

Australian Plants

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Conservation of Australian Flora

Based on Scientific Research

The Society is formulating a policy based upon scientific advice but with action by the concerned citizens of Australia. There are many groups active at the local level doing excellent work and readers are urged to join these activists. A major impact can only be made by our Federal Government with a sound, scientifically based plan with priorities. Confining our concerns to the conservation of the Australian continent with its biodiversity of fauna and flora, we believe we have such a plan. The Australian Flora Foundation is the scientific base/adviser, but we need membership enthusiasm for conservation.

Fortunately, we hear more and more about doomsday predictions and there is little doubt that if we continue the way we are going, life on Earth as we know it will be strangled. What we do not hear is a soundly based plan to "save the Earth" other than to forsake the benefits of modern civilisation. There is a way that will enable future generations to enjoy the best of living and to restore the biological balance of the world, sustainable development, nature's way. Will the government at least heed our advice.

This issue has details of how small groups of people can make a significant impact on the scientific approach. Our No. 131 Issue gave brief details of the first of six initiatives in our master plan, the replanting of forests. This issue gives a second on page 40, Living With Australian Soils. You may well ask how these seemingly unrelated actions can change the decline of the world's natural resources upon which we all depend, but first hear our whole package, and perhaps help yourself as suggested on page 28.

Australian Plants

Our Policy

We must keep our energy on our principal concern, the cultivation of our Australian flora and its development for horticulture and management of wild populations. As I warned, the last issue was somewhat "heavy" although I have been surprised by how many lay people have taken advantage of "let us learn a little more about Nature's riddle and the fascinating way flowers are put together and reproduce." Our principle objective is to learn more about the cultivation of our plants in the garden and the next four issues deal almost exclusively with this. If you are not satisfied with these issues, please advise what you really want — Editor.

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COVER PLATE — *Johnsonia teretifolia*, photography by F. W. Humphreys. See page 6.

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Johnsonia

by Bob Dixon
Horticultural Advisory Officer
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Propagation and Cultivation

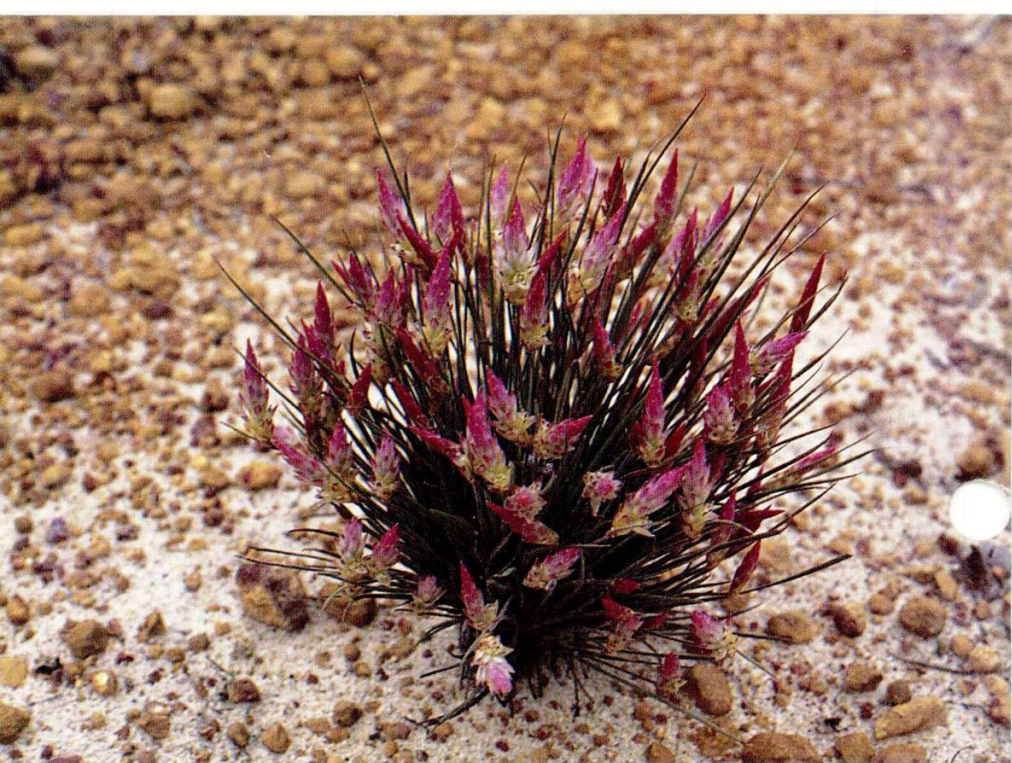
Johnsonia have attractive flowers (bracts) which make them popular cut flowers, both fresh and dried, they are also pressed and dried. They are perennial tufted plants. The scape (flower stalk) is unbranched, leafless and extended beyond the flower by an erect leaf-like bract. All flowers are surrounded (hidden) by large glume-like imbricate bracts, which are the most attractive feature of this plant. The seed is small, fairly hard, kidney shaped, black and shining with a large prominent aril. The seed are most probably taken (dispersed) by ants, as they are regarded as a myrmecophilous plant, and discarded after they have removed their reward — the aril.

The root system of *Johnsonia* is fibrous, and stilt roots are frequently formed on *Johnsonia pubescens* mainly on young seedlings as well as some older plants, especially in the northern populations near Eneabba. Though the stilted plants and northern forms of *J. pubescens* are killed by fire I have no information on the fire tolerance of southern forms or other species. In his treatment of *Johnsonia*, Flora of Australia, Keighery lists *Johnsonia* species as being rhizomatous, however, this term means different things to different people, they do not have large storage organs (underground stems) as in Kangaroo paws.

Propagation and Cultivation

1. **Seed** is often **difficult to collect** as it ripens over a long period and it is often heavily predated by insects. However, seedlings can often be seen in profusion after fire, or mechanical damage, e.g., on fire breaks.
2. **Seed** is very **difficult to germinate** and the seedlings are difficult to grow on. In Kings Park nursery many seed lots have been sown over a number of years, however, germination is a rarity and when seed does germinate the germination rates are very low.
3. **Plant divisions** are difficult to grow on. Plants have been successfully divided, the best time to do this is mid to late autumn, this is when the new roots are being produced. Divisions are best potted up, using a free draining sandy mix low in nutrients. Keep in pots until the plants have recovered and produced a good root system, then plant out into the final growing position or grow on in pots.
4. Problems with **tissue culture** have not been resolved. *Johnsonia lupulina* has been tried in Kings Park tissue culture laboratory. The multiplication rates are good but there was some vitrification. This should be pursued as *Johnsonia* are used in the cut flower trade. There should also be a ready market for pot plants as well as ornamental garden plants, especially when used in a rockery*.

* The Australian Flora Foundation and Plant Research. This is the type of research given priority. It conserves these beautiful plants in the wild and the very best forms are available for horticulture. Our funds are already fully committed on similar projects. If anyone is concerned enough to donate \$25,000 for this research, the Society will add to this and the production of a line of beautiful pot plants in commercial horticulture is reasonably assured. Look at the colour photograph in this issue and consider this proposition. — Editor.



△ *Johnsonia pubescens*

Photography by G. Keighery

Johnsonia lupulina ▽





△ *Johnsonia acaulis*

Photography by G. Keighery

Johnsonia inconspicua ▽



5. **The best growing conditions** for *Johnsonia* would be in the open ground in full sun but in a protected position amongst other vegetation, in a free draining sandy soil. Water plants until they are established, at least the first spring, summer and autumn, they should then be drought tolerant. Leave the old flower heads on the plant, as they remain an attractive feature for several months, though they fade and usually turn brown.

Johnsonia acaulis

This species occurs in sandy soils in heathland, shrubland and woodland from Perth to Lake Grace and Israelite Bay. The floral bracts vary considerably in colour from red to green, therefore colour selections could be made to reproduce better colour forms. Flowers are produced from August to December and the fruit are ripe from October to January. Treat as for *J. pubescens*.

Johnsonia inconspicua

This recently discovered species, named in 1987, is fairly rare, known only from two locations. They grow in sandy soils in woodland. In the Margaret River location (south of Perth) it occurs in deep white/grey sand in open *Agonis flexuosa* woodland. The floral bracts are greenish white or pale pink with a central brown stripe. Flowering is from October to November and fruit are ripe from November to December. Treat them the same as *Johnsonia pubescens*.

Johnsonia lupulina

Hooded Lily

The distribution of this species is between Albany and Collie where it grows in sandy soils usually in eucalypt woodland. It is a very common plant in the Albany area on the edges of roads. It is conspicuous because of its large attractive pink floral bracts. Flowering is from September to November and fruit is ripe from October to December. This, though beauty is in the eyes of the beholder, I would suggest is the most attractive species and would make an excellent border or rockery plant. Though plants grow in full sun they will also grow in broken sunlight. Seed takes 29 to as long as 89 days to germinate.

Johnsonia pubescens

Pipe Lily

The pipe lily is widespread between Eneabba and Serpentine, usually growing in dry sandy soils in *Banksia* woodland, heathland or occasionally in winter wet swampy flats. They usually grow amongst other vegetation which affords them protection from hot winds. However, they seem to thrive on firebreaks around Eneabba where they are fully exposed to all the elements. The floral bracts vary considerably in colour from pink to pink and white, white to greenish white, therefore careful selection of colour forms is necessary in cultivation. You should also select for height as this is also very variable. Plants require a full sun but protected position and a free draining sandy soil, for heavier soils select the forms which grow in swampy flats. Seed takes 21 to 88 days to germinate. Seedlings usually take one year to produce their first flowers. Plants can also be divided in autumn, they also tend to be short lived only surviving for a few years. Photograph on page 4.

Johnsonia teretifolia

Plants occur naturally in duplex loamy and winter wet sandy soils between Albany and the Stirling Range. The plants are quite similar to *J. lupulina* with very attractive pink floral bracts. Flowering is from October to December, the fruit is ripe from November to February. Treat them the same as *J. lupulina*, although they should also adapt well to heavier free draining soils.

WA Lilies

Notes on the Propagation and Cultivation of Western Australian plants from the Liliiflorae Families

by Bob Dixon,
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and Greg Keighery,
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Woodvale, WA

Agrostocrinum scabrum

Blue Grass Lily

A perennial plant with a fibrous root system, but with a compact rootstock. As the common name suggests, the leaves, which are medium to dark green, are grass like, but they are less than the length of the flowering stems which can be up to 90 cm long, but usually much shorter. These stems are usually branching and upright to ascending with terminal dark blue, occasionally light blue or rarely white, flowers. The width of the plant varies considerably, although in open areas they can be up to 1 m across. The hairs on the stem and back of the petals are a prominent feature although forms are recorded without hairs. The flowering period is between September and December with individuals flowering for about five weeks. Photograph on page 9.

In their natural habitat north of Perth, east to Muntadgin and as far as the south coast, then east to Esperance, they grow mainly in forest areas on lateritic or loamy soils, they can also be found in dry sandy soils, e.g., Kings Park and around the edges of winter wet swamps.

In cultivation they are good filler plants between shrubs or used as border plants and are especially valuable as garden subjects. They prefer a sheltered position in full sun or broken sunlight and a free draining soil. Although forms from heavy soils grow well in Perth's sandy soils they require an occasional summer watering. Selection of forms from sandy soils will overcome this problem. When grown in containers they require a light dressing of slow release fertiliser. The only pest encountered to date is red spider mite although when grown in the open ground in tougher conditions this pest is not a problem. I have been growing these plants for six years and they are still vigorous; I would suggest that, in the correct position, they will survive for many more years in the home garden.

