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KNOW YOUR WILDFLOWERS

This issue commences a series that will enable a child to study and learn about our hundreds of pea-flowered plants. Here we present the basic structure of the flower. The next issue will describe how this flower becomes seed to reproduce itself.

Many years ago a very clever botanist, Linnaeus, suggested that plants with similar reproductive organs, be arranged into groups. This has become the base of botanical classification of plants. One large group is the pea-flowered plants with the characteristic five petals as shown opposite. The four principal features that define this large family of plants are listed opposite. Find some pea-flowers, examine their structure and show your child.

SAVE YOUR WILDFLOWERS

I am convinced the survival of the Australian flora is in serious jeopardy. I believe there are thousands of Australians who would like to help if only someone would show them how. It is hoped that this series of articles will encourage many readers to make a start. It is very much a case of the blind leading the blind, but someone has to do something; to reveal how tragic the situation is; to encourage people to look around them and examine their quality of life, not in terms of position, goods and income alone, but in the whole context of nature's realm on this planet. Wake up and do something to help nature keep this planet safe and pleasant to live on. Yes, we are actually living on the planet; gobbling its resources without any real attempt to replace the resources we are devouring, resources that future generations will need for survival. A major and irreplaceable resource is the Australian flora. Nobody is foolish enough to believe that we will preserve our flora by growing it in our gardens. But, if we could find a way to grow it with assured success, it will be a major contribution to its eventual survival in natural areas and preserved places. Let us suppress one Australian characteristic — leave it to the others and if all else fails then the Government is responsible. We are forming the Australian Flora Foundation comprising the leading concerned scientists/botanists in Australia to give a guide to the future but, if anything is to be achieved, it is you, John Citizen, who must appreciate the urgency of the matter — the demise of our Australian Flora.

Step Number 1: Grow as many plants as possible and observe. For those who are really concerned, lots of plants of a limited group of species are needed. We cannot afford to buy so many so we must first grow our own plants. Now turn to page 63.

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COVER PLATE

Gompholobium ecostatum

Photography by C. Woolcock

A pea flowered plant belonging to Group 1 as described in this issue. The large pink back petal, the standard (b) has a yellow patch in the centre, the two lower pink petals (c) also have the yellow marking hiding the remaining two petals known as the keel (d). It is a small plant from Victoria; the characteristic leaves in threes along the stem.

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The Peaflower Plants of Australia

by D. T. Woolcock illustrated by C. Woolcock



The Pea-flowers belong to the sub-family Papilionoideae of the huge Leguminosae family (the plants that have a legume as fruit) and have long held an important position throughout the world, both economically and aesthetically. Including two other sub-families, the Caesalpinoideae (Cassias) and the Mimosoideae (Wattles), the family Leguminosae was second only to the Compositae (Daisies) in the numbers of genera and species. More generally today, the three divisions or sub-families are regarded as three separate families — Fabaceae (Papilionaceae), Caesalpinaceae and Mimosaceae. In Australia the pea-flowers are an important plant family and are widespread through the tropic and temperate regions, through the arid and semi-arid areas of the inland and abundant along the coasts and mountains.

Fabaceae members, from the Latin 'faba' meaning a bean, have a synonymous title Papilionaceae, as the relatively large flowers bear a fancied resemblance to a butterfly (Latin 'papilio' — Butterfly). Individual flowers usually have the complete complement of four whorls:

- (1) the outermost calyx, usually green and cup-shaped, occasionally persisting in fruit, marked 'a' in sketches above and below.
- (2) the corolla of five highly-coloured petals of a typical peaflower, 'b, c & d'.
- (3) the male organs (stamens), marked 'g'.
- (4) the centrally located female organ (pistil) from which the legume (pod) will form, marked 'f'.



- a—the calyx, usually green
- b—the standard, a large coloured petal
- c—two side petals resembling wings
- d—two petals united into a boat-shaped keel
- e—the ovary in the centre where seeds will form
- f—the female organ, the stigma attached to the ovary by the style
- g—the male organs, stamens, 10 in number.

The typical corolla of a pea-flower has two basal petals united into a boat-shaped keel, two lateral (side) petals resembling wings and a single superior petal (standard) conspicuous and flaring out. These petals are arranged so that the flowers are bilaterally symmetrical and in the bud the standard outside folds over the other petals. The stamens number ten and grow from the base of the pistil. Their arrangements — 10 free stamens; or the 10 united as a sheath around the ovary; or the tenth stamen free, the rest united — is a distinguishing feature between groups. The fruit is a pod (legume) two-valved and usually dehiscent.

As is usual for such a large family of plants, the botanists have grouped the many species into genera but here the genera are so numerous that it is desirable to assemble the genera into groups. An early botanist, Bentham (1864) divided the pea-flowers into 11 groups (called tribes) which were split by Hutchinson (1964) to fifty tribes. Recent research confirms the substance of Bentham's classification. In the following pages, members of the family Fabaceae are presented in 10 "Groups" which are adapted for our purposes, but still correspond largely to the tribes of Bentham. The assistance of Alma Lee of the National Herbarium, Sydney, is gratefully acknowledged.

It is hoped that, over a number of issues of Australian Plants, we can present the many hundreds of these delightful flowering plants in such a simple illustrated manner, that the reader may be able to identify his particular plant as to its genus and species.

Group 1. Plants where the ten stamens in the flower are free.



A large group of plants, Bentham named Podalyrieae. The genera illustrated here are typical of the group which is defined on page 50.

Dillwynia glaberrima, above, with a raceme of flowers on the end of a leafy branch. As with all this group, the 10 stamens are free.

Oxylobium alpestre, below, with a large yellow standard (b) and the two wing petals (c) obscuring the keel.

Daviesia oppositifolia, opposite top, that belongs to a group of daviesias that have floral bracts (modified leaves) surrounding the umbel (cluster of flowers) in bud and flowering and becoming much enlarged afterwards to enclose the pods.

Pultenaea foliolosa, opposite bottom, where the red keel is broader and longer than the wings.





Daviesia oppositifolia (top) — *Pultenaea foliolosa* (bottom)

Group 1. Plants where the flowers have all ten stamens free from each other.

This is Bentham's Podalyrieae tribe, which is very well developed in Australia and South Africa. Not only are there many genera, some of them endemic in Australia, but a number of these genera have numerous species — the Bush-peas (*Pultenaea*), for example, having about 120. Many of the common bushy shrubs, from alpine areas to coastal heathland, belong to this group and frequently give colourful massed displays during their flowering period. Some of the prominent genera contributing are — *Pultenaea*, *Daviesia*, *Dillwynia*, *Mirbelia*, *Oxylobium*, *Gastrolobium*, *Jacksonia*, *Gompholobium*, *Viminaria*, *Chorizema* and *Phyllota*.

Because of its size and importance, attempts have been made to subdivide this group. One researcher, Valerie Sands, has suggested divisions based on chromosome number, the number of ovules and morphological similarities as follows:

PART I *Burtonia*, *Sphaerolobium*, *Jacksonia*, *Viminaria*, *Daviesia*, *Erichsenia* and *Gompholobium*.

Ovules 2; chromosome number: $n = 9$ (except *Gompholobium* with several ovules but with other morphological characters closest to genera in this part).

PART II *Oxylobium*, *Nemcia*, *Mirbelia*, *Chorizema*, *Isotropis*, *Brachysema*, *Cupulanthus*, *Leptosema*, *Jansonia* and *Gastrolobium*.

Ovules more than 2 (4 or more); chromosome number: $n = 8$ (except *Gastrolobium* with only 2 ovules but with other morphological characters closest to genera in this part).

PART III *Phyllota*, *Aotus*, *Euchilopsis*, *Dillwynia*, *Latrobea* and *Pultenaea*, *Aotus* and *Eutaxia*.

Ovules 2; chromosome number: $n = 7$ (8). In this part are included *Aotus* and *Eutaxia* with $n = 8$, and *Pultenaea* with many different counts of chromosome number (based on $n = 7, 8$ or 9), because of morphological similarities.

Unfortunately the broad lines suggested by Sands are obscured by detailed enumeration of variation within the divisions. A future issue devoted to this Group 1 of plants will hopefully make identification simpler. Meanwhile the sketch opposite and its caption will serve to distinguish this group of plants from the following groups. A species from each of parts 1 to 3 is illustrated but these are not necessarily representative of all species in each part.

Group 1. Pea-flowered plants with all ten stamens free from each other.

A. The ten free stamens common to all plants in Group 1.

B-E. Section details of *Daviesia mimosoides*.

B. Habit showing the flower spike (a raceme) coming from the point where the leaf joins the stem (known as an axillary raceme), the leaves being alternate (not opposite each other) up the stem.

C. The typical pea flower of this *Daviesia* is enlarged.

D. The triangular seed pod shows only one seed — usually two.

E. The seed showing the aril the raised section in white along the seed body.

F-I. Section details of *Oxylobium alpestre*.

F. Habit showing the leaves in whorls (grouped around the stem at almost the same point) of three, the flowers in short racemes (i.e. a few only on each flowering stem), from the upper axils (i.e. from the point where the leaves join to the stem) the flowering being usually confined near the ends of the branches.

G. A flower enlargement showing, outward from the hairy flowering stem (the pedicel), first a small modified green leaf known as a bracteole, the hairy calyx tube enclosing the base of the flower which is really four modified leaves known as bracts tightly held together to form a tube, the 'leaf' or bract ends turning back as shown, and then the five petalled characteristic pea flower.

H. The hairy pod for this species contains several seeds.

I. The seed which in this case is without an aril, exarillate, *Oxylobium* species may also have arillate seed.

J-N *Pultenaea retusa*

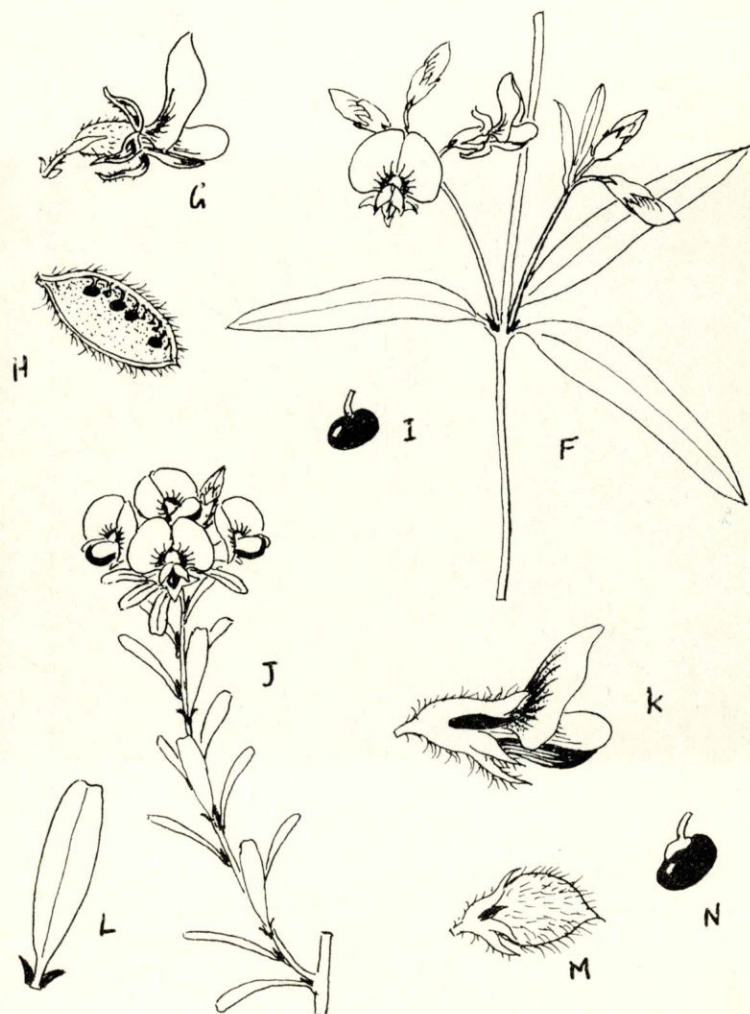
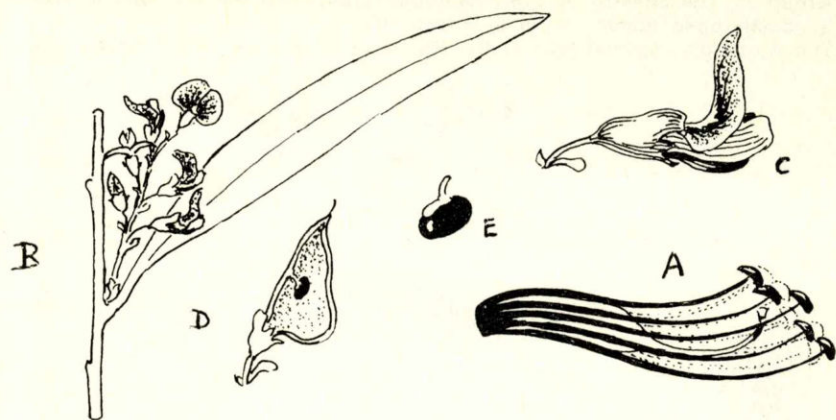
J. The habit showing terminal flower heads on branchlets.

K. The flower enlargement showing in this case, the bracteole in black, attached to the calyx tube.

L. The characteristic leaf shape of the species with tiny leaves (stipules) at the point of attachment to the branch.

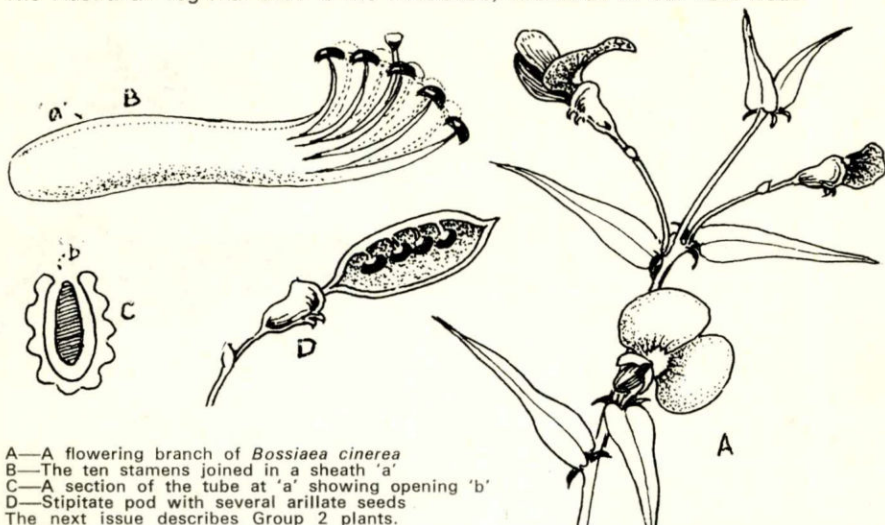
M. The shape of the hairy seed pod that contains 1-2 seeds.

N. The seed showing the aril in white. The seed would be black or very dark and the aril would be a paler colour of grey to brown. All *Pultenaea* species have arillate seed.



Group 2. The sheath- or tube-stamened group. All ten stamens joined in a sheath open above, or in a closed tube.

The Australian regional tribe is the Bossiatae, described in our next issue.



A—A flowering branch of *Bossiaea cinerea*
 B—The ten stamens joined in a sheath 'a'
 C—A section of the tube at 'a' showing opening 'b'
 D—Stipitate pod with several arillate seeds
 The next issue describes Group 2 plants.



Bossiaea bossiaeoides

Photography by Jenny Harmer

This hairless, leafless bluish-green shrub to 2 metres is characteristic of a group of *Bossiatae*. The branches are flattened and have broad "leaf-like" wings, the margins of which are sharply angled and often prickly pointed.

***Platylobium formosum* (opposite top)**

Photography by M. Fagg

One of a genus of four species to be fully described in the next issue, *Platylobium* differ from *Bossiaea* by having winger fruit and with leaves usually opposite on the stem.

