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Our Rainforest Plants—Editorial

This issue commences a survey of our unique rainforest flora, a subject not adequately presented in past issues. Many of the plants named will be strange to readers, so a short description of these plants is given later in the issue. We are interested in their cultivation, so a reference to mention in past issues is also given.

But! Do we want to grow a rainforest? George Thorpe in his article does. In fact his approach to the problem is so visionary I would recommend that you turn to his article to read first.

Rainforest is huge trees, vines, shelter, shades of light and dark, depth, leaf texture, a unique floor, a stillness, a tranquil atmosphere. How can this be present in two dimensions on paper. At least I have tried.—Editor.

Awake! It seems incredible to me that so many of the magnificent trees for which Australia has become famous come from our rainforests. In the forest they grow to giants of 20-80 m, pushing upwards for light and sun. Plant them in the open, even in the hard conditions of a city street, and you have a compact, beautiful, often floriferous tree. How many gems have we hiding in our rainforests, the horticultural potential of which is not even dreamed of? One such is on our cover.

Rainforests—Our Future Issues

This issue can only be an introduction to such an involved subject. An issue on rainforests is being prepared for the next volume dealing more specifically with rainforest flora and their horticultural applications. There are some members who have made a study of these plants and introduced them to the home environment. Please forward any notes that you consider would be of interest.

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COVER PLATE:

Agapetes meiniana is a little-known plant of which Australia can be proud. As shown, the flowers are 3-4 cm, displayed in twos or threes along the woody weak branches. It belongs to the family Ericaceae, which includes the well-known ornamentals *Azalea* and *Rhododendron*. The only Australian genera in this family are *Gaultheria* (the "snowberries" of Tasmania, see our No. 32 issue, page 158), *Pernettya* (also from high plateaux and mountain summits of Tasmania, Issue 32, page 156), *Agapetes* and *Rhododendron*. Yes, Australia has one species of native *Rhododendron*, *R. lochae*, as shown in colour on page 48 of our No. 37 issue, Volume No. 5. It comes from a similar habitat as *Agapetes meiniana* and will be a valuable guide for the cultivation of *Agapetes*. See 9:9P, 10, 15:87, 23:140, 37:48P, 48:151.

This unique plant grows as an epiphyte in the forks of trees in a very restricted habitat high in mountains in North Queensland. It may be grown in a basket or as a pot-plant, allowing the weak woody branches to trail over the sides. As you see from our cover, the bright red flowers, to 4 cm long, hang in pairs, usually from leaf axils along these trailing branches.

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Rainforest Plants as Garden Plants

By F. D. HOCKINGS, Brisbane, Qld.

As Lewis Carroll's Alice said, the right place to start is at the beginning and so I will begin by looking at definitions of rainforest because the distinction is not as clear-cut as one might imagine. Some species (e.g. *Tristania conferta*) are prominent in some types of rainforest and can be equally prominent in some types of eucalypt forest. This can involve arguments about which is a rainforest plant and which is not. At least, if we look at definitions, we will have some general criteria on which to base a discussion.

The Language of Botany defines rainforest as "a closed community dominated by trees which form a two or more layered dense canopy in which lianes and epiphytes are usually conspicuous, and a lower sparse assemblage of small trees, shrubs and herbs, including ferns."

Rainforest in South East Queensland has been defined as "closed forest of densely-spaced broad-leaved evergreen and deciduous plants distinguished by the presence of characteristic life forms such as epiphytes, orchids, filmy ferns, lianes, plant modifications such as buttresses, driptips and cauliflory, and an absence of grasses, annual herbs, eucalypts, acacias".

A definition of tropical rainforest includes, in addition, "vascular epiphytes and tall soft wide-leaved forbs (referring to the families Araceae, Zingibaceae Costaceae and Musaceae), some deciduous tree species, various palms including palm lianes, and narrow marginal areas in which eucalypts, acacias and other sclerophylls occur as emergents above a vine forest under-storey".

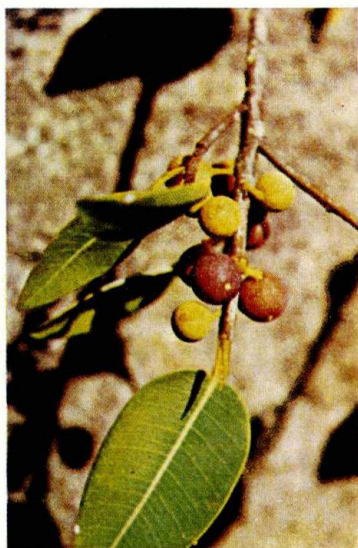
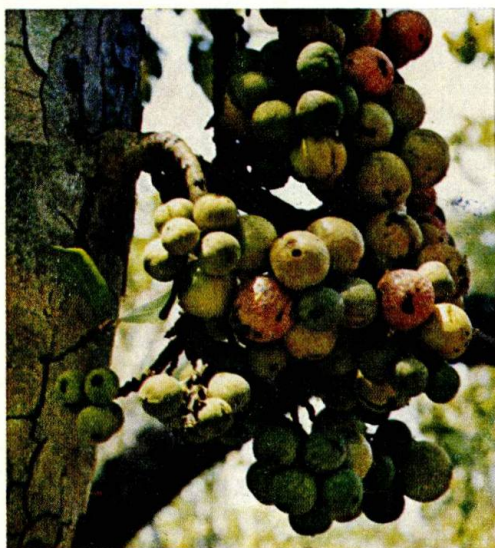
These all add up to a quite bewildering variety of plant types.

Rainforests are widespread in tropical and subtropical lands or parts of those lands which receive a fairly continuous and high rainfall. Rainfall is more important to the development of rainforest than soil types or soil fertility. Provided topography is favourable, areas receiving an annual rainfall of 50 to 60 inches or more (1,275 mm to 1,500 mm) develop rainforest irrespective of whether the soil is basalt, andesite, granite, phyllite, slate or beach sand. At lower rainfalls, down to about 35 inches (900 mm), soil fertility is more important and dry vine scrub, which is a depauperate type of rainforest, develops on richer soils. In parts of Queensland these dry rainforests often include Bottle Trees as well as species such as *Flindersia*, *Aryrodendron* and *Premna* normally found in the moister rainforests. However, under the drier conditions, these trees are much smaller in size.

In Australia rainforests are confined on the mainland to the coastal areas and highlands of the east coast and rarely occur more than 100 miles from the coast. They extend in a very broken and discontinuous strip from the top of Cape York in far north Queensland to Cape Otway in southern Victoria west of Port Phillip, and in Tasmania from the north-eastern portion to the west coast.

In Australia rainforest plants exist as small islands scattered in a vast sea of very different plants, the eucalypts. This is in marked contrast to the rainforests of other lands, where the rainforests plants are surrounded by closely related plants.

Many authorities divide our rainforests into three classes according to latitude, and these are Tropical Rainforest, the similar-looking Sub-tropical



TOP:

Ficus virens in the rainforest at Casuarina, Darwin, showing aerial roots growing downwards from the branches as found in so many of our tropical rainforests.

Photography by J. Harmer

BOTTOM LEFT:

A cluster of fruit borne on the main branches of *Ficus racemosa*, growing on the banks of the Adelaide, River, N.T.

Photography by M. Parker

BOTTOM RIGHT:

The fruits of *Ficus platypoda* trailing over a sandstone cliff in the East Alligator River area.

Photography by J. Harmer

OPPOSITE:

The flower and fruit of *Pithecellobium grandiflorum*. A small shrubby tree sometimes to 9 m. The leaves are bipinnate and deciduous. The colourful stamens are to 5 cm in length and the curled pods can be 15-18 cm.



Photography by D. Hockings

Pithecellobium grandiflorum — flower and fruit.

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Rainforest and the very different Temperate Rainforest. In each of these classes there are several different types, such as coastal lowlands type, mountain gorge type and elevated plateau type. A more exact classification based on careful research is contained later in this issue.

In general Tropical Rainforest refers to that occurring in places from about Townsville to the top of Cape York Peninsula. On closer examination you will find that the really luxuriant rainforests occur from near Tully—just north of Townsville—to near Cooktown. These luxuriant rainforests contain over 800 species of trees alone.

Extending north from about Cooktown, much of the rainforest is of a monsoon type. There are fewer species, the trees are shorter and some trees have a tendency to develop thickened trunks compared with the slender trunks of the wetter rainforests. The most remarkable difference is the predominance of deciduous plants, plants that drop their leaves during the dry season. It is an unusual experience to stand nearly knee-deep in large fallen leaves in one of these monsoon forests.

The Sub-tropical Rainforests extend from behind Mackay down into the northern part of New South Wales and, in fact, some species extend down as far as Kiama, just south of Wollongong. The best development of sub-tropical rainforest is in South Queensland and far northern New South Wales and, at its best, it looks very like the luxuriant tropical rainforest of far North Queensland. Actually, there is a big drop in the number of species, and trees alone are down to between 300 and 400.

There are other subtle differences too, as you move south from the tropics, such as a gradual reduction in average leaf size and a greater tendency for dominant species to show up in some situations. For instance, in some areas Hoop Pine and Bunya Pine emerge through and dominate areas of rainforest. One other remarkable instance is in the rainforest on the very summit of Mt. Lindsay, on the Qld.-N.S.W. border, where huge trees of *Banksia integrifolia* (trunk diameters of 60-90 cm/2-3 ft.) emerge through and form a layer above the rainforest.

As one moves south from the Queensland border the number of tree species soon drops to about 100 to 120, lianes become increasingly scarce and epiphytes such as orchids are gradually replaced by ferns.

The Temperate Rainforests occur in isolated small patches in southern Victoria and north-eastern Tasmania and in large areas of western Tasmania. They contain much fewer species and epiphytes and ferns are replaced by mosses and lichens. The species of Antarctic Beech (*Nothofagus*) usually form a very prominent and characteristic part of the plant life.

Although originally some very large areas of rainforest existed, particularly in the highest rainfall areas, much of this has been extensively cleared. The largest areas still existing would be in places between Ingham and Cooktown, in the Eungella Range behind Mackay, in places north and south of Brisbane, behind Coffs Harbour and in western Tasmania.

More often rainforest occurs as quite tiny patches in sheltered pockets in the hills and mountains and in thin strips along creek banks. Cunningham's Gap National Park, between Brisbane and Warwick, is a good example. From the highway, through the Gap, it appears to be quite substantial, but if you climb the mountain and look down, the rainforest appears as a pathetically narrow strip with other tiny isolated pockets nearby. The Fraser Island and Cooloolool rainforests, so unusual because they have developed on wind-blown sand, likewise are narrow strips confined to the sheltered valleys between the sand ridges.

So much for the incredible diversity of plants in our rainforests, but where did this wonderful array of plants come from? Actually, from two sources. One of these is the very ancient antarctic flora, the remnants and descendants of which are still very much in evidence in southern Australia, New Zealand and in South America. The influence of the old antarctic flora on the patches of rainforest vegetation gradually lessens as one proceeds

north from behind Wollongong and the antarctic-type plants become mixed with other plants. However, the Hoop and Bunya Pines still dominate parts of the rainforests in the southern part of Queensland and there are even remnants on the Atherton Tableland in North Queensland. One of the antarctic beeches (*Nothofagus moorei*) reaches its northern limits in the Macpherson Range of South Queensland. It is interesting that both *Araucaria* and *Nothofagus* have reached the highlands of New Guinea against the tide of plants migrating in the opposite direction.

Our tropical rainforest plants have very close affinities with the plants of the Indo-Malaysian region and it is believed that the ancestors of these spread here from south-east Asia through New Guinea, with which North Queensland was joined until about 10,000 years ago. It is these Indo-Malaysian type plants that give the sub-tropical rainforests a tropical appearance. The migration south of this Indo-Malaysian type flora reaches its southern limits near Kiama. A few of the Indo-Malaysian genera that only just reach Australia are *Rhododendron*, *Garcinia*, *Phalaenopsis* and *Rhaphidophora*.

One of the peculiar features of the rainforests of North Queensland is the relatively large number of genera with one or few species, especially in the family Proteaceae, e.g. *Austromueller*, 1 sp; *Buckinghamia*, 1 sp; *Cardwellia*, 1 sp; *Carnarvon*, 1 sp; *Opisthalepis* 1 sp; *Placospermum* 1 sp; *Musgravea*, 1 sp; *Darlingia*, 2 sp; *Hollandaea*, 2 sp.

If we draw a line across the rainforest belt somewhere about the Richmond River in northern New South Wales, and look at all the rainforests north of this line, we find a large number of genera well represented. The most common and prominent genera include *Argyrodendron*, *Pseudoweinmannia*, *Flindersia*, *Dysoxylon*, *Toona*, *Elaeocarpaceae*, *Ficus*, *Eugenia*, *Cryptocarya*, *Endiandra*, *Litsea*, *Cinnamomum*, *Agathis* and *Araucaria*. Seldom in the rainforests north of this line do you find any species that could be regarded as dominant, except where there are extremes of soil or climate.

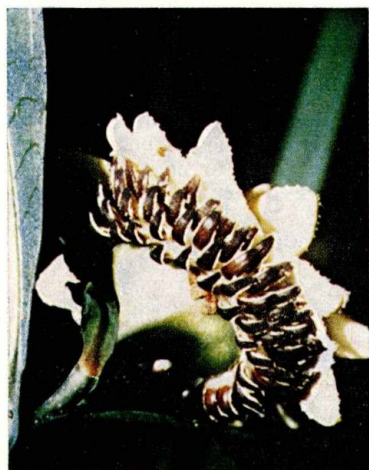
South of the Richmond River line the rainforests contain much fewer species; there is a tendency for some large eucalypts to enter the rainforest and dominance by one or a few species becomes common. For example, the floors of the deep gorges of the Blue Mountains support rainforest of a relatively small type in which *Quintinia*, *Ceratopetalum*, *Doryphora* and *Atherosperma* are conspicuous.

If you look at rainforest trees growing in rainforest (and it's not a particularly good place to look at rainforest trees if you have cultivation in mind), you will be impressed by the tall slender stems or trunks. You could quite easily abandon any idea of using rainforest trees as garden plants. However, having lived for 16 years amongst the glorious rainforests of the Macpherson Range, I have no hesitation in recommending plants such as *Rhodamnia trinervia* and *Oreocallis pinnata* for the garden, even though they are listed as timber trees.

From a cultural point of view, the most interesting place to see rainforest trees is in regrowth country, where there are sparse remnants of the original stands and some regeneration is taking place. The slender trunks of rainforest trees in rainforest are the result of lack of light, which forces the trees up tall and slender. With very few exceptions rainforest trees, when grown in the open, develop short trunks and spreading crowns. There is also a tendency for them to flower more regularly and profusely.

Generally speaking, rainforest plants adapt fairly well to cultivation where the atmosphere is not too arid. Their origin in high rainfall areas and in relatively fertile soils no doubt explains their success when planted with exotics, which are usually given extra water and fertilizer.

The cultivation of rainforest trees is by no means a new concept, and some have been in cultivation as long as there has been settlement here. The Silky Oak (*Grevillea robusta*) has long been used overseas as a foliage plant, and likewise the Umbrella Tree (*Schefflera actinophylla*) is the mainstay of the indoor plant industry both here in Australia and overseas.



Photography by D. Hockings

ABOVE:

Eupomatia bennettii. Eupomataceae is a genus of two species from East New Guinea to Eastern Australia. It is an isolated and ancient group of plants without close relatives. *Eupomatia bennettii* usually has a tuberous root and flowering plants may be as small as a single 20 cm stem or rarely with several branchlets to 70 cm. The buds are covered with a deciduous cup similar to *Eucalyptus*. There are no petals and the ring of fertile stamens surrounds the outside of the flower. The anthers are hidden from above by the large petal-like staminodes which are dotted with raised food bodies on which a specific beetle feeds during the process of pollination. The relatively large urn shaped, flat-topped fruit is edible and palatable when ripe.

