HAMPSHIRE FLORA GROUP

Improvers' Workshop 2009

Notes and Workbook

Author: Martin Rand

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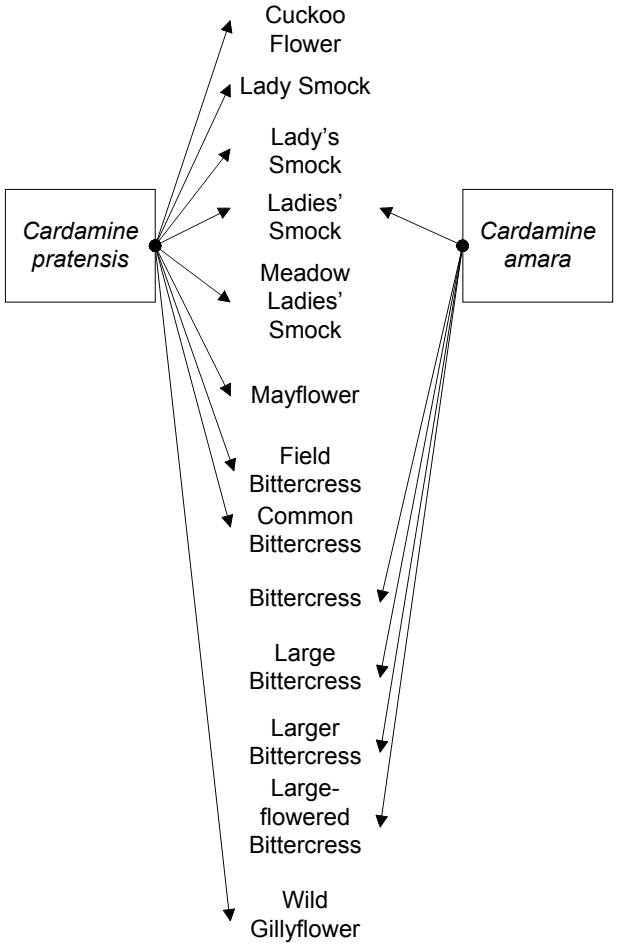
Contents

Scientific Names

Scientific names are the means by which people in all countries can understand whether they are talking about the same biological entity. Scientific names do change, and many scientific names may have been applied to the same plant over time – but there is a controlled mechanism for changing a name, and standard guides to the *synonyms* that have been used.

Why scientific names are a good thing, part 1

This pair of plants has a relatively stable, well-established set of English names in books. Even so, here is the range of names to be found in national floras and field guides.



Why scientific names are a good thing, part 2

Here are just a few of the nearly 50 **local** names that have been given to *Cardamine pratensis*, according to Grigson's *Englishman's Flora* – together with the other plants that those names have been applied to.

Apple Pie	*Epilobium hirsutum* (Great Hairy Willow-herb) *Chamerion angustifolium* (Rosebay Willow-herb) *Artemisia vulgaris* (Mugwort)
Bird's Eye	*Viola tricolor* (Heart's-ease) *Silene dioica* (Red Campion) *Stellaria media* (Chickweed) *Stellaria holostea* (Greater Stitchwort)

	Sagina procumbens (Pearlwort) *Geranium robertianum* (Herb Robert) *Lotus corniculatus* (Bird's-foot Trefoil) *Primula farinosa* (Bird's-eye Primrose) *Anagallis arvensis* (Scarlet Pimpernel) *Pentaglottis sempervirens* (Alkanet) *Myosotis scorpioides* (Water Forget-me-not) *Veronica beccabunga* (Brooklime) *Veronica chamaedrys* (Germander Speedwell) *Euphrasia* agg. (Eyebright) *Glechoma hederacea* (Ground Ivy)
Cuckoo Flower	*Anemone nemorosa* (Wood Anemone) *Silene dioica* (Red Campion) *Lychnis flos-cuculi* (Ragged Robin) *Stellaria holostea* (Greater Stitchwort) *Oxalis acetosella* (Wood Sorrel) *Saxifraga granulata* (Meadow Saxifrage) *Hottonia palustris* (Water-violet) *Hyacinthoides non-scripta* (Bluebell) *Anacamptis morio* (Green-winged Orchid) *Orchis mascula* (Early Purple Orchid) *Dactylorhiza praetermissa* (Southern Marsh Orchid) *Arum maculatum* (Lords-and-ladies)
Lady's Smock	*Stellaria holostea* (Greater Stitchwort) *Convolvulus arvensis* (Bindweed) *Calystegia sepium* (Bellbine) *Arum maculatum* (Lords-and-ladies)

On the other hand, here is a list of the scientific names that have been applied to the plant we now know as *Cardamine pratensis* L.

Cardamine pratensis L.	Linnaeus, *Species Plantarum* 2: 656. (1753)
Dracamine pratensis (L.) Nieuwl.	Amer. Midl. Naturalist 4: 40. 1915
Crucifera pratensis (L.) E.H.L.Krause	Deutschl. Fl. (Sturm), ed. 2 6: 111. pl. 12. 1902

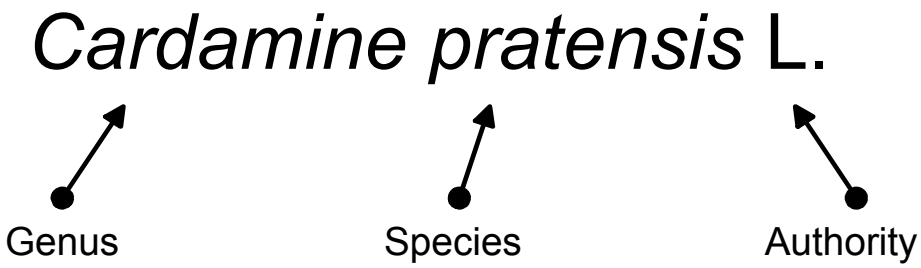
From freely available, regulated sources I can find out:

- which is the currently "official" name;
- who was responsible for the name;
- where each of the names was first used;
- whether any of the names have been applied to any other plant (in these two cases, no);
- what is the plant specimen used to define the plant under its official name.

Anatomy of a scientific name

The scientific name of a species is a two-part name or **binomial**, a convention first employed fairly systematically by Gaspard Bauhin (1560-1624), developed for use with a sound taxonomic method by John Ray (1627-1705), and brought to full flowering (but with a less sound taxonomic method!) by Linnaeus (1707-1778).

The scientific name is often formed from one or more classical terms; but you're not supposed to mix Greek and Latin in the same name! Often a name element is in honour of a person or a place. Some are made-up words that sound vaguely Latinate, and some are just plain silly. (Yes, there is a creature called *Abra cadabra*!)



Genus

The generic name is always capitalised. A *genus* is an attempt to group together plants with a common ancestry but also a well-characterised distinctness from other genera, so that the group does not become so big and generalised as to become useless.

