)

CALYTRIX TETRAGONA

The genus *Calytrix* (Fringe Myrtles) is another beautiful group of shrubs found wild only in Australia. Some 40-50 species have been recorded, mainly in Western Australia, but very few are yet in cultivation. The shrubs are of the type often described as heath-like, with small narrow leaves and thin lightweight branches, belonging to the family *Myrtaceae*, with aromatic foliage and young stems.

The fringed effect is given by the calyx which tapers into points behind each five-petaled, starry flower, in the centre of which is a cluster of prominent stamens. Like so many Australian shrubs, the form

and quality of the flowers and their arrangement on the stems is excellent.

Common Fringe Myrtle (*Calytrix tetragona*), the species described here, is widespread and variable throughout temperate Australia as a dwarf to tall shrub. It exists still as a wild flower around Canberra, though rare, and was found recently on Black Mountain. In 1961 it was recorded in the district formerly known as Westlake on a slope resembling a natural rockery among *Hibbertia*, *Dodonaea*, *Stypandra* and other local species.

Calytrix tetragona is an easily grown and very hardy shrub for the small garden, about 4ft high, although long-lived specimens grow taller: a 20-year-old plant at Canberra Botanic Gardens has reached 8ft. To obtain a bushy plant of this size, watering and regular light prunings are needed to avoid bare wood. With this treatment the species could be used as a hedge plant. The tiny leaves are slightly fleshy with a spicy perfume when bruised. The colour of a healthy shrub is bright green with yellow green young tips.

For most of the year the appearance is neat but undistinguished until flowering in October. Flowers are white or pink, deeper in the pointed buds, clustered along the arching branches, sometimes massed and nearly hiding the leaves. A beautiful deep pink form recently collected near Keith in South Australia appears to have great potential as a garden subject. Cool, moist conditions extend the season of *C. tetragona* into December, but this is not a species which has stray flowers all the year. Bees have been seen crowding around at flowering time.

After flowering the calyces hang on for some weeks, shiny and saucer-shaped with long curling threads, turning golden bronze and purplish. The branches, now delicate and feathery, are as decorative as when they were in flower and will live in water almost until they dry out naturally.

Propagation is by small cuttings of half-ripe tip growth. Young plants are generally available from nurseries dealing in native species.

A garden position in sun or light shade is suitable, with unprepared soil, free from lime and very well drained. During a severe outbreak of root rot (*Phytophthora* sp.) worsened by rains when the soil was periodically soggy, *Calytrix* suffered badly and many plants died. Some plants which suffered partial die-back have since recovered to make new growth. No other diseases or pests have been noticed.

OLEARIA PHLOGOPAPPA

An Alpine Daisy Bush in full flower is often taken for one of the Michaelmas Daisies, which, however, are species of *Aster*, true perennials of the Northern Hemisphere, especially North America.

The genus *Olearia* (Daisy Bushes) is closely related to *Aster*, but comprises shrubs or small trees native to Australasia, about 80 of them being peculiar to Australia and found in all situations. Half-hardy species are well-known in European gardens, as in Ireland and southern England, and in this

Olearia phlogopappa: *Olearia* — olive-like, referring to other shrubs of the genus; *phlogopappa* — from two Greek words, *phlogos*, flame, and *pappos*, grandparent. The meaning is obscure. *Pappus*, implying old man's beard is the name given to the downy hairs on the seeds of some daisies



country about 10 are offered in cultivation. One of the most popular is the species described here, *Olearia phlogopappa*, a light-weight shrub from Tasmania, Victoria and New South Wales, easily grown, very hardy and bringing quick results.

The shrub has a generally grey appearance from a mealy coating of hairs on young growth and the undersides of the leaves, which are under an inch long, narrow and with dentate edges. There is a strongly musky odour, found also in other *Olearias* and often in other members of the family *Compositae*. The flowers have a different scent, light and pleasant.

Flowering starts around the end of September and gradually the thin stems lean with the weight of massed daisies in rounded heads. Light violet and purple pinks are the popular colours and there is a white form; nothing similar is flowering in the native garden at this time. If conditions are cool and moist the season extends into December, but if hot and dry the season is short.

Dry conditions do not bring out the best in this shrub and if a position in light shade can be found, along with regular watering, growth will be more lush. It is at times a dry-looking plant with lower leaves dying out, leading to bare wood and a poor shape. Light pruning helps to increase bushiness if started while the plant is young, as older wood does not break freely into growth. After flowering is the time to prune, although short sprays taken as cut flowers have the same effect as pruning.

Left alone the form is upright and narrow, about 6ft high. A useful idea is to grow the shrub among or behind smaller shrubs to hide the sometimes untidy base. If required for a seaside garden it should not be exposed to sea winds. As with most native species light dressings of blood and bone or a 10:9:8 fertilizer is beneficial in early spring and late summer.

Plants receiving adequate water are long-lived and as they are easily raised from cuttings, young plants may be kept on hand in case of loss if desired. Also, they are frequently stocked by nurseries dealing in native species, sometimes sold under the old name of *Olearia gunniana*.

