

Australian Plants

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Conservation of the Australian Flora, with a cash return!

Conserving this stark but beautiful continent of ours is cost effective!

I hope this is a major message the responsible authority for the year 2001 celebrations will be promoting and that a survival plan for its management into the future, will be promoted. If we in Australia show the way we intend to continue to conserve our inherited natural environment, our continent, and still assure the maintenance of our standard of living beyond 2001, the rest of the world may be encouraged to reverse the deterioration of their continents.

There are some spectacular wildflowers for horticulture in this issue. There are many more described that will be suitable as a cash crop and contribute to the nations prosperity. Even if you do not want to grow wildflowers for cash, the information given is of special interest to you for cultivation of these plants in the garden. Do not pass it over.

Remember the late 1960s and the national concern that we had gone too far in our haste for development and trees across the nation were dying in great numbers? One area was the New England District of NSW, (see page 135) was typical of other areas and there is a lesson to be learnt from a recent study of the crisis, leading to the following observation:

"Despite a growth in interest about the environment and many achievements in recent years, caring for the natural environment remains of peripheral concern to most people. If our society is to become ecologically sustainable, the goal of protecting the natural environment will need to become a central concern. This transition will require cultural change". We need national leadership.

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COVER PLATE, *Banksia integrifolia* (yellow) and *Banksia spinulosa* variety *collina* in a floral arrangement by Lorna Johnston displayed at the launch of the book "Indigenous Gardening, Growing Local Native Plants as recommended on page 108.

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Australian Plants

Their Commercial Potential — 1

by Graeme O'Neill*

The phrase "commercial potential" in its broadest sense; commerce is about profit, loss and opportunities missed or foregone. Past mismanagement of the Australian flora has resulted in economic losses on a vast scale. Its impact on such things as farm profitability, the hydrological cycle involving the continuing loss of good productive land, profits and losses etc. are difficult to quantify. They are no less real than the red and black figures that appear on the accountants' ledger. Because my interest is in science, my perspective will emphasise the scientific underpinnings of commercialisation. Research, I will argue, is essential if we are to exploit the enormous potential of our native flora.

Horticulture

The first wave of general community interest in the horticultural value of the Australian flora occurred in the late 1960s and early 1970s. It was associated with the rise of environmentalism in the 1960s, the Age of Enlightenment. Enlightenment is the child of ignorance, and I think most of us would agree that in the 1970s and early 1980s there was profound ignorance about the special cultivation requirements of native plants. Fortunately there was a cove of enthusiasts who stuck at it, collecting the species, experimenting and recording their results, propagating rarities and distributing them to others with like interests. We have a rich history of gifted amateurs resulting in the setting up of SGAP and its Study Groups. We should not underestimate the value of the empirical research done by enthusiastic amateurs, which in distilled form has matured into a body of authoritative literature that I suspect is unrivalled anywhere else in the world.

The phenomenal success of *Grevillea* 'Robyn Gordon' illustrates the commercial potential of hybrids. Unfortunately there are many second-rate hybrids on the market that arose by chance in gardens and which are inferior to the parent species. Fortunately there is a trend to more systematic hybridisation, using parent species specifically chosen for their colour, form and vigour, duration of flowering and flowering intensity. Using superior forms of pure species we are selecting from nature's smorgasbord, looking for caviar, not baked beans.

Australia is richly endowed with foliage plants that could be exploited for the cut flower trade. The work by Professor Sedgley and her team at the University of Adelaide is worthy of note, *Eucalyptus* forms and hybrids with silvery waxy foliage and attractive buds, for their unusual leaves, and *Acacia* for their foliage and flowers, but is also looking for species or hybrids that can be dwarfed by breeding or chemicals and can be grown in pots.

There is unrealised potential for many of our rainforest species, which have evolved in low-light environments to be grown as indoor plants. Some, like *Musgravea heterophylla*, *Stenocarpus davallioides*, *Athertonia diversifolia*, *Bosistoa pentacocca* or the smaller *Syzygium*, have beautiful foliage or richly coloured new growth.

*This is based upon the A. J. Swaby address given at the Federal Conference of the Association Of Societies For Growing Australian Plants at Ballarat, Victoria in 1995.



△ **Mountain Rocket, *Bellendena montana***, a spreading shrub to 60 cm high. The flowers are in a white-palish pink cone held up for spectacular display, followed by these seed capsules. *Australian Plants* 9:167X,311 12:144,151,362. Photographs by John Simmons.

A Guide to Flowers and Plants of Tasmania. These photographs are an introduction to this excellent book, see page 141. For details about growing Waratah and other plants in the same family Proteaceae such as *Bellendena* above refer to the whole issue of *Australian Plants*, number 147 dated June, 1996.

▽ ***Telopea truncata*, Tasmanian Waratah.**





△ *Scaevola crassifolia*, a hardy coastal ornamental shrub, page 112 (J. Simmons).

Fan Flowers, *Scaevola*, are presented in this issue. They are hardy, long flowering plants, suited for pot culture, basket culture (see page 125) and as ground covers. There is a lot of scientific research and development current because of their enormous horticultural potential as reported on page 112.

▽ *Scaevola hookeri*? See author's note on page 114.

Photo by J. F. Noble.



The cut flower industry, the sooner it is put on a full commercial footing the sooner we will stop squandering the genetic diversity of our native flora. The WA Government still hands out more than a thousand licences annually to cut wildflowers. The harvest, which to my mind has more in common with mining than agriculture, is a legacy of the ignorance surrounding the cultivation of native plants. Why did not we start planting commercial stands of *Banksia*, *Dryandra* and Smokebush two decades ago. We should be concerned at the bush picked cut wildflower trade because it is conducted with scant knowledge of, or regard for, the highly evolved reproductive strategies operating in each species.

Environmental disaster and repair for profit

We all know the consequences of massive clearance of native vegetation during the past two centuries, wind erosion, the accentuation of drought and, at the other extreme, rising water tables and alienation of agricultural land by salinisation. Dr Jim Armstrong, research director of Department of Conservation and Land Management, says many W.A. farmers are facing an economic catastrophe within the next 10 to 15 years because of rising salt. In razing the native woodland and heathland, and replacing it with a crop that pumps water only six months of the year, wheat farmers have brought highly saline groundwaters to the surface.

Research into the native flora has identified what may be the perfect solution: a deep-rooted eucalypt that will lower the water table, while allowing the farmers to diversify their economic base with a new and valuable commercial crop.

Australia, with more than 800 eucalypt species, imports eucalypt oil from Spain and Portugal, where they extract it as a by-product of their commercial timber plantations of Tasmanian bluegum, *Eucalyptus globulus*. Most of the eucalypt oil produced in Australia is distilled from the leaves of the mallee, *E. polybractea*, which grows wild around West Wyalong in NSW, and in Victoria's Bendigo-Ingleswood area. Traditionally cut from the wild; only recently have distillers established *E. polybractea* in plantations.

Eucalyptus polybractea leaves are unusually rich in cineole, the ingredient that gives distilled eucalypt oil its exceptional antibiotic properties; it also is responsible for the eucalypt taste and soothing antiseptic properties of some cough lollies. Cineole is also a valuable solvent, and if Australia ever moves to fuels derived from blending petrol with biomass-derived alcohol, cineole has the unusual property of preventing alcohol absorbing water.

Eucalyptus kochii from the northern wheatbelt of W. A. is also rich in cineole. It gave cineole yields of up to 5% (with a possible increase to 7%) which translates to 50 grams of cineole per kilogram of green leaves. *E. kochii* is about as robust as *E. polybractea*, but has a preference for sandy soils — it could be particularly suited to plantations in the sandy, semi-arid region around Nhili and Dimboola in western Victoria, and in the Victorian Mallee. To complete the story, *E. kochii* turns out to be a perfect species for restoring W.A. farmland at risk of rising salt. The species that many wheat farmers cleared from their land could ultimately prove to be their salvation — CALM is now trying to encourage farmers to plant approximately 10% of the area of their cleared land to *E. kochii*.

Eucalyptus mannensis, 6m tall, south of Everard Range in N-W S.A. was recently discovered growing in the Gibson Desert in W.A., and it has even higher cineole levels than *E. kochii*. It is exceptionally drought tolerant and with further research it could become the basis for a profitable arid-zone industry.

Sandalwood, *Santalum spicatum*, is a deep-rooted possible farm crop. Harvested from the wild, under license it yields an oil which some Asian cultures consider has aphrodisiac properties when burned. Australia exports hundreds of tonnes of sandalwood to India every year. Instead of mining the resource, it would be more profitable if we grew it as a crop, using cultivars selected for maximum oil yield.

Melaleuca alternifolia is another oil-yielding crop established on the northern NSW coast, as a source of ti-tree oil, which has antibiotic properties. Unfortunately, and perhaps inevitably, the quest for a quick return meant that the forms were planted without any selection for maximum oil yield. Hopefully more productive plants will be developed. We must start thinking smart, not rich.

Pharmaceuticals From Native Plants

Biodiversity has become a modern buzzword, and the science of bioprospecting is leading to the discovery of powerful new weapons against cancer and infectious disease. Does the Australian flora contain any potential multi-million dollar drugs? The answer is almost certainly yes. We have heard about conocurvone, a compound extracted from the roots of *W. A. Conospermum* species — preliminary screening identified it as potentially one of the most potent anti-AIDS compounds yet identified. *Castanospermine*, a compound from the rainforest tree, *Castanospermum australe*, also exhibits strong activity against the AIDS virus.

The tissues of every plant — the roots, leaves or seeds — contain numerous compounds that help defend it against insect attack and disease*. The roots of the *Conospermum* that yielded conocurvone obviously have never encountered the AIDS virus. Bioprospecting is a game of chance, and the odds are enormous. There are somewhere between 30,000 and 50,000 vascular plants in the Australian flora. Biologists estimate that every species lives in association with up to 10 specialised fungi, called ecto- and endomycorrhiza, all of which are likely to have an arsenal of chemical defences that allow them to survive.

The spectacular layer-cake striations we see in photographs of the Bungle Bungle range in northern Western Australia reflect not only ancient geology but living biology — the sandstone layers have been colonised by some of the estimated 40,000 species of microalgae that thrive in Australia's ancient soils and rocks. These are likely to contain many chemical compounds new to science.

AMRAD, the Australian Medical Research and Development Corporation in Melbourne, has set up a facility to mass-screen Australian plants, fungi, algae and marine organisms for compounds with pharmaceutical potential. AMRAD's research director, Dr Nick Gough, says that each time 100,000 samples are screened for specific activity against cancer, or for anti-viral or anti-bacterial properties, between 0.1% and 1% of the samples are likely to exhibit selective, reasonably strong activity. Of these, fewer than 1% will ever have all the credentials required to become a new drug, and fewer still will graduate to become multi-million dollar drugs. Even at this low frequency, the potential returns justify the investment, and AMRAD has set up an extensive collecting network through agreements with state and federal research agencies involved in the conservation and study of Australia's biological resources.

Instead of sending samples of roots, leaves or seeds to drug companies, with no commercial return for Australia, commercial development here will secure for Australians the maximum economic benefit from Australia's biological resources.

*See also, "Prickly Fanflower as a Source of Medicine", page 119.



△ *Scaevola striata*, Royal Robe, see page 127, Photo Colin Woolcock.

▽ *Scaevola albida* growing in a garden, see page 126, Photo by Neil Marriott.



Genetic Resources

The bioprospecting industry is exploring the genetic wealth of the Australian flora as a potential source of new genes for agriculture and horticulture.

The model here is *Glycine*, the genus to which the world's most important protein crop, the soybean, belongs. The world's soybean industry rests on a perilously very narrow genetic base — all cultivars are derived from the Chinese species *Glycine max*, which was probably domesticated several thousand years ago. There is only one other species in Asia — and 16 currently recognised species in Australia, which makes us the world centre of soybean genetic diversity.

Working with collaborators in the United States, CSIRO scientists have succeeded in hybridising Australian *Glycine* species with soybeans. The Australian species carry a variety of genes that confer resistance to soybean leaf rust. The research is being conducted in Australia because the American soybean crop is currently rust-free — but non-resistant. The first hybrids, between domestic soybeans and a variety of *Glycine canescens* from Queensland's Coolool National Park, were sterile, but research has succeeded in restoring fertility to several which will make future gene-transfers to soybeans much easier.