Propagation by fresh seed sown in the autumn is easy with germination rates of about 40%, in ideal conditions germination taking three weeks. Seedlings are best grown on in pots for one year before planting out. Plants can also be divided in the late autumn.

Arnocrinum

The three species, all occurring in Western Australia, are perennial rhizomatous herbs with short creeping rhizomes covered by a dense wool and with fibrous roots. The inflorescence is attractive with its terminal condensed spike of flowers, usually with two or three flowers out at the same time. These last one day, however, they are quickly replaced by others. The Perianth (flower), bluish/purple, salver-shaped, with a cylindrical tube which is terminated by six equal spreading segments (petals). In general, the plants are fairly sparse unless in an open position with little competition and their annual leaves are fairly insignificant. Seeds are black, shining, smooth, without an aril.

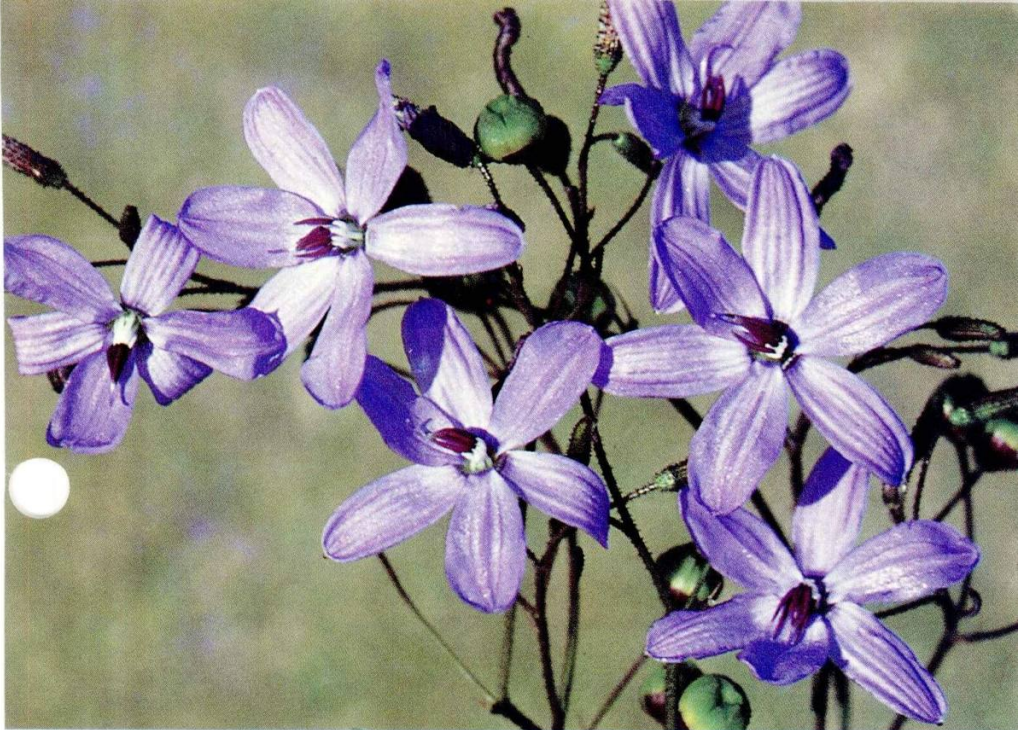
The species are tolerant of fire. The rhizomes, which act as a bud repository, not as a food storage organ, are covered in a dense wool, asbestos-like covering which protects them. They resprout in autumn after summer fires.



△ *Arnocrinum drummondii*
Photography by F. W. Humphreys

▽ *Hensmania turbinata*
Photography by G. Keighery





△ *Agrostocrinum scabrum*
Photography by F. W. Humphreys

Johnsonia teretifolia ▽
Photography by Greg Keighery



Propagation and Cultivation of *Arnocrinum*

Seeds are difficult to collect as plants are hard to find when they are seeding. Plants have been grown from seed which is best sown in autumn in Western Australia, but in general plants are slow growing. Seedlings are prone to damping off disease, therefore, it may be necessary to spray with a suitable fungicide. Grow on in pots which contain an open, preferably sandy, mix and general slow release fertiliser. They prefer a full sun position or midday broken sunlight, with protection from surrounding vegetation. Once established they are drought tolerant. Photograph on page 8.

It may also be possible to divide larger plants (small plants may not have a large enough rhizome) in autumn as new roots are beginning to grow. To my knowledge *Arnocrinum* have not been raised by tissue culture. They are best used in a rockery or in a garden border as a small filler plant, certainly worth growing for their attractive flowers, possibly the largest of any WA lily.

Arnocrinum drummondii

Occurs naturally in deep yellow sands between Watheroo and Cooloomia Station. Flowering is from September to December and ripe fruit can be found from November to January. The inflorescence stems are erect, 25–54 cm long, few branched and glabrous, except for tufts of hairs at the base of each branch or scale. The leaves are 16–70 mm long, sparsely hairy. The flower spike is narrowly cylindrical, 17–20 mm long, 7–9 mm wide, with bracts, soft, acute, brown, sparsely hairy, more or less scarious. Perianth tube of the flower is about 6 mm long with lobes 7–8 mm long and prominent yellow anthers.

Arnocrinum gracillimum

Can be found in the Eneabba region, north of Perth, on lateritic sandy soils among low Myrtaceae and Proteaceae scrub. Flowering is from October to November and ripe fruit can be found from November to December. The inflorescence stems are 25–35 cm long with numerous short, sterile branchlets (a very distinctive feature) and stems covered by long, sparse hairs. Leaves are 20–40 mm long with long, sparse hairs mainly on the margins. The flower spike has depressed-ovate bracts hard, pungent, densely hairy green or brown. Perianth tube of the flower is about 7 mm long with lobes 9–12 mm long and prominent yellow anthers.

Arnocrinum preissii

Occurs naturally in sandy free draining soil between the Hutt River and Serpentine, and can still be found growing in Kings Park bushland, in mixed *Banksia-Eucalypt* woodland. The inflorescence stems are erect to 35 cm long, few branched, glabrous except for a few tufts of hair under each scale or branch. The flower spike is narrowly cylindrical, 18 mm long, 8–10 mm wide with bracts, green brown, hard, pungent, recurved, covered by long, soft hairs, not scarious. Perianth tube of the flower is about 7 mm long with lobes 9–10 mm long and prominent yellow anthers. Flowering is from October to January and ripe fruit can be found from November to February. Seed takes 43 to 84 days to germinate.

Arthropodium capillipes

Chocolate Lily

A perennial tuberous rooted plant with a rosette of light green to reddish green leaves, often completely withering before flowering especially in their natural habitat. Plants occur naturally from Geraldton to south of Norseman on a variety of soils, e.g., poor deep sands, sand over limestone, loam and granitic soils, usually in woodland in broken sunlight. The pink to violet flowers produced between November and March are carried on an open branching flowering stem up to 1 m high. Very few flowers are open at one time, but the flowering period lasts for several weeks. Unlike its eastern relative the chocolate smell of this species is very faint.

Propagation is by fresh seed sown in the autumn and germination, under favourable conditions, takes about three weeks, although germination rates are usually fairly low, about 20%. Seedlings are best pricked out (transplanted) when only a few days old or left until early March when the tubers are still dormant, before repotting. Seedlings are best grown on in pots for two years before planting out in the open ground. It usually takes three years for the first flowering. Unfortunately the tubers are very difficult to divide and until we can develop a good technique, propagation by seed is recommended.

Pot grown plants are best grown under light shadecloth in summer or under the shade of a tree. The pots can be plunged after flowering when water is withheld, as this will stop the tubers dehydrating. In their final growing positions plants prefer a sheltered full sun or light broken shade position in a free draining sandy soil. Surprisingly this plant is rarely seen in cultivation. Watch out for snails which attack the leaves.

Arthropodium preissii

The Perth form which grows in low scrub in winter wet areas around swamps, is usually up to 20 cm high with arching flower stems and pendulous violet flowers. Unfortunately, the flowering period is only about three weeks, September–October but the plants are long lived and adapt well to growing in pots.

Bulbine semibarbata

Leek Lily

An annual herb with fibrous roots generally growing in winter wet clay soils or sandy loam over clay. This is a widespread species in south Western Australia, also occurring in the Pilbara. The bright yellow flowers, which are arranged alternately along the flower spike, have a dense beard of yellow hairs on three of the filaments below the anthers. Flowering is usually between September and October. Light green to sometimes yellow green, linear and upright leaves can be up to 25 cm long, but shorter than the flower stem which is up to 30 cm tall.

They are very easy to grow in pots and are rewarding as they flower for 4–5 weeks. They respond well to slow release fertiliser and need to be kept moist. Plants in the open ground do not grow very well in poor sandy soils, preferring heavier soils where it is best to sow the seed *in situ* in late autumn when regular rainfall is assured. Seedlings appear in 18 days with germ. of 60%. Although plants appear to be very succulent I have not had snails attack them.



△ *Stypana glauca* Photography by F. W. Humphreys. A form previously known as *S. imbricata*.



Chamaescilla corymbosa

Photo above by John Simmons
Photo below by R. J. F. Henderson

See description, page 20.



Chamaescilla corymbosa

Blue Squill

A tuberous rooted perennial plant with light to dark green basal leaves which are 2–35 mm wide, flat, narrow (straplike) and varying considerably in length. The flowering stalk can be simple or branched and may be 10–40 cm tall. Flowers are usually sky blue or dark blue, occasionally pink or white and can be seen between August and October. Plants grow naturally in full sun or broken sunlight in sandy soil usually over clay, loams and in shallow soils or moss swards on granite rocks; most of these soils are seasonally moist. Distribution is from north of Geraldton south to the east of Esperance.

In cultivation it is well worth selecting the different colour forms, the taller forms being better suited to the open ground as they are easier to see. They are best planted in a morning sun or broken sunlight position and thrive in rock gardens or small pockets between large plants. Mark where they are as they can easily be walked on. In the right position they will last for many years and re-seed themselves in the garden. In poor sandy soils select a form which grows naturally in similar conditions. They also make good pot plants, responding well to a light dressing of slow release fertiliser. However, the flowering period is only about three weeks. When drying off the plants for over summering, the pots are best plunged to stop dehydration of the tubers. The only pests I have encountered are slugs and snails which attack the foliage.

Propagation by fresh seed sown in the autumn is the recommended method. Germination takes about four weeks, with rates of 60–70%. Seedlings should be pricked out when only a few days old or left in the seed pots and repotted in March/April, just before the new growth commences.

Chamaescilla spiralis

They grow in similar conditions. The spiralling leaves often start dying off, turning yellow-red, at flowering time especially in dry conditions. They are also grown from seed.

Dianella revoluta

Flax Lily

As the common name suggests the plant is flax like in appearance. The flax like green, grey-green to blueish-green leaves are about 1.5 cm wide and up to 80 cm long, but usually much shorter. Usually towering above the foliage, the long thin flowering stems, often over 1 m high, carry many pendulous dark or light blue, rarely white, flowers with bright yellow anthers. The flowering period is from October to December, followed by the production of small blue fruit, which are another attractive feature of this plant.

New plants are easily raised from fresh seed sown in the autumn, germination taking about four weeks. Initially the seedlings are slow growing and may take up to three years to flower. Division of the rhizomes during the autumn and early winter is the quickest method of reproduction. When dividing the plants they can either be potted up and grown on for one year or planted out directly into their final growing position. Remember to remove half of the leaf growth to reduce transpiration, water loss, until established.

Plants are best grown in full sun, although they grow quite well in broken sunlight. Grow in a free draining preferably sandy soil. Although plants are drought resistant once established, they grow much quicker with an occasional summer watering, but this may reduce their life span. Plants are known to survive in cultivation for 20 years without additional watering.