Traditionally, genera have been defined by structural similarities (morphology): general appearance matters little, and one genus might include large spiny succulent shrubs and delicate weeds a few inches high, for instance, because their flowering and fruiting structures are similar and distinctive. Now that DNA analysis is playing a part in determining common ancestry, a certain amount of shuffling around between genera is going on. This may not always be helpful to the botanist in the field, as it sometimes separates plants that are similar morphologically and puts together others that apparently aren't! Also, its application has so far only been partial. So expect the battle lines to continue to move for a while. There isn't a "correct" answer to what species go together in a genus; however you determine similarities and common ancestry, the line will in the end be drawn arbitrarily, although the form of analysis known as cladistics helps to make the choice more rational. For instance, the Cudweed genus *Gnaphalium* of British botanists is currently divided into three (*Gnaphalium*, *Pseudognaphalium* and *Omalotheca*) by French botanists.

Every genus is expected to have one nominated species which is used as a reference to demonstrate all the features described for the genus: this is known as the *type species*.

For convenience, genera are often broken down into subunits that have increasingly restricted sets of common features as one goes down the hierarchy. There isn't a great deal of consistency in how these are applied and the only formally defined hierarchy is Genus → Section → Series → Species. The International Code of Botanical Nomenclature allows for sticking "Sub-" in front of any of these but doesn't define exactly how they then fit in the pecking order. The main British field floras tend to

stick to “Section” (phew!) but Sell and Murrell use “Subgenus”, “Section” and “Series”.

(Incidentally, a similar system applies between Families and Genera, using “Tribe” and “Subtribe”).

None of these intermediate units have a fixed basis in closeness of common ancestry, and are really just arbitrary aids to description and recognition.

Species

The species name is all lower-case. If you look in older Floras, you may find this rule is not followed in the case of proper names: those based on people or place names, for instance.

The debate over how to define a species goes to the roots of our concept of the natural world and the shifts in understanding that have occurred over the last 200 years. This is much too big a topic to cover in this workshop, but the main lesson to absorb is that there will always be a degree of arbitrariness in defining species, because they are a human construct to lay down certain boundaries for our own ends; and however we choose to define those boundaries, some part of nature will be found busy transgressing them!

The classic modern definition by Ernst Mayr is “groups of actually or potentially interbreeding natural populations, which are reproductively isolated from other such groups”. However this doesn’t work well for plants in many cases. Probably the best that one can say is that species define populations of organisms that have a high degree of genetic similarity. How “high” is defined will often depend on whom you ask, but it is hard to extend this very open-ended definition. The notion that populations of the same species are capable of interacting genetically with one another breaks down in the case of plants which have given up sexual reproduction, such as most of the Hawkweeds. The notion that populations of a species don’t interact genetically with other species in a persistent way obviously breaks down in the case of fertile hybrids and back-crossing. There are indeed whole groups of plants in the British flora for which the word “species” has very little meaning, or at least a rather special meaning (when they are often known as “microspecies”). They include Brambles, Hawkweeds and Dandelions on the one hand, and Male Ferns, Eyebrights and Roses on the other.

The good news is that many plant species do have well-defined and well-accepted boundaries from other species, obey the Ernst Mayr rules, and **can** be recognised by applying a set of fairly simple diagnostics. The other good news is that the ones that are difficult and controversial are fascinating and can reveal a great deal about the workings of life!

Authority

This identifies the person who gave this name to the plant. It is often in abbreviated form. Nowadays the main, and internationally endorsed, reference for authority names and their abbreviations is published by the Royal Botanic Gardens, Kew, but you will find divergences. Everyone agrees that the excellently brief “L.” stands for Linnaeus, which is just as well since so many of his names are still current.

There are rules about how you become the legitimate naming authority for a taxon at any level in the hierarchy. They involve the publication of a description in printed

form; reference to a *type specimen* (either preserved or, where this isn't feasible, illustrated) that shows other people exactly what you are describing and therefore making it open to challenge; and getting there first.

Often a name and typification is published in a paper by several authors, in which case their names and abbreviations are separated by commas and an ampersand; for instance *Lysimachia terrestris* Britton, Sterns & Poggenb.

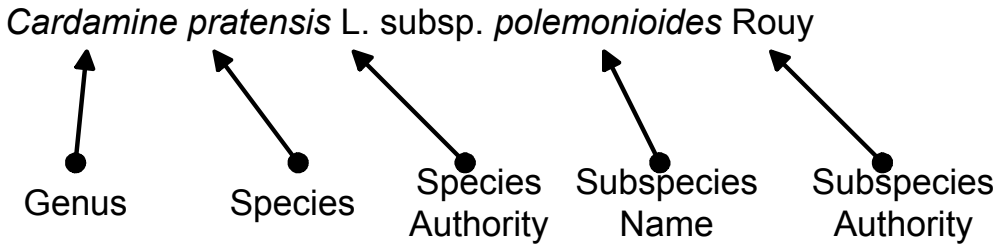
Complications

Infraspecific ranks

Below the level of species there is a whole range of terms for what are known collectively as *infraspecific* taxa; that is, taxa within the species boundary.

A *subspecies* is usually defined as a group of populations within the species that interbreed amongst themselves, but which is geographically isolated from other subspecies and differs in form and/or genes; if two subspecies are brought together, the implication is that they will then interbreed and the differentiations will break down locally.

That sounds straightforward, but it isn't always so. Sometimes other factors than geographical isolation are brought in, or come in by themselves; for instance, if two geographical subspecies have widely separated flowering periods, they will remain isolated for practical purposes even if they are brought together. And with human activity, a great deal of bringing together goes on. Also, on the reasoning above, certain groups such as Eyebrights (*Euphrasia*) should probably be reduced to one or two species in Britain with a large number of subspecies; but they aren't, partly because of reluctance to break with convention, and partly because of the awkardness in then naming all the hybrids (sometimes referred to as *nothotaxa*).



A subspecies name is shown following the abbreviation 'subsp.' or 'ssp.', and has its own naming authority – unless the subspecies designation is applied to the type specimen of the species, in which case the species and subspecies names are the same, and no separate naming authority is needed.

A *variety* (abbreviated 'var'.) is a term used very loosely to describe any variation where the characters may differ through a population but are constant in an individual throughout its lifetime. A *form* or *forma* (abbreviated 'f.') is a minor variety such as a difference in flower colour. Cultivated varieties which are made to persist from one generation to another by selective breeding, grafting, tissue culture etc. are *cultivars*, abbreviated 'cv.' and with the name, often in vernacular, between quotes; horticulturalists often omit the 'cv.'

There is an accepted convention that subspecies ranks above variety ranks above forma, and if more than one of these is applied to a plant, that is the order they appear in. But there is much less agreement about when one term should be applied rather than another. There is a long-running campaign to remove these terms altogether and use a trinomial system of naming, at the same time stopping the use of the same generic name for different plant and animal groups; but it is obviously up against a mountain of accepted practice.

Hybrids

Sometimes hybrid names spell out the names of their parents in full: for instance, *Geranium robertianum* x *G. purpureum*. But often the hybrid itself has been given a "specific" (strictly a *nothospecific*) name: for instance: *Geranium* x *oxonianum* Yeo. The cross (x) denotes that it is a hybrid plant (or "cross"). Authority names follow the same rules as for species.

Hybrids do occur between species in what are currently regarded as different genera (although this obviously raises the question of whether they should be). In that case the hybrid is given a composite generic name incorporating elements of the two generic names concerned, and the cross is placed before this "generic" name. For example, x*Dactylodenia legrandiana*. Again, the authority is quoted according to the naming rules.