CSIRO researchers have also produced some hybrids between Australian *Vigna* species and the mung bean, a staple of the bean sprout industry. Our native *Gossypium* species are a potential source of new genes for the world's most important fibre industry — cotton. There are about a dozen native *Gossypium*, including some that have chemical or architectural traits that protect them against insect attack. Several species have the ability to switch off production of a natural insecticide called gossypol as they begin to set seed. Gossypol can halt sperm production in male mammals, which means it must be treated before it can be fed to livestock. The gene that regulated gossypol production in native *Gossypium* species could save millions of dollars in the cost of treating seeds.

Bush Tucker Industry*

These days airlines are dispensing biscuits containing *Acacia* seed or *Macadamia* nuts. In 1993 the bush tucker industry was turning over more than a million dollars a year. It exported a million biscuits with bush tucker ingredients to Japan, where there is a lucrative market for anything novel in the food line. Bush tucker is still something of a novelty in Australia, but there is clear potential for a much larger, highly organised industry, based around commercial plantations.

Leader in this industry is Vic Cherikoff proprietor of the Bush Tucker Supply Company. He supplies mints from various *Prostanthera* species, lemon and aniseed flavoured leaves from *Backhousia*, Lilly-pilly berries to be eaten as fruit, or to make jams and sauces, native pepper made from the leaves of *Tasmannia xerophila*, native plums from *Davidsonia pruriens*, black apples from *Planchonella australis*, and wild raspberries (*Rubus*). Nearly all are grown on managed plantations that employ native Australians to harvest the crops. One exception is Samphire, which can be eaten as a green, and may have potential as a seed crop — it grows in salt pans.

Warragul greens is used as a native spinach, and *Geitonoplesium* growth tips serves as a native asparagus. There are many other similar bush foods.

*See also 'Australia's, Native Food Industry', page 131.

Athertonia diversifolia is sold as a native almond. Selling something as a substitute for some familiar food is a familiar two-edged sword, it invites unfavourable comparisons. *Athertonia* should be sold in its own right as a new food with its own unique flavour and texture.

Planchonella is described as a native plum, but it has plum, custard and apple flavours. Some imaginative marketing is required for this and other native plums.

Quandongs, *Santalum acuminatum*, several tonnes are sold every year. CSIRO's Dr John Possingham in Adelaide made a major contribution to the selection of commercial cultivars with large, sweetly flavoured, deep burgundy fruits.

Macadamia, so to dessert. We lament the fact that Australians, who were eating wild-harvested macadamias as early as the 1840s, never appreciated the crop's enormous export potential and saw the nut, and even the name, hijacked by enterprising Americans. Virtually all the Hawaiian plantations grow cultivars derived from the first pocketful of *M. integrifolia* × *tetraphylla* hybrid nuts spirited out of Brisbane by William Purvis in 1882.

There are now two million *Macadamia* trees in plantations in NSW and Queensland, and we have surpassed Hawaii as the world's largest trader in macadamias. We have also moved to buy back the farm — Australian companies now own most of the plantations in Hawaii. Hawaiian cultivars dominate the industry, yet they are not particularly suited to commercial cultivation. They take around seven years to begin yielding nuts in commercial quantities, and by 15 years the trees have grown very large, making them difficult to spray and harvest.

The first plant registered under Australian Plant Variety Rights legislation was a *Macadamia* cultivar, developed by a Queensland grower, Mr Henry Bell. This cultivar yields commercial crops two to three years earlier than any Hawaiian variety, a valuable trait, given the high capital cost of establishing plantations. The market is nowhere near saturation, because total world macadamia production is still only equivalent to about 5% of the production of high-volume nut species like peanuts, cashews and hazels.

Research into all 10 species is likely to make a significant contribution to breeding new commercial varieties. Much of the genetic diversity in the two edible *Macadamia*, *M. integrifolia* and *M. tetraphylla*, has been lost to land clearance for dairy and sugar cane farming. Isolated trees survive in small patches of rainforest throughout the species' former range but the remaining wild trees exhibit a very high degree of genetic diversity, evident from the variability of flower shape. Some populations of *M. tetraphylla* have pink to red flowers.

Macadamia jansenii narrowly escaped extinction being discovered in a patch of rainforest near Bundaberg in 1982. This species reaches a maximum height of only 10 metres, compared with 20 to 40 metres for most macadamias, including commercial cultivars. Its nuts contain cyanide, as do the nuts of the fourth species found in the subtropical rainforests of south-eastern Queensland and north-eastern NSW, *M. ternifolia*, which has relatively tiny nuts.

Natural stands of *M. jansenii* and *M. ternifolia* hybridise readily with commercial cultivars, and could be used to help reduce both the size of the tree, on one hand, and the size of the nuts on the other — the world would probably welcome a peanut-sized macadamia for snacks, or used intact in confectionery.

The research team is also working on eliminating cyanide from the toxic macadamia species, which include three species from north Queensland, *M. claudiensis*, *M. whelanii* and *M. grandis*. These species do not hybridise with the southern species, but have some potentially useful characteristics. Radical new breeding techniques such as protoplast fusion and recombinant DNA technology could overcome the barriers that obstruct gene transfer, and gene surgeons are also looking at the possibility of knocking out the gene whose enzyme converts cyanide from an inactive to its toxic form.

Macadamia claudiensis has nuts the size of a small mandarin, with no hard shell.

Molecular breeding techniques and selection programmes might also bring macadamia relatives like *Floydia praealta* and *Hicksbeachia pinnatifolia* into the commercial fold next century. ■

Grass Trees In The Bush and For The Garden

by Judi Mullineux

A joy of bush walking is to meet along the way a noble Grass Tree. The genus, *Xanthorrhoea*, is related to the lilies, but is the only genus in a separate family, Xanthorrhoeaceae, found only in Australia. The grassy tuft rots away to form the trunk, sometimes 4 to 5 metres tall, a very slow process.

Grass Trees are fire tolerant, frost hardy to -70°C , in normal rainfall conditions and endure drought, tolerating very poor soil. With their foliage they make a beautiful feature in any garden or rockery. They need a well drained, sunny position. Flowering is spasmodic, often brought on by fire. It is a joy to behold, the green stalk growing tall with many tiny creamy flowers on the spike. Native bees and birds enjoy the nectar. The dry flower spike can be used in dry flower arrangement.

Transplanting is reasonably easy. I do not suggest you go bush for these plants, but if you know of any that are threatened by road works, clearing or development obtain permission to remove and transplant the grass tree. Prepare a 2 m wide by 1 m deep hole, keeping the area moist before you bring in your grass tree. These trees do not have a tap root, the normal transplanting procedure, trimming old roots, removal of old vegetation from the crown, with generous watering for some weeks, should ensure a successful transplant. Nurseries carry mature plants for resale, but their origin is in doubt.

Propagation of seed is also possible as long as you are patient. Growth is slow but within three years, you should have splendid specimen for your rockery. The leaves will form a tussock, the trunk will take many years to form. There are reports of flowering after 10 years for *Xanthorrhoea australis*.

Grass Trees are spectacular in the wild often growing very tall. I have been overwhelmed by the height of some *X. preissii* growing near Mandala Beach WA in very open sandy country. Near Perth WA I came across a small forest of *X. preissii*, a stand of a couple of hundred trees growing alone in black sandy loam, very beautiful, very old specimens with blackened trunks from fires. In the Karri forest of south western WA there are some very fine specimens of grass tree, their trunks branching once or twice, bending and twisting. Here in south eastern Queensland *X. resinosa* has a shorter trunk growing in *Eucalyptus* forest, in poor soils. Sealing wax and varnish is made from the resin of *Xanthorrhoeaceae*. ■

Indigenous Gardening*

Growing Local Native Plants

by Rosalie Eustace

As our population grows our species will be threatened more and more by loss of bushland to urbanisation, overuse and mismanagement through overburning and/or underburning and invasion of weeds. We need to do everything we can to maintain the diversity of our plants. As individuals we can help to preserve our species by growing them in our backyards and local parks. The experience we gain can be translated into more effective management of reserves and natural areas. Preservation can depend on growing local plants.

Many of our local species should be grown just because they are beautiful and have considerable horticultural potential, either for their flowers or form. Our plants are special, they are different from anywhere else in the world, let us appreciate them, let us flaunt them.

Creating a framework

Bush gardens that allow regeneration of local plants, and include grasses, can look untidy. They deter people from growing local plants. The overall look can be an uncared for, untidy and overgrown allotment. This may apply especially, if you are lucky enough to have a piece of natural bush you can conserve. With careful design the problem can be overcome so that we focus on the beauty of the plants.

Space in the garden. Planned open areas give a balance to the garden allowing us to appreciate the beauty of the plants growing there. Space may take the form of a path either straight or winding, paved or grassed areas, seating areas, an area of river pebble, decomposed granite or gravel or, for the more adventurous, a waterway.

Unity and rhythm. A garden that is too uniform can be boring but for unique sections hidden from each other, the plants chosen should have a unity or sameness of foliage and plant type throughout to blend together and complement one another. Choosing plants from the same type of habitat usually can give unity.

Colour. A native garden tends to be full of subdued hues or grey-green and blue-green leaves which, while relaxing, can also be drab. There can be a lot of colour however and this can be accentuated by putting opposite colours together. The most common in the local bush is yellow and purple. Other opposites are red and green or blue and orange.

Focal point. Focal points will grab your attention and make you take interest. Focus can be in the form of a plant that is an outstanding flowering specimen, has an unusual form. The focus can also be a grouping or copse of shrubs of trees balanced by a sculpture or smaller planting in another part of the garden.

Indigenous Gardening — Growing Local Native Plants is a book by Rosalie Eustace, illustrated by Lorna Johnston. The article above was culled from the introductory 20 pages of the book. This is an important article for anyone wishing to establish a native garden anywhere in Australia. There is much more about the establishment of local plants and if you are interested you should purchase a copy for \$29 including postage available from Rosalie Eustace, 18 Valentine Rd., Birkdale, Qld. 4159. The book has 40 pages describing the local plants of the Redlands Shire in south-east Queensland with a large number shown in full colour photographs. If you live in or near this area then the book is necessary reading for you — Editor.

Contrast and variation. Although the garden requires unity of foliage and form to hold it together, there needs to be contrast of colour, texture or form to add interest. Texture contrast is achieved by choosing plants with large and fine leaves, narrow and rounded leaves, arching and erect plants, rounded and columnar forms. Plants with similar texture and shape such as *Daviesia squarrosa* and *Pultenaea villosa* with arching form, fine foliage and yellow flowers allow unity. Growing *Eucalyptus curtisii* with its contrasting shiny bark, twisted form and larger leaves will add interest. The broad-leaved persoonia, *Persoonia cornifolia* is a useful contrast plant with its light yellow green foliage.

Landscape framework. Structural landscaping will give the garden form and will make it look planned and controlled. Interesting tree trunks or large shrubs with pleasing features could be used to define the scene. Complementary materials will add to the formation of a framework. A treated log fence or bush rocks well placed would add to the beauty of local plants.

Line and shape. Curved garden beds and randomly arranged cluster plantings give an illusion of space and distance and adds some excitement. Curves invite you to look further. What is at the end of the path where it curves? If a more formal style is desired, plant material can be managed so that it fits in with the formal look. Most natives can be selected, trimmed, shaped and arranged to fit into any garden style you like. The only limiting factor is our imagination.

Gardening with local plants. This report deals with the cultivation of local native plants in a home garden situation, the above being a guide to its establishment and further advice is given for its care. A different situation arises where a natural bush area is to be retained and developed.

The natural bush garden

Maintaining a natural bush garden can be a challenge. The natural progression of a block that is cleared and then regenerated is to initially support pioneer plants. They are generally short-lived plants that build up the soil so that longer-lived species can take over. Many of the small pioneer plants are the ones we want to keep as they flower well. Allowing too many trees to grow that will shade out and drop heaps of litter will result in the understorey gradually dying out. Maintaining an open canopy, occasional mowing and pruning can emulate the effect of firing.