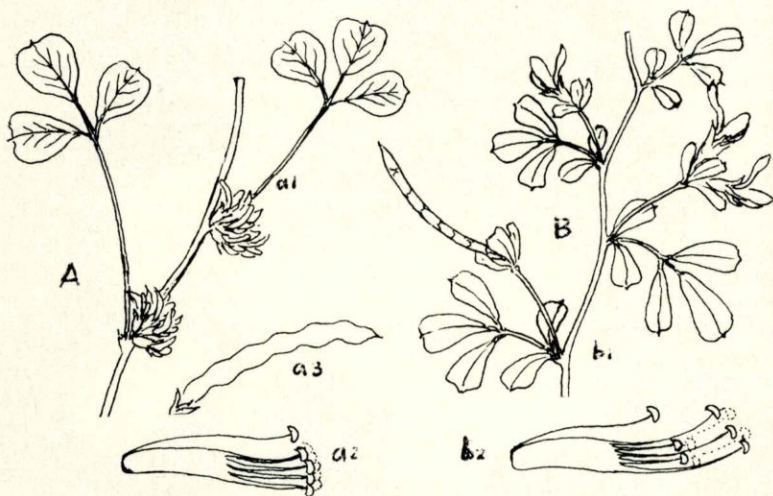
***Hovea pungens* (opp. bottom left)**

***Hovea chorizemifolia* (opp. bottom right)**

Hovea are described in our next issue. These photographs are reproduced with permission from the excellent series of books "How To Know Western Australian Wildflowers" by Blackall and Grieve. See page 90 for availability.



Group 3. The Clover and Medic Group — 10 stamens, the upper one free.
This is one of several groups with (9)+1 — stamens i.e. nine with their filaments joined but with the uppermost stamen free. This group was referred to a tribe Trifolieae by Bentham and is distinguished by always having herbaceous stems and special leaf-characters. In Australia there are many naturalised clovers and medics but only 1 native Aust. genus *Trigonella*.



- A. *Trigonella suavissima* of Group 3, a small clover-like plant. (a1) showing its trifoliate leaves with small clusters of flowers at the axils. The stamens of the flowers are as shown in (a2), nine of equal length with another free, the seed capsule (a3).
B. *Lotus cruentus* of Group 4 is a straggling plant with red, pink or white flowers (b1). The stamens of the flowers are alternately long and short, nine gathered to form a tube (b2).

Group 4. The true Lotus group.

Stamens like the Group 3 ((9)+1) but characterised by special leaf-characters; the lowest pair of the 5 leaflets acting as stipules and the stamen filaments, all or 5 of them, broadened towards the end.

Bentham's tribe Euloteae, which includes 1 Aust. member in the genus *Lotus*.

Group 5. The pinnate-leaved shrubby group.

There are many variations in these features; stamens (9) + 1 as in the last two groups. Many genera or groups of genera show peculiarities, which has led to sub-division:

- 5.1 gland-tipped anthers of *Indigofera* — opposite.
 - 5.2 one-seeded pod of *Psoralea* — and its oil-dotted leaves — page 57.
 - 5.3 style beard of *Swainsona* — page 56.
 - 5.4 acuminate petals of *Clianthus* — opposite.
- Bentham's tribe Galegeae. Hutchinson grouped many of the sub-tribes into tribes.

Indigofera australis — Group 5.1

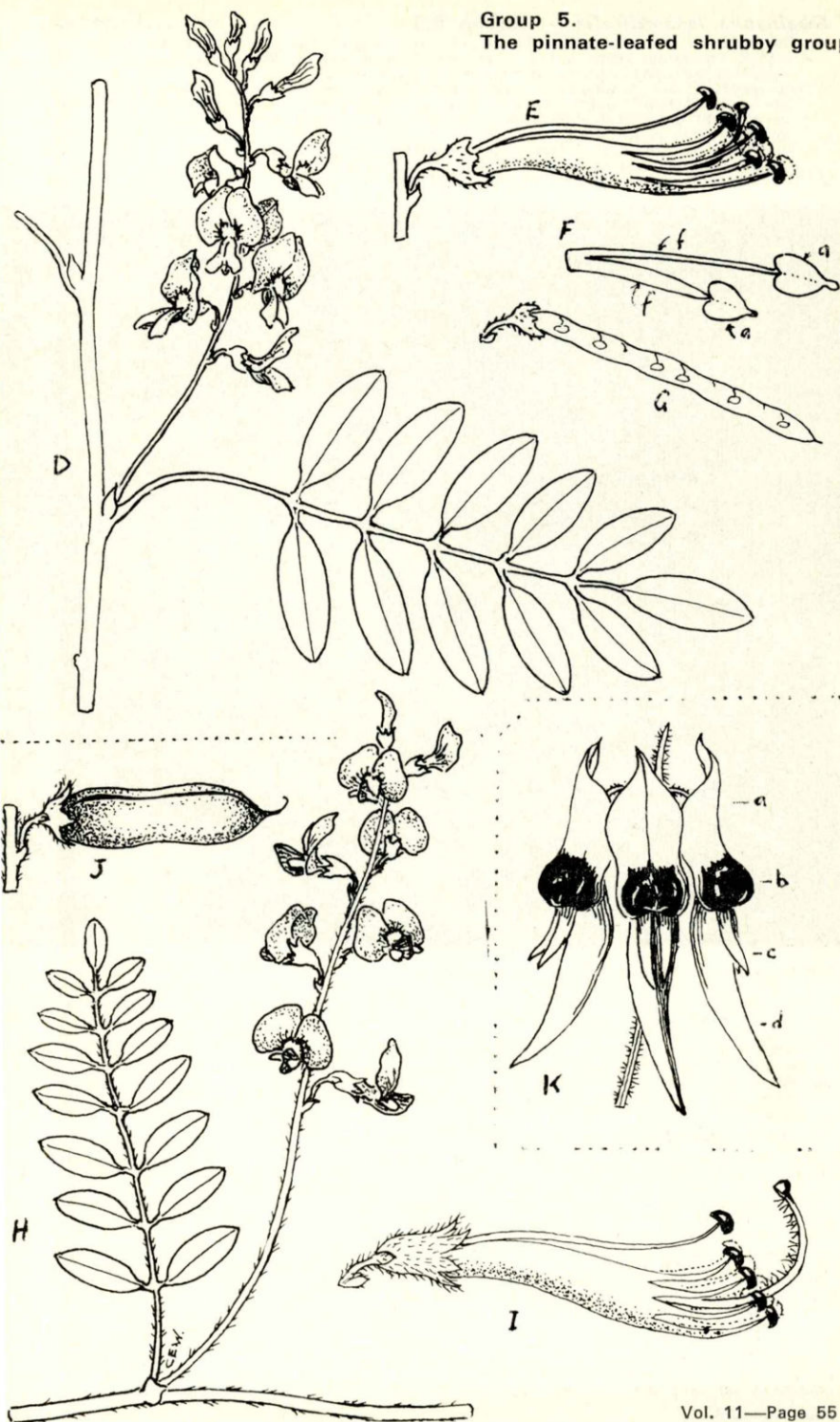
(opposite top)

- D. The habit of this herbaceous shrub showing the impari-pinnate leaves. There may be from 9 to 21 leaflets, each entire and elliptical as shown to 2.5 cm long. The purple (rarely white) flowers are in long racemes, axillary to the point of attachment of the leaves to the stem.
- E. The petals of the flower have been removed to show the 10 stamens protruding from the calyx. Characteristic of the plants in groups 3, 4 and 5, nine of the stamens are grouped or joined in a sheath with the upper one free.
- F. The column (or stalk) section of the stamens is known as the filament (f) and these are alternately long and fine or short and broad as shown. The appendage on the end that secretes the pollen is known as the anther (a), and these are gland tipped.
- G—The seed pod is long, cylindrical but narrow, with several seeds.

Clianthus formosus Sturt's desert pea — Group 5.4 (opposite — left centre)

The unusual shape of this flower (K) does not readily identify it as belonging to the pea-flowered family Fabaceae although its legume type seed pods readily do. The flowers are held up in a round cluster (an umbel) at the head of a hairy stalk, the peduncle. See page 92 for details of this flower and a photograph.

Group 5.
The pinnate-leaved shrubby group.



Swainsona lessertiifolia — Group 5.3

(bottom of page 55)

- H. The habit of this straggling shrub is for the pinnate leaves to stand erect from the usually prostrate hairy stems. The pink flowers are in long axillary racemes with small broad leafy stipules at the base of the leaf.
- I. The petals of the flower have been removed to show the nine stamens in a bundle for most of their length with one free, emerging from a hairy 5 lobed calyx. There is a small bract at the base of the flower stalk and a small bracteole at the base of the calyx tube. Characteristic of *Swainsona* which are sometimes called style bearded, is the hairy style that protrudes out past the ten stamens, with the stigma on the end to receive pollen for fertilization.
- J. The seed pod is oblong, inflated with a pointed tip.



Swainsona swainsonioides — (above)

Photography by H. A. Morrison

This is a small hairy perennial shrub of dry inland areas. The pinnate leaf has 11-21 leaflets, which are smooth on the upper surface, densely hairy below, and these are from 1-3 cm long. The flowers are purple to purplish-red and grow in a long loose raceme from the axils of the leaves. The standard is wide — up to 16 mm — purple streaked with darker lines and has a yellow patch at the lower centre. It is usually reflexed (bent back). The wing petals are shorter and rounded at the summit, but the keel is long and the spiral twist of the beak is not complete as in *S. procumbens*; the outer end is rounded, not pointed, and the tip purple not yellow as they are in *S. procumbens*, which it closely resembles.

Psoralea australasica (opposite) photograph could be of any of the following species:

Psoralea australasica is an erect or semi-erect plant principally to 0.5 m but sometimes to 2 m with a greenish appearance because of the glabrous (shiny hairless) to sparsely hairy above leaves that are hairy beneath at least along the veins. The flowers are noticeably stalked in a long raceme, spaced and on a long stalk. It is a plant of heavy soils principally in Central Australia with forms in Central Queensland and western N.S.W. down to Adelaide in S.A.

Psoralea patens is a prostrate plant again with a greenish appearance with a grey green form in central Australia. The flowers are in a compact short raceme and are of horticultural value as described on page 59. The population is widespread from N.S.W. and Qld. across the centre to W.A. in sandy soils.

Psoralea eriantha is now regarded as belonging to the *P. patens* complex.

Psoralea pallida attempts to grow upright but its branches bend and flop on the ground becoming a decumbent plant. The aspect is grey to white because of the dense hairs on both sides of the leaves. The flowers are similar to those of *P. patens* differing in the calyx which is longer, tubular and with its lower tooth much longer. It is commonly on sand dunes in the dry areas of Qld, N.S.W. and central Australia.



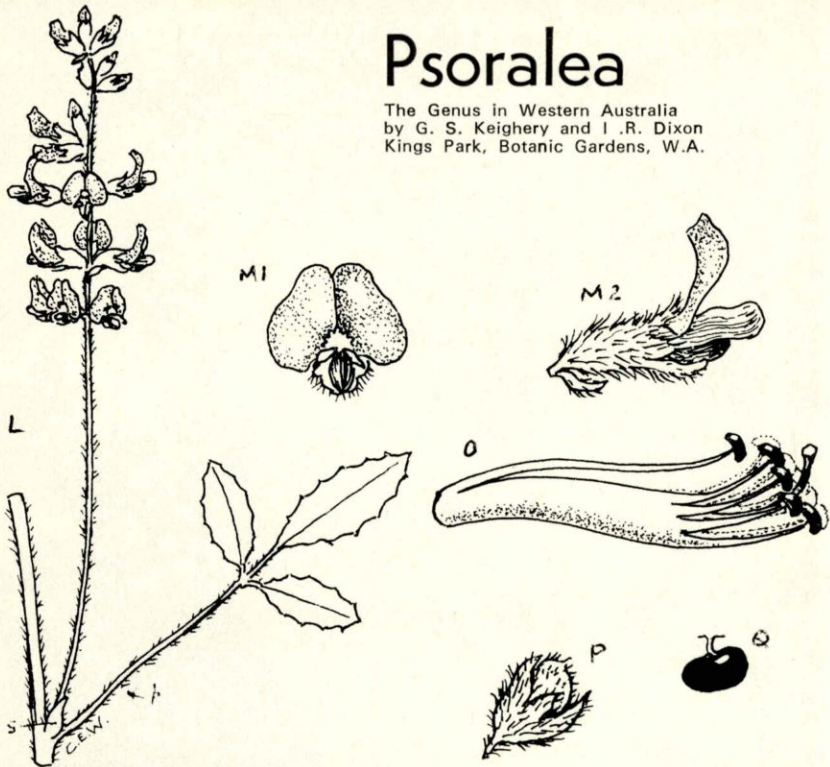
Psoralea australasica (Caption opposite)

Photography by H. A. Morrison

The excellent article "The Peaflowered Plants Of Australia", by D. T. and C. Woolcock is continued on page 59 for Group 6 then page 61 for Groups 7, 8, 9 and 10, following articles on *Psoralea* and *Glycine* by guest writers.

Psoralea

The Genus in Western Australia
by G. S. Keighery and I. R. Dixon
Kings Park, Botanic Gardens, W.A.



Psoralea patens (above) and in colour in page 57

- L. The habit of this herbaceous plant showing its hairy stems, the leaf with three leaflets on a long petiole (P) with a pair of small stipules (S) at its base. The flowers are in long spikes axillary to the leaf/stem.
 - M. The pealflower of *Psoralea*, M1 from the front showing the ovate to round single large upper petal known as the standard and M2 from the side showing the hairy calyx that cups the flower to the stem, the lowest lobe being longer than the other four. The two petals forming the wings are above and longer than the two petals forming the keel.
 - O. As with other genera in Group 5, nine stamens are joined into a tube with the upper one free.
 - P. The seed pod is hairy, about the same length as the calyx, and egg shaped.
 - Q. The seed has a short stalk and is without an axil.
- Sketch and caption by C. Weetcock.

Western Australia has 19 species of *Psoralea*, mostly found in the tropical and desert regions of the State. Members of this genus are largely grown as summer annuals at Kings Park, from seed pre-treated in hot water. Unfortunately the genus contains many species that are largely inbreeding and hence have small unattractive flowers (see *Psoralea cinerea*). The inbreeding species are also the easiest to grow in Perth.

Seven species appear to offer promise for cultivation. The first three below may prove outstanding.

Psoralea martinii. F. Muell.

An erect spreading shrub, recorded as growing to 2m, on red sandy soils. The plant reaches 50cm in Perth. It is uniformly clothed in dense silky hairs, giving the whole plant a grey-green colour. The leaves are single, to 5cm long, obovate with toothed margins and grey-green in colour. The inflorescences are axillary, to 5cm densely woolly and bear small blue flowers.

Psoralea plumosa. F. Muell.

An erect annual herb to 50cm, covered by fine hispid hairs, growing on clay soils. The stems and petioles smell strongly when rubbed. The leaves

are trifoliate, to 4cm long. Flowers are borne in loose axillary racemes of 3-7cm long, blue and of moderate (5mm long) size. The most striking feature is the legumes (fruits) which are inflated and covered in silky hairs.

***Psoralea lachnostachys*. F. Muell. "variant".**

This form differs from typical *P. lachnostachys* in having at least the upper leaves and inflorescence clothed in long soft hairs. It is a perennial shrub growing to 3m in the wild on ironstone or red sand in the Pilbara district of Western Australia. In cultivation it rarely exceeds 1m, and is an annual. The leaves are large, early, trifoliate but soon deciduous to a single leaflet 5-8cm long. Flowers are borne in long racemes, generally clustered at the ends of branches, 8-15cm long, with large blue or purple flowers.

***Psoralea leucantha* F. Muell.**

A slender erect annual/perennial shrub, recorded as growing to 2.5m, in heavy damp soils. Generally in Perth it forms a slender shrub to 1m. Leaves are green glabrous, trifoliate to 15cm long, and the plant bears long showy racemes of small white flowers towards the ends of branches. Useful for its attractive habit and white flowers.

***Psoralea patens* syn. *eriantha* (see page 57)**

This is a prostrate annual/perennial shrub, covering to 1.5m diameter on heavy soils. Leaves are trifoliate, leaflets green, ovate, and toothed. The plant bears numerous compact, erect densely hairy inflorescences to 4cm long of small pink or violet flowers, resembling a *Swainsona*.

***Psoralea babocana* (Blanco). Benth.**

An erect spreading shrub, recorded as growing to 1.5m on heavy soils. Generally in Perth it grows to 50cm. The plant has single leaves, up to 8cm long which are silky villous and strongly scented. Mauve flowers are borne in dense terminal heads.