OPPOSITE—TOP:

The flowers of *Brachychiton discolor*, a tree to 30 m in rainforest but smaller and well shaped in the garden. The flowers are 5 cm across and borne in profusion in warm climates.

OPPOSITE—BOTTOM:

The flowers of *Brachychiton bidwillii*, a sparse shrub or small tree to 3 m.



Photography by D. Hockings

TOP: *Brachychiton discolor*

BOTTOM: *Brachychiton bidwillii*

Other plants used as pot foliage plants include several Figs (*Ficus hillii*, *F. macrophylla* and *F. rubiginosa*). The Moreton Bay Chestnut or Black Bean (*Castanospermum australe*) is also gaining a reputation as an indoor plant, at least in its young stages.

Many rainforest trees have inconspicuous flowers, but others are quite spectacular. The best known of these are Wheel-of-Fire (*Stenocarpus sinuatus*), Flame Tree (*Brachychiton acerifolium*), Lace Bark (*B. discolor*), Silky Oak (*Grevillea robusta*), Native Frangipani (*Hymenosporum flavum*), *Buckinghamia celsissima*, and White Cedar (*Melia azedarach*). I can't recommend this last one because of its serious hairy caterpillar problem.

Other less known showy flowering trees include *Oreocallis pinnata*, *O. wickhamii* (one of the world's outstanding flowering trees), *Euodia elleryana*, *Orites excelsa*, *Barklya syringifolia*, *Akania lucens*, *Pithecellobium grandiflorum*, the rainforest Cassias, *Cassia marksiana* and *C. tomentella*, *Deplanchea tetraphylla*, *Grevillea pinnatifida*, *G. hilliana*, *Eugenia moorei* and *Callicoma serratifolia*.

There are so many others I should mention, such as *Elaeocarpus grandis*, *E. obovatus*, *E. bancroftii* and *E. reticulatus* and many that have a profusion of small flowers, such as *Symplocos stawellii*, *Ackama paniculata*, *Quintinia sieberi* and *Pentaceras australis*. The shrubby myrtaceous trees, such as *Decaspermum fruticosum*, *Rhodamnia trinervia*, *R. acuminata* and *R. argentea*, *Rhodomyrtus beckerii* and *R. psidioides*, *Pilidiostigma glabrum*, *Austromyrtus inophloia*, *A. acmenoides* and *A. bidwillii* and *Backhousia myrtifolia*, *B. citriodora* and *B. angustifolia* are all attractive in their own way.

Some species are or could be grown for their ornamental fruit, and these would include *Rhodosphaera rhodanthema*, *Synoum glandulosum*, *Rhodamnia trinervia*, the *Filindsia* and *Elaeocarpus* species, *Elaeodendron australe*, *Cryptocarya laevigata* var. *bowiei*, *Pithecellobium grandiflorum*, *Phaleria chermideana* and many species of *Eugenia*.

The Black Apple (*Planchonella australis*) has highly ornamental seeds, which I have on occasions seen made into necklaces and other ornaments.

Rainforest trees with edible fruits include *Eugenias*, particularly *Eugenia australis*, *E. coolminiana* and *E. coryantha*, *Schizomeria ovata*, and the native citrus *Microcitrus australis* and *M. australasica*. One or two of the sand-paper figs are quite sweet and palatable, and if you can beat the fruit fly to them, the Black Apple is quite passable too when fully ripe. *Diploglottis cunninghamii* fruit is edible but sour. The Burdekin Plum (*Pteleogynium cerasiferum*) is well known, as are the Macadamia Nuts (*M. tetraphylla* and *M. integrifolia*). The nuts of *Hicksbeachia pinnatifolia* are not so well known, but have been described as equal to Macadamia. Bunya Nuts, the large seeds of *Araucaria bidwillii*, are eagerly sought by some people, and I remember spending quite a lot of time in my young days in Torres Straits collecting and eating the black seeds of the Peanut Tree (*Sterculia quadrifida*). Possibly the best of the native fruit is that of *Antidesma dallachyanum* of the tropical rainforests; they make excellent preserves.

Not enough attention is paid to the beautiful soft young leaves of some rainforest plants. *Eugenia luehmannii*, with its brilliant new growth, is probably the best known of these plants, but *Trochocarpa laurina*, *Endiandra pubens* and *Scolopia brownii* are others that stand out when they are making new growth.

Several other species, such as *Elaeocarpus grandis* and *Omalanthus populifolius* (the bleeding-heart tree) attract attention for the bright colour of the old leaves before they fall. They usually carry a few bright red leaves.

Of the rainforest plants with perfumed flowers, *Triunia youngiana* (the spice bush) is outstanding. Others with a subtle fragrance are *Randia fitzalanii* and *R. benthamiana*, *Pithecellobium grandiflorum*, *Eugenia coolminiana* and *Rhodamnia argentea*. *Eupomatia laurina* has a strong, sweet, over-powering perfume that reminds me of ether.

Some attractive small trees I have not already mentioned include *Helecia ferruginea* and *Floydia praealta*, *Tristania laurina*, *Codonocarpus attenuatus*,

Euodia micrococca, *Stenocarpus salignus* and the unusual, almost palm-like trees *Tieghemopanax murrayi*, *T. elegans* and *Diploglottis cunninghamii*.

While I have confined this talk mainly to rainforest trees, they comprise part only of the total plant life of rainforests. I will discuss briefly some of the other plants, because many of these are very useful for certain garden situations.

I have pointed out how the slender trees of rainforest reach up for light. There are some shrubs and small trees which take little part in this competition and content themselves to the dim light beneath the canopy. In general, these are more difficult to establish in the garden and require some shelter, at least in the establishment period. Some of the best of these would be *Wilkaea*, *Drimys*, *Triunia youngiana* and *Helicia glabriflora*, *Alyxia*, *Citriobatus*, *Randia*, *Eupomatia*, *Cuttsia*, *Psychotria slmondsiana*, *Anopterus macleayana*, *Ervatamia angustisepala*, *Brachychiton bidwillii* and the brilliant *Eugenia wilsonii*.

A number of beautiful palms are found in our rainforests. The best-known genera are *Archontophoenix*, *Livistona*, *Linospadix*, *Licuala*, *Ptychosperma* and *Caiamus* (the climbing palms). Some of the following, too, are found in rainforest and are often classed with palms: *Macrozamia*, *Lepidozamia* and *Bowenla*. Other palm-like plants include the *Cordylines*.

There are several genera of ginger relatives, such as *Alpinia*, *Tapeinochelios*, *Amomum*, *Hornstedtia* and *Costus*, which, together with a few species of rainforest *Pandanus*, deserve more attention for sheltered garden planting.

Lomandra spicata is an attractive, coarse, grass-like plant for shade or sun, and similar plants include *Gymnostachys anceps* and species of *Dianella*. Plants from wet areas in shade include *Alocasia*, *Elatostema* and the beautiful *Orthothylax glaberrimus*.

The floor of rainforest is dimly lit, but nevertheless there are some ground-cover plants where a little light filters through. These include *Viola hederacea*, *Lobelia trigonocalis*, *Hydrocotyle pedicellosa*, *Pollia crispata* and *P. macrophylla*, *Kreysigia multiflora* and *Drymphila moorei*.

I will not attempt to discuss ferns and orchids, which contribute such an important character to rainforest. However, I will list some of the genera of climbing plants: *Cissus*, *Pandorea*, *Millettia*, *Derris*, *Lonchocarpus*, *Aphanopetalum*, *Faradaya*, *Hoya*, *Tecomathe* and, for the wetter shady areas, *Fieldia* (one of our few Gesneriads), *Freycinetia* (the climbing *Pandanus*), *Piper* and *Rhaphidophora* (the native version of *Philodendron*).

Some rainforest trees excel as street plants. I have already mentioned how tall slender-trunked rainforest trees take on a squat habit with a spreading top when grown in the open. This squat habit is particularly useful under overhead wires. Suitable rainforest trees include *Harpullia pendula*, *Cupaniopsis anacardioides*, *Jagera pseudorhus* and *Buckinghamia celsissima*.

The principal deciduous rainforest trees include Red Cedar, White Cedar, *Ficus virens*, *F. superba* var. *hanniana* *Ehretia acuminata*, *Brachychiton acerifolium*, *B. discolor*, *Pleiogynium cerasiferum* and *Gmelina leichhardtii*.

The adaptability of some rainforest trees to different conditions is quite remarkable. A notable example is the White Cedar, *Melia azedarach*, which thrives as a street tree in arid inland places such as Charleville (19 inches of rain a year) and Cunnamulla (14"). The Burdekin Plum is another example which can be seen in the main street of Boilun (16"). The Silky Oak (*Grevillea robusta*) from the rain forests of south-east Queensland, thrives in places such as the Darling Downs and other western slopes of the Great Dividing Range on heavy black soils with a neutral to alkaline reaction. While I would encourage the idea of growing rainforest species, I think the idea of growing a complete rainforest is hardly practicable or desirable on a suburban allotment.

Rainforest is so diverse that it's going to involve a large number of species. You would need to develop a gloomy, moist atmosphere to suit a range of plants and to grow a few large rainforest trees will increase the



ABOVE:

Licuala muelleri, the Fan Palm. One of the many fine palm trees occurring in rainforests.

Photography by G. MacFarlane

OPPOSITE—TOP:

Tecomanthe hillii. The 17 species of *Tecomanthe* are distributed from Malaysia and New Guinea to Queensland and New Zealand. *Tecomanthii hillii* is the only species so far recorded in Australia. It is a tall climber that usually grows close to water and has been found at Cooloola, Fraser Is. and near Cooktown. The 6-8 cm long flowers are borne in clusters along the upper portions of the plant and sometimes also on the lower leafless stems near the ground. It is a showy climber for sheltered, well watered positions. It propagates readily from cuttings or seed.

OPPOSITE—BOTTOM:

Phaleria chermsideana. This small erect tree may attain a height of 7 metres and bears a profuse cover of sweetly scented pinkish blossoms which are followed by red fruit.



Photography by D. Hockings

Tecomanthe hillii (top)

Phelaria chermideana (bottom)

density and extend the area of shade to an extent that may not be welcome in a confined area or by close neighbours.

Let us look at what happens when rainforest is cleared. There is an awful lot of nonsense spoken either ignorantly or deliberately, by persons who should know better, to the effect that once rainforest is cleared it can never come back again. Like the rest of the Australian flora it has an amazing capacity for recovery; the Australian environment never was kind to plants.

Examples are common of land which has been cleared of rainforest for pastures or bananas, and which has now gone back to rainforest. The speed at which this occurs depends on the proximity of untouched rainforest as a source of seeds.

When a gap occurs in rainforest it's quickly filled by quick-growing annual or weak perennial plants that normally play no part in mature rainforest. Nowadays these include exotic weeds such as Wild Tobacco, Inkweed, Lantana and Thistles. These are soon invaded by quick-growing woody plants such as *Acacia*, *Alphitonia*, *Omalanthus*, *Commersonia* and *Glochidion*, which raise the height of the cover and intensify the shade and protection. Finally, if bushfires don't set the succession back, seedlings of the mature canopy gradually take over and restore the rainforest.

The phenomenon is known as progressional succession, and there are indications that something like 50 to 100 years are needed to elapse for regeneration of good rainforest in close proximity to existing rainforest. Certainly it would be quicker in an area clear felled and then immediately allowed to regenerate than in an area that is ploughed and cropped first.

If you attempt to plant an area to rainforest, may I suggest that you first plant with short-lived, quick-growing species to provide shade and protection. Acacias are ideal and the following species should be planted at 20 to 30 feet spacings: *Acacia irrorata*, *A. fimbriata* and *A. melanoxylon*.

These can be followed with an interplanting of *Commersonia bartramia*, *Omalanthus populifolius*, *Glochidion terdinandii* and similar quick-growing plants. Following the establishment of these species, you could introduce trees such as *Brachychiton*, *Tristania*, *Castanospermum*, *Euodia*, *Eugenia*, *Elaeocarpus* and *Araucaria*. If there are any old stumps, try planting *Ficus* in the tops.

Finally, when the shade and protection are provided, which would probably take 3-5 years or more, you will be able to underplant with Palms, Cordylines, *Alpinia*, *Dianella*, *Pollia*, tree ferns and ground ferns and shade-loving shrubs such as *Randia*, *Eupomatia*, *Helicia*, *Mallotus clayoxloides* to give the place the characteristic bush smell, and Lawyer Vines, *Millettia* and *Cissus*. Last of all would come the epiphytic orchids and Stag and Elk ferns.

As I stated earlier, rainforests occur on all types of soil. However, as rainforest develops, it also develops a loose friable soil, which is rich in organic matter both as humus and also as leaf litter in various stages of decomposition. The soil need not necessarily be deep, but it is loose, retains moisture, yet is coarse enough to be always well aerated.

Rainforest requires a high rainfall, but a common mistake gardeners make is in thinking that this means rainforest plants need lots of water. If your soil is low in organic matter and is not loose and friable, but tends to set quite hard after watering, it will be difficult to establish rainforest plants, and lots of water can be fatal. Wet or poorly-drained sections of rainforest usually develop into groves of palms, *Alocasia*, *Elatostema* and other moisture-loving species.

I suggest that if you are planting rainforest plants you tip about 10 litres of shredded peat moss at each planting site, mix this into the top (23-25 cm) of soil and plant into the middle of the slight mound thus made. Mulches of leaf mould should also be used.

The atmosphere within a rainforest is heavily charged with moisture. This is due partly to the great mass of transpiring plants, but largely to the exclusion of strong wind and bright sunlight.

While most rainforest trees will grow quite well in full sun, at least in coastal and highlands areas, understorey rainforest plants, and even some of the weaker trees, will probably need protection, at least until they are well established and have grown 3 or 4 feet in height.

In inland districts, scorching sunlight and arid air are usually too severe for most of the rainforest plants, unless some sort of protection can be given. The frost tenderness of the tropical and sub-tropical species also has to be taken into consideration if you attempt to cultivate them.

Rainforest plants have no special idiosyncrasies as far as propagation is concerned. Seed usually germinates easily and the most difficulty is in obtaining seed. Seed of the soft fruits such as *Eugenia* loses its viability as soon as it's dry and therefore it cannot be stored, but should be collected fresh and kept in a plastic bag, even though the flesh rots. Seed of other species, such as *Oreocallis*, *Stenocarpus* and *Ceratopetalum*, also loses its viability fairly quickly.

Cuttings of some species strike root fairly easily, particularly if shoots can be taken from down near the ground, but cutting propagation of most of the rainforest plants has probably never been attempted.

The following species will grow easily from root cuttings: *Macaranga*, *Commersonia*, *Austromyrtus*, *Rhodomyrtus*, *Decaspermum* and *Pentaceras*.

I am a firm believer in S.G.A.P. regions or, more importantly, the branches confining their efforts, and investigations largely (but not exclusively) to plants of their own and similar geographic, climatic and geological areas. This is important in order to fulfil our responsibility of getting the best out of our entire Australian flora and to avoid the tendency for everyone to be trying to grow West Australian or Hawkesbury Sandstone or Grampians plants, which might be quite unsuitable in the long run in many areas.

However, the valuable contribution that the Brush Box (*Tristania conferta*) has made to tree planting in such places as Melbourne, Adelaide and Perth is proof of the need for wide-scale trials with many species. Holliday and Hill, in their book *Australian Trees*, list 19 tropical and sub-tropical rainforest trees as being successful in Adelaide.

By all means let's try a lot more of them. Their greater tolerance of conventional gardening methods, when mixed with exotics, places them at a decided advantage over the small-leaved, sun-loving, heath type and sand plains plants, at least in gardens east of the Dividing Range.

Rainforest Plants — Descriptions

As rainforest plants have not been given prominence in past issues, there are many plants mentioned in this issue that will be strange or new to the reader. They have been listed alphabetically and briefly described by the author, David Hockings. To assist readers in their cultivation, and for further information, a reference is given to past issues where they have had a mention.

