CONTINUING EDUCATION

ROSEWOOD

Dysoxylum fraseranum

A rainforest tree, common in N.S.W.

HOW TO IDENTIFY PLANTS

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Published by Department of Continuing Education
North Coast Regional Office & Namoi Regional Office
P.O. Box 200, P.O. Box 591
COFFS HARBOUR JETTY 2451 TAMWORTH. 2340

Printed by University of New England Printery

First Printed 1979
Reprinted February 1984
ISBN 0 85834 279 0

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INTRODUCTION

These notes are designed to help in the identification of plants in the field, and at home, by giving the basic outline of plant structures and the terms used to describe them. Such an understanding is necessary so that various "Regional Floras" can be used to identify and check the descriptions of plants.

Plant structures make us think! All structures, and modifications of them, have significance. It is important and interesting to look at the ways plants have adapted to unfavourable conditions. At how plants protect themselves and often prevent themselves being eaten by animals. The various mechanisms plants have developed to help them climb and so be exposed to the sunlight.

Many modifications are to ensure the species continues. Whether such modifications enable the plant to replicate itself without sexual reproduction, or by allowing it to survive on stored food reserves and water over unfavourable times, or to produce flowers and seeds under such conditions and then die.

The basic function of flowers is sexual reproduction. To ensure that this takes place and that cross pollination occurs, the structure and the colour of the flower varies and is related to the pollinating agent. Pollen can be carried by wind, water, insects or birds.

It is essential not only that plants reproduce, but also that the seeds are scattered over wide an area as possible. The fruits are adapted for this role of dispersal. Some are eaten by animals, and so the seeds are scattered far and wide. Some fruits have hooks, etc., so that they can be carried by animals. Others are adapted to be blown in the wind, carried by water or have their own explosive mechanism to disperse them.

Many plants can be recognised by their general appearance. However, if we want to be certain of their identity we need to know exactly what to look for, and the essential characters which distinguish one kind of plant from another.

The most notable feature in many plants is the flower. It is often the colour which attracts attention – but this is not sufficient to distinguish one plant from another. It is necessary to look at the shape and form of the flower and how the flower is arranged on the plant. Other characters are also useful and often essential in determining its identity. These include the structure, arrangement and appearance of the leaves, the habit of growth, and the type of fruit. Therefore it is necessary to look at the basic structure of the whole plant and at the terms used to describe them.

BASIC STRUCTURES OF THE FLOWERING PLANTS

Plants have underground and aerial organs. In the identification of plants it is usual to consider the aerial parts as being most important as they are the most conspicuous. In most cases it will be found that the flower is the structure most commonly used in classifying and identifying plants. However, in distinguishing between some groups the subterranean structures are also referred to.

UNDERGROUND STRUCTURES

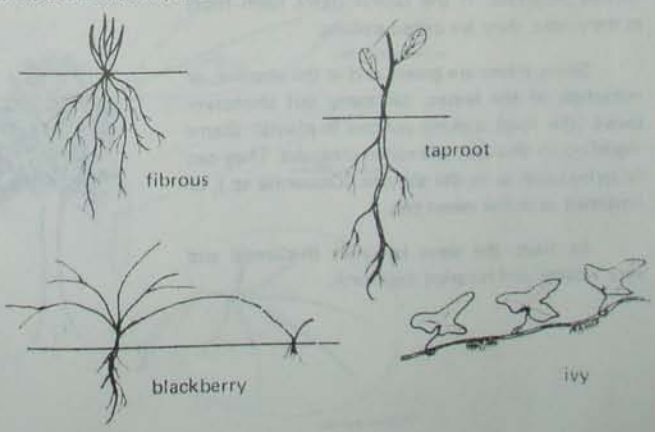
Underground parts can be roots or modified stems.

Roots anchor the plant in the soil and absorb moisture from it, and have food stored in them. Roots can be classified as *fibrous, tap,* or *adventitious.*

Fibrous roots are numerous ones, of similar size arising from a common point, as in many grasses.

A *taproot* is a single main root with smaller roots branching laterally from it. Many taproots are swollen and store large amounts of food reserves, as in the carrot.

Adventitious roots grow from stems or leaves. Such roots can be seen growing from ivy stems to help it climb, and in blackberries when the tips of the stems touch the ground.



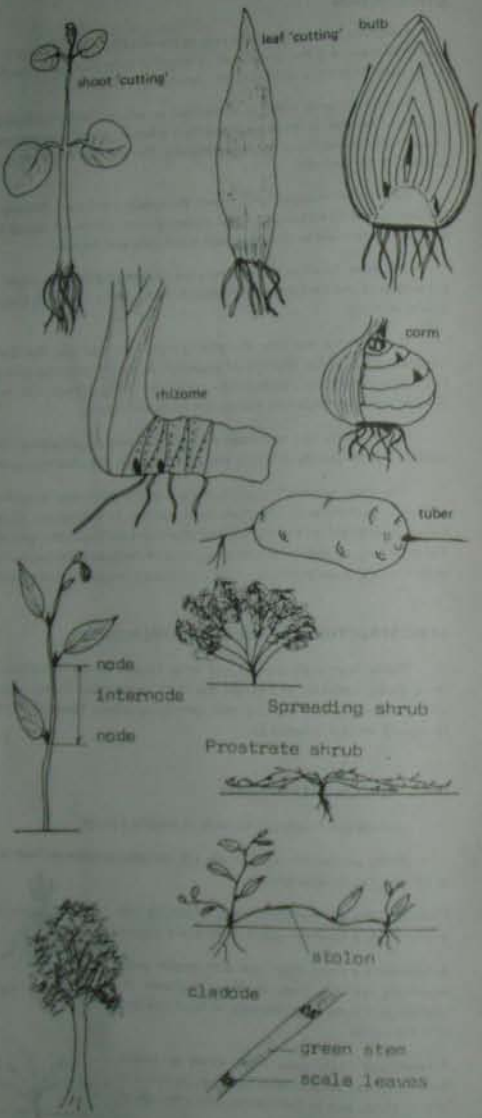
The capacity of some plants to form adventitious roots is exploited by plant propagators in the establishment of new plants exactly the same as the parent, as in 'layering' and shoot and leaf 'cuttings'.

Most stems are above the ground but some are partially or completely subterranean. Such stems are usually modified and often are food storage organs. One of these specialised stems is a *bulb*, which consists of a very short stem surrounded by many fleshy leaves. Onions and daffodils are bulbs.

A *corm* is another underground stem similar in many ways to the bulb, but lacking the fleshy leaves. In this case the stem is compressed, with scaly leaves around it, as in the gladiolus.

A *rhizome* is an elongated stem, more or less horizontal, growing partly or completely beneath the ground. Iris has a swollen rhizome, most ferns have a rhizome.

A *tuber* is a swollen underground stem with numerous buds called 'eyes', as in the potato.



AERIAL STRUCTURES

STEMS

The stem is the typically upright portion of the plant connecting the roots with the foliage. It is distinguished from a root by having joints, *nodes*. Leaf buds and lateral shoots develop at the nodes: the spaces between the nodes are called *internodes*.

Stems are considered *simple* when made up of one main axis, or *branching*, when as in many shrubs, lateral shoots occur. Although most stems are *erect*, some are oblique to the ground and termed *spreading*. When stems are flat on the ground, as in some *Hibbertia* species, they are termed *prostrate*. If the lateral stems form roots at the nodes, they are called *stolons*.

Some stems are green, and in the absence, or reduction of the leaves, can carry out photosynthesis (the food making process in plants). Stems modified in this way are called *cladodes*. They can be cylindrical as in the she-oak (*Casuarina* sp.), or flattened as in the sweet pea.

In trees the stem becomes thickened and very woody and is called the *trunk*.

LEAVES

Leaves are lateral outgrowths of stems, arising at nodes, and are responsible for photosynthesis in the majority of plants. Leaves have a bud in the fork between its base and the stem – such a bud (called an *axillary bud*) can develop and give rise to leafy branches and, or, flowers.

Most leaves are divided into a flat blade or *lamina*, and a narrow stalk or *petiole*. The petiole attaches the leaf to the stem at the leaf base. If the petiole is lacking and the blade is attached directly to the stem the leaf is said to be *sessile*.

Some leaves have small accessory leaf-like structures where they join the stem, called *stipules*. Stipules may fall off after a short time and leave scars, or may be permanent structures and take various forms, such as spines in *Acacia armata*.

In certain plants, such as grasses, the leaves are divided into a blade and a sheathing base which encircles the stem. At the junction of the blade and the sheath there may be a small flap of tissue called the *ligule*.

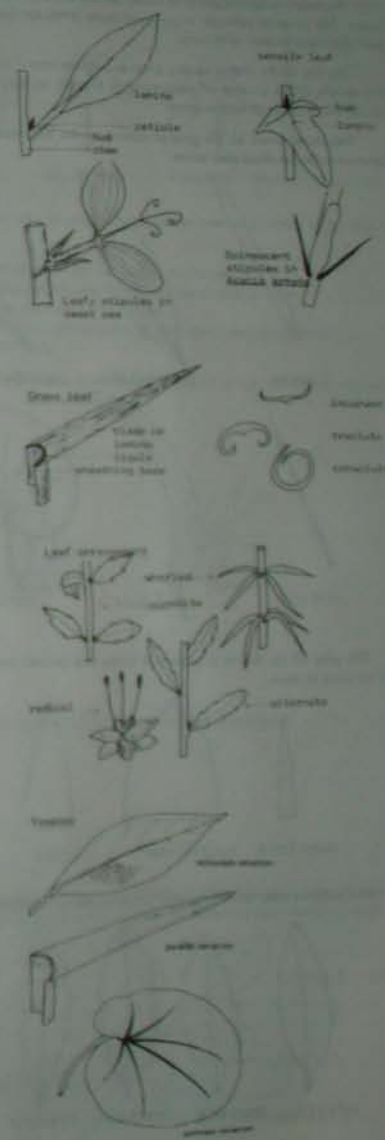
Leaves may be relatively flat or have their margins curved, or rolled, upwards or downwards, in extreme cases the margins overlap each other (*convolute*).

In some plants such as onions and some water plants the leaves are tubular.

Leaves can be arranged in a number of ways on the stem. If two leaves are opposite each other at a node then the arrangement is called *opposite*. If more than two at the same node, *whorled*. Usually leaves are spirally arranged on the stem, with one at each node, and the arrangement *alternate*.

Sometimes the leaves have developed on such short stems that all the leaves appear to come from ground level where they form a *rosette*, such leaves are called *radical* leaves. The collective term referring to leaves on an elongated stem is *cauline*.

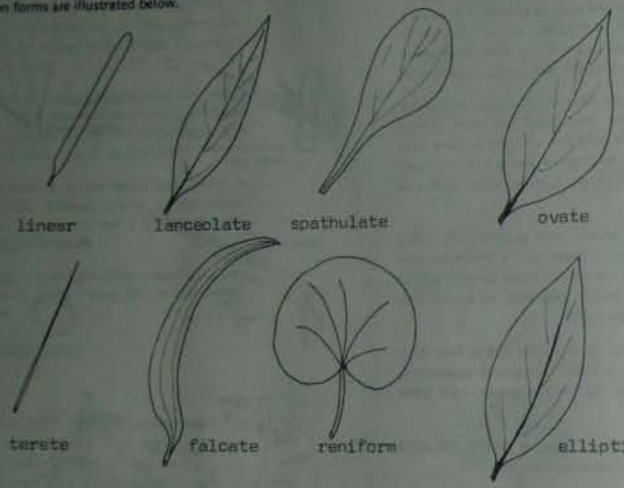
The *venation*, the distribution of the veins in the leaf is often used in the classification of plants. The venation is usually *reticulate*, *parallel* or *palmate*. In reticulate venation a network of veins is usually obvious, with a midvein and smaller veins branching from it. In *parallel* venation many veins are present and more or less parallel to each other and the leaf margin, as in a grass leaf. *Palmate* venation often occurs in rather broad leaves in which two or more large veins arise at or near the base of the lamina.



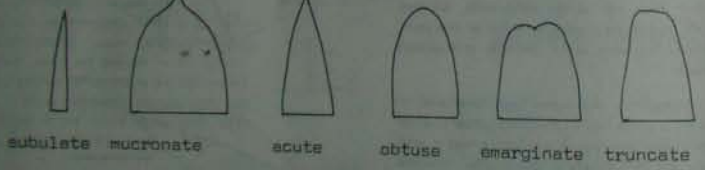
The chief variable features of leaves are the overall size and shape, the apices, margins and bases, and the texture and colour. The range of variation is great and many terms are used to describe them accurately. Some of the more commonly used terms will be dealt with here.

The size of the leaf is usually given as a measurement of the length and breadth at its widest point, in millimeters or centimeters. Often a range of measurements is given to cover the average sizes. Occasionally the size is given as a ratio, e.g. the leaf is 'twice as long as broad'.

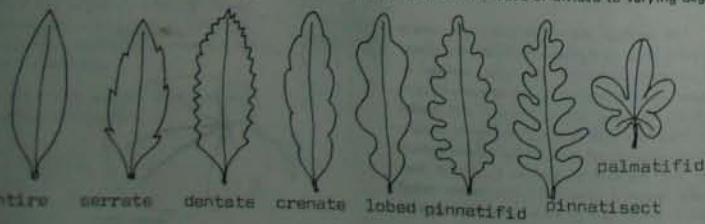
The shape refers to the general outline of the leaf blade usually excluding the apex and base. Some of the more common forms are illustrated below.



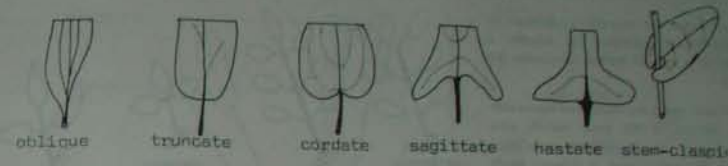
The apex of the leaf in very general terms may be pointed, rounded or flattened. See diagrams below, with the terms used for some of them.



The margins may be entire, that is having no indentations, or may be serrate, lobed or divided to varying degrees.



The *base* refers to the way in which the leaf blade joins with the petiole; these bases can vary in a number of ways. For some plants this is very characteristic.

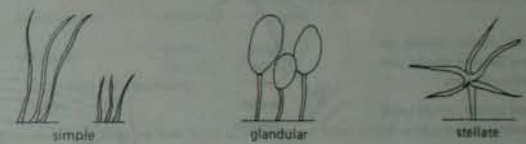


The *texture* of leaves can also vary considerably, this may be primarily due to the internal structure of the leaf, or may also be due to the surface structure of the leaf.