The choice of plants is not as simple as it seems though most pea-flowered plants and mint bush do not seem to mind. In recent issues we have seen that to grow a waratah there must not be root competition from trees. They grow naturally in the vicinity of trees! The fact remains that if you want to grow a waratah and many other plants that we regard as forest plants you must exclude the very intrusive roots of eucalypts.

Editor's note: Trees are a major problem. They look good when small but will take over all areas with shade above and roots below. Coppicing, pruning at ground level, will take the place of pruning. If done quietly and before they are too large, pruning at ground level (only in the hottest weather) such that they sucker up and produce nice new sapling growth technically is defensible as pruning. When I suggested this to Rosalie she replied "Coppicing eucalypts may work well in other states but is not successful here in Queensland. Their growth is too rapid and produces an ugly product. A coppiced or lopped eucalypt can result in a dangerous tree as it will produce several very tall large branches that will have a weak junction and snap off in the many storms we have up here. Most of the eucalypts that grow well here are very large trees and we have turned to grafted ornamental flowering trees."

The myth of the low maintenance garden

Throw away the mower and the pruners, stop fertilising and let nature do it for you. Wrong! You need to replicate nature's way and this needs some work. Nature cleans out the system and regenerates every so often with a fire, not a very desirable maintenance method for the average garden. Look at bush that has been regenerated for a short time after fire, then look at bush that has been undisturbed for many years. Note the accumulation of leaves and bark and the gradual disappearance of understorey plants due to shading and litter accumulation.

Pruning. Pruning is necessary to prolong the life of plants, to improve flowering, improve the shape so that plants stay vigorous and bushy rather than tall and spindly, and to remove dead wood that occurs naturally with many of the drier land plants. Most native plants can be pruned without ill effect, provided you do not cut back heavily in stress conditions such as the middle of a drought or in the middle of a heat wave. A good time to prune is late winter after flowering and before new growth occurs with the increase in temperature and spring rain. Moderate annual pruning, that is, cutting back by a quarter to a third, or continual pinching back of new shoots. Heavy pruning could be fatal. However many of the banksias, callistemons, melaleucas and leptospermums respond well to heavy pruning even back to a stump. This is due to the presence of masses of dormant buds in lignotubers at the base of the plant or epicormic tissue under the bark that in nature allows them to regenerate after fire. The heavy pruning of eucalypts is mentioned above in relation to maintaining an open canopy. It is a common sight to see eucalypts regrowing from these buds under the bark of the trunk after a bush fire. However the pruning of eucalypts up the trunk is not recommended. It leaves weak joints where the new limbs grow making them prone to breaking off in a wind and the tree looks unsightly.

Most natives respond much better to pruning than you think. I have seen *Acacia fimbriata* successfully hedged at one metre high, *Hovea acutifolia* cut back from two to one metre without ill effects.

Mulching Native gardens, especially the local variety, creates a lot of work. Eucalypts are one of the chief culprits with the huge load of leaves. It has been considered in the past that the litter was a good source of mulch, and that it helped plants to grow due to moisture retention. Observations show that little grows under these trees in open forest after litter has accumulated. This is possibly due to competition but also due to the high phenol content of the leaves and bark which are toxic to plants growing underneath. The solution? raking up the litter and composting it with other discarded vegetable matter. Mulches to avoid for all plants are RAW woody products such as sawdust, pine bark and wood chip as these will draw nitrogen out of the soil at the expense of the plant and also interfere with iron uptake. The use of low toxic, readily decomposable mulch such as sugar cane straw may be preferable to retain moisture as well as to build up the organic component of the soil.

Whether mulching is the answer for a wide range of understorey shrubs and herbs is debatable. In the bush companion plants such as grasses provide protection from surface soil drying out, also breaking down to provide self-mulching and non-woody plant material that breaks down quickly, adding organic matter to the soil. Flowering understorey plants often thrive with little leaf litter or mulching materials accumulated. While mulching cuts down the necessity for weeding, it can impede the access of water.

Watering and wetting agents. Some of the sandy soils become water repellent when cultivated. The effect seems to be worse with the addition of organic materials which break down encouraging fungal growth and the formation of a waxy coating on sand grains. Once the soils are wet, it is easier to rewet; but, if they are allowed to dry out, water will not penetrate and the plants will not thrive. The use of wetting agents has been a boon to the establishment of plants, especially in these low water retentive soils. The new granulated formulation is expensive but easy to apply and long lasting. Liquid wetting agents are also available but beware of phytotoxicity that can occur with some.

Provided plants are selected carefully, little watering should be required beyond the establishment stage. During long dry spells help nature along a bit by hand watering. Infrequent watering to run off is the best as light watering will not penetrate the root zone and will evaporate. Continual light watering encourages surface roots that dry out in short dry spells perpetuating the need for continual watering. Plants should be left to near wilting point before rewetting to ensure roots move down the profile.

Fertilising. Fertiliser regimes can vary from the use of organic materials such as straw, composted grass and leaves and no fertiliser, to a light dressing of slow-release low-phosphorus fertilisers, an expensive alternative. A light dressing of nitrogen-based fertiliser could be useful to boost vegetative growth annually in the growing season, especially in sandy soils.

The acidity of the soil and its effect on nutrient release is important. The soils here in the Redlands area are acidic with a range of 5 to 5.5 and for the wallum coastal heath, as acid as 4. If the soil has become less acid through liming or importing pH balanced topsoil, the availability of nutrients to the plants will be effected. The addition of organic matter to soils as well as sulphate of ammonia will gradually reduce the pH and increase acidity.

Pesticides. One of the delights of a garden full of local plants is the vast array of insects, birds and reptiles attracted to the garden, not to mention frogs, bats, possums and koalas. Insects may become pests initially but if you use self control and do not resort to sprays an ecosystem will develop or, in other words, nature's pest control will take over and rarely will pest populations occur. If desperate, think about pruning off infected areas and burning or collecting insects and disposing of them mechanically. ■

Organic Gardening

by Peter Bennett

The very essence of good gardening is detailed in this book. Of course it is aimed to produce vegetables but the prepared gardening practice is equally suitable for the cultivation of the Australian flora to perfection. This is to eliminate or reduce chemical fertilisers and pesticides, build a healthy soil biomass in which roots, worms, fungi, moulds, bacteria and viruses abound to look after the trees and animal life and build a sustainable, fertile system capable of producing vegetation of the highest nutritional quality.

All the creatures you will need for a healthy garden are illustrated and described in simple terms. Their role in nature's natural cycle is given together with suggestions for natural control of those that compete with our efforts. Birds and how to create a haven for lizards are included in this 60 pages section. Another 76 pages are devoted to care of the soil, composting and mulching. Of course if you are into vegetables the next 70 pages are a must. The book is widely available for \$24.95 or by mail as indicated inside our rear cover. ■

Fan Flowers in Horticulture

Propagation of *Scaevola nitida**

by Beng Tan (Environmental Biology, Curtin University of Technology, Perth) and Jeshua Yee (Muresk Institute of Agriculture).

The genus *Scaevola* (plant family Goodeniaceae), is characterised by distinctive fan-shaped flowers. They have a special value in horticulture as rockery or ground-cover plants and several have been used in traditional 'bush medicine', e.g., *Scaevola spinescens* (see page 119) and *S. taccada*.

Recently, the most popular *Scaevola* in cultivation is *Scaevola aemula* 'Purple Fanfare'*** (photograph on page 117), a vigorous spring and summer flowering rockery plant producing abundant dense heads of lilac fan flowers each displayed in a circle as shown in the photograph on page 117. Its success in horticulture stems in part from its availability and ease of propagation. Non-flowering stem cuttings 'strike' easily, and shoot tips can be cloned rapidly in tissue culture.

Other *Scaevola* which are equally suitable for rockery landscaping, or as ground-cover plants are *Scaevola striata*, *S. phlobopetala* and the softer mat-forming species, namely *Scaevola hookeri* and *S. albida*. As with *Scaevola aemula*, stem cuttings and shoot tips of these herbaceous scaevolae will strike satisfactorily when taken after a growth flush. They can also be propagated by plant tissue culture techniques although, in these particular cases, there are no clear advantages for adopting *in vitro* techniques in preference to conventional ones.

Small ornamental shrubs are also well represented within the genus. *Scaevola crassifolia*, a spreading (1.5 m x 3 m) hardy coastal shrub, is commonly planted with other native species in a programme designed to beautify and stabilise the sandy verges and embankments of new coastal highways in metropolitan Perth.

*Scaevola nitida** is another hardy and highly ornamental shrub from coastal southwestern W.A. Compactly shaped, it can grow to 2 m with a 1.5 m spread. Flowering occurs from September to November with a prolific display of blue to lilac fan flowers arranged in tight whorls in terminal inflorescences.

In spite of its aesthetic and floriferous nature, this *Scaevola* shrub is surprisingly uncommon in cultivation. Plant stocks are rarely available from nurseries, even specialist ones. We suspect that, unlike herbaceous scaevolae, it may be one of those notorious difficult-to-propagate species. On page 114 we confirm this. ►

**Scaevola nitida* is a very decorative and floriferous plant, yet it is not available for horticulture. We suspected that this was because it is difficult to propagate and this we confirmed. Nearly all cultivated scaevolae are prostrate species and only a few are shrubs. Apart from *Scaevola crassifolia* and *S. nitida*, most are either 'horticulturally deficient' or little known, especially coastal scaevola shrubs from sub-tropical Western Australia. The species that have been found to yield valuable medicines are from the W.A. interior and are not aesthetic.

**Editor's Note: The comments here prompted me to make a comment on the year-round flowering and ease of propagation of this exceptional plant. This developed into the article "Prostrate *Scaevola* For Rockeries and Containers" on page 123.



△ *Scaevola nitida* with its clustered blue/lilac fan flowers. A non-flowering bush is shown on page 116. The photography used to illustrate this article and the following one is by Beng Tan (excellent work) unless otherwise credited.

▽ *Scaevola nitida* seeds have been germinated *in vitro* as described on page 115.



Propagation of *Scaevola nitida* from stem and leaf cuttings

Semi-hardwood stem cuttings were taken in early winter from a single mature four-year-old shrub planted in isolation on the Curtin campus. The shrub had just come through an autumn growth flush but was several months from flowering. The cuttings were disinfected with dilute bleach, thoroughly washed and treated with a rooting hormone gel ('Clonex' 3,000 ppm IBA). Fifty treated cuttings were prepared for root induction ('strike') in a light pasteurised cutting mix (1 part polystyrene beads: 2 parts perlite: 2 parts peat) in two plastic trays (36 cm × 30 cm × 5 cm), 25 cuttings to a tray. An additional 20 untreated cuttings (control group) were prepared in a separate tray. The cuttings were intermittently misted (8 seconds every 30 minutes) on a glasshouse propagation bench provided with bottom heat (25–30°C); the glasshouse ambient temperature varied between 22° and 28°C.

In a separate trial looking at leaf cutting as a potential propagule (see photograph on page 117), leaves were taken from the same shrub in the following autumn. After disinfestation, one-half (36/72) of the leaves were hormone-treated by dipping the 'petiole end' (note: the leaf is sessile i.e., without a stalk) in Clonex gel (3,000 ppm); the other half was untreated (the control group). The leaves were prepared for 'striking' by partially embedding the 'petiole end' of each leaf in the cutting mix. Three trays of embedded leaves were prepared, with each tray containing an equal number (12) of treated and untreated leaves. Misting, bottom heat and glasshouse conditions were similar to those provided for stem cuttings.

Results of cutting trials

Stem cuttings — no cuttings in the control group rooted.

Those treated with IBA hormone gave 20% strike rate, but was slow, taking 8 months.

Leaf cuttings — the controls gave a 53% rooting but only 6% of rooted cuttings continued development to become plants after 5 months.

Those treated with IBA hormone gel gave 47% success but, overall, only 4% of cuttings developed into plants after 6 months.

Rooting hormone is beneficial for root induction in stem but not leaf cuttings.

Root induction precedes shoot regeneration in the leaf cutting, both of which occur at the cut petiole end. The regeneration of adventitious shoots may depend on elevated production of endogenous cytokinins which, in this case, emanates presumably from meristem tips of newly-formed adventitious roots. As a corollary, pretreatment of donor foliage with a spray of cytokinin several weeks before taking leaf cuttings may have been beneficial.