Acacia fimbriata—A quick-growing wattle; small narrow phyllodes; yellow flowers in small globular heads; 5 m in height and very spreading. Issue 55:129 (page), 62:106.

Acacia irrorata—A quick-growing bipinnate-leaved wattle to 6 m; pale flowers in small globular heads; bark often green in colour. Issue 37:39 (page).

Acacia melanoxylon—A large woody wattle to 25 m in rainforest, but shorter and more spreading in the open; phyllodes 8-12 cm long; flowers in small globular heads. 42:280, 51:304, 55:129.

Ackama paniculata—Rose-leaf Marara, a tree to 45 m, often with buttresses in rainforest; pinnate leaves; branched panicles of small white flowers from the upper leaf axils.

Agapetes meiniana—(cover plate—see inside front cover).

- Akania lucens*—A slender tree to 15 m in rainforest; large pinnate leaves to 1 m in length, with long narrow-toothed leaflets; flowers in large loose panicles; fruit 3 cm long, red, velvety.
- Anopterus macleayanus*—A shrub or sparse tree to 7 m; large 35-50 cm leaves clustered towards the ends of the branches; showy white flowers on short racemes from the upper leaf axils; pointed capsules. 27:325.
- Antidesma dallachyana*—Herbert River Cherry. A large shrub or small tree with simple leaves; fruit the size of a large cherry; used for jam and preserves.
- Araucaria bidwillii*—Bunya Pine. A large symmetrical tree to 45 m and trunk diameter to 2 m. The large ripe cones may weigh 10-15 kg and fall from the top of the tree. The edible seeds are egg-shaped, about 5 cm long. 34:262, 36:358, 49:205.
- Austromyrtus acmenoides*. A tree to 20 m in rainforest, but a small shrubby tree in the open; small simple glossy leaves; white flowers in the upper leaf axils; bark smooth, deciduous, mottled green or orange.
- Austromyrtus bidwillii*. A shrub or small tree with small simple leaves and white flowers in loose racemes in the leaf axils.
- Austromyrtus inophloia*. A small tree with small simple leaves; cymes of small white flowers in the leaf axils.
- Backhousia angustifolia*. A tall shrub or small tree; simple narrow leaves; white flowers clustered in the upper leaf axils.
- Backhousia citriodora*. A tree to 15 m or more in rainforest; leaves simple; white flowers clustered in the upper leaf axils. 49:202, 55:132.
- Backhousia myrtifolia*. A shrub or tree to 6 m; leaves simple; white flowers in small cymes; sometimes contracted into heads.
- Banksia integrifolia*. Usually a large shrub or small tree in coastal situations or open eucalypt forest elsewhere; leaves long and narrow; yellow flowers in dense erect spikes or heads. 40:164.
- Barklya syringifolia*. A tree to 16 m, but shorter in an exposed situation. Leaves broadly heart-shaped; flowers rich gold in dense racemes in the upper leaf axils. 49:202.
- Brachychiton acerifolium*—Flame Tree. A tree to 40 m in rainforest, but much smaller in exposed situations; broad leaves lobed or entire; branched red panicles of red flowers from the leaf axils or leaf scars. 9:2,5, 40:183P, 55:154, 63:107.
- Brachychiton bidwillii*—A sparse shrub or small tree to about 3 m; broad-lobed leaves; pink or red flowers in small clusters along the branches. 9:4,10. Colour plate on page 341.
- Brachychiton discolor*. A tree to over 30 m in rainforest, but much smaller in drier or exposed situations; broad-lobed leaves; large pink flowers in panicles from near the ends of the branches. 9:1P,4,8 Colour pp. 341.
- Buckinghamia celsissima*. A tree to 16 m or more in rainforest, but much smaller and spreading in the open. Leaves lobed or smaller and entire on mature branches; long spike-like racemes of small white flowers from the upper leaf axils. 19:244, 245P (Colour Plate), 44:18,44P, 49:202, 63:107, 64:149P.
- Callicoma serratifolia*. A tree to 12 m in rainforest, but often a medium-sized to large shrub in the open; attractive serrated leaves, fluffy cream flowers in globular heads. 40:170, 41:199, 55:110.
- Cassia marksiana*. A slender tree to 25 m in rainforest or to 6 m in the open; leaves pinnate; 8 cm racemes of yellow flowers. 68:353.
- Cassia tomentella*. A tree to 8 m or shorter in an exposed situation; leaves pinnate, yellow flowers in short pendulous racemes. 68:351.
- Castanospermum australe*—Black Bean. A large tree to 40 m in rainforest or a spreading tree to 8-12 m in the open; leaves pinnate; flowers in short sparse racemes along the older wood; large pea flowers at first yellow, but turning red; large 18-20 cm beans. 62:63, 64P,79, 63:102.
- Codonocarpus attenuatus*—Bell Fruit. A slender tree to 9 m; simple leaves tapering sharply to each end; bell-shaped fruit about 2 cm long.

(Continued on page 372)

A General Classification of Australian Rainforests

By L. J. Webb, C.S.I.R.O., Division of Plant Industry, Rain Forest Ecology Section, Long Pocket Laboratories, Private Bag No. 3, P.O., Indooroopilly, Queensland, 4068

The Need for Classification

Until recently there was no general classification of Australian rain forests that was sufficiently detailed for use as a fairly precise reference framework, nor was one accessible to people other than professional botanists and ecologists. Yet the need was always felt for some form of classification that allowed for differences in complexity of the vegetation and catered for differences in interest and application. It is of course intellectually satisfying to be able to name a plant or bird or to classify a vegetation community or habitat, and such abilities often become deepened into aesthetic experience which is its own justification. But classification also has strong practical implications for environmental management, be that at the scale of an ecological region, a land system, or a home garden. A closer understanding of nature, as things and processes, is basic for scientific land use planning and the conservation of natural resources. It requires a system of standard reference points in language that enables general rather than particular statements to be made and communicated to others. Only by using some kind of classification can we understand what we and others are talking about!

Rainforests, because of their complexity and variation in pattern at different scales ranging from tens of metres to hundreds of kilometres, continue to repel attempts to provide a general classification in terms of their *floristic* composition. Either taxonomic knowledge, especially in the tropics, is inadequate for the task, or a floristic classification based on species becomes too unwieldy and arbitrary even for limited regions in which it may be possible. Floristic classification based on genera may be, more feasible, but already the mesh of the taxonomic net may be so large that the subtleties of species patchiness and dynamics escape. Besides, floristic classification at the level of species or genus does not permit comparison of rainforest vegetations of similar environments in different regions and continents where the floras are different (for historical reasons). And floristic classification at the next highest level, the family, although like that of genera of some interest to phytogeographers, reverts to taxonomic jungle in which ecological meaning is obscured.

Yet the early botanists and ecologists continued to believe that a helpful and relatively simple classification should be attainable, and already the intuition and experience of foresters, farmers and indigenous peoples had provided a systematic if incomplete differentiation of rainforest vegetation in local areas. The question arose: if botanical species could be used intuitively to define different plant associations, how could different *vegetation* communities and habitats be defined? It became clear that the structure and physiognomy of a forest, the combinations of its different growth forms, gave the observer an overall "gestalt" impression. So it remained to disentangle the structural elements and somehow to identify and if possible quantify them. This led to the idea of taxonomy or classification of them as "ecological species".

Different combinations of structural features characterise different environmental types, although single features and life-forms may not be confined to a single environmental type. For example, small (nanophyll and microphyll) simple evergreen leaves with toothed margins characterise many of the woody plants of cool moist situations such as in temperate

rainforest. On the other hand, large (macrophyll and mesophyll) compound raingreen (more or less deciduous) leaves with entire margins characterise hot wet areas such as tropical humid lowland rainforest. However, there are notable exceptions to these and similar correlations. The problem is therefore to select those structural features which are most relevant to a particular kind of classification — whether this be a general ecological classification (which is generally correlated with climatic and soil factors), a classification of wildlife habitat, and so on. Another practical constraint is that the recording of the presence, absence, or abundance of the different features should not become too elaborate nor too subjective, so that observers disagree too widely.

Earlier structural classifications of rainforests were pioneered by ecologists such as Burtt Davy; Richards, Tansley, and Watt; and Beard, for tropical areas in South Africa and South America, and relied on the intuitive evaluation of structural features on a qualitative rather than a quantitative basis. For Australia, a similar intuitive structural classification was provided by Webb (1959, 1968). This structural classification was further developed by numerical analysis and computer processing in a series of papers by Webb, Tracey, Williams and Lance (e.g. 1967, 1970, 1976), producing more objective methodology and a reduced list of significant structural features.

However, it is our purpose to present a broad intuitive classification of Australian rainforests based on structural types as a working tool and as a convenient introduction to rainforest ecology, since every person carries a computer between his/her shoulders! The detailed floristics of the different plant groupings in the structural types comes later, and the data are still incomplete for some of the types, especially in northern Australia.

Definitions of Rainforests

What is usually referred to as rainforest in eastern and northern Australia has, in the light of recent ecological work here and abroad, become increasingly elusive of definition. The fourth edition of "The Australian Environment" dropped the term "rain forest" in favour of "closed-forest", prefixed as "tall" in the well-watered coastal regions, or "depauperate" in the seasonally dry areas of the north of the continent.

The implication that rain is the sole determining environmental factor is certainly unfortunate, and led G. N. Baur to propose the spelling "rainforest" as a single word to indicate its status as a fully independent plant formation which is subject to a variety of environmental determinants besides moisture. This spelling is accordingly adopted here to denote the general formation-type or formation-class of rainforest, comparable on a world scale with summergreen and mixed deciduous forest of temperate regions, conifer or boreal forest, etc. However rainforest is replaced by structural types at the level of formation and sub-formation. This avoids the bizarre juxtaposition of "dry rain" forest which some authors still use to describe the drier inland varieties of the subtropics. S. T. Blake had earlier suggested "monsoon forest" for these communities, and this term is now freely used to denote similar types in Northern Australia in the genuinely monsoonal zone. The term may be less applicable to the "Bottle tree scrub" and "Hoop pine scrub" of subcoastal south Queensland and northern New South Wales which are remote from monsoonal influences, i.e. they are "submonsoonal".

The rather purist definition of rainforest by J. S. Beard as entirely evergreen vegetation under optimal conditions of temperature, moisture and soil aeration would exclude this formation-class from Australia, where practically all vegetation is subject to seasonal lack of moisture and would be classified as seasonal forests by Beard. This seems undesirable in the light of the ecological peculiarities of Australian vegetation for which seasonal drought is often correlated with evergreenness or deciduousness depending on low or high soil fertility respectively. It therefore seems preferable to follow P. W. Richards' more catholic definition of rainforest as including less luxuriant and seasonal types.

Evergreenness has in fact been used loosely in the world literature and often applied to rainforest vegetation in which there may be up to 25 per cent. of deciduous species. The term is a hangover from the early assumption that moisture relations control the periodicity of leaf-fall, but it is now clear that temperature regime, soil nutrient availability and even soil aeration are important ecological factors over a broad range of moisture conditions.

Leaf texture is also difficult to classify, and although "sclerophyll" is traditionally used for the open woodlands and scrubs dominated by eucalypts, acacias, etc., the leaves of many rainforest canopy species even in humid areas are not "mesophytic" or mesomorphic, and may be coriaceous, sclerophyllous, or even "pachyphyllous". Faced with the problem of classification of leaf texture for world vegetation, F. R. Fosberg in some desperation recently proposed "orthophyll" to mean leaves of "ordinary texture" in contrast to "sclerophyll" as "hard, stiff, or coriaceous". At least we can conclude that the sclerophyll of the characteristic myrtaceous, leguminous and proteaceous vegetation of Australia is quite different anatomically and chemically from that of the hard, stiff and coriaceous leaves of some species in rainforests and monsoon forests. Surprisingly, however, little anatomical work has been done on this point.

Where species are sclerophyllous in the traditional Australian sense, and are emergent (e.g. *Acacia*, *Casuarina*, *Backhousia*, *Eucalyptus*, *Syncarpia*, *Tristania*) above a rainforest understorey of various heights, opinions have differed whether the stand is rainforest or not. These differences have even developed political implications in recent times, when foresters have denied the claims of conservationists that rainforest was being converted to blackbutt plantations: the rainforest area in question (Whian Whian State Forest, N.S.W.) had sclerophyllous emergents. There does, however, seem to be a consensus among foresters and ecologists, and in the literature, that mixtures of rainforest and sclerophyll forest elements be excluded from the definition of mature rainforest. Such mixtures are important dynamic phases of rainforest succession and development, so that a *potential* rainforest area may be defined as mixtures in which the sclerophyllous species do not regenerate. The exclusion of Australian sclerophylls from the strict definition of rainforest means that cool temperate rainforest in Tasmania is reduced to an association, in the canopy, of *Nothofagus cunninghamii* & *Atherosperma moschatum*.

Popular names for different types of rainforest are to be encouraged where they are original, well-used, or capable of such use, but not where the name refers to quite different types of non-rainforest in another State of Australia or overseas. "Vine scrub", "cyclone scrub", "maiden scrub", "bastard scrub", etc., as used in Queensland coastal areas to denote tall rainforest is unfortunately well entrenched, even in the official documents and publications of foresters. However, scrub is understood in the other States, in inland areas of Queensland, and certainly in the international literature, to mean closed communities of shrubs or small trees in which canopy closure is at a maximum height of some 8-10 m. In subcoastal areas of Queensland the vernacular "Bottle tree scrub" and "Hoop pine scrub" fit this definition, and "Brush" as used in some coastal districts of New South Wales also does not suffer from ambiguous use elsewhere. Following recent linguistic studies by anthropologists in the rainforest areas of northern Australia, some suitable names for different rainforest types are available and their popularization is overdue: an example is "Rija" used to describe deciduous vine thickets in Arnhem Land.

* "Rija" is a widely used term among the Yulngu-speaking people of northeast Arnhem Land, and refers to the whole range of vine forest types which are important as sources of yams, fruits, and fibres (N. Peterson, ANU Department of Prehistory and Anthropology, Canberra, personal communication).

Perhaps it is easier to define rainforest in Australia in negative terms, because in no other country is there such a striking difference between

relatively small areas of rainforest and an all pervasive vegetation of widely different structure, flora, and distinct evolutionary history. Rainforest typically occurs as scattered patches of varying size and interspersed with sclerophyllous elements, and the opacity, texture and colour of its closed canopy readily set it apart. Rainforest trees are closely spaced, with the crowns arranged in one or more continuous storeys or layers, the uppermost of which forms the closed canopy, which may be even, uneven or very broken and in places descend to ground level (as the result of natural disturbances such as windfalls, cyclones, and landslips). Rainforest is distinguished from other closed canopy forests by the prominence of characteristic life forms such as epiphytes, lianes, root and stem structures, and by the absence of annual herbs on the forest floor. Seeds of rainforest tree species in mesic habitats vary considerably in their viability and longevity: species occurring late in succession and in the mature canopy generally have seeds that are short-lived. Species distribution in complex rainforests, where there are many rare species represented by relatively few individuals, is characteristically patchy. The dynamic patterns and associations of plants and animals in rainforests depend on the most complex set of interactions of any plant community.

Distribution of Rainforests in Australia

The excessively small-scale maps so far available show rainforests as scattered patches along the eastern coast of the mainland and in western Tasmania. Occurrences in subcoastal north-eastern Australia and in northern and north-western Australia are neglected. However, for the present purpose, and although there may be a case for separating at least the north-western types as monsoon forests, all more or less closed multistoried communities characterized by woody lianes and other special life forms are included in the definition of rainforest, and form a floristic continuum.

The discontinuity of the rainforest patches along the wetter eastern coast is in fact exaggerated by small-scale maps. Except for "dry corridors" in the Coen-Cooktown, Ingham-Bowen, and Sarina-Gladstone areas, the larger patches of rainforest are "tied together" by frequent outliers in gullies, along streams, and on hill tops and mountain tops where soils are favourable and cloudiness augments precipitation. In drier subcoastal areas, the distribution is much less continuous and is correlated with the scattered occurrence of favourable soils and topographic niches, rocky outcrops, "jump-ups" that function as "fire shadows", or that are relatively frost-free. In the true tropical region to the north, where there are no frosts, fire-adapted species of genera in the closed rainforests are interspersed in the open sclerophyll woodlands on favourable soils.