Terms to describe characters relating to the internal structure of the leaf include the following:
mesomorphic — relatively thin, soft leaves as in many rainforest plants, and herbaceous plants such as clover.
sclerophyllous — hard, usually thick leaves as in many wattles, banksias and eucalypts.
succulent — thick, fleshy leaves as in some epiphytes e.g. the orchid *Dendrobium* sp., and many sand dune plants.
membranous — very thin, more or less translucent, as in filmy ferns.

Terms referring to the surface of the leaf include those to describe if hairs are present or not, and if they are present their shape, size, density and stiffness.

Types of hairs include simple, glandular and stellate.

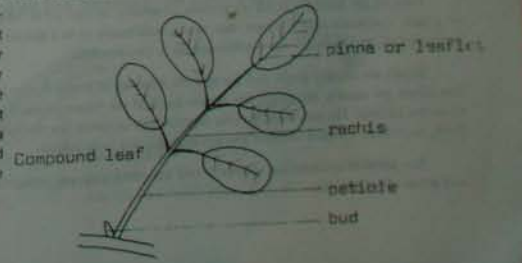


Terms for sufaces which do not have hairs:
glabrous — no hairs present.
glaucous — covered with a waxy, usually whitish covering.
viscid — coated with a sticky substance.

Terms for surfaces which have hairs:
pubescent — often used to mean hairs of any type, more correctly refers to short to medium length hairs.
scabrous — rough to the touch due to short stiff hairs.
hirsute — long, moderately stiff hairs.
tomentose — covered with a mat of short to medium hairs.
villous — long soft hairs present.

SIMPLE AND COMPOUND LEAVES

Leaves may be either simple or compound. A *simple* leaf consists of one definite leaf blade, with or without a petiole. The leaf blade may be variously shaped or lobed. A *compound* leaf is one in which the blade has been divided into definite and distinct segments — *pinnae* or *leaflets* — attached to a common axis or *rachis*. At times it is difficult to decide whether a 'leaf' is simple or part of a compound leaf. If there is a small bud or branch in the fork between the petiole and the stem it is a simple leaf, if no such bud is present the 'leaf' usually is really a leaflet and part of a compound leaf. It is common for compound leaves to have a leaflet at the end of a rachis, while stems never have a leaf in such a position.



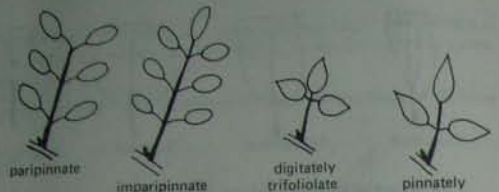
Compound leaves may be divided in a number of different ways. They are classified on how the leaflets are arranged along the rachis, how many arise at one point and if a leaflet is at the end of the rachis.

Pinnate leaves can be either *paripinnate* or *imparipinnate*, depending on whether a leaflet or a pair of leaflets terminates the rachis.

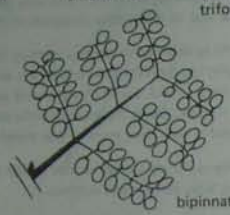
Trifoliolate leaves are compound leaves with three leaflets. If the three leaflets arise at one point, it is a *digitately trifoliolate* leaf. If the leaflets arise at different levels it is *pinnately trifoliolate*.

Palmate leaves have 4, 5 or more leaflets arising from the one point.

Bipinnate leaves are twice pinnately divided, as in many wattles. In such a leaf the leaflets are divided into secondary leaflets or *pinnules*.




palmate leaf


bipinnate leaf

LEAF MODIFICATIONS

Leaves, or parts of leaves, can be modified so that they can function in other than the usual way.

Tendrils can be a leaf, leaflet, stipule, or even a stem which has become slender and coils and aids the plant in climbing.

Phyllode – a flattened petiole, which takes over the functions of the whole leaf, as in many wattles.

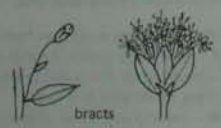
Scale leaves – in plants such as she-oak, (*Casuarina* sp.) the leaves are reduced to scales, and the stem (a *cladode*) usually takes over the functions of them.

Bract – a more or less modified leaf situated in an inflorescence or near a flower, usually with a flower or an inflorescence-branch arising in its axil.


leaflet tendrils


phyllode


scale leaves


bracts

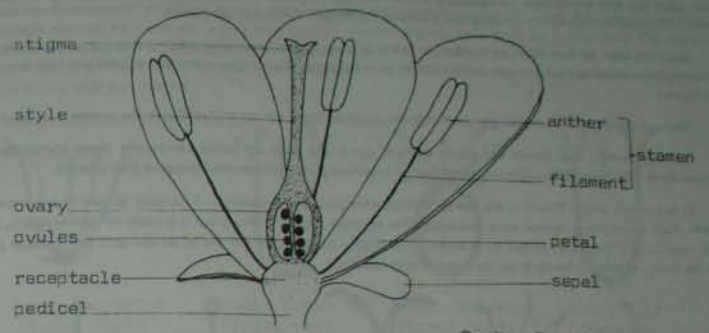
FLOWERS

The function of the flower is to produce seed and so perpetuate the species. It is usually the most notable structure on the plant and it is the one most commonly used in classification and identification as its characters are the most constant. That is, it is not influenced to any marked degree by the surrounding conditions.

Flowers are basically made up of rows, or *whorls*, of four parts, *sepals*, *petals*, *stamens* and *carpels*. These are inserted on a base, the *receptacle*. Flowers may occur individually or in a cluster, an *inflorescence*. The stalk of an individual flower is the *pedicel*, and the stalk of an inflorescence is the *peduncle*.

Sepals are usually green and protect the other parts of the flower in the bud, and are collectively known as the *calyx*. The petals are usually colourful, the showy parts of the flower, attracting insects to the flower and are collectively referred to as the *corolla*. The calyx and corolla together can be called the *perianth*, especially if it is difficult to distinguish between them, as in lilies. Flowers without any perianth are said to be *naked*.

The parts of a flower are shown in the following diagram, indicating those parts which are essential for reproduction and those which are not.



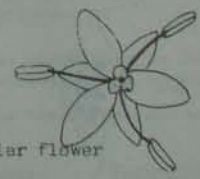
Parts of a Flower

A. ESSENTIAL PARTS
- (Gynoecium – carpels – (stigma, (style, (ovary – ovules
- (Androecium – stamens – (anther with pollen, (filament

B. PARTS NOT ESSENTIAL
- (Perianth – (calyx – sepals, (corolla – petals
- (Receptacle (Hypanthium)
- (Pedicel

Individual petals and sepals may be free from each other, or fused into a tube, part of the way up or all the way to the top. The shape of such a tube may vary.

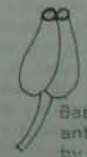
Flowers may be *regular* with the individual parts of each whorl all alike, giving the flower radial type of symmetry. *Irregular* flowers occur when the parts of one whorl are not alike. Such a flower has bilateral symmetry. In extreme forms, spurs, hoods or lips may occur.

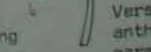

Regular flower


Irregular flower

Petals of different sizes and shapes.

The *stamens* are the male reproductive parts of the flower, and collectively referred to as the androecium. Each stamen consists of a narrow stalk, the *filament*, and the pollen producing portion, the *anther*. The filament may be fixed, or joined to the anther at the base (*basifixed*) or at the back (*dorsifixed*). The anther is said to be *versatile* when it swings freely on the end of the filament.


Basifixed anther dehiscing by terminal pores.


Versatile anther with parallel slits.


Diadelphous stamens.

Anthers release their pollen, *dehisce*, in various ways. The usual method is by parallel slits in the anthers, although in some cases the slits are oblique. Occasionally anthers dehisce by pores. The pollen can be shed towards the centre of the flower – *introrse* dehiscence, or towards the outside of the flower – *extrorse* dehiscence.

Stamens may be free from each other or fused in a number of ways. *Epipetalous* stamens are fused to the petals. *Monadelphous* stamens are fused into one structure, as in Hibiscus. *Diadelphous* stamens are fused into two sets, as in many pea flowers.

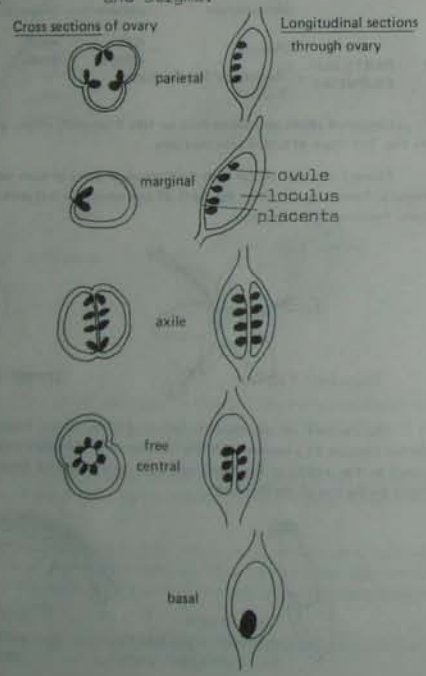
Stamens can be of the same height or of different heights. They may be enclosed with the corolla or extend beyond it.

In some flowers (e.g. *Cassia* sp.) sterile stamens occur and these are called *staminodes*. Some staminodes resemble stamens while others are quite different, some may be modified as nectaries or even petaloid (like a petal).

In the centre of the flower is the female reproductive part, the *gynoecium*. It consists of one or more, free or fused *carpels*. Each carpel has a *stigma*, *style* and *ovary*. The stigma is usually sticky when it is ready to receive pollen. It can be a single structure, often hairy, or can be branched. The stigma is usually at the top of an elongate style, which connects it with the ovary. However, the style can be reduced or even absent.

Single free carpel. 3 free carpels. fused carpels with bifid stigma. fused carpels lobed ovary and stigma. fused carpels simple stigma.

The ovary can be formed from one carpel, or result from the fusion of a number of carpels. It has one or more compartments or *loculi* (sing. *loculus*), in which the *ovules* are attached on *placentae*. The *placentation*, the arrangement of the placentae in the loculi is often used during the identification of plants. It is also important to examine the ovary and determine how many carpels make it up. To do this it is necessary to cut a section across the ovary, and one through it longitudinally. To see the details of the placentation more easily sections through a young fruit should be cut.



Common types of placentation are:

parietal – the ovules are attached to the outer wall of the ovary, which is one-locular and from a number of carpels.
In diagram 3 carpels, 1 loculus.

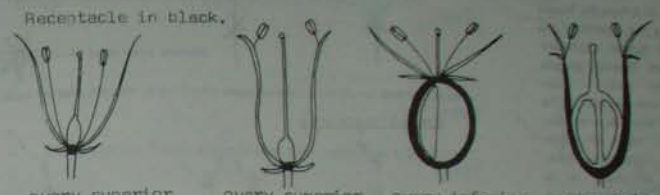
marginal – the ovules are along one side of the ovary, along line of dehiscence, as in a pea.
Always 1 locular from 1 carpel.

axile – an ovary with 2 or more loculi with the ovules attached at the centre, the number of carpels equals the number of loculi.
In diagram 2 carpels, 2 loculi.

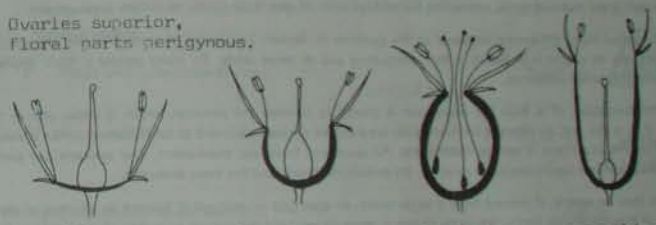
free central – the ovules are borne on a central column in a single loculus, from 2 or more carpels.
In diagram 2 carpels, 1 loculus.

basal – the ovules are attached at the base of the single loculus formed from one carpel.

Flowers can have *superior* or *inferior* ovaries. Flowers in which the floral parts (sepals, petals and stamens) are inserted on the receptacle beneath the ovary are said to have *superior* ovaries, and the floral parts are *hypogynous*. The ovary of a flower in which the receptacle is fused to the sides (and often over the top) of the ovary is *inferior*, and the floral parts which arise on top of the ovary are *epigynous*. In some cases the receptacle is fused only part of the way up the ovary wall and the ovary is said to be *half-inferior*.



In other flowers the floral parts are borne on the rim of an expanded receptacle structure called a *hypanthium*; this cup-like structure is not fused to the ovary wall, so the ovary is still superior. In such cases the floral parts are said to be *perigynous*. The degree of perigyny can vary.



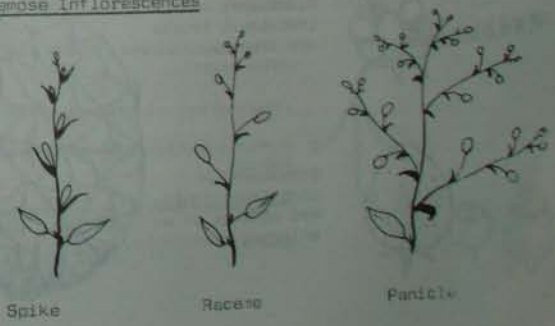
Flowers are usually bisexual, but some are unisexual having only the male or female reproductive structures. Male flowers are called *staminate* flowers, and female flowers *pistillate* flowers.

If unisexual flowers of both sexes occur on the same plant it is *monoecious*. If on two separate plants *dioecious*.

INFLORESCENCES

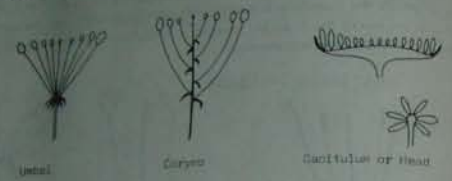
An inflorescence is a stem bearing flowers, it can range from a single flower to a very complex arrangement of many flowers. The stalk of an individual flower is called a *pedicel*, and the stalk of an inflorescence a *peduncle*. Individual flowers may be pedicellate (with a stalk) or sessile (without a stalk) on the stem. Each flower is subtended by a leaf or bract.

Racemose Inflorescences

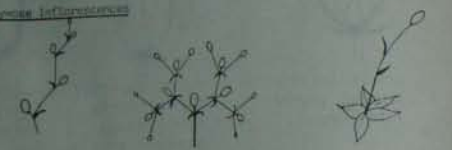


In most inflorescences the oldest flowers are at the base, thus allowing further growth of the stem, and are called *racemose* inflorescences. However, in others the flower terminates the growth of the stem, and further expansion takes place through growth of axillary buds – such inflorescences are said to be *cymose*. There are a number of distinct types of inflorescences, illustrated here, however, at times it is difficult to ascertain the type with certainty.

Racemose Inflorescences (cont.)