It is unusual for native shrubs to be propagated from leaf cuttings. Considering their relative abundance, the use of leaves as potential propagules appears attractive, notwithstanding the protracted response time of 6 months. The following report on *in vitro* propagation will show that **leaf cutting propagation is the more attractive option**. Further technical refinement and study could see an improvement in both percentage of success and plant production time.

Author's note: The photograph of the alpine *Scaevola* on page 101 has given us a lot of trouble. I am assured that it was taken on Mt. Kosciuszko but while it is labelled *Scaevola hookeri* it does not appear to be this species. Hopefully a reader will help with identification. We will have to accept it at this late stage as "a little known prostrate alpine species". I wish to acknowledge the taxonomic assistance given by Alex George and Leigh Sage from the WA State Herbarium.

In vitro* Propagation of *Scaevola nitida

An initial attempt at tissue culture propagation using nodal cuttings and shoot tips proved unsuccessful; despite rigorous surface sterilisation, these explant tissues manifested endogenous micro-organisms which caused medium fouling during the culture initiation stage, or soon after the initial subculture.

The alternative strategy, starting with *in vitro* germinated seedlings, was explored. A small quantity of seed was collected from the same mature bush, which was also the source of stem and leaf cuttings. As the shrub was grown in isolation the collected seeds can be assumed to result from self-pollination.

Two seeds were germinated *in vitro* on a basal tissue culture medium. Seedling stem sections bearing nodal (axillary) buds were cultured and sub-cultured over six months on the same hormoneless basal medium (Murashige and Skoog's salt mixture with minimal organics and 2% sucrose, gelled with 0.8% agar). Nodal shoots derived from these juvenile stem tissues provided a pool of explants for comparing shoot growth rates and adventitious shoot formation on four culture media containing combinations of different levels of kinetin (a cytokinin) and GA₃ (a gibberellin). The shoot cultures were maintained under light (approx. 2,000 lux) in a 16/8-hour day/night cycle and an ambient temperature of 25 ± 3°C.

Results of response of *Scaevola nitida* nodal stem explants in tissue culture:

Medium* (hormone in mgL ⁻¹)	Basal callusing	Growth rate of nodal shoots	Adventitious shoots
control (basal)	nil	slow (10 mm in 30 days)	nil
0.5 kinetin + 0.5 GA ³	++	slow-moderate (13 mm)	nil
0.5 kinetin + 1.0 GA ³	++	moderate (17 mm)	+
0.5 kinetin + 0.5 GA ³	+	moderate (18 mm)	+
1.0 kinetin + 1.0 GA ³	++	moderate-fast (24 mm)	nil

*Three replicate jars per medium; each replicate jar contained 5 explant stem pieces, each bearing two nodal buds.

The results indicated that a combination of kinetin and gibberellic acid stimulated the growth of nodal shoots. Earlier observations made from casual experimentation had indicated that kinetin alone caused excessive basal callusing and stunted nodal shoots, an effect that was overcome by the addition of gibberellin. On the other hand, the latter without a cytokinin produced weak, spindly growth. The above data will provide a basis for further experimentation.

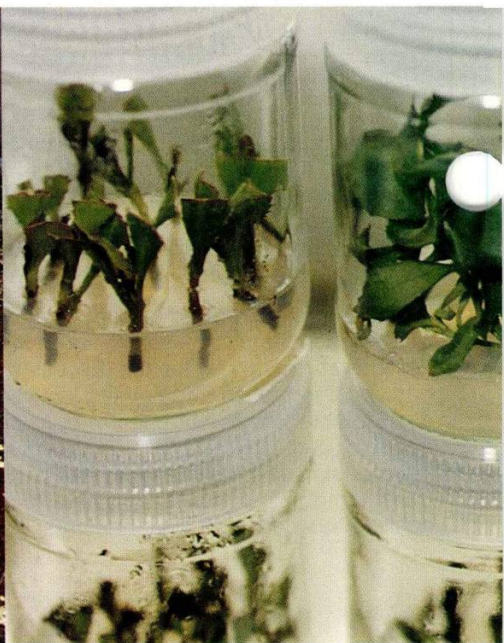
The formation of adventitious shoots can be viewed as a supplementary mode of shoot multiplication. Their formation was preceded by basal callusing, which is stimulated by kinetin. Excessive callusing, however, inhibits adventitious shoot formation and nodal shoot growth. A weak cytokinin such as kinetin is preferable to a potent one like benzyladenine in this regard, but it should be applied judiciously at a level that stimulates callusing and adventitious shoot regeneration at the same time. The results suggest that kinetin in the range of 0.5–1.0 mgL⁻¹ in combination with GA₃ in a similar concentration range should achieve this desirable developmental response.



△ *Scaevola nitida* *in vitro* propagation showing adventitious shoots from basal callus formed on the plants opposite as described on page 115.

▽Left — A juvenile shrub of *Scaevola nitida* produced from a leaf cutting.

▽Right — Stages of *in vitro* shoot multiplication of above.





△ *Scaevola aemula* 'Purple Fanfare' as mentioned on pages 112 and 123.

▽ *Scaevola nitida* leaf cuttings: rooting and shoot regeneration after six months.



No formal experimentation was carried out to induce roots in both nodal and adventitious shoots; however, experience based on a small number of these *in vitro* shoots suggests that rooting can be induced in a rooting medium containing 2 mgL⁻¹ IBA; a period of etiolation in darkness before transfer to the root induction medium is also beneficial.

Although it is clear that *Scaevola nitida* can be propagated in tissue culture, the rate of shoot multiplication is relatively slow. Nodal shoots could be harvested and subcultured only every 8–10 weeks and root induction took about 4–5 weeks, not to mention a further 3–4 weeks for hardening off under mist in a glasshouse. In comparison, the *in vitro* shoot multiplication rates of common native species such as *Chamelaucium*, *Grevillea* and *Verticordia* would be about double that of *Scaevola nitida* thanks to a faster growth rate and hence a shorter subculture cycle. As shown above leaf cutting holds the greatest promise. ■

Clever Strategies in Goodeniaceae

by Beng Tan, Environmental Biology, Curtin University of Technology, Perth.

Scaevolas, dampieras, lechenaultias and other members of the plant family Goodeniaceae go to great lengths to avoid self-pollination and hence inbreeding. This is accomplished by a combination of protandry (i.e., pollen becoming available before the stigma is receptive) and **secondary pollen presentation** (SPP), a physical process whereby pollen released from the anther sac is deposited at some other place of the flower so that they cannot come into contact with its own receptive stigma. An additional self-sterility barrier in the form of pollen: style incompatibility may also be erected in some cases.

Secondary Pollen Presentation SPP, is particularly well demonstrated in the *Lechenaultia formosa* flower (Plate1) as illustrated:

Plate 1: Young flower bud (left) and opened flower of *Lechenaultia formosa* 'Red Devil'. The early and intermediate stages of SPP occur in the young flower bud — see Plates 2–3.

Plates 2A and 2B: The flower is protandrous; pollen is shed from mature inward-facing anther sacs forming a corona above a rapidly elongating but immature stigma. (In 2A the petals have been cut away above the calyx, to reveal the anther corona, whilst in 2B two stamens have also been removed to reveal the young stigma and style).

Plate 3: As the elongated style brushes against the corona of dehiscing anthers, pollen is collected in the open stigmatic pouch (pollen indusium).

Plate 4: The stigmatic pouch closes and bends away from the split corolla tube; entrapment of its own pollen is complete. Sticky villi-like projections develop adjacent to the upper lip of the pouch, to form the receptive part of the stigma.

Plate 5: For artificial hybridization purposes, entrapped pollen can be released by gently squeezing a mature stigma. But how is secreted pollen

transferred to an insect vector in natural situations? Goodeniaceae flowers are brightly coloured and produce a modest quantity of nectar at the base of the ovary to attract insect pollinators; colour contrast (e.g., yellow throat) and tactile hairs (both present in *Scaevola aemula* — see Plate 6) guide insect vectors to the nectar. Pollen transfer occurs presumably only with loose pollen, i.e., those that are not completely trapped within the stigmatic pouch.

Plate 6: SPP in *Scaevola aemula* 'Purple Fanfare'. Pollen is "tucked away" in a flattened pouch; note that the anthers below the style are shrivelled and devoid of pollen, although this flower has just opened.

Plate 7: SPP in *Lechenaultia biloba* 'Autumn Blue'.

Plate 8: Fruit of *Scaevola striata* obtained after crossing with *Scaevola phoebopetala*. *Scaevola striata* itself is highly self-sterile.

Plate 9: In vitro germination of *Scaevola striata* × *S. phoebopetala* seed. The fruit is two-chambered, each containing an embryo.

Plate 10: *Scaevola* 'Curtin Fare', an interspecific hybrid between *Scaevola striata* 'Misty Blue' and *Scaevola phoebopetala* 'Purple Robe', raised and propagated in tissue culture. The hybrid has a purple flower similar in size to that of *Scaevola striata* but the purple hue is a shade lighter than that of the *Scaevola phoebopetala* parent; its foliage is intermediate in shape and hairiness.

Plate 11: Mixed plantings of *Scaevola phoebopetala* 'Purple Robe' (blue to deep purple), *Scaevola striata* 'Misty Blue' (light purple) and *Scaevola striata* 'Pink Perfection' (light pink). 'Misty Blue' is genetically unstable and regularly throws up the pink "sport" ('Pink Perfection') ■

Prickly Fanflower an Aboriginal medicine?

Australian Plants, Their Commercial Potential 2

Pharmaceutical Investigation of *Scaevola spinescens*

by Dr R. B. Longmore and P. G. Kerr, School of Pharmacy, Curtin University of Technology.

Over several years we have been investigating the chemical constituents of *Scaevola spinescens* known as Currant Bush, Maroon Bush or more generally as Prickly Fanflower. It is widely distributed in the arid areas of Austin and Coolgardie in Western Australia, and also in South Australia. Evidence of the plant's medicinal use amongst Aborigines appears in both States. A bitter tasting tea can be brewed from the plant and this has been used as a 'bush tonic' over the years by many Aborigines and outback people. The main claim to fame for this plant, however, is its anecdotal reputation as an anti-cancer treatment, which has never been substantiated in fully controlled scientific trials.



△ Plate 1. *Lechenaultia formosa*: young flower bud (left) and flower.
▽ Plate 3. Elongated style (red) brushes against the (yellow) anthers.



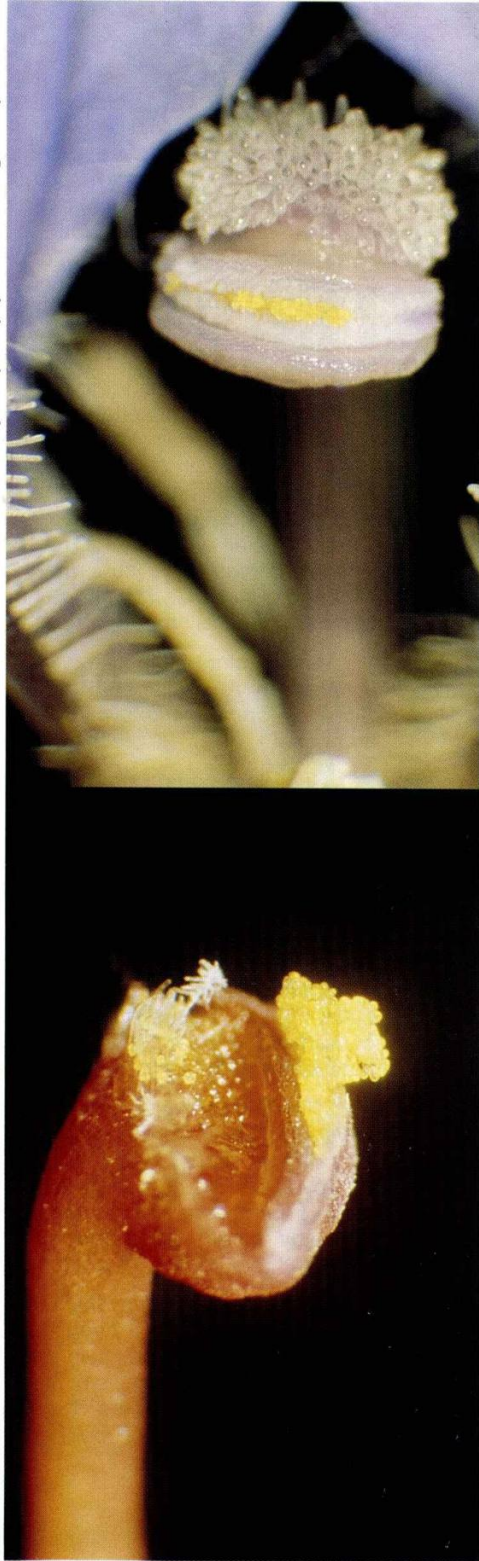
△ Plate 2A. Petals cut away to reveal the anther 'crown' (yellow).
▽ Plate 2B. Two stamens removed to reveal stigma (red) and style.