Dianella will respond well to a general slow release fertiliser and do not appear to be susceptible to any particular pests. Seedlings often appear around parent plants when you do not cultivate the soil. Unfortunately these plants are not often grown in cultivation, although they are probably one of the easiest plants to grow. There is tremendous scope for selection of good clones not only for flower and leaf colour, but also for differing climatic conditions. Plants grow in loamy or poor sandy soils from Carnarvon to the south coast and east to the Nullabor Plain.

Hensmania

There are three species in the genus endemic in southwestern Australia. They are rhizomatous or stilt rooted, tufted perennials with fibrous roots. The leaves are perennial, terete with sheathing bases. The inflorescence is a terminal, turbinate or ovoid, umbel-like spike, shorter than the leaves. Flower perianth segments are six, equal, united in tube in lower third. These insignificant flowers are covered by imbricate pungent bracts. Though these are a clumping plant, they are fairly insignificant and are not in cultivation. Seeds are shiny black, kidney shaped with a prominent aril and, therefore, could be distributed by ants. *Hensmania stoniella* is killed by fire, *H. turbinata* resprouts from a rhizome. The response of *H. chapmanii* is unknown.

Hensmania chapmanii

A rhizomatous plant, with leaves 3 mm or more in diam and 24–38 cm long. The inner involucre bracts are all pungent; bracteoles not divided into fine hairs. Plants occur naturally in lateritic soils in the Coorow area north of Perth. Flowers are cream and produced from December to January, ripe fruit can be found from February to March. This species has not been recorded from many locations and is thought to be rare.

Hensmania stoniella

A stilted plant to 15 cm tall. In its natural habitat in the Hill River to Eneabba area, it grows in low heath and low *Banksia* woodland in sand over clay or laterite. The inner involucre bracts are pungent, the outer being hard and dark brown; bracteoles divided into fine hairs, woolly. Flowers are pale cream and can be seen from September to November.

Hensmania turbinata

Plants are rhizomatous, to 20 cm tall. They occur naturally in deep sandy soil in *Banksia* woodland and can be found between Cataby and Serpentine. The inner involucre bracts are acute, not pungent, the outer ones pale fawn and not hard. Flowers are pale yellow and can be seen from November to January. Ripe fruit can be found from December to February. Photo, page 8.



Hodgsoniola junciformis

Photography by Greg Keighery

Hodgsoniola junciformis

The only species in the genus is confined to Western Australia. It is a rhizomatous, tufted, perennial herb, with fibrous roots. This is a very attractive plant, which to our knowledge is not in cultivation, which is surprising as it was named in 1861. A clumping plant to 20 cm in diameter, it occurs naturally in winter wet swampy sand, which dries out during summer, in *Kingia* heath, often in quite thick vegetation, or amongst sedges, between Capel and the Scott River plains. The leaves are radical, terete 45–85 cm long, 1–2 mm diameter and acute. The inflorescence is an elongated raceme on a bracteate scape which is as long as the leaves and can carry up to 50 purple/blue flowers. The perianth is more or less equally divided into six segments shortly united at the base. Seeds are dull black slightly pitted with a large aril and are, therefore, most probably distributed by ants.

Seeding plants would be difficult to find. Seed can be sown in autumn in Western Australia, probably spring in cooler climates. Grow on in pots for one year, then plant out in free-draining sandy soil amongst other vegetation in full sun or broken sunlight. Like most other Liliaceae they should tolerate a small amount of general slow release fertiliser. Flowering is from October to December; ripe seed can be found from November to January.

Stypandra glauca

Blind Grass

A perennial herb up to 1 m high with soft stems turning woody as they age. The narrow clustered grass like leaves vary in colour from light green to blue green. Dark to light blue or occasionally white pendulous flowers with yellow anthers can be found between August and early November. In its natural habitat between Geraldton and the south coast and east to Esperance plants can be found growing mainly amongst granite rocks, occasionally in laterite or clay soils. Plants have also been found growing on coastal limestone. Plants can be raised by seed sown in the autumn, germination taking three to four weeks. The easiest method of propagation is by division of the plants in autumn. Replanting directly into the open ground is very successful as long as the plants are kept moist until the onset of heavy winter rains. Photo, page 12.

In cultivation Blind Grass grows rapidly making a good rock garden plant or filler plant amongst taller shrubs, in full sun or broken sunlight. In Perth's sandy soils regular summer watering is required. When grown in alkaline soils plants suffer from lime induced chlorosis. To my knowledge the coastal limestone forms are not in cultivation and they would certainly be worth trying in alkaline soils. You rarely see Blind Grass for sale in nurseries. This is probably because the plant is toxic to grazing stock and often causes blindness. However, it is a rewarding plant and deserves a place in the home garden.

Stawellia dimorphantha

Arrowsmith Stilt-lily

Stawellia are perennial evergreen plants with terete leaves and fibrous roots. Their insignificant flowers are held on a condensed globular spike, surrounded by imbricate scarious bracts and this is the main reason why they are not widely grown. *Stawellia dimorphantha*, a more or less creeping plant to 20 cm tall, stems 2–4 cm long, stilt rooted at the nodes. The leaves are few, terminal below inflorescence, to 4.5 cm long. Peduncle very short; spike 3–4 mm wide, with 10–20 flowers. Perianth 4–5 mm long, pale purple or cream.

Stawellia dimorphantha occurs on free draining sandy soils near Eneabba (north of Perth) usually in *Banksia* shrubland often close to or under the canopy of *Eucalyptus tottidiana*. The insignificant pale purple or cream flowers are produced between June and December. Seeds are difficult to collect, mainly because the plants are difficult to find. The seeds are black and shining, kidney shaped, have a prominent aril and are, therefore, probably dispersed by ants. As this rare species is Declared Flora it has been in tissue culture in the Kings Park Tissue Culture Laboratory for some time. It is very easy to culture, but like all species hardening off out of culture and potting into soil mixes have proved difficult. When growing use an open free draining potting mix and sheltered position. For the open ground we suggest a full sun position, or midday broken sunlight, with protection from surrounding vegetation and a free draining sandy soil. Water the plants at least for the first spring, summer and autumn; they should then be drought tolerant.

Stawellia gymnocephala

A tufted rhizomatous plant to 40 cm tall, aerial stems being absent. The leaves are numerous, radical 15–40 cm long. Scape 15–22 cm long, usually as long as leaves; spike about 6 mm long to 8 mm wide, with 20–52 flowers. Perianth 4–5 mm long, pale purple with a darker central stripe. It occurs naturally, usually in mallee heath, but in the west in open *Eucalyptus wandoo* woodland. It can be found in duplex and sandy soils, from Cranbrook (Stirling Range) to Cape Arid. Flowering is from September to November and ripe fruit can be found from November to January. Though the pale purple flowers are insignificant, this plant could be grown for its foliage and just used as a minor filler plant. If trying division we suggest you do this in autumn, about the time when new root growth is starting.

Tricoryne elatior

Yellow Autumn Lily

A small sub shrub, that is a plant with firm but not woody perennial stems, 10–50 cm high and up to 1 m across usually with a sprawling habit. Plants occur naturally in full sun or broken sunlight on very poor sandy soils, sandy loams or occasionally lateritic soils. They can be seen from Kalbarri to east of Kalgoorlie, are common on the Swan Coastal Plain and on the south coast at Albany and Cape Arid, with populations also occurring in the Kimberleys.

The small star-like bright yellow flowers, about 18 mm across are carried in small terminal heads, and can be produced almost any month of the year. However, the main flowering period is from late spring to early autumn. Young plants and regrowth from the rootstock after a bushfire, are leafy with medium green foliage. As the plants age they appear to be almost leafless. Yellow Autumn Lily is an ideal filler plant between small shrubs, along borders, or in a rock garden, as long as it is not too exposed to strong winds. It prefers a free draining, sandy soil and full sun position. When established it is long lived and drought tolerant, although it will tolerate an occasional summer watering. Plants from seed produce a few flowers when one year old and a mass of flowers the following year. Ripe seed can normally be found from December to late autumn and if sown in the autumn, no pre treatment is necessary. Germination takes about 23 days.

Propagation is best by division of the rootstock in autumn, planted *in situ* or potted up and grown on for later planting. Removal of the top growth of a large plant by pruning, to stimulate suckering, can sometimes be fatal.

As the common name suggests you would expect the flower to be vanilla scented, but to date, I have been unable to detect any scent. Probably, the less commonly used name Purple Tassels would be more appropriate. This perennial tufted herb has long, narrow, medium to dark green leaves, usually less than half the length of the flower stalk. Flower stalks are 15–46 cm long, rigid or ascending, terminating in heads of purple, occasionally pink or rarely white flowers with golden yellow stamens. Occasionally other flower heads are found in the lower leaf axils. The flowering period is normally from August to October, with peak flowering, in bushland situations, after a bushfire has cleared away surrounding competition. In its natural habitat from Kalbarri to Denmark with outlying populations at North West Cape, plants are found on poor sandy or sandy clay soils in woodland, low scrub and occasionally in open areas in winter wet clay soils. In the home garden plants can be long lived and should not be watered once they are established as overwatering rots the rootstock. Although they tolerate slow release fertiliser, too much causes lush growth which is more susceptible to pests, e.g., snails, and damage by frost. They make excellent rock garden subjects, good filler plants between shrubs and grow well in pots. These should be dried off and protected during summer. After their summer dormancy and the tops have died back new shoots appear from the rootstock in April, often long before the onset of heavy rain.

Propagation is best by division of the rootstock in autumn when the new shoots are emerging. Although one plant will provide many small divisions suitable for potting-on, larger portions are preferred for direct, *in situ*, planting. Make sure the soil is kept moist until the onset of heavy winter rains. In new gardens or exposed areas it is best to mulch around the plants in spring to stop dehydration of the rootstock during summer. Plants may also be raised from seed sown in autumn, germination taking about three weeks in ideal conditions. The first flowers are usually produced when the plants are one year old.

Wurmbea dioica

A perennial herb with three narrow and upright medium green leaves, dying down to a corm in summer. In its natural habitat from north of Geraldton to Albany, it occurs in mainly damp habitats and in winter wet swamps in clay soils. The flower stems, which can be up to 30 cm high, carry one to ten small white or rarely pink flowers with a prominent purple band on each petal. The colour combination of these flowers makes them very attractive. Flowering in the natural habitat is between July and September with individual plants flowering for about three weeks.

In cultivation *Wurmbea* have proved to be very difficult to keep going in pots, and in the open ground, unless you have exactly the right growing conditions. Container grown plants tend to get weaker each year as the corms get smaller. The only way I have been able to keep plants going is by giving them an occasional summer watering (even though the corms are dormant during summer) and keeping the pots plunged or covered in leaf litter.

Propagation by fresh seed in autumn is very easy, guess estimation germination rate of 80%, taking about three weeks to germinate. It is best to leave the seedlings in the seed pot over the first summer, then pot on before the corms start growing again about April. It usually takes three years to first flowering. Some of the rare and endangered species of *Wurmbea* are being raised by tissue culture in Kings Park Laboratory. ■

Chamaescilla

The Genus by R. J. F. Henderson¹

The genus is probably most closely related to *Caesia* from which it differs principally in the angular fruiting capsules and the flattened seeds lacking any appendage (aril or caruncle). It is endemic in Australia and contains two species that occur in temperate southern regions of the continent. Plants usually occur in damp sandy soils. Photograph on page 13.

