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Colour Photography by Frank Hurley

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THE KANGAROO PAW

This issue describes all the species of kangaroo paw from West Australia and gives details of how to grow them in your garden.

Growing The Kangaroo Paws

By DR. J. S. BEARD, Director, King's Park and Botanic Garden, Perth

The eight species of *Anigosanthos* and the single species of *Macropidia* which comprise the kangaroo paws are confined to the southwestern botanical province of Western Australia, that is to say, the western and southern coastal strip from Shark Bay to Cape Arid and up to 100 miles inland.

Strange and bizarre flowers of no little beauty in their own way, they cannot help but attract interest, and one of them (*A. manglesii*) has been officially adopted as the floral emblem of the State of Western Australia.

To understand the conditions under which these plants should be cultivated we should first study their morphology, the form and structure of the plant, and its ecology, the circumstances of its natural environment. We then consider the characteristics of each plant, similar species being grouped together, and then conclude the article with recommended conditions for their cultivation with a special section for their propagation.

Morphology:

The basic structure of the kangaroo paw plant consists of a small rhizome which generates shoot buds above and root buds below. The leaf is a broad strapshaped organ with a defined midrib, the two sides being folded forward along the midrib and fused together except at the base where the apposed sides form an envelope from which a later shoot or inflorescence emerges. In summer in the wild in some species the leaves wither off, in others they remain green, but in all cases the root system withers away with the onset of dry weather and is renewed with the following rains. In cultivation with summer watering it seems that this dormancy does not necessarily take place. The rhizome is from $\frac{1}{2}$ to 1-inch thick and extends horizontally in the soil giving rise to one or more new fans each season. Branching of the rhizome to form clumps of fans is more pronounced in some species than others, but can be expected to become more frequent in all species under cultivation. Each fan in due course produces an inflorescence, simple or branched according to species, with a terminal head of flowers of varying numbers, arranged one above the other and opening successively from the bottom upwards.

Ecology and Distribution:

The natural habitat consists first of a winter rainfall climate with precipitation between 20 and 40 inches a year (up to 60 inches for *A. flavida*), 80 per cent of which falls from May to October. In summer drought is the rule, with low relative humidity (average 50 per cent at 9 a.m.) and high temperatures (average 80°F., extreme of 105°F.).

Topography is of low relief and low altitude (under 1,000 feet above sea level). Soils are ancient, pedologically mature, highly leached and mineral deficient. The kangaroo paws occur for the most part in the low and open bush or scrub of the poorest of these soils, on the deep sands of the coastal plain in open *Banksia* bush or in sand and gravel heaths where the ancient soil profile has developed a sandy top soil overlying ironstone gravel or in later stages has lost the top layer leaving the ironstone outcropping, the vegetation being reduced to stunted bushes.

Continued on page 129 where the paws are described in pairs

The Kangaroo Paws of W.A.

BOTANY of the GENERA *ANIGOSANTHOS* and *MACROPIDIA*

By B. J. GRIEVE and N. MARCHANT, Botany Dept., University of W.A.

Discussions and decisions about the choice of State or National floral emblems are often complicated by the fact that there may be two or three native wildflowers which have high claims to the title. It is, therefore, perhaps significant and indicative of the sustained popular appeal and interest in the kangaroo paws in Western Australia that one of them (*Anigosanthos manglesii*) was unanimously selected in 1960 as the State's Floral Emblem. All of the eight species of *Anigosanthos* and the single species of the closely related *Macropidia* are strikingly unusual. Their visual impact and aesthetic appeal stem from three features, firstly the shape of the buds which when young, really look like kangaroo paws, secondly the arresting colours or colour contrasts in the flowering heads, and thirdly the unusual effect which is due to the fact that the flowers and stalks are covered with thick matted hairs.

The first of the species within the genus *Anigosanthos* to be described was *A. rufa*, which was collected on the south coast near Cape Riche in 1792 by the Frenchman, La Billardiere, who was the naturalist on D'Entrecasteau's expedition. La Billardiere was impressed by the strange appearance of the flower and, taking some liberties with the letters in the original Greek words *anisos*=unequal, and *anthos*=a flower, he coined the name *Anigosanthos*. For a considerable time this was spelt *Anigozanthos*, but the correct usage to conform with the Article of the International Code as pointed out by Mr. J. Green (M.Sc. Thesis, 1958) is to use the *s* instead of *z*.

A German botanist, Ludwig Preiss, who made an extended stay in Western Australia between 1838 and 1842, collected many of the other species of the genus and on his return to Europe they were described in *Plantæ Preissiana* (1847).

Robert Brown who was botanist on Flinder's ship *Investigator* also made extensive collections in the King George's Sound area, while James Drummond, Government Gardener in the Colony, collected assiduously for many years over a wide area of the south-west, sending his specimens to Hooker. By 1850 all the species of *Anigosanthos* and the closely related *Macropidia fuliginosa* had been carefully described and named by European botanists. With the publication of Bentham's *Flora Australiensis* in 1873, the purely botanical phase of the story of *Anigosanthos* and *Macropidia* was largely complete. We have in the intervening period, of course, come to know more about their distribution and biology. In their natural environment these plants have continued to excite the wonder and admiration of wildflower lovers and tourists to Western Australia. Diels (1901) and Gardner (1942) have described how they reach their main development on the sandy heath areas of the south-west of the State. Like many other Western Australian plants they are geophytes, their growth habit being characterised by the possession of more or less horizontally growing underground stem structures or rhizomes. Their leaves show the equitant or folded arrangement. The flowering stalk grows out of the sheathing leaves and may, as in the case of *A. flavida*, extend up to two to three metres in height. Owing to the woolly appearance of the inflorescences and the vivid colours they stand out conspicuously, particularly in sand-heath vegetation.

CAPTION TO COLOUR PLATE

The colour plate illustrates four of the species. The lower two *Anigosanthos rufa* on the left and *A. pulcherrima* on the right, illustrate "branching" heads of flowers typical of species in Section 1 of the following key to the species. The upper two species, *Anigosanthos preissii* on the left and *Anigosanthos bicolor* on the right, show the simple forked head of flower typical of all species in section 2 below.

ANIGOSANTHOS & MACROPIDIAKANGAROO PAWS

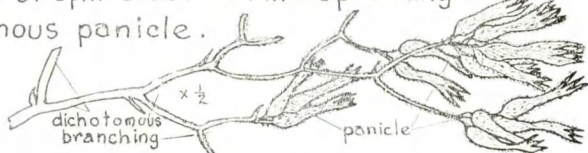
A. Ovules two or more in each cell.

ANIGOSANTHOS
SECTION 1.

A. Ovules solitary in each cell.

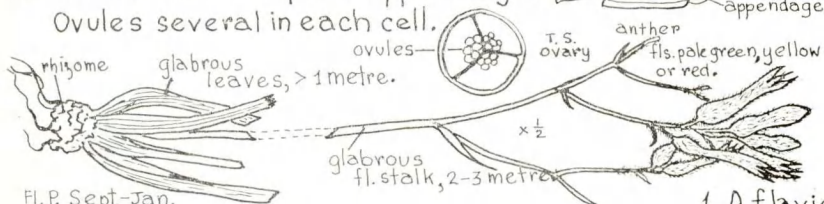
MACROPIDIA
SECTION 2.SECTION 1

A. Racemes or spikes several in a spreading dichotomous panicle.



B. Anthers with apical appendage.

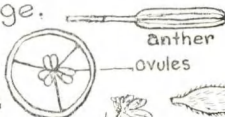
Ovules several in each cell.



Fl. P. Sept.-Jan.

B. Anthers without appendage.

Ovules two in each cell.

1. *A. flavida*
Giant Kangaroo Paw

C. Leaves glabrous.

Fls. red, purple or yellow.



C. Leaves mostly tomentose.

Fls. rich yellow.



Reading the key: All the paws are in Section 1, except the "black paw" *macropidia*. The paws fall in two groups, those with flowers on many "branches" and includes *A. flavida*, *A. rufa*, *A. pulcherrima* (as shown in the colour plates of these two species), and the others with the "flower head" on one stalk. Key item B distinguishes *A. flavida* from the other two species by the appendage on the anthers and *A. rufa* may be distinguished by its red colour or if in its yellow form, by its glabrous (without hairs) leaves as distinct from the tomentose (covered mostly with matted dense hairs) leaves of *A. pulcherrima*. *A. flavida*, above, also has glabrous leaves.



Photography by F. W. Humphreys
Anigosanthos preissii — *Anigosanthos rufa*

Anigosanthos bicolor — *Anigosanthos pulcherrima*

THE RED AND GREEN KANGAROO PAW

(*Anigsoanthos manglesii* Don.) selected as the State Emblem, may perhaps be described here to illustrate the habit, the flower structure and other features of interest. It grows as a low sub-shrub from an underground rhizome and its equitant leaves reach a height of 30 to 60cm. The flowering stem emerges from the leaves and grows up to approximately one metre in height. The flowers are borne as racemes or spikes at the apex of this single or once-forked flowering stalk. The flower stalk is clothed with woolly hairs of a deep red or purplish-colour. This colour continues on to the swollen bases of the flowers but then changes for the rest of the flower to a velvety green colour. The colour contrast makes a very striking impression. In the unopened stage the inflorescence gives the impression of a kangaroo's paw. When mature each six-partite perianth splits to expose the smooth pale green of the inside and the tips of the perianth parts fold back leaving the six bright yellow stamens protruding like prongs from their points of attachment.

The character of the stamens and the shape and length of the green perianth parts serve to distinguish the species from other closely related ones. The style is long and often projects out beyond the anthers. Tracing the style back we come to the inferior ovary and if we cut transversely across this we see that it has three compartments with two to several ovules in each cell (see illustrated key). This ovary-ovule character is constant for the genus and contrasts with the situation in the closely related genus *Macropidia* where there are three compartments each with a solitary ovule.