***Psoralea pustulata*. F. Muell.**

An erect slender annual/perennial shrub recorded as growing to 2.5m on red loams and clays. The leaves are trifoliate, to 8cm long, bright green and leathery to touch, covered by small black pustules which emit a strong resinous smell upon crushing. Inflorescence is a long raceme to 10cm exceeding the leaves and bearing many moderate sized blue-purple flowers. In Perth it achieves 1m during summer.

Brief notes on other species are:

- P. archeri* F. Muell. Erect shrub to 1m, fls. pink, King Leopold Ranges.
- P. balsamica* F. Muell. Erect perennial herb to 1m, fls. blue. Desert edges of Kimberleys.
- P. cinerea* Lindl. Erect annual herb to 1.5m, fls. blue or pink. Clay, silt, sand, loam. Eremaean, Pilbara.
- P. clementii* Domin. Erect sparse single stemmed shrub, fls. white. Pilbara.
- P. cuneata* W. V. Fitz. Erect dense shrub, hirsute, to 30cm, fls. purple. Kim.
- P. graveolens* Domin. Erect (to 20cm) or spreading annual herb, fls. pink. Clay, loam, Eremaean; Austin, Pilbara.
- P. pallida* N. T. Burbidge. Prostrate annual, fls. purple/pink. Red sand dunes. Eremaean; Carnegie. See page 56.
- P. testariae* F. Muell. No data.
- P. viscosa*. No data.
- P. virens* W. V. Fitz. Erect glabrous ?annual herb, to 2m, fls. pink. Basaltic slopes, bauxite slopes. Kimberleys.
- P. walkingtonii* F. Muell. Erect glabrous ?annual herb, to 3m, fls. pale mauve. Alluvium. Kimberleys.

Group 6. The segmented-pod group. Pea-flowered plants from page 56

The pod breaks across into indehiscent segments ('articles') or is only one 'article'. The stamens are all joined in a tube or sheath open above; or with (5) + (5) in a tube split along the bottom as well as the top. Bentham's tribe Hedysareae — *Desmodium* & *Zornia* as Aust. members.

Group 7. The peas and vetches, which have pinnate leaves.

The terminal leaflet is replaced by a tendril or awn. The stamens are 9 joined, 1 free. Bentham's tribe Viceae — no Aust. natives in the group but some naturalised members, mostly species of *Vicia*.

Continued on page 61 for Group 8, Pea-flowered plants



Photography by C. Woolcock

Glycine

From notes by the Fabaceae
study group of the Society.

***Glycine canescens* F. J. Hermann.** Silky glycine occurs in the Mallee where it is rare and inland tracts of all states except Tasmania. The whole plant is hoary with closely applied silky hairs, the 3 leaflets being narrow, 3-5 cm long without reticulate veins. The calyx is densely covered with rusty hairs, the lobes being equal to or slightly longer than the tube. The pod is covered with silky hairs and the seeds are smooth.

***Glycine clandestina* Wendl.** Twining glycine has clusters of up to 20 lavender to purple flowers on stems longer than the leaves, arising from the upper axils. There are three leaflets; the pods are straight and narrow, with a minute straight or hooked point on the end. It occurs in all states but N.T., in a variety of temperate habitats ranging from the desert to the Alps, climbing among the undergrowth to 1 metre or more.

***Glycine falcata* Benth.** has short, hairy stems with leaflets 2-5 cm long, and flower clusters on long erect hairy stems. It has very hairy pods 1-1½ cm long, and occurs in tropical and subtropical Australia. Untried in gardens.

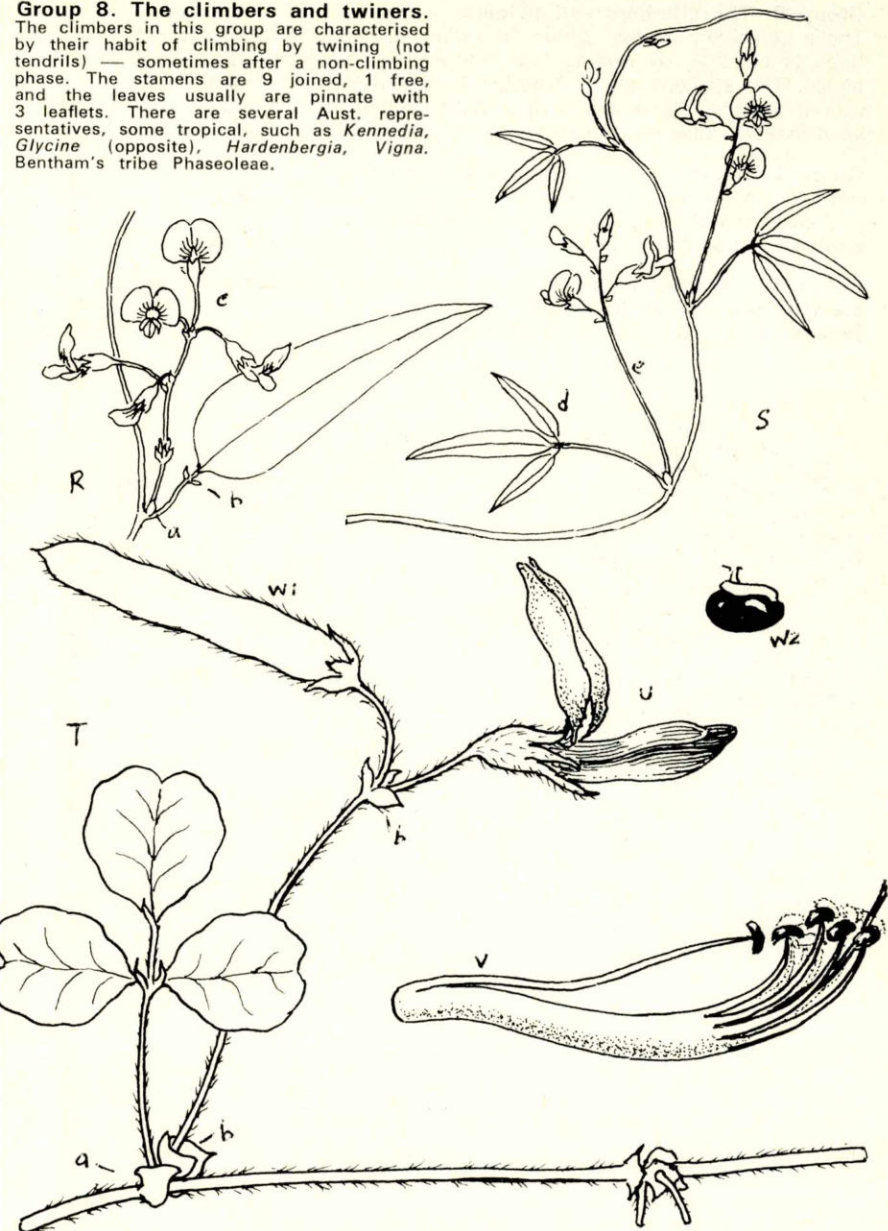
***Glycine latrobeana* Benth.** Clover glycine is from the south eastern states; scattered and uncommon, on lowland grassy plains. The deep purple flowers are borne in compact clusters, sometimes reduced to 1-4.

***Glycine tabacina* Benth.** Variable glycine is widespread in open country in all states but N.T. and Tasmania. It occurs also in New Caledonia and Fiji. The leaflets of the lower leaves are conspicuously veined and the end leaflet is always some distance from the other two. The pod is glabrous to slightly hairy. Calyx lobes equal to or shorter than tube.

***Glycine tomentosa* Benth.** Found in N.S.W. north to N.T. and Philippines to South China this twining or prostrate plant has velvety oblong leaflets in threes, very obtuse. The pod is 1-1½ cm long and hairy. The calyx lobes of the flower are longer than the tube. ■

Group 8. The climbers and twiners.

The climbers in this group are characterised by their habit of climbing by twining (not tendrils) — sometimes after a non-climbing phase. The stamens are 9 joined, 1 free, and the leaves usually are pinnate with 3 leaflets. There are several Aust. representatives, some tropical, such as *Kennedia*, *Glycine* (opposite), *Hardenbergia*, *Vigna*. Bentham's tribe Phaseoleae.



R. *Hardenbergia violacea*, a trailing or climbing plant with simple leaves with stipules (a) and stipels (b), and an axillary raceme (c) of purple flowers.

S. *Glycine clandestina* showing its twining habit, trifoliate leaf on a long petiole (d) and an axillary raceme (e) of mauve flowers.

T. *Kennedia prostrata*. A trailing running plant with hairy stems and trifoliate leaf with stipules (a) at the base of the leaf stalk (petiole) and leafy bracts (b) at the base of axillary racemes of flowers and at the base of the flower stalks (pedicels).

U. The large flower of *K. prostrata* with a reflexed standard (the large upper petal bent back at the sides), the keel formed by the two lower petals as long as the standard but the wings a little shorter. The ten stamens (v) have the upper one free and nine joined to form a tube.

W. The seed pod of *K. prostrata* (W1) is oblong and hairy. The seed (W2) has an aril (shown in white) with a short stalk.

Group 8. The climbers and twiners.

These (climbers in this group including beans) are characterised by their habit of climbing by twining (not tendrils) — sometimes after a non-climbing phase. The stamens are 9 joined, 1 free, and the leaves usually are pinnate with 3 leaflets. There are several Aust. representatives, some tropical, such as *Kennedia*, *Glycine*, *Hardenbergia*, *Vigna*. Bentham's tribe Phaseoleae.

Group 9. A group of trees and woody climbers.

Here the stamens as in group 6 — 10 in a sheath or tube or (5) + (5). The pod does not split open and is not segmented.

Bentham's tribe Dalbergieae. *Derris* & *Lonchocarpus* occur in Australia.

Group 10. Another group of trees and woody climbers but with the 10 stamens all free as in Group 1.

Bentham's tribe Sophoreae. *Castanospermum* is the best-known Aust. genus. ■



***Derris scandens* Group 9 — Above left.**

Woody climber with stems several metres long — the younger parts rusty-pubescent, but becoming glabrous with age. Leaves are alternate, pinnate; leaflets 9-13, opposite, ovate, or elliptic, up to 5 cm long. Flowers are in axillary racemes, which can be up to 25 cm long; each flower is stalked. Corolla is yellowish in colour. Stamens are joined though the upper filament is free at the base, united with the others at the middle. Pod is long, up to 8 cm, indehiscent, with a narrow wing along upper suture, and has 1 or few seeds. This is a tropical species, growing from N. of N.S.W. through E. Queensland and it flowers in the summer.

Figure X shows the very long hairy stems; large alternate pinnate leaves; flowers in axillary raceme on long peduncle, each flower stalked. The flowers have a large erect standard the wings and keel being much shorter. The stamens are much longer than the corolla and hang out beyond the petals.

***Castanospermum australe* Group 10 — Above right**

Castanospermum australe. Black Bean or Moreton Bay Chestnut. Group 10. A large tree described in previous issues and illustrated in colour in Issue No. 62, page 64, it has a woody branch (a), the leaf (b) is compound with large alternate leaflets (9-17), each 8-13 cm long. The flowers (c) are crowded in long racemes, axillary or (as here) on leafless older wood; flower stalks about 2-5 cm long. The flowers are large (about 5 cm long), the calyx small-toothed, the standard 2-5 cm, reflexed with wings and keel much shorter. The 10 stamens are free and not enclosed by the keel as is usual for all plants except for those in group 1.

WILDFLOWERS FROM SEED

Part 2 — by W. H. Payne

Part 1 of this series describes how I started with pea-flowered plants using various methods of pre-germination. A report is provided below. This exercise is designed mainly to provide a guide to get you started. Now is the time to purchase seed ready for planting in early 1981. As described, I planted 84 packets of seed in egg cartons and now I have 8 cartons bulging with hundreds of seedlings "bursting out all over".

Seed ready for germination needs to be planted in a moist warm virtually sterile medium and protected from a host of predators to the stage where four small leaves have formed. There are many important factors here.

Germination

The process where the living embryo in a seed is stirred to life to produce a root for sustenance and green foliage for sunshine and air. This process is described in Vol. 2 Page 7 for those keen to study the diagram and simple description. See also page 65.

Seed Ready For Germination? Viability!

Is the seed alive and will it grow given the right conditions? Unfortunately for an amateur, it is not easy to verify this. Vol. 6:256 describes one method. Most people would be like me. You don't know if the seed is viable. If it does not grow as many did not in my exercise, you suspect the worst. It is time someone devised a simple method. In the case of the hard-coated seed in my experiment, "dead" seed did not swell when immersed in boiling water and insisted on floating. When you squeezed them they collapsed showing rotten insides. We shall have to trust the seed supplier and plant what we can get. Most seed has a limited period of maximum viability. Most seed needs to be fresh, really fresh, as recorded in various reports published previously.

Seed Ready For Germination? Dormancy!

One of nature's ways to preserve species is to delay germination of seed until conditions appear right for survival of the seedling. Dormancy is discussed in Vol. 2:91 and other references will be of interest.

Seed stratification of *Macropidia* 2:135; *Grevillea* 4:327; *Epacris* 2:103. These mainly involve keeping freshly picked seed in a cool place, even in refrigeration, for a certain period.

Unless there is an authoritative report on a particular genus of plants as above, I assume the seed as supplied is ready for planting if I can frustrate nature's dormancy barrier built into the seed coat.

Frustrating Nature's Barrier to Germination so that it is Ready to Grow

In my exercise with hard-coated seed, I achieved this with boiling water. Other methods are described in Vol. 4:294 and for *Anigozanthos* 6:339. Removal of seed coat completely has been successful with *Grevillea* 2:83 and for a particularly difficult species of *Eriostemon* chipping off the seed coat and prolonged washing, was necessary. In many cases we do not have the answer yet. This is discussed further on page 66.

Despite all this there is a huge range of seed that will assure success if you follow simple procedures.

My First Report on Success and Failure

Confining my report to the hard-coated Fabaceae, pea flowered plants, the first report is one of success. The exercise involved two species of *Aotus*, *Bossiaea* 5 spp, *Brachysema* 2, *Burtonia* 1, *Chorizema* 2, *Daviesia* 3, *Gompholobium* 6, *Hovea* 5, *Kennedia* 3, *Mirbelia* 1, *Oxylobium* 2, *Pultenaea* 3, *Sphaerolobium* 1, *Swainsona* 1, *Viminaria* 1.

As described in Part 1 of this series, I pre-germinated the seed after soaking in boiling water by placing it into egg cartons. Each carton slipped nicely into a sliced bread plastic bag with enough length to seal the opening of the bag with an elastic band. The bags were laid out on a table in our sunroom so as to receive direct sunlight for an hour or two each day. Remember it was winter in Sydney. In the summer, no direct sunlight would be necessary.

Every two days it was necessary to remove those seeds that had commenced to grow thrusting out a shoot that would eventually be a branch carrying leaves and flowers.

While some seed came quicker than others, practically all seed germinated. In some cases the shoots appeared when the seed was still soaking in the water. Here it was not necessary to pre-germinate the seed in the egg cartons.

Some experienced propagators will say, "Why use the egg cartons at all?" They are correct for their methods where they sow the seed in rows in a flat seed tray and prick out the seedlings as they appear. You could try their method. On the other hand it is fun to handle the small bundles of stirring life and if you intend to place only one seed in each pot as I propose to do, then it could save a lot of dormant pots and wondering just what is doing.

A Report from S. M. Reynolds, Paterson, N.S.W.

I cannot understand the continuing publicity concerning soaking wattle and pea seed in boiling water. In the first place there is no need to soak it. Just pour boiling water on to the seed and then prepare to plant it. But what a messy business trying to separate the sticky seed. For over four years now I have been using the following method with no failures. I use coarse sand (river) 4 parts to one of peat moss. Almost fill container, place the seed and cover very lightly. Place a piece of old blanket over it and then pour boiling water on at the rate of a quart to a half gallon ice cream container. Make sure there is no delay in pouring boiling water on . . . in short it must be boiling. Leave blanket on for 5 minutes then take off, cover seed to required thickness and then wait for it to come up. This works with any pea seed as well as wattle. Just try it out for yourself.