Name changes

Yes, scientific names do change! And it's very annoying, if you've struggled to get used to one name, to find another is now "official".

However, the principle is that names only change for a small number of good reasons and have to be publicly justified on that basis.

The main reason for changing a specific epithet is **priority**. That is, it's discovered that an author described and provided type material for a plant under a different name, before the currently accepted name came into use. And in some cases this rule can be overruled, where the later name is in such wide use that confusion would result.

The other important reason is that a plant is assigned to a different embracing taxon, most often a different genus, because of a change in opinion about its taxonomy. This can be the most confusing, as the same plant can be known by very different names at other times or in other parts of the world, depending on the taxonomic views prevailing. However, it is possible to look up synonyms for plants in standard references.

When a name changes, the authority name will change. Where the plant was first described by author 'A' under a different genus or at a different taxonomic rank, but part of the old name is retained, his name appears in parentheses before author 'B' who has given the new name. For example, the wallflower *Erisymum cheiri* (L.) Crantz; Linnaeus assigned this plant to the genus *Cheiranthus*, so his name is *Cheiranthus cheiri* L. Since authors can have second thoughts, it's possible to see, for instance, (L.) L.

Names also get recycled. Sometimes the author of a plant name will ascribe the use of the name to another person, but that person did not supply the typification of the plant to which the name is now applied. In that case the names appear separated by the word 'ex' ('out of'). For instance, *Pittosporum crassifolium* Banks & Sol. ex A. Cunn.

Meanings of names

Although some generic names are constructed from people's names or place-names, and a few are nonsense (often anagrams of existing names: for instance, *Filago* has spawned *Gifola*, *Iflago* and *Logfia*), many older ones have specific meanings that help to make them memorable. Unfortunately British floras have given up the practice of explaining these. A number of good sources of information are given in the next section.

Learning more

Stearn, *Botanical Latin*, paperback edition 2004.

This probably doesn't sound like your ideal bedtime companion! And not many people will feel the need to read the sections on writing a new plant description in well-formed Latin. But there is a huge amount of information about the derivation of descriptive terms in here, and extensive dictionaries and glossaries, both general and covering specific topics such as place names, colour terms, parts of plants, and the meanings of prefixes and suffixes. Sells new for about £14 and second-hand for about £10.

***Hillier Plant Names Explained*, 2005.**

This is largely an extract from the above book, with much horticultural detail added, making for a lively but concise dictionary. The main part of the text is devoted to species names, but there are panels under each initial letter covering genus names, cultivar names, and English name correspondences. There are also panels throughout the text bringing together terms for size, shape, colour, place-names etc. Sells new for £8-£10 and second-hand for about £5. Recommended.

***International Code of Botanical Nomenclature*, Vienna Code, 2006.**

http://ibot.sav.sk/icbn/main.htm

Amaze your fellow-guests at dinner-parties with your in-depth knowledge of the rules for typification, priority and infraspecific taxon naming.

Curiosities of Biological Nomenclature

http://www.curioustaxonomy.net/index.html

After the challenges of this section, here's the ideal relaxation. Discover what sort of creatures are *Ba humbugi* or *Pieza kake*. Find out what lunatic was responsible for *Brachyta interrogationis interrogationis* var. *nigrohumeralisscutellohumeroconjuncta.* And which botanist hated consonants so much he came up with the genus name *Aiouea*?

Terminology

Technical jargon is unavoidable in Floras, and one has to learn a reasonable amount of it to be able to make unambigous sense of the descriptions and keys. But it should be there to make descriptions more **concise** and more **precise**. For example, to say that a leaf is "cordate" is certainly more concise than saying it's "with lobes like a cartoon heart". And there are separate terms "cordate" and "obcordate" for saying it's "with lobes…at the bottom" and "with lobes…at the top".

This is not so say that all jargon is really that useful. "Petiole" doesn't give much advantage over "leaf-stalk" and "Leaves petiolate" even less over "leaves stalked". And is "velutinous" really better than "velvety"?

We can't possibly cover all the terms you are likely to meet in handbooks and Floras in this guide. Authors tend to have favourites. Also it would be nice to say that these terms are so precise that everyone uses them the same way. But this isn't the case. If you are puzzled by the use of a term in the book, always consult the book's own glossary. And if the term is missing or vague there, tell the publisher!

Forms of plants

Basic growth forms

Tree	A self-supporting woody plant that in nature and undamaged, forms a single main stem
Shrub	A self-supporting woody plant that forms multiple stems from the ground, often but not always smaller than trees
Subshrub	A low-growing plant woody at least at the base but usually producing non-woody stems above
Liana *or* liane	A woody plant that is not self-supporting but grows up other plants or structures
Herb	A non-woody plant

Life cycles

You will be familiar with the terms annual (growing from seed and dying in less than a year), biennial (growing from seed in one year, flowering in the next and then dying) and perennial (persisting for more than two years).

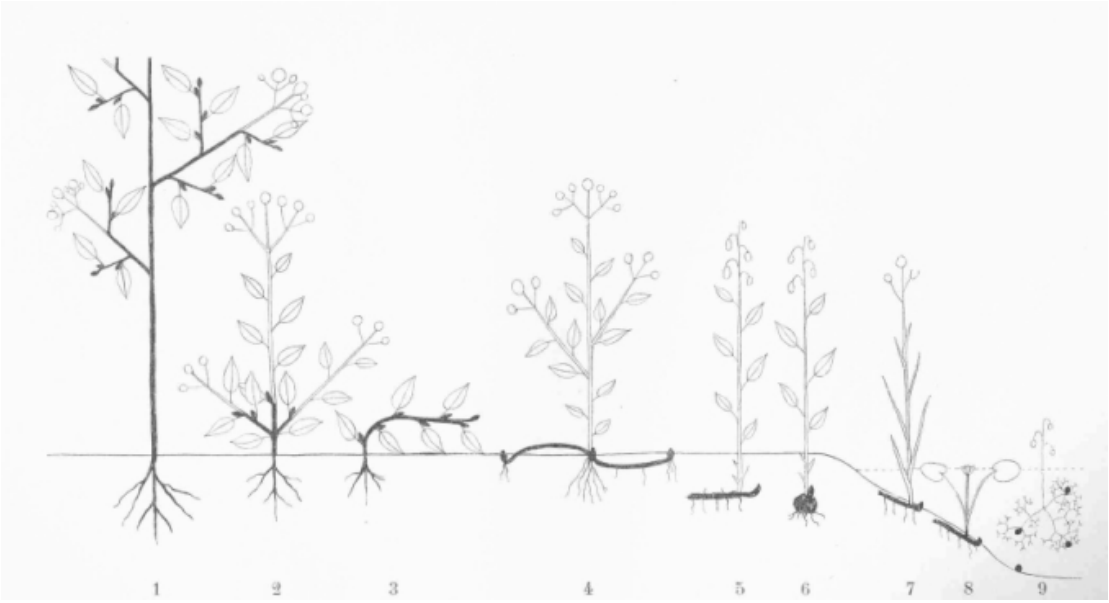
An **ephemeral** is an annual that takes much less than a year to complete its life cycle, the species spending most of the time in seed form. Not to be confused with ephemeral flowers, which last for a day (although an ephemeral can also be an ephemeral flowerer).