Chamaescilla was formally described to accommodate two *Caesia* species by the British botanist George Bentham in his *Flora Australiensis* in 1878. However, Ferdinand von Mueller in Melbourne had commented in print some eight years earlier that these two, *C. corymbosa* and *C. spiralis*, either constituted a distinct section of *Caesia* or belonged to a new genus he suggested be called *Chamaescilla*. The name comes from the Greek *chamai*, meaning, in the botanical sense, "false", and *Scilla*, the name Linnaeus in 1753 gave to the genus containing the sea squill. It refers to the appearance of included plants.

Chamaescilla corymbosa (R. Br.) F. Muell. ex Benth.

Commonly known as Blue Stars, Blue Squill, Love-of-the-morn, Australian Star of Bethlehem, this plant has tufted rather soft plants 5–40 cm tall (including inflorescences), the tufts less than 2 cm across near ground level and more or less enveloped with fibres from old leaves. The broad spindle-like root tubers are 0.6–10 cm long. The outwardly curving leaves are 5–25 cm long with a blade 1–33 mm wide and with margins smooth or shortly hairy. Individual flowering axes have from one to 35 flowers, each flower having a stalk 2–15 mm long. Flowers are white, pink or blue, and are up to about 2 cm across. The smooth stamens are 2–6.5 mm long. The ovary contains 4–12 ovules per locule which develop into more or less discoid black seeds 1–2 mm across, in a capsule more or less obovate to heart-shaped in outline and about 8 mm long. This species is very variable and published chromosome counts for it ($2n = 6, 12, 24, 44$) indicate that polyploidy may be responsible for much of this variability. Three varieties are recognised.

var. *corymbosa* is a plant from 5 cm to about 20 cm tall. It has 1–9 leaves per shoot, a linear leaf-blade usually 1.5–8 mm wide, an inflorescence with 1–10 flowers, and floral segments 6–9.5 mm long. The style usually is as long as or shorter than stamens. This variety is widely distributed across temperate WA and SA through Vic. to Tas.

var. *latifolia* is a plant 15–40 cm tall differing from varieties *corymbosa* and *paradoxa* in having 1–3 leaves per shoot, an elliptic to narrowly oblong leaf-blade 10–35 mm wide, an inflorescence with 12–35 flowers, and floral segments 8.5–11 mm long. The style usually exceeds the stamens. This variety occurs in a small area to the north, east and south of Perth, WA.

var. *paradoxa* is a plant usually much less than 12 cm tall differing from other varieties of *C. corymbosa* in having 1–3 leaves per shoot, a filiform to linear leaf-blade 1–4 mm wide, an inflorescence with 1–3 flowers, and floral segments 5–7 mm long. The style always exceeds the stamens. This variety occurs sporadically in southwestern WA from north of Perth to near Esperance.

¹This article is based on *Flora of Australia*, Volume 45, Pp. 288–292, 441–442, 472–473 (1987).



Chamaescilla corymbosa A, habit $\times 0.5$; B, spent flower showing spiralling effect on dying and a flower to 2 cm across with the six tepals ("petals") with line markings, and six stamens; C, a fruit. The variety *paradoxa*, D, to the same scale, is a much smaller plant.

Chamaescilla spiralis E, habit $\times 0.5$ showing the spiralling habit of the foliage.

***Chamaescilla spiralis* (Endl.) F. Muell.**

This plant differs from *C. corymbosa* principally in having more leaves per tuft (eight to many) and these being spirally twisting towards their tips, 20–100 flowered inflorescences that are 15–40 cm tall, tufts to about 3 cm across near ground-level, and more or less cylindrical root tubers that are 1–8 cm long. The leaves are 4–15 cm long with the blade 1.5–4 mm wide and with margins smooth. Individual flowers have a stalk 1–8 mm long, are blue, and are about 1.5 cm across. The stamens are 5–7.5 mm long. The ovary contains 8–18 ovules per locule which develop into seeds 1–1.3 mm across in a capsule more or less circular to broadly elliptical but emarginate in outline and about 8 mm long. This species occurs in damp sandy soils in forest and scrub in southwest Western Australia, from north of Perth to about Esperance on the south coast. ■

Kangaroo Paws

Pests and Diseases

by Keith R. Oliver,
Honorary Research Associate,
Murdoch University

I write on this subject not because I am an expert on pests and diseases, but to summarise what is known to me and what I have observed in my own gardens over a period of 28 years and to indicate areas that need further investigation. In particular I appeal for more information relating to the new phenomenon called "Flower Bleach Deformity" or "Flower Abortion" that has appeared in kangaroo paws in recent years.

The kangaroo paws consist of 12 species of perennial herbs native to southwestern Australia. In their natural habitat most of the species are fire opportunists and colonisers of areas of secondary regrowth. They are not long lived but produce large quantities of seed which is shed each summer and tends to remain dormant in the soil until the area is burned. The autumn after a fire the seed germinates to produce large numbers of seedlings which proliferate for several years before being overgrown by larger and longer lived species. Under these conditions pests and diseases of kangaroo paws tend to be rare. However, in cultivation, in row cropped monocultures or in gardens, where summer watering and the use of fertilisers is normal, and where the plants are exposed to introduced species of snails, slugs and other pests, many problems are encountered.

The species *Anigozanthos flavidus* is an exception in that it is not short lived. It can live for at least 30 years in cultivation, possibly for much longer and it is an exceptionally vigorous, hardy and disease free species that has been widely used in breeding the hybrid kangaroo paws that are now widely grown, both within Australia and in other countries¹. Careful selection from the hybrid progeny of *A. flavidus* yields plants that have good disease resistance and which are little eaten by snails. They are also hardy and vigorous and live much longer than most species of kangaroo paws.

Recorded Pests — Snails and slugs, Caterpillars, Aphids, Leaf miners, Leaf nematodes, Spittlebugs and Parrots.

Diseases include Ink disease or inkspot disease, Rust, Crown rots, Root rots, Damping off of seedlings, and Anthracnose?

Other problems are **flower bleach deformity** or flower abortion.

Control of Snails and Slugs is achieved by:

The slash and burn method of growing may give at least partial control of snails and many other pests and diseases of kangaroo paws.

Elimination of potential breeding sites, rockpiles, hedges, ground hugging creepers, rubbish and rough weedy areas, etc.

Khaki Campbell or Indian Runner ducks give good control.

Beer traps and sawdust barriers etc., are useful in small areas.

Baits of Methiocarb (pellets) and metaldehyde (pellets, powder or paste).

Sprays such as Bordeaux mixture, methiocarb or metaldehyde.

Continued on page 23

Caterpillars — The damage caused by caterpillars can usually be distinguished from snail damage in that the caterpillars do not eat into the leaf deeply enough to expose the vascular bundles, as snails do, and that snails tend to eat away long strips of tissue, not irregular circular or oval areas. Hand plucking may suffice for small areas. A selective insecticide for leaf eating caterpillars is Dipel® (*Bacillus thuringiensis*) which is a highly effective stomach poison for caterpillars but is non-toxic to other insects, fish, birds and mammals. Other stomach action insecticides include Endosulfan, Fenthion [Lebaycid®] and Rotenone [Derris®]. These must be eaten by the pest before they are active, so are useful against foliage chewing insects.

Aphids — It has been reported that kangaroo paws can become infested with aphids during the spring or autumn². Control by spraying with Metasystox® or Rogor® is recommended. I personally have rarely seen aphids on kangaroo paws and tend to think that they may only occur on excessively soft growth.

Leaf Miners — These are also outside of my experience but have been reported on kangaroo paws². Control is with Metasystox® or Rogor® when the larvae are active (winter).

Ink Disease or Inkspot Disease has been described as a hypersensitive host reaction to several species of fungi, early workers implicating *Mystrosporium adustum*³ or *Drechslera iridis*⁴ but later work has attributed the disease primarily to *Alternaria alternata*^{5, 6, 7}.

Species of kangaroo paws differ in their susceptibility to this disease. *Anigozanthos manglesii* and *A. gabrielae* are usually killed by the disease while *A. viridis*, *A. pulcherrimus* and *A. rufus* are less affected and *A. flavidus* is highly resistant. Other species are susceptible in varying degrees.

It is important to note that different isolates (or races) of *Alternaria alternata* from kangaroo paws differ in their virulence and that each species of kangaroo paw varies in its susceptibility to many of the different isolates. This complicates the breeding of resistant hybrids or varieties as although the fungus is ubiquitous, apparent resistance in particular plants may not persist against a wide range of fungal races.

The symptoms of ink-spot disease vary from brown sunken lesions with some chlorosis and a black rim, to black lesions, or to large black lesions (the rare "big blotch" form) that is seen even on the stems of inflorescences, causing withering of the stem and destruction of the flowers. These symptoms are easily confused with other blackening or the leaf tips or spots on the leaves due to such things as water stress, damage by insects and by other physiological and environmental stresses, so that great care is needed in diagnosing ink-spot disease.

Further Notes on Ink Disease

Work done by Lisa Gillespie-Sasse (pers. comm.) at the University of Western Australia in 1989 indicates that ink-spot disease is a result of a plant-toxin interaction and that different isolates of *Alternaria alternata* taken from kangaroo paws can be divided into different races according to the types and levels of toxins that they produce and further that the symptoms associated with ink-spot disease may be associated with more than one fungus.

In view of the number of races of *Alternaria alternata*, the possible involvement of other fungi, and the variability in disease expression, great care must be taken before claiming resistance or tolerance to ink-spot disease for any particular clone of plants. It has come to my notice that in one case disease resistance was claimed for plants that failed to develop symptoms within six months when not protected by fungicides. Such claims should be treated with great caution.

Cases are known where clones of plants have been unaffected for many years only to quickly succumb and die when infected with other races of pathogens. Nevertheless clones of plants are known which have survived for many many years without any protection from fungicides and which have undoubtedly been exposed to many races of ink-spot and rust pathogens and which have never become infected with either disease. These are clearly valuable plants to breed from as resistance is known to be inherited. Nevertheless, no absolute guarantee can be given that these plants or their progeny will not succumb to an unknown or new race of pathogen some time in the future, but for the present they may be said to be disease resistant.

Rust Disease of Kangaroo Paws is evident as small (approx. 2 mm diameter) reddish brown pustules on the leaves, which usually become more and more dense until the plant is killed. Rust is rare on, if not absent from, wild populations of kangaroo paws, but is a serious disease of cultivated kangaroo paws. Unlike the ink-spot fungus, the rust fungus *Puccinia haemodora* cannot live as a saprophyte (i.e., it cannot live on dead plant tissue) for a part of its life cycle but must always be a parasite (i.e., live on living plants). It has different races and these are often specific to a particular species*.

The story is told of some researchers in an eastern Australian state who inoculated plants of *Macropidia fuliginosa* with rust taken from *Anigozanthos manglesii*, and finding no infection then concluded that the former species is immune to rust disease. This is clearly untrue, because at this same time rowcropped *M. fuliginosa* in Western Australia was being devastated by rust. Also from my own experience I had hybrid plants that had survived trouble free for about 12 years, but which were quickly killed when a suitable race of rust attacked them.

Anigozanthos flavidus seems to be immune to rust attack. *A. pulcherrimus* and *A. rufus* may also be resistant⁸, but most of the other species are susceptible. In my experience *A. humilis* seems to be particularly susceptible. When *A. flavidus* is crossed with other species the resultant hybrids are variable but many seem to be highly resistant to rust, but *A. humilis* × *A. flavidus* hybrids are often susceptible to rust.

Control of Ink-spot and Rust Diseases of Kangaroo Paws

Spraying with Mancozeb[®] is recommended for ink-spot disease and spraying with Baycor[®] is recommended for rust. These may not be fully effective in preventing the diseases. Growing disease resistant hybrid plants is a good solution but there may be a disadvantage from irritant hairs on the stems of *A. flavidus* hybrids if large areas of flowers are to be picked.