Cymose Inflorescences



FRUITS

A fruit is technically a ripened ovary and it contains the seeds. It may assume a number of forms depending on the number and arrangement of carpels in the flower and on whether any other structures are associated with it.

The seed is the matured ovule, containing the embryo with its own food supply to initiate development.

Many actual fruits are known as 'seeds' to the gardener or farmer. The kernel of corn or wheat, the so called 'seed' of the sunflower or carrot is in reality a fruit containing one or more seeds. To many people a 'fruit' implies a fleshy structure, but this is not always so.

In the formation of a fruit the ovary wall is altered to become the *pericarp*, which is either *dry* or *fleshy*, i.e. succulent. If it is dry and on ripening the fruit splits open to free the seeds it is said to be *dehiscent*; or the whole fruit may be shed from the plant and is termed *indehiscent*. All succulent fruits are indehiscent. The pericarp can sometimes be distinguished into three layers, the outer *exocarp*, the middle *mesocarp* and the inner *endocarp*.

Fruits may be simple, if derived from a single ovary, or aggregate or multiple if formed by clusters of simple fruits. *Simple fruits* may be dry or fleshy; the ovary of one or more carpels; and the mature fruit may be dehiscent or indehiscent. *Aggregate fruits* are formed from a single flower and consists of many simple fruits attached to a common receptacle, as in a blackberry and strawberry. *Multiple fruits* are formed from several flowers more or less grown together into a single mass.

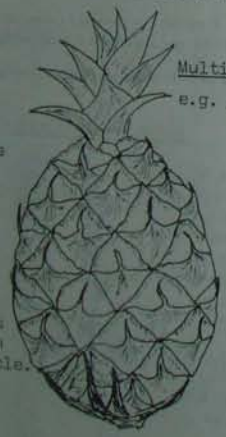
Aggregate Fruits

Blackberry – individual fruits are drupes.

Strawberry – individual fruits are achenes on an enlarged receptacle.

Multiple Fruit

e.g. pineapple



KEY TO MAIN TYPES OF SIMPLE FRUITS

A *FRUIT FLESHY*, often brightly coloured

B Seed or seeds enclosed in a woody inner layer of fruit, e.g. cherry
..... DRUPE

B* No woody inner layer present.

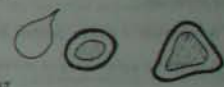
C Ovary inferior. Main fleshy layer formed from floral cup, e.g. apple
..... POME

C* Ovary superior. Fleshy tissue formed from ovary wall, e.g. tomato
..... BERRY

A* *FRUIT DRY WHEN MATURE*

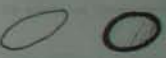
D *Fruit not splitting open when ripe*

E Wing present on 1-seeded fruit, e.g. maple
..... SAMARA



E* No wing present

F Single seed loose inside the fruit
..... ACHENE & NUT



F* Single seed fused to ovary wall, e.g. in all grasses
..... GRAIN

D* *Fruit splitting open, or apart when ripe*

G Fruit separating into carpels when ripe, e.g. geranium
..... SCHIZOCARP

G* Fruit splitting open by valves, without separating into carpels.

H Fruit from a single carpel (or free carpels)

I Fruit opening on one side only, e.g. *Grevillea*
..... FOLLICLE

I* Fruit opening along 2 sides, e.g. peas and *Acacia*
..... LEGUME or POD

H* Fruit from a compound ovary, i.e. from 2 or more fused carpels.

J Two valves separating from base upward, leaving a partition
..... SILIQUA

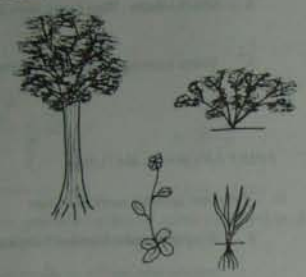
J* Fruit splitting differently, often by valves from apex down, e.g. tulip, eucalypt, poppy
..... CAPSULE

CLASSIFICATION OF VEGETATION

PLANT HABIT

It is essential in identifying plants that we look not only at the individual structures which make it up, but also at the plant as a whole and its relationship with the environment. We assume that a plant is adapted to the habitat it occupies and that the adaptation is expressed in its habit, or form of growth. Leaves show great variety of form: the shape, size and texture can reflect responses to different conditions. In Australia leaf texture is particularly important and can be related to habitat conditions.

A relatively simple method of classifying plants is into three basic groups on their habit – trees, shrubs or herbs.



A *tree* is defined as a woody plant more than 5 m. high, and with usually one stem.

A *shrub* is a woody plant less than 5 m. high, and usually with more than one stem arising from near ground level.

A *herb* is a non-woody plant.

Such a distinction between herbs and shrubs is not always clear cut, as at times it is difficult to decide on whether a plant is woody or not.

Other terms can be used to describe habits of plants which do not fit easily into the above groups, or are adapted to growing under special conditions.

An *epiphyte* is a plant perched on another, but not obtaining nourishment from it, many orchids are epiphytes.

A *parasite* is a plant living on another and deriving nourishment from the host plant, e.g. mistletoes.

A *saprophyte* is a plant using dead organic matter as food stuffs, as in many fungi.

Hydrophytes are plants which live in water or permanently damp places, their stems and leaves are adapted to live in water.

Xerophyte is a term used to cover plants growing in dry conditions, a drought resistant plant.

A *liana* is a climbing plant with a woody stem that twines around other plants. Lianas are common in rainforests.

PLANT COMMUNITIES

In a given area a number of individual plants will occur and these collectively form a plant community. Although each plant is largely independent of the others, within the community they will certainly influence one another. A tree will affect smaller plants by shading them, providing shelter from wind and possibly competing with them for moisture and nutrients from the soil.

Factors which control the plant community are climate, topography, soil parent material, length of time it has had to develop, and biotic factors such as man, animals, micro-organisms, the plant species available to the area (the flora), and competition between them. Relationships between these factors are complex and dynamic. If one component changes, or is altered, the effects are felt throughout the whole system. These factors, the living and the non-living, together with the plant community, and all the interactions between them form the *ecosystem*.

Plant communities can be distinguished on the basis of their general structure. This can be done without knowing the names of any of the species and using only the form and spatial distribution of the plants. It is on this basis we recognise the broad types of vegetation known as forest, woodland, heath, grassland etc. Each of these structural forms can be divided into sub-forms, and some of the most commonly found are:

Rainforest – tropical, sub-tropical and temperate rainforest.
Sclerophyll Forest – wet and dry sclerophyll forest.
Woodland – tall and savannah woodland.
Other forms are heath, bog, fen, alpine herbfield, savannah and grassland.

Trees or shrubs are the dominant forms of growth in many Australian plant communities, but they may be absent from ones developed in areas subject to water-logging, severe frost, or prolonged drought. In these situations a wide variety of forms may be the conspicuous part of the community. For example, in waterlogged, swampy conditions water and marsh plants will abound, some with their shoots in the water, others with them in the air. Frost pockets may give rise to *grassland*. Poorly drained, broad shallow valleys in cooler areas give treeless swamps, with sedges and rushes prominent and in some cases *Sphagnum bogs* are formed.

CLASSIFICATION OF THE PLANT KINGDOM

All plants may readily be separated into two divisions, plants without seeds and plants with seeds. The former include the bacteria, seaweeds, pond-slimes, moulds, fungi, lichens, liverworts, mosses, club-mosses and ferns. The majority of such plants are not a conspicuous part of the vegetation and therefore often not considered to be of any great importance. However, each group plays an important role within the ecosystem. Little work has been done on many of these groups in Australia and so information is not readily available.

The most primitive plants are those which have not developed the capacity to live and reproduce on land. This is due largely to the reproductive structures being uni-cellular and not having any protective structures around them. Also the plant body is not differentiated into true vegetative structures as in the higher plants.

Such primitive plants with chlorophyll (green pigment) are called *algae* and those without chlorophyll *fungi*.

Algae are plants of wide distribution, mainly in fresh or salt water, but also in damp soil. They may be single-cell organisms, in filaments, or form colonies. The seaweeds, such as kelps, can have very large plant bodies but they do not have roots, stems or leaves.

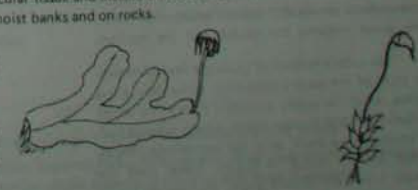
Fungi lack chlorophyll and so are unable to manufacture their own food. They live either as parasites on other living organisms or as saprophytes which obtain their food requirements from dead organic matter. Fungi, together with bacteria are the decomposers within the ecosystem.

Fungi consist of microscopic filaments which grow by elongating and branching and which often form a solid mesh of threads. The most obvious parts are usually the spore producing organs, as in mushrooms. The most conspicuous fungi are toadstools, puff balls and bracket fungi, which are often brightly coloured.

Lichens are a unique group of plants in which two completely different organisms form one composite body. The organisms are an alga and a fungus, both of which are essential, closely associated in a mutually beneficial union. Lichens are important pioneering organisms since they are the first conspicuous plants to colonize bare rock surfaces. Small crustaceous lichens appear first, etching the rock surface with acid excretions. Particles of dust gather around the lichen enabling larger lichens, mosses and eventually higher plants to be established.

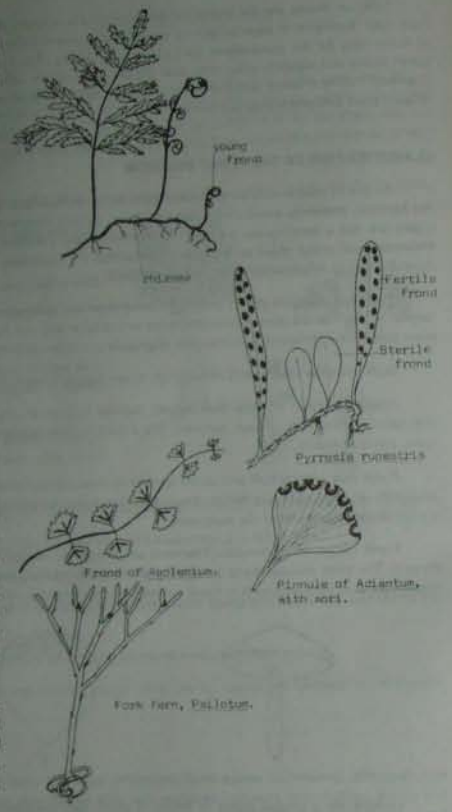
The first group of plants which are specialised to live on land are the *bryophytes*: the liverworts, hornworts and mosses. These plants are small in size and have no vascular tissue and instead of roots have simple rhizoids. They are usually found growing in masses in moist areas such as along moist banks and on rocks.

Liverworts are usually flattened structures, which branch dichotomously, and are attached to the ground by rhizoids.



Mosses usually have an erect stem which bears small leaves. The spore bearing capsule can often be seen at the end of the stem. Mosses shrivel up during dry periods but readily recover after rain. Large areas of *Sphagnum* moss can form bogs.

The *ferns* are the first major group in the plant kingdom which have vascular tissue for conducting water and nutrients throughout the plant body. They, in common with higher plants, have roots, stems and leaves. Most ferns are shade-loving plants of relatively small size, their upright leaves or *fronds* generally being the most prominent feature. The fronds vary greatly in form, texture and size, from a few centimetres and membranous in *Hymenophyllum* to 3 metres long and leathery in the tree fern *Cyathea*. They differ from leaves of flowering plants in that spores are frequently borne on the lower surface. Most ferns have an underground rhizome with fronds and adventitious roots at the nodes.



Reproduction in ferns may occur in one of the following ways.

I. *Vegetative* reproduction by the death and decay of older portions of the rhizome and subsequent separations to give new plants. In some species the development of leaf-borne buds which become detached and grow into new plants.

II. *Sexual* reproduction by spores. The spores are borne in *sporangia* which usually develop on the lower surface of fronds. Not all fronds are fertile (i.e. spore producing) and they may not be the same shape as the sterile (non-spore producing) fronds. The distribution and the shape of the sporangia varies considerably and is used in the classification of ferns. Sporangia may cover much of the surface of the frond or be grouped into *sori* which develop in definite relationship with the veins or margins of the frond. Sori may be protected by a flap of tissue – the *indusium*.

Fern Allies is a heading to include the most primitive vascular plants which are closely related to ferns, but differ mainly in their reproductive and leaf structures. This includes the skeleton fork-fern, *Psilotum*; adder's tongue, *Ophioglossum*; club-mosses, *Lycopodium*; and species of *Selaginella*.

The second major group of the plant kingdom, the seed producers, is the one which gives the most conspicuous plants in the vegetation. These plants have developed the most extensive and effective root and stem systems which have enabled many to become very large trees. These plants can be readily divided into the *Gymnosperms* and the *Angiosperms*, on the position and protection given the ovule and seed during development.

The Gymnosperms have seeds which are not enclosed in an ovary but naked on seed leaves, or scales, which are usually spirally arranged in cones. This group includes the *cycads* and the *conifers*.

The *cycads* millions of years ago formed extensive areas of the earth's vegetation, today only a few genera remain in widely separated areas of the world. Cycads have large pinnate leaves, usually coming from an underground trunk, as in the Burrawangs (*Macrozamia* species) found in N.S.W. Large male and female cones are formed singly, on separate plants.

Conifers are the dominant trees over large areas of the Northern Hemisphere. Most have narrow, needle-like leaves as in the pines, firs and cedars. Australia has only three conifer genera, the most widespread being the cypress pine, *Callitris*. These trees have scale leaves and small globular cones occuring singly or in groups on the ends of small branches.

Angiosperms are the flowering plants with their ovules and seeds enclosed in an ovary. They are the vast majority of plants in Australia. The angiosperms are divided into the *monocotyledons* and the *dicotyledons*. The monocotyledons produce only one seed leaf or cotyledon on germination, while the dicotyledons produce two. There are a number of external differences between the groups which are more readily discernible, and are usually consistent for the group.

Monocotyledons	*Dicotyledons*
One cotyledon or seed leaf.	Two cotyledons or seed leaves.
Parallel venation in leaf.	Reticulate venation in leaf.
Parts of flower in 3's.	Parts of flower in 4's and 5's.
Fibrous root system.	Taproot system.

In the field the venation and number of flower parts are the most distinctive characters.