You should be aware that many plants are not hard and fast exponents of these lifestyles, and some may behave as annuals or biennials depending on particular seasons or local conditions.

Raunkiaer's life forms

The Danish botanist Christen Raunkiaer classified plants according to how they persisted from one year to the next, dealing with any unfavourable season. Although you will not often see his terms used in British Floras (unlike Continental Floras),

they are a useful way of thinking about how plants fit into their environment and how they tend to form communities with a common survival strategy.



In the diagram, the parts that persist from year to year are shown in black.

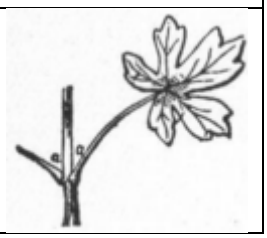
1 Phanerophyte	Resting buds more than 25cm above the ground
2-3 Chamaephyte	Resting buds above ground, but not more than 25cm above
4 Hemicryptophyte	Resting buds at or near soil level
5-9 Cryptophyte	Resting buds below soil or water surface
5-6 Geophyte	Resting buds below the soil surface, e.g. as rhizome buds, bulbs and corms
7 Helophyte	Resting buds in soil or mud below the water surface (and usually applied to those with emergent leaves)
8-9 Hydrophyte	Resting buds below the water surface, with floating or submerged leaves
(Not shown) Therophyte	Annual with seeds as its resting form

Habit

Acaulescent	With no obvious stem
Ascending	With the branches held above the horizontal
Narrowly ascending	With the branches making an acute angle with the vertical
Obliquely ascending	With the branches making an obtuse angle with the vertical
Caespitose	Growing in tufts
Caulescent	With an obvious stem

Columnar	With the whole plant forming a narrow cylinder 
Decumbent	With stems lying along the ground but turning up to a greater or lesser degree at the ends
Drooping *or* nutant	With branches or branch tips pointing or curving towards the ground
Fastigiate	With the branches ascending more or less vertically 
Horizontal	With the branches held parallel to the ground
Pendulous *or* weeping	With branch tips dangling vertically down
Procumbent *or* creeping	With stems lying along the ground
Prostrate	With the branches held parallel to and close to the ground
Rhizomatous	With root-like runners (usually at or below the soil surface), producing buds and roots at intervals (may be close-packed)
Stoloniferous	With stem-like runners (usually at or above the soil surface), rooting at the nodes
Suckering	Producing aerial shoots from roots or rhizomes beneath the surface

Parts of plants, general arrangements and general terms

Abaxial *or* anterior	The side away from the main axis of the plant or organ (underside)
Adaxial *or* posterior	The side towards the main axis of the plant or organ (upper side)
Adherent	Pressed close to, but not united with, another organ
Adnate	United with another organ
Adventitious root	Root arising from elsewhere than the primary root system
Adventitious bud	Bud arising from elsewhere than the axil (leaf/stem joint) of a leaf
Anastomosing	With veins branching and forming a network more or less closed towards the margins
Apomixis; apomictic	Reproduction without sexual fertilisation; a plant exhibiting this
Ascending	Sloping or curved upwards
Axil	The joint formed by a leaf or leaf-stem and its supporting stem 

Axillary *or* alar	In the axil
Bud-scales	Scales enclosing a bud before it opens, often shed on opening
Bulb	A usually underground organ with a flattened disc-like stem bearing succulent scale leaves and one or more buds
Bulbil	A small bulb or tuber usually on an aerial part of the plant, often in an **axil** or in the inflorescence
Cladode	A branch flattened and taking on the function and appearance of a leaf 
Coleoptile	The hardened sheath that protects the growing subterranean bud in grasses
Concolorous	Of a single colour
Connate	United with a similar organ, usually in such a way as to form a mirror symmetry
Connivent *or* convergent	Coming together at the tips
Corm	A swollen underground stem, without fleshy scale leaves
Cotyledon	Seed-leaf, different in appearance from other leaves; 1 in monocotyledons, 2 in dicotyledons, generally several in gymnosperms
Culm	The flowering stem in grasses
Decurrent	(Of a lateral organ such as a leaf or side-branch) having its base extended down the main stem 
Dehiscent	Opening by itself
Distal	At or towards the opposite end of the point of attachment
Divergent	With the tips of branches farther apart than their bases
Divaricate	Widely divergent
e-	(As a prefix to another term) without, lacking
Epicormic shoots	Shoots growing directly from the trunk of a tree
Erect	Upright
Exserted	Protruding
Fascicle	A close-set bundle or bunch
Foliaceous	Looking like a leaf (when it isn't)
Free	Not joined to another organ except at a single point of attachment
Gland	A secreting organ (it may be sunken, superficial, or stalked)
Glandular	Either having glands (e.g. "stems glandular") or being a gland (e.g. "glandular hair")
Imbricate	Overlapping
Included	Not protruding

Indehiscent	Not opening or splitting by itself
Internode	The portion of stem between two adjacent **nodes** 
Latex	Milky or rubbery sap
Lax	Loose, not dense
Leaf-opposed	Borne on the stem next to, but on the opposite side from, a leaf
Ligule	A strap-shaped structure; in particular, the projection from the top of a leaf sheath in Sedges (*Cyperaceae*) and Grasses (*Poaceae*). See also **Flower parts and arrangements** 
-merous	(Combined with a number suffix) composed of, or divided into, several parts; e.g. trimerous, in 3 parts; pentamerous, in 5 parts.
Monocarpic	Flowering and fruiting once before dying
Node	A position on a stem where branches, leaves or flowers arise
Ochrea	A sheath formed by the fusion of two **stipules**
Patent	Spreading roughly at right angles
Pedicel; pedicellate	Flower stalk; having such a stalk
Peduncle; pedunculate	Stalk of an inflorescence or group of two or more flowers; having such a stalk
Petiole; petiolate	Leaf stalk; with a leaf stalk
Petiolule	Stalk of a leaflet in a compound leaf
Proximal	At or near the point of attachment
Recurved	Curved backwards
Reflexed	Bent abruptly backwards
Revolute	Rolled backwards
Rhachis	The stem forming the axis of an inflorescence or a compound leaf after the first branching, i.e. the portion above the peduncle or petiole, "within" the inflorescence or compound leaf
Rhizome	A root-like stem on or under the ground surface, bearing buds, shoots and **adventitious** roots
Scale leaf	A leaf reduced to a small scale
Scape	A stem bearing flowers but no leaves other than at its base
Sessile	Unstalked
Sheath	An enclosing tube, particularly at the base of a leaf in Grasses (*Poaceae*).