Control of Pests and Diseases by the Slash and Burn Method

Slashing and burning of plants after flowering in late summer to autumn will reduce the inoculum load and give the plants a "clean start" for the following year*. Dixon⁸ recommends similar treatment for many species but notes that a slow hot burn can kill the plants and also that in the case of plantation grown *M. fuliginosa* slashing and burning can cause heavy losses. *A. flavidus* hybrids respond well to slashing but there is no data concerning their response to burning.

*In the cemetery at Gingin there are populations of *A. manglesii* and *A. humilis* which have been slashed and burned in late spring or autumn every year but one since 1973 and probably since the early 60's (Stephen Hopper, pers. comm.). Under these conditions these crowded populations of kangaroo paws have kept remarkably free of pests and diseases. When I thoroughly checked the area in September 1990 I could find no trace of disease and almost no pests, only a very few flowers showing some insect damage.

Flower Bleach Deformity of Kangaroo Paws*

The first symptom is some loss of pigmentation in the developing flower buds, followed by total loss of pigmentation, over all of, or over large areas of the buds, giving them a white colour. This is accompanied by abortion of the entire inflorescence. Usually only some of the stems on any one plant are affected and only more or less randomly scattered plants are affected. Following the abortion of the primary inflorescence a secondary inflorescence will often develop from a lower node of the primary inflorescence stem and so far as has been observed these nearly always develop normally.

Many reasons for this strange disorder have been suggested or advocated, some of these are: adverse weather, too hot, too cold or too changeable; nutritional imbalance, manganese toxicity, copper deficiency; genetic faults in plants; weakness induced by tissue culture, etc. In my opinion, these are all untenable. There has always been adverse weather on occasions and plants have been grown on many soils for many years, but no flower bleach has occurred. Also flower bleach has occurred on seedling plants and on plants dug up in the wild as well as on tissue cultured plants.

Most biologists are fairly certain that it is not caused by a fungus or a bacteria and after discussion, I have formed this hypothesis:

1. It is caused by a pathogen that is probably new to Western Australia, or even to Australia;
2. The pathogen is probably a myco-plasma-like organism (MLO)**.
3. The vector is possibly a green leaf hopper that is occasionally seen sucking sap from soft young flower stems.

*I first observed this in my own garden in Wilson in August 1987. I had never seen it before although I have been growing and observing kangaroo paws since 1963. I have also been unable to obtain any reports of any one else having seen this before 1987, but in 1987 or 1988 it was found in other parts of the Perth metropolitan area (Warwick, Wanneroo), and in at least one country centre in Western Australia (Augusta), as well as in Victoria and Queensland. It seems to be spreading in area and increasing in severity and possibly poses a threat to all kangaroo paws, both in cultivation and in the wild.

**Siva Ganeson of Bentley Technical College, Jonathon Majer of Curtin University, K. Sivasithamparam of the University of Western Australia, Peter Wood of the Department of Agriculture, Western Australia and John Considine of University of Western Australia. Dave Cahill of Australian National University suggests that the pathogen could be an internal fungus.

***The MLO's (or other internal pathogens) do not become systemic in the plant and probably perish when the inflorescence aborts. This may be because they do not or cannot move down the stem or it may be because the plant produces phytoalexins which isolate and/or destroy them. The second alternative is favoured because new shoots from the lower nodes of affected stems are almost always clean and it is thought that phytoalexins produced by the plant in response to the initial infection may protect these new shoots.

The pathogens survive in an alternate host. This could be almost any perennial plant but the prime suspect at present is a thistle that has distorted leaves that is found growing in my garden.

The hypothesis is supported by the following facts and observations:

(a) Flower bleach, so far as is known, was not recorded before 1987, but kangaroo paws have been cultivated at least since the 1950's.

(b) The distribution of the disorder indicates an insect vector as distribution is patchy in affected areas and it occurs in seasonal epidemics.

(c) The occurrence of the leafhoppers in my garden seems to correspond with the occurrence of the disorder.

(d) Lesions on affected stems consistent with feeding by sap sucking insects were found by Jonathon Majer.

(e) Leafhoppers are often seen feeding on soft young flowering stems in my garden. They are never numerous but leafhoppers are low density pests, i.e., a few can do a lot of damage.

(f) Using the DAPI technique⁹ a positive stain was obtained for a MLO on a soft young affected flowering stem whereas an unaffected stem and an old aborted stem gave negative results. This work was done by Peter Wood. This evidence is not merely circumstantial as is the rest of the evidence, but it still needs to be repeated.

Plants affected one year may be clean the next year, only some stems on a plant are affected and clean shoots grow from a lower node of affected stems. All of this indicates that the MLO is not systemic.

Spraying with copper oxychloride is reported to cure the problem although the work did not include unsprayed control plants. As there is circumstantial evidence against the disorder being caused by a copper deficiency and as it is reported that the copper must be sprayed onto the leaves and not added to the soil it is thought that the copper may make the stems either unpalatable or poisonous to the insect vectors, or that in some other way the copper prevents infection by the MLO.

Establishing the cause or causes of flower bleach deformity, along with means of control, is an urgent task that many readers of *Australian Plants* may be able to contribute to. Perhaps some have already established the cause, and if so, they may like to share their findings with others. I would certainly like to get reports of any occurrence of the disorder, including dates and localities, species or hybrids affected, and any attempts at control, whether successful or not. Any recordings of the disorder prior to 1987 would be particularly valuable. So far as is known to me at present, no varieties of kangaroo paws show any resistance to the disorder. Wild populations of kangaroo paws as well as cultivated plants may be at risk. Please help in the understanding and the solution of this problem by writing to me or to the editor of *Australian Plants*.

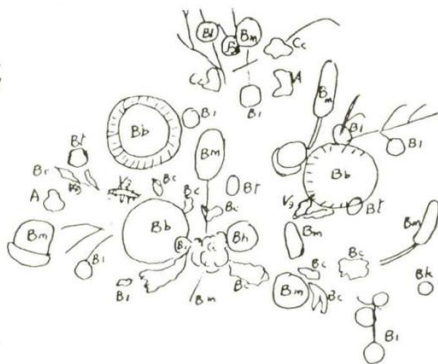
References

- ¹Oliver, K. R. (1991). Hybrid Kangaroo Paws. *Australian Plants* **16**: 116, 53–60.
- ²Reid, A. (1988). Cultivation of Kangaroo Paws. *Farmnote No. 54/88*, Western Australian Department of Agriculture.
- ³Smith, W. T. (1963). The Ink Disease of the Paws. *Australian Plants* **2**: 16, 115.
- ⁴McMaugh, J. (1985). in *What Garden Pest or Disease is That?* Weldon Publishing, Willoughby, New South Wales.
- ⁵Sivasithamparam, K. and Watkins, P. A. (1982). *Alternaria alternata* as a causal organism of ink-spot disease of *Anigozanthos* spp. in Western Australia. *Australian Plant Pathology* **11**: 18.
- ⁶Sivasithamparam, K. (1985). Diseases. In *Horticulture of Australian Plants*. (eds B. Lamont and P. Watkins). Pp. 99–102. Western Australian Department of Agriculture, South Perth.
- ⁷Verhooght, M. M. and Sivasithamparam, K. (1986). Ink-spot disease of 'Kangaroo-paws' (*Anigozanthos* Labill. and *Macropidia* Drumm. ex Harv.) in Western Australia. *Crop Research* **26**: 49–55.
- ⁸Dixon, I. R. (1991). Kangaroo Paw. *Australian Plants* **16**: 116, 77–87.
- ⁹Ulrike Schaper and R. H. Corverse (1985). Detection of Mycoplasma-like Organisms in Infected Blueberry Cultivars by the DAPI Technique. *Plant Disease* **69**: 193–196. ■

Flower Arrangement

An arrangement by Elizabeth George.
This arrangement was entered in the Fantasy of Flowers Floral Competition, 1992.

- A — *Acacia roosei*
- Bb — *Banksia baueri*
- Bh — *Banksia hookeriana*
- Bl — *Banksia laricina*
- Bm — *Banksia menziesii*
- Br — *Banksia repens*
- Bt — *Banksia telmatiaea*
- Bc — *Blancoa canescens*
(See page 33)
- Ce — *Calectasia cyanea*
- Vg — *Verticordia grandis*



The next issue will present our plans to feature flower arrangements in future issues. Readers are invited to submit colour slides of flower arrangements they have created. Colour prints can be used but the reproduction is not as good. If you would like to join in this activity, but are unsure how to do it, perhaps our next issue will assist you. I do not mean this sort of grand arrangement but smaller pieces suitable for decoration in the home.

Bush Gem[®] Kangaroo Paws

Their Cultivation in Southern Victoria

by Richard Anderson,
Merricks Nursery, Victoria

For the past six years I have had much pleasure in growing the Bush Gem[®] range of Kangaroo Paw in our garden at Merrick's on Westernport Bay, 70 km south of Melbourne. Our soil is a heavy loam to a depth of approximately 40 cm and the garden is on a gentle slope, in full sun.

Anigozanthos 'Bush Ranger'

Anigozanthos flavidus × *A. humilis*

This is a dwarf growing plant to 0.5 m high with prolific branched red flowers all year, year after year, demonstrating good longevity. It makes a small clump about 0.5 m wide and can produce up to 30 flower stems at the one time. It benefits greatly from pruning the spent flower stems off right at the base. Snail damage can be a problem but is easily controlled.

Anigozanthos 'Bush Emerald'

Anigozanthos manglesii × *A. viridis*

A taller growing plant to 1 m high featuring bright red and green flowers on slender stems mainly during winter and spring, but flowering occasionally at other times. It is less vigorous than others but still well worth growing because of the brilliantly coloured flowers. Its average life span is three years.

Anigozanthos 'Bush Opal'

Anigozanthos humilis × *A. bicolor*

A dwarf growing plant that is truly stunning with its bright red and yellow flowers on numerous flower stems to 50 cm high. The individual flowers last many weeks before fading. Most growth and flowering is in the cooler months and sometimes plants go dormant and stop flowering during our dry summers, but they always rejuvenate with the autumn rains. Photograph on page 29.

Anigozanthos 'Bush Nugget' Polyploid (*Anigozanthos humilis* × *A. flavidus*)
× (*A. humilis* × *A. bicolor*)

A robust, vigorous plant with large yellow flowers on thick stems to 1 m tall. The plant in our garden is three years old, healthy and is nearly always flowering. We prune off all old faded flower stems at the base and these are always replaced quickly with new leaf fans and flowers.

Anigozanthos 'Bush Baby'

Anigozanthos flavidus × *A. humilis*

Grows to about 0.6 m high in our garden. An interesting feature is its constantly changing flower colours according to the time of year (most likely a function of ambient temperature). During winter it produces pastel pink coloured flowers whilst summer flowers are rustic brown and orange, however, most flowers are produced during winter and spring.

Anigozanthos 'Bush Surprise'

Anigozanthos onycis × *A. preissii*

A dwarf growing plant to 0.5 m high. We have had mixed success with this one. A couple of plants have grown, flowered and then succumbed to fungal disease in less than 12 months, whilst others in a more open part of the garden have performed well and are into their third year! Its spectacular large, bright orange flowers are the brightest of our collection.

Anigozanthos 'Bush Glow'

Anigozanthos humilis × *A. flavidus*

We have found this to be a robust and reliable plant growing to about 1 m high. Its branched stems of massed orange flowers are very attractive. Flowering is mainly during winter and spring.