SIMPLE KEY TO THE MAJOR GROUPS OF PLANTS

1 No vascular tissue present.
- 2 Plant body not specialised into stem and leaves, reproductive cells not surrounded by protective layer.
  - 3 Chlorophyll present.
    - 4 Plants usually in water ..... Algae
    - 4* Plants usually on rocks or trees ..... Lichens (also some algae)
  - 3* Chlorophyll not present ..... Fungi
- 2* Plant body often specialised into stem and leaves, reproductive cells surrounded by protective layer.
  - 5 Plant body dorsiventral, thalloid or leafy ..... Liverworts
  - 5* Plant body radial, leafy ..... Mosses

1* Vascular tissue present ..... Ferns
- 6 Sexual reproduction by spores ..... Ferns
- 6* Sexual reproduction by seeds ..... Gymnosperms
  - 7 Seeds not enclosed in an ovary, but often on scales in a cone ..... (Angiosperms)
  - 7* Seeds enclosed in an ovary, flowers present ..... Monocotyledons
    - 8 Parallel venation in leaf, flower parts in 3's, fibrous root system ..... Dicotyledons
    - 8* Reticulate venation in leaf, flower parts in 4's or 5's, taproot.

FLORA LISTS

Lists of plants growing in a specific area, such as a National Park, usually includes all the species known to occur within the Park boundaries and species occuring nearby and suspected of growing within the Park itself. Such a list is called a 'flora list'. Some areas have 'plant lists' which include only the species known to occur within the area.

In N.S.W. the National Parks and Wildlife Service is standardizing all flora lists, with vascular plants being listed in four groups (I-IV). Within each group the families, genera and species are listed alphabetically, except in Group I, where all the genera and species are listed alphabetically, not in families.

Group I	Ferns and Fern Allies
Group II	Gymnosperms
Group III	Monocotyledons, and
Group IV	Dicotyledons.
Group V	Non-vascular plants listed under mosses, liverworts, lichens etc. alphabetically by genera.

Plant lists of various kinds are available from many National Parks, Reserves and other areas of interest. These are valuable as records of a species distribution and in comparing species growing in one area with those in another.

SCIENTIFIC PLANT NAMES

Each of the major groups of plants is further split into *orders*, and the more commonly used divisions of *families*, *genera* (sing. genus) and *species*. The species form the units on which the whole classification system is built. The scientific name of every species is a *binomial* consisting of two words, the genus name and the specific epithet. For example all wattles belong to the genus *Acacia*, in the family Mimoscaceae. To distinguish one wattle from another it is necessary to use the specific names also. *Acacia baileyana* is Cootamundra wattle, while *Acacia spectabilis* is the Mudgee wattle. The scientific name is usually in italics or underlined.

After the scientific name it is usual to cite the name of the botanist who originally described the plant. The Swedish botanist Linnaeus (1707-1778) first described many European and cosmopolitan species and is considered the father of taxonomic botany. The author's name is usually abbreviated, e.g. L. for Linnaeus. Botanists, and their abbreviations, who described many Australian plants include Robert Brown (R.Br.), Ferdinand von Mueller (F. Muell.), G. Bentham (Benth.) and J.D. Hooker (Hook.f.).

The complete scientific name of Cootamundra wattle with its authority is *Acacia baileyana* F. Muell.

COMMON NAMES OF PLANTS

Many plants have vernacular names which are used extensively for a particular plant, in a certain area. Confusion arises when more than one name is used for the same plant, or when the same common name is used for several plants, often entirely different in separate areas. Native fuchsia is the common name for *Correa reflexa* and *Epacris longiflora*, while the the noxious weed *Echium lycopsis* is known as patersin's curse and salvation jane.

Therefore as vernacular names are frequently used, to avoid further confusion it is necessary to standardize them as far as it is possible. No such standardization has been undertaken for Australia as a whole. However, J.H. Willis in 'A Handbook to Plants in Victoria' (vol. 1 1962, vol 2 1972) has listed the vernacular names most frequently used in Victoria, and many of these are applicable for N.S.W.

HOW TO COLLECT AND PRESERVE PLANTS

Very little equipment is necessary for the identifying, collecting and preserving of plants. Essential items are a razor blade and a hand lens (magnification X10 or 15, usually available at opticians). If the plants are to be collected and examined later, plastic bags, a note book and labels will be required, and rubber bands to close the bag of specimens.

If a permanent collection of plants is to be made, the most convenient method is that of pressing and drying, followed by mounting on sheets of paper or cards. Such specimens will last indefinitely.

Care must be taken at the time of collecting the specimens to ensure that all necessary organs are included. Specimens, where possible, should always bear flowers, as leaves by themselves are usually worthless. Specimens should be in the vicinity of 30-40 cm long, and if the plant is small the whole plant, including roots should be taken. In some groups, organs other than flowers and leaves are essential for identification. For example, in wattles the pods are necessary and in eucalypts the fruits, buds and bark are usually required.

Relevant information at the time of collecting should be recorded. This should include notes on the habit, habitat, soil and plant community, plus any other points of interest.

Pressing of the specimens should be carried out as soon as possible after collecting. Most plants will keep for a number of hours in a plastic bag if moistened. Plants are placed between sheets of newspaper and stacked in a press. A press can be made from old refrigerator trays or wooden lattices bound firmly together with nylon cord or leather straps. The papers are changed daily until the plants are dry.

Specimens can be mounted on standard size sheets of paper (about 25 X 40 cm), using gummed paper (not sticky tape). If a smaller sized collection for easy reference is required, plants can be mounted on 20 X 10 cm index cards, placed in a similar sized plastic bag and filed in a card cabinet.

The relevant information is put in the lower right hand corner, or on the reverse side of cards, and should include:

Name .....
Family .....
Community .....
Locality .....
Collector ..... Date .....
Remarks on Habit, soil, altitude, etc. .....
.....

HOW TO IDENTIFY PLANTS

"In endeavouring to identify a species, it should be remembered that there is scarcely any rule in botany without exceptions."

Now one has collected the plant, and has a basic understanding of plant structures and the terms used to describe them it is possible to work out its name.

Most books use an artificial key to the groups which eventually leads to the plant's name. Most keys are *dichotomous* and consist of a series of *alternatives*. Each of the alternatives must be considered, one of which will be accepted and the other rejected. When one is accepted, it will usually lead to successive alternatives, and so repeated until a group, or name is reached.

First decide if the plant is a monocotyledon or dicotyledon, and use a key to the families to determine which one it belongs to. After the family, a key to the genera of that particular family followed by a key to the species within the genus. This process is simplified if only a small number of genera or species occur within the determined group.

A number of points must be remembered and carefully followed.

1. At each step always look at both alternatives.
2. Read both alternatives fully, the second part often contains modifications or exceptions.
3. Always check the correctness of the determination by a description of the family, genus and species.
4. If after reading both alternatives fully, you still can't decide which is the correct one, it is necessary to follow both through until a group or name is worked out. On checking descriptions the correct one is usually found.

HOW TO USE A KEY — Refer to 'Simple key to the major groups of plants'. page 15.

UNKNOWN I — a toadstool.

Start with alternatives 1 and 1*, the correct alternative is 1. The next alternatives are 2 and 2* — the plant has no stem or leaves, therefore 2 is correct. Next 3 and 3*, no chlorophyll present so the unknown is 3*, in the division, Fungi.

UNKNOWN II — *Plantago* sp., a Dicotyledon which has parallel venation. The following course would be taken:

Alternatives 1 and 1*, vascular tissue present, therefore is 1*. Follow down the alternatives from 1*, that is below to 6 and 6*. 6* is correct, 7* is also correct and it is an Angiosperm. On looking at 8 and 8*, the first part suggests it is a Monocotyledon, on examining both alternatives fully, it is a Dicotyledon.

On keying the unknown out to the family, Plantaginaceae, in a family key, the description would be checked. It would be found that a characteristic of this family is leaves with the main veins parallel.

It is important that average characteristics among a group of plants are considered, and not the extremes, or abnormalities. Plants will often vary considerably depending on whether they are found in favourable or adverse situations.

BOOKS TO USE IN THE IDENTIFICATION OF NATIVE AND NATURALISED PLANTS

The most commonly used books to identify and check descriptions of unfamiliar plants are 'Floras' of particular regions. These usually provide keys, descriptions, glossaries of terms used, and often illustrations, with which an unknown may be compared once its name has been determined from the keys.

There is no single Flora for the plants of N.S.W., similar to those available for Victoria and South Australia. However, there are floras for some parts of the state, and together with those from adjoining states most plants can be identified.

1. REGIONAL FLORAS

BEADLE, N.C.W., EVANS, O.D., & CAROLIN, R.C. (1976) "HANDBOOK OF THE FLORA OF THE SYDNEY REGION" (Reed: Sydney). A flora of the central coast of N.S.W. as far north as the Hunter River and including the Blue Mountains and Illawarra districts. Some illustrations included.

BEADLE, N.C.W. "STUDENTS FLORA OF NORTH EASTERN N.S.W." (U.N.E. Armidale)
PART I, (1971) – PTERIDOPHYTES
PART II, (1972) – GYMNOSPERMS, KEY TO ANGIOSPERM FAMILIES,
ANGIOSPERMS: Families 37-83
PART III, (1976) – ANGIOSPERMS; Families 84-106
This flora covers the area north of the Hunter River, west to Coonabarabran, north along the Newell Highway to the Qld. border. Many line drawings.

BURBIDGE, N.T. & GRAY, M. "FLORA OF THE AUSTRALIAN CAPITAL TERRITORY". (A.N.U. Press: Canberra). A useful work including keys and species descriptions; drawings of 500 species.

BLACK, J.M. (1943-57) "FLORA OF SOUTH AUSTRALIA" Parts I - IV, 2nd Edit. (Govt. Printer: Adelaide). Flora of the complete state, illustrated with some line drawings. Useful in inland N.S.W.

EICHLER, H. (1965) "SUPPLEMENT TO J.M. BLACK'S FLORA OF SOUTH AUSTRALIA". (Govt. Printer: Adelaide). Updates Black's Flora by means of numerous additions and corrections.

WILLIS, J.H. (1962) "A HANDBOOK TO PLANTS IN VICTORIA: Vol. 1. FERNS, CONIFERS AND MONOCOTYLEDONS" (Melbourne Uni. Press: Melbourne).

WILLIS, J.H. (1972) "A HANDBOOK TO PLANTS IN VICTORIA: Vol. 2. DICOTYLEDONS" (Melbourne Uni. Press: Melbourne).
These two volumes form a very concise flora in the form of detailed keys with brief descriptions. No illustrations. Useful for western, southern and cooler parts of N.S.W.

2. IDENTIFICATION OF SPECIFIC GROUPS OF PLANTS

ANDERSON, R.H. (1968) "THE TREES OF N.S.W." (Govt. Printer: Sydney). A valuable book with brief descriptions of all native and naturalised trees with notes on their distribution. Keys to the species, including all eucalypts and larger wattles; and illustrations of buds and fruits of many eucalypts.

BLAKELY, W.F. (1972) "A KEY TO THE EUCALYPTS" Forestry and Timber Bureau, Canberra. A key and description of most eucalypt species. Somewhat out of date as the text is still that of the 1935 edition.

CHIPPENDALE, G.M. (1968) "EUCALYPTUS BUDS AND FRUITS" Forestry and Timber Bureau, Canberra. A companion book to Blakely's, illustrations of buds and fruits of most eucalypts.

HALL, N., JOHNSTONE, R.D., CHIPPENDALE, G.M. (1970) "FOREST TREES OF AUSTRALIA" (Aust. Govt. Pub. Services: Canberra). Descriptions and photographs of the more common eucalypts and other forest trees.

FRANCIS, W.D. (1951) "AUSTRALIAN RAINFOREST TREES". Forestry and Timber Bureau, Canberra. Reasonably complete coverage of rainforest trees of N.S.W., Victoria and sub-tropical Queensland. Includes photographs of many of the trees in their natural habitats.

FLOYD, A.G. (1977) "KEY TO MAJOR RAINFOREST TREES OF N.S.W." Forestry Commission of N.S.W., Research Note No. 27. A useful key to many of the taller-growing species, to be used in conjunction with the following series.

FLOYD, A.G., HAYES, H.C., N.S.W. RAIN FOREST TREES, Part 1, 1960, Research Note 3
Part 2, 1961, Research Note 7.

FLOYD, A.G., N.S.W. RAINFOREST TREES, Part 3, 1973, Research Note 28,
Part 4, 1976, Research Note 30,
Part 5, 1977, Research Note 32,
Part 6, 1977, Research Note 34,
Part 7, 1978, Research Note 35.
Each part contains one large or a number of smaller families of rainforests. Gives characteristics of families, keys to species, with descriptions of all species, with many line drawings.

GOLDSTEIN, W. (Ed.) (1977) "RAIN FORESTS" National Parks and Wildlife Service, Sydney. Collection of articles on rainforests, discussing as entity and the various components within it.

ASTON, H.I., (1977) "AQUATIC PLANTS OF AUSTRALIA" (Melbourne Uni. Press). A guide to the identification of aquatic flowering plants and ferns, many illustrations.

JONES, D.L., GRAY, B. (1977) "AUSTRALIAN CLIMBING PLANTS" (Reed: Sydney). A valuable aid to the recognition of climbing plants, many coloured photographs with descriptions.

WHITTET, J.N. (1958) "WEEDS" (Government Printer: Sydney). Many weeds described, well illustrated. No keys.

3. IDENTIFICATION OF NON-FLOWERING PLANTS

BRIGHTMAN, F.H., NICHOLSON, B.E. (1966) "THE OXFORD BOOK OF FLOWERLESS PLANTS" Oxford. Many of these genera are cosmopolitan, and even though this book is on Northern Hemisphere plants it is valuable in the recognition of many Australian plants. Many coloured illustrations and descriptions of flowerless plants.

MARTIN, W., CHILD, J. (1972) "LICHENS OF NEW ZEALAND" (Reed: Sydney). Covers Australian lichens, descriptions and illustrations.

ALLISON, K.W., CHILD, J. (1975) "THE LIVERWORTS OF NEW ZEALAND" (Univ. of Otago Press: Dunedin). Keys, descriptions and line drawings. Very good, covers Australian species.

ALLISON, K.W., CHILD, J. (1971) "THE MOSSES OF NEW ZEALAND" (Univ. of Otago Press: Dunedin). Keys, descriptions and illustrations. Useful for beginners in the recognition of moss genera.

SCOTT, G.A., STONE, I.G. (1976) "THE MOSSES OF SOUTHERN AUSTRALIA" (Academic Press: London). A comprehensive book on mosses of southern Australia, includes keys, descriptions and illustrations, to the species level.

JONES, D.L., CLEMESHA, S.C. (1976) "AUSTRALIAN FERNS AND FERN ALLIES". (Reed: Sydney). Covers species, giving details of distribution, habitat, cultivation and means of identification.

WAKEFIELD, N.A. (1975) "FERNS OF VICTORIA AND TASMANIA" (Field Nat. Club of Vic.). Family and species described, well illustrated, useful.

WILLIS, J.H. (1963). "VICTORIAN TOADSTOOLS AND MUSHROOMS" (Field Nat. Club of Vic.). A key with descriptive notes, illustrated with line drawings and photographs.