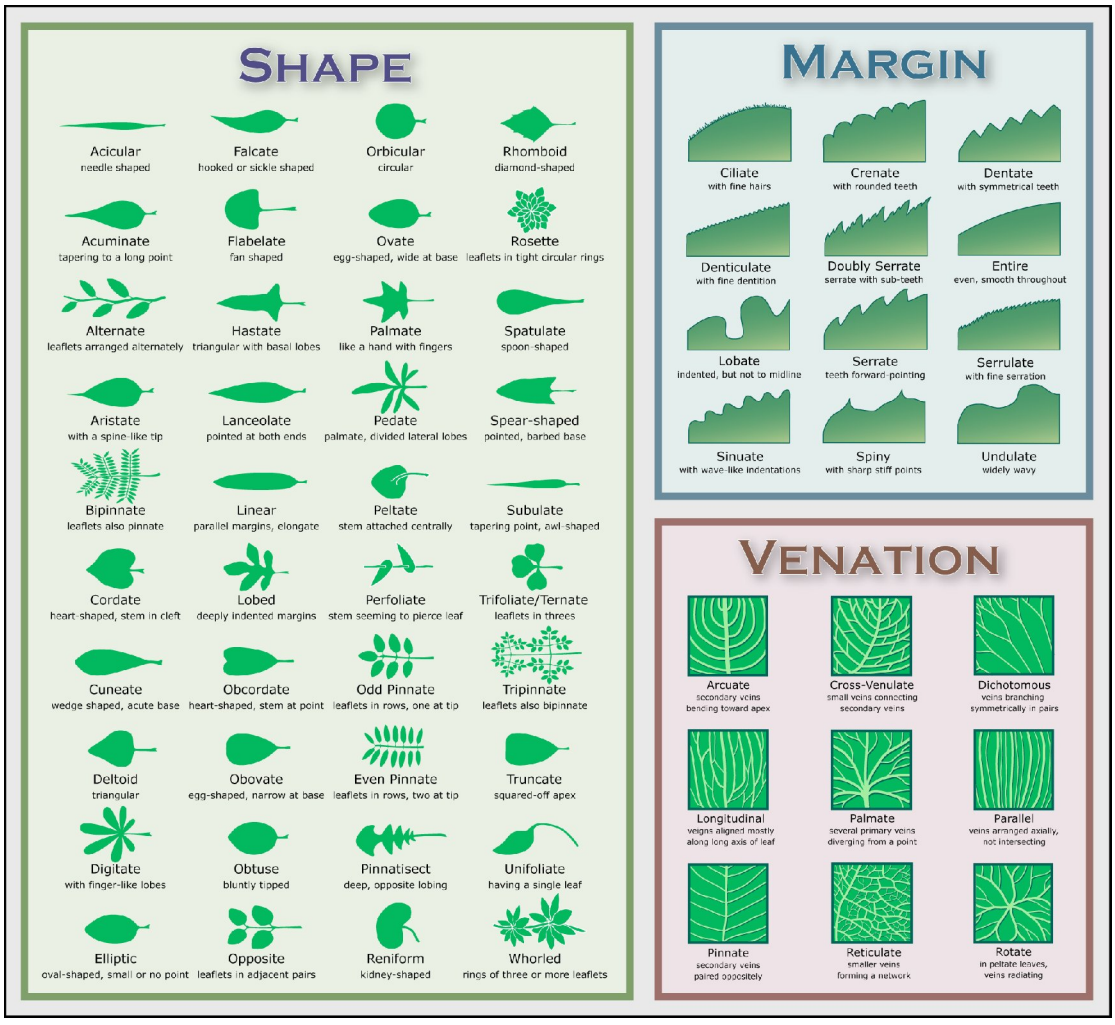
Spathe	A large bract arising from beneath a flower or inflorescence, and often more or less enclosing it 
Spur	A slender projection from an organ, often tubular or pouch-like
Stipule	An appendage at the base of a leaf or leaf-stalk; sometimes leaf-like, often in pairs 
Stolon	A horizontal lateral stem at ground-level, producing roots at its **nodes**
Stoma; stomata	A stem pore allowing exchange of gases with the outside world; plural form
Subtending	Bearing other organs in its **axil**
Suture	A seam along which one or more organs are joined, often splitting during development
Tendril	A twining, thread-like structure produced from a stem or leaf
Terminal	Ocurring at the apex
Tiller	A lateral shoot growing at ground level from the main stem in Grasses (*Poaceae*)
Tuber	A swollen root or underground stem
Turion	In terrestrial plants, an underground bud or shoot that subsequently develops into a stem. In aquatic plants, an often detached floating or submerged bud that develops into a new plant
Whorl	A group of lateral organs where occurring more than two at a node
Wing	A flat memranous or leafy extension to an organ

Leaf and bract arrangements and divisions

Alternate	Occurring singly at the **nodes** of a stem, either **distichous** or **spiral**
Amplexicaul	Clasping but not encircling the stem
Bipinnate *or* 2-pinnate	**Pinnate** with the primary leaf segments again pinnate
Bipinnatifid *or* 2-pinnatifid	Pinnately lobed, with the primary leaf segments again **pinnatifid**
Biternate *or* 2-ternate	Divided into three parts, each part again divided into three
Bract; bracteate	A modified, often reduced and simplified, leaf, beneath a flower or a branch; having bracts
Bracteole; bracteolar	A small supplementary bract often on a flower stalk; having such bracts
Cauline	Borne on the stem
Compound	Divided right to the stalk into leaflets

Decussate	**Opposite**, with alternate pairs arranged at right angles to each other 
Distichous	Occurring singly at the **nodes** of a stem, each successively at 180 degrees from its neigbours
Heterophyllous	Having leaves of more than one shape
Imparipinnate	**Pinnate** with a solitary terminal leaflet
Involucral bract	One of the ring of bracts surrounding the head of flowers in families such as *Asteraceae*
Isophyllous	With all leaves the same
Lyrate	**Pinnatifid** with a large rounded terminal lobe
Opposite	Occurring singly at the **nodes** of a stem, each successively at 180 degrees from its neigbours
Palmate	With the segments divided almost to the base or free and all arising from a single point at the end of the leaf stalk
Palmatifid	With lobes radiating from a single point at the end of the leaf stalk, divided little more than half way at most
Palmatisect	With lobes radiating from a single point at the end of the leaf stalk, divided more than half way
Paripinnate	**Pinnate** with an even number of leaflets and no terminal leaflet
Pectinate	**Pinnatifid** with the segments set closely like teeth of a comb
Pedate	**Palmate** but with the main lobes again more or less divided
Perfoliate	Clasping and encircling the stem at the base 
Phyllary	Another name for an **involucral bract** when applied strictly to the family *Asteraceae* 
Pinna	The top-level division of a **compound** leaf
Pinnate	With more than three leaflets, the majority of leaflets arising in opposite pairs on each side of a common stalk
Pinnatifid	With lobes arranged pinnately but not divided to much more than half way to the stalk
Pinnatisect	With lobes arranged pinnately but not divided all the way to the stalk

Rosette	A cluster of leaves at the base of a stem
Simple	Undivided, not **compound**
Spiral	Occurring singly at the **nodes** of an axis, each successively **not** at 180 degrees from its neigbours
Ternate	Compounded of, or divided into, three
Trifid	Divided into three lobes to at least half way
Unijugate	With a single pair of leaflets
Verticillate	Arranged in a **whorl**