Anigozanthos 'Bush Gold'

Anigozanthos 'Bush Glow' Mutant

Similar in all respects to 'Bush Glow' except it produces bright gold flowers most of the year, but particularly in winter and spring. Our two year old plant is very vigorous and healthy.

Anigozanthos 'Bush Dawn'

Anigozanthos pulcherrimus × *A. flavidus*

A robust tall growing plant to 2 m high with bright yellow flowers. Our plants usually flower during spring and summer, however, we have found that flowering seems to vary from season to season, perhaps reflecting a function of soil moisture as they certainly perform better with summer moisture.

Anigozanthos 'Bush Sunset'

Anigozanthos flavidus × *A. rufus*

This plant grows into a large clump to nearly 1 m wide. It produces bright red flowers on 2 m high stems in summer. It has been trouble free. ■

Research On Epacridaceae

An S.G.A.P local group sponsors scientific research

The North Shore Group of the Society for Growing Australian Plants decided to donate \$2,400 of their hard-earned group funds to the Australian Flora Foundation and nominated that they would like the money to go towards research on factors affecting the cultivation of species in the plant family Epacridaceae. The AFF arranged for Dr A. E. Ashford of the University of New South Wales to submit a proposal for consideration. This was forwarded to the Research Committee of the AFF for approval of the scientific procedures nominated. On final approval the research proceeded.

One year's research has already yielded five scientific papers either already presented to such bodies as the Australian Conference of Electron Microscopists, February 1992 or awaiting publication in scientific journals such as the Journal of Cell Science. Results of the research will be published in Australian Plants in a form we can read in association with other articles in preparation on species in this family such as *Epacris*, *Woolisia*, *Lysinema*, etc.

Supporting Scientific Research?

You can sponsor your own project

The above is an example where a very concerned group of people have used their funds to promote scientific research of the highest order. You can do this yourself. Following are some projects already approved and awaiting funding.

Vegetative Propagation of <i>Banksia</i>	\$3,000
Germination of <i>Ixodia achillaeoides</i> , a flower used in dried flower arrangements	\$3,000
Conservation of Small Populations: A Study using <i>Grevillea barklyana</i>	\$3,000
Germination of <i>Persoonia</i> starting with native population	\$2,700
Germination of <i>Actinotus</i> (<i>Flannel Flower</i>)	\$2,700
<i>Wahlenbergia</i> as a landscape plant, its use on road verges and landcover schemes	\$3,000

You may readily ask "How far will such a small sum (large to me but a drop in a bucket to scientific research spending) go to a meaningful result?" The report on Research on Epacridaceae above will reassure you that your \$3,000 will be well spent. The Australian Flora Foundation has arranged with its scientists to make full use of existing facilities at their research establishments and available student labour. In some cases the donation is seed money facilitating a successful application for much larger sums.

You, too, can fund science furthering the preservation of our magnificent flora for just \$3,000.



Anigozanthos 'Bush Pixie' (above)

Photograph from Biotech

Anigozanthos 'Bush Opal' planted in a mounded bed of heavy red loam with a small amount of coarse sand mixed into it. This four-year-old plant will probably be attractive for another three years. We prune back all old flower stems to the ground and remove other dead plant material in late autumn.



Tuberous, Cormous and Bulbous Plants*

by Kingsley Dixon
and John Pate

1. Bulbs

The bulb is generally described as a modified perennating shoot, comprising a vertically-compacted stem bearing overlapping swollen 'scales' (Fig. 1A). These scales are the principal sites of storage of reserve substances and may be the equivalent of swollen bases of foliage leaves, specialised subterranean leaves, or a mixture of these two types of structures. During periods of vegetative growth the meristem(s) of the bulb produce above-ground foliage leaves: a scape bearing a flower or inflorescence forms if the plant assumes a reproductive condition as shown in Fig. 2 on page 35. Adventitious roots also develop each season from the base of the bulb. The reserves of the older scales of the bulb become progressively exhausted, their withered remains persisting for many further years to provide a multi-layered, waterproof covering to the bulb. New scales of storage tissue are added to the centre of the bulb.

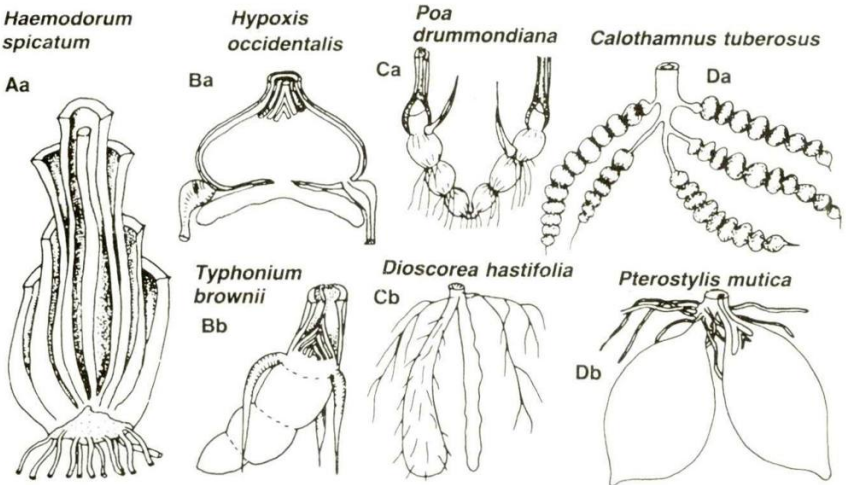


Fig. 1. Aa, the bulb of *Haemodorum spicatum* showing the overlapping 'scales' comprising a bulb. Ba, the corm of *Hypoxis occidentalis* showing the flattened vertical underground stem on top of the compacted remains of the previous season's corm. Bb, the corm of *Typhonium brownii* showing the effect of each new season's corm being formed on top of the corms of previous seasons. Hence, this plant is three years old. The new season's roots grow from the newly forming corm on top during the 4th year. Ca, the stem tuber of *Poa drummondiana* showing a series of joined stem tubers which are added to annually. Cb, the stem tubers of *Dioscorea hastifolia*, a native species of yam. The tubers are stalked and penetrate downwards for up to half a metre before enlarging into a relatively thick cylindrical structure. The larger tuber (with roots) is the parent tuber and was formed the previous season, and a replacement tuber is forming and filling during the current season. Da, the root tubers on *Calothamnus tuberosus* are regular swellings on portions of a branched root system, see photograph on page 36. Db, the root tubers of *Pterostylis mutica* formed by swelling of adventitious roots.

Tuberous, Cormous and Bulbous Plants*

by John Pate and Kingsley Dixon

During the course of their evolution, plants have adapted to extremes of terrestrial environment and habitat by developing a diverse range of highly-specialised life forms. One type of specialisation for a range of plants is the habit of forming subterranean fleshy storage organs. A simple description of these organs may assist in the cultivation and propagation of these plants. This excellent, well illustrated book and is still available for \$39.50. The article above is largely based upon this book.

2. Corms

A corm is a swollen, much compacted underground stem. Viewed in dormant condition it carries a well-defined, apical meristem, and various forms of scar tissue marking points of attachment of previous leaves, inflorescences and roots (Fig. 1 Ba, Bb). The corm in almost all instances is oriented vertically. Unlike the bulb, the main storage tissue of the corm lies within its stem. Corms of certain species may be protected by the fibrous bases of leaves of previous seasons.

Each growing season the apical meristem of the corm produces a set of aerial leaves: a flowering stem then forms if the plant becomes reproductive. Storage tissue arises through the swelling of new nodal and internodal tissue. This may collectively produce a discrete new-season's corm on top of, or to the side of, the previous season's corm giving a multi-jointed appearance, comprising in effect sequences of seasonal additions to the plant's underground shoot system (Fig. 1 Bb), or may merely add storage tissue to the top or side of an already-existing corm (Fig. 1 Ba).

Cormous plants may reproduce vegetatively by forming offset corms laterally, usually as a corona of small axillary buds on the outer flanks of a single large corm or daughter corms may arise through bifurcation of the corm's apical meristem prior to the addition of new storage tissue. Adventitious roots form from previous and current-seasons' corm tissue during each growing season.

3. Stem Tubers

Stem tubers may be considered to embrace in the broadest sense, namely any globoid, thick-cylindrical or jointed swelling of underground fleshy stem tissue. In one type, 3.1 (Fig. 1 Ca for *Poa*, a grass) the tubers consist of swollen, underground lateral shoots of vertical or horizontal orientation, whose storage potential is increased seasonally by extension and thickening of existing tubers or by development of new tubers. In some instances the below-ground shoot system consists of a series of joined stem tubers which may be oriented horizontally or in a vertical fashion. The jointed appearance clearly distinguishes these structures from a rhizome. In other cases it is only the fore-shortened appearance of the tuber and its limited potential for horizontal spread which sets the storage structure apart from a rhizome.

A second, 3.2 (Fig. 1 Cb for *Dioscorea*) form of stem tuber is one in which each storage unit arises separately as a highly-modified swollen lateral shoot on an otherwise unswollen underground shoot system. Each single plant possesses during any one growing season a single pair of stem tubers: one of these, the parent tuber, formed from the previous season, the other, the replacement tuber, forming and filling during the season of observation. Frequently the pair of tubers hang downwards closely opposite to each other, originating in effect from leaf-axils at opposite nodes on the lower part of the stem. This side-by-side replacement of paired tubers is a relatively common storage strategy. The genera *Drosera* and *Dioscorea* provide particularly good examples of the habit. In *Drosera* spp. the stem tubers are generally globoid in shape, and in some species form within the epidermal sheaths left behind by previous-seasons' tubers. In *Dioscorea hastifolia* — a native species of yam — the tubers are stalked and penetrate downwards for up to half a metre before enlarging into a relatively thick, cylindrical structure. A stem tuber of this second type is often the only organ of a plant to survive from one growing season to the next.



△ *Tribonanthes longipetala*

Photography by John Simmons

▽ *Conostylis seorsiflora*





More lily-like plants

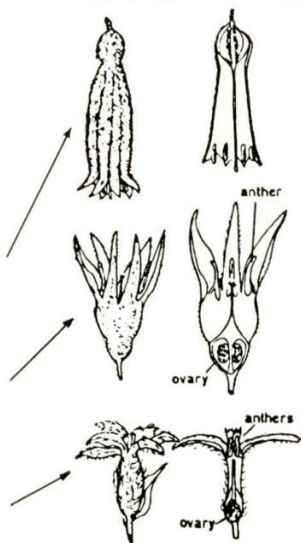
The Plant Family Haemodoraceae

This group of plants are also monocotyledons, closely related to Liliiflorae presented in this and the last two issues. Included as well are *Anigozanthos*, Kangaroo Paw, *Haemodorum*, Blood Roots and *Phlebocarya*. They will respond to similar garden conditions.

Blancoa canescens (above). This dusky red Christmas Bell look-alike is the only species of *Blancoa*. We need to find the very best and showiest form. Who knows of one?

Conostylis seorsiflora (bottom left) represents a large group of species all described and illustrated in colour in our No. 116 issue of Volume No. 14. Exceptional garden, rockery and container plants.

Tribonanthes longipetala (top left) represents a genus of five species all growing from bulbs (see page 39) in winter-wet swamps or high run-off areas on the edge of granite rocks — a container plant?



4. Root Tubers

Two principal classes of root tubers may be recognised: one in which the tubers arise on existing 'true' roots or on roots formed on 'true' roots, the other in which the tubers form on 'adventitious' roots which have arisen from stem tissue as opposed to already existing root tissue.

4.1 *Tubers representing regular swellings* on portions of a branched root-system (Fig. 1 Da, such as *Calothamnus tuberosus*) see photo on page 36.