The only disease noticed here has been die-back of branches possibly as a result of root-rot (*Phytophthora* sp.) when continuous rains and cold weather prevented natural drying out of the soil. This can be dealt with only by assisting drainage in any way possible and relying on the vigour of the plant for it to recover.

JACKSONIA SCOPARIA

Jacksonias are pea-flowered shrubs or small trees found wild only in Australia, mainly in the west. Their distinctive feature is flat, angular or winged branchlets which are entirely leafless except in young growth. They are rarely grown in gardens, though they were sent by early discoverers for growing under glass in England from 1803.

Jacksonia scoparia: *Jacksonia* — after G. Jackson, a librarian to a botanist early last century; *scoparia* — brush or broom-like, referring to the manner of growth



Dogwood (*Jacksonia scoparia*), the species described here, is a beautiful small light-weight tree of milder areas and mountains of New South Wales and Queensland. It has been known to supply some drought fodder and also to have some minor value as timber. The common name of Dogwood is one given to various quite unconnected plants and in this case refers to the smell from the wood when burnt—it is no indication of its ornamental value.

Jacksonia scoparia reaches about 15ft high—the height and size often needed in the garden—and is an interesting small shade tree, specimen or fence cover. Growth is helped by a twice-yearly dressing of blood and bone.

Most of the year the general effect is of a dense and softly drooping crown, with many thin branchlets somewhat tufted, and of a dull or greyish green. The slender trunk becomes dark and furrowed with age.

This is a hardy and long-lived species in Canberra, and has survived severe droughts and storms, eg, a 15-year-old tree in the Botanic Gardens lost two limbs from the weight of snow in August 1965 but today is still quite healthy. Adequate watering improves condition and flowering as long as drainage is good.

Flowers open about the third week of November and soon the branchlets are weighed down with masses of Pea flowers $\frac{1}{4}$ in across. They are a soft light orange, and in some specimens there is a red blotch at the base of the standard petal. Each calyx is hairy, giving silvery tints. The delicate flowers fall quickly and continue for three weeks in moist, cool conditions or less in drought and heat.

Seeding is prolific, each pod holding one tiny seed. Like many other Legumes the hard seeds require soaking in hot water before sowing, and each plant must be in a separate pot for transplanting without damage to the roots.

An open, sunny position should be chosen and lighter soils appear to be preferred. The slender young plants may need protection from breakage by staking, while developing slowly.

Cut flowers do not last long in water but press well, the sprays retaining their bright orange when dry.

No pests or diseases have been noticed apart from suspected root-rot which may have caused the loss of a mature tree at Canberra Botanic Gardens growing in the path of water seepage.

CALOTHAMNUS SPP.

Net Bushes or One-sided Bottle Brushes are found wild only in Western Australia, where 24 species are known. They are rigid shrubs, often with pine-like foliage, and all have fairly similar flowers in which the showy parts are the groups of stamens as in *Callistemon* (Bottle Brushes) to which they are related. In this case the stamens are joined in the lower parts, feathering out towards the tips and forming irregular flowers of good substance. They are set close in to the stems mostly facing one way, but sometimes in large clusters nearly encircling the stems. Flower colour may be of varying shades of red and sometimes pale yellow, with golden anthers.

Nectar-eating birds are attracted to the flowers, and a lemony scent has been noticed in some. Oil glands are present in the leaves and young stems—however dry and stiff they may appear—and when bruised they give off beautiful lemony and spicy perfumes. This is in common with all members of the family *Myrtaceae*, which includes the *Eucalypts*.

About half the known species of *Calothamnus* are in cultivation in Australia, growing easily in most soils unless extremely alkaline. They are valued especially for dry conditions. Some are suitable for seaside gardens and for hedges. Not all tolerate humidity and many species succumb to mildew in the seedling stage in some districts. All are partially frost tender and should be covered during winter nights in cold climates, as young plants can be lost overnight. The covering material should not touch the plant but should be held well up on stakes.

The genus *Calothamnus* is an interesting group to observe in Canberra Botanic Gardens where examples of several species are established, some up to 10 years old and with a history of surviving extremes of weather. Older plants were grown hard in unprepared ground, lacked water, and were never covered against frost although some were sheltered by trees. These were sparse, thin-limbed shrubs with papery old bark, but now with freer watering, mulching and



Calothamnus homalophyllus:
Calothamnus — from two Greek
words meaning beautiful and shrub;
homalophyllus — with flat, level or
horizontal leaves

light feeding, they are becoming more lush. *C. robustus* in a sunny position has had tip growth killed by frost for years and is now a dense and flat-topped shrub 8ft across. At times it has lost wood through extreme drought and through root-rot (*Phytophthora* sp.) in over-wet conditions, but has grown away from these setbacks. *Calothamnus* are long-lived in the sense that although they may lose wood from various causes they regenerate into shapely growth again, and can be pruned hard into old wood.

The most common species in cultivation is *C. quadrifidus*, with pine-like foliage sometimes sharply pointed. The leaves are variably covered with long transparent hairs giving a soft appearance, specially when enhanced in winter as cold tends to increase protective coverings on leaves. Very hairy forms are grey, and young growing tips give reddish tints from autumn onwards.