THE OTHER PAWS

The arrangement of the flower spikes mainly on a single stem as in *A. manglesii* is characteristic of three other species of the genus, namely *A. viridis* (the green or swamp kangaroo paw), *A. bicolor* (small two-colour kangaroo paw), and *A. humilis* (where the name is varied to cat's paw). This distinction is reasonably valid in separating the above species from *A. preissii* (Preiss's kangaroo paw), *A. flavida* (giant kangaroo paw), *A. pulcherrima* and *A. rufa*, all of which possess several spikes on spreading dichotomously branched panicles. In the first group, however, it may be noted that *A. bicolor* typically has a once-forked rhachis while even *A. manglesii* in the northern (beyond Geraldton) extension of its distributional range, shows a characteristic branching of the rhachis. Another character which is helpful in separating the species, relates to a curious little glandular appendage which is present on the end of the anthers of *A. flavida* and *A. preissii*.

THE BLACK PAW — MACROPIDIA

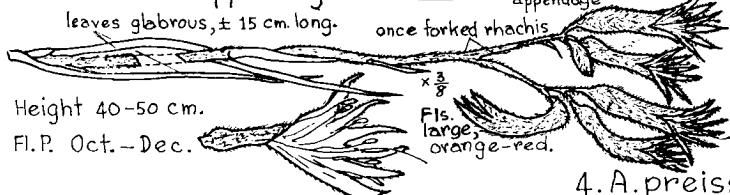
The genus *Macropidia* with its single species, *Macropidia fuliginosa* (Hook.) Druce—black kangaroo paw, was first described by Hooker in 1847 from material collected by James Drummond. It is a perennial with strong rhizomes rather like the garden iris, and strong fibrous roots. The equitant leaves are borne on corymbosely branched scapes about one metre tall which are covered with a sooty black wool. The flowers are pale yellowish green in colour and also covered with black plumose woolly hairs.

Botanically it is closely related to *Anigsoanthos* and the dichotomously branched panicle resembles that of *A. rufa*. The shape of the flowers is, however, recognisably different from that of *Anigsoanthos* and the perianth lobes are also split much more deeply. A section cut across the ovary shows, moreover, that there is only one ovule in each compartment in contrast with the two to several ovules per compartment for *Anigsoanthos*.

ANIGOSANTHOS & MACROPIDIA

- A. Racemes or spikes on simple or once forked rhachis.

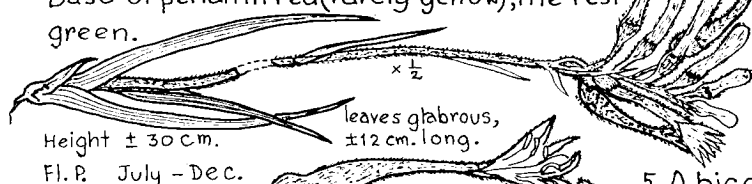
- B. Anthers with appendage.



4. *A. preissii*

- B. Anthers without appendage.

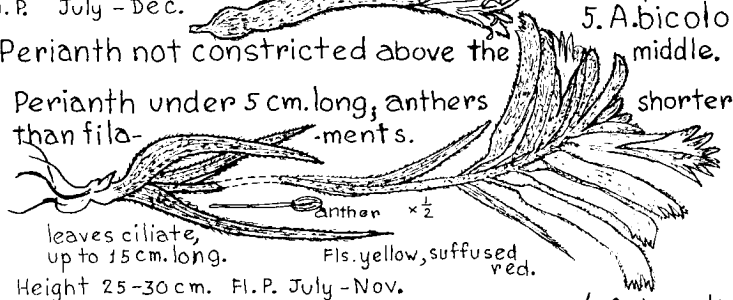
- C. Perianth much constricted above the middle. Base of perianth red (rarely yellow), the rest green.



5. *A. bicolor*

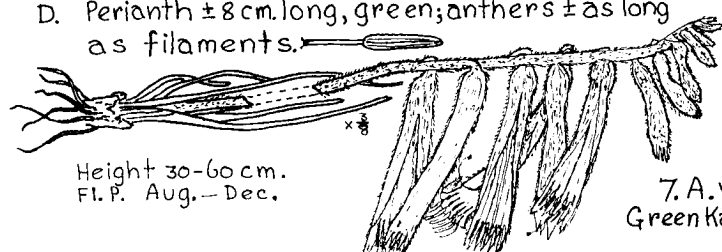
- C. Perianth not constricted above the middle.

- D. Perianth under 5 cm. long, anthers shorter than filaments.



6. *A. humilis*
Cat's Paw

- D. Perianth ± 8 cm. long, green; anthers ± as long as filaments.



7. *A. viridis*
Green Kangaroo Paw

Regarding the key: This second group of paws is also easily identified. *A. preissii* is the only species with an appendage to the anthers, and usually stands higher than *A. humilis*, the only other species it resembles. *A. bicolor* resembles *A. manglesii*, but is smaller, with the characteristic constriction (narrowing) of the perianth (the coloured paw-like flower comprising the flower head) before it spreads to reveal the bright anthers. *A. viridis* may be distinguished from its anthers—filament length, but is characteristically all green in various shades and smaller than *A. manglesii*, which it resembles in shape.

These pictorial keys are produced by the kind permission of Professor B. J. Grieve, University Press, Western Australia. They are typical of the thousands of illustrations that form Vol. 1 and Vol. 2 of *How To Know Western Australian Wildflowers*, by W. E. Blackall and B. J. Grieve. These books give a key to the flora of the Temperate Regions of Western Australia, and also carry many full colour plates of beautiful wildflowers. They are available at 30/- each, plus 2/6 postage.

WHERE THE PAWS GROW

The species of *Anigosanthos* and the single one of *Macropidia* show an interesting distribution as may be seen from the accompanying maps.

The tall growing *A. flavida* with its pale green-yellow (or sometimes red) flowers is commonly found in moister swampy areas in the deep south-west. *A. viridis* with bright green flowers and green stems also grows best on sandy clay soils which are wet in winter. *A. rufa* possessing a rich purple coloured indumentum to the flowers which are borne on scapes of about one metre in height, grows on low sand-heath extending in from the south coast. These sandy heaths appear quite dry and arid when the plants are in flower from October to December and the inflorescences show up more vividly perhaps for this reason.



FIG. 1: The above maps show the area of occurrence of kangaroo paw

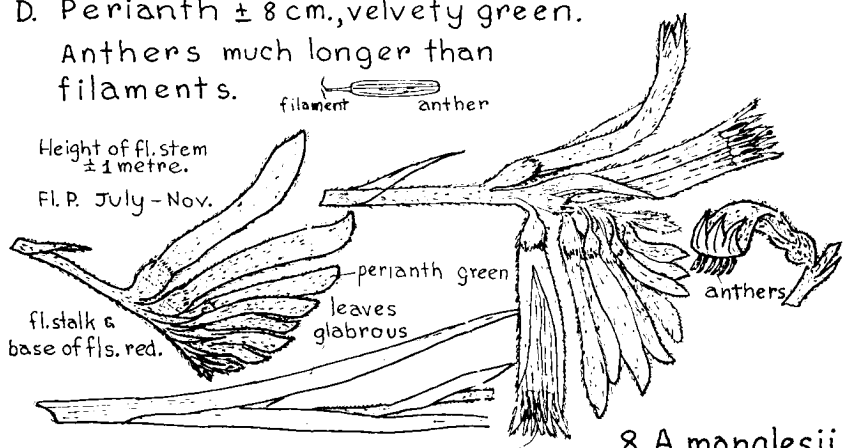
A. pulcherrima possessing a bright yellow perianth is among "the loveliest which this country can boast" as James Drummond wrote of it to Hooker. This species occurs on sand plains to the north of Perth in the Mogumber-Three Springs area. *A. manglesii* shows what appears to be a southern and a northern range.

A. humilis, the cat's paw, is common on sandy patches of the Swan Plain and has a wide overall distribution in the south-west. Although relatively inconspicuous in terms of height (± 30 cm.) and not as spectacular in its colour values (its flowers are yellow suffused with red) as the other species, nevertheless when well developed, as for instance on the Muchea and Yule

ANIGOSANTHOS & MACROPIDIA

D. Perianth ± 8 cm., velvety green.

Anthers much longer than filaments.

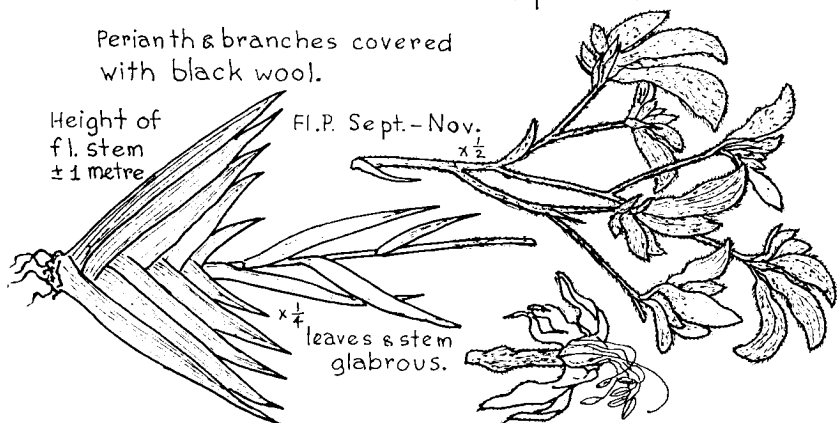


8. *A. manglesii*
Mangles' Kangaroo Paw

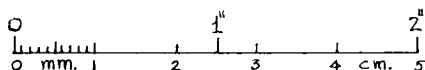
SECTION 2

Inflorescence a dichotomous panicle.

Perianth & branches covered with black wool.



Macropidia fuliginosa
Black Kangaroo Paw



sands at the University Botany Department reserve near Cannington, it can be quite impressive.