The extension of frosts on the coastal moist lowlands as far north as about Ingham (19°S. lat.) has unique implications: for example, comparison of similar structural types of rainforest in eastern Australia and eastern Brazil shows that the tropical types are displaced about seven degrees latitude northwards in Australia. The geographic tropic therefore has little ecological significance in the differentiation of climatic types of Australian rainforests. The distribution of structural types, and a floristic analysis yielding floristic provinces, enable the broad geographical location of the climatic types shown in Fig. 1. The boundaries of the climatic types are of course approximate, and floristic outliers occur outside each "core area" as the result of past climatic changes. Soils play a major role in the differentiation of community-types within each province.

Method of Classification by Structural Features

The development of a structural typology, intuitively or with the aid of the computer, has already been noted. However, unless the observer is engaged in systematic and large-scale surveys, the use of the structural *pro forma* and numerical analysis described by Webb *et al.* (1976) may not

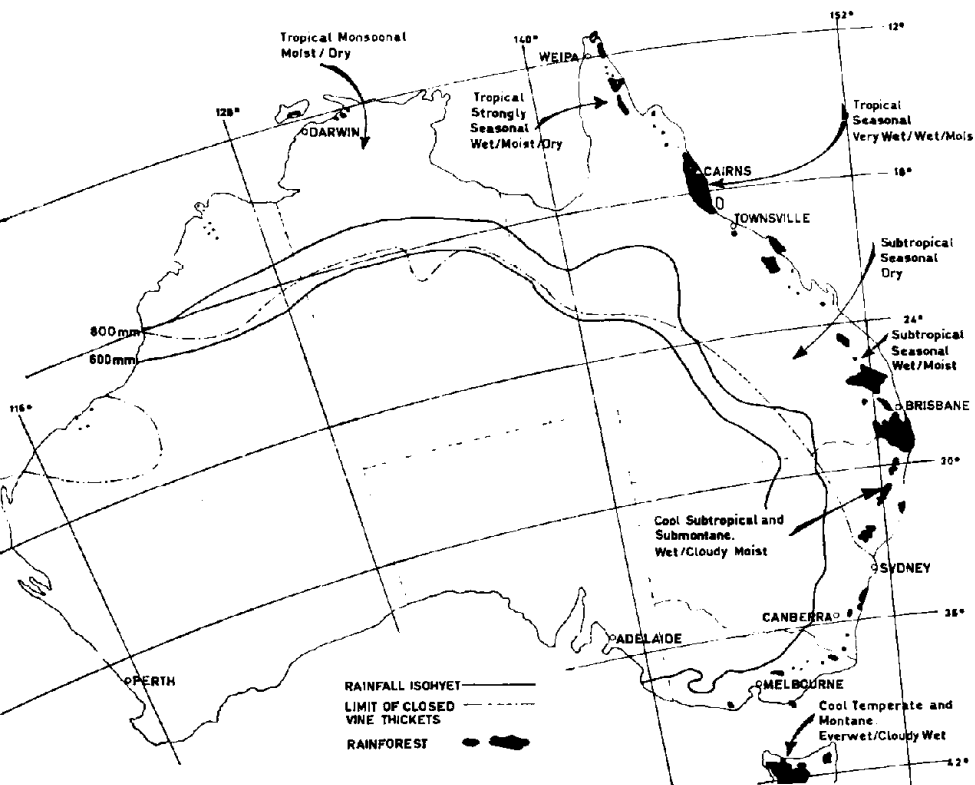


FIG 1. Distribution of the different climatic types of Australian rainforest vegetation. The arrows indicate the approximate centre of distribution ("core area") of each climatic type, but the boundaries of each type overlap as the result of past climatic changes.

be relevant or feasible. What the naturalist needs is a broad perspective, from the synecological point of view, of local, regional and continent-wide rainforest types. This perspective provides a framework into which more detailed information about particular plant communities and plant species (autecology) can be fitted.

Since the structure and physiognomy of a given plant community reflects the integrated impact of the physical environment, the distribution of the same structural type indicates similar combinations of physical factors of climate and soils. In this way, each structural type of vegetation functions as a "phytometer", measuring equivalent biotic environments. Structural classification of rainforests has been shown to work at quite detailed levels geographically, but requires the use of an increasing number of features which experience and the modern methods of numerical analysis show to be diagnostic. In fact, structural classification works best with increasing complexity of the vegetation—although this means that the mind finds it increasingly difficult to grapple with large data sets and to produce intuitive classifications. That is where the computer comes in. On the other hand, simple vegetation communities are easily recognized and more usefully identified by their dominant species, e.g. Coachwood forest, Mountain Ash forest. The structural classification also works best in relatively undisturbed and mature stands of rainforests and associated forests. This is because

recent disturbance by clearing, heavy logging, etc., causes a simplification of structure and flora which reflects an historical event that distorts the integrated impact of the physical environment. A successful typology of secondary communities therefore requires the use of different structural features than for mature communities, but the results tend to be trivial when the names of a few dominant species such as *Lantana*, *Senecio*, *Acacia*, *Macaranga*, *Alphitonia*, etc., could be used instead.

Given certain diagnostic features of structure and physiognomy, a broad, intuitive classification of Australian rainforests can be established. For convenience it is produced as a dichotomous Key, but it should be realized that this has its limitations even on a general scale (23 main structural types). A Key attempts to fit a given stand into a pre-existing "pigeon-hole" in a series of pigeon-holes that has been subjectively erected. This amounts to chopping up a continuum of vegetation, so that there are many misfits. That is why it is better to let the data sort themselves, using an "open-ended" *pro forma* that allows for the addition of new or striking features relevant to the classification, but which require another pigeon-hole. Anyone interested in learning more about this method (which, however, has the disadvantage of requiring a tame hardware computer rather than one's own head) should consult the paper by Webb *et al.* (1976).

Explanation of the Structural Features Used in the Key

Physiognomic and structural features of rainforest vegetation that are helpful in classification are divided, for convenience, into four categories:

- (1) *height and depth of canopy closure* (prominence of different tree storeys or layers, evenness of canopy surface, presence and type of emergents, regularity of distribution of trunks of upper canopy trees, crown shapes, vertical extension of crowns in relation to length of trunks, etc.),
- (2) *leaves* (size, shape, texture, periodicity of leaf-fall, etc.),
- (3) *trunks* (texture and colour of bark, extent of covering by epiphytes, cauliflory, stilt roots, spreading surface roots, club-like base, etc.),
- (4) *special life forms or growth forms* (types of palm-like, fern-like, pandan-like, banana-like, bamboo-like, grass-like plants; stranglers; banyans; thorns, prickles and hooks; robust, slender and wiry vines; types of epiphytes and their vertical extension, etc.).

Definition of features that are unfamiliar to those without any botanical knowledge requires illustrations as well as verbal description. Some briefing in the field to explain how to assess prominence of features is most desirable. In systematic surveys, prominence of a feature is estimated on a four-point scale (0 if not evident, 1 if rare and/or inconspicuous, 2 if occasional or rare but conspicuous, 3 if common, either uniformly or in patches). The scores are then entered on a *pro forma*.

It is difficult to avoid a taxonomic flavour in describing some of the life forms which are most easily identified as palm-like (e.g. true palms, cycads), etc. Only a few of the structures that are necessary for understanding and using the Key will be given, and a more exhaustive list is available in Webb *et al.* (1976).

Leaf sizes are classified into five classes, and for convenience the leaf (or leaflet) shape is assumed to be regular (lanceolate, elliptical, etc.), and size is related to length of the blade as follows:

- nanophyll—small leaves less than 2.5 cm (1 inch) long,
- microphyll—a little larger leaves, but less than 7.5 cm (3 in) long,
- notophyll—leaves longer than 7.5 cm (3 in), but less than 12.5 cm (5 in),
- mesophyll—large leaves longer than 12.5 cm (5 in), but less than 25 cm (10 in).
- macrophyll—the largest leaves, exceeding 25 cm or 10 inches in length.

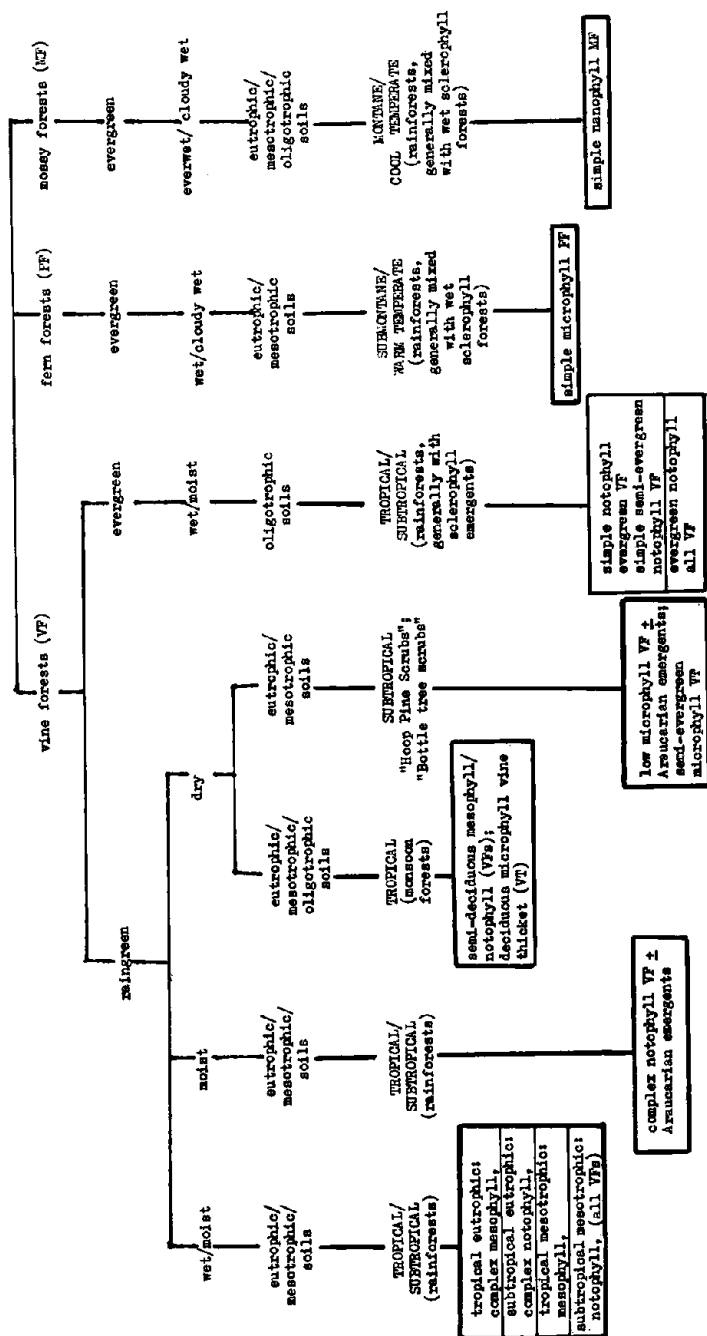


FIG. 2. Structural classification of Australian rainforest vegetation in relation to climatic-adaphic factors (after Webb 1966).

The size of leaves of most species in the canopy of a rainforest decreases at higher altitudes and higher latitudes, and on soils of lower moisture and nutrient status.

Rules for determining common leaf size:

- (1) Consider only tree layers (upper, middle or lower). Understorey shrubs and low-growing plants such as ferns, or species with very deeply divided leaves such as palms, are ignored.
- (2) In compound leaves, a leaflet is regarded as a leaf.
- (3) Consider only mature, exposed ('sun') leaves of evergreen (not deciduous) species.
- (4) Avoid 'shade' leaves, and secondary growth, e.g. along roadsides.
- (5) For leaves of roughly lanceolate or elliptical shape, it is generally sufficient to estimate length of leaf blade.
- (6) The general impression of leaf size of tall trees may be confirmed by inspection of fallen leaves on the forest floor, allowing for some larger sizes due to shading or understorey and vine species.
- (7) It is generally easy to decide which two adjacent leaf classes are most common, i.e. meso-noto, noto-micro, and micro- or smaller. In naming the subformation, the larger leaf size is taken, e.g. Mesophyll Vine forest for meso-noto sizes.

Many other diagnostic features are linked with changes in leaf size and different combinations of them can be correlated with linear environmental gradients, e.g. decrease in availability of moisture and increased seasonal drought in warm climates is correlated with not only overall decrease in leaf size, but also increasing deciduousness (especially of larger leaves), reduction in canopy height, loss of plank buttresses, increase in flaky and scaly barks, increase in thorns and prickles, lowering of crown extension towards base of trees (to produce shrub-like forms), and so on. It is possible to simplify trends of structural and physiognomic change along a particular environmental gradient (e.g. moisture, temperature, soil nutrient availability, soil aeration, exposure to wind, cloudiness on upper mountain slopes, liability to incursions of wildfires, etc.), and to draw diagrams of the different types at different intervals along the gradient (see e.g. Webb, 1968). But environmental factors do not operate singly, and it is not possible to illustrate the many interactions of them which are, however, so faithfully portrayed by the characteristic structure of the forest stand itself.

Plank buttresses are often confused with thick and rounded ("spur") buttresses, and are defined as parallel-sided, relatively thin and roughly triangular flanges or "fins" which extend at least 1-2 m up the trunk. Plank buttresses are best developed under hot humid conditions, especially in situations with impeded soil drainage. True plank buttresses are absent from submontane (warm temperature) and cool temperate rainforests, and usually from monsoon forests. As a rule, trees with plank buttresses are shallow-rooted and in Australia characteristically belong to families such as Myrtaceae, Meliaceae, Sterculiaceae, Elaeocarpaceae, Moraceae. On the other hand, deep-rooted trees belong to families such as Leguminosae, Sapindaceae, Rutaceae, Celastraceae, Cunoniaceae. There are, of course, exceptions, but plank buttressing is genetically fixed.

Lianes are invariably present in tropical and subtropical rainforests. Generally, they are robust and woody—the so-called 'monkey ropes' of tropical jungles—and ascend to the upper tree layers. Common families with robust vines are Ampelidaceae, Menispermaceae, Apocynaceae, Asclepiadaceae, Leguminosae, Palmae. With few exceptions (e.g. *Parsonsia straminea*, *P. eucalyptophylla*), woody lianes do not invade adjacent sclerophyll forests. There is a striking contrast in appearance between closed vine-tangled rainforest and more open sclerophyll forest without vines, epiphytes, etc.

Lianes are classified as robust woody (stem diam. > 5 cm); slender woody (stem diam. 1-5 cm); and thin wiry (stem diam. < 1 cm). Robust lianes are most common in tropical types, and slender woody lianes become more prominent in subtropical moist situations. Slender wiry lianes, restricted to lower tree and shrub layers, replace the woody forms in temperate and submontane zones, and eventually become rare or absent.

Epiphytes are also of diagnostic value. Vascular epiphytes (orchids, ferns, aroids, etc.) are conspicuous and abundant on the branches and trunks

of tropical-subtropical rainforest trees in moister regions. Mosses and lichens are also present, but less prominent. The tree trunks are normally obscured by trailing curtains of aroids (e.g. *Pothos*, *Rhaphidophora*). This feature, together with the larger leaves and much branched trees, provides the dense shade and greenery of tropical wet forests. By contrast, in cool temperate rainforest, non-vascular epiphytes (mosses, lichens, liverworts) are most conspicuous; except for certain ferns, vascular epiphytes are absent or rare. The trunk spaces (i.e. between the lower parts of the tree stems) are relatively unobscured, and tree crowns tend to be sparse and compact.