Watered plants in light soil grow rapidly, becoming dense and heavy-limbed and reaching 7ft high and 12ft wide in six years. This type of growth is liable to fall or blow down and is best controlled by pruning if the situation is open to wind. This species could be used as a hedge. Tip growth is still frost tender when about 5ft high, but this merely acts as a light pruning increasing bushiness.

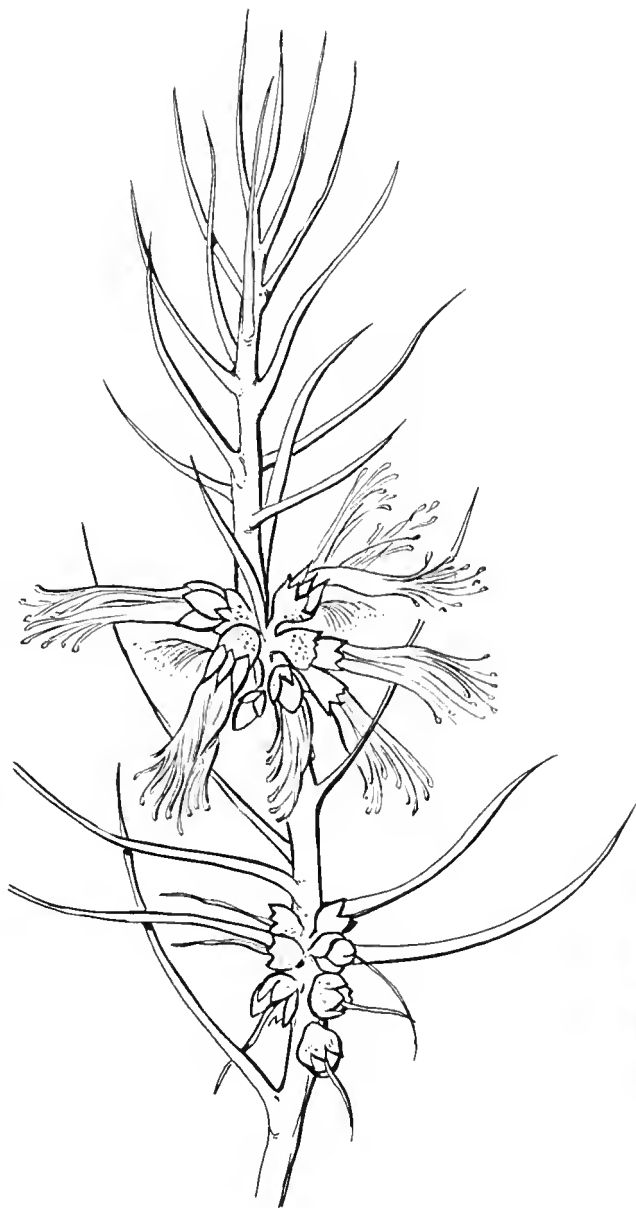
Red flowers open from mid-October to January and are at their best in November; in some years stray flowers appear almost every month. The long stems of even and healthy foliage are most decorative and last many weeks in water.

Branches have been lost through stem borer which can be checked by injecting the hole with Rogor 40 insecticide or methylated spirits. Affected plants soon make new growth.

C. gilesii is an upright, sparse shrub 6ft high with long, rough pine-like leaves of dull green. It is interesting for its long flowering season from late spring to winter, and although the flowers are not densely clustered they show up well among the widely spaced leaves. A delightful lemon scent has been recorded.

Calothamnus shrubs are easily raised from seed, or if a particular colour form is required cuttings taken in summer are successful.

Most nurserymen concentrating on native plants stock several *Calothamnus* species.



Calothamnus gilesii: gilesii —
from the name of a person called Giles

LYTHRUM SALICARIA

Lythrum salicaria, known commonly as Purple Loosestrife, is an interesting species native not only to Australia but widespread in Europe, Asia and North America. It is a herbaceous perennial related to *Lagerstroemia* (Crepe Myrtle) and known from ancient times. Investigation of the meaning of the name leads back into the literature of many countries and is an example of the fascinating history behind names.

One record of the use of Purple Loosestrife in medicine and tanning is found in a Dr Lindley's 'Flora Medica' 1838. The old English common name indicates a use as an astringent, but *Lythrum* has strange connections. The Greek word *lythron* meant blood in a sinister sense, ie, impure, as from flowing battle wounds and other causes. As none of this group of plants has blood red flowers, it is possible the name indicated that the plant was used for stopping blood. A reference found in a Chinese book suggests this. Few Australian plants can have such lore behind them.

The species favours wet situations such as swampy ground and the water's edge, but will persist in dried-out land and is long-lived, wild or cultivated. In Australia it grows in the eastern States and Tasmania, often occurring in drifts. Not far from Canberra it grows by the roadside indicating damp ground, though it is not conspicuous in years of drought. After several showery seasons it spreads freely, and is easily seen when in flower between January and March. Its light purple spikes shine out among surrounding grassy herbage which is turning brown at this time.