Of the other two species, *A. preissii*, with large orange-red flowers, is restricted to the area from the Stirling Range south to Albany, while *A. bicolor* (which resembles *A. manglesii* in colour but is smaller and its flowers are constricted above the middle) has a more diffuse extension from the Swan

Plain down to the Stirling area and on to Ravensthorpe. The restricted distribution of *Macropidia* in comparison with that of the different species of *Anigosanthos* is well brought out in Fig. 1, Map No. 1.

EXPERIMENTS IN GROWING THE KANGAROO PAW

The fascinating appearance of the kangaroo paws has naturally led to many experiments to try to grow them for interest and display purposes in areas rather distinct in climatic and soil characters from that of their natural environment. One of the most interesting of these experiments so far is at Yanchep National Park, 30 miles from Perth, where in the spring and early summer the massed flowers of successful transplants including *A. rufa*, *A. flavida* and *Macropidia fuliginosa* make an impressive display.

An interesting experiment at the Phytotron (a complex glasshouse system for growing plants under controlled environment conditions) in Pasadena, California, by Dr. Frits Went, when one of us (B.J.G.) was working there in 1956, also shows the possibilities for horticultural development. Plants of *Anigosanthos manglesii* were grown in sand or vermiculite nutrient culture in four different glasshouses under four different temperature conditions. In the hot glasshouse they grew at 73°F. during the day and at 63°F. at night. In the cool glasshouse the day temperature was 68°F. and the night temperature 57°F., while in the cold glasshouse the temperature was 63°F. (day) and 53°F. (night). The best growth and colour development in the flowers occurred in the cold glasshouse. It was not quite as good in the cool glasshouse. In the warm glasshouse the plant finally produced a flower stalk, while in the hot glasshouse little or no floral development occurred. It may also be noted that in the warm glasshouse much less red pigment developed in the hairs so that stems appeared pink and the ovaries orange, while also a much smaller number of flowers opened.

Dr. Went's experiments show that the flowers of *A. manglesii* can only be formed under cool temperature conditions. That is why the plant flowers in spring when the low temperatures in winter have induced flower formation.

These experiments may provide a guide to the interested grower as to how different environmental conditions are likely to affect the growth and colour values of the kangaroo paw flowers.

The red colour of the hairs on the stalk and swollen bases of the flowers in *Anigosanthos manglesii* is due to an anthocyanin pigment which has interesting properties. The pigment can change colour for instance, as it becomes more acid or alkaline. Dr. Went has carried out interesting experiments in which the red pigmented hairs on the stem can be changed to a purple colour using mild alkaline vapours. In mild acid vapour on the other hand, the stem hairs turn red again, as do also the green hairs on the perianth. He suggests that anyone who grows these plants can alter their colour to conform to the colour scheme of the room in which they are used.

Cytologically the species of the genera *Anigosanthos* and *Macropidia* show no diversity. Mr. J. Green working in the University Botany Department (Thesis, 1958) was able to show that the *n* chromosome number of all the species of *Anigosanthos* and *Macropidia fuliginosa* is 6. This interestingly enough contrasts with the variation in the chromosome number in the species of the closely related *Conostylis* (cone flowers) where the *n* numbers range through 4, 5, 7 and 8 to 14.

The ease with which fascinating hybrids may be obtained between selected

species was demonstrated some years ago at the Institute of Agriculture of the University of W.A. by the crossing experiments of Dr. Keith Finlay. He obtained viable seed from such crosses as *A. manglesii* x *A. humilis*, *A. viridis* and *A. flavida*. Although all the F_1 hybrids were sterile he could obtain viable seed by backcrossing to *A. manglesii*. There is clearly considerable scope here for the horticulturist interested in plant breeding.

So far as we are aware no colchicine treatment has as yet been applied to try and produce polyploids in the kangaroo paws, but there is possibly a valuable field of study here. The same might be said of treatments using gibberellic acid to discover whether this can bring about any spectacular growth effects as are now known for many other genera of plants.

While it is fortunate that our kangaroo paws respond well to cultivation, nevertheless continuing efforts need to be made to ensure their conservation (together with representative groups of all our unique plants) in their natural wild state.

The list of Nature Reserves in Western Australia (contained in the Report of the Academy of Science's W.A. Sub-committee on National Parks and Nature Reserves) shows that with the possible exception of *A. preissii*, good provision has been made for preserving species of kangaroo paws.

Some of the areas, including that of the University Botany Department Educational Reserve at Mt. Lesueur, where *A. pulcherrima* and *M. fuliginosa* occur are, however, C class reserves which could be lost as population pressure grows and land use increases. It is hoped that the sub-committee's recommendations to have such areas included in A class Nature Reserves will be implemented so that the plants may be preserved in perpetuity.

THE INK DISEASE OF THE PAWS

By W. P. CASS SMITH—Division of Biological Services, Dept. of Agric., W.A.

From the symptoms reported by your Editor of a disease experienced on kangaroo paws growing in gardens in the Eastern States of Australia, it would appear that it is probably the same disease that occurs on *A. manglesii* in W.A. It is commonly termed "ink" disease, and is attributed to the fungus *Mystrosporium adustum*.

This fungus has been isolated from diseased specimens on several occasions, but proof of pathogenicity by inoculation has not been carried out.

Our native iris plant (*Patersonia occidentalis*) is also a host and as this species is more widespread than *A. manglesii*, it seems probable that in many cases the disease on kangaroo paws originated from the native iris. In New Zealand both iris plant and *Lachenalia*s are hosts of the disease, according to a private communication I received from one of their research workers a few years ago.

This trouble has proved difficult to control, but in local trials some reduction of the disease has been obtained by spraying with copper oxychloride (1oz. in two gallons of water) or thiram (1oz. in three gallons of water).

A wetting agent, e.g., triton or agral added to these sprays increases their effectiveness, as the plants are rather hard to wet.

Other diseases recorded in W.A. on native plants were listed in the journal of the Western Australian Department of Agriculture, Vol. 5, No. 6 (June, 1963), pp. 401-408.

BLACK DISEASE OF KANGAROO PAW

By Dr L. R. FRASER—Senior Biologist, Department of Agriculture, N.S.W.

Kangaroo paw in cultivation in coastal New South Wales is subject to a disease known as Black Disease which is both disfiguring and debilitating. Species vary in their susceptibility, some showing very little of the condition and others suffering badly. The disease commences with the appearance of small black spots on the older leaves, sometimes so numerous that they coalesce over large areas and the leaves die off prematurely. It has the appearance of a fungus disease but although numerous attempts have been made to locate a fungus on or in the affected tissue microscopically and by cultural methods nothing has so far been found. The disease is most severe in damp and protected positions. A somewhat similar though milder disease sometimes occurs in *Kniphofia* varieties.

In an attempt to find some possible explanation seedlings were sprayed with a suspension of spores of the grey mould fungus *Botrytis cinerea* and maintained in a moist condition for 24 hours. Within a week small black spots developed on the spore-sprayed leaves whereas leaves sprayed only with water were unmarked. In this case also it was impossible to recover the fungus from the spots.

A possible explanation is that the grey mould spores germinate on the moist leaf surface and penetrate the surface cells, causing them to die and discolour, but that the fungus is not sufficiently strongly parasitic to become established in the leaf tissue and dies out as soon as this initial penetration and injury occurs. This type of reaction, which is a hypersensitive host reaction, is known to occur when *Botrytis* attacks some other species of plants. It is possible that other species of fungi could induce the same reaction. The ink-disease fungus *Myrothecium adustum* has not been observed here though it may occur.

The control of the disease presents great difficulty since the leaves can be attacked at any age. The obvious first approach would be to grow the plants in an open situation, well away from shelter, so that the leaves will dry out quickly after rain and dew. Spraying with captan or thiram at weekly intervals may have some value during periods when infection is particularly likely to occur such as during cool, damp weather in autumn or spring.

STUDY SECTION

For those who wish to learn more about growing wildflowers but do not have any experience, there are a number of special study sections. Each section is confined to a particular genus of wildflowers with competent leaders and with expert advice available. By sending a stamped and addressed envelope for reply, readers can join in the work of these sections. Complete instructions are given as to the best plants to grow, germination of seed, development of best forms, flowers, etc. Your only contribution is the growing of these plants in your garden as directed, and reporting results.

Why not join one or more of the following sections already established. Initial inquiries c/o the Editor:—*Acacia*, *Banksia*, *Blandfordia*, *Boronia*, *Cassia*, *Correa*, *Dampiera*, *Dryandra*, *Eucalyptus*, *Grevillea*, *Leptospermum*, *Melaleuca*, *Nuytsia*, orchids (epiphytal), orchids (terrestrial), photography, street trees, *Stylidium* (trigger plants), *Telopea*.

Support the new *Dampiera* section leader, Mr. D. Ali, 12 Vine Street, Klemzig, South Australia, by joining or by sending him fresh cuttings from plants in your garden or your area. Who will engage in a study of *Nuytsia*, W.A. Christmas bush, with J. L. Lucas, 1 Botany Court, Clayton, Victoria, or send him root suckers or cuttings?

Who will join a new group in *Anigosanthos* (kangaroo paw), *Hovea*, or name your favourite genus? I have some interesting work prepared for those interested.

YOUR GUIDE TO NATIVE PLANT SEEDSMEN

Nindethana Box 5, Dripstone, N.S.W. For all Native Seed. Packets, ounce or pound lots. Free list on application. Special supplies of West Australian Seed.

Australian Seed Co. Robertson, N.S.W. Bulk or packet lots. Stamped envelope brings lists.

Western Wildlife Supply, Gilgandra, N.S.W.—Bulk supplies of natives and exotic tree and shrub seed to the trade—Special collections to order.

Kings Park Seed Supply, King's Park, Perth, Western Australia—Seed list 1/6, post free. Seed 3/- pkt.