Periodicity of leaf-fall, and the proportion of deciduous, semi-deciduous, semi-evergreen, and strictly evergreen species and individuals in a rainforest stand are of fundamental ecological importance in the differentiation of the structural types. Its use as a diagnostic feature has the disadvantage that observations over a number of dry (winter) seasons are necessary in the tropical and subtropical regions where leaf-fall is marked. However, as already noted, evergreenness and degrees of deciduousness are still not readily quantifiable, so some closer definition is necessary. Raingreen (*regengrüne*) as opposed to evergreen is a useful term in the German ecological literature which connotes full leaf in the rainy (summer) season of the tropics and subtropics, whereas the more widely used "summergreen" refers to the restoration of leaves in warmer spring and summer in the deciduous woodlands of temperate countries. It is helpful in our environment therefore to consider different degrees of raingreenness where there is a complicated relationship between onset of the rainy season and the triggering effect of increase in temperature on leaf emergence. "Deciduous" in reference to a rainforest stand means that the species in question, or at least certain individuals in the species population, completely lose their leaves for a time and that this behaviour is obligatory and fixed for the species. "Semi-deciduous" indicates that most leafless species are truly deciduous, but that some are facultative, i.e. leaf-fall is controlled by the severity of the dry season, rather than by being obligate. On the other hand, "semi-evergreen" means that few or none the species are truly deciduous, and that most of those that shed their leaves do so incompletely depending on the severity of the dry season. Unfortunately, quantitative data on leaf longevity of rainforest species are meagre, e.g. Frankenberg's study of *Eugenia smithii* in Victoria, which indicated an average life of leaves of 2-3 years. Field observations nevertheless suggest trends towards evergreenness in tropical-subtropical rainforest communities that are correlated with lowered temperatures, increased moisture availability throughout the year, lower soil fertility, and combinations of these and other yet vaguely appreciated factors.

The term forest is applied to vegetation in which canopy closure (excluding scattered emergents) occurs at heights above an average of 9 m. Forest can be designated as tall if greater than 37 m (120 ft), medium 18-37 m (60-120 ft), and low 9-18 m (30-60 ft). Thicket is used to describe stunted rainforest vegetation in which the canopy closes at 3-9 m (10-30 ft), and the use of scrub is avoided.

"Simple" and "complex" are two useful categories which denote an overall impression of the degree of structural complexity of a forest, and which can be allocated with confidence at the extremes, depending on the presence and abundance of features listed in the Key.

Rainforests Are Plants

The structural classification described here may seem abstract and a little remote from the living plants that "flesh out" the structural types. Yet, as was explained in the beginning, a perspective about vegetation is needed if the detailed parts are to be properly understood in relation to their more intimate requirements of soil, moisture, aspect, temperature, etc. Fortunately this paper will appear in an issue of the periodical *Australian Plants* that contains articles and photographs by other writers to convey some of the mystery of the rainforest to the reader.

In a subsequent article to appear in a future issue of *Australian Plants*, I will collaborate with others to present the rainforest flora, fitted into the structural framework presented here. The classification will continue with a Field Key to Structural Types.

Field Key to Structural Types of Australian Rainforest Vegetation

1. Mesophylls and notophylls most common
 2. Robust lianes, vascular epiphytes, plank buttresses, macrophylls and compound mesophylls prominent; trunk spaces generally obscured by aroids and palms; stem diameters irregular, many av. 60-120 cm; canopy level av. 21-42 m.
 3. Deciduous emergent and top canopy trees rare
 4. Palm trees not prominent in canopy.....Complex mesophyll vine forest (CMVF)
 4. Feather palm trees prominent in canopy.....Mesophyll feather-palm vine forest (MFPVF)
 3. Deciduous and semi-deciduous emergent and top canopy
 4. Mostly mesophylls.....Semi-deciduous mesophyll vine forest (SDMVF)
 4. Mostly notophylls.....Semi-deciduous notophyll vine forest (SDNVF)
2. Robust lianes and vascular epiphytes not conspicuous in upper tree layers which are simplified; spur rather than plank buttresses prominent; trunk spaces open, stem diameters (except for evergreen emergents) generally regular, av. 60 cm; canopy level av. 24-36 m. Simplification of structural features does not, however, approach that of simple notophyll evergreen types. Sclerophylls (e.g. *Acacia*) may be scattered in canopy.
 3. Deciduous emergent and top canopy trees rare or absent. Mostly mesophylls.
 4. Palm trees not prominent in canopy.....Mesophyll vine forest (MVF)
 4. Fan palm trees prominent in canopy.....Mesophyll fan-palm vine forest (MFAPVF)
1. Notophylls and microphylls most common
 2. Robust and slender woody lianes, vascular epiphytes, plank buttresses, and compound entire leaves prominent; trunk spaces generally obscured by the Aroid *Pothos*; stem diameters irregular, many av. 60-120 cm.
 3. Canopy level uneven, av. 21-45 m, emergents mostly evergreen and umbrageous.....Complex notophyll vine forest (CNVF)
 3. Canopy level uneven, av. 15-36 m, occasional deciduous species with common emergent *Araucaria* or *Agathis*, reaching av. 36-51 m.....Araucarian notophyll vine forest (ANVF)

2. Robust lianes and vascular epiphytes inconspicuous in tree tops; slender woody and wiry lianes prominent in understorey; plank buttresses inconspicuous; simple toothed leaves prominent; trunk spaces open; stem diameters (except for emergents) generally regular av. 60 cm; tree crowns evergreen and generally sparse and narrow; strong tendency to single species dominance (e.g. *Ceratopetalum*) in upper tree layers; canopy level even, av. 21-33 m often with sclerophyllous emergents and co-dominants Simple notophyll evergreen vine forest (SNEVF)
2. Robust lianes, vascular epiphytes and plank buttresses present, but not so prominent as in complex types; tree crowns mostly evergreen, but with a few semi-evergreen or deciduous species, ie. structural features are intermediate between simple and complex types Notophyll vine forest (NVF)
2. Robust and slender lianes generally present, wiry lianes (climbing ferns) generally conspicuous in understorey; vascular epiphytes and plank buttresses inconspicuous; feather palms generally conspicuous; tree crowns evergreen; canopy level av. 20-25 m Evergreen notophyll vine forest (ENVF) $\pm$ feather palms
2. Robust, slender and wiry lianes generally inconspicuous; fleshy vascular epiphytes may be prominent on trunks; plank buttresses inconspicuous; simple entire leaves prominent; deciduous species generally absent but many tree crowns become sparse during the dry season i.e. semi-evergreen; typically mixed with sclerophyllous emergents and co-dominants.
 3. Canopy level av. 10-20 m Simple semi-evergreen notophyll vine forest (SSENVF)
 3. Canopy level av. 3-9 m, generally even, and canopy trees often branched low down (shrub-like) Simple semi-evergreen notophyll vine thicket (SSENVt)
1. Microphylls most common
 2. Mossy and vascular epiphytes inconspicuous in top tree layers; robust lianes generally prominent; plank buttresses absent; prickly and thorny species frequent in usually dense shrub understorey; ground layer sparse; compound leaves and entire leaf margins common
 3. Canopy level uneven, av. 9-15 m with mixed evergreen and semi-evergreen emergent and upper tree layer species; araucarian and deciduous emergents rare or absent Low microphyll vine forest (LMVF)

3. Canopy level uneven, av. 9-15 m with some deciduous and semi-evergreen species; frequent araucarian (*Araucaria cunninghamii*) emergents to av. 21-36 m Araucarian microphyll vine forest (AMVF)
3. Canopy level uneven, av. 4-9 m with mixed evergreen, semi-evergreen and deciduous emergents to av. 9-18 m, swollen stems ('Bottle Trees') common Semi-evergreen vine thicket (SEVT)
3. Canopy level uneven and discontinuous, av. 4-9 m; practically all emergents are deciduous, and many understorey species are deciduous or semi-evergreen; swollen stems ('Bottle Trees' and other species) may be common Deciduous vine thicket (DVT)
2. Mossy and vascular epiphytes usually present in top tree layers; robust lianes inconspicuous; slender and wiry lianes generally prominent; plank buttresses absent; prickly and thorny species absent; simple leaves with toothed margins common; strong tendency to single species dominance (*Nothofagus*, *Eucryphia*) in tree layer; tree ferns and ground ferns prominent; sclerophyll emergents generally present in marginal situations
 3. Canopy level tall, even except for sclerophylls, av. 20-45 m Microphyll fern forest (MFF)
 3. Canopy level stunted, generally even and mixed with sclerophylls, av. 6-9 m Microphyll fern thicket (MFT)
1. Nanophylls most common
 2. Mossy epiphytes conspicuous; robust lianes and true prickles and thorns absent or rare; plank buttresses absent; simple leaves with toothed margins common; strong tendency to single species dominance (*Nothofagus*) in tree layer; tree ferns and ground prominent; floor often peaty and covered by mosses; sclerophyll emergents generally present
 3. Canopy level tall, except for sclerophylls, av. 18-40 m Nanophyll fern forest (NFF) and mossy forest (NMF)
 3. Canopy level stunted, uneven, often with sclerophylls, av. 6-9 m Nanophyll fern thicket (NFT) and mossy thicket (NMT)

Discussion of the Key

As anticipated, there are many misfits. For example, many situations are encountered as experience increases where structural features (plank buttressing, robust woody lianes, evenness of canopy surface, tendency to single species dominance, regularity of stem diameters, presence of characteristic life forms such as palms or tree ferns, etc.) seem to fall "somewhere in between" simple and complex. In such cases, the prefixes should be omitted, and either mesophyll vine forest or notophyll vine forest used.

Predominance of robust woody lianes, tree ferns and ground ferns, and mossy epiphytes in the tree crowns is used to denote (1) vine forests, (2) fern forests, and (3) mossy forests, respectively (see Fig. 2). In the fern forests, ferns are prominent and lianes are generally present, but are wiry and slender. In the mossy forests, tree ferns and ground ferns are also prominent, but using leaf size differences it is possible to identify microphyll fern forest, nanophyll fern forest, and nanophyll mossy forest. Although mossy epiphytes may occur in some places in microphyll fern forest and microphyll vine forest, such occurrence is regarded as an exposure facies (e.g. on misty mountain summits) rather than diagnostic of the rainforest formation. In mature fern forest, only two tree layers are usually evident, whereas in mature mossy forest there is typically only one tree layer with *Nothofagus cunninghamii* and in places *Atherosperma moschatum*.

In nature, although "nodal" types exist in continuously varying systems of vegetation along gradients of dominant factors such as moisture, temperature, soil fertility, soil drainage, exposure, etc., it is often difficult to make clear-cut distinctions between the three main categories. In such cases, structural types such as vine-fern forests, fern-mossy forests, notophyll-microphyll, microphyll-nanophyll, etc., may be conveniently used.

Mixtures with sclerophylls, which occur as scattered emergents above a well-developed rainforest understorey ("subclimax" stages of succession), or as more densely spaced emergents above a relatively low rainforest understorey ("pioneer" and "building" stages of succession) also present problems. Even though such mixed forests are excluded from the strict definition of rainforest, it is necessary to allocate them an ecological position in relation to mature stages. Fire is the universal factor which initiates many successions, although topography, soil fertility and soil drainage are important influences. In certain topographic and edaphic situations within a given climatic zone it is in fact arguable whether mixed communities represent a succession or a zonation, i.e. "subclimax" stages may never reached maturity if fire were excluded. If fire is inevitable, even as rarely as every 200-300 years, it will disrupt succession and produce a permanent "disclimax" forest. Whether ecological knowledge is adequate or not to define the stage of succession, it is possible to use neutral terms such as "sclerophyll vine forest", "sclerophyll fern forest", and if necessary to refine such classifications by adding further words such as notophyll, or even the name of the dominant sclerophyll, e.g. in *blackbutt*-SNEVF transitions.

Environmental Relationships of the Structural Types

At a very general level, and avoiding the complexities of climatic indices and the difficulties of measuring soil fertility in closed forests where much of the nutrient capital is above ground and being recycled, it is possible to indicate climatic and edaphic parameters for the structural types.

The effectiveness of precipitation depends of course on seasonal distribution as well as total amount, and on differences in evapotranspiration under different temperature regimes. Meteorological data are in any case rarely available for sites actually within rainforest areas, so that selected recording stations give only a rough idea of forest conditions. The average climate station selected for each structural type has a greater amount of meteorological data than is presented in Table 1, and for further details the Commonwealth Bureau of Meteorology's "Climatic Averages—Australia", Metric Edition August, 1975, should be consulted.

Soil mineral nutrient status, loosely termed soil fertility, may be inferred from the mineral composition of the parent rocks, provided that climatic and topographic conditions are not extreme. Details are given in Webb (1968). Briefly, parent rocks are classified into (1) acid or highly siliceous rocks low in nutrients, e.g. sandstone, quartzite, siliceous shale; (2) sub-basic or orthoclase-feldspathic rocks well supplied with potassium, but generally low in phosphorus, calcium and magnesium,

TABLE 1—*Distribution of the structural types of Australian rainforests as in the field key in relation to climate and soils (from Webb & Tracey 1978).*

Structural Type	Climatic Type	"Average" Climate Station	Rainfall				Soil fertility
			A	B	C	D	
complex mesophyll vine forest	tropical seasonal very wet/wet	Innisfail, N.Q.	3,644	155	760	15.1	high
mesophyll feather-palm vine forest	tropical seasonal very wet/wet	Innisfail, N.Q.	3,644	155	760	15.1	high/med. drainage impeded
mesophyll fan-palm vine forest	tropical seasonal very wet/wet	Innisfail, N.Q.	3,644	155	760	15.1	low drainage impeded
semi-deciduous mesophyll vine	tropical strongly seasonal wet	Iron Range, Q.	2,049	202	215	18.4	high/med. often riverine alluvium
mesophyll vine forest	tropical seasonal very wet/wet	Innisfail—(see above)					medium
semi-deciduous notophyll vine forest	tropical strongly monsoonal seasonal/moist	Thursday Is., N.Q.	1,652	145	93	22.2	medium
		Darwin N.T.	1,534	109	110	18.9	generally enriched coast. sand
complex notophyll vine forest	subtropical seasonal wet/moist	Mt. Tamborine, S.Q.	1,551	131	517	7.9	high
		Condong, N.S.W.	1,722	142	550	5.8	high
araucarian notophyll vine forest	subtropical seasonal moist	Gympie, S.Q.	1,161	117	354	6.0	high/medium
simple notophyll evergreen vine forest	subtropical seasonal wet	Coolum, S.Q.	1,876	163	558	6.7	low
simple notophyll evergreen vine forest	cool subtropical	Whian Whian, N.S.W.	2,388	147	762	5.8	medium/low
	submontane cloudy/moist	Clouds Creek, N.S.W.	1,397	138	413	-0.3	high/medium
notophyll vine forest	subtropical seasonal wet cool	Mt. Tamborine—Q		(see above)			
	subtropical wet	Whian Whian—N.S.W.		(see above)			
evergreen notophyll vine forest	tropical monsoonal strongly seasonal moist	Oenpelli N.T.	1,360	92	51	17.9	coastal sands or quartzose sandstone
		Snake Bay N.T.	1,594	97	129	17.8	
		Moreton N.Q.	1,362	102	66	17.0	alluvia of low fertility, but perennial spring fed soakage
low microphyll vine forest	subtropical seasonal dry	Nanango, Q.	805	86	251	2.7	high/medium
araucarian microphyll vine forest	subtropical seasonal dry/moist	Kalpower, Q.	905	89	245	3.7	high/medium
	subtropical cool/moist	Cloud's Creek N.S.W.					
semi-evergreen vine thicket	subtropical seasonal dry	Biloela, Q.	699	75	187	5.1	high/medium
deciduous vine thicket	tropical seasonal/monsoon dry	Kowanya, Q.	1,222	71	36	14.8	high/medium/low
microphyll fern forest	warm/temp. submontane cloudy/moist	Wentworth Falls, N.S.W.	1,374	149	405	1.5	high/medium
microphyll fern thicket	as above	but exposed					
nanophyll fern thicket	cool/temp. montane ever wet cloudy/moist	Waratah, Tas.	2,201	252	820	1.5	high/medium/low
nanophyll fern/mossy thicket	as above	but exposed					

KEY—A = Mean annual rainfall in mm
 B = Mean annual rain days
 C = Mean rainfall in the driest 6 months in mm
 D = Mean minimum temperature in the coldest month—°C

Soils of high fertility (eutrophic) are derived from basic rocks in all topographic situations (eluvial or ridge-top sites, colluvial or slope sites, and alluvial sites), or from sub-basic rocks in alluvial situations. Medium fertility (mesotrophic) soils are derived from sub-basic rocks in colluvial situations, or from mixtures of acid rocks in which there is a substantial contribution from sub-basic or basic soil parent materials. Low fertility (oligotrophic) soils are produced from acid rocks in any topographic situation, although there is always the possibility of enrichment in alluvium and other sites of accumulation. Rainforest soils are typically well-drained and permeable clays, clay loams, silts and coastal dune sands of high to medium fertility. There are many exceptions where chemical analysis indicates that the profile of a rainforest soil is low in mineral nutrients, e.g. coastal dune sands, podzolics on chlorite schists. In such cases it is likely that nutrient enrichment has been inherited from basic soil parent materials which have weathered away, or from atmospheric accession of minerals in maritime situations. Hence the essential nutrients are preserved in the closed nutrient cycle and restricted to the top few centimetres of soil where there are feeding roots. Destruction of rainforests in such places initiates regressive succession and there is no possibility that the original rainforest can return, even if seed sources are available, on any time scale relevant to human generations.