Shapes

Acute	Pointed and making an angle of less than 90 degrees
Acuminate	Narrowing gradually to a point
Apiculate	With a short, sharp point
Appendage	A protrusion or extension to an organ
Aristate	With an awn or stiff bristle
Attenuate	Gradually narrowing to a drawn-out tip, stalk or other structure.
Auricle; auriculate	A lobe or ear-like extension at the base of an organ; having such an extension

	extension
Awn	A bristle-like **appendage**
Bifid	Divided into two parts, at least half way and often more
Bifurcate	Forked into two more or less equal branches
Campanulate	Bell-shaped
Capillary	Hair-like
Capitate	With a knob-like or pinhead-like termination
Caudate	With an extended "tail"
Circinate	Coiled in a flat spiral
Cirrhose	Ending in a long coiled tip or tendril
Clavate	Club-shaped towards the tip
Compressed	Flattened
Conduplicate	Folded once lengthwise, or furrowed to appear so
Cordate	Shaped like the two lobes of a caricature heart
Cuneate	Wedge-shaped
Cuspidate	Ending abruptly in a sharp point
Deltoid	Having three more or less straight sides (and therefore **truncate** at the point of attachment)
Depressed	(Usually applied to **globose** organs) slightly flattened and so broader than tall
Dimorphic	Occurring in two different forms
Dissected	Deeply divided into segments
Dorsiventral	With a definite upper and lower side
Echinate	With spines
Ellipsoid	A solid shape which is elliptic in side view from any angle
Elliptic	A flat shape widest in the middle and longer than broad
Emarginate	With a distinct more or less angled notch at the tip
Ensiform	Sword-shaped
Entire	Neither toothed nor lobed
Falcate	Sickle-shaped
Filiform	Thread-like
Flexuous	Wavy
Globose	Spherical
Hastate	Spearhead shaped, with two sideways-projecting lobes at the base
Inflated	With a gap between an organ and its contents
Keel	A longitudinal ridge
Laminar	In the form of a flat leaf
Lanceolate	In the shape of a lance; narrowly ovate, usually with an acute tip
Lenticular	In the shape of a lens (usually but not invariably biconvex)

Ligulate	Strap-shaped
Linear	Long and narrow with parallel edges
Lunate	Crescent-shaped
Monomorphic	Occurring in a single form
Mucro; mucronate	A short straight bristle-like tip; having such a tip
ob-	(In front of another shape term) the other way round to the normal term: e.g. obcordate, with heart-shaped lobes at the apex; obovate, an **ovate** shape widest nearer the tip
Oblong	A flat shape longer than broad, with the middle section more or less parallel sided
Obtuse	Making an angle greater than 90 degrees
Orbicular	A flat circular shape
Oval	A flat shape widest nearer the base, longer than wide, and the greater part of each side convex; overall egg-shaped, rounded at the apex
Ovate	A flat shape widest nearer the base, longer than wide, and the greater part of each side convex; overall egg-shaped, although it could be a very pointy egg
Ovoid	A solid shape **ovate** in outline from all side views
Pandurate *or* panduriform	Fiddle-shaped
Peltate	A flat shape with a stalk arising from a flat surface and not the margin
Plicate	Folded more than once lengthwise
Praemorse	Ending abruptly and more or less jaggedly
Pulvinate	Cushion-like
Reniform	Kidney-shaped
Retuse	Shallowly notched at the apex
Rhombic	A flat shape longer than wide, widest at the middle and angled at that point, with more or less straight margins running to the base and apex (i.e. roughly diamond-shaped)
Rostrate	With a beak
Runcinate	With sharp lobes or divisions directed backward towards the base
Sagittate	Shaped like an arrow-head at least at the base
Spathulate	Spoon-shaped
sub-	(In front of another shape term) weakly, indistinctly or imperfectly: e.g. subcordate, with shallow heart-shaped basal lobes; subglobose, not quite spherical
Subulate	Tapering evenly from the base to a fine point at the apex
Terete	Rounded in cross-section
Transverse	Lying cross-ways, with the point of attachment on a side
Triangular	Having three more or less straight sides (and therefore **truncate** at the point of attachment when attached by the margin)
Trigonous	With three angles in cross-section

Triquetrous	With three more or less sharp angles in cross-section
Trullate	A flat shape widest near the base and with straight sides running towards base and apex (i.e. trowel-shaped)
Truncate	Cut off in a straight line at either the base or the apex
Unguiculate	Narrowed at the base into a claw
Urceolate	Urn-shaped or pitcher-shaped

Toothing and lobing

Bidentate	Having two teeth; or having teeth of two different sizes
Biserrate	Having saw-teeth of two sizes
Crenate	Having rounded teeth
Dentate	Toothed
Denticulate	Finely toothed
Entire	Not toothed or lobed
Fimbriate	With the margin cut into long slender lobes
Lacerate	Jaggedly and irregularly cut
Laciniate	Deeply cut into narrow lobes
Lobe; lobate	A division, more substantial than a tooth and usually more or less rounded; having one or more lobes
Serrate; serration	With more or less saw-like teeth with their points directed towards the apex; such toothing
Sinuate *or* sinuous	With the margins curving in and out in the plane of the more or less flat organ
Sinus	The gap between two teeth or lobes (a **basal sinus** is an indentation where a flat organ meets its stem)
Tooth	A more or less shallow, pointed projection
Undulate	With the main body flat but the margins undulating in the vertical plane

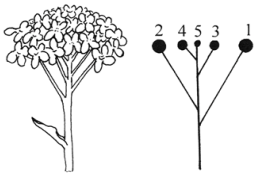
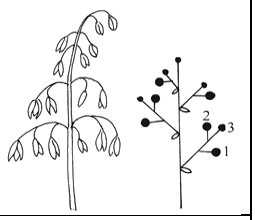
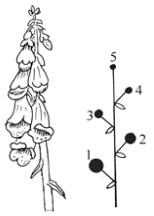
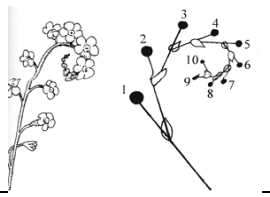
Hairs, spines, sculpturing, surfaces and texture

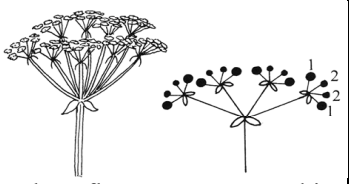
Acicle	Between a stiff bristle and a slender prickle
Aculeate	Prickly
Arachnoid	With a web of interlaced hairs
Barb	A hooked hair
Bloom	A waxy covering on leaves and fruits and occasionally on stems
Bullate	With blister-like convexities on the surface
Canescent	Densely covered with short. Greyish white hairs
Cartilaginous	Hardened and not green but readily cut with a knife
Ciliate	Fringed with long hairs
Ciliolate	Fringed with not so long hairs

Comose	Having a tuft or tufts of hairs
Coriaceous	Leathery
Dendritic	(Of hairs) branched
Glabrous	Hairless
Granulose	Having a slightly rough surface
Hirsute	With coarse hairs
Hispid	With rough, stiff hairs or bristles
Hyaline	Thin, membranous and translucent
Moniliform	(Of hairs) like a string of beads
Muricate	Rough with short stout points
Pannose	Felted with densely matted woolly hairs
Papilla; papillose *or* papillate	A small projection shaped like a nipple; covered with such projections
Pilose	Softly hairy
Prickle	A sharp-pointed outgrowth usually with a broader base
Pruinose	With a **bloom**
Puberulent	Covered in minute soft haris
Pubescent	Covered in soft hairs
Punctate	Marked with dots, spots or glands
Pustulate	Covered with pimples
Reticulate	Marked with a network pattern
Rugose	With a wrinkled surface
Scabrous *or* scabrid	Rough to the touch with minute bristles, prickles or projections
Scarious	Thin, membranous and not green
Sericeous	Silky
Seta; setaceous; setiferous *or* setose	A bristle; in the form of a bristle; with bristles
Spine	A sharp, stiff woody outgrowth; sometimes distinguished from a **prickle** by not having a broader base
Squamose	Covered in broad scales
Squarrose	With a rough surface from projecting scales
Stellate	Star-shaped (usually of hairs or glands, but can be applied to other organs)
Striae; striate	Fine, longitudinal lines, grooves or ridges; having such
Strigose	Bearing stiff hairs or bristles
Sulcate	Grooved or furrowed
Tomentose	Densely covered in soft hairs
Tubercle; tuberculate	A small ellipsoid, spherical or cylindrical swelling; covered in such swellings
Velutinous	Velvety