WILDFLOWERS FROM SEED

Experience by R. N. Smith, Hobart, Tasmania

I had been obtaining poor results in raising wildflowers from seed by using conventional methods so, in 1961, I tried three methods:—(1) The standard or conventional method; (2) The bog method as described in *Australian Plants*, issue No. 3; and (3) The "full sun method" as described in *Australian Plants*, issue No. 7.

BOG METHOD

Seed pans generally Willow brand baking or cake tins in galvanised iron, unpainted. Sizes about 8½in. x 4in. deep, 7¾in. x 7¾in. x 3in. Pans had ½in. dolerite quarry crushed gravel for drainage then filled to about ½in. from tip with vermiculite soaked for a few hours in standard Aquasol and Formula 20, then ½in. finely grated sphagnum moss, then seed.

The pans (probably containing four rows, each a different species) were put in a plastic basin, 8in. deep, and filled with water to wet or damp top level, top of basin covered with clear plastic sheet, held on by elastic, and put against house wall on SE side and shaded with carton on a very hot sunny day. When seedlings begin to appear cover is loosened and moved back over two weeks then gradually transferred to full sun.

FULL SUN METHOD

Pans and drainage, etc., as above; but all hard-seeded types soaked in just off boiling water from overnight to several days. Seed sown in vermiculite with sphagnum and vermiculite, covered to twice seed depth. Fine seed sown on top of sphagnum. Pans were put out on planks in the garden in full sun, about 2-3ft. above ground level.

Watered usually every morning with a fine hose.

When seedlings were 1in. to 2in. high they were put into jam tins or veneer tubes and given two days' dark under the house before moving to full sun. The potting medium for both methods was coarse river sand with sieved rotted gum leaves added (about 20 per cent) and immersed in Aquasol and Formula 20 till all bubbles ceased.

Following the 1961 trials I abandoned the standard method for the other two that gave much better results. The use of sphagnum moss was also abandoned as it tended to form a skin in hot weather which prevented water reaching the seedlings. 67 pans were sown using the full sun method and 6 using the bog method. The pans are not really deep enough and rust in about three years.

BOG METHOD: As before but changed rapidly to full sun after germination, say 2-3 days.

FULL SUN METHOD: As before but Banksia, waratah and Dryandra as described in *Australian Plants*, issue No. 1, with Banksia needles and not tinned until 3in. high. Banksia have been very good, whereas by the old standard method I lost nearly all by damping off in semi-shaded conditions.

The two days' darkness was abandoned because of the work involved with more than 1,500 seedlings; it being sufficient to put them in semi-shade.

Species germinated in the bog method include *Callistemon* 4 sp., *Kunzea* 3 sp., *Leptospermum* 6 sp., *Melaleuca* 20 sp.

Species germinated in the full sun method include *Acacia* 24 sp., *Anigosanthos* 3 sp., *Aptosrocinum*, *Aconis*, *Albizia*, *Blandfordia*, *Boronia* 2 sp., *Brachysema* 2 sp., *Calothamnus* 6 sp., *Darwinia* 2 sp., *Daviesia*, *Dryandra* 3 sp., *Eucalyptus* 27 sp., *Gompholobium*, *Hakea* 3 sp., *Hardenbergia*, *Howea*, *Indigophera*, *Lambertia*, *Mirbelia*, *Pimelia*, *Phebalium*, *Sollya*, *Stirlingia*, *Swainsona*, *Templetonia*.

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Terrestrial Orchid Seedlings

By WARREN P. STOUTAMIRE, *Cranbrook Institute of Science, Bloomfield Hills, Michigan, U.S.A.*

Epiphytic and semi-epiphytic orchids have interested horticulturalists for many years but terrestrial species have been largely ignored, both in research and in horticulture. There are several reasons for this disparity, one of which is the fact that the epiphytes often have large, showy flowers of commercial value while the majority of ground-growing species are less spectacularly flowered. Another reason is that seedlings of epiphytes are usually immediately photosynthetic upon germination and are able to produce at least some of their own food. This leads to comparatively rapid initial growth and simplifies their cultural requirements. Some terrestrial species also produce chlorophyll in the early stages of germination but the majority do not and this produces unique cultural problems. Plants of this type would form mycorrhizal association with fungi in nature and grow for indeterminate periods underground. These species initially grow much more slowly in sterile culture and their behaviour has discouraged most of the people who have tried to work with them. The slow growth coupled with the very inadequate knowledge of their physiological requirements has delayed our interest in this large group of orchid species.

Very little is known about the initial stages of germination of terrestrial orchid seed in natural conditions. Seedlings of from one to several millimeters have been repeatedly found, usually about the base of mature plants. These seedlings are already quite advanced, however, and have already formed the mycorrhizal association with a fungus. The minute size at initial stages makes their detection very difficult. We do not know what physical conditions operate in nature to start the germination process, nor do we know much about the delicate balance between fungus and the apparently parasitic orchid seedling.

I have been interested in our natural North American terrestrials for several years, and have experimented with various sterile media in attempting to germinate seed. European species have been included in the study, and recently a number of Australians have airmailed seed of terrestrial species for experimental work. A number of these are beginning to grow and this paper is primarily a description of the techniques used in germinating the seeds, as well as a description of the young plants.

Of the media tried to date, Knudson C has been most used in assaying the germination of seed samples. Burgeff's N₃f medium and White's medium plus vitamins have also been used. My general impression is that seeds which germinate on one usually grow on all media, although not necessarily at the same rate. Most of the Australian seedlings illustrated here were produced on White's medium. The species also grow on Knudson C in the few cases which have parallel cultures on both media.

Drs. Downie and Vermeulen, working with European terrestrial species, found that some would begin growth in distilled water. This has been checked here by sterilising seeds and placing them in sterile distilled water blanks. Some species begin growth by swelling, bursting the seed coat, producing rhizoids, and developing chlorophyll. Vermeulen found that germination was speeded up if sterilised seeds were kept in distilled water several days before being placed on nutrient agar. A germination-inhibiting compound may be involved here, which is washed out by the water. North American species which begin growth in water continue to grow when transferred to a nutrient agar medium. I have not had time to adequately test the Australian species, but water germination seems to be less frequent in the species which I have, than in northern hemisphere orchids. A wider selection of species may change this.

Details of propagating media are given at the end of the article.

I have not attempted the fungus-orchid cultures used by others for several reasons. The fungus growth must be carefully controlled to prevent its overbalancing the slow orchid development. Fungal cultures have a disconcerting habit of changing their physiological characteristics when subcultured for any length of time, and the introduction of the fungus greatly complicates the biological relationships in the culture flasks. It is more to the point to determine the basic temperature, light, moisture and food requirements of these plants before adding another organism.

The significance of acidity is poorly understood in terrestrial orchid culture, and should be thoroughly studied. Withner, cited below suggests that pH may be of more significance in regulating the availability of insoluble compounds than in having a direct effect on growth.

Some North American orchids grow in a wide pH range, while other species are found in very limited pH ranges. An example of the latter is *Cypripedium acaule* which occupies two superficially dissimilar habitats in Michigan—wet sphagnum mounds, and dry sandy woods. Both of these habitats have pH values of 3.5-4, however. On the other hand, I have recorded *Cypripedium calceolus* from soils with a pH range of 4-8. Ideally, a series of media with varying pH ranges should be tested with each species. Hydrogen ion concentration may be very important for some species and less so for others. I have tested fresh soil samples for the past year and am beginning to appreciate the significance of why certain species are so local. Some of our orchids, frequently surrounded by highly acid *Sphagnum*, are actually rooted in neutral muck soils below. The whole subject of soil pH needs to be investigated.

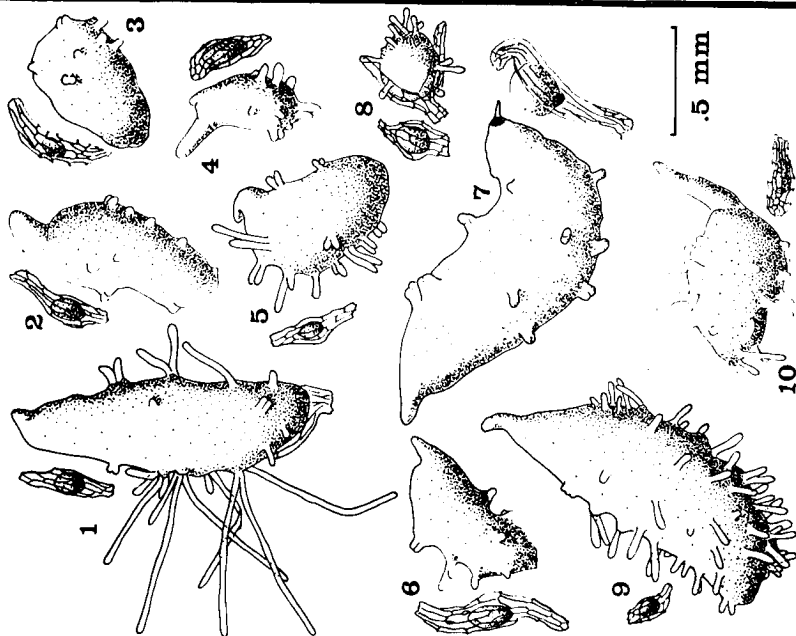
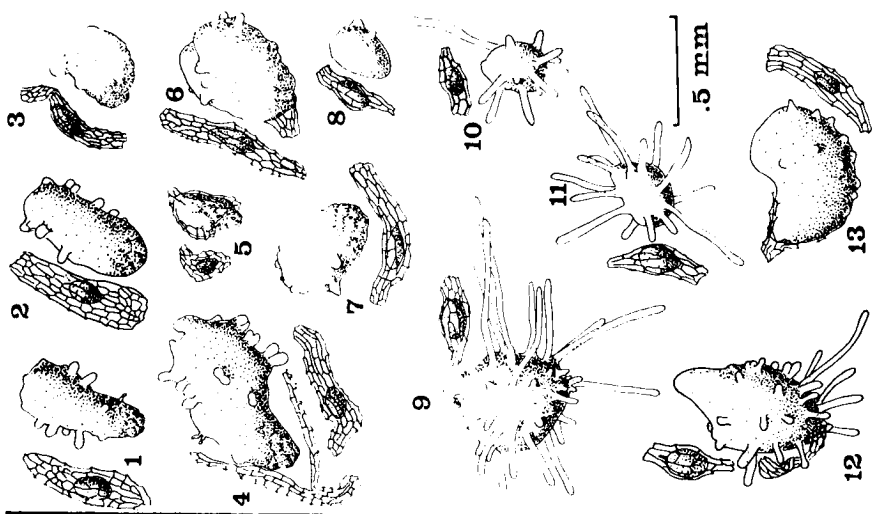
The amount of light required by photosynthetic orchid seedlings is not high. They grow quite well for me under 300-700 foot candles of illumination supplied by fluorescent lights, timed for 12 hours of light. The non-photosynthetic species appear to be insensitive to light, and grow as well or poorly in light or darkness. Cultures in office windows and under fluorescent lights grow in temperatures varying from 60-90°F., but growth appears to be slightly better in a controlled temperature room at 68°F.