Summary of Part 2

Hopefully readers are getting the message. I am hoping to stir up as many readers as possible to grow plants under certain conditions of trial and to report results. It does not matter which species of wildflower. It could be just one species grown in quantity and conditions varied with results recorded.

The report by S. F. Reynolds above is particularly important as it would apply to most seed large and small. Not all seed can be handled in the egg cartons. My trials, yet to be reported, of a wide range of seed indicates that hot water does not damage the seed and the method of heat treating the seed while in a seed pot or box could be widely applied for all seed. Try it!

Now is the time to buy seed for 1981 planting.

In the next part of the series I plant hundreds of germinating seeds. ■

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Functions of the cotyledons of *Acacia*

by David R. Murray, Biology Department, The University of Wollongong, N.S.W. 2500

The cotyledons or seed leaves of flowering plants are often adapted as storage organs, containing food reserves upon which the developing seedling will depend after germination of the seed. In addition (or alternatively) the cotyledons may develop chloroplasts which enable them to function as the first photosynthetic organs of the new plant. Recent studies of *Acacia itea-phylla* seeds and seedlings have shown clearly that both functions, storage and photosynthesis, are conducted by the cotyledons in *Acacia*. Ashcroft and Murray, 1979.

Storage of Reserves

Initially the cotyledons occupy more than half the seed volume. They contain many thick-walled storage cells, as illustrated in Fig. 1. The main reserve materials are starch and protein, found conspicuously as starch grains and protein bodies (Fig. 1). Another prominent feature of these cells is the vacuole, which contains digestive enzymes. It appears to function by gradually engulfing the individual protein bodies, breaking down the proteins into their component amino acids, and releasing these for the synthesis of new proteins. Starch is broken down to release sugars, but the starch grains are not consumed by the vacuoles in the same way as the protein bodies.

Seedling Development

Mature seed collected from *A. itea-phylla* had an average seed weight of 44.4 mg, of which the seed coat accounted for 38.1%. In hard-seeded species like *Acacia* the time taken for germination to begin varies enormously under natural conditions because of seed coat-imposed dormancy. Seeds were

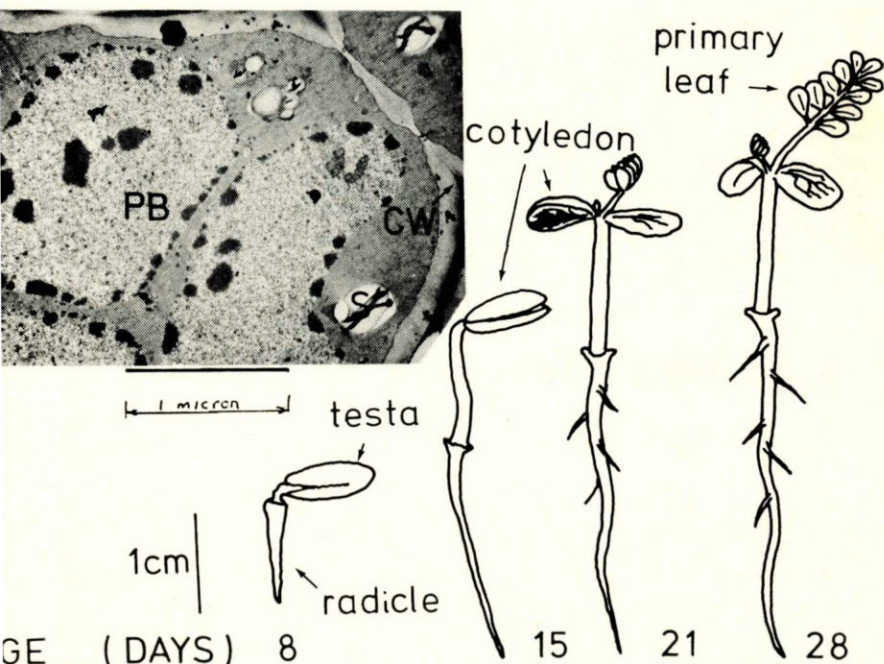


Fig. 1. (top left). Electron micrograph of transverse section of *Acacia itea-phylla* cotyledon (8-day stage) showing cell walls (CW), starch grains (S) and protein bodies (PB) of storage cells.

Fig. 2. *Acacia itea-phylla* seedlings at about weekly intervals from the beginning of water uptake.

germinated uniformly by placing them between two layers of wet cotton in petri dishes at 19°C following treatment to overcome dormancy. This consisted of suspension in boiling water for 30 seconds, or removal of a small piece of the seed coat from the end of the seed furthest from the embryonic axis with a sharp razor blade. This treatment usually gave 100% germination within a week. By comparison, heat-treated seeds lagged 3 to 4 weeks, showing a lower final percentage germination.

After 4 days, imbibed germinating seeds were transferred to vermiculite in plastic pots or tubs and placed in a glass house under ambient conditions (Melbourne spring 1977; max. day temperature c. 20-24°C). Seedlings were progressively removed and analysed for dry matter and water content. Cotyledons were also extracted for analysis of protein content and composition. The appearance of *A. iteaphylla* seedlings at about weekly intervals was as shown in Fig. 2. Eight days after the beginning of imbibition the radicle had reached a length of c. 1 cm. Growth of the root and hypocotyl proceeded rapidly in the second week, at the end of which the hypocotyl was unhooking. In most seedlings the cotyledons had changed colour from yellow to purple on the abaxial (under-) surface. During the third week the adaxial (upper) surface of the cotyledons greened and the cotyledons became thinner, proceeding from the margins towards the central vein. The pinnate primary leaf expanded rapidly from the end of the third week.

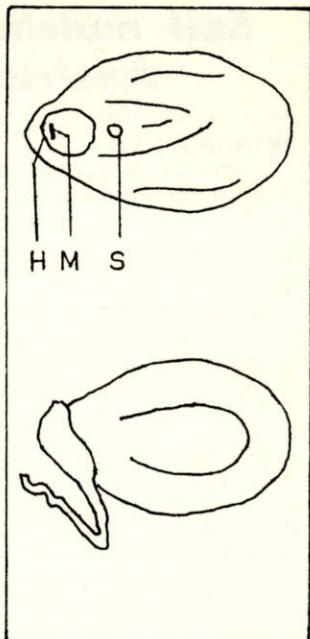
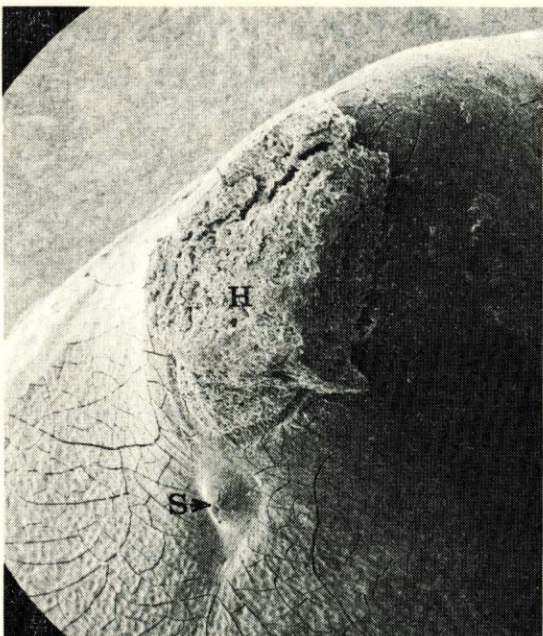
Analyses of the protein content and composition of the cotyledons showed that reserve proteins were degraded slowly in the first two weeks, although the total dry matter content of the cotyledons had been depleted by c. 70% in the same period. A phase of rapid breakdown of reserve proteins then occurred in the third week, accompanying the synthesis of chloroplast proteins and chlorophyll in the cotyledons themselves and in the primary leaf. Ashcroft and Murray (1979) showed further that the gains in dry matter in the roots, stem and primary leaf which occurred in the fourth week came about mainly through photosynthesis in the cotyledons.

The cotyledons of *A. iteaphylla* are thus capable of conversion from storage organ to photosynthetic organ. This capability appears to be widespread in the genus *Acacia*. Accordingly, it may be argued that the family to which *Acacia* belongs (Mimosoideae or Mimosaceae) is not the most primitive of the three groups comprising the Leguminosae, but rather is intermediate between the Caesalpiniaceae (many examples with cotyledons not adapted for storage, but obviously leaf-like) and the Papilionaceae (or Lotoideae or Fabaceae) including many examples with cotyledons adapted for storage, but not photosynthesis. This assessment of the Mimosaceae disagrees with that of many taxonomists (e.g. Lawrence 1960) but agrees with that of Hutchinson (1973). ■

Germinating *Acacia* seeds by disturbing the aril

by V. N. Tran, Division of Electrical Engineering, Deakin University, Victoria 3217.

The term strophiole is used here due to the lack of an appropriate word to designate a small structural feature on an *Acacia* seed, next to the hilum and on the side opposite the micropyle as shown in Fig. 1. The palisade cells of the strophiole in an *Acacia* seed are much shorter than elsewhere in the seed coat and the vascular bundle most closely approaches the surface (Tran, 1979). The appearance of a raised strophiole after microwave treatments, (see Australian Plants No. 83) suggests that the palisade cells may not adhere strongly to the inner layer of the seed coat. The question of how the strophiole is evolved and what function it plays in the development of an *Acacia* seed is still unclear. However it is established that the strophiole is a weak and unstable area which can be made permeable to water by heat, boiling water or microwave energy. The length of the palisade cells varies



An electron scanning micrograph of an *Acacia adunca* seed where H = hilum; S = strophiole. The sketch to the right shows these points on a seed.

from about 20 μm in a seed of *A. longifolia* to 80 μm in a bigger seed of *A. farnesiana* and yet some strophioles were found to be capable of withstanding the forces of nature for up to 50 years.

To make the strophiole permeable to water, it is not necessary to use boiling temperature. In fact prolonged heating at 60°C in a laboratory oven was found sufficient to make some strophioles of the following *Acacia* species become permeable to water: *A. longifolia*, *A. sophorae*, *A. triptera* and *A. howittii*.

Curious about the delicate nature of the strophiole I attempted to disturb it with the sharp point of a scalpel to see if the seed so treated would swell and germinate. This was done on the following species: *A. longifolia*, *A. sophorae*, *A. adunea*, *A. calamifolia*, *A. farnesiana* and *A. terminalis*. The results obtained were most satisfying. For instance, 96% of the *A. longifolia* seeds germinated at 20 days, which compared favourably with 88% achieved by nicking a similar number of seeds. Equally high percentages of germination were obtained for the other species.

To use the technique one must first learn to identify the strophiole, and its position relative to the hilum. It is advisable to begin with a large seed e.g. *A. farnesiana* or *A. sclerosperma* because its strophiole can be easily identified. More details about the strophiole (trace rapheale) are given by Vassal (1963). When one is familiar with the strophiole of a large seed, one can then learn to identify that of a smaller one. To do this a magnifying glass or a microscope is needed. Under magnification, the strophiole appears like an Adam's apple on a man's neck without the head. The neck contour represents the hilum and the Adam's apple the strophiole. Without magnification, the strophiole of a small seed can often be seen with the naked eye after microwave treatments or after being fried in a dry frypan for a few minutes. When the strophiole of an untreated impermeable seed is located, it can be made to appear raised and golden in colour by pressing a sharp point against it. It does not take much pressure and no similar effect can be produced at other places on the seed coat. This is all that is necessary to make the seed permeable to water. The technique causes no damage to the embryo and has been found effective with all the seeds treated so far. However it requires a bit of 'skill' and care is recommended. ■

Soil mulches and their effect on Australian native plants

by T. J. Christensen and E. J. McAlister, Botanic Garden, Adelaide.

INTRODUCTION

The use of mulches to control weed growth and to conserve moisture is a practice well established in horticulture. Among the many materials used are pine bark, sawdust, almond and apricot shells and inorganic materials such as gravel and scoria. This investigation was initiated to observe the effects of four different types of mulch on some commonly grown Australian native plants.

MATERIALS AND METHODS

The mulching treatments selected for trial are as follows:

Treatment 1 — Control i.e. no mulch

Treatment 2 — Shredded pine bark

Treatment 3 — Shredded pine bark, pre-soaked in water for 1 week, the water being changed after 1, 3 and 5 days

Treatment 4 — Sawdust

Treatment 5 — Almond husk and shell — available as "Almond Mulch".

The plants chosen for investigation were *Melaleuca diosmitolia*, *Eucalyptus maculata*, *Acacia baileyana* 'Purpurea' and *Kunzea baxteri*. These plants were chosen as they are commonly grown plants in Adelaide gardens and had been noted as being in poor condition in some areas under various types of surface mulch.

Plants in 5 cm tubes were potted-on with a soil and fertilizer mix used in Adelaide Botanic Garden for most native plants. It is basically a John Innes seedling mix with extra gravel added, and has proved quite suitable for the Australian native plants raised in the Botanic Garden. It comprises 3 level barrows loam, 2 level barrows sand, 2 level barrows sieved peat and 1 level barrow 3 mm ($\frac{1}{8}$ ") gravel, PLUS 290 g Dolomite, 290 g Garden Lime, 372 g Superphosphate, 4 kg Dry sand and 115 g Fritted trace elements.

The *Eucalyptus maculata* and *Acacia baileyana* 'Purpurea' plants were potted into 25 cm black plastic bags and the *Kunzea baxteri* and *Melaleuca diosmitolia* into 15 cm bags. The pH value of the soil at the commencement of the trial (13th June 1979) was tested and found to be 7.0.

After potting the plants were placed on benches in a glasshouse with the temperature regulated at 21°C. Each species was arranged in a block of 25 plants, 5 plants per row. On the following day, the 5 treatments were randomly assigned to each row in each block. A 4 cm deep layer of mulch was then applied to the appropriate row and water added.

The height of each plant was recorded at this stage and then at 14 day intervals over the next 20 weeks. Leaf colour was also recorded each fortnight on a rating scale of 1 to 5, 5 being assigned to normal healthy colouring and 1 to a strong yellow, chlorotic colour.

Soil pH values were recorded on a 4 weekly basis (see Table II) using an Analytical pH meter with a standard 1 : 4, soil : distilled water dilution.

RESULTS

The mean plant height (mm) for each treatment is given in Table 1; these heights were also graphed against time. No effect on growth was noted under Treatment 2, 3 or 4.

Pine bark was used in treatments 2 and 3 but the amount of bark used was small. In previously reported cases of pinebark toxicity the bark has been used as a potting mix additive, thus larger amounts are used. In addition all bark used in Adelaide has been aged for 2-3 months. As reported by Yazaki & Nichols (1978), fresh bark from *Pinus radiata* trees inhibited the growth of turnips, lettuce and tomato seedlings. Inhibition was due to the effects of compounds in the bark such as catechin, procyanidins B¹ and B³ etc., however, this effect can best be eliminated by the ageing of the bark for 35-40 days. Similar effects have been reported by Bennett et al (1978).

Sawdust is notorious for its ability to "tie-up" Nitrogen in the soil. In this trial the sawdust in treatment 4 was used as a surface mulch thus little nutrients would be "tied-up" as the results show.

The results on *Acacia baileyana* 'Purpurea' and *Kunzea baxteri* indicated that there may have been a significant difference in growth between the control and Treatment 5 (almond mulch). However, comparison by a two-way t-test proved to be nonsignificant.

The duration of the trial was 20 weeks, except in the case of *Eucalyptus maculata* which was terminated after 18 weeks following severe damage from a mite infestation.

No trend was observed concerning the change in leaf colour. Any colour change that occurred was merely associated with new growth flushes.