The climatic and edaphic relationships of the structural types are summarized in Table 1. The climatic types refer to those derived from floristic vegetation provinces and are given in Fig. 1.

Within the wet and moist tropics and subtropics, raingreen rainforests of complex structure are correlated with soils of high fertility at low to medium altitudes (less than 400-800 m). On the other hand, soils of medium and lower fertility support evergreen rainforests of increasingly simplified structure, and mixtures with sclerophylls (and incursions of wildfires) are characteristic in marginal situations.

Climatic and topographic factors tend to outweigh soil nutrient availability at the climatic extremes of the tropical monsoonal and cool temperate regions. Thus vine thickets become semi-evergreen on soils of low as well as of high fertility, and fern forests and mossy forests are evergreen irrespective of soil fertility status.

It would make Table 1 too complicated if the distribution of all the structural types that occur outside the "core area" of the climatic type were shown. Thus except for the types which stand at the extremes—the hot wet forests on high fertility soils (optimal tropical rainforest), the cool everwet forests, and the hot seasonally dry forests of the monsoon zone—it is possible for a structural type to occur where climatic and edaphic conditions are favourable in more than one geographic region. For example, at lower latitudes in North Queensland, complex notophyll vine forest which characterizes the subtropical lowlands of South Queensland and northern New South Wales occurs at higher altitudes on basalts, e.g. Atherton and Evelyn Tablelands. At increasingly higher altitudes at lower latitudes, microphyll fern thicket occurs far north of its usual range. In the north-west, patches of semi-deciduous mesophyll vine forest occur in moister coastal situations in a region otherwise characterized by semi-deciduous notophyll forests and deciduous microphyll thickets.

Selected References

- Webb, L. J. (1959). A physiognomic classification of Australian rainforests. *J. Ecol.* 47: 551-570.
- Webb, L. J. (1968). Environmental relationships of the structural types of Australian rainforest vegetation. *Ecology* 49: 296-311.
- Webb, L. J., Tracey, J. G. and Williams, W. T. (1976). The value of structural features in tropical forest typology. *Aust. J. Ecol.* 1: 3-28.
- Webb, L. J., Tracey, J. G., Williams, W. T. and Lance, G. N. (1967). Studies in the numerical analysis of complex rainforest communities. I. A comparison of methods applicable to site/species data. *J. Ecol.* 55: 171-191.
- Webb, L. J., Tracey, J. G., Williams, W. T. and Lance, G. N. (1970). *Ibid.* V. A comparison of the properties of floristic and physiognomic-structural data. *J. Ecol.* 58: 203-232.
- Webb, L. J. and Tracey, J. G. (1978). An ecological framework of Australian rainforests. *Aust. J. Ecol.* (in press).
- Webb, L. J. and Tracey, J. G. (1978). Australian rainforests: patterns and change. In *Ecological Biogeography of Australia*, 2nd edn. Ed. A. Keast (W. Junk, Amsterdam, in press).

Rainforests — Soil Fertility

By Jim L. Charley and Bryant Richards, Dept. of Botany, Univ. of New England

The luxuriance one associates with rain forests should not be taken as an indicator of high soil fertility since the favourable moisture and temperature conditions that are primarily responsible for the vegetative bulk and complexity are likewise prime causes of advanced weathering and leaching of the underlying substrate that gives rise to soil. There are exceptions where soils associated with rain forests are in fact of moderate to high fertility status. More commonly, however, soil mineral reserves in rain forests are quite low and maintenance of a large and vigorous biomass is dependent upon internally cycled elements.

In the tropics where rain forests are cleared for shifting cultivation, and in Australia too, where in the early days apparently fertile basalt derived soils were cleared of rain forest to make way for pasture or permanent cultivation, the subsequent results have often been much poorer than originally expected because it was not appreciated that mass of vegetation is not always a good measure of site fertility.

During development of ecosystems the continuous repetition of the mineral uptake-utilization-decomposition cycle gradually leads to accumulation of elements in the litter layer, the underlying surface soil and the biomass. Minerals are absorbed from the whole soil volume explored by roots, but as these elements must pass at some stage through the forest floor sub-system there is a tendency for reorganisation of mineral capital towards the soil surface. Additionally, because litter fall provides the mineral and energy requirements for decomposer organisms, and these release elements in an available form for plants, the forest floor sub-system also becomes the focus for most decomposition activity and root development. All terrestrial ecosystems show this accumulation pattern to some degree, but it seems that it is best developed on poor sites. Thus, in rain forests and hardwood forests growing in the deep impoverished sands of Fraser Island, for example, a greater proportion of total ecosystem mineral capital would be found in the vegetation and forest floor compartments than in the case of forests of equivalent stature developed on better soils on the mainland. Accordingly, as site quality becomes poorer, the biomass and forest floor sub-systems become more significant storehouses of essential elements and tighter and more conservative cycling of minerals is to be expected. As the degree of this kind of development accentuates, so too must susceptibility of the ecosystem to gross disturbance by man or natural agencies.

Rainforests And Their Conservation

There is need for considerable concern about the future of the remnants of rainforest that have survived the onslaught of man. This statement is true for all the natural forests but here we are concerned with rainforests. Readers are referred to the publications below and in particular to The Australian Conservation Foundation and The National Parks and Wildlife services in your state. They need your support.

The National Parks and Wildlife Service (N.P.W.S.) of N.S.W. produces an irregular periodical, Parks and Wildlife. The current subscription is \$10.00 for the 5 numbers in Volume 2, sent to the Service, 189 Kent St., Sydney, N.S.W. Reproduced below are extracts from their Vol. 2, No. 1 issue devoted principally to Rainforests. The issue examines many aspects of rainforest: firstly the history and general pillage of the once extensive rainforests of N.S.W., followed by ecological factors and the wildlife it supports, all beautifully illustrated in brilliant colour. All material on rainforests has been reprinted as a book entitled "Rainforests" and this is available for \$3.00 plus 50c postage from the Service as above. The following two articles were extracted from this journal.

The Australian Conservation Foundation produces a periodical called "Habitat" in six issues a year, the subscription being \$6.00. For membership or just for the periodical address mail to 206 Clarendon St., East Melbourne, 3002. Issues that relate to endangered rainforest areas are Vol. 4, No. 3 — Special Border Range Issue and Vol. 2, No. 3 — Incredible Fraser Island. The foundation also has a 14 pages publication, The Rainforests — A.C.F. Viewpoint. If you are concerned for the future of our rainforests, write for advice on how to help, to the foundation.

Rainforest Plants — A Colourful Guide

Produced in sets of large beautiful full colour plates, the series "A Horticultural Guide To Australian Plants" as advertised below, has many rainforest plants illustrated. The series is so well produced that readers are urged to purchase a set. The plan is to produce a separate sheet for each species of wildflower punched for filing in a two ring binder. On the front of each sheet is a very good quality colour plate of a flower and on the rear, a description of that flower, where it occurs naturally and other details of interest.

The rainforest species so beautifully illustrated are: *Abarema sapindoides* (syn. *Pithecellobium prinosm*), *Anopteris glandulosus* and *A-macleayanus*, *Asplenium australasicum* the Bird's Nest or Crow's Nest Fern, *Backhousia citriodora*, *Barklya syringifolia*, *Brachychiton acerifolium*, *Buckinghamia cel-sissima*, *Cratera religiosa*, *Darlingia darlingiana*, *Drynaria rigidula*, *Elaeocarpus grandis*, *Eugenia wilsoni* (syn. *Syzigium*) *Zuodia elleryana*, *Grevillea pinnatifida* and *G. robusta* (together with 23 other *Grevillea* not from rainforests mentioned especially as these are a feature of the series), *Hoya australis* and *H. macgilivrayi*, *Lepidozamia peroffskyana* syn. *Macrozamia denisonii*, *Macadamia integrifolia* the Queensland Nut, *Millettia megasperma*, *Orthosiphon aristatus*, *Pandorea jasminoides*, *Platycerium superbum* the Staghorn, *Schefflera actinophylla* syn. *Brassaia actinophylla*, *Stenocarpus sinuatus*, *Xanthostemon whitei* and *X. youngii*.

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Rainforests — The Ecosystem Concept

By Bob Harden, Research Officer N.P.W.S.

The rainforest is the outcome of the interactions between plant, animal or environmental factors. These three factors and their interactions comprise the ecosystem.

The environmental components of the ecosystem can be conveniently summarised as climate, parent material, topography, organisms available to form the system, and time. These components will determine the gross forms the system can take; for example, a rainforest cannot develop in an arid area (climate), nor can macropods be a part of African ecosystems (these species are not available to African ecosystems).

One useful way of classifying the biotic components of the ecosystems is to place together, in a number of pools, all the organisms which have the same function in the ecosystem (see fig. 1). Each pool derives its requirements from the pool before it so that energy and nutrients cycle always in one direction, around the ecosystem. Using this model the interdependence of the biotic components of the ecosystem are more clearly seen.

The Primary Producer Pool (or autotrophic pool) is the plant component of the ecosystem and here the energy to drive the whole ecosystem is obtained. This is done by the process of photosynthesis where some of the sun's radiant energy is "trapped" and used to produce organic compounds from inorganic nutrients. These organic compounds are the potential energy source of the whole system and are, of course, incorporated into the plant material. All the fauna of the ecosystem ultimately depend on this plant material as an energy source.

The consumer industry (Consumers 1 and 2) is supported by the living part of the Primary Producer Pool, i.e. Consumer 1 animals (herbivores) eat directly from the Primary Producer Pool and Consumer 2 animals are predators of Consumer 1 animals.

Dead material from all pools forms the Dead Organic Matter Pool, and this supports a decomposer industry similar to the consumer industry, i.e. Decomposer 1 animals feed from the dead material and Decomposer 2 animals are predators of Decomposer 1. The decomposer industry has an additional pool, Decomposer 3. This pool, of micro-organisms and fungi, is responsible for the ultimate breakdown of dead material and the subsequent release of inorganic nutrients which are then available again to the Primary Producer Pool.

This model is, of course, an oversimplification. Animals do not necessarily fall discreetly into one pool; for example a dingo is both a Consumer 2 (predator) and Decomposer 1 (scavenger). Likewise, the pools are not always spatially discreet. The dead wood in the pipe of a tree trunk belongs to the Dead Organic Matter pool while the live parts belong to the Primary Producer Pool. The model, however, helps us visualise functional relationships in an ecosystem.

One final important feature of terrestrial ecosystems is that the biomass of the consumer and decomposer industries is largely composed of invertebrates. The animals which we commonly think of (mammals, birds and reptiles) contribute only a small amount of the total biomass of these pools, and are probably much less important in the functioning of the ecosystem than the invertebrates.

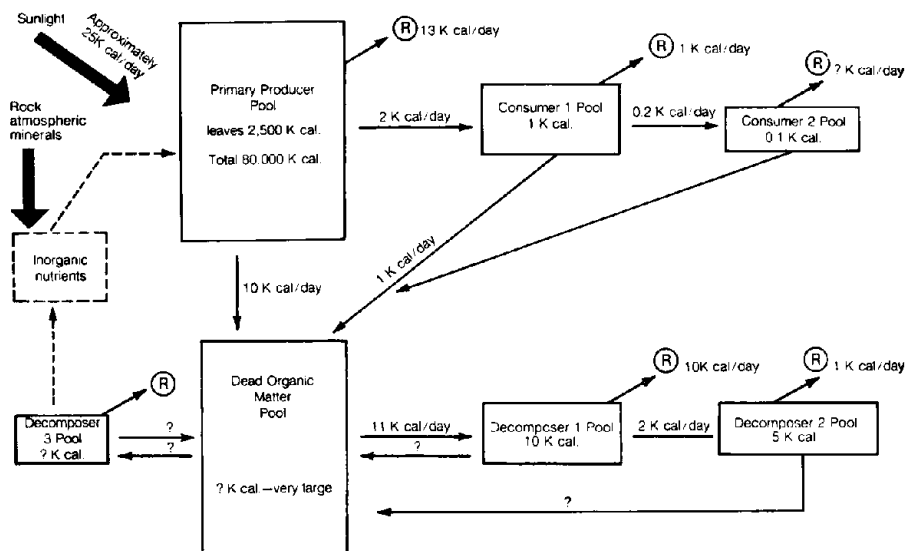


Figure 1: A functional model of a forest ecosystem. Solid lines indicate direction of transfer of biomass (energy and nutrients in an organic form) and broken lines, transfer of inorganic nutrients. Figures in K cal are:— (1) in pools biomass/m² expressed as K. calories; (2) between pools energy flow rate K cal/m²/day; (3) (R) respiratory losses of energy in K cal/m²/day. Data on energetics modified after Odum.

The Rainforest

Yes, It may be Copied

By GEO. W. THORPE

Who, having ventured deep into a rainforest for the first time, could fail but be captivated by the sheer overwhelming power of the scene, even sensing a feeling of oppression as the abundance of life forms closes in around one. The sight of so many tall trees, their trunks forming the framework of the rainforest as they stand so close together, some with gigantic buttresses, others straight stemmed and varying little in girth from ground to topmost branch, is surely a magnificent and awe-inspiring experience. But then stand still and observe that, as well as the trees, there are ferns, epiphytes, mosses, fungi and small plants, some growing at ground level, others clinging to tree trunks and branches or merging into the green canopy above, and the spectacle makes one wonder how the earth can support and sustain such a weight of living material in an area so small.

Here, deep in the forest, with so much vegetation blotting out the outside world, and only soft filtered light penetrating the canopy, is a retreat of solitude and tranquillity such as can be found in few other places.

In this quiet haven in the rainforest, with no outward signs of civilisation, a man is certainly in the natural surroundings which he needs in order to contemplate his world. Once he has recognised the awesome beauty of the scene, and acknowledged what an extraordinarily complex living thing the rainforest is, then he can far better accept his responsibility to preserve these fascinating and valuable areas for future generations.

How then can we bring more people to the realisation that just as man can use the rainforest for his relaxation and interest, so it needs his understanding to ensure its continued survival. The simple answer is to make more rainforest visible to more people by bringing it closer to them. Hence my reason for encouraging the creation of rainforest plantations within home gardens and project areas, so that man and the rainforest can both survive. Note that I don't enthuse about the growing of individual rainforest plants as specimen subjects. I can tolerate that use, but as my love is for the rainforest as an entity, I always see an isolated plant as lonely and longing for the company of its own kind.