PREPARATION OF SEED

All seed is sterilised by shaking for 20 minutes in a 7.5% calcium hypochlorite solution, carefully pouring off the solution and shaking the seeds with two changes of sterile distilled water to remove excess hypochlorite. Great care must be taken during the washing to prevent contamination, and to reduce the inevitable loss of seed. Bottles of sterile media and tubes of distilled water are then inoculated with the hopefully sterile seed, and then begins a vigil of anywhere from one to 12 months to await developments. Cultures are checked frequently during the first month to watch for contaminating bacteria and fungi. If contaminants are discovered at an early stage, most of the seeds can usually be transferred to a fresh bottle, eliminating the infection.

PHOTOSYNTHETICS

I would divide terrestrial seedlings into two groups depending on whether the embryos develop chlorophyll during the first month or not. Our North American species which do this are characteristically plants of sunny and wet situations, where seedlings could be expected to survive at the surface for several months without drying out. It would be very interesting to know whether photosynthetic seedlings are also characteristic of Australian orchids from similar habitats. This class of chlorophyll producers grows comparatively rapidly in culture. The greater number of species so far tested do not immediately develop chlorophyll however, and this results in slower and often strange forms of growth. The species with this type of growth will be dependent on food sources in the media for periods ranging from several months to several years. All the Australian species illustrated here are still colourless, with the exception of some plants of *Thelymitra rubra*, *Pterostylis falcata* and *Caladenia patersonii* which are beginning to develop small amounts of chlorophyll. *Thelymitra rubra* was drawn from a protocorm growing in distilled water which had become contaminated with a fungus. Protocorms were visibly green, unlike parallel cultures on agar. Either the water or fungus may be responsible for this differential growth.



TERRESTRIAL ORCHID SEED GERMINATING

Comparative seedling morphology is discussed in the text. Each species is represented by an ungerminated seed, consisting of a spheroidal embryo surrounded by the transparent seed coat, and a growing plant from the same culture, all drawn to the same magnification.

Legend for Figure 1: Number following species name is my accession number, followed by seed collector and number of days seed has been in culture.

1. *Caladenia patersonii*. 4226. F. Coate. 94 days.
2. *Caladenia patersonii*. 4156. E. B. Mills. 131 days.
3. *Caladenia patersonii*. 4164. B. J. Dudman. 131.
4. *Caladenia patersonii*. 4180. E. B. Mills. 131.
5. *Caladenia cardiochila*. 4154. E. B. Mills. 131.
6. *Caladenia carnea*. 4163. B. J. Dudman. 131.
7. *Caladenia carnea* v. *gigantea*. 4181. E. B. Mills. 131
8. *Calochilus campestris* x *padulosa*. 4221. L. Sweeney
9. *Caleana major*. 4165. S. Clemesha. 131.
10. *Microtis unifolia*. 4167. S. Clemesha. 131.
11. *Pterostylis curta*. 4129. L. I. Cady. 196 days.
12. *Pterosyllis falcata*. 4194. S. Clemesha. 131.
13. *Pterostylis nutans*. 4160. H. C. England. 131.
14. *Pterostylis pedunculata*. 4158. H. C. England. 131.
15. *Pterostylis boormanii*. 4184. S. Clemesha. 131.
16. *Pterostylis nana*. 4159. H. C. England. 131.
17. *Pterostylis furcata*. 4158. S. Clemesha. 131.
18. *Thelymitra flexuosa*. 4162. B. J. Dudman. 131.
19. *Thelymitra pauciflora*. 4161. B. J. Dudman. 131.
20. *Thelymitra nuda*. 4178. E. B. Mills. 131.
21. *Thelymitra rubra*. 4156. B. J. Dudman. 94.
22. *Thelymitra ixioides*. 4179. E. B. Mills. 131.
23. *Diuris sulphurea*. 4182a. E. B. Mills. 131.

OBSERVING ORCHID SEED DURING GERMINATION

The species of *Caladenia*, *Caleana*, *Microtis*, *Pterostylis*, *Thelymitra* and *Diuris* begin growth by a general swelling of the tiny mass of cells within the transparent seed coat. The cells begin to divide and the enlarging mass splits one side of the seed, protrudes, and ultimately pushes the coat aside. Elongate absorbing hairs or rhizoids are produced along the sides of the ovoid structure which is called a protocorm. Cells at one end begin to divide actively and from this organised centre the first leaf primordia will be produced. The protocorms are too small and undifferentiated at this writing to have produced root primordia.

Inter-generic differences appear in the protocorms illustrated. *Pterostylis* species are characterised by short rhizoids while the *Thelymitra* protocorms are producing much longer rhizoids. *Thelymitra flexuosa* plant is too immature to have developed normal rhizoids. Paired as well as single rhizoids are present in all *Caladenia* and in some *Pterostylis* protocorms but these paired structures are lacking in *Caleana*, *Microtis*, *Thelymitra* and *Diuris* species grown under this particular set of cultural conditions. New structural differences may appear as the protocorms become better differentiated.

Terrestrial orchid species are often very specialised in their ecological requirements, and are in an exceedingly delicate balance with the environment. Changes brought about by man are usually detrimental, resulting in some of our orchids becoming either rarer or being eliminated completely from large areas. It is very important that we try to discover everything possible about the growth of these plants if we are to intelligently discuss their preservation. I think that a good place to start is at the seedling stage, where the greatest mortality occurs in nature, and which is the stage most easily handled in the laboratory. I hope to continue working with the unusual Australian orchid flora and will welcome identified seed samples from anyone who would like to airmail them to me.

I wish to thank Dr. P. B. Kaufman of the University of Michigan Botany Department for his help in providing samples of White's medium, and Dr. A. G. Norman of the University Botanical Gardens for providing space in controlled temperature rooms. I would also like to express my appreciation for the assistance I have had from many Australians in providing me with seed and information about native growing conditions of the terrestrial orchids.

MEDIA

MEDIA

Knudson C (reprinted in Withner C, 1959, <i>The Orchids</i> , p.595.	N3f (Burgeff, H., 1936. <i>Samenkeimung der Orchideen</i> , p.294.
Monopotassium acid phosphate 0.25 gm.	I. Magnesium sulphate (MgSO ₄ -7H ₂ O) 0.25 gm.
Calcium sulphate 1.00	Potassium chloride (KCl) 0.25
Ammonium sulphate 0.50	Ferrous sulphate (FeSO ₄ -7H ₂ O) 0.02
Magnesium sulphate 0.25	Calcium nitrate (Ca[NO ₃]2-4H ₂ O) 1.00
Ferrous sulphate 0.025	Ammonium sulphate ((NH ₄) ₂ SO ₄) 0.25
Manganese sulphate 0.0075	II. Citric acid 0.09
Sucrose 20.00	Dipotassium acid phosphate (K ₂ HPO ₄) 25
Agar 17.50	
Water 1000.00 ml.	

I and II are each dissolved in 500cc. of distilled water and the two solutions are then combined. To this is added 10 grammes of glucose, 10gm. fructose and 12gm. agar.

White's medium is considerably more complex, and too involved to describe here. Its preparation is described in *The Cultivation of Animal and Plant Cells*, Philip R. White, 1954. The Ronald Press Co., New York. The modified version used here contains a standard salt and trace element mixture, plus ferric citrate, pyridoxine, calcium pantothenate and biotin. I reduce agar to 8gm./litre in all above media. The range of acidity in the above media is pH5-5.5.

PRESERVATION BY CULTIVATION

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My Encounter With Galeola

By L. P. BUTT

The dense rainforest belt of South-east Queensland produces many beautiful plants and quite a few unusual orchids. One we found when rambling through the upper reaches of Currumbin Creek in the region known as "Garden of Eden". It proved to be the largest of the native species of *Galeola*—*Galeola foliata*. This giant climbing orchid is almost "leafless" having only an occasional fleshy "leaf" (actually, they are bracts) protruding from its stout vine-like stems.

The specimen found was at least 40ft. long and must have been dislodged from a large tree. Great branching panicles of blooms were all over the track and a honey-like perfume was very evident. The flower was 2½ins. across the brilliant yellow sepals and petals. The fringed labellum was cherry red and marked with faint lines. The plant has also been known as *Galeola ledgeriana*.

Galeola cassythoides is a smaller species with stems growing up to 15-20ft. The vine is dark in colour, the flowers similar to the other species but small in size. Colour is brownish yellow, the labellum being broad and with undulated lateral lobes. The stems are entirely "leafless". There are only two species of *Galeola* native to Australia.

These plants are saprophytic on decaying wood and usually climb up dead or live trees, flowering on the vine where it is exposed on the trunks of the trees. Actually the life cycle of these plants is very short as they are dependent on their very existence for wood at a certain stage (and that stage only) of decay. *G. cassythoides* has a much longer life cycle and could possibly be semi-parasitic on the roots of trees.