4. A BASIC BOTANY TEXT BOOK

WEIER, T.E., and others (1974) "BOTANY: AN INTRODUCTION TO PLANT BIOLOGY" (John Wiley & Sons: New York). A very good general botany book, includes classification, plant kingdom and life cycles, ecology, plant structure and function.

5. POPULAR WILDFLOWER BOOKS

Many books on the wildflowers of Australia have been published in recent years. In general the photographs and, or, drawings are useful, but the range of species is limited. Therefore, such books can be used for checking a plant's name, but by themselves are not a reliable means of identification.

GALBRAITH, J. (1977) "A FIELD GUIDE TO THE WILD FLOWERS OF SOUTH EAST AUSTRALIA" (Collins: Sydney). Provides a comprehensive identification guide to native flowering plants, except eucalypts, in the temperate eastern region. Guide to families and simple keys to groups occur through the text. Descriptions of all species with many line drawings & photographs.

CRIBB, A.B. & J.W. (1974) "WILD FOOD IN AUSTRALIA" (Fontana). An informative well-illustrated book with descriptions of plants which have edible parts.

BLOMBERRY, A.M. (1977) "AUSTRALIAN NATIVE PLANTS" (Angus and Robertson: Sydney). Very useful, Family and generic descriptions, many drawings.

BLOMBERRY, A.M. (1973) "WHAT WILDFLOWER IS THAT?" (Hamlyn: Sydney). Photographs and descriptions of over 750 native species, with useful descriptions on plant habitats.

BAGLIN, D., & MULLINS, B. (1969) "AUSTRALIAN WILDFLOWERS IN COLOUR" (Reed: Sydney). Over 30 of the most typical Australian families described, photographs of species included.

MACOBOY, S., & BLOMBERRY, A (1975) "AUSTRALIAN COMPLETE BOOK OF FLOWERS" (Hamlyn: Sydney). Photographic reference of over 1660 plants of both native and introduced flowers. Arranged in genera, in alphabetical order.

ROTHERHAM, E.R., BLAXELL, D.F., BRIGGS, B.G., & CAROLIN, R.C. (1975) "FLOWERS AND PLANTS OF N.S.W. AND SOUTHERN QUEENSLAND" (Reed: Sydney). High quality photographs and descriptions, species arranged in ecological zones.

COCHRANE, G.R., FUHRER, B.A., ROTHERHAM, E.R., & WILLIS, J.H. (1968) "FLOWERS AND PLANTS OF VICTORIA" (Reed: Sydney). Same series as above, many of the species also in N.S.W.

HOLLIDAY, I. & HILL, R. (1969) "A FIELD GUIDE TO AUSTRALIAN TREES" (Rigby: Adelaide). Descriptions and photographs of 111 species, with drawings of leaf, flower and fruit.

Many other books are also available, these include books in the following series.

JACARANDA WILDFLOWER GUIDES (Jacaranda Press: Brisbane)
PERIWINKLE GUIDES (Periwinkle Books: Melbourne)

HOW TO RECOGNISE SOME DISTINCTIVE FAMILIES

Some families are very natural groups of species and can be recognised on a few basic characteristics. Most families have many genera in them, however, they can often be recognised readily by the characteristics of a well known genus, which is typical of the family. In some families only one genus is commonly found in the area.

I. DICOTYLEDON FAMILIES

Family CASUARINACEAE — She-oak

This family has only the one genus, *Casuarina*. Members of this genus are trees or shrubs. They are easily distinguished by the small needle-like stems which are *cladodes*, and the minute scale leaves. The flowers are reduced and unisexual. The fruits (samarae), with their bracts and bracteoles are aggregated into a dry woody cone-like multiple fruit.

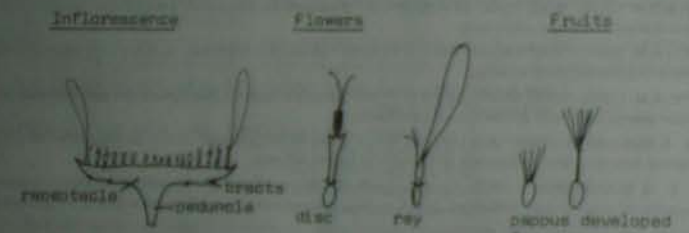

cladode


multiple fruit

Family COMPOSITAE — the Daisy family

This family is distinguished by the head or capitulum type of inflorescence. It is the largest family in the world with nearly 1,000 genera and 20,000 species. Many are garden plants, and due to their successful dispersal mechanism many are weeds. Most are herbs, with some being shrubs.

Individual flowers are small and of two basic types. *Regular disc flowers*, which are usually bisexual, and found in the centre of the capitulum, *irregular ray flowers*, which are usually female, and have a showy corolla, on the outside of the capitulum. Involucral bracts, which are often green but may be coloured, papery (paper daisies) or spinescent (many thistles), surround the head. Some genera have only ray flowers, while others only have disc flowers in the head. The ovaries are inferior and the calyx is represented by a pappus, which is the fruit aids in dispersal.



Family DILLENIACEAE — Guinea Flowers

The only genus in the area *Hibbertia*, is large but is recognised by the gynoecium of separate carpels and the stamens usually in groups. The distinctive flowers are yellow, solitary, and have 5 petals and 5 sepals. The stamens are few to numerous and sometimes on one side of the free carpels.

Hibbertias are shrubs or trailing plants, the fruit a follicle.


Drosera sp.


Hibbertia sp.

Family DROSERACEAE — Sundews

Sundews (*Drosera* species) are insectivorous plants. They are usually small herbs growing in damp situations, such as bogs, along small streams or seepage lines. On the upper surface of the leaves are glandular hairs with longer ones around the margin, and these are responsible for trapping small insects. The hairs also digest and absorb organic nitrogenous material from the insect's body. The leaves can be all radical, or radical and cauline. The basal rosette is often reddish, and may have withered before flowering occurs. The flowers are usually pink or white.

Family EPACRIDACEAE — Heaths

Usually distinguishable by the sub-parallel venation on the underside of the leaves. The leaves are usually small, sclerophyllous, often pungent and sometimes sessile.

Flowers are usually small, regular, 5 sepals, 5 petals fused into a tube, stamens 5, epipetalous, ovary superior and usually 5 locular. Often spirally arranged bracteoles occur under the calyx. Fruit a 5-valved capsule, or drupaceous with 1-5 units.

Genera include *Styphelia*, *Epacris*, *Leucopogon* and *Melichrus*.


Styphelia sp.


Leucopogon sp.


Brachyloma sp.

Family EUPHORBIACEAE

Distinguished by unisexual flowers and superior, 3-locular ovary with 3 styles and the frequent presence of milky latex. Flowers are usually regular and often very reduced, petals or the whole perianth absent.

Herbs, shrubs or trees, usually monoecious, leaves usually alternate and with stipules.

Wedding bush, *Ricinocarpos*, has petals 1 - 1½ cm long, either pink or white, and is a widespread shrub of heaths and forests on sandy soils. In the shrubs *Beriya* and *Beyeria* petals are absent. Many of the common species are herbs.


Ricinocarpos - staminate flower


staminate flowers

Bertya pomifera

Family LABIATAE — Mint family

This family is recognised by its square stems and leaves which are strongly aromatic and are opposite or whorled. Flowers mostly irregular. Sepals 5, fused into a tube which is ribbed, is persistent and 5-10 toothed or 2-lipped. Corolla tubular, typically 5-lobed and 2-lipped. Stamens epipetalous, either 4, 2 plus 2 staminodes, or only 2. Ovary superior, 4-lobed with gynobasic style which is bifid.

Genera include *Prostanthera* and *Westringia*. These can be separated by the form of the calyx tube. In *Prostanthera* the calyx tube is usually striate and is 2-lipped, while in *Westringia* it is 5-toothed.


Square stem with opposite leaves.


Prostanthera sp. Flowers and calyx tubes.


Westringia sp.

Family VERBENACEAE

This family has a number of characters similar to those in the family Labiatae. These include the stems often square, leaves usually opposite, the calyx tubular with 4 or 5 lobes or teeth, and the corolla irregular. However, it differs in that the leaves are usually not strongly scented and are rarely whorled. The corolla tube is seldom 2-lipped, and the style is not gynobasic.

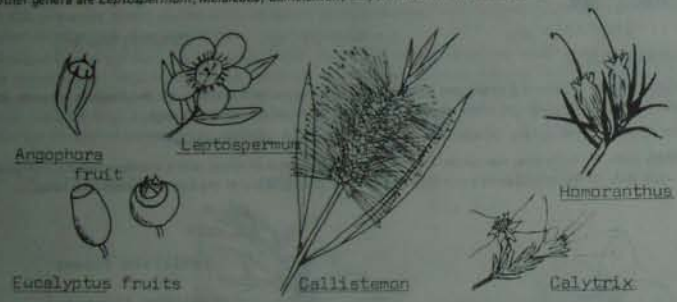
Family MYRTACEAE – Eucalypts, tea trees.

This large family is very prominent in the Australian vegetation. The trees and shrubs have leaves dotted with oil glands.

Sepals 4-5, free or, as in eucalypts fused with the petals to form an operculum. Petals 4-5. Stamens numerous and usually the conspicuous part of the flower. The gynoecium of 2-10 fused carpels, ovary inferior or half-inferior. Fruit an inferior capsule, drupe or nut.

Trees include *Eucalyptus* and *Angophora* which are very similar but can be separated on the adult leaves and fruit. In *Angophora* the leaves are opposite while in *Eucalyptus* usually alternate. In *Angophora* the sepals are persistent as raised ridges on the floral tube and extend upwards as teeth around the rim in the fruit.

Other genera are *Leptospermum*, *Melaleuca*, *Callistemon*, *Calytrix* and the unusual *Homoranthus*.



Family PROTEACEAE – Banksia and Grevillea.

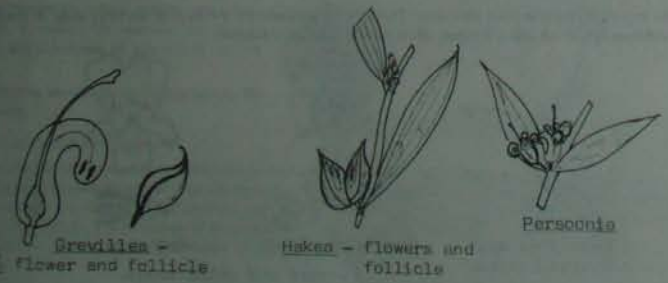
An important family in the native flora.

Distinguished by the floral structure, by usually having 4 stamens opposite the perianth segments and the filaments fused to them, and the 1-carpelled, superior ovary. The ovary is usually on a stalk called the gynophore.

Trees or shrubs with harsh, sclerophyllous leaves which are entire or pinnatisect.

Fruit a follicle, achene or drupe.

Genera are *Banksia*, *Grevillea*, *Hakea* and *Persoonia*.

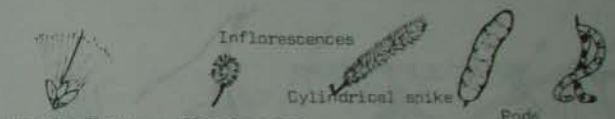


The following three families are often grouped together in the one large family ***LEGUMINOSAE***, on the basis of the common fruit type – a legume.

Family MIMOSACEAE – Wattles

Wattles, genus *Acacia*, have small, regular flowers which are arranged in globular heads or cylindrical spikes. The sepals and petals are inconspicuous and the obvious parts are the numerous stamens which give the characteristic fluffy, yellow appearance of wattles. Wattles are trees or shrubs with bipinnate leaves or phyllodes.

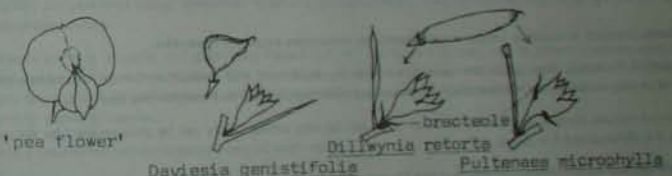
More details – see Genus *Acacia*, page 26.



Family PAPILIONACEAE – the pea family

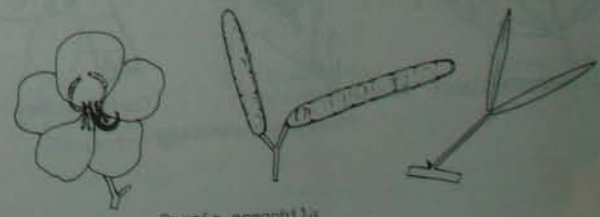
This family is recognised by the irregular and characteristic 'pea flower'. The flower has 5 sepals, usually in a tube; 5 petals, with the large *standard* outside the 2 lateral *wings*, and the 2 lower petals fused into a *keel* which surrounds the stamens and single carpel. Stamens 10, all free, all fused, or 9 fused and 1 free. The fruit is usually a legume, but occasionally a lomentum. Leaves simple or compound, stipules often present.

Many members of this family are well known, including the purple *Hovea* spp., *Hardenbergia* sp., and the yellow and orange *Pultenaea*, *Daviesia* and *Dillwynia* species.



Family CAESALPINIACEAE – Cassias

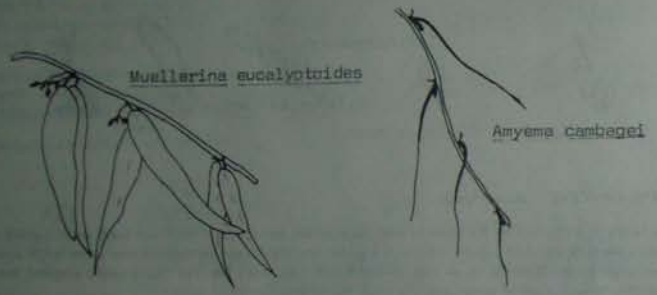
The genus *Cassia* has large yellow flowers which are slightly irregular, and similar to the pea flower except that the standard is inside the 2 lateral petals. Stamens 10, free and some reduced to staminodes. Carpel usually curved. Leaves usually pinnate or bipinnate.



Family LORANTHACEAE – Mistletoes

Mistletoes are usually branched shrubs epiphytic and parasitic upon the branches of trees or shrubs. The haustorium (specialised root) grows into the host branch and secures water and mineral salts from it. This enables the relationship to be one of partial dependence, as the mistletoe has chlorophyll in its leaves.

The leaves are usually opposite and often thick and leathery, sometimes reduced or absent. Some mistletoes are host specific (i.e. only grow on particular species) and in such cases they usually resemble the host plant. The mistletoe *Amyema cambagei* has terete leaves resembling the *Casuarina* sp. cladodes, while *A. pendula* and *Muellerina eucalyptoides* have broad leaves like the eucalypts they grow on.