However, lest our impassioned pleas encourage the over enthusiastic approach to the growing of rainforest plants, I think it is only fair to point out that there are some disadvantages. Firstly the work angle, and even though a visit to a well-established rainforest garden may evoke the observation, "well, here is a real minimum-care garden, no lawn, no weeds, no pruning, no spraying, nothing to do but enjoy and encourage the exuberant efforts of Mother Nature," there is a "but". However, you as keen gardeners will know that a lot of work has to go into the initial preparation of any garden, and in order that a recognisable rainforest may be produced a tremendous amount of work is usually necessary. In four or five years time, and I think that's long enough to wait to enjoy the fruits of one's labour, the work content will have dwindled to almost zero, and the enjoyment soared to great heights.

Unlike a "normal" garden, a rainforest plot does not become "leggy" or sprawling with age. Its character is permanence, as growth is upward, where space is abundant and age serves only to add usefulness. Tree trunks and branches become robust enough to accommodate epiphytic orchids and ferns, and the canopy reaches the right height for nesting and roosting birds. Under natural rainforest conditions trees grow for perhaps a hundred, or maybe hundreds of years, until they reach maturity then die

and decay on the spot to provide food for those that remain, so the cycle goes on "ad infinitum". Only a rainforest tree can be a thing of beauty during the decay phase, as any rainforest enthusiast will testify.

Tall trees in a suburban allotment scare the wits out of some people, and particularly in Queensland where we're liable to receive winds of cyclonic force, it can be argued that tall trees are a potential hazard. The reason for the abhorrence of tall plants by some people is, I think, rooted in the idea that man is the dominant creature on the earth and must be able to stand above his garden and look down on his subjects. Just as I illustrated earlier that some people feel claustrophobic when taken deep into a rainforest, so some people cannot tolerate a garden in which man is insignificant and the plants dominate the scene.

A further benefit from a rainforest garden is the reduction in temperature which results from the micro climate produced by the rainforest plot itself. In summer this is very welcome, and within our own backyard rainforest I have regularly measured temperatures of five to ten degrees celcius below ambient on very hot days. It is certainly conceivable that we could reduce the temperature of large tracts of suburbia if sufficient people could be induced to follow the rainforest plan.

A rainforest plot may not be considered to have the eye appeal of a well laid out, landscaped, log-edged, bark-chip mulched bed of healthy vigorous flowering grevilleas, melaleucas, callistemons, etc. As opposed to this the enjoyment of a rainforest garden is the opportunity it provides to stand within the garden completely enshrouded by masses of vegetation. Here the pleasure is in the feeling of total absorption within a soft green mantle enhanced by the subtle intermingling of various leaf shapes, colours and patterns, and the play of sun and shadow through the canopy above, all of which combines to generate feelings of harmony and tranquillity.

Repeatedly visitors to our backyard rainforest plot express the feeling as "gee, isn't it peaceful in here, you'd never know you were in a city". Isn't it ominous, people always associate the bush with peace, never the city! But it is wonderful to be able to provide yourself and your visitors with marvellous tranquillity and a breathing space away from city pressures just by judicious use of the right plants in the right situation, and isn't that what gardening is all about?

One characteristic of rainforest plants in a rainforest situation which may be a disadvantage to some people is the paucity of flowers on plants which in an open situation may flower profusely. *Hymenosporum flavum*, the so-called native frangipani, provides a good example of this phenomenon. In open sunny situations I have seen it remain for years as a tall-growing shrub or small tree with branches and leaves to ground level, and in season smothered in creamy yellow sweet-scented flowers. However, in our rainforest *Hymenosporum flavum* in five years has grown to 10 m, with a slender trunk 10 cm in diameter, on which the lower branches in turn die and are shed, leaving a long bare trunk with leaves only on the few topmost branches. It still flowers, but the flowers are quite remote and unnoticed. This is often the style of rainforest trees, particularly in well-established situations.

Before deciding to establish a rainforest garden there is a need to ensure that sufficient space is available, and an area of 16 m square is probably the minimum size in which desirable results can be achieved. Remember, I prefer to see rainforest plants used in as authentic a rainforest situation as possible. Just as we would, for very good reasons, if deciding to construct a semi-arid garden keep the appropriate plants together and not scattered among other more tolerant plants, so for those same good reasons I like to see rainforest plants in company with their own kin.

If your 256 sq. m plot contains a deep gully you're in luck, but few of us have the good fortune of Canberra Botanic Gardens, so we have to make do on the site the good Lord, or the developers, gave us.



TOP:

Pilidiostigma glabra. A moderate to tall shrub 2-2.5 m. The pleasing dense foliage is highlighted by the bronze colour of the young shoots.

Photography by D. Hockings

BOTTOM:

Triunia youngiana — Spice Bush. A low to tall straggling shrub bearing erect 4-6 cm spikes of cream to pink delicately perfumed flowers.

Our home rainforest site was most inhospitable, being a few cms of poor topsoil derived from Brisbane metamorphic shale, which has little to recommend it except that tree roots are able to force their way into its fissures and gain a firm footing, but nothing else. It is a S.W. facing slope, and that in Brisbane means that in winter it receives all the icy blasts from Hobart via Melbourne, and the cold dry westerly winds from the interior, but in summer it has some advantages because we avoid the full effect of the sun and get shelter from the hot drying N.W. winds.

There were no humps or hollows on the site, so our first moves were to throw up contour banks, which of course slow up water runoff, but more importantly for rainforest production stop organic material from being carried away. As the top soil was so scarce and of such poor texture we knew that rainforest plants would not flourish until soil quality had been vastly improved.

It is a popular notion that rainforest land is inherently fertile, and this misconception in the past was, and probably still is, the reason why rainforest was and is being felled to make way for agricultural pursuits. The truth is that rainforest creates its own fertility through the decay of organic material (the original organic garden), hence the ability of rainforest to flourish on pure white sand in places such as Fraser Island and Cooloola in Queensland, and on extremely rocky places in other areas. But the mystery to me is how in nature the first rainforest plants know when it's time to establish themselves. We know that areas which are now rainforest covered must have begun their soil/plant relationship with very hardy species, slowly building up through a succession of varying species, until such time as pioneer rainforest species appeared. As conditions became more suitable more rainforest species would have arrived on the scene, and eventually the complex rainforest community that we see today would have evolved.

Well we, of course, had to short circuit this procedure, and knowing that organic material is the key to success we arranged to collect all the "waste" lawn clippings, raked leaves, prunings, etc., from all the homes around us. I even mowed and scythed vacant allotments in the neighbourhood, much to the bewilderment of locals, who thought I was either mad or uncommonly civic-minded, or both.

After months of organic matter collection, and repeated heavy applications of a 15:3:10 fertilizer, soil texture began to improve and the earthworm population exploded. During these early days we made preparation for our rainforest by planting a complete external shelter belt of non-rainforest hardy species, including *Casuarina glauca*, *Acacia fimbriata*, *A. spectabilis*, *A. podalyriifolia* and *A. cunninghamii*, *Grevillea pteridifolia*, *G. Coochin Hills*, *G. banksii*, *Eucalyptus tereticornis*, *Hakea florulenta*, *H. gibbosa*, as well as *Callistemon pachyphyllus* and *C. polandii*, all species able to withstand sun and wind and tall enough to force the young rainforest plants upwards.

That is what we did, but with the benefit of hindsight we now know that we could have avoided the use of non-rainforest plants by using a group of rainforest plants which are, or can be, pioneer species, and under the good conditions provided would have been perhaps more effective as a shelter belt. I refer to plants in the family Sapindaceae such as *Alectryon*, *Cupaniopsis*, *Sarcopteryx*, *Jagera*, *Toeckima*, *Ellatostachys*, and *Harpullia*. Other hardy rainforest plants may be found in the family Euphorbiaceae and include the genera *Glochidion*, *Baloghia*, *Croton*, *Mallotus*, *Macaranga* and *Omalanthus*. Other genera which are hardy enough to use as initial planting material include *Alphitonia*, *Aphananthe*, *Trema*, *Streblus* and *Ficus*; also we could include genera from the family Celastraceae such as *Maytenus*, *Denhamia* and *Elaeodendron*. The list could go on and on, but those plants mentioned are ones whose seed is usually available in sufficient quantity to provide material to "wall" in any area selected for a rainforest plantation. Propagation material for some of the rainforest species may present supply problems, but at least in Queensland we have organised a small group of enthusiasts who regularly exchange plants and seeds.

Having defined the edges of the rainforest, thought may then be given to the body of the rainforest, where the choice of plants is limitless. Plants growing in our own rainforest which have responded to garden culture, in addition to those previously mentioned, include, from the family Pittosporaceae several *Pittosporum* species and *Hymenosporum flavum*; from Verbenaceae, *Clerodendron tomentosum*, *Gmelina leichhardtii* and *Premna lignum-vitae*; from Oleaceae, the fast-growing *Olea panicula*; from Araliaceae, *Delarbrea michieana*, *Tieghemopanax elegans* and the best known of our rainforest trees, the ever-popular umbrella tree, *Schefflera actinophylla*. A big group of our plants comes from the family Myrtaceae and includes several *Eugenia* species, *Rhodamnia trinervia*, two *Ptilidostigma* species, two *Backhousia* species, the very beautiful 'Golden Penda', *Xanthostemon chrysantha*, and the equally delightful *Tristania laurina*. The family Sterculiaceae is represented by *Sterculia quadrifida*, the interesting peanut tree with edible seeds, the flamboyant Flame Tree, *Brachychiton acerifolium*, trees with attractive foliage, *Argyrodendron* species and *Commersonia bartramia*. From Elaeocarpaceae come three *Elaeocarpus* species and *Sloanea australis*, and from Anacardiaceae come the beautiful 'Deep Yellow Wood' *Rhodosphaera rhodanthema* and the very useful 'Burdekin Plum' *Pleiogynium timorense* with edible fruits. Meliaceae is represented by the well-known 'Red Cedar' *Toona australis* by the tree renowned for glorious 'Rosewood' cabinet timber *Dysoxylum fraserianum* and the 'Scentless Rosewood' *Synoum glandulosum*; family Rutaceae has the interesting 'Thorny Satin Wood' with its beautiful floral display, *Zanthoxylum brachyacanthum*, also *Geijera salicifolia* the 'Scrub Wilga', *Euodia elleryana* the food plant of the flashing electric blue Ulysses butterfly, *Pentaceras australe* covered in white flowers in November, *Flindersia australis*, in my opinion Australia's most shapely shade tree when grown outside the rain forest, and *Acronychia laevis*, with the attractive white to blue turpentine flavoured fruit. The family Fabaceae gives us the golden-flowered *Barklya syringifolia* and the well-known 'Moreton Bay Chestnut', *Castanospermum australe*; Caesalpinaceae has the rainforest *Cassia* species, and Mimosaceae those plants with delightful white and pink pom-pom flowers and spiral seed capsule the *Pithecellobium* species. Family Cunoniaceae has given us the attractive foliaged *Ackama paniculata* and the plant which was the original Wattle of Port Jackson days, *Callicoma serratifolia*; Escalloniaceae is represented by the low-growing tree of the gullies, *Cuttsia viburnea*, by the rare and extremely beautiful *Anopterus macleayanus* and the delightful small tree *Polyosma cunninghamii*. From Lauraceae we have taken *Neolitsea dealbata* and *Cryptocarya glaucescens*, and Proteaceae gives us the rainforest *Grevillea* species and the well-known 'Wheel of Fire' *Stenocarpus sinuatus*. Several additional species have come from minor families, and as we explore further we find more and more plants that demand attention.

Two things I haven't mentioned are the requirements of climate and water. Both are important, but just how important I am not in a position to speak positively. Suffice to say that as all the rainforest species which I have utilised and mentioned come from the sub-tropical areas, it's reasonable to assume that they would fail in cold climates.

Experience in Canberra, however, has proved otherwise, but of course there the site for the rainforest was carefully chosen, and climate has been modified. Such work could be done in other places, and I'm sure that we in Queensland would be only too happy to assist in whatever was necessary to see that a project started in what should be, according to the rules, a hostile rainforest situation, could become a useful and valuable exercise.

Water is necessary to a rainforest, but is not the "be all", and as I mentioned earlier the better term for rainforest is closed forest. Rainforest type communities occur naturally in areas of quite low rainfall, but of course under garden situations we can usually adjust water application to best suit the needs of the plants. The ideal for a constructed rainforest garden is a sprinkler system with mist-type spray nozzles, for to keep a rainforest looking

its best it's more important to keep the leaves damp than the ground wet; the sprinklers therefore should be set as high in the canopy as possible and rise as it rises. Added bonuses available with a good watering system are the ferns, vines, epiphytes, etc., earlier mentioned, which of course make the rainforest garden into a true green paradise. The collection and establishment of these additional plants are grounds for another story, which I'm sure will be told by other people.

Tracks are important in a rainforest garden and should be planned in the early stages. They must allow for free movement through the rainforest, but be routed carefully to avoid trampling sensitive areas. We continually throw chopped-up organic material around our tracks to counter the compacting effect of pedestrians, and that does seem to alleviate the problem. The chopped material is produced in an old hand-powered chaffcutter, which is one of the most valuable tools we have. It accepts all prunings, even quite thick stems and reduces a bulky heap to manageable proportions in quick time.

We now use a 10:2:8 fertilizer (General Fertilizers 'Sulphapine') broadcast four times a year at an annual rate of 1 kg to 6 sq. m. This rate may seem excessive, but when you contemplate the amount of living material which occupies each of those 6 sq. m then it really is reasonable.

After six years of growth . . . leaf and litter drop in our rainforest almost maintains a sufficient amount of organic material, but the rate at which it is converted to a beautiful friable soil mixture by earthworms and bacteria is incredible. The original 5 cm of poor topsoil has now grown to 30 cm or more of high-grade material, and the process continues.

As the rainforest develops, and tree trunks increase in length, there is a danger that the floor of the rainforest will become exposed to too much sun and wind. To combat this natural progression we have planted low-growing shrubs around the edge, and within the rainforest, to maintain the closed-in condition. For this duty plants of the genera *Citriobatus*, *Capparis* and *Carissa* have proved their worth. They are all thorny and provide an ideal cover for small birds in their ceaseless efforts to avoid predators. We have found that our rainforest is the night quarters for dozens of birds of varying species and our feathered friends sing our praises all day long.

Rainforest is a fascinating part of our ecological system, and I feel that if preservation of the flora is one of our major activities then with even a small rainforest plot we can both enjoy the "feel" of rainforest and at the same time help to preserve a very great number of rainforest species.

RAINFOREST PLANTS—Descriptions—from p. 348

Commersonia bartramia. A tall shrub or spreading tree to 12 m. The many flowered cymes of white flowers are followed by spiny fruit.

Cryptocarya laevigata var. *bowiei*. A large shrub or small tree; leaves simple, glossy, with 2 prominent nerves; fruit red about 2 cm diameter.

Cupaniopsis anacardioides. A tree to 12 m, or much smaller, with a dense rounded top in the open; leaves pinnate; small greenish flowers in branched panicles; brown three lobed fruit. 18:183, 62:71, 63:111.

Decaspermum fruticosum. A shrub or small tree, often growing in colonies; small simple leaves; small white flowers in profusion on short racemes in the leaf axils; fruit small, black.

Deplanchea tetraphylla. A tall rainforest tree, but usually shorter and more spreading in the open; large broad simple leaves; yellow flowers in dense, erect, flattened terminal heads. 33:202.

Diploglottis cunninghamii—Native Tamarind. A tree to 30 m in rainforest, but much smaller, slender and palm-like in the open; large pinnate leaves; leaf stalks and young shoots covered with dense rusty velvety hairs; flowers in large panicles; brown fruit one, two or three lobed; seeds surrounded with orange edible pulp.