Could it be there is just a dormant season when they die back right to the ground and that they spring forth with sudden vigour in early spring flowering generally from November till late January. This plant deserves all the protection we can give it, as it is exceptionally beautiful, and who knows one day we may find the secret of its growth and support it artificially to scramble over our fernhouse.

AUTHOR'S NOTE: the usual size of *G. foliata* bloom is less than 2in., but on this occasion the largest flowers could have been up to 3in. across and G. Ashlev and E. Holden (also of S.G.A.P.) with me at the time, were most impressed. Was it a special variety? Who else has seen such large flowers?

THE ORCHID GALEOLA FOLIATA

By A. W. DOCKRILL, Cairns, Queensland

This is essentially a plant of the rain forests, dependant on wood at a certain stage of decomposition for its existence. It is most frequently seen climbing trees or straggling along the ground or over tree stumps or logs along old timber tracks. It is not a common orchid, even though seen in fair numbers in some areas, and its short life cycle and manner of growth render it a most unsuitable (well nigh impossible) horticultural subject and every effort should be made to preserve it in its natural habitat.

GALEOLA FOLIATA (F. Muell.), F. Muell., *Fragm.* 8:31 (1873)

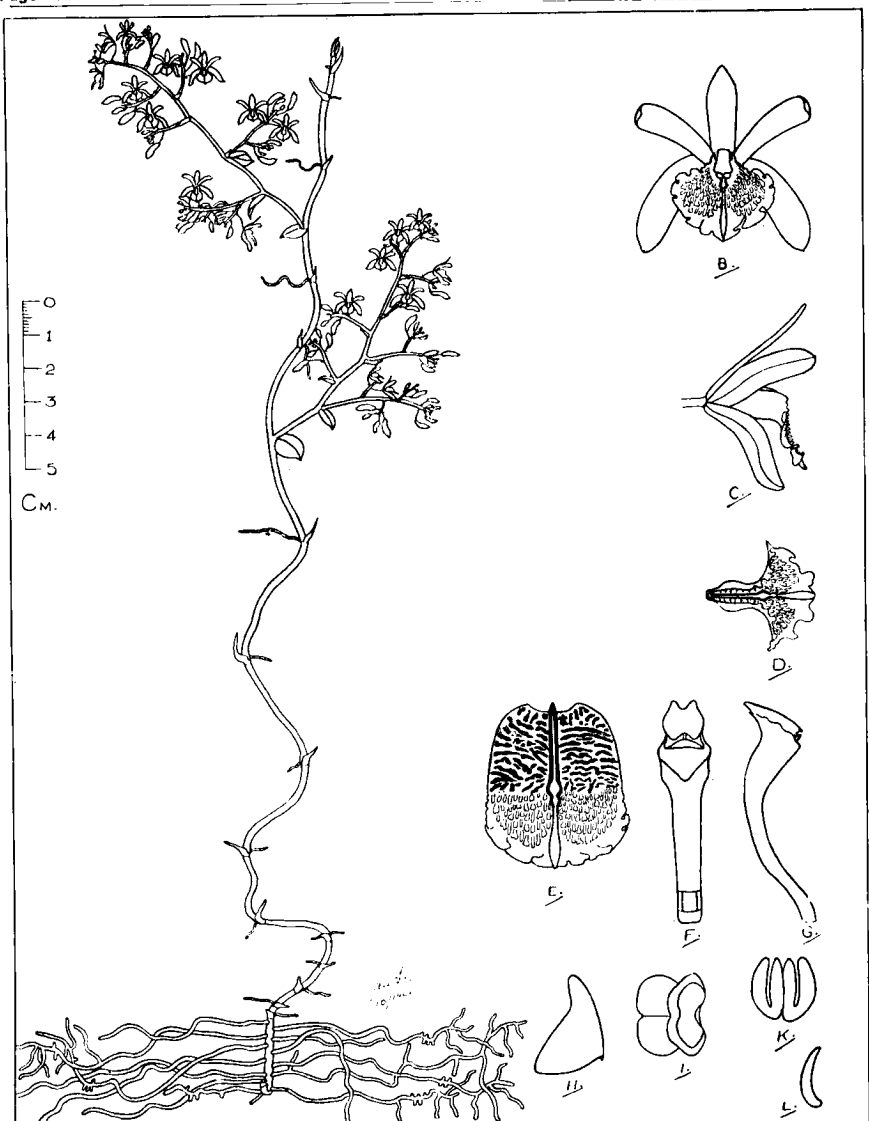
Syn.: *Leogeria foliata*, F. Muell., *Fragm.* 2:167 (1861)

Galeola ledgeriana, F. Muell., *Fragm.* 9:127 (1881)

Galeola ledgerii, Fitz., *Aust. Orch.* 2, Pt. 2 (1885)

DISTRIBUTION: From the Bellinger River, N.S.W., to far North Queensland.

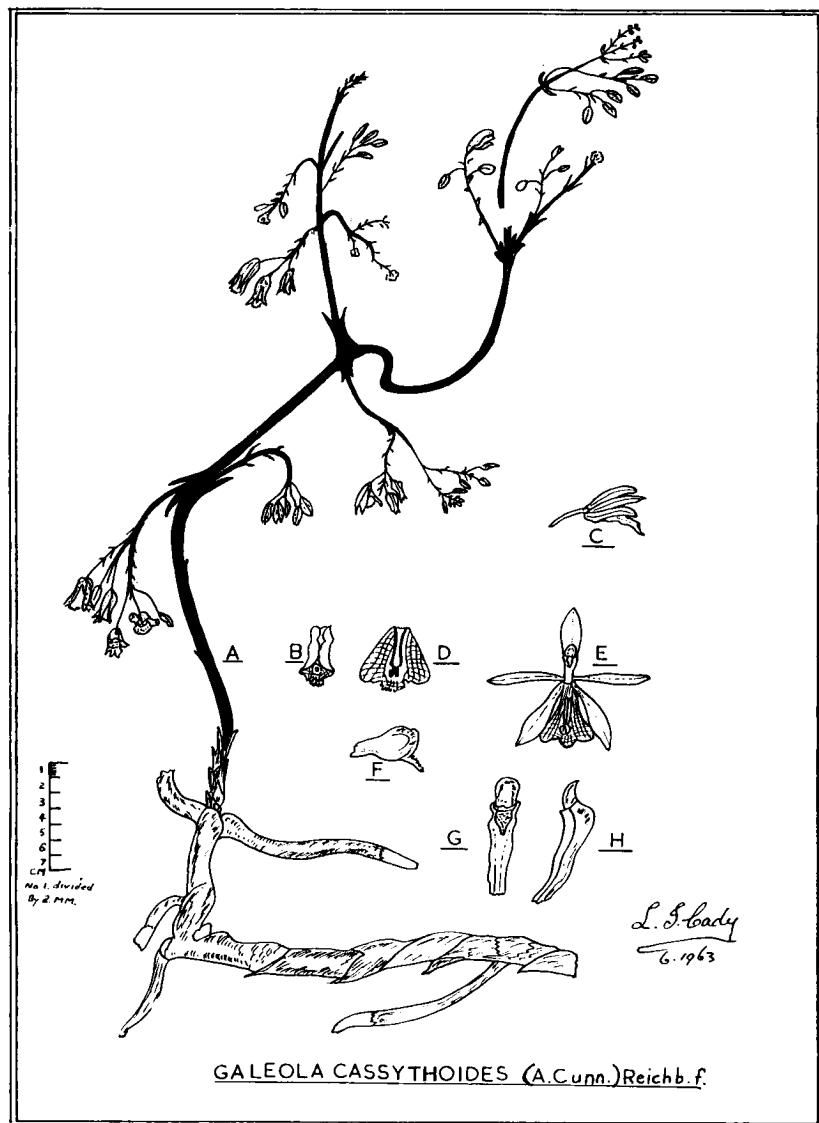
FLOWERING PERIOD: October to January.



- A. A very small plant to scale $\times \frac{1}{4}$ indicated scale
 B. Flower from the front to scale $\times 2$
 C. Flower from the side to scale $\times 2$
 D. Labellum from above to scale $\times 2$
 E. Labellum flattened out to scale $\times 3$
 F. Column from the front to scale $\times 5$

- G. Column from the side to scale $\times 5$
 H. Anther from the side to scale $\times 10$
 I. Anther from above to scale $\times 10$
 J. Pollinia from the front to scale $\times 10$
 K. Pollinium from the side to scale $\times 10$

A very large saprophyte with yellow (sometimes green) extensively creeping stems up to 15m. x 6-10mm.; bracts 3-6mm. long, subcordate, often green. Roots long, thick, brittle, and towards their apices, usually extensively branched; those of the stem (which adhere to the bark of trees or logs, etc.) much shorter, thinner and sometimes much branched. Inflorescences paniculate, 10-180 x 8-90cm., containing up to 150 flowers, so that a large plant could have thousands of flowers. Flowers usually about 2.5cm. diam., golden yellow with pink and red markings on labellum, widely expanding. Sepals subsimilar, about 20-25 x 4.5-5.5mm., linear, the dorsal one acute, the lateral ones obtuse. Petals similar to lateral sepals but a little shorter and narrowed. Labellum about 16 x 16mm., almost tubular in basal half (column enclosing), expanding into a semi-orbicular apical lamina which has crested, undulate and contorted margins; basal half pink with red markings, lamina pink with numerous short, thick and blunt yellow calli, the fringe yellow; disc with two high parallel ridges. Column projected forwards, about 13mm. long, slender, rather large, broad-crescentic. Stigma obdeltoid. Rostellum upcurved, rather large, broad-crescentic. Anther very tall, peaked, with a broadly befid appendage; rostrum very small. Pollinia two, each deeply and broadly cleft, farinaceous.