As may be expected of a widely distributed plant, *Lythrum salicaria* is an easy garden plant, thriving in any soil and generally healthy. It is a beautiful subject for late summer colour in a border, shrubbery, large pond or slow-moving water. Well-watered and reasonably sheltered it reaches over 6ft high here. It will grow by the sea also.

Unlike many perennials which grow bare in the centre with age, this plant forms a bushy and well-shaped clump. The tall stems are strong, branching freely, and they



Lythrum salicaria: *Lythrum* —from one of the Greek words for blood, with complex meaning; *salicaria* — willow-like, referring to the leaves or flower spikes

tend to curve inwards in a self-supporting manner so that staking is not necessary.

Lateral buds develop while the main spikes are flowering and these continue the season till near the end of March. The soft, light green foliage often turns red in aging towards autumn. Top growth dies down for winter and should be cut back to ground level.

Propagation is by root division or seed, and self-sown seedlings often appear in open ground. If desired, cuttings may be taken from non-flowering laterals in mid-summer and struck outdoors in shade.

This species is not grown commercially in Australia as often as might be expected, though in other countries named garden varieties have been grown for years. These range from white to pink and deep purple and include double flowers.

Short flower spikes last well as a cut flower in water.

CALLISTEMON CITRINUS

(SYN. *C. LANCEOLATUS*)

Callistemons are found wild only on this continent but are among the best-known Australian plants grown in other countries where several half-hardy species are widely grown and adaptable to garden treatment. The *Callistemon* flower with the showy part consisting of massed stamens, not petals,

Callistemon citrinus: *Callistemon* — from two Greek words meaning beautiful stamens; *citrinus* — lemon-scented, of the leaves



is a novelty in cooler climates, and where the plants will not survive outdoors they are prized as pot plants under glass.

The Crimson Bottle Brush, chosen here, is a shrub from swampy areas of Victoria, New South Wales and Queensland. In cultivation, however, it may reach small-tree proportions if conditions are favourable. It is generally described as bright red, tipped with dark anthers.

Here and abroad, many beautiful garden forms have been raised and distributed under this name. As the species crosses freely with others grown nearby it is likely that some of these are hybrids, bringing in colour variations. In addition superior forms are often discovered in the bush.

The special attraction of this Bottle Brush is its habit of flowering twice a year if well-watered. In years of extreme heat and cold in Canberra, and lacking water, flowering has been sparse.

The main season is from early November, but its autumn flowers are even more welcome from the end of March. The brilliant red looks fresh in late summer heat waves and warm in early winter.

Leaves are flat and stiff and growth is also stiff and dense, made more so by pruning. This may be done after the spring flowering or in autumn in frost-free climates; an old specimen pruned for years forms a tough shrub with stringy lower bark. An average height would be 8ft. The Bottle Brush can be used for a large hedge trimmed hard, or trained for a small tree by keeping one stem and staking in early years; for this purpose 10ft would be a good height in Canberra.

The woody seed capsules remain closed on the branches for years and open when taken off and placed in warmth, as on a sunny window-sill. Seed is plentiful and young plants are easily raised this way. Cuttings of semi-ripe wood can be used to increase specially good forms.

This is one native plant which is easy to obtain and may be planted in any position or soil including really wet conditions or by the sea. No shrub could give a more brilliant display for so little trouble. Bees and small birds are frequently seen around the flowers.

In some years the leaves are badly blemished by a tiny scale which causes a blistered appearance and some twisting, as well as some attendant smut. To control this a spray of white oil and Rogor 40 can be applied any time the pest is seen. A repeat spray may be required in 14 days.

HAKEA LAURINA

Hakea laurina (Pin-cushion Hakea) is one of the most admired native plants of south-western Australia, and is grown in quantity in this and other countries. In Italy and America its uses include street and hedge planting.

In Canberra Botanic Gardens it is grown singly as a shrub or small tree reaching 15ft. Specimens 20 years old in light shade are rather slender and sparse and in this position they do not flower well or regularly. Others, starved in early years, are smaller and have never flowered.

The best specimens are in open beds of light soil, watered but well drained. In full sun the species forms an upright shrub with a compact, rounded head, flowering freely and evenly each year on the well-ripened wood.

The species is frost tender in the new tip growth made during autumn and some of this is generally lost each winter, unless sheltered by trees. As a precaution, young plants are covered nightly with hessian during winter till about 4ft high.

The general impression is of bold and handsome foliage, slightly blue-green, though closer inspection shows that the foliage is blemished at various times of the year with fungus spots. The simple and shapely leaves are widely spaced and wave and curl attractively. They are up to 6in long, thick and smooth, with rows of prominent veins.

As early as December tiny new flower buds can be seen, becoming fat and pointed by autumn and covered with ornamental scales, whitened by coverings of fine hairs. In good years they are packed in tight clusters on ripe wood, nestling among the leaves yet not hidden.

Flowering starts towards the end of April, is at its best in July in a mild winter and ends towards the end of August, although in an extremely cold winter flowers are both held back and reduced in size. The perfectly rounded pin-cushion flower heads are soft cardinal or cherry red, with projecting long styles, white to pale pink on aging. A faint, pleasant scent can be detected and bees have been seen visiting the flowers.