- Drymophila moorei*. A perennial herb with a slender rhizome from which arise simple 15-30 cm stems bearing a number of leaves. Small flowers are borne pendulously from the leaf axils. 55:120.
- Ehretia acuminata*. A tall shrub or, in rainforest, a tree to 25 m; leaves simple oval with toothed margins; small cream-coloured flowers in dense panicles.
- Elaeocarpus bancroftii*. A tree to 30 m in rainforest; leaves simple; large white flowers in short racemes; large green fruit.
- Elaeocarpus grandis*. A large tree to 40 m in rainforest, but 10-12 m with spreading open canopy in the open; leaves simple; flowers greenish-white in short one-sided racemes; fruit blue.
- Elaeocarpus obovatus*. A large tree to 40 m in rainforest, but 6-9 m with a dense compact canopy in the open; leaves simple; small white flowers in great profusion on short one-sided racemes; small blue fruit.
- Elaeocarpus reticulatus*. The rainforest form to 15 m, with smaller leaves and rounder fruit than the smaller growing lowlands and open forest form; leaves simple; flowers white or pink in short one-sided racemes; small blue fruit. 40:189P.
- Elaeodendron australe*. A shrub or small tree; narrow, slightly toothed leaves; bright orange-red fruit.
- Endiandra pubens*. A tree of about 12 m; leaves simple 8-20 cm long; rusty, hairy while young; fruit globular, 6 cm in diameter, and red when ripe.
- Ervatamia angustisepala*. A shrub or small tree, often in groups or in colonies; white jasmin-like perfumed flowers; twin canoe-shaped fruit 3-6 cm long, turning orange when ripe.
- Eugenia australis* (*Syzygium paniculatum*). A tree to about 18 m in rainforest, but smaller and more spreading in the open; white flowers from the leaf axils; oval red edible fruit. 63:112P, 115.
- Eugenia coolminiana* (*Syzygium coolminianum*). A tree to 9 m, but a tall shrub in the open; white flowers in small panicles from the upper leaf axils, round or oval purplish red fruit. 63:112P, 115.
- Eugenia corynantha* (*Syzygium corynanthum*). A tree to 30 m in rainforest; white flowers in short panicles at the ends of the branches or from leaf axils; orange-red funnel-shaped fruit.
- Eugenia luehmannii* (*Syzygium luehmannii*). A tree to 30 m in rainforest, but a narrow dense shrubby tree in the open; small flowers; fruit oval, red. 49:201.
- Eugenia moorei* (*Syzygium moorei*). A tree to 23 m in rainforest; pink to red flowers in dense panicles from the branches below the leaves; white fruit.
- Eugenia wilsonii*. A sparse straggling shrub or small tree in rainforest; terminal clusters of red flowers; small white fruit. 37:20, 49:204P, 63:128.
- Euodia elleryana*. A tree to 25 m in rainforest, but forming a quick-growing open pyramid-shaped tree to 9 m in the open; large trifoliate leaves; dense clusters of pink to lavender flowers along the branches. 49:201P, 63:115, 65:240P.
- Euodia micrococca*. A small tree with trifoliate leaves and bearing dense clusters of white flowers below the leaves.
- Eupomatia laurina*. An erect shrub or small tree; broad simple leaves, more or less in two rows; flowers cream in the leaf axils, at first covered with a cap; edible globular flat-topped fruit.
- Ficus hillii*. A large very spreading dense tree with somewhat drooping branches. 32:174.
- Ficus macrophylla*—Moreton Bay Fig. A large tree to 45 m in rainforest; huge trunk over 2 m diameter often formed by fusion of roots that have enmeshed another tree. In an open situation it may form a very spreading tree to 10-12 m. 64:179.
- Ficus rubiginosa*—Port Jackson Fig. A large tree to 45 m in rainforest. 27:299.
- Ficus superba* var. *henniana* (*gracilipes*). A partly deciduous tree to 8 m.

- Ficus virens*. A large partly deciduous tree to 30 m, sometimes growing directly in the soil, but more often initially as an epiphyte; then with its roots enmeshing and strangling the host tree. Colour plate on page 336.
- Floydia praealta*. A 20 m tree in rainforest, 3-4 m in the open; leaves similar to *Stenocarpus sinuatus*; white flowers in narrow racemes about 15 cm long; reddish or rusty 6 cm diameter fruit.
- Glochidion ferdinandi*. A tree to 25 m or much less in the open; simple leaves, but the small twigs easily mistaken for pinnate leaves; insignificant flowers in the leaf axils followed by dry flattened ribbed capsules. 28:360, 55:114.
- Gmelina leichhardtii*—White Beech. A large tree to 40 m in rainforest or 6-10 m and spreading in the open; broad oval leaves, purple and white flowers in erect terminal pyramid-shaped panicles; fruit purple. 15:96.
- Grevillea hilliana*. A tree to 30 m in rainforest, but lower and spreading in the open; large leaves often deeply lobed; flowers white in dense cylindrical 10-15 cm racemes. 27:307, 45:7.
- Grevillea pinnatifida*. A tree to 25 m in rainforest, but much smaller in the open; large leaves deeply lobed or entire and copper coloured underneath; small white flowers in branched racemes. 27:308, 45:18,29.
- Grevillea robusta*—Silky Oak. A large tree to 40 m; leaves divided into many narrow segments; one sided 8-10 cm racemes of orange flowers borne mainly on the old wood below the leaves. 21:37, 37:41P, 45:38, 62:63.
- Gymnostachys anceps*. A tufted perennial with tuberous roots; grass-like leaves up to 1 m long; slender wiry flowering stem 1-2 m; tiny dark-coloured flowers in short spikes.
- Harpullia pendula*—Tulipwood. A tree to 25 m in rainforest or much smaller with a dense rounded top in the open; leaves pinnate; panicles of yellowish flowers; two lobed, red or orange fruit. 16:127.
- Helecia ferruginea*. A tree to 9 m in rainforest; large dark green leaves; brownish flowers in dense racemes 9-12 cm long; oval fleshy dark blue fruit.
- Helecia glabriflora*. A shrub or small tree; leaves simple; yellowish flowers in slender racemes; dark blue fleshy fruit.
- Hicksbeachia pinnatifolia*. A slender tree to 8 m; leaves 60 cm or more long, deeply lobed and serrated; flowers in long racemes; fruit oval, red, edible. 55:146.
- Hydrocotyle pedicellosa*. A prostrate creeping perennial herb with orbicular leaves.
- Hymenosporum flavum*. A Native Frangipani. A tree to 20 m in rainforest, but 6-9 m in an open situation; leaves simple; large cream flowers turning yellow, or some forms purple and yellow with age in loose terminal panicles. 41:213, 49:202, 55:142.
- Jagera pseudorhus*—Foam Bark. A tree to 16 m in rainforest, but forming a small compact rounded tree in the open; leaves pinnate; small flowers followed by hairy lobed fruit, at first rich purple, then dull yellow.
- Kreysigia multiflora*. A perennial herb with a short knotted rhizome from which arise simple stems to 30-45 cm bearing stem clasping leaves, 9-12 cm diameter; pink flowers in succession from the leaf axils. 35:120.
- Lobelia trigonocalyx*. A creeping weak perennial herb with erect terminal racemes of blue flowers.
- Lomandra spicata*. A coarse grass-like perennial with short creeping rhizomes; dense clusters of narrow leaves to .5 m long; spikes of small flowers followed by yellow fruit.
- Macadamia integrifolia*. A tree to 20 m in rainforest, but much lower and of dense growth in the open; leaves usually in whorls of three; margins smooth or a few teeth; flowers usually creamy white with few hairs in pendulous racemes; nuts round and smooth. 37:29, 63:119.
- Macadamia tetraphylla*. A tree to 20 m in rainforests, but much lower and of denser growth in the open; leaves usually in whorls of four, long, narrow and much toothed; flowers usually pinkish and densely hairy in pendulous racemes; nuts rough. 37:29, 55:146.

- Mallotus clayoxyloides*. A tall shrub or small tree with broad leaves; inconspicuous flowers and a rough three lobed dry capsule.
- Melia azedarack*—White Cedar. A large deciduous tree to 50 m in rainforest, or a much lower spreading tree in the open; leaves bipinnate; lilac coloured flowers in large panicles from the leaf axils. 14:55, 15:36, 39:112, 55:122, 64:167.
- Microcitrus australasica*—Finger Lime. A spiny shrub or small tree; leaves small and simple; fruit 3-12 cm long, 1-2 cm in diameter.
- Microcitrus australis*. A spiny shrub or small tree to 6 m; leaves small and simple; globular fruit 3-6 cm in diameter.
- Nothofagus moorei*—Antarctic Beech. A tree to 30 m, but generally much less and of irregular growth and shape; leaves tough and camellia-like; male catkins in the lower leaf axils; female flowers in the upper leaf axils.
- Omalthus populifolius*. A tall, soft-wooded, quick-growing shrub or small tree with broad simple leaves; insignificant flowers. 41:213.
- Oreocallis pinnata*. A tree to 20 m or more in rainforest, but much smaller in exposed site; leaves pinnate or simple, flowers red, crowded into broad, erect heads at the ends of the branches. 37:4P,7,36.
- Oreocallis wickhamii*. A tall tree in rainforest, but 6-9 m when grown in the open; immature leaves large and lobed; mature leaves smaller and entire; flowers in corymbs in the upper leaf axils and at the ends of the branches. 37:4P,36, 49:202.
- Orites excelsa*. A tree to 30 m in rainforest, but much smaller in the open. Juvenile leaves, large, serrate and deeply divided; mature leaves small and entire; white flowers in slender spikes from the leaf axils.
- Orthothylax glaberrimus*. A tufted perennial with sword-shaped leaves produced in broad fan-shaped clumps; leaves 1-2 m long; showy panicles of pinkish flowers longer than the leaves.
- Pentaceras australls*. A tree to 20 m in rainforest, but usually 3-4 m in the open; leaves pinnate; numerous white flowers in large loose-spreading terminal panicles. 65:212.
- Phaleria chermisideana*. A small erect tree; leaves simple; flowers pinkish in terminal or lateral heads, perfumed; fruit oval red, 2 cm long. 24:172.
- Pilidiostigma glabrum*. A moderate to tall shrub; leaves simple; cream flowers in short cymes from the leaf axils; oval black fruit. See page 369.
- Pithecellobium grandiflorum*. A small shrubby tree sometimes to 9 m; leaves bipinnate; large flowers in terminal panicles; long crimson and white stamens; pods 15-18 cm long, flat and curled. 49:204. Colour-page 337.
- Planchonella australis*—Black Apple. A tree to 30 m in rainforest; leaves simple; flowers not conspicuous; fruit 6 cm diameter, dark plum coloured when ripe.
- Pleiogynium cerasiferum*—Burdekin Plum. A tree to 25 m in rainforest, but to about 6 m and spreading in the open; leaves pinnate; flowers in panicles from the upper leaf axils; fruit 2-5 cm in diameter, purple when ripe. 62:71, 63:123.
- Polia crispata*. A robust creeping herb, rooting at the nodes and resembling a robust Wandering Jew; small white flowers clustered in a terminal panicle.
- Polia macrophylla*. A robust creeping herb, rooting at the nodes and resembling a robust Wandering Jew; small white flowers clustered in a terminal panicle.
- Psychotria simmondsiana*. A small leafy shrub of 1-1.5 m; heads of small white flowers; small pale yellow fruit.
- Quintinia sieberi*. A tree to 25 m in rainforest, but much shorter in the open; leaves simple; white flowers in racemes from near the ends of the branches.
- Randia benthamiana*. An erect shrub to 3 m; leaves oval, 10-18 cm long; fragrant white flowers with narrow petals; fruit oval, 2-3 cm long.
- Randia fitzalanii*. A tree to 18 m in rainforest, but much smaller in the open; leaves broad and simple; fragrant white flowers; globular fruit 3-6 cm diameter.

- Rhodamnia argentea*. A tree to 30 m in rainforest, but a slender tree to about 6 m in the open; leaves simple three nerved; flowers perfumed and creamy white in cymes in the leaf axils; berries black.
- Rhodamnia trinervia*. A tree to 28 m in rainforest, but usually a tall shrub in the open, leaves simple, three nerved; flowers creamy white in small cymes in the leaf axils and along the smaller stems; red berries.
- Rhodomyrtus psidiodes*. A tree to 12 m in rainforest, or a small to spreading shrub, sometimes forming colonies in the open; leaves simple; cream flowers in cymes from the leaf axils and smaller stems.
- Rhodosphaera rhodanthema*. A tree to 25 m in rainforest, but much shorter in an exposed situation; leaves pinnate; small red flowers in dense panicles; dry shiny light brown berries.
- Schefflera actinophylla* (previously known as *Brassaia actinophylla*). A tree to 12 m, or often growing as an epiphyte on the forks of other trees; large digitate leaves; huge branched terminal head of long racemes of small red flowers. 15:85,87, 31:108, 62:63, 63:107,113P.
- Schizomeria ovata*. A tree to 30 m in rainforests, but often a large spreading shrub in the open; leaves simple, serrated; small flowers in loose terminal cymes; edible white fruit 2 cm diameter.
- Scolopia brownii*. Sometimes a tree to 25 m, but more often a small spreading tree or large shrub; leaves simple, but sometimes with one or two angles on the margins; short racemes of tiny yellowish flowers in the leaf axils; small globular fruit.
- Stenocarpus sinuatus*—Wheel of Fire. A tree to 30 m in rainforest, but usually a narrow 8-10 m tree in the open; leaves large and lobed, or smaller and entire; red flowers in wheel-like clusters from the leaf axils or old wood. 36:364P, 45:18.
- Stenocarpus salignus*. A tree to 30 m in rainforest, but much smaller in exposed situations; leaves mostly entire; spherical clusters of green and white flowers from the leaf axils.
- Sterculia quadrifida*—Peanut Tree. A tree to 18 m in rainforests, but smaller in drier or exposed situations; broad leaves; short racemes of greenish flowers; 6-9 cm follicles, bright red when ripe. 9:3, 15:88.
- Symplocos stawellii*. A tree to 30 m in rainforest, but much smaller in an exposed site; leaves simple; racemes of small white flowers from the leaf axils.
- Synoum glandulosum*. A tree to 18 m in rainforest, but small and shrubby in the open; leaves pinnate; short axillary panicles of four petalled white flowers; three lobed fruit, often red in colour.
- Tieghemopanax elegans*—Celery Wood. A slender tree to 25 m in rainforest; large bipinnate leaves smelling of celery. 15:96.
- Tieghemopanax murrayi*. A palm-like tree, unbranched, to 6 m or more; long feathery pinnate leaves.
- Tristania conferta*—Brush Box. A tree to 40 m in rainforest, but much smaller in drier exposed situations; leaves simple, crowded at the ends of the branches; white flowers in cymes just below the leaves, or in the axils of the lower leaves. 10:27, 34:274.
- Tristania laurina*—Water Gum. A tree to 20 m in rainforest, but much smaller in drier or exposed situations; leaves simple; flowers yellow from the leaf axil. 34:275, 55:132.
- Triunia youngiana*—Spice Bush. A low to tall straggling shrub; leaves simple, but often slightly toothed; fragrant white or pink flowers in erect terminal 4-6 cm racemes. Colour plate on page 369.
- Trochocarpa laurina*. A tree to 12 m in rainforest, but in the open a shrub or small tree; leaves clustered at the ends of each year's shoots, brightly coloured while young; terminal spikes of small white flowers; small black fruit. 25:196.
- Viola hederacea*. A tufted or creeping herb; leaves 2-5 cm broad; blue and white flowers 2-3 cm in diameter. 74:277P.

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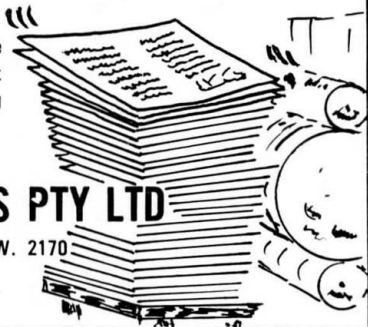
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