△ Plate 4. The *stigmatic* pouch closes entrapping its own pollen.
 ▽ Plate 5. The stigma bends away from the split corolla tube.

△ Plate 6. *Scaevola* flower, (left) anthers have shrivelled below style.
 ▽ Plate 7. *Lechenaultia biloba* sticky receptive papillae above stigmatic pouch.



In 1946 Mr C. A. Gardner, Government Botanist, reported to the Drug Panel (responsible for the evaluation of the potential of W.A. native plants for therapeutic uses), on "a plant known only to the natives themselves, which it was claimed had been responsible for the recovery of a native from an incurable cancer". This was at a time when chemotherapy of cancer was very primitive, highly toxic and often unavailable to the general public. In September 1946, then Constable Athol Monck, based in the Murchison District, reported the use of this plant in an apparently successful cancer cure of an Aboriginal called Nibberong (or Neebrong). Nibberong had been diagnosed with cancer of the tongue seen as a red raw discharging mass by a Dalwallinu doctor in 1937. Nibberong was to have been transferred to Perth for treatment. He had naturally been distressed to learn that he might suffer excision of the tongue and had fled the hospital and returned to the bush. Eighteen months later Nibberong was again examined by the same doctor and found to be cured of his cancer! No trace of the disease could be demonstrated. Questioning revealed that Nibberong had been treated by another Aborigine named Hedlun, who used a decoction of Maroon Bush stem wood mixed with the ashes of Desert Poplar or Mustard Tree, *Codonocarpus cotinifolius* (Desf.) F. Muell. These findings were confirmed by a Dr Anderson who had first attended Nibberong in 1937. The tea decoction made from Maroon Bush is extremely bitter and was even found to be too nauseating for some.

An account of this history was published in "The Progress of Public Health in Western Australia 1829-1977" by Dudley Snow as "The Sad Saga of *Scaevola spinescens*", which as the title suggests was not exactly glowing in its praise!

Such information on the use of the plant generated great public interest and indeed was ultimately a major factor in the foundation of the Department of Pharmacology at the University of Western Australia (UWA). This move was encouraged by the continual efforts of Constable Monck and the sponsorship of John Tonkin, later Premier of Western Australia. The Wellcome Foundation made a generous donation of 62,500 pounds sterling in November 1958 to investigate the pharmacological (biological) properties of W.A. flora. In 1981 the W.A. Cancer Council expressed concerns that extracts of the plant continued to be supplied to certain cancer patients, and were even sold on the black market. This is still going on. We find this attitude interesting, all things considered. It's almost as if cancer patients must play the game right up to their last breath!

The Government Chemical Laboratories, now the Chemistry Centre (W.A.) have supplied an extract since 1957 to certain patients upon the recommendation of their general practitioner. The fact that *Scaevola* extract is still an unproved cancer cure lead to a major decision not to add any more patients to the treatment list and to cease production when none of the current patients was any longer using the extract. On compassionate grounds, surviving patients have continued to be supplied with the extract.

That is the scenario which stimulated our interest. Could we find compounds in the plant which had been demonstrated to possess anticancer properties elsewhere? Initial studies focused on some brightly fluorescent compounds visible in alcoholic extracts of the plant using the technique of thin layer chromatography which separates chemicals by running a solvent across a thin layer of silica gel absorbent supported on a plate or sheet. *Continued, page 134.*

Prostrate *Scaevola*

For Rockeries and Containers

by W. H. Payne*

My *Scaevola* 'Purple Fanfare' has been flowering for two years without a break. As noted on page 112 this showy scrambling plant is supposed to flower only over spring and summer. The native Fan Flower belongs to a group of plants known as *Scaevola* (See-vo-la) and as there are a number of native fan flowers becoming available a review of some of these could be of interest.

They all propagate easily from cuttings. The rule for propagation of *Scaevola* is to not take cuttings from a flowering branch. I waited and waited for mine to stop flowering and in desperation, took off a trailing branch 30 cm long, cut the flower head off the end and chopped the remainder up into a number of cuttings. They all grew and I now have perpetual mauve fan flowers in all parts of the garden.

One of the first two plants I had, I cut back removing 50% of the flowering branches right back near the rooting stem. This is still flowering like crazy in its third year but the other original plant exhausted itself and died after two years continuous display, ho-hum, more from cuttings is so easy.

The review of the genus *Scaevola* in *Flora of Australia*, Volume 35, divided the 71 Australian species into groups of similar plants, and although the botanical treatment appears to defy ready understanding, the prostrate species of special horticultural interest were defined as those with:

Scaevola species that have a fruit in which the seed is enclosed by a hard dry seed casing or pod; and a flower head which is held on the end of the branches.

1. Prostrate species with sessile (not stalked) flowers in the head and the bracts are covered with stiff hairs e.g.: *Scaevola aemula*, *S. albida*, *S. argentea*, *S. auriculata*, *S. densifolia*, *S. humilis*, *S. microphylla* and *S. macrophylla*.
2. Prostrate species where the individual flowers are pedunculate (on stalks) or if sessile in the bract, the closest leaves on the branch are reduced e.g.: *Scaevola calliptera*, *S. hookeri*, *S. phlobopetala*, *S. pilosa*, *S. striata* and *S. tenuifolia*.

***Scaevola aemula* 'Fairy Fan Flower'**, is an ascending to decumbent herb to 50 cm tall with obovate (rounded) leaves (10–80 mm long × 4–30 mm wide) tapering towards the base, stem clasping and dentate (toothed). The blue or white flowers are in spikes to 24 cm long. It is a variable plant, the prostrate form 'Diamond Head', being used to create a number of cultivars such as 'Blue Fandango'. Other outstanding cultivars are *Scaevola* 'Summertime Blues', *Scaevola* 'Purple Fanfare' (photo, page 117), *Scaevola* 'Fanfare' and *Scaevola* 'Fan Dancer' which is more compact. References in *Australian Plants* record success in all states, volume 5: 11CD (Brisbane), 12 (photograph), 302CD (SA), 7: 114C, 115D (Sydney), 9: 250CD 11: 364C (Vic) 12: 66C 18: 118CD, 296CD

*The article on Fan Flowers by Beng Tan on page 115 prompted me to prepare these notes. There are many prostrate *Scaevola* not included but I have attempted to describe those already identified as having horticultural potential. Some plants included are not usually prostrate but have forms that tend this way and these forms have been used to develop exceptional plants.



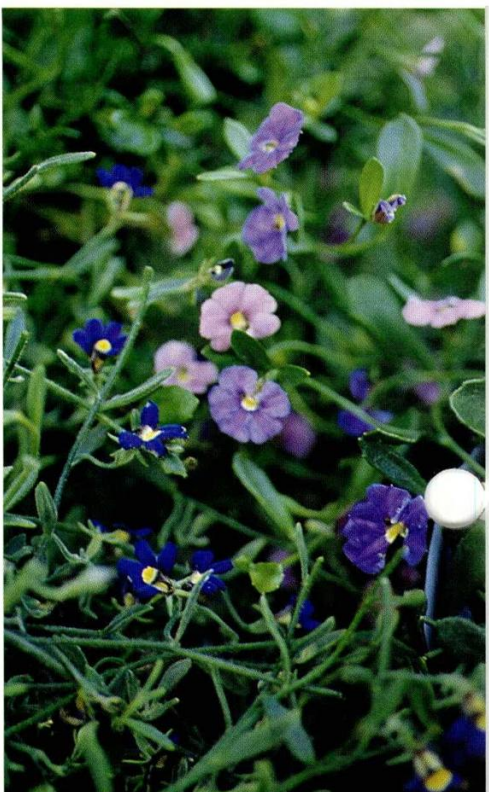
△ Plate 8. A fruit (cut open to reveal the seed) of *Scaevola striata* hybrid.

▽ Plate 9. *Scaevola* 'Curtin Fare' Fruit two-chambered, each with embryo.



△ Plate 10. *Scaevola* 'Curtin Fare'. Raised and propagated in tissue culture.

▽ Plate 11. A mixed planting of *Scaevola*, see caption on page 122.





△ *Scaevola albida* in a hanging basket.
 ▽ *Scaevola microcarpa* in hanging basket.

Scaevola spinescens, a source ▷
 of medicine, see page 119



Scaevola albida is a prostrate to ascending herb to 50 cm tall. Shown in a hanging basket on page 125. It is superficially similar to *S. aemula* above (shown well in the photograph on page 112 of volume 18), but the leaves are scattered along the stem, are not stem-clasping though without leaf stalks, and the stem is without conspicuous hairs. The flowers are blue or white. It has proven a reliable plant, an exceptional form being marketed as 'Karwarra Pink' described on page 302 and well illustrated on page 329 in volume 18. It was used for ***Scaevola* 'Light Fantastic'** (18: 296, an exceptional plant shown in the photograph on page 18: 292). References to cultivation are 6: 272D 9: 250C 14: 22C 18: 112 (photograph), 302CD, 329 (photograph).

Other cultivars probably based on the two plants above are ***Scaevola* 'Fan Dancer'** (18: 296CD), ***Scaevola* 'Mauve Clusters'** (18: 177CD, 295CD) and ***Scaevola* 'Petite Cascade'** (18: 296CD), the only plant with plant breeders rights.

Scaevola argentea is a prostrate much-branched shrub from the sand heath of the Ravensthorpe, Ongerup area of WA. The name means 'silvery-hairy' and this seems to apply to the whole bush even to the flower petals. This feature as well as its recurved leaves (8–20 mm × 3–13 mm, sessile and rounded) distinguishes it from its close allies. *Scaevola aemula* and *S. humilis*. The mauve to blue flowers are in dense spikes and this plant would appear to have horticultural potential.

Scaevola auriculata is an ascending herb with stems to 70 cm long and sessile, stem-clasping, elliptical, toothed leaves 25–75 mm long × 15–35 mm wide. The blue flowers in loose racemes to 24 cm long are densely bearded inside with light brown hairs. It is from the Porongurup Range in WA. Photograph on page 137.

Scaevola calliptera, a native of south-eastern states (NSW, SA, Tas. and Vic.) can be upright to 40 cm tall. The stems are hairy, the sessile leaves being narrowly rounded and toothed, 20–60 mm long and 4–25 mm wide. The blue to purple flowers with a yellow throat, are in terminal racemes to 30 cm long, the bracteoles cupping the flowers 10–35 mm long and toothed. Photo, page 137

Scaevola densifolia is a prostrate subshrub with stems to 40 cm long, from the heath along the Oldfield and Fitzgerald Rivers of WA. The white or cream flowers are in terminal racemes.

Scaevola hookeri is a prostrate, stoloniferous herb often forming mats on the eastern highlands from northern NSW to Tasmania, usual at higher altitudes in damp situations. The sessile leaves are rounded, usually not toothed, 6–15 mm long × 2–15 mm wide. The white or blue flowers, sometimes yellowish in the throat are in racemes to 10 cm long. 6: 244 (photo) 7: 114, 382. Photo, page 101

Scaevola humilis is a decumbent or ascending herb to 35 cm tall. A delightful small plant that is shown well as a container plant in the photograph on page 313 of volume 18 (18: 313C). This white form was selected because of the display of white flowers for a large part of the year. The foliage is a deep green, the variable leaf shape being shown in the photograph. There are blue and pink forms and one with vivid purple flowers from a silvery blue foliage.