The bright, sturdy balls up to 2in across, in



Hakea laurina: *Hakea* — after Baron von Hake, 20th century botanist;
laurina — laurel-like, of the leaves

the middle of a cold winter, on a shrub easy to obtain and grow, make this a good choice for one of the basic plants for a new garden. There are several other *Hakeas* with globular flower heads, less easy to obtain.

Seed is occasionally found here and is the means of raising young plants, which may be obtained from nurseries dealing in native species. Almost any garden soil is suitable as long as it is lime-free. Staking is advisable, as plants are weakly rooted and do not hold well in all soils or in exposed positions. At about 5ft high a well-grown specimen is heavy and may lean badly.

Root-rot (*Phytophthora* sp.) may have caused severe die-back of branches with leaf curling and distortion, due to continuous cold rainy weather, but new growth was made after the soil was able to dry out. Moderate pruning and shaping may be done as required and short stems of flowers may be cut for indoor decoration.



Sollya heterophylla: *Sollya* — after R. H. Solly, a naturalist; *heterophylla* — having leaves of more than one shape

SOLLYA HETEROPHYLLA

(SYN. *S. FUSIFORMIS*)

The Australian Blue-bell Creeper (*Sollya heterophylla*) is a medium shrub or climber, attractive as the seasons change, adaptable to various garden uses and very easy to grow. It is related to *Pittosporum*, and though a native of south-west Australia, is completely hardy in the Canberra winter. In severe drought it receives a slight check, but recovers well later, though as with most plants regular watering gives a better specimen. Planted in full sun it grows compactly, and in light shade with free watering its young stems are more lax with long internodes.

As a slender twiner it grows with medium vigour in the Canberra climate and may be

set at the foot of a tree or post though it is not a rapid fence cover here. Planted in a window-box and climbing up a pillar it would be very pleasant viewed from inside the house. If not kept to several main climbing stems or if away from supports and other plants, it twines upon itself and develops into a matted and durable shrub of good rounded habit. Though the main stems are thin and lightweight, specimens have not been seen affected by strong winds. In foliage alone the shrub is attractive. The simple leaves vary up to 2in long and are very smooth, thin and slightly leathery. General appearance is unblemished, a fresh and shiny green all the year.

The flowers of clear gentian blue open in a very long season between November and April. They are dainty small bells under ½in long with five pointed petals, and hang on long-stemmed clusters. In February they are at their best, dotted all over the plant and a welcome, cool colour at this time of year. Sometimes the flowers are a pale rose pink, but the blue are the most showy.

While still in flower during summer, the shiny finger-shaped fruits are swelling. These are as ornamental as the flowers as they are blue on the upper surface and deepen in colour until winter, hanging on for several months. Sprays of these shiny berries are beautiful and rich-looking in flower arrangements. They are easy to arrange and live many weeks in shallow bowls of water either as short sprigs or long sprays.

The berries are packed with sticky seeds but cuttings root so easily that this method is used for raising young plants. In Canberra, cuttings root easily outdoors in a shady damp patch during spring and summer. The species is not new in cultivation and may be obtained from various nurseries dealing in native plants.

Any soil, heavy or light, is suitable as long as it is lime-free and no pests or diseases have been seen. Pruning is not necessary unless to control shape.

ACACIA SPECTABILIS

Acacia spectabilis: *Acacia* — may be from the Greek to sharpen, alluding to the prickliness of the first species discovered. Another opinion refers to the Egyptian Thorn (akakia), a species of *Acacia* which yields gum arabic; *spectabilis* — showy



The Glory or Mudgee Wattle (*Acacia spectabilis*) is only one of many fine wattles of garden value and is often chosen because it is ornamental all the year, even when out of flower. It has a silvery grey bloom on its trunk and branches, which wears off lower parts slightly as it ages.

In cultivation in a light soil and with good watering it can make a tree 15ft tall within five years and can exceed this height. In an open position some plants begin to branch freely near ground level, forming a graceful and spreading head in which the pale stems show up through the foliage. Other specimens, particularly when they are crowded near other plants, reach 4-5ft before branching and then form a slender tree, often leaning, with fewer main branches.

It is hardy in frosty areas, but continued drought causes some yellowing and loss of leaves and adequate water must be given.

The graceful pinnate leaves are about 4in long, smooth and glaucous, and their grey appearance is enhanced during the Canberra winter. During mid-July in a mild season spikes of yellow-green flower buds form, and while waiting to open are almost as ornamental as flowers contrasted against the grey foliage.

A warm spell at the end of August may bring out a few early flowers, but September to October is the main season. The flowers are fairly large balls of good substance and a clear golden yellow . . . one of the brightest among wattles.

The weight of the flowers often bears the branches down. A light scent is noticeable when the tree is in flower. After flowering it is generally hung with seed pods which have a purplish bloom.

Nurseries dealing in native plants may stock this species. However, care should be taken to select one which is not pot bound or checked in any way. Maltreatment will show in a yellowing of the leaves.