Treatment number	(a)				
1	2	3	4	5	
(a) <i>Melaleuca diosmifolia</i>					
144.8	108.0	116.0	152.4	138.4	
172.8	152.8	153.2	171.2	143.2	
187.2	174.2	178.8	192.0	163.6	
233.6	213.2	215.4	230.2	198.0	
292.8	267.6	283.0	282.4	256.4	
351.4	333.0	347.8	351.2	317.2	
419.0	401.0	420.8	421.4	376.8	
489.2	486.4	489.6	492.6	455.8	
573.0	573.6	567.6	577.6	548.0	
659.0	647.0	624.0	645.8	626.6	
760.8	729.2	709.2	733.6	715.6	
(b) <i>Eucalyptus maculata</i>					
1	2	3	4	5	
144.8	118.6	150.2	137.6	135.4	
158.0	128.8	168.6	147.4	148.4	
182.8	147.0	194.8	174.0	180.8	
210.8	169.4	248.7	202.6	225.2	
255.4	221.6	299.3	254.6	279.0	
309.4	276.6	340.0	326.8	312.6	
359.2	342.6	415.0	378.4	357.0	
403.4	419.0	482.7	448.0	405.2	
460.6	475.0	562.7	483.8	467.0	
533.8	517.6	645.0	509.0	489.6	
terminated after 18 weeks.					
(a) <i>Acacia baileyana</i> 'Purpurea'					
183.4	155.0	175.2	156.2	161.8	
205.2	204.8	214.6	197.2	202.8	
239.2	244.6	259.8	240.0	246.4	
293.2	299.8	314.2	299.2	300.8	
340.4	363.0	377.6	364.0	352.0	
410.8	441.6	453.4	435.6	403.6	
486.2	510.2	518.4	501.4	460.6	
595.4	599.0	616.6	595.0	552.0	
722.6	704.2	737.2	703.4	651.0	
835.0	813.6	841.6	810.0	751.6	
977.4	953.4	989.4	965.2	900.0	
(d) <i>Kunzea baxteri</i>					
169.0	150.4	177.6	173.4	159.4	
199.2	177.8	191.4	184.2	172.6	
226.2	206.4	203.6	210.6	190.0	
262.4	251.0	233.0	248.6	215.6	
309.8	287.6	277.0	290.0	246.0	
346.4	310.2	316.0	327.6	265.8	
370.8	331.8	341.2	360.4	287.4	
390.4	351.0	357.8	390.8	303.4	
419.6	383.0	380.2	416.2	323.8	
465.0	409.8	404.8	447.8	350.0	
514.0	435.8	431.4	482.0	379.4	

Table I Change in height (mm) with time for 4 Australian species.
Trial period 20 weeks. All heights given are mean of 5 plants.

Table II shows the soil pH values at each measurement time. The pH value in 4 of the 5 treatments remained relatively constant with only a slight decrease from 7.0 over the trial period. The slight decrease in pH levels can be attributed to the presence of the decaying organic mulch in conjunction with the leaching of lime from the potting compost.

Treatment number	(a) Time from commencement (weeks)				
	4	8	12	16	20
(a) <i>Melaleuca diosmifolia</i>					
1:	7.0	7.0	6.5	7.0	7.0
2:	7.0	7.0	7.0	6.9	7.0
3:	7.0	7.0	7.0	6.7	6.9
4:	7.0	7.0	7.5	6.9	7.0
5:	8.0	8.0	8.5	8.1	7.7
(b) <i>Eucalyptus maculata</i>					
1:	6.5	6.5	7.0	7.0	6.8
2:	7.0	7.0	7.0	6.7	6.8
3:	7.0	7.0	7.0	6.6	6.6
4:	7.0	7.0	7.0	6.8	6.7
5:	7.5	7.5	8.0	7.8	7.8
(c) <i>Acacia baileyana</i>					
1:	7.0	7.0	7.0	6.4	6.5
2:	7.0	7.0	7.0	6.4	6.4
3:	7.0	7.0	7.0	6.4	6.7
4:	7.0	7.0	7.0	6.4	6.5
5:	8.0	8.0	8.0	7.9	7.8
(d) <i>Kunzea baxteri</i>					
1:	7.0	7.5	7.0	6.4	6.5
2:	6.5	7.0	7.0	6.4	6.5
3:	7.0	7.0	7.0	6.5	6.5
4:	7.0	7.0	7.0	6.6	6.6
5:	7.5	8.0	8.0	8.0	8.0

ALMOND MULCH

The notable exception to the above trend was in Treatment 5 (almond mulch). In this treatment the pH value of the soil increased from the outset and remained in the alkaline range for the duration of the trial (see Table II). This result was totally unexpected, and made a chemical analysis of the almond mulch necessary. Results of the analysis can be seen in Tables III and IV. Both chemical analyses showed an extremely high concentration of potassium. It is apparent from Table IV that the outer husk of the almond is the part containing the largest concentration of potassium and this should be the fraction of the mulch having the greatest effect on soil chemistry.

Table III Almond mulch analysis*

Nitrogen (N)	0.47%
Phosphorus (P)	0.10%
Potassium (K)	2.14%
Calcium (Ca)	0.42%
Magnesium (Mg)	0.12%
Sodium (Na)	0.10%
Iron (Fe)	290 ppm

Table IV Almond mulch analysis **

	Shell	Outer Husk
Sodium (Na)	55 ppm	150 ppm
Potassium (K)	780 ppm	6000 ppm
pH—initial	4.8	4.5
pH—1 week soaking	5.5	8.2 - 8.4

* Analysis conducted by Chemistry Division, Department of Services and Supply, Adelaide.

** Analysis conducted by Mr G. J. White, Botany Department, University of New England, Armidale, N.S.W.

The husk fraction of the mulch was observed to break-down very quickly with watering. At the termination of the trial, the husk fraction was almost completely decayed while the shells appeared to be virtually unchanged. It has been suggested that breakdown of the husk is caused by the action of micro-organisms which are tolerant of high levels of potassium and have potassium bicarbonate (KHCO_3) as a by-product (White, 1979). Jarrell et al. (1979) have shown that the addition of KHCO_3 solution to soil increases the pH rapidly, reaching pH 8 using 0.1 m ($= 10.1 \text{ g/litre}$), and pH 9 when a 0.2 m ($= 20.2 \text{ g/litre}$) solution is used. As chemical analysis shows a very high potassium content in the husks it is reasonably safe to assume that one by-product of the breakdown of the husks is KHCO_3 which causes the rise in soil pH. The duration of this rise in pH is unknown and will be ascertained during field trials to be conducted in 1980. The work of Jarrell et al. (1979) indicates the effect is only of short duration, as the KHCO_3 either leaches out of the soil or becomes neutralised.

DISCUSSION AND CONCLUSIONS

The results of this pot trial indicate that for two of the species chosen, viz. *Eucalyptus maculata* and *Melaleuca diosmitolia*, the type of mulch used has no apparent effect on plant growth and there was little likelihood of any significant effect occurring even if the trial were run for a longer period. With *Kunzea baxteri* and *Acacia baileyana* 'Purpurea', although no statistically significant difference in growth occurred, there is a possibility of significance if the trial were prolonged. On observation, *Kunzea baxteri* showed growth depression under all treatments when compared to the control.

The most significant result obtained was the dramatic effect of the almond mulch treatment on soil pH. As described above it is apparent that this is caused by the breakdown of the husk fraction of the mulch releasing the very high proportion of potassium. In comparison to the husk the shell fraction of the mulch has a relatively low potassium content, and its release would be over a much longer period owing to the slower breakdown process.

Following the observations made in the pot trial various pH readings were taken in the Adelaide Botanic Garden. At a depth of 10 cm in areas where almond mulch had been used 6 weeks previously, consistent pH values of 8.3 were recorded, cf. pH 6.9 to 7.4 in adjacent unmulched areas.

This investigation would indicate that it is unwise to use commercially available almond mulch, i.e. mulch containing both shell and husk, on alkaline soils, eg. most S.A. soils, as the breakdown of the husk could either bring about or accentuate pH related problems. ■

ACKNOWLEDGEMENTS

Grateful acknowledgement is made of the assistance given by the Chemistry Division, Department of Services & Supply, Adelaide and Mr. G. J. White, Botany Department, University of New England, Armidale, N.S.W., for the analysis of almond mulch. Also, South Australian Woods & Forests Department for providing the plants used in this trial.

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Mulching for Good Garden Care

by Norm McCarthy, Toowoomba, Qld

During the recent prolonged drought, Australia-wide, tragic losses of native plants have occurred in gardens. Perhaps now as never before it can be realised that husbanding of gardening materials is most essential. Long terms benefits can accrue from good gardening habits in the form of mulching.

Why do we Mulch?

Soil moisture can be retained where most needed. That is in the area under the mulch, as generally required by the roots of the plants. Thus we save drying out of the soil by sun and wind.

Weed and grass growth is restricted to a minimum, saving competition. Compaction of the soil surface is reduced and water entry is improved. The roots of plants are kept cool during hot weather.

The soil texture is improved increasing the earth worm population.

Soil on banks and slopes is retained and erosion minimised.

Which Materials can be Used?

There is a wide range of suitable materials which can be used to great advantage. Grass clippings, leaves, cuttings, sawdust (untreated), cane bagasse, spoilt hay, peanut shells, pine bark and decayed animal manures. In fact, all biodegradable materials which eventually break down to become good garden humus. Other materials in use are gravel, stones and sheet plastic.

Continued on page 86

AUSTRALIAN PLANTS AS WOOL DYES

The Fastness of Mordanted Plant Dyes on Wool

by IAN W. STAPLETON, C.S.I.R.O., Division of Protein Chemistry, Victoria

Many books and articles have appeared over the past ten years or so describing methods and recipes for dyeing home-spun wool with extracts of native plants^{1,2,3}. Although these sources describe dyeing methods and the various shades of colour obtainable from plant extracts, there is, to my knowledge, no quantitative information published concerning the fastness of the dyed wool to washing and sunlight.

Being a native plant enthusiast and a dye chemist by profession, I decided to submit wool fabric dyed with mordanted plant dyes to several of the standard fastness tests that are adopted by the textile industry. The dyes used in the tests were obtained from plants belonging to twenty genera; the species examined are listed in the table along with the colours and shade depths obtained with mordants. In most cases the dye extracts were derived from the plant leaves, but the colours produced by bark and flowers were also investigated. The wool (in this case fabric) was dyed according to a published method⁴, with slight modifications.

Mordanting

The wool (about 100 gram was used for each 2 litres of solution) was scoured and then added in a wet state to a solution of the metal salt where it was gently agitated at the boil for 1 hour, (the composition of the mordant baths are listed below). The bath was cooled and the wool rinsed thoroughly in cold water and wrung-out. It was then stored in plastic bags in a refrigerator

<i>Mordant</i>	<i>Metal Salt</i>	<i>Weight of mordant (and additives) for every 2 litres of water</i>
Copper	Copper sulphate	2 gram
Chromium	Sodium dichromate	2.5 gr (plus 5 gr of ammonium sulphate)
Aluminium	Aluminium sulphate or Aluminium potassium sulphate (alum)	20 gr (plus 5 gr of cream of tartar)
Iron	Ferrous sulphate	4 gram

In the case of the iron mordant, the treatment with the ferrous sulphate solution was carried out after dyeing due to the low affinity of wool for ferrous iron. Tin salts were not examined because of the chemical degradation to the wool.

Dye Extraction

About 100 gram of finely chopped (or blender-macerated) plant material (leaves, bark or flowers) was steeped in water just below the boil for 1 hour with intermittent stirring. By holding the temperature below the boil, natural oils are retained which may add an aroma, or soften the handle of the wool. The extract was strained through a muslin cloth and the residue re-extracted until a combined liquor volume of 1 litre was obtained.

Dyeing

The wet mordanted wool was added to the cold plant extract (about 4 litres for every 100 gm of dry wool) and the temperature raised to around 95°C. After about 1 hour, the wool was lifted from the dyebath and rinsed in several changes of warm water. In the case of iron colours, the dyed wool was placed immediately in a hot mordant solution and gently stirred for 1 hour just below the boil.

After-soaping

In nearly all cases of mordant dyeing with plant extracts, the colour shade and/or depth of shade can be altered by vigorously agitating the dyed wool in a hot soap solution (2 to 4 gram of soap flakes per litre) for ½ hour at 50° to 70°. Many colours were found to take on different hues and deepen in

intensity. Alum-mordant dyeings, however, lost their colour brilliance and took on a rather drab brown colour.

The reason for this effect is unknown, but may be due to the formation of new coloured substances as a result of the alkalinity of the natural soap solution. This type of colour change has recently been reported by Scottish dye chemists⁴ for wool dyed with traditional vegetable dyes such as logwood.

Fastness Tests

The most important property of a dyed fabric is, apart from its colour, the ability to withstand the fading caused by sunlight.

The most commonly used method in determining the rate of dye fading requires the test sample to be exposed to sunlight (or a strong lamp) alongside a set of selected blue dyes on wool. These are numbered from 1 to 8 and the faded sample is visually matched with the standard dye that is judged to have faded to the same extent. A rating of 1 is indicative of a rapidly fading dye whereas a rating of 8 would indicate that the dye is extremely resistant to fading. A rating of 4 or better is considered a satisfactory light-fastness for a wool dye in the textile trade.

Aluminium mordants were found to be very rapidly faded (ratings of less than 2, regardless of the plant source), especially the bright yellows. Furthermore, the colours did not fade "on-shade", but were transformed into a brown shade before becoming paler. After-soaping improved the light-stability but, as mentioned, this treatment dulls the brightness of the colour. The three other mordants all gave satisfactory ratings (in the 4 to 6 range), with chrome colours exhibiting the greatest resistance to fading. After-soaping increased chrome and copper colour fastness to light.

These findings suggest that aluminium mordants should never be exposed to direct sunlight, and yellow colours desired for drapes should be sought among the chrome or copper mordants.

Washfastness

The standard method of assessing the fastness of a dyed fabric to washing is to subject it to one of a series of tests of increasing severity. The test appropriate for knitted wool yarn entails a tumble wash of the sample in a soap solution (5 gm/litre) at 50°C for 45 mins. The test sample is made up into a "sandwich" consisting of the test fabric covered each side by a piece of undyed cotton and wool; the assembly is stitched together with a section of the test fabric exposed to the wash liquor. After the sample has been through the wash cycle, the various pieces are separated, and the fastness assessed on how much dye has been lost. This is done by visually matching the difference in colour between the washed and unwashed fabric by comparison with a set of white and grey chips. The colour transferred to the white pieces of wool and cotton is also assessed by the same method, and this gives a measure of the tendency of the dye to stain.

All dyes in this survey showed very high fastness to washing with ratings of 4-5 (5 is a perfect score), and showed no tendency to stain white fabric.

Rubfastness

This is a test designed to assess the ease with which a dyed fabric will stain white cotton when the two are rubbed together under pressure, either in the dry or damp state. This could arise where a white undergarment is in close contact with dyed outerwear, for example, around belt lines.

Iron mordants of plant dyes performed poorly in this test, which indicates that the dye is located on the surface of the wool fibre and, hence, easily rubbed off. The other mordants were satisfactory in this respect and were further improved after soaping; iron colours, however, were not improved.

New Mordants

Experiments were carried out with a range of potential colour-forming chemicals with the aim of producing colour shades hitherto unattainable with the traditional range of mordants. Those which showed some promise are sodium phosphomolybdate and ammonium metavanadate which both produced unusual hues. Their cost may prove prohibitive for dyeing large quantities.

Caution: The metal salts used in the mordanting process are toxic to aquatic life and, therefore, should never be disposed of into natural waterways.

DYE MORDANT COLOURS FROM SOME AUSTRALIAN NATIVE PLANTS

The colour shade corresponds to the nearest colour in the British Council Dictionary of Colour Standards-Wool. The colour depth is a subjective assessment based on a scale of 1 (very pale) to 10 (very deep).