4.2 *Tubers formed by swelling of adventitious roots* — Monocotyledons bearing root tubers are classified under this heading in view of the 'adventitious' or 'nodal' character of their mature root systems. Examples are the families Orchidaceae, Liliaceae, Xanthorrhoeaceae, Juncaginaceae and Comelinaceae. The root tubers of certain dicotyledons are also of adventitious character, examples in this case coming from Stylidiaceae, Asteraceae, Gentianaceae, Apiaceae, Vitaceae and Ranunculaceae. Two principal forms of this type of root tuber are evident:

4.2(a) *Plant bearing many tubers, tubers added seasonally as new adventitious roots form* — There is great variation in tuber morphology and life form of parent species within this category, ranging from the long, tapered tubers of the geophyte *Burchardia* spp. to short, fat tubers. Usually the young tubers form above the older emptying set of tubers, the younger being readily discernible in mid-growing season by their light colour and smooth surface, the older by their partly withered appearance, dark colour and presence of fibrous feeding roots.

4.2(b) *Sessile paired tubers with annual side-by-side replacement of the previous-season's parent tuber by the new-season's replacement tuber* (Fig. 1 Db for the orchid *Pterostylis mutica*) — Except for the fact that the tubers are modified roots not shoots, this storage strategy is essentially similar to that described above for species bearing paired stem tubers. Members of the Orchidaceae form the bulk of the species in this group, and virtually all examples are relatively shallow-rooted geophytes.

5. Development of Storage Organs in Seedlings

5.1 *Bulb-forming species* — *Haemodorum spicatum* and *Crinum asiaticum* (Fig. 2 X and Y) germinate on or below the surface of the soil, and the apical part of the cotyledon (C) remains within the seed, where it presumably acts as an organ for digesting and absorbing the reserves of the endosperm. The radicle (R) and plumule (P) of the seedling are pushed downwards into the rooting medium by extension of the proximal end of the cotyledonary sheath. Throughout this process the radicle end of the embryo remains as a compacted, inverted cone of tissue, noticeable for its copious secretions of mucilage. The latter no doubt aids in the downward penetration of the seedling shoot and root into the soil. While the cotyledon is expanding, the first foliage leaves (L_1 , L_2) burst through the cotyledonary sheath and emerge above the soil; and, through the photosynthetic activity of these leaves, reserves are laid down in the first scales (SL) of the young bulb.

The seedling of *Crinum asiaticum*, Fig. 2Y, differs from that of *Haemodorum spicatum*, Fig. 2X, in that it produces only one to three leaves in its first season of growth, and exhibits contractile properties in its deeply-penetrating tap-root (CR, stages 2 and 3). This is the only thick root to form during the first year of growth, and its contraction in the period immediately preceding dormancy pulls the young bulb much deeper into the substrate than occurred previously through the downgrowth of the cotyledonary sheath. Unlike the situation in *Haemodorum spicatum*, bulbs of young plants of *Crinum asiaticum* become progressively more deeply buried in subsequent seasons due to the contractile activity of the generations of adventitious roots which form seasonally from the stem stock of the bulb. Eventually, when attaining flowering condition, a mature plant of *C. asiaticum* may have the apical meristem of its bulb buried up to 0.5 m.

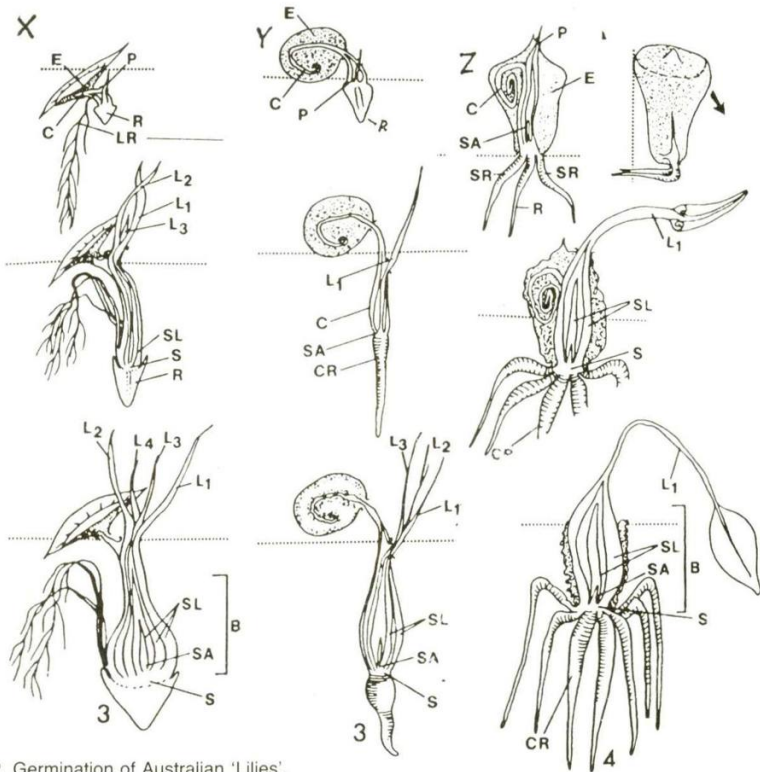


Fig. 2. Germination of Australian 'Lilies'.

X. *Haemodorum spicatum*. The seed is on the ground surface or just below it. The radical (R, root) thrusts downwards, while the first seed leaf (plumule P or single cotyledon) thrusts upward. The first foliage leaves, L₁ and L₂, finally appear after the radicle thrusts down and expands into a cone to anchor the plant eventually forming a new bulb, B.

Y. *Crinum asiaticum*. The seed rests on the ground sending down a deeply-penetrating tap-root which eventually forms a seed.

Z. *Psoiophys alba*. The two 'seminal' roots, SR, emerge from the bottom edge of the bulb anchoring it into the ground and pulling it upright.



△ Root tubers of *Calandrinia primuliflora*

Excavated tubers of *Calothamnus tuberosus* ▽





Australian Indigenous Orchids. Vol. 1

by A. W. Dockrill

At last this indispensable reference has been reprinted. Completely revised and enlarged to include all new species, it has been necessary to produce the work in two volumes, the first of which is now available for \$78. (As a special Christmas offer, orders sent to Surrey Beatty & Sons, 43 Rickard Road, Chipping Norton, NSW 2170, before 31st December, 1992, are post free.) The republishing has been done in a prestige manner with excellent paper, binding, etc. All the characteristic Dockrill features remain — a line drawing of a species with fine details opposite a description of the species with a non-technical paragraph at the foot of the page. All the Australian epiphytic orchids are individually described and illustrated, together with the tropical terrestrial species. A feature of the new publication is the very large number of colour photographs of orchids, many of which have never been published before.

Priophys alba characteristically germinates on the ground surface. A 'primary' root (R) and two or more 'seminal' roots (SR) emerge from the micropylar region of the seed, these having the effect of anchoring the seed in the soil, and pulling the seed into vertical orientation, micropylar end downwards (see stage 2, Fig. 2Z). The first true foliage leaf (L_1) then emerges from the top of the seedling; this normally being the only leaf to form in the first season of growth. The cotyledon (C) remains coiled within the endosperm throughout germination and, unlike the situation in *Haemodorum* and *Crinum*, it does not participate in any way in burying the seedling in its substrate. Burial is accomplished by the contractile activity of the seedling's roots (CR), and in subsequent seasons by sets of adventitious roots which arise from the base of the bulb. By this means a bulb is sited at a depth of 1–2 cm in its first season, and progressively to a final depth of 10–15 cm by the time of reaching mature size.

5.2 Corm-bearing species — *Philydrella pygmaea* exhibits a form of germination in which the cotyledon (C) extends greatly in length both above and below the ground surface after germination. The plumule (P) is then pulled underground by the combined action of the downward growth of the basal region of this cotyledon and the contractile activity of the primary root (R, CR). The latter is the only root to form in the first season of growth. Only one leaf (L_1) is formed in the first season. By the time of dormancy at or near the end of the first season, stem tissue has swollen below the apical bud to form a diminutive corm (CO), and all other parts of the seedling, including the contractile root (CR), have withered and died.

Stylidium petiolare on germination has two or three foliage leaves (L_1 – L_3) in addition to a pair of photosynthetic cotyledons during the first season of growth. The radicle (R) and lateral roots (LR) developing from the hypocotyl region of the seedling are of a contractile nature (CR) and together function in pulling the developing corm (CO) under the substrate. Each season a replacement corm forms laterally by swelling of an axillary bud of the parent corm. This new corm forms adventitious contractile roots before it in turn is emptied during the next season of growth. Final depth (usually less than 2 cm) has been attained by plants by the end of their second year. Mature corms are very small, usually less than 5 mg in weight.

5.3 Stem tuber-forming species — *Drosera* germinates with the cotyledons remaining wholly within the seed, even if germination has taken place on the soil surface. The radicle (R) and first foliage leaf (L_1) quickly emerge. A deep-rooting, fibrous root-system (LR) then develops from the radicle, and a number of glandular leaves are added as the season progresses. A single axillary shoot or 'dropper' (D) forms in mid-season from a node close to the cotyledonary node. It extends vertically downwards for up to 2–5 cm before swelling terminally to form a globose stem tuber (ST). Due to eccentric growth of the tuber its apical meristem (AM) eventually becomes displaced from base to top of the developing tuber. At the end of the first season all plant parts other than the tuber die, and in subsequent seasons replacement tubers form at progressively greater depth.

Tribonanthes variabilis germinates with the seed coat (SC) pushed above the soil by the emerging cotyledon (CT). One or two foliage leaves (L_1 – L_2) form in the first season and, as with *Drosera*, the stem tuber forms terminally on a positively geotropic 'dropper-like' structure (D).

5.4 Root tuber-forming species (Fig. 3F) — The species *Arthropodium capillipes* forms root tubers as swellings of adventitious lateral roots. The photosynthetic cotyledon (C) produces up to three leaves (L_1 – L_3) and usually only one tuber in its first growing season. The root tuber (RT) forms as an ovoid-cylindrical swelling at the distal end of a specialised, tuber-forming root (TR). This root, and the feeding roots (LR) which form around it, exhibit strongly contractile properties (CR) and collectively pull the compacted stem stock (S) into the soil. The same process reoccurs each season.

Burchardia umbellata differs from *Arthropodium* in its non-photosynthetic cotyledon, sessile root tubers and in the non-contractile nature of its seedling roots. Usually only one leaf forms in the first season. Placement of the shoot in the rooting medium is determined during this season by the stem apex and radicle (R) being pushed down into the substrate by downgrowth of the proximal region of the cotyledon (C). A single tapered root tuber (RT) forms on seedlings of *B. umbellata* by swelling of the primary root of the seedling (see stage 3, Fig. 3E). Further tubers and leaves form in subsequent seasons. Each tuber of *B. umbellata* lasts for at least two seasons and develops an investment of feeding roots in the second and later season(s). ■

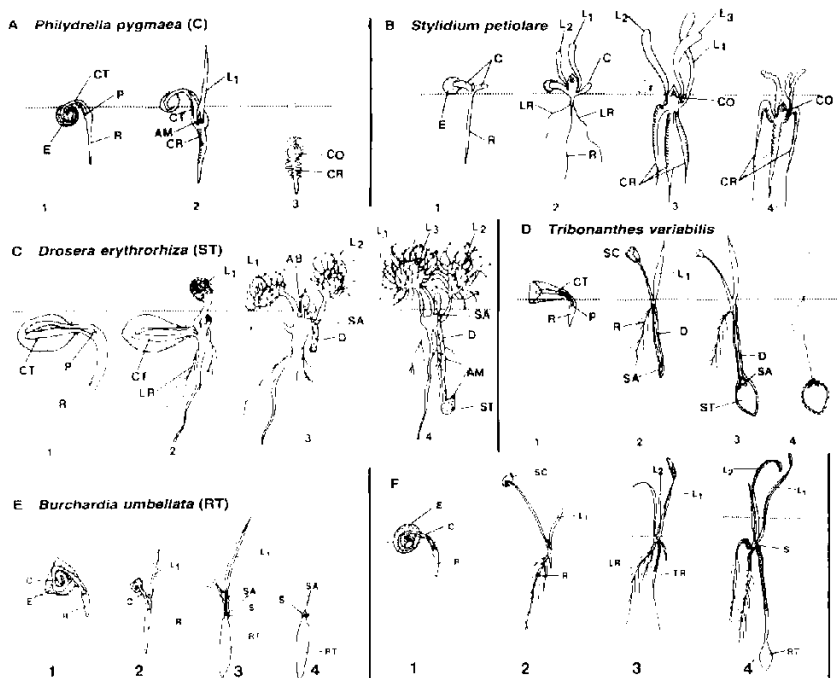


Fig. 3. Corm-bearing plants: A, *Philydrella pygmaea* and B, *Styliidium petiolare*. Stem tuber-forming plants: C, *Drosera erythrorhiza* and D, *Tribonanthes variabilis*.