Scaevola macrophylla is an upright herb to 40 cm tall from the Cape Riche area of WA. The blue flowers in short dense racemes to 5 cm long have a yellowish beard inside the petals surrounding a purplish beard on the ovary in the centre.

Scaevola microphylla is a decumbent herb with stems to 50 cm long, from forest margins in south-west WA. The blue flowers are in loose racemes to 15mm long. A white form is shown in a hanging basket on page 125.

***Scaevola phlobopetala*, 'Purple Robe'**, is a prostrate herb that can mound to a height of 30 cm with a spread of 1.5 metres. The stems are prostrate, spindly and hairy, carrying green narrow, hairy leaves 20–100 mm long and 3–17 mm wide, sometimes recurved. The flowers are a deep purple with a yellow throat, the five fan-shaped petals being striate. It is related to *Scaevola striata* and *S. calliptera* from which it is distinguished by its linear bracteoles and deeper flower colour. A photograph of a plant and the flowers is on page 140.

Scaevola pilosa is an ascending to decumbent herb to 70 cm high from south-east WA. The blue to mauve flowers in racemes to 50 cm have white hairs outside and a short dense beard of hairs inside. It is closely related to *Scaevola ramosissima*.

Scaevola platyphylla is a spreading shrub to 70 cm tall with appressed hairs on the stems. The sessile leaves are stem-clasping, elliptic, 24–63 mm long and 13–42 mm wide. The blue flowers are in racemes to 17 cm long each densely hairy inside and outside the petals. It is similar to *Scaevola auriculata* but less hairy outside the flower cupped by longer bracts at least as long as the flower. **18: 177.**

Scaevola ramosissima is widely known in eastern Australia where it extends as far north as the Blackdown Tablelands in Queensland. It is a prostrate plant with wiry stems bearing large, pale violet to purple flowers. It does not display as many flowers as others described. **7: 114, 116 (photograph) 18: 177.**

***Scaevola striata* 'Royal Robe'** is a hirsute (hairy leaved) prostrate plant which spreads by suckering, usually to one metre across. The rounded coarsely toothed, hairy leaves are variable ranging from 10–50 mm long and 3–20 mm wide. The bright blue-purple flowers are produced in racemes to 30 cm long at the branch ends during spring and summer. The pronounced nerves in the corolla (petal) wings and the entire bracteoles (leaves cupping the flower) separate it from *Scaevola pilosa* which has stem-clasping leaves, and *Scaevola calliptera* which has serrated bracteoles.

The plant has great potential for use as a trailing plant in rockeries, as a border plant or in a container. Because of this a number of garden cultivars have been developed. ***Scaevola striata* 'Misty Blue'** is named for its blue/mauve flowers. It is not genetically stable and chimeras displaying pale pink and mauve petals (and half petals) on a single flower can be seen along with pink flower 'sports' on an otherwise mauve flowered plant. ***Scaevola striata* 'Pink Perfection'** is a vigorous, free flowering ground cover, the pink fan flowers occurring over a long period of the year.

Scaevola tenuifolia is a decumbent to prostrate herb to one metre diameter. The leaves are sessile, linear and revolute, 7–45 mm long by 1–4 mm wide. The blue to mauve flowers are in racemes to 20 cm long, each with white hairs at 90° outside and densely bearded inside. It is from East Mount Barren and Thumb Peak Range of WA. It is similar to *Scaevola striata* but with curved flower stalks and without striations on the petal wings. The narrow leaves distinguish it from *Scaevola pilosa*. ■



Everlastings Daisies

Some Unique Australian Species

Based upon "Observations on the Reproductive Biology of some Western Australian Asteraceae" by P.S. Short*

Rhodanthe sterilesceus syn. *Helipterum sterilesceus*, (top left) is an annual species that grows in the Gascoyne and Murchison Regions of Western Australia. It is the only native Australian daisy to produce two types of capitula (heads of flowers) on the same plant. In good conditions small, not very showy capitula are produced near the base of plants and larger capitula, occur further up the stems. Plants growing under adverse conditions only produce small, near basal capitula. Photograph by B. Fuhrer.

Rhodanthe cremea (top right) occurs in the Shark Bay region of Western Australia. It is an unusual species in that the florets (flowers), instead of being uniformly coloured and 5-lobed, have three lobes of equal size, and two larger, purple-black lobes. This attribute suggests that the species is mimicking the floral pattern seen in *Rhodanthe chlorocephala* subspecies *splendida* and *Cephalopterum drummondii*, both being species with which it commonly grows and which have purplish bands at the base of the inner bracts. *Rhodanthe cremea*, as illustrated, may also have bracts with basal bands but they are rarely as conspicuous. Photograph, P. Short.

Rhodanthe chlorocephala subspecies *splendida* syn. *Helipterum splendidum* (centre left) is an annual that produces the largest single heads of any of the annual everlastings. After good rains in areas such as Shark Bay and Paynes Find it may form mass displays with other everlastings such as *Cephalopterum drummondii*. The dark purplish band at the base of the involucre bracts are assumed to play a role in attracting pollinators. Photograph, P. Short.

Siloxerus pygmaeus (bottom left) is confined to SW Western Australia and commonly grows amongst samphire on the edge of inland salt lakes. Plants produce compound heads which are about 1 cm in diameter. As with *Chthonocephalus pseudevax* the florets are inconspicuous and bisexual and produce little pollen. Fruit are heteromorphic. Photograph, B. Fuhrer

Chthonocephalus spathulatus (bottom right) is only known from the Carnarvon region of Western Australia. Unlike the above species the bisexual florets are comparatively showy, with each floret producing several thousand pollen-grains. ■

*The original article was published in *Gondwanan Heritage — Past, Present and Future of the Western Australian Biota*, edited by Stephen Hopper et al, published by and available from Surrey Beatty & Sons, 43-45 Rickard Road, Chipping Norton, NSW 2170 for \$80.00.

The book is a collection of scientific papers, a valuable reference for scholars. The introduction dealing with the early history of our planet in the period of continental drift is a revelation, quite the best explanation of this theory I have read. It leads to a description of the possible changes to our continent since this time, especially Western Australia. This area has drifted twice to the North Pole, to the South Pole, and is now moving north again. Climatic changes because of the ocean currents and the ice banks at the polar caps have been extreme and our remaining flora has survived this and adapted to its isolation. There is little wonder that our flora is unique. — Editor.

Chthonocephalus pseudevax (centre right) is a seemingly stemless herb consisting of a compound head 0.5–3 cm in diameter, surrounded by a basal rosette of leaves. The flowers are bisexual and on average each floret produces little more than 100 pollen-grains, a feature which is indicative of a high degree of self-pollination. It produces heteromorphic fruit, i.e., most of the fruit are small (0.5 mm long) but a small percentage are much larger (to 0.95 mm long). The seed size is presumably linked with water uptake, germination rate and staggering of germination times. It is one of six species of *Chthonocephalus* and is widespread across much of southern Australia. Photograph of both, B. Fuhrer ■

Blandfordia — Christmas Bells

Successful Marketing of Cut Flowers

by W. H. Payne*

The farm cropping and overseas marketing of Christmas Bells as cut flowers has now been established as a profitable business due to the co-operative efforts of the growers with the support of research at university level and Agriculture NSW. They meet twice a year as the Blandfordia Research Extension Group (BREG) to report on their successes and problems, learning from each other.

A leader of one support group is Dr Ross Worrall with his research team and facilities of Agriculture NSW. A research study supported by the Rural Industries Research and Development Corporation (RIRDC) has yielded the following results.

- 1 **The vase life** of *Blandfordia* cultivated for cut flowers, was 7 days after adequate storage and transport even for periods as long as 30 days since picking. The picking handling, packaging and transport of the product has been a successful co-operative study of the BREG group.
- 2 **Cool storage** under defined conditions at 1 degree C for up to 30 days did not significantly effect quality of blooms at market or in consumer's vase.
- 3 It was not necessary to supply **external water** (e.g., standing in water or sachets) during long periods of storage. 'Dry' storage under high humidity gave significantly better results.
- 4 **Recutting of stems** did not improve vase life after 'dry' storage and stem length and rehydration temperature had had a minimal effect on vase life.
- 5 The use of **floral preservatives** (8-hydroxyquinoline sulphate [HQS], sucrose and silver thiosulphate) applied as a pulse or vase solutions did not improve the keeping quality of *Blandfordia* stems picked with one flower about to open or already open.
- 6 The only **disease** problem identified in the project was that of flower rotting caused by *Botrytis cinerea*. The fungicide iprodione was found to be highly effective in the prevention of rotting when applied as a dip after harvest.
- 7 The control of **pests after packing** is effective using the present methods, which included effective pre-harvest control of insects, careful inspection of the large flowers and buds and an insecticidal dip before packing. ■

*This is a brief report on a very detailed scientific study but the findings are clear and of great value to the commercial growers. Similar studies and frank exchanges between growers have combined to create a profitable export industry for Australia. Gardeners will also benefit.

Australian Native Food Industry

Prosperity From Australia's Natural Resources — 2*

by Australian Native Produce Industries Pty Ltd (ANPI)**

We have a vision, to develop an Australian native food cuisine that will become an established part of Australian culture. We are active in propagation, cultivation, collection and processing of Australian food plants and animals.

ANPI's first priority was to develop markets, before farming. A commercial plant nursery was established in Renmark, and an export standard food processing factory in Adelaide, where it developed the Red Ochre® range of gourmet native food products. As in any industry, markets will be secured if there is a reliable supply of consistently high quality product. Priorities include the development of new gourmet product recipes, the selection of superior genetic material, development of reliable plant propagation methods, crop management systems, mechanical harvesting, post-harvest handling, and transport system.

Native foods are very nutritious, have unique flavours and are versatile in their use. For example, the Bush Tomato contains high levels of protein, carbohydrate, minerals and Vitamin C. It can be eaten raw as the Aborigines of the Central desert have done for years, or added whole to casseroles and chutneys, or ground to a spice. Other products such as pastas, dressings, chutneys, salsas, jams and jellies have been successfully marketed at international food fairs. Shipments have been exported to London, Zurich and New York indicating an export market both present and increasing.

The performance of a species will vary according to genetic differences within the species, different soil and climatic conditions, and different management systems (e.g., dryland versus irrigation, intensive versus extensive, chemical monoculture versus organic polyculture). Significant resources have been invested to obtaining, the best genetic material currently available. Some species are the subject of ongoing genotype selection.

In main-stream horticultural terms, the market for all the crops listed is small. It is, however growing, and all indications are that it will continue to grow and be sustainable. ANPI is keen to supply other growers with superior planting material, and in the medium to long term, establish "buy back" contracts to ensure a reliable supply of high quality raw produce.

For plantations to be established under drylands conditions, it is assumed that this will only be attempted in areas receiving equivalent or greater annual rainfall than the species would receive within its natural range, and that irrigation is available for the critical establishment period. In addition, it is assumed that adequate plant protection is provided from grazing herbivores and pests such as snails, grasshoppers, mice, etc. Little is known of fertiliser practice to optimise crop production. Due to the phosphate intolerance of many species, it is recommended that a low phosphate (3% or less), organic fertiliser be used.

*The first article in this series was in Australian Plants, Volume 19 page 90.

**Australian Native Produce Industries Pty Ltd (ANPI), an Australian-owned and operated company formed in 1992, in part to help supply the multiple award winning Red Ochre Grill restaurants in Adelaide. Andrew Fielke, Master Chef and native cuisine pioneer, of these restaurants, is a director of ANPI. A second Red Ochre Grill™ has opened in Cairns with plans for restaurants in Melbourne and Sydney. For information phone ANPI (085) 951611.

Plants already established for Berry Crops

Kunzia pomifera (Muntries) is an evergreen, prostrate or hummocky creeping shrub (0.5 to 3 m across). Grass-green rounded (5 to 10 mm). Dense, fluffy white flowers in late Spring to early Summer. Green berries (10 to 15 mm diameter), become tinged with pink to purple when ripe. It occurs naturally in 500 to 800 mm rainfall areas of south-eastern SA and south-western Vic, on lighter textured soils with good drainage.

Culinary uses. Fruit ripens in Summer. The sweet, apple-flavoured berries are used fresh in desserts and fruit salads, or cooked in pies, chutneys, jams and sweet savoury sauces. This has great potential as a fresh berry fruit.