Any neutral or acid soil is suitable and an open position allows the head of the tree to develop fully. For several years it will respond to pruning to shape the tree as desired, so that if a shade tree is wanted it may be kept to one leader before being allowed to branch out at several feet high. Light pruning after flowering will lead to a more bushy growth, though regrowth would not follow cutting into older wood.

GREVILLEA OLEOIDES VAR. DIMORPHA

Grevillea oleoides var. *dimorpha*: *Grevillea* — after C. F. Greville, one-time patron of botany and President of the Royal Society, London; *oleoides* — olive-like referring to leaves; *dimorpha* — having two forms, one with broad and another with narrow leaves



A native of Victoria and South Australia, *Grevillea oleoides* var. *dimorpha* is one of the best of the smaller Grevilleas, providing a long season of bright red flowers any time between autumn and early spring. It is a very hardy shrub of tough, stiff growth and generally reaches a size of about 4ft high and 2-3ft wide. In light soil and away from strong winds it has been known to reach 5ft high and 6ft wide at five years old. The habit of branching is generally sparse with a few main branches, often throwing out one or two angular branches along the ground. However, some plants develop a more curving and bushy form from ground level.

The stiff leaves are mostly alternate and, like the branches, uneven in spacing and length varying from 2-6in long on the same plant; likewise the leaf stage is extremely variable. There is one form of the species with very narrow leaves pointing upwards close to the stem, and another form has leaves up to $\frac{3}{4}$ in wide, either straight or curving outwards. Their colour is mid-green, rather dull on the upper surface and silvery beneath.

During spring and summer this shrub may go unnoticed as its general appearance is not outstanding, specially when grown in a harsh dry situation; but as soon as the flowers open it becomes a shrub of distinction. Blood-red spider flowers with long, stiff styles up to 2in long, set in the axils of the leaves, are very showy against the open outline of the plant. If several specimens are grown in the garden they may not all flower at the same time but over a period from the end of May till the end of November, quite unaffected by the coldest winter weather. The last one appears in early December, fading with the heat, and eclipsed by brighter species flowering at this time.

The species may be propagated from tip cuttings taken in mid-summer. Nurseries specialising in native plants stock this shrub, and it should be planted in lime-free light soil, where it will come into flower at an early age. Though drought hardy, soft, bushier growth may be encouraged by good watering and tip pruning when young. Occasionally scale and the associated black smut may give trouble but control may be exercised by spraying with Rogor 40 solution in white oil.

SWAINSONA GALEGIFOLIA

The Darling Pea (*Swainsona galegifolia*) of inland New South Wales and Queensland is a long-lived shrubby perennial worth having in every garden because of its easy cultivation and very long flowering season. Branches grow annually from the crown and make a growth of from 3-4ft each year. In a crown crowded with new shoots, the outer ones tend to be pushed outward and lead to a more spreading shape, especially if the shrub is allowed ample room when it is first planted. In groups, plants support each other and lead to a more upright habit. Top growth is susceptible to frost and in a cold area such as Canberra, plants may be partly killed. However, when this wood is cut out at the end of winter it is replaced by strong new stems. Branches are well clothed to ground level with fine pinnate leaves about 4in long. They are smooth and sometimes greyish, forming a bold, graceful outline, even without flowers.

They are generally pest and disease free but are occasionally attacked by aphids and caterpillars.

Flower spikes are up to 6in long and are held well on long stems. They open to sturdy pea flowers nearly an inch across in colours from pure white through clear pinks, mauves to magenta crimson; these are followed by balloon-like pods, often tinted pink. The best display is in November.

The old flowered branches must be cut out each year at the end of winter, or in warmer climates after the main flowering season in autumn. If this wood is not removed the plant becomes weak and sparse with branches falling about and blowing off in strong winds.

Plants are available from some nurseries, but seed is plentiful and easy to raise. Seedlings should be finally planted out from small pots and will flower about a year later. They thrive in any soil, are useful for a



Swainsona galegifolia: *Swainsona* — after Isaac Swainson, an English botanist; *galegifolia* — with leaves like *galega*, a well-known Northern Hemisphere shrub of the same family

quick cover in a difficult situation and excellent as single specimens. Allow about a 4ft spacing in group plantings. Occasional applications of weak fertiliser dressings are helpful in spring and summer.

Swainsona is poisonous to stock.

An annual form of *Swainsona* — *S. canescens* — grows up to 2ft in height and has violet coloured flowers in long dense sprays.

HELICHRYSUM BRACTEATUM

Helichrysum bracteatum:
Helichrysum — from Greek words
meaning sun and gold, alluding to the
bright flowers; *bracteatum* —
emphasising the fact that the bracts,
often wrongly called petals,
are numerous and brightly coloured



Under this name, and found wild in all States, grows a wide variety of Everlasting Daisies — from prostrate to upright, perennial and annual. The perfect form and condition of their flowers, among which a poor colour is never seen in a long season, makes them among the most important of native species with ornamental uses. They are easy to grow and most are easy to obtain.