SPECIES	MORDANT							
	Chrome		Copper		Aluminium		Iron	
<i>Correa 'Mannii'</i>	Bronze	2	Khaki	2	Maize	2	Fawn	2
<i>Ficus macrophylla</i>	"	3	Beige	4	Cinnamon	2	Charc.-grey	3
<i>Eugenia smithii</i>	"	8	Brown	5	Khaki	3	Jet Black	8
<i>Pittosporum undulatum</i>	Khaki	3	Khaki	3	Fawn	3	Charc.-grey	2
<i>Exocarpus cupressiformis</i>	Gold-brn	3	Olive yell	3	Bronze	4	Olive-grey	3
<i>Casuarina torulosa</i>	Khaki	5	Brown	5	Khaki	5	Jet Black	10
<i>Callitris arenosa</i>	Bronze	5	Beige	3	Maize	3	Fawn	2
<i>Banksia collina</i> {Leaves	Khaki	2	Khaki	2	Cinnamon	3	Charc.-grey	3
{Flowers	Olive	2	"	2	grey	3	"	3
<i>Banksia ericifolia</i> {Leaves	Nutmeg	3	Brown	3	Cinnamon	3	"	3
{Flowers	Khaki	2	Khaki	2	Fawn	3	"	2
<i>Melaleuca armillaris</i>	"	5	Brown	3	Khaki	5	Deep grey	5
<i>Melaleuca incana</i>	Bronze	4	Bronze	3	Lemon	5	"	7
<i>Callistemon citrinus</i>	Khaki	5	Brown	3	Bronze	4	Black	7
<i>Acacia baileyana</i> {Leaves	Gold-brn	7	"	5	Buff	4	Dark brn	5
{Flowers	" "	8	"	5	Bronze	5	" "	4
<i>A. podalyrifolia</i> {Leaves	Brown	10	"	5	"	5	" "	5
{Flowers	"	10	"	5	"	5	" "	5
<i>A. floribunda</i> {Leaves	Fawn	2	Fawn	2	Fawn	1	Fawn	3
{Flowers	Buff	3	Khaki	3	"	2	"	2
<i>Agonis flexuosa</i>	Bronze	5	Bronze	3	Bronze	2	Black	7
<i>Thryptomene 'Paynei'</i>	Brown	7	Brown	7	"	4	Jet Black	10
<i>Baeckea virgata</i>	Khaki	4	"	5	Khaki	3	" "	10
<i>Leptospermum nitidum</i>	Bronze	4	Bronze	4	Pale Lemon	2	" "	8
<i>Eriostemon myoporoides</i>	Khaki	3	Beige	3	Khaki	2	Charc.-grey	2
<i>Prostanthera ovalifolia</i> {Leaves	Bronze	4	Khaki	2	Tuscan Yell	2	Olive-grey	3
{Flowers	Khaki	3	"	2	Bronze	2	Fawn	2
<i>Grevillea robusta</i>	Gold-brn	4	Brown	3	Sulphur Yell	3	Charc.-grey	3
<i>G. rosmarinifolia</i>	Khaki	2	Khaki	2	Apricot	1	"	3
<i>Angophora costata</i>	Olive brn	4	Brown	5	Khaki	3	Jet Black	10
<i>Eucalyptus viminalis</i> {Leaves	" "	4	Bronze	4	"	3	" "	10
{Bark	Brown	4	Brown	5	Bronze	4	" "	8
<i>Eucalyptus citriodora</i> {Leaves	Bronze	4	"	5	Lemon	2	" "	10
{Bark	Olive brn	4	"	5	Bronze	4	" "	8
<i>E. polyanthemus</i> {Leaves	Gold brn	4	"	5	Saffron	4	" "	10
{Bark	Beige	10	Khaki	2	Fawn	3	Fawn	2
<i>E. botryoides</i> {Leaves	Brown	4	Grn-yell	3	Bronze	2	Jet Black	10
<i>E. viridis</i> {Leaves	Khaki	4	Brown	5	"	3	" "	10
<i>E. cladocalyx nana</i> {Leaves	Brown	4	"	4	"	1	" "	10

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ECOLOGY AND DISTRIBUTION OF NATIVE WESTERN AUSTRALIAN PLANTS

By G. J. Keighery, Kings Park and Botanic Gardens, Perth, W.A.

Western Australia has a rich, highly endemic and remarkable flora, that is still very imperfectly studied. Because of the large size of the State and a very small population, few groups have been subject to intensive study either of a biological or taxonomic nature. Despite this lack of knowledge, the flora is being subjected to increasing pressures, which urgently require detailed biological knowledge to enable adequate conservation measures to be taken.

Kings Park, as the State Botanic Gardens, has as one of its major aims the eventual compilation of a Biological Flora of Western Australia. However, such a project requires large amounts of basic data on all species. This is currently lacking. A current long-term project being undertaken by the author hopes to correct some of these deficiencies.

Basically the project aims to map, on a more detailed grid scale than the regions of Beard (1970), all native Western Australian species of vascular plants. The grid scale being used is 1° latitude x 1.5° longitude, which corresponds to a 1:250,000 map sheet. Detailed locality gazettiers are available for these sheets, and being a relatively coarse scale, there is considerable latitude for errors in locality data without compounding the initial error.

The 1° x 1.5° grid has already been used by Churchill and de Corona (1972) to map the Victorian Flora, and has subsequently been suggested by Canny (1973) and Brooks (1976) as the ideal scale for Australia wide maps of flora and fauna. Thus the grid has the advantage of being relatively easy for each State to generate, since Western Australia, the largest State, is covered by 179 grid squares.

During mapping, each grid square is labelled after one collection has been recorded within its boundaries. At present no attempt has been made to record multiple collections, although these are retained on the basic data sheets. Only records backed by a herbarium collection have been recorded.

A series of reports are being prepared, each dealing with a particular family or genus, providing as well as a map for each species and named infra specific categories, data on the pollination, breeding systems and other aspects of the group. One of these reports, Part 1: Olacaceae is reprinted below.

Other reports published are on *Triodia*, Juncaginaceae, Restionaceae, Tremandraceae, Rhamnaceae, *Iridaceae* and *Eucalyptus* as listed in the references below. Others are currently in press. Copies of these reports may be obtained from Mr. G. Keighery, Kings Park, West Perth, 6005, at a nominal charge of 40c each to cover postage. They are in manuscript A4 paper form at this stage and unless the information is required for immediate research, interested people would be advised to await their proper publication in 1982.

Concurrent with the mapping project, we (C. Robinson and the Author) are undertaking a revision of the Descriptive Catalogue of Western Australian Plants which is hoped to be completed in 1982. Part 1: Olacaceae, page 76. ■

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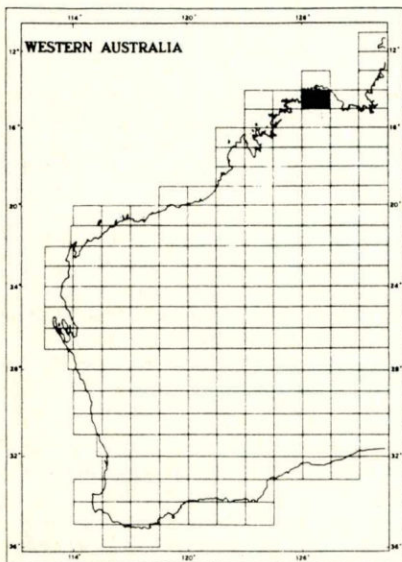
Notes on the Biology and Phytogeography of W.A. Plants —

Part 1: Olacaceae

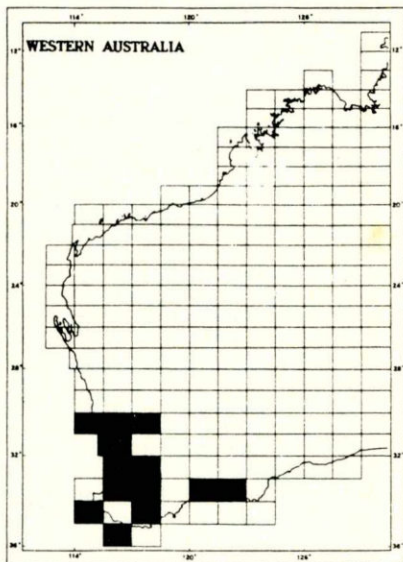
Introduction:

Olacaceae is a small family of approximately 120 species, chiefly tropical and subtropical in distribution. In Australia one genus, *Olax* is found throughout the Continent.

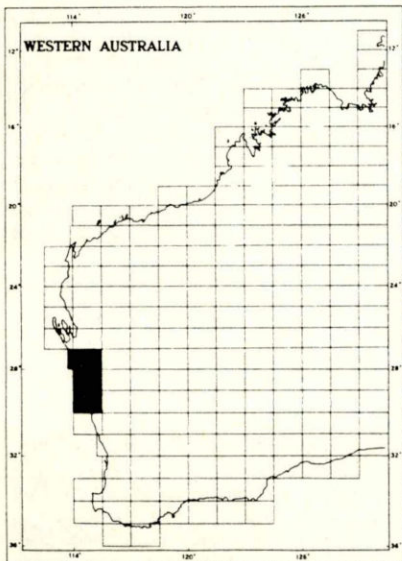
The South-west appears to be a major centre for the group, two species, namely *O. phyllanthi* and *O. aff benthamiana* are endemic to this region.



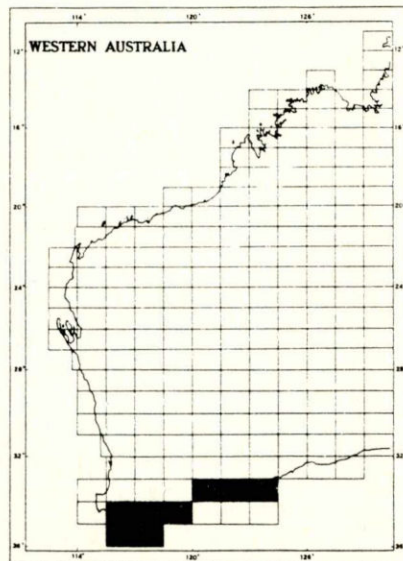
Olax aphylla



Olax benthamiana



Olax aff benthamiana



Olax phyllanthi

All species are hemiparasitic, soft wooded shrubs with glaucous foliage. New growth is green but upon maturity becomes grey/green.

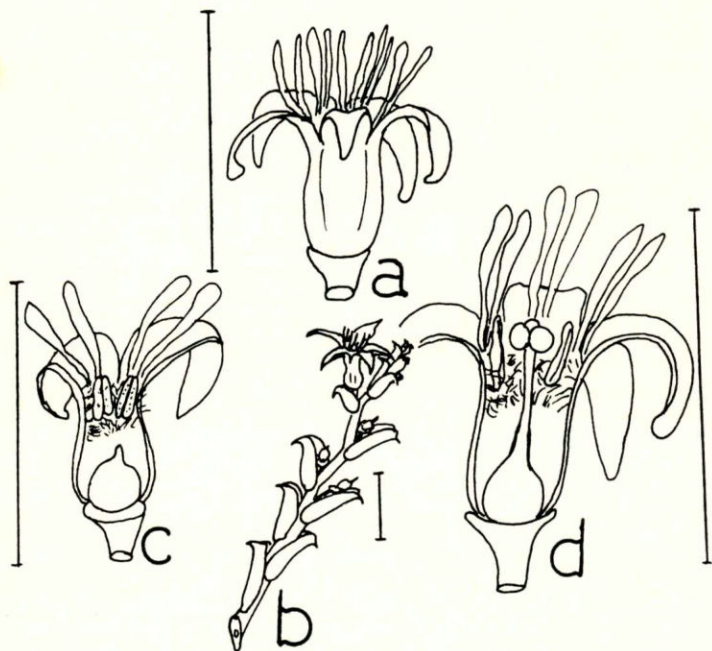
Breeding Systems:

Olax benthamiana was studied at City Beach. Flowers do not possess a noticeable scent, but produce copious amounts of nectar which is held on hairs in the throat of the flower (fig. 1, a). The flower is markedly protandrous, the stamens withering before maturation of the style (fig. 1, c and d). Flower life is brief, from 2 to 3 days.

Pollination is achieved by bombyllid flies, wasps and rarely native bees. Not self fertile, 47 gneitogamous (self) pollinations on 3 bushes set no fruit. Fire: *Olax* is frequently encountered after fires, since at least *O. benthamiana* is killed by fire, this is probably due to enhanced seedling survival.

Fruits: The seed is a large drupe, with a fleshy red or orange covering. Dispersal is presumably by birds but observations are lacking.

Notes on Individual Species:



Olax benthamiana a, the flower — b, a flowering branch — c, a young open flower showing dehiscent anthers — d, an older flower with mature stigma. Scale bar = 5 mm.

OLAX

O. aphylla R. Br.

Erect open shrub, to 1.5m., sandstone.

O. benthamiana Miq.

Single stemmed but low branched erect shrub (rarely prostrate) to 2m., foliage pale green or glaucous, fls. cream or white, 3-10. Yellow sand over clay, lateritic, sand or clay stable dunes, limestone.

O. aff benthamiana

Single stemmed but much branched slender shrub, to 1m., fls greenish-yellow or white, 3-6, sand over clay, limestone sand, sand. (Differs in slender habit, much larger leaves which are not overlapping).

O. phyllanthi R. Br.

Erect broomlike shrub to 1m., foliage glaucous, fls. white, 2-10. Sandy soils, coastal dunes, granitic loam. ■

Novel Western Wattles

by Alf Gray

In the East the Eucalypt dominates, but the West has such a vast range of Acacias that I don't think anyone has a firm concept of the actual number. For years I had difficulty in procuring names for quite familiar wattles, but it isn't always species that confuse so much as the variations in form, bearing in mind that the genus does not hybridise freely like Eucalyptus.

Acacia spathulifolia

Some western acacias appear to have little affinity with eastern ones — we will take *A. spathulifolia* as an example. This intriguing species is remarkable if only for its range of distribution on the Indian littoral from the Harvey Estuary in the south to well beyond Dirk Hartog's Island, Shark Bay and Bay of Rest in the north west, a distance of well over a thousand miles. The species was fairly common between the Moore River and Lancelin, the fisherman's paradise, in the days when I was collecting. Also at Northern Gully just east of Geraldton, yet never far inland, a true denizen of the littoral. It is by no means a typical *Acacia* and it was quite a while before I realised it was one. The dense bushy habit, the short bronze-green leaf like phyllodia, tend to resemble a dwarf *Melaleuca*, but the small "old-gold" heads carried above the bush on long peduncles give *A. spathulifolia* away when in flower.

It may not have the same appeal to others — wattles are not everyone's cup of tea — but there is a certain comeliness about this one I could never resist. When I finally had seed to sow and transplanted a specimen in the border of my arboretum, it flourished until a passing bulldozer removing a tree brushed it clean out of existence. As usual the driver couldn't make out why I was upset. When I dumbly pointed out the ruins among branches he was no wiser and probably regarded me as a case for a psychiatrist. He wasn't the only one!

Acacia grasbyi

South of Moora up the Geraldton Highway the Moore River crosses under a culvert on its way to Regan's Ford, the mecca of banksia fans. Alongside the road there a thicket of wattles used to beckon me to pull up on my way north in Spring. In full bloom it obviously consisted of several species growing together, and since that meant plenty of seed in due course they had much interest for me. All were about man height and vigorous in that moist situation — a joy to behold. The nearest was novel in respect of the long down-curving peduncles that carried the bright yellow oblong flower heads. I don't remember seeing another wattle bearing its blossoms in that manner. The short terete phyllodia curved inward and upward from their junction at the nodes. If I have not been explicit in my description you can look it up in *Western Australian Wildflowers*, for this *Acacia grasbyi* was a new one to me. The grooved phyllodia, the short oblong flower spikes and the curly brown bark all marked it down as a member of the "mulga" series to which many western wattles belong. The species was published by Maiden in 1917, who may have found it where I saw it near that road thirty years later.

Acacia hemiteles

As with *A. grasbyi* another wattle had curious circular pods ("circinate" as the botanist terms it). They were of a light brown colour and resembled those of *Cassia circinata* of Central Queensland except these latter actually encircle the branches. *Acacia hemiteles* syn. *A. graffiana* belongs to a series

much better represented in the east than the mulgas. The pods were numerous and fat with ripe seed, which I harvested. I often wonder where all that seed went, and if somewhere a long, long way from Moora a 'grower' is still puzzling about a ring-podded wattle in his garden.

Acacia beauverdiana

If these acacias no longer exist near Moora, I have seen them north-east of the rabbit fence on the way to Paynes Find. With them grew another most beautiful species, *A. beauverdiana*, which also belongs to the mulga series. It bears finely parallel nerves in long slender phyllodia as well as the typical oblong 'rod' flower spikes. At the risk of criticism I would regard this one among the finest flowering wattles in the west, especially since no-one can possibly have seen all of them in flower, there are so many. A recent census (1981) published by the Western Australian Herbarium lists 401 species. Current research by B. R. Maslin is expected to increase this.