Family RUTACEAE – Boronias

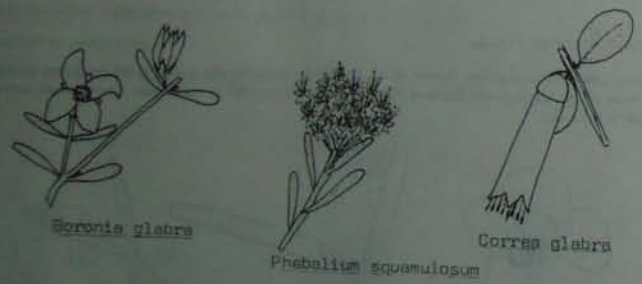
Distinguished by the aromatic leaves with numerous translucent oil glands, and the lobed ovary which is elevated on a disc.

Leaves alternate or opposite, simple or compound and sometimes small and heath-like.

Sepals 4-5, usually free, petals the same number as the sepals and free (except in *Correa*). Stamens equal to the number of petals, or double the number. Ovary superior and often surrounded by a cushion-like disc.

Genera include *Boronia* and *Zieria*, which at times can be very similar. They can be distinguished by the number of stamens, 8 in *Boronia* and 4 in *Zieria*.

Other genera are *Eriostemon*, *Phebalium* and *Correa*.



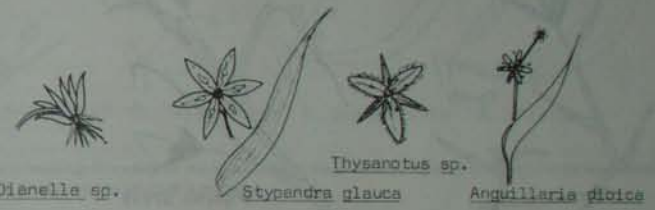
II. MONOCOTYLEDON FAMILIES

Family LILIACEAE – Lily family

This large family has many cultivated plants, such as tulips, lilies (*Lilium* species) and onions, as well as many native representatives. The plants are mostly perennial herbs, often with rhizomes, bulbs, corms and occasionally tubers.

The flowers are usually regular with 6 perianth segments in two rows, 6 stamens and the gynoecium of 3 fused carpels with a superior ovary. The fruit is usually a capsule.

Native genera include *Dianella*, *Stypandra*, *Bulbine* and *Anguillaria*.



Family ORCHIDACEAE – Orchids

A very large family with a highly specialised and distinctive floral structure. Species are widely distributed with many in the tropics where most are epiphytes.

Orchids are perennial herbs, terrestrial, epiphytic or saprophytic. Most temperate Australian species are terrestrial with underground tubers.

Flowers are very irregular and specialised. Have 6 perianth segments in 2 rows, free or joined in various ways, referred to 'sepals' and 'petals' even though alike. One petal is nearly always of distinctive size and shape (labellum). The column is a structure bearing anthers and stigmas (up to 3 of each, although never all functional). Ovary inferior, of 3 fused carpels, 1 locular with numerous ovules.

Fruit a capsule containing large numbers of small seeds.

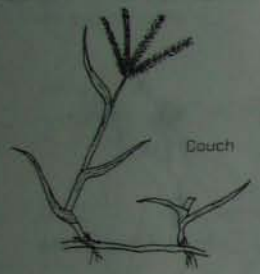
Native genera include the epiphytic *Dendrobium*, common in rainforests. Terrestrial species include *Pterostylis* (greenhoods), *Thelymitra* (sun orchids) and *Diuris* (donkey orchids).

Family GRAMINEAE – Grasses

A very large family of great economic importance and is an important component of some extensive vegetation communities. In Australia many genera are shared with other countries, as well as some indigenous and introduced species.

Grasses are annual or perennial herbs, some woody (bamboos) with fibrous roots, rhizomes usually present. Leaves have a parallel-veined lamina with a sheathing base, a ligule often occurs at the junction of it with the lamina.

The flowers are very small and reduced and many usually arranged together in an inflorescence, which is usually a panicle.


Couch


Kangaroo grass

Family CYPERACEAE – Sedges *Family JUNCACEAE* – Rushes

Members of these two families often occur together in damp or marshy habitats. They are usually perennial herbs with rhizomes, and the flowers are small and inconspicuous.

In the sedges the stems are usually triangular, and the leaf blade is grass-like but the sheathing base is usually closed with no ligule present. Leaves often at base of stem.

Sedges include species of *Cyperus, Carex, Scirpus, Lepidosperma* and the large *Gahnia*.

In the rushes the leaves are mostly basal, cylindrical or flat with a sheathing base, or reduced to a sheath only. The leaf sheath is open in species of *Juncus* and closed in *Luzula*. These are the only two genera in the area.


Cyperus sp.


Juncus sp.

HOW TO IDENTIFY WATTLES

Genus *ACACIA* – Wattles

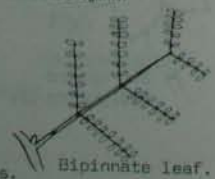
Most people with certainty can recognise a wattle, but are not aware of the characters which distinguish one species from another.

The conspicuous 'flower' of the wattle is a group of small flowers arranged in globular heads or cylindrical spikes. Globular heads can occur single, in pairs or in small groups in leaf axils. The fluffiness of the heads is due to the many yellow stamens. In the centre of each flower is a single carpel, superior ovary. The fruit is a legume.


Pod

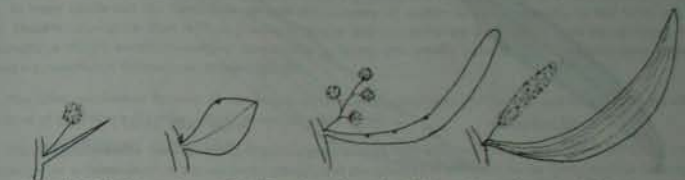

Globular head of flower buds.


Cylindrical spike of flowers.


Bipinnate leaf.

Leaf form

The most important character in dividing the genus up is the form of the leaf. The basic form is bipinnate, as in *Acacia baileyana*, the Cootamundra wattle. However, the majority of Australian wattles have simple leaf-like phyllodes. These are flattened petioles which function as the leaf proper, and have their edges upwards. Phyllodes vary greatly in shape and size.


A. ulicifolia A. cultriformis A. gladiiformis A. cheelii

In *Acacia* seedlings it is usual for the leaves to be bipinnate at first, followed by others with flattened petioles and a few pinnae till finally only the phyllode is produced.

Stipules can be present and may take the form of spines.

Glands are usually obvious on the rachis of bipinnate leaves and along the upper margins of phyllodes, e.g. *A. cultriformis* has one gland at the angle of the phyllode, and *A. gladiiformis* has 3-5 glands.

Venation of the phyllode is another distinguishing feature. Some species have a distinct mid vein, others have several longitudinal veins distinct, while in some species the venation is indistinct.

Pod The shape and the colour of the pod is often referred to as well as funicle and the seed.

HOW TO IDENTIFY EUCALYPTS

Genus *EUCALYPTUS* – Eucalypts

The eucalypts are the most conspicuous component of much of our vegetation. In such a large genus difficulties in distinguishing between the species can often arise.

A number of characters are commonly used in keying the species out. These include the habit of growth, bark type, foliage (both juvenile and adult), inflorescence and the buds and fruit.

1. *Habit* can be the usual tree, or may be a mallee; that is a shrub with many stems arising from the lignotuber.

2. *Bark* This is usually the most obvious character in distinguishing between groups of eucalypts. The texture, colour and extent the rough bark is up the trunk and branches are used.
   a) *Gums or Smooth Barks* – the bark is usually smooth all over, except perhaps for some rough bark on the base of the trunk.
   b) *Ironbarks* – the bark is hard, rough usually deeply corrugated, and often very dark.
   c) *Stringybarks* – the bark is usually fibrous and stringy and covers the trunk and most of the branches.
   d) *Bloodwoods* – the bark is rough, cracked into squarish pieces, more or less scaly. The adult foliage and the urn shaped fruit are characteristic for this group.
   e) *Boxes* – the bark is rough and sub-fibrous, usually persistent on the trunk and for varying distances on the branches.
   f) Other rough barks, such as *peppermints* and *ashes*.

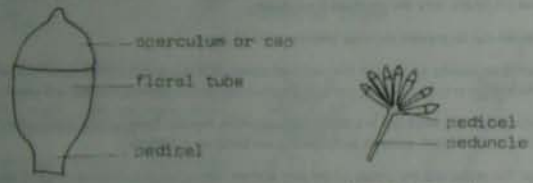
3. *Foliage* Most eucalypts have a *juvenile* leaf form which differs from the adult form. It often differs in size, colour, and arrangement on the stem. The juvenile leaves can often be seen in suckers on the stem, and they are usually opposite each other.

Adult leaves are usually used in identifying species. The points to be noted include, the length and shape, colour, thickness and venation. This latter character is particularly useful. The midrib, and the angles the lateral veins make with it, and the prominence and position of the intra-marginal vein should be noted.

A bloodwood leaf.

Snow gum leaf.
Eucalyptus pauciflora

4. *Buds*. The buds consist of two portions, the lower floral tube and the upper operculum or cap, which covers the inexpended stamens. The operculum (which can be a single or double structure) falls off as the flower matures, and it is important to note if an outer operculum scar is present or not. The features to note are the shape of the operculum and its length relative to the floral tube and the pedicel. Most buds occur in groups or umbels and these are on a peduncle.



Bud

Umbel of buds

5. *Fruits* are essential in keying species out, and the following features should be noted.
   a) *Shape* – most books have diagrams of the various shapes and the terms used to describe them.
   b) *Size* – the pedicel is not included in measurement.
   c) *Valves* open to release the seeds. They can be enclosed at the top of the fruit, exserted or more or less flush with the top of the fruit.
   d) *Disc* may be prominent and broad, narrow and obscure, rounded, convex, flat or depressed within the fruit.

Fruit with exserted valves

Bloodwood fruit with enclosed valves

Fruit with valves flush with top.

6. *Anthers* form the basis of some technical classification systems of the eucalypts. Three major types are recognised on the shape of the anther, the attachment of the filament to the anther and the form of dehiscence.

Poranthereous
opening by pores,
filaments basifixed.

Basanthereous
cells confluent at
apex, filament
dorsifixed.

Macranthereous
opening by parallel slits
filament dorsifixed.

RAINFORESTS

1. RAINFOREST CHARACTERISTICS

A rainforest is generally easy to distinguish from other types of vegetation by a number of features. Perhaps the most striking is its dark green dense appearance when seen from above or from a distance. This is due to the closely growing mass of trees with dark green broad leaves, forming a canopy which looks very different to that of a eucalypt forest or an acacia scrub. In most rainforests the trees show considerable diversity of species as well as a variety of leaf forms and growth habits. Usually sclerophyll trees such as eucalypts, acacias and casuarinas are quite absent from the rainforest. However occasionally a mixed eucalypt-rainforest community is found; this usually indicates that some vegetation change is in progress e.g. succession following an earlier major fire.

The other distinctive features of rainforests are the lianas, epiphytes and ferns – special growth forms which add luxuriance of structure and further variety of species to the forest.

The lianas or woody vines generally require a good deal of light and their leafy crowns are found either high in the tree canopy or at lower levels at the rainforest margins and along breaks in the forest beside rivers, roads or clearings. Lianas have solved the problem of gaining sufficient light by climbing on trees and saplings using a variety of specialised aids: twining stems, twining petioles, leafless tendrils, stinging roots and prickly or thorny branches for scrambling. Some of these are shown on the accompanying page of drawings. The growth forms of the vines fall into two major size groups: the robust *lianas* with thick woody stems which may be from 2 cm up to as much as 30 cm in diameter, and the wiry lianas with thin but tough and wiry stems.

The epiphytes also show many remarkable adaptations to their way of life. Most epiphytes require fairly high light levels and are most common on the upper trunks and main branches of the trees. This is especially true of the larger vascular *epiphytes* including most orchids and several ferns. The second main group is the smaller mossy epiphytes or non-vascular *epiphytes*, comprising many mosses, liverworts and lichens. These are best adapted to densely shaded and very humid conditions and colonise lower tree trunks, low branches and exposed roots as well as rock outcrops and fallen logs. They are most frequent in the very wet rainforests of cool mountain areas.

Ferns may occur at almost any level in the rainforest and show a wide range of growth forms including both large and small ground ferns, tree ferns, delicate filmy ferns on rocks tree trunks and tree fern stems, crowning epiphytes and some large nest-epiphytes.

In New South Wales rainforests are usually classified into four main types or subforms. These are explained and compared in the following table, *Subforms of Rainforest in New South Wales*.

SUBFORMS OF RAINFOREST IN NEW SOUTH WALES

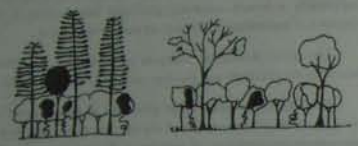
SUBTROPICAL RAINFOREST

Trees – 2 or 3 strata of trees
- diverse : 10-60 species in canopy
- leaf size large: notophylls and mesophylls common
- leaves often compound, and mostly with entire margins
- stranglers (figs) often common
- palms often common
- plank-buttresses common
- uneven, non-uniform canopy

Vines – large, thick-stemmed vines common and diverse
Large epiphytes – (orchids, ferns aroids) common and diverse
Special features – large-leaved herbs and ground-ferns common
Habitat – high rainfall (>1300 mm)
- eutrophic parent rocks (basalt, rich shales, some granodiorites, etc)
- favoured by shelter eg. in gullies
- warmer areas : sea level to 900 m

Some major occurrences of STRf
- McPherson Range and Tweed Range
- basaltic lowlands of Richmond River area
- Dorrigo plateau and Bellinger Valley
- Hastings and Wilson Rivers
- Comboyne plateau
- Barrington – Gloucester areas
- gullies all along east side of Dividing Range
- Illawarra coastal plain and scarp

Note – although the tree species are very diverse the commoner ones often include : *Argyrodendron* spp. (booyongs), *Sloanea woollsii* (yellow carabeen), *Dysoxylum fraserianum* (rosewood), *Ficus* spp. (figs), *Acmena*, *Syzygium* (lilly pillies).