Cultivation Comments. An attractive, vigorous species which has been extensively used in southern Australia for landscaping purposes. Suitable for light textured, well drained soils only. Moderately tolerant of drought, frosts, lime and saline soil conditions. Tolerant of coastal exposure. Fruit size and quality is very variable unless clonally propagated selected genotypes are used. Partial shade has a beneficial effect on fruit size and flavour.

Estimated Yield and Gross Return. For estimating purposes, under irrigation, at a spacing of 2 × 3 m (1,650 plants per ha), an average yield of 1.5 kg of berries per plant could be expected in the third season after planting. At a farm gate value of \$10 per kg, a gross return of \$24,750 per ha could be achieved. Wider spacings should be used under dryland conditions, and quality and quantity of produce can be expected to vary significantly from season to season.

Billardiera cymosa (Sweet Appleberry) is a non-vigorous twining climber if supported, or spreading shrub to 3 m if unsupported. Narrow, dark green foliage (approx. 50 × 10 mm). Blue or white star-shaped flowers (5 mm) in Spring to Summer. The finger-like berries (12 × 6 mm) are covered with fine hairs and turn from green through reddish-brown to translucent when ripe in Summer to Autumn. It occurs naturally in 300 to 800 mm rainfall areas of south-eastern SA and south-western Vic.

Culinary Uses of Sweet Appleberry. A tasty dessert berry with an apple and aniseed aftertaste. Current use of this crop is largely experimental.

Cultivation Comments. Has a history of cultivation as a garden plant in southern Australia. Prefers well drained lighter textured soils, moderately tolerant of drought, frosts and lime soil conditions.

Edible Seed Crops

Wattles — The seeds and pods (ripe and green) of selected *Acacia* species are traditional foods of Australian Aborigines. There is growing interest in their use for human nutrition in the developing world. Ripe seeds are typically high in protein, fat and carbohydrate and will produce a highly palatable and nutritious flour for damper, breads, cakes, pastries, desserts and beverages. *Acacia retinodes* and *Acacia victoriae* were described in our last issue.

Editor's note: This was in association with another article describing *Acacia thomsonii* as a potential food resource for cultivation in the tropical dry zone of Australia on harsh, stony sites. The selection of crops acclimatised to our conditions over thousands of years could be one answer to the production of foods requiring less water and harmonious with our environment.

Brachychiton populneus (Kurrajong) is an evergreen, spreading small to medium tree (8 to 20 m) with rounded crown. dark green poplar-like leaves (although may be quite variable in shape), seed borne in light brown to black "boat like" pods. Fragile hairs in pods shatter when disturbed to produce an irritating powder. White bell-shaped flowers with red-brown spots in Spring to early Summer. Widespread species occurring naturally in 450 to 750 mm rainfall regions of Vic, NSW and Qld, on a broad range of soil types.

Culinary Uses. Seeds ripen in February to April. A uniquely flavoured, highly palatable flour is produced by roasting and milling cleaned seed. Uses are listed in the introduction to this section.

Cultivation Comments. Adaptable multi-purpose species for temperate, low rainfall areas (also suitable for areas of higher rainfall). Often has slow initial growth (1 to 3 years), then tends to grow more rapidly. Southern provenances are frost tolerant, moderately drought tolerant and tolerant of lime soil conditions. Attractive shade tree when mature, a wind firm shelter belt species. High quality drought fodder, often cut for this purpose. Deep rooting allows other crops to be grown to the base of the tree. Long lived.

Estimated Yield and Gross Return. This crop lends itself to dryland cultivation. For estimating purpose, at a spacing of 6×6 m (275 trees per ha), allow a yield of 2 kg per tree in the fifth year after planting. At a farm gate value of \$20 per kg, a gross return of \$11,000 per ha could be achieved.

Fruit Crops

Capparis mitchelli (Wild Orange) is a small rounded tree or bushy shrub (5 to 8 m) with a dense crown. Juvenile foliage usually prickly, sometimes carrying through to mature foliage. Dark green foliage, fleshy fruit 20 to 50 mm in diameter. Attractive, large white flowers at any time of the year, flowers wither after opening for one full day. It occurs naturally in 100 to 300 mm rainfall areas (confined to watercourses at lower end of range) of temperate SA, Vic, NSW, Qld and NT, generally on heavier textured soils.

Culinary Uses. Fruit is ripe when some brown colour develops on the skin, and may be eaten raw or used in desserts (e.g., mousse, gelati and ice-cream etc.) and cordials. Peak fruit ripening tends to be in mid to late Summer. Current use of this crop is largely experimental.

Cultivation Comments. Attractive multi-purpose tree for hot, low rainfall areas. Rarely seen under cultivation. Slow initial growth rate (1 to 3 years), then more rapid. A highly regarded stock fodder tree when it occurs naturally. Tolerant of frost, drought, periods of waterlogging, and lime soils.

Eremocitrus glauca (Desert Lime) is an evergreen, upright prickly shrub to small single stemmed tree (2 to 8 m) with rounded crown. Grey-green foliage, fruits yellow-green 2 cm in diameter, often seedless. It occurs widely in nature, growing naturally in the 200 to 500 mm rainfall areas of temperate SA, NSW and Qld, on a broad range of soil types. Small white flowers in Spring.

Culinary Uses. Fruits ripen in mid to late Summer (10 to 12 weeks after flowering). Fruits are used in chutneys, jams, marmalades, sweet and savoury sauces, desserts, ice-cream and refreshing drinks. There is rapidly growing interest in this plant for gourmet applications.

Cultivation of Desert Lime (*Eremocitrus glauca*). This is a very hardy arid and semi-arid zone fruit producing species. Closely related to commercial *Citrus*, it can be grafted onto a range of *Citrus* and *Microcitrus* rootstocks because of the slow initial growth (unless grafted to vigorous rootstock). On its own roots (seedling), it is moderately tolerant of frost, drought and lime soil conditions (or according to particular rootstock). Responds well to pruning and shaping. Seeds sometimes parasitised by gall wasp. An interesting garden and tub plant.

Estimated Yield and Gross Return. For estimating purpose, under irrigation, at a spacing of 4 × 4 m (625 per ha), an average yield of 2 kg per tree can be expected in the fifth season after planting. At a farm gate value of \$8 per kg, a gross return of \$10,000 per ha could be achieved. Wider spacings should be used under dryland conditions, and a lower yield (quality and quantity) should be expected. Budded selections, promise earlier fruiting and higher yields.

Cultivation Comments. Very fast growing, attractive plant. Suited to most soils in full sun or partial shade. Requires adequate water to do well in low rainfall areas. Some frost sensitivity when young, tolerant of moderate lime soil. ■

Prickly Fanflower, an Aboriginal medicine? *Continued from page 122*

A chemistry project by one of our (R.B.L.) students, Elizabeth Curry, in 1992 demonstrated the identity of two of these compounds as possibly being the compounds seselin and xanthyletin. These compounds are a type of coumarin, a class of substances with a range of biological properties, including vasodilation, blood platelet aggregation and central nervous system stimulating or sedation effects. Several other coumarins were partially characterised.

More recently, one of us (P.G.K.) has carried out doctoral studies over the last three years on the chemical constituents of *Scaevola spinescens*. A variety of extracts have been prepared using different organic and aqueous solvents of the plant tissue, which have then been examined using a number of separation techniques. We have been able to demonstrate several classes of very interesting compounds which may be associated with possible biological actions of extracts. In particular we have noted that the plant is a rich source of triterpenoids and especially the compounds myricadiol and lupeol. In fact we have the impression that *Scaevola spinescens* is one of the richest sources of myricadiol yet reported. So far it has received little mention as a biologically active compound other than that it possesses a hormone-like mineralocorticoid activity.

The coumarins mentioned previously are now more firmly characterised and in addition we have shown the definite presence of a further similar compound, nodakenetin, an isomer of which, marmesin, has previously been reported to be mutagenic and to be cytotoxic. We have tested some of these compounds and extracts against a biological indicator of antitumour activity, the crown gall potato disc assay which utilises inhibition of cultured *Agrobacterium tumefaciens*. Results have shown that indeed there are good indications of activity to be found.

That's the story so far. We have been successful in demonstrating the presence of several interesting compounds in *Scaevola spinescens* which may provide a clue to the reported use of the plant as an anticancer treatment. However such studies tend to be long and tedious and still far removed from producing a possible treatment for some cancers. The point is that this plant is being investigated and may yet make a contribution to Australia's natural product inventory for treatment of human diseases. ■

Eucalypt Dieback

Crisis at New England, NSW

(A Crisis For Australia*)

D. Curtis, C. Nadolny and H. A. Ford

In the 1970s large number of trees died over a relatively short period on the Northern Tablelands of New South Wales, a phenomenon that came to be called "New England Dieback". This dramatic collapse in tree populations was the galvanising factor for collaboration by farmers, scientists and townspeople, devoted, not to development of an economic structure, but to solving an environmental problem. A network of concerned people grew as a response to the eucalypt dieback and rural tree decline.

Despite a growth in interest about the environment and many achievements in recent years, caring for the natural environment remains of peripheral concern to most people. If our society is to become ecologically sustainable, the goal of protecting the natural environment will need to become a central concern. This transition will require cultural change and the development of new symbols. (A lesson to be learnt, see page 98)

The Northern Tablelands is a diverse region in northeastern New South Wales. It is a high plateau of undulating hills, mostly about 1,000 m above sea level but with peaks over 1,500 m. In the east it borders steep escarpments and rugged gorges, which are heavily timbered. The western boundary is less well defined, with a more gradual drop in altitude towards the western slopes. Before European occupation the region was covered in a mosaic of grassy eucalypt forests and woodlands with small areas of shrubland, lagoons and grassy plains. The region had a patchwork of bush, through which the Aboriginal people built up the first human social and economic network. In a most awe-inspiring way the European settlers have imposed a very different pattern on to the landscape.

The Tablelands could be seen as ecologically degraded when compared with its state before the arrival of Europeans. **The flat land is almost totally clear of trees** and those present are frequently exotic, most wetlands have been drained, and shrubs are confined to some creeks and small knolls. The lack of natural vegetation means there is a distinct lack of the many animal species that depend on it; birds, bats, gliders, possums, etc. Livestock has damaged trees and seedlings.

It is rare to find places completely devoid of native species. Stands of trees range from blocks of over 100 ha to small groups or isolated individuals. **Native herbs and grasses** grow throughout with a mosaic of communities dominated by natives through to those dominated by exotics. By the mid-1970s there were considerable stands of dead trees on many farms. Affected areas stretched more than 200 km from north to south through the areas where the grazing industry was most highly developed. Concern was sufficient to prompt the establishment of a Ministerial Working Group.

*A Crisis For Australia, 'lethargy', 'she'll be right mate', "despite a growth in interest, caring for the natural environment remains of peripheral concern to most people" (quoted from above). I am convinced the Australian society wants to become ecologically sustainable but we need a leader to inspire the cultural change necessary to make it a way of life. I have used valuable space on this history to illustrate how important it is that the people responsible for the centenary celebrations in the year 2001 study our proposal — Editor.

The New England Eucalypt Dieback Research Fund (or "Dieback Fund") was established in 1979 by the local community to raise funds for research into dieback. At the fund's launch 700 people crowded the Armidale Town Hall and nearly \$100,000 was raised in two years. This funded many research projects including broadscale surveys of dieback, studies into the role of birds, fungi, lizards and land-type in relation to dieback.

Landholders had many reasons for **concentrating on exotics prior** to and during the 1980s. Exotic pines were cheap and readily available, and poplars and willows could be planted easily as cuttings from existing trees. Failures with the first plantings of natives and the fear that re-established native may continue to be affected by dieback were also powerful reasons for farmers to plant mainly exotic species. There were also cultural reasons, many graziers had links with Britain and had a general liking for Northern Hemisphere species.

The International Year of the Tree in 1982, inspired the formation of the Armidale Tree Group in 1983 under the auspices of a University based environment group, and this led to **concentrated planting of locally native species**. The group followed the model of tree groups in Victoria with volunteers going into the bush, collecting seeds and propagating them. The original target to grow 10,000 trees each year was reached in 1987 (when the group established a commercial nursery) and was exceeded tenfold by 1994. The group did small plantings on both farmland and public reserves but after 1988, plantings on farmland were done on contract with paid employees, and volunteers planted on public land.