Acacia denticulosa

The west has always inclined to secrecy in the matter of botanical rarities. Who can blame it, once gone no power on earth could replace them. One day in an expansive mood the Government Botanist sketched what I took to be an oval leaf on his pad and passed it across to me. When he added teeth to its margins he labelled it *Acacia denticulosa*. That was the first I knew about this wattle but since he obviously expected me to be impressed I volunteered to go and collect it. Nothing doing. Many years later Ken Newbey obtained the locality from the State Herbarium, collecting specimens in the flowering season but of course no seed. After the harvest was in he offered to take me up with him to get seed early one Sunday morning, warning me of the long journey ahead up where most place names end in 'Rock', the elbows of great granite plateau protruding through the barren terrain said to have eroded down from several thousand feet. Yet still a high plateau where no seas have intruded since time immemorial.

At the base of these tors the run-off is absorbed in deep decomposed granite mixed with organic matter. This is where the settler obtains his water supply and the vegetation thrives. There are no rivers where the rainfall is so low and uncertain.

Here at the foot of a cluster of tors Ken found the wattle we had come so far to collect. *A. denticulosa* was quite unlike any other I had seen in the west, especially the phyllodia which were obovate, about 3 in. long with 3 or 4 parallel nerves and toothed margins, more like a hakea than a wattle at first sight. Though this was seed time there were still some late flowers on 10 cm spikes, enough to convey the impression this would be a very showy species in full bloom. We harvested a meagre quantity of seed (evidently the fauna had been there before us!) for testing under cultivation in nursery and garden. Later on I looked up this wattle to determine its relationship, being such an unusual one. To my surprise it was classified in a series of four species, the other three belonging to the tropical north, the Gulf of Carpentaria and north-east Queensland. No wonder *A. denticulosa* appeared so novel here on the fringe of the Ereman Province in south-west W.A. Baron von Mueller described this species over a hundred years ago. I would not think he collected it himself, though he wasn't so very far away about that time. I believe he was on sick leave battling through virgin scrub between the Hutt River and Shark Bay. What a man! What a collector with his precious bags of seed on the pommel of his saddle. The real Australians respected him so he went unharmed, as did James Drummond ("he who walks with his head down"). Their kind were the great men of the flora. It is a high honour to tag along so very far behind a century later.



Acacia anfractuosa (above)

Photography by F. W. Humphreys

Going to or returning from the Eastern States wildflower enthusiasts can hardly fail to observe anywhere between Southern Cross and Tammin one of the most curious wattles ever. This is *Acacia anfractuosa*, a denizen of white sand plain stretches. It may not be as common on the Eyre Highway as it once was but it ranges far in the Southern Cross region to well beyond the rabbit proof fence east of Hyden.

A. anfractuosa also belongs to the mulga series, with the characteristic short oblong flower arrangement and terete grooved phyllodia, something like long pine needles, which latter in this case may exceed 10 cm in length to sweep the sand at the ends of the long slender zig-zagging branches. The phyllodes as well as the flower spikes in season are borne singly at the nodes where the branches change direction, the whole plant in fact developing in this peculiar manner of growth to an attenuated shrub or small tree. The regions of habitat in usually unstable desert sands are very exposed to strong winds which suggest their influence over a long period of time have induced the remarkable habit of *A. anfractuosa*.

In the cultivation this form still prevails, except that cultivated specimens grow more dense in crown, and the trailing branches with even longer phyllodia make very fine specimens. Above all the attributes of *A. anfractuosa* is the delicate fragrance of the rich yellow rod spikes distributed over the crown and down the trailing branches. If such a perfume be considered exceptional in an acacia, many desert species at least seem to bear a hint of it, especially the mulga series.

When this article was first written Alf knew this wattle as *A. hynesiana* because of its similar habit with flexuose, often pendulous branches and its long narrow phyllodes and legues. *A. anfractuosa* differs significantly from *A. hynesiana* and its closely related *A. merinthophora* in that the phyllodes are differently veined and the flower heads are pedunculate and 5-merous. *A. anfractuosa* has since been described by Maslin in *Nuytsia* Vol. 2, No. 2 together with four other phyllodinous species, *A. argutifolia*, *A. jacksonioides* and *A. simulans*. *A. anfractuosa* is allied to *A. heteroneura* and *A. jutsonii* but it differs from both in its often pendulous flexuose branches and its curved phyllodes. — Editor.

If there would be grower clamors for seed from your precious *A. anfractuosa* in the garden there need be no alarm. Just wave him on and say "Help yourself", adding to your reputation for benevolence at no sacrifice. Except when the very slender pods are dead ripe and shedding seed it is very difficult to locate them in the tangle of branches and phyllodes, with which they share the general form. It is quite easy to grow this wattle in conditions at least approaching the natural environment.



Acacia lasiocalyx (above)

Photography by F. W. Humphreys

George Althofer said *Acacia lasiocalyx* was the best western wattle collected by me. I conclude it is the form collected near Lake Grace, which grows to tree height like a weeping willow. The phyllodia are up to 0.6 m long, very slender with a prominent mid rib and about the colour of the weeping willow. The flower spikes are up to 5 cm and of a rich sulphur yellow. The branches sweep the sand beside the lakes where it grows, also elsewhere in the area because these lakes were much larger in past time. In full flower *A. lasiocalyx* is a magnificent sight; besides it is a useful drift arrester as well as shade and shelter in this very exposed region. Further south in the Stirling-Barren Range zone this wattle becomes a bright green, compact shrub about man height, no longer a lakeside dweller. Both forms are hardy and adaptable with, in my opinion, great possibilities, the shrub preferring heavier and even rocky habitats.

Acacia redolens

Another wattle George appreciated was *Acacia redolens*, a grey procumbent species about 4 metres across when less than a metre high at the centre, and a mass of bloom in spring. If you are thinking in terms of ground cover and large, here you have it. In addition if you run out of soap any time, wet your hands before crushing the phyllodia for a solvent. The habitat ranges from Ongerup to Ravensthorpe near the copper mines. I like the latter form which seems to enjoy the soil mineralisation, having a brighter richer appearance. No doubt the solvent would be stronger too but it does not seem to have had a noticeable effect on the price of soap locally!

Acacia rossei

Returning to the Southern Cross area we find *Acacia rossei* often in the company of the preceding species and just as novel in its own way. The habit is that of an upright single stemmed plant not above man height as I have seen it. It does not appear to have wide distribution and could be classed as rare. On page 187 of *Western Australian Wildflowers* a drawing shows the manner of inflorescence at the summit of the stems, also the phyllodia below, but they are not verticillate (i.e. in regular whorls) though belonging to a small series having that arrangement. The globular flower heads on long divaricate peduncles are of a bright golden yellow and very attractive, but it was the pods that always took my fancy. A dull chocolate brown, they were a little over an inch long by half that broad, with panelled insets of rough pattern and deeper colour. Very curious indeed, but more so was the delightful fragrance they gave off. I'm not sure whether the flowers were scented too, it was hard to tell in the presence of the pods. Enthusiasts may be able to enlighten us because the species must surely have attracted most growers who passed along the Eyre Highway when it was in flower. Many a pinch of seed and even a few plants have been given me in the hopes I could raise this wattle, yet it didn't seem to value my acquaintance, my methods, or the soil. It hankered for those deep white sand plains. I hope others might have or have had better luck, while consoling myself with the probability those 'twenty-eight' parrots that infest my arboretum at harvest time would have destroyed this tender wattle anyway. Gorging on spilled grain in the farm yards they flutter off to the most succulent specimens in the arboretum to ringbark and nibble for the rest of the day. Lovely birds? Oh yes! But also a splendid example of the delicate balance of flora and fauna nevertheless.

Acacia inophloia

When it comes to boiling the billy in the bush stringybark comes in handy, especially if both weather and wood are damp.

Stringybark gums are the usual source of supply and there are many kinds bearing the vernacular but not the specific name. It is not generally known however that one sheoke, *Casuarina inophloia*, and a cypress pine, *Cupressus inophloia*, also a wattle, *Acacia inophloia*, are also stringybarked. Of them all I think the wattle is most deserving of the title because of the coils of fine resin impregnated bark that form in the forks of the branches so ready to hand.

A mallee-like curly barked small tree of the same 'mulga' series most of these novel species belong to, in 'foliage' and flower it is typical. The finely striate terete phyllodia and single rod spikes emerging together from the nodes of branchlets are similar. As for fragrance, well, if you prefer the smell of resin on the bow just put your head in among the branches.

The habitat of the stringybark wattle is on the eastern margin of W.A.'s central wheatbelt. Beyond lies a vast arid stretch of sparsely settled terrain, a virtual no-man's-land so far as the flora is concerned, even today, but where I feel sure other species of these stringybark acacias may be found. ■

QUANDONG — A Garden Shrub — Flowers — Fruit to Jam by David J. Searle

My *Santalum acuminatum* is growing under a tall *Eucalyptus ficifolia*. The soil is deep sand, very dry, but however, the water table is only two metres below the surface. The tree is six years old. It bore six pieces of fruit at three years, 140 pieces at 4 years, 250 at 5 years and 400 in 1980. At the moment the tree is covered with tiny flowers. It is 2.5 metres high and about the same wide.

The fruit makes very good jam and pies. It can be mixed with equal quantities of dried apricots or other fruit if desired for cooking.

***Verticordia* Study**

One of the many projects in hand to contribute to the knowledge of our flora is the "Verticordia Reference Collection". Flowering specimens are needed to complete the collection especially of species in Queensland, South Australia and Northern Territory. Write to Elizabeth Berndt, 226 Grove Road, Lesmurdie, W.A. 6076. Please help.

NUTRIENT DEFICIENCY

D. G. Nichols, D. V. Beardsell and Annette Hallpike

Nurserymen who grow Australian native plants are familiar with some of the nutrient deficiency and toxicity symptoms that occur with their plants. Sometimes they are not aware of exactly which nutrient is causing the problem. Common problems that occur are nitrogen deficiency in a wide range of plants, phosphorus toxicity in Proteaceae and iron deficiency in various species, notably *Banksia* spp., *Hypocalymma* spp., *Dampiera* spp. and *Prostanthera* spp.

The nutrition of the wide range of native plants grown has not been studied in great detail and consequently likely deficiency problems are poorly understood. A programme has therefore commenced at HRI, Knoxfield, to examine the responses of selected Australian species to deficiencies of essential nutrients. Facilities for the work are limited and so that as many species as possible can be examined, each species is exposed to the deficiency for only a short time (no more than 12 weeks.) In this time it is not possible to produce obvious deficiency symptoms for all of the elements. The objectives of the programme then are confined to examining symptoms that are expressed fairly quickly and are possibly the ones most likely to occur in nursery practice.

So far we have examined eleven species covering eight genera and five families. The plants were transplanted as seedlings or rooted cuttings into 8 cm pots in a medium of washed river sand, and allowed to establish before treatment. Eight treatments were used and there were 8 plants per treatment. The control consisted of a complete nutrient solution containing the following elements:

Nitrogen (as nitrate)	112 ppm	Trace Element	
Potassium	78 ppm	composite solution	
Phosphorus	41 ppm	Manganese	0.43 ppm
Calcium	160 ppm	Copper	0.064 ppm
Magnesium	36 ppm	Zinc	0.065 ppm
Sulphur	59 ppm	Molybdenum	0.019 ppm
Iron (as Na Fe E.D.T.A.)	5.6 ppm	Boron	0.324 ppm

Deficiencies of individual elements was achieved by eliminating the element from the solution while maintaining the balance of the remaining elements. In order to do this it was necessary to alter the sulphur content of different solutions. No attempt was made to produce a sulphur deficient solution.

Observations were made of leaf and stem symptoms and of root growth and the occurrence of specialised root formations such as nodules and pro-teoid roots. Extension growth was measured and this is shown in Table 1 together with counts of plant mortality which occurred as a result of the treatments.

Table 1 Mean Extension growth (cm)

	Comp	-N	-P	-K	-Ca	-Mg	-Fe	-T.E.
<i>Eugenia cyanocarpa</i>	63.0	13.8	38.1	62.4	48.1	53.1	44.1	68.3
<i>Ficus watkinsiana</i>	18.9	9.0	14.9	16.8	21.1	25.0	17.6	21.8
<i>Grevillea rosmarinifolia</i>	84.8	9.3	40.0	83.9	79.0	97.8	95.3	78.0
<i>Brachysema lanceolatum</i>	62.2	50.2	27.6	49.2	47.0	68.6	63.6	31.0
Prost. 'Ragged Robin'	128.6	41.8	92.0	78.4	71.8	115.2	96.0	93.0
<i>Eucalyptus gunnii</i>	251.4	17.9	134.4	134.2	N.D.	265.1	241.4	201.1
<i>Eucalyptus leucoxylon</i>	171.0	9.9	39.4	113.9	N.D.	185.4	172.1	158.4
<i>Kennedia glabrata</i>	60.0	53.9	81.6	65.2	95.8	97.0	101.4	31.5

Fig. 8



Fig. 3



Fig. 1



Fig. 6



Fig. 4



Fig. 2

Fig. 8 Potassium deficiency in *Eucalyptus leucoxylon*.

Fig. 3. Growth reduction in *Eucalyptus gunnii* due to potassium deficiency.

Fig. 1. Growth reduction in *Eucalyptus gunnii* due to nitrogen deficiency.

Fig. 6 Phosphorus toxicity in *Banksia ericifolia*. Note defoliation in plant on the left which received phosphorus compared with plant on the right which received no phosphorus.

Fig. 4 Potassium deficiency in *Banksia integrifolia*.

Fig. 2. Growth reduction in *Eucalyptus gunnii* due to phosphorus deficiency.

Comments and observations

Eugenia cyanocarpa There was a considerable growth reduction and some yellowing when nitrogen was absent from the solution, and a lesser growth reduction with a slight darkening of the foliage when phosphorus was absent. There were no obvious symptoms in the other treatments.

Ficus watkinsonia The symptoms here were similar to those for the *Eugenia*. *Grevillea rosmarinifolia* Nitrogen and phosphorus deficiency both appeared as growth reductions. Lack of potassium resulted in leaf scorch on the tips of older leaves. A distinct chlorosis appeared on the young leaves when iron was absent. Masses of new proteoid roots (16 per plant on average) and increased root growth occurred with lack of phosphorus. The only other treatment to induce proteoid roots was the one lacking in nitrogen (8 per plant on average).

Grevillea aquifolium At least half of the plants died in all treatments except that deficient in phosphorus which suggests that this species is susceptible to phosphorus toxicity. The leaf symptoms before death appeared as necrosis of the foliage in patches which spread across the leaf and was followed by abscission. Proteoid root growth occurred when phosphorus was absent.

Fig. 9



Fig. 11



Fig. 7

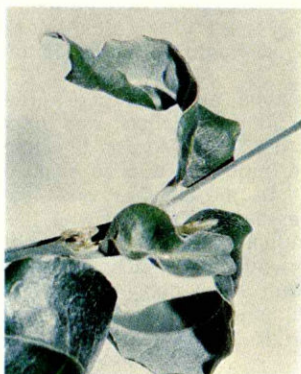


Fig. 10



Fig. 5

- Fig. 9 Trace element deficiency in *Eucalyptus leucoxylon*.
 Fig. 11 Iron deficiency in *Prostanthera* 'Ragged Robin'.
 Fig. 7 Iron deficiency in *Eucalyptus leucoxylon*. Note interveinal chlorosis.
 Fig. 10 Trace element deficiency in *Brachysema lanceolatum*. Note leaf distortion.
 Fig. 5 Iron deficiency in *Banksia integrifolia*. Note chlorosis of young leaves only.

Brachysema lanceolatum Growth reductions were greatest when phosphorus and trace elements were withheld. Plants lacking nitrogen grew satisfactorily but there was some chlorosis on the new leaves. This treatment induced large numbers of nodules in the root system. Leaf curling and distortion occurred when trace elements were omitted as shown in Fig. 10. This symptom together with the growth reduction is consistent with boron deficiency. *Prostanthera* cv. 'Ragged Robin' Growth reduction and chlorosis occurred with nitrogen deficiency. When iron was absent there was distinct interveinal chlorosis on new growth as shown in Fig. 11. There was some darkening of the foliage towards the tips of older leaves when potassium was absent. *Banksia ericifolia* This species showed great sensitivity to lack of potassium, iron and nitrogen in the early stages and ultimately to phosphorus toxicity. Potassium deficiency showed up as necrosis of the tips of leaves, iron deficiency as chlorosis of the new growth and nitrogen deficiency as reduced growth and general chlorosis. Phosphorus toxicity occurred with all treatments except the one lacking phosphorus. This also occurred as tip necrosis and followed by defoliation as shown in Fig. 6, and plant death. Proteoid roots were present when phosphorus was absent.