In Europe they were already well-known last century, and were used in the early years to develop the strains known in gardens as Strawflowers. These are annuals or short-lived perennials—depending on the climate in which they are grown—and have nearly globular flower heads in many colours including maroon and bronze. Seed is sold under such names as *Helichrysum monstrosum*—a horticultural name only, with no botanical significance. This is a case where the cultivated form of a plant is not necessarily superior to the wild one, and some people prefer the clear tints of the daintier natural flowers which open flat to show a good eye.

The petals are actually the bracts of the flower head and are dry and shining in character and resist damage and fading. Bees, butterflies and numerous other insects are seen around a bed in full flower on a sunny day. From the centre of annual forms comes a perfume similar to Clove Carnations.

As cut flowers they will often live in water without drooping. For drying they may be taken any time from tightly budded to the half-open stage, giving more life-like variety to a bunch of the dried flowers.

The leaves of all varieties are soft. In dry conditions the foliage is rather poor, but a cool and showery season brings out its best. It is then lush, forming a cool green background for the flowers. Good watering makes for better plants in every way, and growth is naturally rapid and bushy. Aphids sometimes attack the plants. The best treatment is to cut out the affected parts and then spray with Rogor 40. This pruning also serves to improve vigour.

Seed is generally plentiful, though reduced in years when pollen-collecting insects are very active. Perennials may also be raised from cuttings. Annuals should be sown in late autumn or early winter in seed boxes in a frost-free situation. Young plants may then be pricked out into peat pots and kept sheltered until ready for planting out about 12-18in apart in early spring. Although they will grow in any soil, light soil gives the

best results; it should be moderately rich to feed the long season of dense growth and flowers. At planting time light dressings of blood and bone or mixed fertiliser may be mixed into the top soil, and applied once or twice during the season as well.

Flowering starts in mid-December, continuing in vigorous plants until winter, when they die out.

Annual forms from Western Australia include a canary yellow, tinged with bronze and a white variety, *H. bracteatum* var. *albidum*, which has beautiful creams and rose pinks as well as pure white. On looking into a plant in full flower the delicate range of tints can be seen in flowers through all stages of opening. They vary in size up to 2in diameter on rounded plants 2ft high, and succeed in full sunlight or very light shade.

Forms from the eastern States are all a similar colour, ranging from lemon to buttercup yellow. They flower in summer and autumn, a time when their particular brilliance is scarce in the garden.

One common form found in New South Wales is a tall, upright annual, reaching over 5ft high in Canberra in moderately rich soil with good watering. It is very robust and takes its place well among shrubs, specially if nipped back at 2ft high, after which it branches strongly. It seeds freely and in a light soil self-sown seedlings may appear. Seedlings of all ages may be seen at any time of the year and these bright green rosettes transplant well if moved before hot weather arrives. Self-sown seedlings do not appear in heavy compacted soil.

Among the perennials, one form found in the mountains of Queensland and in northern New South Wales is proving an outstanding garden plant in Canberra and has flowers of arresting size and quality. They are 3in across on branching stems up to 2ft high, and have pointed gold petals which open flat and then reflex slightly. In shady and sheltered patches of light soil under Eucalypts the form has wintered well, though in cold weather the size of flowers and leaves is reduced. It is at its best in February, forming robust loose clumps with rosettes of leaves. A web of fine hairs on the upper and lower leaf surfaces gives a lush grey-green appearance to the leaves, when well watered and moderately fertilised.

Another perennial is quite different in character. It is found on exposed headlands on the mid-north coast of NSW, and forms



Isotoma axillaris: *Isotoma* — equally divided (Greek), referring to the shape of the corolla; *axillaris* — with flowers growing from the leaf axils

a distinctive compact cushion 18in across. The foliage is small and neat, and short-stemmed gold daisies open over a long season. This is a plant to set in a gravel or tan-bark bed, or in a rockery. It, too, may be raised from seed or from cuttings.

Apart from the use of *Helichrysums* as specimens among perennials, they may be combined with other annuals to make summer bedding displays made up entirely of native species in the same way as the introduced plants, *Petunias*, *Verbena* and *Pelargonium* are used. Species of equal vigour and flowering season are needed, with contrast in form and colour. Some of these are far more showy when massed than in small groups. The following are a few annuals for a bright summer and autumn show, all raised from seed.

Trachymene caerulea (Syn. *Didiscus*) — Blue Lace Flower is well known in other countries, often as a pot plant. Related to carrots, it has rounded heads of soft blue flowers and reaches 2-3ft high. It is a good cut flower, and after the petals have fallen the head remains ornamental for a time, with pink tints.

Isotoma axillaris — Rock Isotome is a small plant found in rocky situations of the East Coast. It is very bushy, 1ft high, fragile looking and smooth, but hardy. The foliage is light green, nearly hidden in masses of the flat flowers of a clear cobalt blue or occasionally pink.

Hibiscus trionum — Bladder Ketmia, has cream tints. It also is well known abroad. Its large silky flowers have maroon centres, and they are followed by papery ornamental fruits that are full of dark seeds. The plants reach 2-3ft high.