KEY TO PLATE

- | | |
|---|------------------------|
| A. Plant natural size to scale (showing small part of base of plant and tip). | F. Labellum, side view |
| B. Labellum, natural position. | G. Column, front view. |
| C. Flower, from side. | H. Column, side view |
| D. Labellum, flattened out. | |
| E. Flower opened out flat. | |

TERRESTRIAL ORCHID GROWERS

From D. L. JONES, Balwyn, Victoria.

A plant of *Pterostylis nutans*, when separated from its bulbs and placed either in a jar of water or planted, has been observed to continue growing and produce bulbs. This has been observed also in *Pterostylis pedunculata* and *Acianthus exserius*.

EDITOR'S NOTE: This small item above could be the most important reference in this journal. Will all readers experiment with this procedure and report result. The multiplication of plants is the major obstacle to the wider growth of terrestrial orchids. Various stimulants and fertilisers could also be tried. This is a simple experiment that I hope all terrestrial orchid growers will join in.

While on the subject—we are working too much in the dark when speculating on what happens to the bulbs when under the ground—especially in the dormant season, which seems to be when most plants are lost. Experiments in removal of bulbs, storing, treating and observing should be commenced. Who will join in?

COOKTOWN ORCHID IN NORTHERN N.S.W.

Prepared for The Northern Rivers Orchid Society by G. Hobb.

I find your Brisbane method of culture for this hard cane *Dendrobium* quite suitable for the Northern Rivers (Lismore) area, except for one very important section, that under the heading of Port and Basket Culture. We find pots quite unsuitable as we get much better results growing them on Prickly Teatree and red cedar blocks, both of which grow in this area. Select limbs about 4in. thick, cut green and leave the bark on, which is paper-like on teatree but rather smooth on cedar. Saw into lengths about 6in. or 8in. long according to the size of the plant, and attach a staple in one end to hang the block up. Tie the plant firmly to it in an upright position with the base of the plant about half way up the block and with the lead eye facing outwards. Use nylon line or copper wire for tying. I prefer fine plastic covered wire such as is used by the P.M.G. No fibre of any kind is used to cover the roots. When the roots come on the new growth they will run round the wood, firmly attaching the plant. The wire can then be removed.

As the plant continues to grow more pseudo bulbs each year, it builds itself out from the block with the roots going back and downwards on to the wood, some growing downwards and away from the block as if enjoying their freedom of growing in the air.

SITUATION: I have them hanging in a glass-house with plenty of light. Do not paint or shade the glass too heavily or it will darken the flowers and cause weak growth. Lightly paint the glass with white paint to break the sun's rays and prevent burning. They have complete protection from orchid beetle and other insects which nip off the flower sprays while they are young and tender. It also allows them to be kept dry on the dry side during their resting period. Make sure the glasshouse has sufficient ventilation.

FERTILISING: Regular applications of any of the liquid fertilisers on the principle of weak and often during the growing season.

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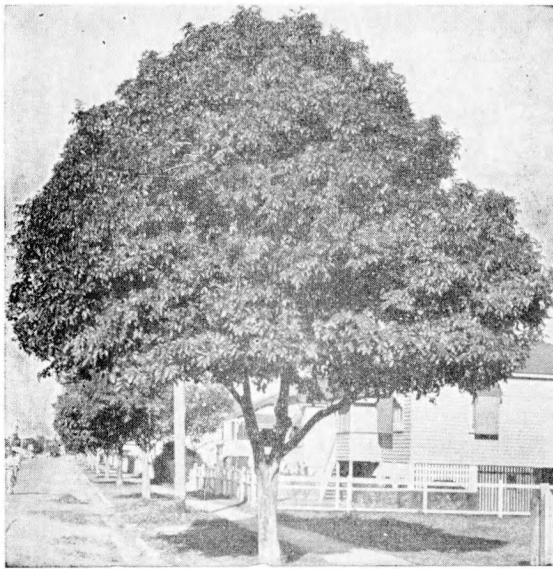
A WIDE RANGE OF EXOTIC SHRUBS AND PERENNIALS ALSO IN STOCK

SEND STAMPED, ADDRESSED ENVELOPE FOR LIST OF NATIVES

STREET TREES — *Harpullia pendula*

By H. OAKMAN, A.I.L.A.

Harpullia pendula, or tulipwood, has been fairly extensively planted as a street tree in many Queensland cities and there are quite a number of well-grown avenues in Brisbane and other towns as far north as Cairns and south down to Grafton. Its native habitat is the coastal fringe of Queensland and Northern New South Wales, where it does exceptionally well in sand dunes and on the rainforest fringes.



The tulipwood is very suitable for street planting as it is a vigorous grower under the harsh conditions obtaining on footpaths and surfaced roadways. It seldom becomes a nuisance as its growth is distributed into numerous twiggy stems instead of sturdy branches that would quickly force growth into overhead wires and demand regular pruning back. Pruning is seldom required as the growth is very even and relatively slow when compared with such fast growers as *Bauhinias*.

Under normal conditions growth is fairly rapid but when young trees are interrupted in their early growth there is a tendency towards dormancy from which it is very difficult to force them into activity again. In its natural habitat the tulipwood sometimes reaches a height of 80 feet, but this is generally induced by forest conditions under which competition for light forces the growth upwards.

The tulipwood is an evergreen and makes an excellent shade tree. The bark is smooth, brownish-grey in colour and quite attractive. Occasionally the young leaves are colourful in reddish-brown tonings, the mature leaves are deep green, shiny, three inches long and pinnate. Flowers are inconspicuous but the yellow to reddish fruit capsules are very colourful. These

EDITOR'S NOTE: Queensland trees will be featured in every issue, the next issue commencing a series by the Department of Forestry, Queensland.

contain one or two round, shiny, black seeds which germinate readily and retain viability for a considerable time.

However, it is less successful as a showy ornamental subject. There are odd trees that bear prodigious quantities of bright berries and these are a sheer delight. Such trees could eventually become the parents of future avenues.

Asexual propagation was seldom practised in the past, it being so much easier to grow large quantities of young trees from seed, consequently the present avenues consist of trees with variations in growth, time of berry production, colour and quantity of berries, and some trees carry small quantities of berries throughout the year while others crop heavily over a short period during November.

As a rule these trees prefer areas of good soil but in Brisbane this simply means relatively good soil as opposed to the schist zones where growth of any kind is difficult and where only the hardier trees can be grown after large holes have been prepared and filled with imported soil. It is relatively pest-free, consequently spraying is unnecessary.

It is very seldom that the roots of the tulipwood cause any annoyance or drainage trouble, but there have been a few instances where their roots have entered into poorly laid drainage pipes and caused blockages.

Timber is close-grained and has been used for cabinetmaking and tool handles.

EDITOR'S CRY FOR SUPPORT

If you appreciate my efforts in producing this journal for you entirely in an honorary capacity, then I request your support in the following respects:—

SALES

Until Volume No. 2 is completed and bound ready for sale I will have a difficult time financially. Sales are the key to success. The next issue, December, will again carry the Christmas greetings plaque to enable you to use it as a Christmas card. Send Christmas greetings with flowers in colour pictures. Bound copies of Volume 1 are also available as beautiful presents and a copy of the December issue with the greetings plaque completed will be sent with each book sent as a present.

FLOWERING SPECIMENS

During the current flowering season I need flowering specimens of the following plants to illustrate future articles for you. Please send a good spray in a jam tin, parcel post, cost 5d, to Mrs. H. Spurway, 11 Stellmack Street, Everton Park, Brisbane, Queensland. If you are not sure of the name you can also send a spray to me and it will be identified for you.

Hovea—The beautiful mauve or purple pea flowered shrubs: *H. chorizemifolia*, *H. pungens*, *H. acanthoclada*, *H. trisperma*, *H. stricta* and *H. elliptica*, all from W.A.; *H. acutifolia*, near Caloundra; *H. heterophylla*, from near Brisbane; three forms of *H. longifolia* at Helidon, near Toowoomba, and *H. longipes* from the vicinity of Peppel Bay, Maranoa, Burdekin and Fitzroy Rivers, and near Rockhampton and Canarvon, Qld.

Westringia: Those beautiful bushes that closely resemble *Prostanthera*. We need flowering specimens of all species except *W. rosmarinifolia*.

Pitiosporum: Specimens of flower, fruit and leaves of all species are required.

Boronia: Specimens of species *B. tetrandia*, *B. purdiana* and *B. crassifolia* are required.

Gompholobium: All species except *G. lalifolia* and *G. grandiflorum*.

Melaleuca: All species not already described *Melaleuca* growers!

COLOUR SLIDES

Please send what colour slides you have for inspection. They will be returned promptly. The photographers amongst us are letting us down badly.

PHOTOGRAPHIC SECTION AND COMPETITION

Based on the high standard set by the late Frank Hurley in the many plates reproduced in this journal, in all aspects such as presentation of a group of flowers in a natural-like arrangement showing leaf, etc., detail, colour harmony, etc., the first national competition for readers will be a colour slide of a *Hovea* species, a *Verticordia* species, a native orchid from North Queensland and of the Victorian Christmas bush, *Prostanthera lasiantha*. The four separate competitions will close on January 1, 1964. Photographic sections are being formed in each State. Details from the Editor.

WILDFLOWER SHOWS THIS SPRING

ADELAIDE: October 19 and 20, Belair Community Hall.

ARMADALE, WESTERN AUSTRALIA: September 21, Armadale Lesser Hall.

CASTLE HILL, N.S.W.: September 28, CWA Rooms, Castle Hill, 11.30 a.m.—9.30 p.m.

WYALANDRA NURSERY

47 JACANA GROVE, HEATHCOTE

Wilflowers of the Heathcote area

In Stock: Species of *Boronia* & *Eriostemon*

GROWING KANGAROO PAWS—continued from page 106**THE RED AND GREEN KANGAROO PAWS**

1. (a) *A. manglesii*. Large red and green kangaroo paw, the State emblem, named after George Mangles, an English amateur who promoted botanical exploration in Western Australia and grew many species in England. West Coast, from Margaret River to the Murchison and up to 50 miles inland, on the coastal plain and Darling Range, in sand and gravel heaths, poor forest and wet sandy flats.