DRY RAINFOREST

Trees – mostly 2 strata with the lower stratum 6-18 m tall and continuous, the upper one mostly of scattered tall *Araucaria* or semideciduous spp.
- diverse range of species : 10-30 species in lower layer
- leaf size small, mainly microphyll
- leaves often hard and with blunt tips
- plank buttressing rare
- palms ± absent
- stranglers rare or frequent

Vines – large vines very common and diverse
Large epiphytes – rare, or sometimes common, but few species
Special features – mosses and ground ferns rare, no tree-ferns, prickly shrubs common
Habitat – warm areas with fairly low rainfall (630-1100 mm). Eutrophic parent rocks (basalt, etc) and/or good shelter

Some major occurrences of DRf
- Upper Clarence Valley eg. Unumgar S.F.
- Richmond Range west of Casino
- Guy Fawkes River National Park
- gorge systems of Macleay River headwaters eg. Wollomombi – Apsley areas
- Hastings Valley (on serpentine)

Note – the common emergent trees include : hoop pine, *Araucaria cunninghamii*, lace-bark tree, *Brachychiton discolor*, teak, *Flindersia australis*.

– the canopy layer is often dominated by trees of a few families: Sapindaceae, Euphorbiaceae, Celastraceae, Oleaceae, Anacardiaceae, Moraceae.

WARM-TEMPERATE RAINFOREST

Trees – 2 strata of trees
- less diverse than STRf: canopy layer of 3-15 species
- leaf size medium: notophylls and microphylls common
- simple leaves with toothed margins most common
- stranglers and palms rare or absent
- plank-buttresses rare or absent
- fairly even canopy

Vines – large vines sparse to fairly common
Large epiphytes – sparse to fairly common, but few species
Special features – slender rather uniform tree trunks
- many trunks with whitish covering of lichens
- ground ferns frequent

Habitat – fairly high rainfall (over 1300 mm)
- medium to high altitude (450 to 1200 m)
- poorer soils on oligotrophic rocks eg. rhyolite, trachyte, slates, but on eutrophic rocks (eg. basalt) in southern localities

Some major occurrences of WTRf:
- McPherson Range (higher parts)
- Gibraltar Range – Washpool area
- Dorrigo plateau, on slates, shales etc
- Hastings River headwaters
- Barrington and Gloucester Tops
- Blue Mountains (deep gorges, also on basalt knobs)
- Robertson plateau

Note – the commonest trees are usually coachwood, *Ceratopetalum apetalum*, sassafras, *Doryphora sassafras* and various Lauraceae

COOL-TEMPERATE RAINFOREST

Trees – mostly 2 strata, sometimes 1
- very low diversity: canopy even and uniform, with 1 up to 3 species
- leaf size small: microphylls and nanophylls most common
- simple leaves with toothed margins most common
- stranglers and palms absent
- plank buttresses absent but base of trunks sometimes massive

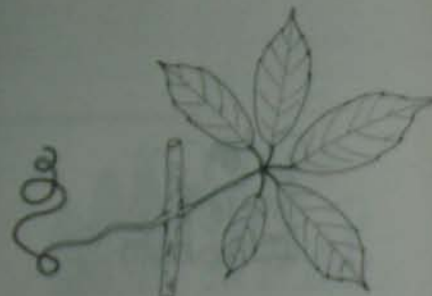
Vines – large vines rare or absent, but thin wiry vines may be common
Large epiphytes – rare or absent but a few small ferns and orchids frequent
Special features – mossy epiphytes and lichens very abundant
– ground ferns and treeferns often very common
Habitat – very high rainfall (1750 - 3500 mm)
- high altitude (900 to 1500 m)
- frequent mists
- varied soil parent materials, eg. trachyte, basalt, slates, granodiorite, rhyolite

Some major occurrences of CTRf:
- Tweed and McPherson Ranges (high misty rocky knobs)
- Upper Dorrigo Plateau and New England National Park
- Bellangry and Mt. Boss areas (Macleay River – Wilson River divide)
- Barrington Tops and Gloucester Tops

Note – the commonest and often the only dominant tree is the southern beech, *Nothofagus moorei*

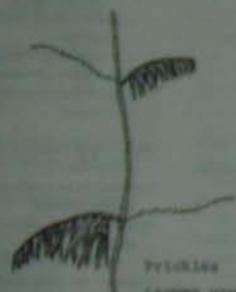
CLIMBING MECHANISMS

Short coils and knot-like bends formed around supports.
KNOT VINE *Loeseneriella sp.*

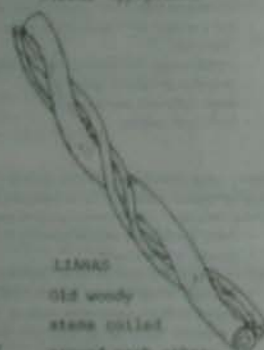


Tendril of WATER VINE *Cissus hypoglauca*

Axillary thorns
COCKSPUR THORN
Maclura sp.



Prickles
LAWYER VINE
Calamus muelleri



LIANAS
Old woody stems coiled around each other.

Young twining stem of NATIVE WISTERIA *Millettia megasperma*

POTHOS
Pothos longipes

PEPPER VINE
Piper novae-hollandiae

Climbing roots.

2. PLANT FAMILIES IN RAINFORESTS

Most of the species of trees and lianas are either from tropical plant families or are from tropical genera of more widely distributed families. These tropical families and genera often appear strange to the naturalist who is familiar with the sclerophyll and semi-forest flora. However the plants tend to have such distinctive leaf features that identification and recognition of species can be done on this basis. Some of the more common rainforest families are listed below with one or two examples from each.

Some Families of Rainforest Trees and Shrubs in N.S.W.

Arecaceae (palms)	Moraceae (figs)
Cunoniaceae (coachwood, crab apple)	Myrtaceae (lilly pillies)
Ebenaceae (ebony, persimmon)	Proteaceae (silky oak, prickly ash)
Elaeocarpaceae (yellow carabeen, brush quandong)	Rutaceae ([illegible], crow's ash)
Lauraceae (laurels, maple)	Sapindaceae (tamarind)
Meliaceae (cedar, rosewood)	Sapotaceae (black apple)
Monimiaceae (sassafras)	Sterculiaceae (kurrajong, flame tree)

Some Families of Rainforest Lianas in N.S.W.

Apocynaceae (milkpod vines)	Papilionaceae ([illegible])
Asclepiadaceae (milk vines)	Passifloraceae (passion fruit)
Bignoniaceae (wonga vine)	Piperaceae (pepper vine)
Cucurbitaceae (cucumber, bryony)	Rosaceae (bramble)
Menispermaceae (tape vine)	Smilacaceae (supplejack, sarsaparilla)
Oleaceae (jasmine)	Vitaceae (grape, water vine)

3. HOW TO LOOK AT RAINFOREST PLANTS

These notes are intended as a guide to the main features to be checked in attempting the identification of any tree, shrub or climber of the N.S.W. rainforests, using a key based on leaf and twig specimens.

What to collect –

2 or 3 specimens of fresh, normal leafy shoots, avoiding only the extreme shade forms or seedling plants. If flowers or fruits are available these are useful for confirmation, using one of the standard floras, but they are not essential for the keys usually used to identify rainforest plants.

What to note in the field –

ESSENTIAL FEATURES – (1) any special growth habit characteristics which may not show up on a small leafy shoot, e.g. if a liana, note the climbing mechanisms, if a tree or shrub, note whether it is a treefern, palm, etc.
(2) any milky latex or other exudates from the cut twig, petiole or bark.

NON-ESSENTIAL FEATURES – which are often useful –
(3) any aromatic scent in the crushed leaves,
(4) nature of the bark surface (smooth, furrowed, corky, [illegible], etc.),
(5) any prickles or thorns on the main branches,
(6) leaf arrangement, especially in the case of large compound leaves. This is often easier to check on the plant itself than on a small separate specimen.

ESSENTIAL EQUIPMENT FOR EXAMINING THE SPECIMEN –
(1) a strong light, i.e. desk lamp, or sunlight;
(2) a strong lens, magnifying 8 or 10 times; cost is about $3. (Simple wide magnifying glasses of low magnification are of little use);
(3) small ruler 15 or 30 cm long, clearly marked in millimetres and centimetres;
(4) sharp knife, or single-edged razor blade.

TWO GENERAL HINTS – (1) specimens may be checked for identification in the field but you may prefer to do it at home. Specimens will keep fresh for several days if placed in a large plastic bag, sprinkled lightly with water and the bag tied with a rubber band to [illegible] [illegible].
(2) learn to use the lens properly – this is essential to looking at hairs, glands, oil dots, leaf buds, fine veins etc. The essential point is to hold the lens up close to the eye and to bring the specimen up with the other hand until the lens is focused on it. Thus you move the specimen back and forth to get it in sharp focus, rather than moving the lens. There are two advantages here, first you get a wide field of view and the greatest useful magnification that the lens

can give, second it is much easier to get good light on the specimen, without shadows being cast on it by the lens.

Notes on the main points to check in the specimen –

We now come to the points which you will need to check in the leafy shoot. Notes on these are given below, with explanations of the few botanical terms which need to be learnt. (We *have* kept these to the minimum). The basic ideas and terms relating to leaves and twigs should be revised, see especially pages 6 to 9. Glossaries in floras are also useful.

The essential points are dealt with in Part 1 below. Once you understand these you can use the keys and should be able to make positive identifications. Some additional points are explained in Part 2; these are only occasionally met with in the keys.

PART 1: THE BASIC POINTS –

1. **Form of Leaf.**

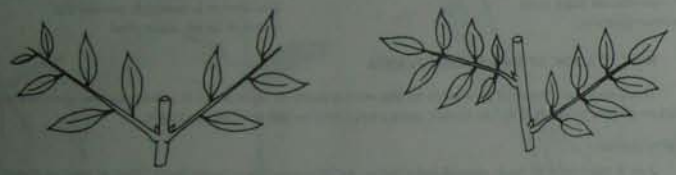
1.1 Leaf *simple* or *compound* – see pages 5 and 6.

1.2 Types of compound leaf – *pinnate, bipinnate, trifoliolate, palmate* (=digitate), *odd-pinnate* (= imparipinnate), *even-pinnate* (=paripinnate), and *one-foliolate*. One-foliolate leaves are reduced compound leaves with only one leaflet at the end of the petiole. These are distinguished by the leaf-blade being *articulate* on the petiole (an *articulation* or 'knee-joint' at the junction of the petiole with the leaf-blade). See Fig. 3.

2. **Arrangement of Leaves on the Twig.**

Leaves may be *alternate* or *opposite* or *whorled*. Note that compound leaves may be either alternate or opposite, irrespective of how their leaflets are arranged.

FIG. 1. LEAF ARRANGEMENT



Leaves opposite, paripinnate, but leaflets alternate.

Leaves alternate, imparipinnate, but leaflets opposite.

3. **Leaf Margins.**

The basic distinction is between leaves with *entire* (i.e. smooth) margins, and leaves with the margins variously *toothed* or *lobed*. See page 4.

Another feature, found in certain species only is a markedly wavy or *undulate margin*.

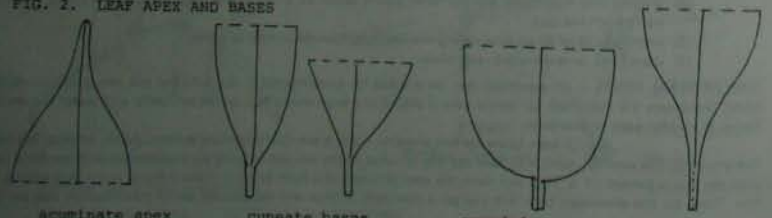
4. **Form of the Leaf Apex.**

The leaf apex is often a distinctive feature in rainforest species. See page 4 noting the *acute, obtuse, mucronate* and *emarginate* types of apex. A further type of importance is the *acuminate* apex, where the leaf is narrowed, then gradually drawn out to a long point at the apex (see Fig. 2). This gives us the "drip-tip" which is a typical feature of many rainforest trees, especially in the wetter habitats.

5. **Base of the Leaf-Blade.**

As well as the types of base shown on page 4, three other forms of leaf base often need to be recognized (See Fig. 2).

FIG. 2. LEAF APEX AND BASES

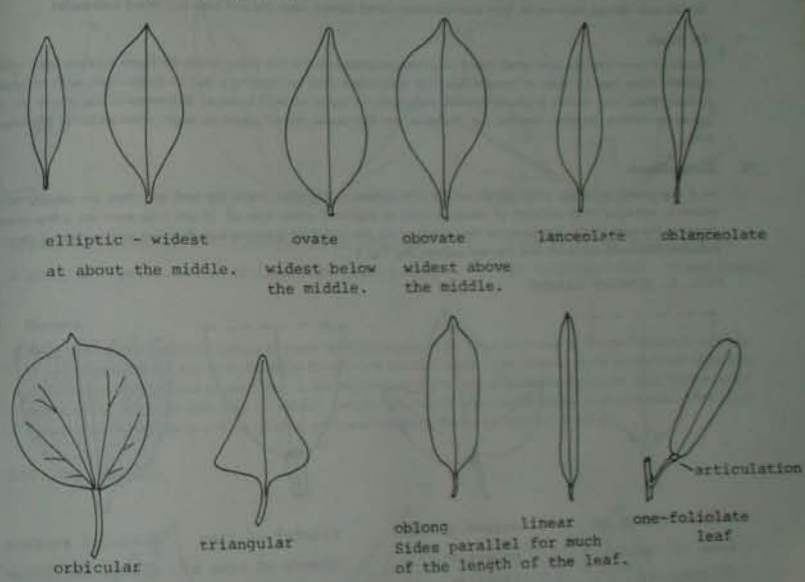


acuminate apex | cuneate bases | rounded base | attenuate base

6. **General Shape of the Leaf-Blade.**

The main descriptive terms used for leaf-shape in rainforest plants are shown in Fig. 3. *Note* – a double descriptive term is often used – e.g. narrow-elliptic, ovate-lanceolate, oblong-lanceolate, broad-ovate, etc.

FIG. 3. SHAPES OF LEAF-BLADE



elliptic - widest at about the middle. | ovate widest below the middle. | obovate widest above the middle. | lanceolate | oblanceolate

orbicular | triangular | oblong Sides parallel for much of the length of the leaf. | linear | one-foliolate leaf | articulation

7. **Surface of Leaf.**

The *colour* is noted, especially any marked contrast between upper and lower surface colours. Most rainforest leaves are dark green above, and paler green underneath. Several species have a distinctive white or silvery undersurface; a few others have a strong yellow or yellow-green tinge underneath.

Leaves of some species have a pale grey or whitish waxy *bloom* on the undersurface and are said to be glaucous. If the surface is rubbed the wax disappears, leaving a normal green surface.

The reflection of light from each surface may be distinctive, especially the extreme cases of a highly glossy or a very *dull* surface.

8. **Venation Pattern.**

The venation pattern is one of the most obvious and distinctive features in most leaves. It offers several points which add up to a good set of recognition features.

Note the three main types of vein in most leaves – *midvein, main lateral veins*, and *fine vein network* (reticulate veins or net-veins).