Good perennials to associate with *Helichrysums* are the vivid pink *Swainsona galegifolia*, the blue *Scaevola aemula*, and the magenta *Lythrum salicaria*.

LEPTOSPERMUM SCOPARIUM VAR. ROTUNDIFOLIUM

Leptospermum scoparium var. *rotundifolium*: *Leptospermum* — thin, thread-like seeds, from the Greek words *lepto*, slender, and *sperma*, a seed; *scoparium* — brush-like; var. *rotundifolium* — variety, with rounded leaves



The Round-leaved Tea Tree, which grows naturally in parts of New South Wales, is outstanding among *Leptospermums* for the size and quality of its flowers which are spectacular for several weeks in spring. In cultivation it is generally a large shrub which withstands frost and periods of water shortage, remaining in good condition for years if kept trimmed. Five years after planting it can be 5ft tall and 12ft across, eventually reaching at least 10ft tall unless cut back. Growth is dense and stiff with long, sweeping branches covering the ground well and tending to curve in various directions.

The small leaves, of neat and crisp appearance, are openly spaced along the branches. They are rounded with pointed tips, smooth and slightly shiny and give off an aromatic perfume, like other members of the same family, when bruised.

Flowers are larger than those of other *Leptospermums* and are borne both on short lateral stems and on newer wood right to the tips. Round buds open to flat flowers each with five rounded petals surrounding a large green eye which is fringed by a row of upright stamens. The eye is often shining with nectar. Though flowers are generally single, plants with double flowers are occasionally found. Flower size varies from plant to plant, but they are up to an inch across. Colours range from white through flesh pink to clear tints of deeper pink and mauve.

This species has one flowering season a year from the end of October to the end of November, bursting quickly into full flower in a warm spell of weather. If the season is hot and dry, flowers last only about three weeks. Despite this the shrub is worth having in a home garden for its mass of colour down to the ground. Bees are attracted to the shrub.

Nurseries specialising in native plants can supply this plant often under the name of *Leptospermum rotundifolium*, in varying forms and colours, with named varieties. Propagation is from seed or cuttings, but seed will not necessarily come true to colour. Any soil is suitable and good watering brings rapid growth and flowers at an early age.

Many species of *Leptospermum* are successful in Canberra. Tea Trees have been among the most popular of Australian native plants for hybridising. These hybrids and cultivars can include dwarf and prostrate forms suitable for rockery and ground-cover use.

ASTARTEA FASCICULARIS

The False Baeckea (*Astartea fascicularis*) is an easy-to-grow Western Australian medium shrub of the Tea Tree family. It has a neat and fresh appearance throughout the year and flowers during most months except those of extreme heat or cold.

In habit it is more or less upright with an open framework of slender tapering branches. The plant can reach a height of 3ft with a spread of 4ft at three years old. It is a plant which will withstand frost, drought and wind although in harsh situations it tends to become a stiff shrub with a few main branches. In a more sheltered site with good watering, growth becomes softer and more dense with graceful branches arching to cover the ground. In these more favourable circumstances it can grow to a height of 4ft with a spread of up to 8ft at about four years old.

Main branches are set with short lateral stems pointing upward. Clusters of small narrow leaves—also pointing upward—along the stems give an effect of spires. The waxy leaves are less than ½in long and, like the pinkish stems, have a spicy scent when bruised.

Each lateral produces up to eight buds which open to small, flat flowers like those of any Tea Tree. The flowers are about ½in across with five rounded white or pale pink petals, often tinged in a deeper pink at the base, and a green eye. All are arranged facing upward along the stems in dainty sprays. Flowering is profuse in spring and autumn. At other times in response to rain or watering, flowers are usually dotted about the shrub.

Planting should be done in lime-free soil in either an open or shaded location. The plant grows at a medium rate and flowers while young. Dense growth can be encouraged by pruning, which will also control the shape of the shrub. Pruning can be performed at any time of the year and the stems used as cut flowers.

As well as being a valuable specimen shrub, *Astartea* will succeed as a hedge plant if trimmed from early years and



Astartea fascicularis: *Astartea* — after Astarte, pertaining to the stars and a Syrian goddess, possibly stressing the starry flowers; *fascicularis* — in bundles or clusters, the leaves

watered well to produce bushy growth. The plant is more suited to an informal than a formal hedge and when used for this purpose should be spaced about 4ft apart.

Astartea fascicularis is available from some nurseries which specialise in native plants. It is raised from cuttings. The Baeckea referred to in the common name of this plant is a genus of Australian native plants.

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The botanical name of the unusual pendulous form of Australia's floral emblem featured here is *Acacia pycnantha*; *Acacia*—may be from the Greek to sharpen, alluding to the prickly nature of the first species discovered. Another opinion refers to the Egyptian Thorn (akakia) a species of *Acacia* which yields gum arabic; *pycnantha*—from two Greek words, *pycnos*, dense, and *anthos*, flower, ie, dense-flowered.

FRONT COVER: *Telopea speciosissima*: *Telopea*—from a Greek word meaning from afar, alluding to the brightness of the flowers; *speciosissima*—most beautiful. This plant can be grown in a well-drained protected situation in Canberra.