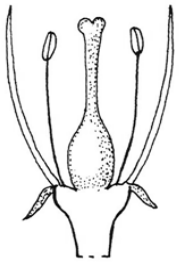
Verrucose	Covered in small warty projections
Vesiculose	Covered in small bladders
Villous	Covered in long shaggy hairs
Viscid	Sticky

Inflorescences

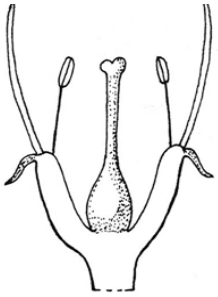
Capitulum	A head of stalkless flowers surrounded by a ring of bracts (**involucral bracts**), as in *Asteraceae*
Catkin	A spike of reduced, petal-less flowers usually adapted for wind pollination
Corymb	A **raceme** where the lower flower stalks are longer than the upper ones, giving a more or less flat-topped or shallowly domed inflorescence 
Cyme; cymose	A branching inflorescence with a flower at the end of each branch, terminating further growth on the branch; having an inflorescence of this type 
Dichasium	A **cyme** with two side-branches at each **node** or branching point
Inflorescence	A group of flowers in a branching system together with any associated **bracts** and **bracteoles**
Monochasium	A **cyme** with a single side-branch at each **node**
Panicle; paniculate	A much-branched inflorescence, that can be either **cymose** or **racemose**; having an inflorescence of this type 
Proliferating	Bearing small plants or vegetative buds instead of flowers in the inflorescence
Raceme; racemose	An inflorescence where the oldest flowers are on the lowest (most **proximal**) position and the apex continues to grow beyond them; having an inflorescence of this type 
Scorpioid cyme	A **monochasium** that is coiled up in a spiral when young 
Spadix	A fleshy axis with close-packed flowers

Spike	A **raceme** with unstalked flowers 
Spikelet	A part of the inflorescence of a Grass (*Poaceae*) comprising one or more florets with a pair of bracts (the **glumes**) at the base
Thyrse; thyrsoid	An inflorescence where the main axis grows like a **raceme** and the side branches grow like **cymes**; having such an inflorescence
Umbel; umbellate	An inflorescence where all the branches arise from a single point; having such an inflorescence. In a **compound umbel** the branches bear umbels in their turn. 
Verticillate; verticillaster	Arranged in a whorl; an inflorescence where flowers are arranged in one or more whorls up the axis

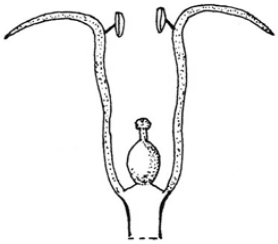
Flower parts and arrangements



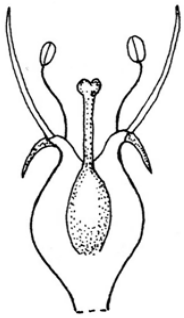
Ovary superior, flower hypogynous



Ovary superior, flower perigynous



Ovary superior, flower perigynous



Ovary inferior, flower epigynous

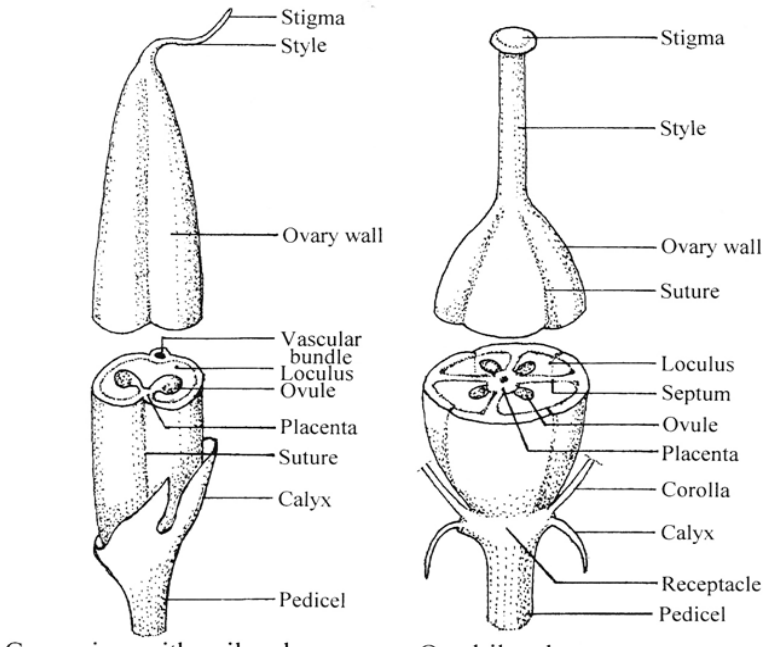
Actinomorphic	Radially symmetrical ("ray form") (It is possible to bisect the flower through its centre along more than one line and get a mirror image)
Anther	The part of the stamen that produces pollen
Anthesis	Flowering time, or applied more strictly to mean the time of release of pollen
Apetalous	Without petals
Asepalous	Without sepals
Basifixed	Attachment of the **anther** to its **filament** by its base

Callus	A hardened area where the **lemma** of a grass flower detaches from the **rhachilla** or axis of a grass inflorescence
Calyx	The outer part of a **perianth** when it is in two ranks, comprising **sepals**
Calyx lobe	One of the free segments of a calyx that is **gamosepalous** (fused at the bottom)
Calyx tube	The tubular basal part of a calyx that is **gamosepalous** (fused at the bottom)
Carpel	A single female reproductive unit of a flower, comprising the ovary, style and stigma
Carpophore	A stalk separating the **ovary** from the **receptacle**
Chasmogamous	With flowers opening to facilitate sexual reproduction between different flowers
Claw	A narrowed base to a petal
Cleistogamous	With flowers not opening, permiting only self-pollination or **apomixis**
Column	A stout structure formed from the fusion of close adherence of stamens and styles
Connective	The top end of a **filament** that joins the **anther** cells
Corolla	The inner part of a **perianth** when it is in two ranks, comprising **petals**
Corolla lobe	One of the free segments of a corolla that is **gamopetalous** (fused at the bottom)
Corolla tube	The tubular basal part of a corolla that is **gamopetalous** (fused at the bottom)
Corona	A structure between the stamens and the corolla, sometimes fused with the former
Dioecious	Having the male and female flowers on different plants
Disc floret	One of the central, more or less **actinomorphic** flowers in daisy-like *Asteraceae* with two types of flower
Dorsifixed	Attachment of the **anther** to its **filament** by its middle
Epicalyx	Bracts around a flower, outside and additional to the true **calyx**
Epigynous	("Above the female bits") A flower with an **inferior ovary** (i.e. with the calyx, corolla and stamens inserted on top, or on an extension of the **receptacle**, the **hypanthium,** that extends from the top of the ovary)
Filament	The stalk part of a stamen that bears the **anthers**
Glume	A bract at the base of a flower in Sedges (*Cyperaceae*) or a spikelet of flowers in Grasses (*Poaceae*)
Gynodioecious	Having plants some of which bear female flowers only and some of which bear **hermaphrodite** (bisexual) flowers
Gynoecium	The group of all the **carpels** (female parts) in a single flower
Hermaphrodite	Having flowers that individually combine male and female organs
Heterostylous	Having two forms of flowers with female organs on different plants, differing in the **styles** and/or **stigmas**