From the Moore River southwards inflorescences are nearly always simple, northward generally compound. The genetic basis of this variation has not been examined in cultivation. Leaves grey-green to green, broad, glabrous, with scattered stiff hairs on both edges in young plants. The inflorescence is commonly 2ft. to 3ft. tall (up to 6ft. in cultivation), the rhachis and flower

Colour Photography by Frank Hurley

Block by courtesy John Sands Pty. Ltd.



base bright scarlet, the corolla brilliant green, paler inside. Flowers in July-December, mainly September-October. In some plants, rarely, the red is darkened almost to purple, and there is also a rare golden-yellow form (both rhachis and flowers) which is thought due to introgression from *A. viridis*. Natural hybrids among *A. manglesii*, *A. viridis* and *A. bicolor* are found in the wild.

A. manglesii suffers from a fungus disease caused by *Myrothecium adustum**, which creates black spots on the leaves. It is very widespread in nature but can be controlled by fungicides in cultivation. Some other fungus appears to be responsible for death of plants during the summer which is frequent even in nature; the clumps are not long lived but regenerate actively from seed. This species becomes dormant and the leaves largely dry off in the summer, resprouting with the winter rains, and the roots also die and are replaced, but death of the plant seems often to intervene after about the third year. In cultivation the plants, if watered, do not become dormant and this is not injurious. It is, however, generally fatal to water in summer plants which have once become dormant.

Seeds are dark grey-brown, irregular in shape but a sort of flattened ellipsoid, about 1mm. long, the surface pitted. They number about 38,000 per oz. of clean seed.

(b) *A. bicolor*. The small red and green kangaroo paw, is like a smaller edition of *A. manglesii* which it resembles in colour and form, but is normally only about 12-18 inches tall with narrower leaves. It occurs on the western fringe of *A. manglesii* up to 100 miles inland from Kojonup to Marchagee. It is best known at the foot of the Darling Ranges near Perth where it finds the wet flats which it inhabits, ill-drained ground, waterlogged in winter. It flowers from August to November, and becomes dormant in summer. Seed is a darker brown but otherwise indistinguishable from *A. manglesii*.

THE RED AND GOLDEN KANGAROO PAWS

2. (a) *A. rufa*. Red kangaroo paw. South Coast, Stirling Range to Cape Arid, in sand and gravel heaths up to 30-50 miles inland. Leaves are dull green, glabrous, edges densely clothed with stiff hairs. The inflorescence is 2-3 feet tall, compound, the rachis and corolla deep red, pale inside. There is a rare pink form. Flowers October to January. Foliage does not dry off in summer. Seeds are pale brown, an irregular ellipsoid, smooth, about 1 x 1½ mm. and run about 44,000 per oz.

(b) *A. pulcherrima* (meaning "most beautiful"). The golden kangaroo paw. Found in a restricted area on the west coast north of Perth from Yanchep

*See article by W. P. Cass Smith on page 115.

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to the Hill River and up to 50 miles inland, in sand and gravel heaths. The leaves are grey-brown and densely tomentose. The inflorescence is 2-3 feet tall, compound, resembling that of *A. rufa* except in colour. The rhachis is sometimes red, sometimes golden, the corolla from dull yellow to full gold or rarely apricot, pale inside. Flowers November to February; foliage does not wither in summer. The seeds are indistinguishable from those of *A. rufa*.

THE GREEN KANGAROO PAWS

3. (a) *A. viridis*. The green kangaroo paw. West Coast from Augusta to Watheroo and up to 50 miles inland in winter-wet places, mostly swampy. Leaves are variable, grey-green, from broad, flat, falcate with stiff hairs at the edges to narrow and almost terete. The inflorescence is almost 2-feet tall, simple, the stem green, the base of the flower yellow-green and the corolla bright emerald green, pale inside. Flowers September to November, becomes dormant and dries off in summer. Seeds are grey, a flattened ellipsoid in shape 1½mm long, the surface deeply pitted, about 38,000 per oz.

(b) *A. flavida* (meaning "yellowish"). The giant kangaroo paw. South Coast from Albany to Cape Naturaliste and up to 50 miles inland, in karri and jarrah forests and associated scrub communities. This is the best watered part of the State with rainfall up to 60 inches annually, and is relatively cloudy and cool. *A. flavida* grows in large perennial clumps, the leaves glabrous, bright yellowish green with some traces of marginal hairs in young plants; the inflorescence compound, up to 6-7 feet tall, the rhachis green, the flowers all shades of colour from green to deep red via yellowish tints. This species is the one that has been most successful in cultivation outside Western Australia, though its flowers unfortunately are the least interesting in the genus. It flowers October to December. Seeds are slightly lighter than those of *A. viridis*, running some 44,000 to the oz. and are blacker in colour but otherwise the same.

THE CAT'S PAWS

4. (a) *A. humilis*. This species is described on the rear cover under the full colour plate.

(b) *A. preissi* (named after the botanist Preiss). The Albany cat's paw. Confined to a restricted area on the south coast near Albany and Denmark, in sand heath. This species grows typically as single plants, not in clumps, the leaves shiny green, quite glabrous, narrow, thick and fleshy. The inflorescence reaches about 18 inches tall and is typically double-headed, forking near the top. The flower base is reddish orange, the corolla yellow. Seeds are dark grey, pyramidal as in *A. humilis* and resembling tiny chips of granite. They are larger, measuring about 2 x 1mm. and run only 17,000 per oz.

THE BLACK KANGAROO PAW

5. *Macropidia fuliginosa*. The generic name of the black paw comes from that of the kangaroo (*Macropus*) while *fuliginosa* refers to the sooty black hairs on the inflorescence. The species occurs near the west coast from Muchea to Geraldton and up to 30 miles inland, in sand and gravel heaths. It grows in large clumps, the leaves yellow-green with a yellow margin and dark tip, glabrous. The compound inflorescence reaches 3ft. in height and is greenish-yellow covered with black hairs which completely clothe the rhachis and buds. Opened flowers are less fully covered. The flowering season is from September to November. An ink disease similar to that in

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GROWING KANGAROO PAWS—continued from page 131

A. manglesii and possibly caused by the same organism attack it and causes spotting of the leaves. Summer rotting of rhizomes, at least in the wild, does not appear to be a problem however. The leaves remain green all summer. There are three seeds to each ovary which dehisce with part of the ovary wall attached. Each seed is therefore shaped like a segment of a sphere, with black hairs still attached to the outer, convex side. They are much bigger than seed of *Anigosanthos*, being 4-5mm. across and run only about 2,500 per oz.

Growing Paws From Seed:

It is possible to propagate kangaroo paws by division of clumps, or from seed. Seed matures in the ovaries about a month after the flowers have dried off and must be promptly collected, otherwise, it is shed from the ovary as soon as it is ripe. Only in the case of *A. rufa* and *A. pulcherrima* this is not the case: seed is retained and the ovaries must be cracked to liberate it. It is not yet known how long viability is retained in storage. Seed of *Anigosanthos* includes no dormancy factor and requires no treatment before sowing. In the King's Park nursery with autumn sowing (in flats, outdoors) in 1962, times from sowing to seedling appearance of about 25 days were observed for *A. manglesii*, *A. flavida* and *A. viridis*, but could be up to 50 days where only a poor germination rate was being obtained, probably from old and poor seed.

Plants have been successfully pricked out in flats and pots when 1½ in. to 2 in. high. In the garden they should be given a warm, open position, good drainage and an acid soil. Inflorescences may be cut off when the flowers have withered if seed is not being collected. Appearance of ink disease should be checked by spraying with fungicide. It is possible also that cutting back of the plant after flowering, if all waste material is carefully removed and burnt, may serve to check spread of the ink disease, since it is observed in the field that burning off appears to have a sanitary effect so that plants are disease-free next season.

In autumn, 1963, seed collected in 1961-62 and sown in April, 1963, give these results: *A. flavida* (two forms), good, 30 days; *A. bicolor*, moderate, 33 days; *A. viridis*, poor, 36 days; *A. preissii*, poor, 44 days. Weather was cooler and wetter than in autumn, 1962.

Seed collected in 1962-1963 was sown in May; an extremely long and wet spell followed, and *A. pulcherrima* first germinated in 39 days; all other seven species in 33 days.

Macropidia on the other hand does appear to suffer from a dormancy factor and is notoriously difficult to germinate. In autumn 1962 three sowings from the same lot of seed were made, one treated with boiling water, one heat treated, one untreated: results nil. During winter a further lot of seed was stratified for two months (stored in damp sand in a plastic bag in a domestic refrigerator), sown in September and gave approximately 25 per cent germination beginning in 41 days. Unfortunately the stratified seed was not from the same collection as the seed sown in autumn, and no control sowings of untreated seed were made in spring, so that the result is not conclusive. Results of a repetition this season are not yet available. However, it does appear to indicate that something more than seed-coat dormancy is present in *Macropidia*, which may be overcome by stratification.



Reprinted from *Australian Native Plants and Trees*. Blocks courtesy of Patterson Brockensha P./L.

THE CAT'S PAWS

4 (a) *A. humilis* ("small", "humble"). The cat's paw. A very widespread species, ranging from near the south coast near Albany north to the Murchison River and from the west coast to the fringes of the wheat belt. It inhabits low and open vegetation, mainly sand and gravel heaths but also on coastal limestone. Leaves are green, glabrous with stiff hairs on the inner edge, strongly falcate. The simple inflorescence is only 6-18 inches tall (rather rarely populations reach 24 inches), the rhachis greenish yellow, the flowers yellow and orange. Local variations range from purely yellow to red or purple. Flowers June-November, becomes dormant and dries off in summer. Seeds are black, pyramidal in shape about 1mm. across and run about 44,000 per oz.