It is usually necessary to check whether these 3 vein systems are distinct and obvious, and also whether each is raised above the leaf surface, or level with it (*flush*) or sunken (*impressed*).

The feature of first importance here is the pattern of the largest veins, i.e. is it the normal pattern of midvein with *laterals*, or does the leaf have 3, 5 or more veins radiating from the base (*palmately veined* – many climbers show this feature) or with 3 or more true *longitudinal veins* (running most of the length of the leaf and converging near the apex)?

A *marginal (intra-marginal) vein* is a regular feature of a few species, appearing as an obvious extra vein running longitudinally a little way in from the margin.

In some species the venation is not very obvious when the leaf is looked at from above, but if held up towards the light, every fine vein is clearly seen, especially if a lens is used.

For a few identifications, it may be necessary to dry some leaves and then examine the venation. This applies to some species with fibrous veins which form a conspicuous raised pattern when the leaf dries (e.g. many Lauraceae).

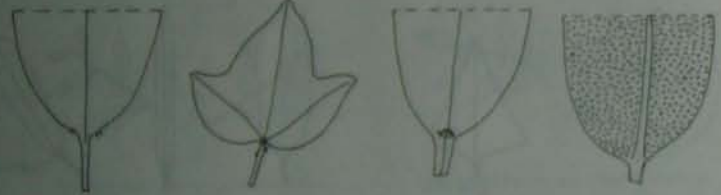
9. **Oil Glands.**

Leaves of some families have small round oil glands embedded in the leaf tissue, giving the leaves a strong smell when crushed. They may be seen as innumerable fine translucent dots on holding a leaf up to the light, with its upper surface facing you. A lens is usually needed, especially for leaves of the Lauraceae, Monimiaceae etc. where the oil glands are minute. In other families, e.g. Rutaceae and Myrtaceae, the oil glands are larger, often visible to the naked eye.

10. **Surface Glands.**

In a few genera there are small glands on the leaf surface rather than inside the leaf, and they are usually non-aromatic, secreting small amounts of nectar or resin or pigments rather than oil. In one type there are a few *raised glands* at the base of the lamina or on the petiole or on the rachis. In a second type there are very numerous round, *coloured gland-cells* scattered over the leaf surface. See Fig. 4.

FIG. 4. SURFACE GLANDS



raised glands at base of lamina (*Cleistanthus*)

raised glands on petiole (*Faoseiflora*)

cluster of tiny glands at base of midrib (*Maroudenia*)

coloured surface glands (*Mallotus*)

11. **Pubescence (hairs) and scales.**

Shoots may be quite hairless (glabrous) or may have a coating of hairs on the leaves, stems or leaf buds (pubescent). The pubescence varies in its density and in the type of hair present. See page 5 for terms used to describe hairs, and hairy surfaces. A lens may need to be used here. Note especially the *stellate hairs* found on a few families.

The most distinctive form of pubescence is where the whole undersurface of the leaf is covered with a dense mass of hairs, obscuring the venation and giving the surface a pale or whitish appearance.

In some species the leaf surface may appear silvery or brownish-shiny due to a dense mat of minute *flat scales* developed on the leaf epidermis.

12. **Latex.**

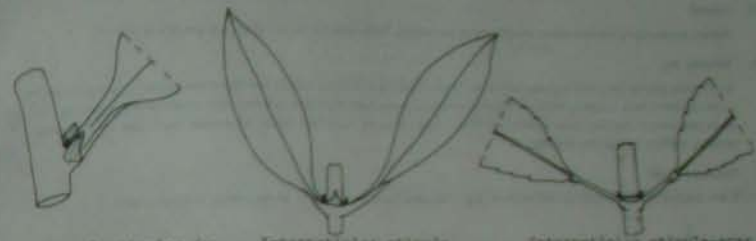
A characteristic which can only be checked in fresh shoots is the presence of latex, usually seen as milky fluid exuding from twigs, petioles or leaves when they are cut or broken. This milky latex is found in a few families only and is formed in a special system of latex ducts. Certain other species may have watery or yellowish latex.

13. **Stipules.**

Although *stipules* are often very small, they are usually quite consistent features of a plant family, and often form a good check on whether an identification is correct. They must be looked for in the young parts of the shoot, as they are often shed while the leaves are expanding. Even then, their presence can be deduced if a pair of stipule scars is visible (lens needed) at each leaf base in the mature shoot.

In two families with opposite leaves, Rubiaceae and Cunoniaceae, the stipules have a very distinctive form. They are joined together in pairs and are borne on the stems between the leaf-bases of the pair of leaves at each node. These *interpetiolar stipules* are an absolute indication of either the Cunoniaceae (if leaf-margins are toothed), or Rubiaceae (if leaf margins are entire).

FIG. 5. STIPULES



Normal stipules in a pair at leaf-base.

Interpetiolar stipule of *Canthium* (Rubiaceae)

Interpetiolar stipule-scar of *Pancheria* (Cunoniaceae)

14. **Domatia.**

Another small but consistent feature of many rainforest species is the presence of a series of small hollows or swellings or hair-tufts along the midrib in the angles formed with the main lateral veins. These **domatia** are gland-like structures of unknown function, but of much help in the recognition of plants such as Rosewood, Cedar, Blue Quandong and many others. They are best seen on the leaf undersurface, but if large may be visible as small lumps on the upper surface also. Sometimes tiny mites (acarids) are found inhabiting the hollow types of domatia.

FIG. 6. DOMATIA

Hair-tufts in *Cleana anteretica*.

Hollow domatia in *Myrsine* sp.

Hollow domatia in forks of main veins (*Pennantia*).

PART 2: SOME ADDITIONAL FEATURES –

15. **Buds.**

Check the main terminal buds. They may be scaly or non-scaly, pubescent or glabrous.

16. **Petioles.**

Petioles may be thick or slender, green, whitish or brown, cylindrical or flattened, grooved above or smooth. Their size may also be a good recognition feature, especially if very short or very long.

17. **Twigs.**
Note thickness, colour, pubescence, whether cylindrical or angular, any special patterns of lenticels or raised leaf-scars.

18. **Prickles, Thorns and Spines.**
Usually distinct and obvious if present.

19. **Pulvini.**
Pulvini are abruptly swollen bases of petioles or petiolules. Note whether large pulvini are present or absent.

20. **Tendrils, etc.**
In climbing plants the modifications which facilitate climbing should be noted. *Twining stems* are very common, while a few climbers have clinging roots on their runners and some have *thorns* or *prickles* with which to grip supports. The more specialised climbers have leafless *tendrils*, which may be modified forms of almost any organ e.g. branches, petioles, leaflets, peduncles, stipules.

21. **Texture of Leaf.**
A few species have a distinctive leaf-texture, e.g. sclerophyllous, or very soft, or very thick and succulent.

GLOSSARY OF BOTANICAL TERMS

As far as possible we have avoided using technical terms, however some have been used, and these are defined below :–

Achene . . a dry, one seeded fruit.
Adventitious . . (roots) arising in irregular or unusual positions.
Alternate . . (leaves) arising at different levels.
Androecium . . male part of the flower, collective name for the stamens.
Annual . . plant that flowers and dies in less than a year.
Anther . . part of stamen which produces pollen.
Articulation . . swollen joint at junction of petiole and leaf blade (Fig. 3).
Ascending . . branches spreading horizontally then turning upwards.
Awn . . a straight or bent bristle-like extension.
Axil . . the angle between the leaf and the branch.
Axillary . . arising from the axil of a leaf.
Berry . . an indehiscent, succulent fruit with an outer skin and an inner pulp containing usually many (sometimes one) seeds.
Bifid . . two lobed.
Biennial . . plant that flowers in its second year and then dies.
Bipinnate . . twice pinnately divided (Page 6).
Bract . . leaf or scale in whose axil a flower or inflorescence arises.
Bracteole . . small bract like structure on the pedicel or calyx (Page 23).
Calyx . . collective name for the sepals, outermost whorl of the flower, usually green.
Carpel . . the female unit structure in the flower, containing one or more ovules. A flower may have one carpel, or two or more free carpels, or two or more fused into a compound structure (Page 8).
Capsule . . dry fruit derived from a compound ovary that splits incompletely into two or more parts when ripe.
Cladode . . modified stem, functioning as a leaf, sometimes flattened.
Compound . . (leaf) divided into pinnae or leaflets.
Corolla . . collective name for petals, usually coloured.
Cordate . . heart-shaped, often referring to the base of a leaf.
Cyme . . an inflorescence with the central terminal flower opening first, with axillary ones later.
Dehiscent . . opening or bursting at maturity.
Digitate . . (leaf) = palmate, divided into 5 or more leaflets, all arising at one point.
Digitately trifoliolate . . compound leaf with three leaflets, the petiolules all the same length.
Dioecious . . with male and female flowers on different plants.
Distichous . . (leaves) regularly arranged in two rows, one on each side of the stem.
Domatia . . small cavities or projections on a leaf, in the axils of lateral veins (Fig. 8).
Drupaceous . . a fruit with the structure of a drupe, but derived from more than one carpel.
Drupe . . a succulent, indehiscent fruit derived from a single carpel and having an outer skin, fleshy layer and inner woody layer surrounding the seed or seeds.
Entire . . with an unbroken margin.
Epipetalous . . (of stamens) borne on the petals.
Filament . . the stalk of a stamen.
Follicle . . a dry, dehiscent fruit derived from one carpel, splitting along one side.
Glabrous . . without hairs.
Glaucous . . with a whitish or pale grey or blue-grey surface, usually due to a surface waxy bloom.
Gynobasic . . (style) one which extends to the base of a gynoecium between the carpels.
Gynoecium . . the female part of the flower, collective name for the carpels.
Gynophore . . the stalk of a superior ovary.
Habit . . general appearance of a plant, including size, shape, etc.
Habitat . . the environment in which a plant lives.
Hastate . . triangular and with spreading basal lobes.
Hypanthium . . a cup-like or tubular extension of the receptacle upwards, with the perianth parts and stamens borne on the rim (Page 9).
Imparipinnate . . compound leaf with an odd terminal leaflet (Page 6).
Indehiscent . . not opening at maturity.
Inflorescence . . arrangement of flowers on a stem.
Internode . . part of the stem between two nodes.
Interpetiolar stipule . . stipule between the petioles of opposite leaves (Fig. 5).

Interpetiolar stipule-scars . . scar visible on the stem between the petioles after an interpetiolar stipule has fallen off (Fig. 5).
Irregular Flower . . a flower in which not all members of a whorl (especially the corolla) are similar in size and shape.
Labellum . . one of the petals of an orchid, different from the others, and usually appears to be on the lower side.
Lamina . . leaf-blade, expanded portion of the leaf.
Lanceolate . . shaped like a lance, tapering at both ends and with the widest part below the middle.
Latex . . milky sap.
Legume . . a pod, a dry dehiscent fruit formed from one carpel and having two longitudinal lines of dehiscence.
Ligule . . a membranous or hairy outgrowth at the inner junction of the leaf-sheath and the blade of grasses.
Linear . . very narrow and with parallel sides.
Lomentum . . a dry fruit derived from one carpel which breaks up transversely into one-seeded units.
Mericarp . . a single fruiting carpel freed by the breaking up (apart) of a schizocarp.
Monoecious . . with male and female flowers on the same plant.
Node . . part of the stem from which a leaf or bract arises.
Nut . . a dry, indehiscent, one-seeded fruit formed from two or more carpels.
One-foliolate . . compound leaf with one leaflet, recognised by the articulation at the junction of the petiole with the leaf-blade (Fig. 3).
Opposite . . (leaves) two leaves at same level on stem, but on opposite sides of the stem.
Palmate . . (leaves) divided into 5 or more leaflets, all arising at the one point.
Panicle . . a much branched inflorescence.
Paripinnate . . pinnate leaf without a terminal leaflet (Page 6).
Pedicel . . a stalk of a single flower.
Peduncle . . stalk of an inflorescence.
Perennial . . plant living for more than two years.
Perianth . . collective term for the calyx and corolla especially in flowers where the sepals and petals all appear similar, or where there is only one whorl.
Petal . . one segment of the corolla, often brightly coloured.
Petiole . . stalk of a leaf.
Petiolule . . stalk of a leaflet, in a compound leaf.
Phyllode . . flattened and expanded petiole, as in most wattles.
Pinna . . primary division of a compound leaf; a leaflet.
Pinnate . . compound leaf with leaflets arranged on either side of the leaf axis.
Pinnately trifoliolate . . compound leaf with three leaflets, the petiolule of the terminal leaflet longer than the petiolules of the side leaflets.
Pinnatifid . . simple leaf, cut into lobes on both sides of the midrib.
Pinnule . . segments of a divided pinna, as in a bipinnate leaf (Page 6).
Placentation . . arrangement of the placentae, with their ovules, in the ovary (Page 8).
Procumbent . . trailing on the ground.
Prostrate . . lying flat on the ground.
Pungent . . with a needle-sharp hard point.
Raceme . . inflorescence of stalked flowers, the oldest at the bottom.
Rachis . . the axis of a compound leaf bearing leaflets.
Receptacle . . the upper part of the axis bearing the floral parts, see Page 9.
Regular flower . . having all the parts in each whorl similar to each other.
Revolute . . rolled backwards, as in the leaf margins of *Ricinocarpos*.
Rhizome . . an underground stem.
Rosette . . cluster of leaves at the base of a plant.
Samara . . a winged achene or nut.
Scabrous . . rough to the touch.
Scape . . flowering stalk arising from near ground level.
Schizocarp . . dry, dehiscent fruit which breaks into individual carpels called mericarps.
Sclerophyll . . plant with hard, stiff leaves.
Scrub . . a community dominated by shrubs.
Sepal . . one segment of the outer whorl (calyx) of the flower, usually green.
Sessile . . without a stalk or petiole.
Silique . . a dry dehiscent fruit formed from a superior ovary of two carpels and with two parietal placentae connected by a false septum.
Sorus . . a group of sporangia on fern fronds, brown when spores mature.
Spike . . a racemose inflorescence with sessile flowers.
Stamen . . male part of the flower, produces pollen, consists of anther and filament.

Staminode . . a sterile stamen, usually modified morphologically.
Stipule . . appendage, often leafy, at base of petiole, usually paired.
Tendril . . part of plant modified for climbing, is slender and coiling, not leafy.
Terete . . cylindrical, or almost so.
Trifoliolate . . (leaves) compound and with three leaflets (Page 6).
Umbel . . racemose inflorescence in which all the pedicels arise from one point.
Venation . . arrangement of veins in the leaf (Page 3).
Viscid . . coated with a sticky substance.
Whorl . . a group of three or more structures arising from one level, e.g. leaves, petals.

ISBN 0 85834 279 0