Banksia integrifolia Growth reduction together with some chlorosis of new leaf occurred with nitrogen deficiency. Root growth was largest with this treatment and there were masses of proteoid roots. The treatment in which phosphorus was left out also produced proteoid roots but only in small numbers on 2 of the 8 plants. This species was also sensitive to lack of iron which was again expressed as inter-veinal chlorosis on new growth. The effect of potassium deficiency is shown in Fig. 4 and of iron in Fig. 5.

Eucalyptus gunni Showed clear symptoms of nitrogen deficiency; greatly reduced growth and pale foliage, phosphorus deficiency, reduced growth and pale foliage, phosphorus deficiency, reduced growth and reddish pigments in the stems; potassium deficiency, leaf tip and marginal necrosis and iron deficiency, interveinal chlorosis on young leaves. The effect of nitrogen deficiency is shown in Fig. 1, phosphorus in Fig. 2 and potassium in Fig. 3.

Eucalyptus leucoxylon Produced similar symptoms to *E. gunni*. In addition this species exhibited a reddening of leaf tips and margins where trace elements were absent. Further work is needed to determine which element is involved. The effect of iron deficiency is shown in Fig. 7, potassium deficiency in Fig. 8, and trace element deficiency in Fig. 9.

Kennedia glabrata This species grew poorly under the conditions of the experiment. Growth responses were poorly defined. High nodule counts were found when nitrogen (13 on average) and iron (15 on average) were absent.

Conclusions

All except the *Brachysema* exhibited poor growth when nitrogen was absent from the solution. Some chlorosis was apparent but this was by no means a dominant symptom. The chlorosis that nurserymen often associate with nitrogen deficiency is probably due to lack of iron. Iron deficiency developed rapidly in most of the species and the symptoms were quite distinct. Young leaves were affected usually with the veins remaining green while the interveinal area adopted a bright yellow colouring.

The species responded variably to phosphorus. In some cases there was a marked reduction in growth when phosphorus was absent while in others the plants died when phosphorus was present. Nurserymen growing a wide range of plants would need to be careful in separating plants according to phosphorus needs.

Potassium deficiency was exhibited as a growth reduction usually accompanied by classic symptoms of curling and necrosis.

No obvious magnesium and calcium symptoms were manifested in the 12 weeks of testing for any species.

Lack of trace elements showed up in two species.

Overall, however, the nutrients which may require special attention from growers of native plants are nitrogen, iron and phosphorus.

Mulching for Good Garden Care—cont'd from page 71

So many of us waste the "biodegradables" by burning or dumping because they are deemed untidy. If only we would realise we are discarding what our very own gardens need most. A constant supply of "organics" replace that which our plants are constantly consuming and it should not be wasted. Applied organic materials are inclined to lionise available nitrogen from the soil. Extra nitrogen can be added in the form of sulphate of ammonia, urea or Nitram. If applied in small amounts at intervals, and well watered, it will combat this interaction satisfactorily. Nitram is pelletised and coated and will stay unabsorbed until rain falls, or watered artificially.

Sawdust and Shavings — A review of reports in previous issues — Ed

The concern has been that this compacts and when dry prevents the entry of water. It should be 4-6 weeks since it was first sawn. Bern. Schubert reports in Vol. 1, No. 12, page 19, that he gets excellent results by covering the whole area to 30 cm deep. To plant, dig a hole in this shavings cover, 30 cm square, down to the soil, fill this with garden loam and plant. Spread gravel on the surface around the plant. Pax Lindsay (1, 12, 19) recommends the application of a fertilizer to the soil surface, spread shavings to 5 cm deep followed by an application of 45 grams of sulphate of ammonia per square metre of area. J. Zwar of Leigh Creek, SA, where a salinity problem exists in a very low rainfall area (8, 165), regards mulching as vital. Clay subsoil can be

turned quickly into quality top soil by incorporating sawdust mixed in with ammonium nitrate, 10 kg per tonne of sawdust. W. Martin of Victoria (5:212) found 5-8 cm of shavings superior to a pebble cover with a polythene underlay.

Bluemetal Screenings

Boddy of Victoria (3, 54) found that an original tanbark mulch provided so much food for the plants that root systems remained near the surface. Penetration of rain and supplementary watering was severely restricted by tan bark. A mulch of 2 cm blue metal to a depth of 5 cm is recommended.

Other Materials

Judy Hamersley of WA (2, 13), mentions the use of sawdust and shavings (difficult to water through when they get dry), seaweed (good), casuarina and pine needles (excellent), dried grass (easy and available) and gravel for ground hugging plants. Winifred Bristow of Qld (4, 314) solved a very difficult weed problem with layers of paper as a mulch. Ken Warnes of SA with a highly alkaline situation used half a corn sack then a 10 cm depth of straw as a mulch. ■

Wildflower Nurseries in New South Wales

Bundara Native Nursery — 37 Carters Road, Dural, Sydney, 2158. Tel. 651-1962. Specialising in *Grevillea*. Open weekends. Weekdays please ring first.

Cranebrook Native Nursery — R23 Cranebrook Road, Cranebrook, N.S.W. Tel. (047) 77-4256. Four miles north of Penrith, between Tadmore and Taylor Roads. Open 10.00 a.m.-6 p.m. Closed Sundays.

Denovans Nursery — 188 Marco Ave., Panania, 2213. Tel. 77-8891.

Forest Native Nursery — 9 Namba Road, Duffy's Forest. Tel. (02) 450-1785. We specialise in a wide range of native plants. Catalogue \$4.50 posted. Open 7 days.

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 Plant — 96c George's River Rd., Campbelltown 2560. Tel. (046) 25-1583. Open 7 days.

Sylvan Nursery — Portsmouth Road Erina. Large range. Open weekends. Mon.-Fri. Please ring first (043) 67-7417.

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

Wirreanda Nursery — end of Wirreanda Rd., Ingleside, 2101. Tel. (02) 450-1400. Over 20,000 advanced and semi-advanced native trees, shrubs, ferns and indoor plants. Public and trade welcome. Open 7 days. Send S.A.E. for list.

Deanes Orchid Nursery — Specialist in Australian Native Orchids. 29 Hemers Rd., Dural 2158. Tel. (weekdays) (02) 651-1798. Nursery closed Friday. Plants sent anywhere. Please send for descriptive list.

Wildflower Nurseries In Victoria

Austraflo — The nursery with the "Native Know How." — Belfast Rd., Montrose 3765. Tel. 728-1353. Mon.-Sat. 9-5.30 p.m. Sun. 10-5.30 p.m.

Belbra Nursery — Box 12, Halls Gap, 3881. In the heart of the Grampians. Large range of Australian natives. Closed Wednesday only.

Grass Tree Native Plant Nursery — Brown's Rd., Rosebud S. 3939 (opposite Hyslops Rd.) 10 a.m.-5 p.m. Wed. to Sun. inc. In natural setting.

Flora Terra Australis — Cnr. Bellevue Cres. and Seaford Rd., Seaford 3198. Kevin Reed — Native Plants specialist, a collectors nursery. Huge selection from ground cover to trees, rare and the common, sizes large or small. Closed Mon. & Tues.

Wildflower Nurseries in Queensland

Fairhill Nurseries — Fairhill Rd., Yandina 4561. Tel. (071) 46-9193. P.O. Box 100. Trees, shrubs, ground covers, climbers, ferns, palms and orchids for the sub-tropical and tropical east coast. Extensive display gardens 8.30 a.m. to 5 p.m. anyday. Catalogue \$1.50.

Lakkari Native Plant Nursery — Specialist growers of Australian Plants, retail & wholesale. Large range available. Browse through our display gardens. Many selected natives unique to Queensland as well as new cultivars and hybrids. *Grevilleas* and rainforest species our speciality. Catalogue available \$1.00 posted. Open 6 days (closed Saturday only). 477 Redland Bay Road, Capalaba, Queensland. Tel. (07) 206-4119.

Utingu Native Plant Nursery — Wholesale and retail. — 37 Sorbiston St., Wellers Hill, 4121. Tel. (07) 397-5706. Open 7 days. Trees, shrubs, ground covers, ferns, hanging baskets.

Wildflower Nurseries In Tasmania

Banksia Nurseries P/L — Waratah Hwy., Elliot 7325. Tel. (004) 36-3128. Open 7 days, 9-5. Grower of rare and common Australian native plants. Available in most sizes at certain times of the year. Advanced and tube lines a speciality. Send S.A.E. for list.

Australian Wildflower Seed Suppliers

Nindethana Seed Service — Largest selection of native seed in Australia. Nindethana, Narrikup, W.A. 6326. Available in 50c pks. gram lots or kgs. Send 20c stamp for free catalogue.

H. Grant — 2 Sandra Pl., Dubbo, 2830. West N.S.W. a speciality. Two stamps for a catalogue posted.

Helmholtzia glaberrima

C. Napier Thomson

This little known plant of great horticultural potential belongs to the small family Philybraceae, of which the "Frogsmouth", or "Woolly Waterlily" *Philydrum lanuginosum* is the only common member.

The plant was mentioned in the article "Rainforest Plants as Garden Plants" by F. D. Hockings (Vol. 9, No. 76, September, 1978, page 335), under the name of *Orthothylax glaberrimus*. However, the botanists of the N.S.W. National Herbarium (see below) argue that the species should be retained in the genus *Helmholtzia*.

When not in flower the plant looks very similar to the common horticultural agapanthus or clivia, with similar though slightly darker and stiffer leaves. The tall flower spike bears an erect much-branched panicle of numerous pink flowers which last for many weeks, but which gradually fade to white. In Sydney the flowers open about October and last over Christmas. A full botanical description is given in N.S.W. National Herbarium Flora Series No. 31(1966).

In spite of having spent a day last year walking in the rainforests of the Tweed River, I have never seen *Helmholtzia* growing in nature. I understand it grows in the deep ravines of the mountains where the sun does not penetrate at all and where the atmosphere is perpetually humid. I was given a small plant by a timbercutter in 1964. I planted it in suburban Sydney on the south side of the house where it is sheltered from sunlight and winds, and watered it regularly. It thrived and flowered the second spring.

As far as I can tell no seeds are produced in Sydney, at least in the conditions I give my plants. I find that after 3 or 4 years I can divide the roots into an average of half a dozen separate plants. This method is too slow for commercial propagation, and if it is to be propagated for horticultural purposes it will have to be by seed, which will probably have to be produced in Queensland or northern N.S.W.

The plants grow equally well in a garden bed or in a pot, but in either case must receive no sunshine at all. A small amount of sunlight burns the leaves. They would probably be useful as permanent indoor plants, provided the atmosphere was not dry, but I have not tested this. ■

BOOKS ON WILDFLOWERS

Alison Ashby's Wildflowers Of Southern Australia

Deluxe edition \$105.00 or Standard edition \$55.00 from S.A. Museum, North Terrace, Adelaide, 5000. A limited exclusive edition of the work of Alison Ashby, a well known wildflower pioneer and accomplished artist. 34 large colour plates opposite descriptive text of the wildflower illustrated.

Trees and Shrubs for Eastern Australia

Forestry Commission of New South Wales Available from booksellers or N.S.W. University Press for \$4.95. A reprint in 190 pages of a book produced as a guide to those purchasing trees and shrubs from the Forestry Commission of N.S.W. Well presented and illustrated in colour.

Around Mount Isa — A Guide to the Flora and Fauna

Helen Horton Illustrated by sketch and colour, the flora in the area around Mt. Isa from the Gulf of Carpentaria, south to Longreach, is described so that most people will be able to identify flowering plants that they find. Illustrated sections on birds, reptiles and mammals will also be of interest. Available from a bookseller or the Univ. of Qld. Press, P.O. Box 42, St. Lucia, Qld. 4067, for \$7.95 plus postage.

Australian Ferns and Fern Allies — Jones and Clemesha

At last the second edition of this excellent book is available. 47 new species and varieties have been added to this new edition bringing the total described to 358 species. If you are interested in Australian ferns this is the one and only book you need, in fact you must have it. Price \$19.95 from Editor

Flowers and Plants of Victoria and Tasmania — Rotherham etc.

This series is well known. If a layman wants to be able to approximately name an Australian wildflower, especially if he is on tour, the best series of books are "Flowers and Plants of Western Australia" available from the editor for \$23.95, "Flowers and Plants of N.S.W. and S.E. Qld.", to be reprinted shortly and now the revised edition, "Flowers and Plants of Victoria and Tasmania", available from the editor for \$23.95. You will note that this revised edition has been extended to cover Tasmania with good work by Marion and John Simmons of Launceston. However if you still have a copy of the first edition covering Victoria only, keep it as it is much better than the second edition. Despite this the three books in the series are excellent for the layman, wildflower gardener, bush walker or traveller. Price \$23.95 from Editor



Helmholtzia glaberrima

Readers experiences in the cultivation of rain forest plants should be forwarded to the editor for an issue on our rainforest flora now in preparation.

Photography by C. Napier Thomson

AUSTRALIAN PLANT GENERA by J. A. Baines.

Price \$9.90 plus 60c post

The author has subtitled this book "An etymological botanical dictionary of Australian Plant Genera. I would refer to it as a reference to the flowering plants of Australia, the whole Australian Flora. The non-botanist and student has, for many years, needed a reference to the whole of the Australian flora in a simple compact form. This was not possible without using scientific names and presented in a logical manner. The result has been an ideal reference for the student as well giving:

1. The generic name, with correct pronunciation, and origin.
2. Interesting notes about the genus and the species with distribution.
3. The correct names of all species in the genus except for large genera.

A great deal of effort has gone into the accurate quoting of the correct botanical name of each plant. Inevitably, current research will involve more changes and this problem of correct names and disagreement among the botanists has no doubt prevented such a publication in the past. In our case we can advise of new species and name changes in the periodical Australian Plants, so we have taken the initiative and produced the first complete reference to the Australian flowering plant flora.

Fortunately this year will see the first of the many volumes on the flora, to be published over many years in the future but in the meantime "Australian Plant Genera" will serve as the only complete reference.

BOOKS ON WILDFLOWERS

This is a mail order service of books, postage free with, in some cases, a discount. You may be able to buy the following books a little cheaper and some groups in the society are offering certain books at a bigger discount so if you want to shop around after reading my reviews, then do so. However the service we offer will be convenient and any small profit made is reinvested in the production of Australian Plants. You may pay a little more through this service but the donation will be well used.

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"Native Plants Of Queensland" by Keith Williams	\$30.00
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"Handbook to Plants in Victoria", Willis — Vol. 1 \$18.80; Vol. 2	\$30.00
"Flowers and Plants of Victoria and Tasmania"	\$24.95
For South Australia	
"Flora of South Australia" — Part 1, Black	\$16.90
"Flora of South Australia" — Parts 2 & 3. B/red	\$6.50
For Northern Territory	
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For Western Australia	
"Flowers and Plants of Western Australia"	\$24.95
"West Australian Plants — A Descriptive Catalogue", Beard	\$8.00
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The Society is for people interested in the Australian flora. Its preservation and cultivation in the wild, in parks, and in public and private gardens. Preservation of our magnificent flora will, in the long term, depend on the knowledge accumulated, on its cultivation under a wide range of conditions. We hope to learn more about this by cultivating wildflowers in the garden, encouraging research on this aspect, and to record this in "Australian Plants". Enquiries for membership should be directed to:

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Clianthus formosus

Sturt's Desert Pea

One of Australia's, one of the world's most famous pea-flowered plants. This issue of *Australian Plants* is the first of a series on the pea-flowered plants of Australia, their identification and cultivation. Page 54 mentions this species, the flower parts illustrated being:

- (a) the standard — the large red back upper petal is broad but longer than most pea flowers, tapering to a point. It has a large dark (often black) boss (b) at the lower centre.
- (c) the wings — in this case the two petals are short and linear with an acute tip.
- (d) the keel — in this flower the two petals that form the keel are as long as the standard and pendulous i.e. hanging down instead of standing out at right angles to the standard as is usual for most pea flowered plants. The keel is acute or with a pointed tip as shown.

Reports on recent successes in the cultivation of this plant should be forwarded to the Editor, to accompany other articles being prepared.