Root tuber-forming plants: E, *Burchardia umbellata* and F, *Arthropodium capillipes*. Note that the 'lilies' A, D, E and F, being more monocotyledons, only have one seed leaf, L_1 , appearing first on germination (like grass, also a monocotyledon) but the dicotyledon (the rest of the flowering plant kingdom), *Styliidium petiolare*, has two cotyledons, C.

Living with Australian Soils*

by Dr. P. McPhee,
University of Sydney

Australia is an old continent and its soils are usually nutritionally poor and highly leached. Australian plants have adapted to these conditions by forming mutually beneficial associations with micro-organisms which improve the supply of two very important mineral nutrients. Bacteria supply a few plants with usable nitrogen. The bacteria live in specialised nodules on the roots of *Casuarina* and various legumes. Most plants, however, form associations with fungi in soil. The associations are called mycorrhizas. The fungi explore the soil beyond the root and deliver phosphate to the plant along its filaments. In both cases, the micro-organisms are supplied by the plant, with energy for their growth and survival.

The absence of these microbes leads to some severe nutrient deficiencies being experienced by plants. Mycorrhizal fungi are killed by severe soil disturbance as in mining or reduced when vegetation is removed as in clear felling in forestry. Absence of mycorrhizas becomes a problem when the disturbed areas come to be revegetated. Seedlings which are planted out often die. Only where the plant is supplied with fertiliser will a few of the hardier species survive. Many Australian plants are said to be hard to establish. In many cases, these plants will not grow without their mycorrhizal associate.

Mycorrhizal fungi also play a direct part in stabilising the soil. Because fungi grow through the soil, the fungal filaments bind soil particles together. Soil is eroded away because the fungal filaments are no longer dense enough to prevent wind and water removing the smaller particles.

Australians have long recognised that the indigenous plants are rare and unusual. We are in danger of losing these plants if we do not also consider the micro-organisms that exist with them in the soil. National parks are one way of preserving them. We must also learn to manipulate the micro-organisms so that we can make the most of our soils and preserve the soil for future generations to exploit and enjoy.

*This is one of the conservation objectives adopted at the Federal Conference in Perth for achievements for the year 2001. Another, the Replanting of Rainforests, was announced in Issue No. 131 of Australian Plants. The package of proposals adopted, and to be presented one at a time, represents a major contribution to the conservation of the Australian flora for future generations.

The Society's proposals are soundly based, scientifically, with the assistance of the Australian Flora Foundation. To open their campaign, the Australian Flora Foundation has funded the following research projects during 1992.

Mycorrhizas of Arid Zone Vegetation

Mycorrhizas are the associations of common soil fungi with the roots of plants. A major nutritional benefit for the plants involved in such associations is a more effective supply of phosphorus. Practically nothing is known about the mycorrhizal associations of native chenopods (*Chenopodiaceae*). In the arid zone of South Australia, it is believed that saltbush (*Atriplex vesicaria*) has little or no mycorrhizal development unless it grows with the grass *Stipa nitida*, which normally displays mycorrhizae. These two plant species commonly grow together, and a mycorrhizal link may be the most beneficial arrangement for the saltbush. Dr Mark Tester of the Botany Department of the University of Adelaide is investigating the role of mycorrhizae in the phosphorus nutrition and growth of both species. This could be a critical factor in the retention of soil in the arid interior — why let it blow away!



Colostemma purpureum △

Photography by Tony Rodd

Recruitment in the Western Myall (*Acacia papyrocarpa*)

The Western Myall is an endangered species of *Acacia* restricted to arid and semi-arid pastoral lands of South and Western Australia. This species is endangered in the sense that, although there are lots of them binding our desert sands, there are no young ones surviving. In real terms it is the land on which they grow that is in a state of crisis. Natural regeneration is evidently prevented by herbivores; seedlings are eaten by both native and introduced animals (rabbits, sheep). Mrs Carolyn Ireland, at the Botany Department of the University of Adelaide, intends to discover more about the reproductive biology of this species. She will study flowering, seed production, seed dispersal and how establishment of new seedlings would normally occur when herbivores are prevented from eating the seedlings. The aim is to develop a management strategy for the conservation of the species and our inland soils.

1. The species is poorly conserved in arid rangeland parks and there has been massive damage from rabbits, goats, etc.
2. The simpler plant communities of arid rangelands are easier to study, to observe and predict changes due to climate change due to the greenhouse effect, etc., and are likely to be the first vegetation to respond.
3. Being remote from cities, fewer botanists have been involved in these studies in the past.

The projects have been funded by the Society for Growing Australian Plants in the full awareness that they are not horticultural/cultivation orientated. It indicates our commitment to the conservation of the Australian flora and the adoption of basic scientific research to further the commitment.

Practical Craft Ideas from Your Garden

by Janet Taylor

Not specifically presented for Australian wildflowers, this small book has many interesting practices briefly presented in chapters such as: Flower Arranging, Dried Flowers, Flower Pressing, etc. Selling at \$12.95.

Coastal Gardening in Australia

by Rodger Elliot

A superb presentation from a very popular, competent, experienced author and gardener. Those who live by the sea know too well how difficult it is to create a pleasant garden. This small book presents all the problems with solutions. The recommendations are not confined to Australian plants. Selling at \$12.95.

Wildflower Nurseries in Queensland

Fairhill Plants and Botanic Gardens — Fairhill Rd., Yandina, 4561. Tel. (074) 46-7088. 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 \$12.00 posted.

Wildflower Nurseries in New South Wales

Bryants Native Plant Nursery — Cosy Camp Road, Bex Hill, N.S.W. 2480. Tel. (066) 28-4323. 15 kms north of Lismore. Open 7 days (from 11 a.m. on Sundays). Extensive range of trees, shrubs, groundcovers, rockery, grafted Grevilleas, rainforest plants. Excellent quality and service.

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.

Dealbata (cold climate) Aust. Plant Nursery — off Bloomfield St., Dalgely, 2630. Tel. (064) 56-5043. Specializing in alpine and dry Monaro plants — grown from locally collected material. Phone to arrange visit.

Floralands — Parry's Nurseries Pty. Ltd. Kariong via Gosford, 2250. Tel. (043) 40-1142. Preservation by cultivation. Send \$1.50 for descriptive catalogue.

Kentlyn Native Plants — 206 George's River Rd., Campbelltown, 2560. Tel. (046) 25-1583. Open 7 days.

Newcastle Wildflower Nursery — 45 Pacific Hwy, Bennetts Green 2290. Tel. (049) 48-8576. Extensive range of native plants including rare and endangered species.

Sydney Wildflower Nursery — Branches at Duffys Forest (02) 450-1785, Heathcote (02) 520-3335, Marsden Park (02) 637-4585.

Wariapendi Farm Nursery — Church Ave., Colo Vale (7 km north of Mittagong off F5, take Colo Vale exit). Tel. (048) 89-4327, Fax (048) 89-4092. Growers of frost hardy natives from tubestock to advanced. Open 7 days.

Wirrimbirra Native Nursery — Hume Hwy, between Bargo and Tahmoor E. side 2574 (3 km from Freeway entry). Wide range including unusual plants. Tel. (046) 84-1112.

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.

Wildflower Nurseries in South Australia

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.

Anne and Colin Dealtry — Lot 2, Trevilla Rd, One Tree Hill, SA 5114. Large range of tube-stock plants. Display Gardens. Open most of the time but phone to check. (08) 280 7079.

Wildflower Nurseries in Victoria

Australfora — The nursery with the "Native Know How" — Belfast Rd., Montrose 3765. Tel. (03) 728-1222. Mon-Sat. 9-5.00 p.m. Sun. 10-5.00 p.m.

Bushland Flora — Indigenous plants of Melbourne. Ph. (03) 736 4364 for stocklist.

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 3134. Mel. Ref. 50 B5. Tel. (03) 879 4076 — open 7 days.

Pomonal Wildflower Nursery — Grampians. Sign opposite Grampians Store Pomonal. Garden and Nursery open most of the time but phone (053) 56-6250 to check. Browse round our gardens.

Australian Wildflower Seed Suppliers

Nindethana Seed Service — Largest selection of native seed in Australia. RMB 939 Woogenilup, W.A. 6324. Available in 50¢ pks, gram lots or kgs. Please forward a stamp-addressed envelope for free catalogue. Tel. (098) 54-1066 in business hours. Telex: AA 91938.

R. Horner — 1 Grundy St., Alice Springs, N.T. 0870. Seed of trees and shrubs of Central Australia. Please send 45¢ stamp for a list.

Western Australian Wildflower Society — P.O. Box 64, Nedlands 6009. A wide selection of Western Australian seeds is available at \$1.00 per packet, plus postage of 45¢ for a number of packets. Send for a catalogue for \$2.00 plus 80¢ postage. A huge range of seeds at a price you can afford expertly collected, labelled and packed. A book "Hints on Growing ..." 40 pages, \$3.80 posted.

"Australian Plants", The Australian Flora Periodical

Past issues are available for all volumes (4-10), each volume is bound and cased, beautifully presented with green vinyl covering and gold lettering for \$21.00, 950 gs.

Volumes 12, 13, 14 and 15 of Series A, the volumes published in the 1980s are available only from The Editor, Australian Plants, 860 Henry Lawson Drive, Picnic Point 2213, post free for \$40.00 each. Each are superbly bound and carry a complete index. If you are a new reader it is suggested that the set of volumes of Series A will represent the most complete reference book available.

Volume 16, the first of Series B, the volumes published in the 1990s, is now available also. Recent separate issues are available at \$2.70, 80 gms each.

Binders to hold the eight separate issues of Australian Plants in a volume are \$5.50, 300 gs.

Other Books Published by the Society:

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"**Australian Plant Genera**" by J. A. Baines. \$9.90, 750 gs.

"**Banksia Book**" by Alex George. A complete reference in colour to all *Banksia*. \$31.50, 1 kg.

"**Cradle of Incense**" by G. W. Althofer. A delightful book on Mint Bushes. The Genus *Prostanthera*. \$8.00, 500 gs.

"**Creating an Australian Garden**" by John Hunt. A practical guide for a wildflower garden. \$22.45, 700 gs.

"**Field Guide to the Native Peaflowers of Victoria and southeastern Australia**" \$13.45, 200 gs.

"**Friends and Foes in your Garden**" by D. Hockings. The best guide on pest and disease control. \$20, 1.2 kg.

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