In 1984 it was decided to shift emphasis from the causes of dieback to re-establishing and **protecting remnants of native regeneration**. It initiated the Eucalyptus Regeneration Program on 12 properties and an extensive programme of direct seeding trials, tree planting trials and monitoring of natural regeneration.

Collaboration between interested groups lead to the mass use of locally provenanced tube stock, milk carton tree guards, widespread use of sawdust mulch, direct seeding, use of cheap seedlings (called "speedlings") and the introduction of planting and seeding machinery.

By the mid-1980s Jon Taylor had designed and built a self-propelled tree planting machine and had formed the first tree planting service in the region, planting about 20,000–70,000 trees each year.

Increasingly the shift in trees on farms was **towards an ecosystem approach** and it became more widely accepted by landholders by the early 1990s.

The period 1987–1990 was a period of breakthroughs as far as native plant growing was concerned on the Tablelands. Large plantings of native plants by the Armidale Tree Group were successful. The Eucalyptus Regeneration Program attracted Federal funding. Trials were showing that **native trees and shrubs could be established successfully** even in dieback-affected areas by both direct seeding and planting. Many landholders developed a sense of optimism towards the use of native trees. Also by 1990 many of the trees that had been moribund in the 1970s had recovered, and regeneration of saplings was prolific in many areas. Research on means of encouraging natural regeneration showed promise where juvenile eucalypts were still present and stocking rates were low. By 1990 the annual output grew to 200,000 seedlings and by 1993 it had risen to 400,000 seedlings per annum, with several tree planting contractors active.



△ *Scaevola auriculata*, see page 127
Photography by J. F. Noble

▽ *Scaevola calliptera*, see page 127
Photography by John Simmons



The Landcare movement began, Greening Australia opened a regional office in Armidale and tree planting became tax deductible. Grants became available through the federal 'One Billion Trees Program', 'Save the Bush', 'National Resources Management Strategy' and 'National Soil Conservation Program', all fused into the National Landcare Program in 1993. Landcare has been an important development encouraging neighbours to gather socially regularly and to discuss environmental issues of concern.

In 1992 the region hosted the first Treefest. This was a major field day focusing on all aspects of trees on farms and has gone on to become a national event. Over 70 exhibitors and 6,000 visitors came from all around Australia to share in what became a major celebration. Planning involved the major players in the local tree movement, including Landcare groups and staff, innovative landholders, the Armidale Tree Group, Greening Australia, tree planting contractors, nurseries, Trees on Farms, and the University of New England. Collaboration was important for many reasons. The fact that so many people, mostly farmers, came from all around the region and beyond, to a field day devoted solely to trees and rural conservation issues (including organic farming) marked a change in priorities. That the tree industry had grown to the extent that it could stage a major agricultural field day (usually the province of agribusiness) showed how conservation could have an economic base as well as an ethical one.

The Society for Growing Australian Plants has assisted the Citizens Wildlife Corridors group, a large project involving about 550 landholders in the southern part of the region. This is a pilot scheme for one of the proposals submitted to the Year 2001 committee for adoption Australia wide.

The rural recession and accompanying drought in 1991–1994 have slowed tree planting activities. Unfortunately, many recently planted trees and shrubs were badly affected in the 1994 drought. The drought had at least one positive effect, it demonstrated the comparative resilience of well managed native pastures. As a result, use of native grasses increased, and with lower stocking rates, so did eucalypt regeneration. Social and economic change is accelerating and increasing the rate at which people need to adjust to new circumstances. In Australia the decline of agriculture has been dramatic. The relative contribution of on-farm production to the Australian domestic product fell from 15.3% in 1963 to 2.8% in 1991 and the number of agricultural enterprises in the country fell from over 200,000 to about 125,000. Over this period the quantities of farm produce have been increasing but their relative value has fallen. These changed circumstances have created an air of desperation in the rural community. New scientific approaches and planning principles, or diversifying their operations have become necessary.

Since the early 1970s researchers at the University of New England and New South Wales Agriculture have studied and advocated the use of native pastures in the region. Native pastures allow persistence of a large proportion of the original ground flora, and the possibility of continued natural regeneration of trees. Some farmers now turn to native pastures as a way to develop more sustainable grazing systems. Careful controlled use of natural pastures could provide an alternative to traditional pasture improvement, a factor which is believed to have exacerbated dieback.

There have been many examples of collaboration between landholders and conservationists to work on areas of common concern. However, the potential for conflict real because of the concern by landholders of encroachment on their traditional rights by outsiders.

Despite the impressive work done in tree establishment, conservation is still a minor activity on most farms. Despite general concern among farmers about the global environment, only a small proportion intend to do anything about it. A similar attitude is typical of most of the population.

Alienation of people from the natural environment is probably increasing. There has been a growth in interest and concern about the natural environment but we appear to be a society increasingly remote from it. We visit "the environment" on holidays, but urban and rural environments continue to become less natural and more degraded, and our lifestyles remove us further from nature.

What motivates many to plant trees on their farms or strive for a better environment is mostly inspiration. Consequently many argue for the need to develop a conservation ethic, that is, we need to replace the hegemony of consumerism with a hegemony of ecological sustainability. To develop such a momentous paradigm shift, however, requires a major shift in perception.

It is celebrations and festivals which give us the potential to link conservation of the natural environment with the rest of our human concerns, and which allow conservation and care of the environment to penetrate all existing social networks, rather than being a separate, peripheral network. Perhaps **we have to think creatively and imaginatively of ways to celebrate the natural environment.** Most people only become interested and active in the environment when the problems become so severe that they could no longer be ignored. Incorporating a celebration of nature into community festivals and rituals would allow communities to be more intimately involved.

Our concluding statement is in the form of a picture in which we have tried to incorporate our ecological and social themes, "Nova-anglica" after three local endemic species *Eucalyptus nova-anglica*, *Banksia spinulosa* var. *neoanglica* and *Leptospermum nova-angliae*. Nova-anglica (New England) the name given to the area by the first European settlers as it reminded them of England.

The species chosen symbolise the network of vegetation that needs to be re-established. To be ecologically sustainable this network has to be of indigenous species and has to interconnect throughout the region. *Eucalyptus nova-anglica* leaves were chosen to symbolise this vegetation network since it grows throughout the Northern Tablelands. It was also the species most affected by dieback, but has exhibited a strong capacity to recover. The banksias and leptospermums symbolise the need to include a wide range of native shrubs with tree plantings. Leptospermums provide a rich nectar source for parasitic wasps and banksias provide nectar for honeyeaters. The wasps and birds help control scarabs, one of the major tree defoliators.

From a social viewpoint, the leaves symbolise networks of people connected via branches. Leaves fall off and are replaced by others. The defence of *E. nova-angliae* against insect defoliation reminds us that conservationists have little physical defence against environmental degradation, except, like the peppermint, they do have the ability to rebuild and regenerate.



Scaevola phloeobopetala, the plant and flower

Photographs by John Simmons

A spectacular ground cover with huge potential for development for pot culture and rockeries, see page 127.





A Guide to Flowers and Plants of Tasmania, a book by Launceston Field Naturalists Club and available from them, PO Box 1072, Launceston, Tasmania, 7250 for \$24.00 including postage. The photographs here are an example of how 300 Tasmanian wildflowers are illustrated each accompanied by a complete but non-technical description. An excellent reference beautifully illustrated.

△ *Cyathodes parvifolia* Photography by John Simmons

▽ *Prionotes cerinthoides*



Eucalyptus species more commonly known as Eucalypts or Gum Trees are not easy to identify for the beginner. This well illustrated 228 page book seeks to rectify this by encouraging you to do this using easily recognised features such as the number of flower buds or fruits in a cluster and where they are arranged and the type of bark on the trunk. All this is illustrated with colour pictures and a distribution map. Published by Reed Books it is widely available for \$24.95.

Eucalyptus or *Corymbia*?

Editor

Previously I had to apologise to people for some eucalypts being called *Angophora*. Now I find I need to say some are *Corymbia* and I cannot explain why. Is there a simple explanation? Scientific texts such as Flora of Australia, Flora of NSW and the book above, ignore *Corymbia*, why not us.

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Australian Plants On Line

Yes we are on the Inter-net.

Say G'day at: <http://www.ozemail.com.au/~sgap/index.html>

Australian Plants On Line will be operated to complement the printed *Australian Plants*. Who knows, in the future the present journal may go on the internet but we do not see this happening within 10 years. This publication goes worldwide and internal Society matters are confined to this page, apart from some conservation objectives. *Australian Plants On Line* will provide more detailed advice on what the Society is all about and using its feature of continually updating, it will advise of current events, where to go to see wildflowers etc.

There has been comment that the information in Study Group newsletters should be more widely available, possibly through *Australian Plants*. Those familiar with these groups will have noticed that 'crystallised' information has been published often devoting a whole issue to the particular genus. The newsletters contain personal comment and speculation on growing plants and this spontaneous flow should not be interrupted because of concern that an idea still germinating is published prematurely. The information in their newsletters is privileged and for members to discuss further or it is a source of income for the groups and a reasonable delay should be allowed to enable the groups to function effectively.

Australian Plants On Line is building up pages on each study group genus and wider availability of information will be provided. Reviews of data developed that will constitute a valuable reference in the future will continue to be published in *Australian Plants*. Readers will not miss out. You will increasingly be able to arrange contact with people with internet access, one member in a local group may be organised, so that this progressively updated service will be more widely available pending more detailed publication in *Australian Plants*.

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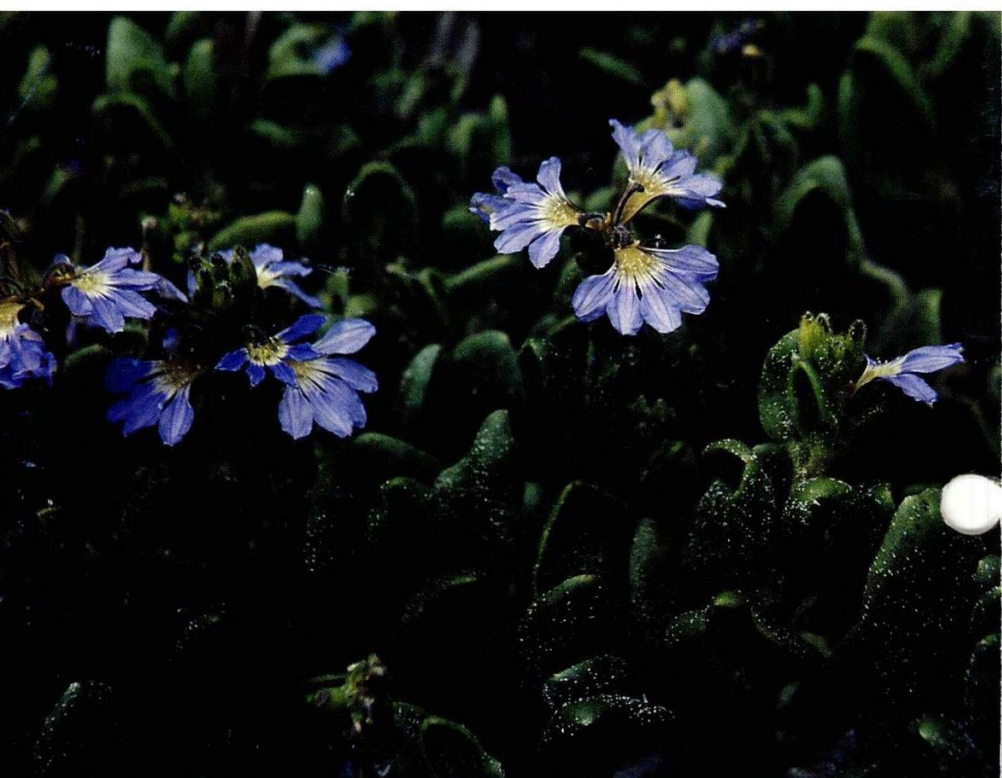
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△ *Scaevola calendulacea*

▽ *Scaevola pulvinaris*