Hypanthium	An extension of the **receptacle** above the base of the ovary, forming a flange or tube
Hypogynous	("Below the female bits") A flower with a **superior ovary** (i.e. with the calyx, corolla and stamens insterted round its base)
Inferior ovary	An **ovary** that has the calyx, corolla and stamens inserted on top and is more or less sunk into the surrounding **receptacle**
Keel	A floral part shaped like a keel
Labellum	The 'lip' or ornately developed third petal of an orchid
Labiate	With **lips**
Lemma	The lower of the two bracts enclosing the individual flower in a Grass (*Poaceae*) spikelet
Ligule	The strap-shaped limb of a **ray floret** in *Asteraceae*
Limb	The more expanded **distal** part of a **corolla**, **petal**, **calyx** or **sepal**
Lip	A **distal** part of a **corolla** that is differentiated from the rest and distinct in shape
Lodicule	One of two tiny scales at the base of a Grass (*Poaceae*) flower, probably representing a vestigial **perianth**
Monoecious	Having separate male and female flowers on the same plant. (Some authors use it to embrace **hermaphrodite** flowers as well, so that it means more loosely "having male and female organs on the same plant".)
Nectary	A gland or surface that secretes nectar
Ovary	The basal part of the **carpel** that contains the **ovules**
Ovule	The organ that develops into a seed
Palea	The upper of the two bracts enclosing the individual flower in a Grass (*Poaceae*) spikelet
Papilionaceous	With a **corolla** made up of a **standard** petal, two lateral wing petals and a lower pair of petals forming a **keel** (as in the Pea family, *Fabaceae*)
Pappus	A calyx made up of a ring of scales or hairs in *Asteraceae* and a few other families
Perianth	The outer parts of the flower that do not bear reproductive organs, i.e. the **calyx** and **corolla**, or all **tepals**, taken together
Perigynous	("Around the female bits") A flower with a **superior ovary** but where the **calyx, corolla** and **stamens** are attached above the base of the ovary on an extensiuon of the **receptacle** (the **hypanthium**) that isn't directly attached to the ovary
Petal	One of the segments of the inner whorls of the **perianth**, when these are free to the base.
Ray floret	One of the outer, **ligulate** or **zygomorphic** flowers in daisy-like *Asteraceae* with two types of flower; or, in dandelion-like flowers, making up all flowers of the head
Receptacle	The end of the stem (**pedicel**), often expanded, which bears the floral parts
Receptacular scales	Chaffy scale-like bracts mixed in with the florets on the receptacle in some *Asteraceae*

Rhachilla	The axial stem within a **spikelet** of grass flowers
Semi-inferior ovary	An **ovary** that has its lower part more or less sunk into the surrounding **receptacle**, but the upper part free and projecting above calyx, corolla and stamens
Sepal	One of the segments of the outer whorls of the **perianth**, when these are free to the base
Stamen	The male reproductive unit of a flower, comprising **filament**, **connective** and **anthers**
Staminode	A sterile and often modified **stamen**
Stigma	The variously shaped topmost part of the **gynoecium** (female reproductive unit), which is receptive to pollen
Style	The stalk which bears the **stigma**(s)
Superior ovary	An **ovary** that is borne above the calyx, corolla and stamens
Tepal	A name for a perianth segment when the **perianth** is not differentiated into **sepals** and **petals**
Throat	The point where the **limb** of a corolla or calyx joins the tube
Tube floret	One of the more or less **actinomorphic** flowers in daisy-like *Asteraceae*; in those with two types of flower in a head, usually comprising the central **disc florets**
Utricle	Properly, any bladder-like structure, but usally applied to the rather membranous sac that holds the fruit in true Sedges (*Carex*)
Valve	One of the segments into which an anther splits to release pollen
Zygomorphic	Mirror symmetrical ("yoke form") (It is possible to bisect the flower through its centre along only one line to get a mirror image)

Fruit



Gynoecium with unilocular ovary (legume of *Vicia faba*)

Quadrilocular ovary which develops into a capsule (*Euonymus europaeus*)

Achene	A dry, one-seeded fruit that does not open up at maturity
Aril	A fleshy outer covering to a seed (outside any fruit wall)
Axile	An attachment of seeds on the central axis of the **ovary**, in the angles of the dividing walls (**septa**)
Beak	A narrow projection from the top of a fruit
Calyptra	A cap-like structure over a fruit
Capsule	A dry, **dehiscent** fruit (one opening on ripening) bearing more than one seed
Carpel	The basic fruiting unit, which may be single or multiple
Carpophore	A stalk-like structure that bears the fruit above the **receptacle** in some plants
Caryopsis	A dry one-seeded **indehiscent** fruit; the "grain" of *Poaceae*
Commissure	The surface along which adjacent carpels are joined together
Cupule	A cup-shaped structure around the fruit formed of more or less fused bracts
Drupe	A fleshy fruit containing one or more hard seeds ("stones" or "pips")
Follicle	A dry fruit comprising a single **carpel**, usually many-seeded, opening along one side
Free-central	With the seeds developing along a central axis of the ovary that is not joined transversely to the ovary wall
Hilum	The scar on a seed where it broke from its point of attachment
Legume	A usually dry many-seeded fruit formed from a single carpel and splitting along two edges
Loculus	A compartment of an ovary
Mericarp	A single carpel that splits away from a joined multicarpel fruit (**schizocarp)** at maturity
Monocarpous	Composed of a single **carpel**
Nut	A dry, one-seeded, **indehiscent**, woody-walled fruit
Nutlet	A small **nut**, often also a woody **mericarp**
Pappus	A calyx made up of a ring of scales or hairs in *Asteraceae* and a few other families
Parietal	An attachment of seeds on the tips of the incomplete divisions in an ovary
Pericarp	The fruit wall, developed from the **ovary** wall
Schizocarp	A fruit composed of more than one carpel, that then breaks up into one-seeded portions (**mericarps**)
Septum; septate	A wall or membrane fully or partially dividing the **ovary** into cells; having such walls
Testa	The hard coating of a seed
Valve	One of the segments into which a fruit splits to release the seed(s)

Colour

Fulvous	Tawny
Fuscous	Greyish-brown
Glaucous	Bluish-white
Rubiginous	Rust-coloured
Stramineous	Straw-coloured

Learning more

Hickey and King, *Cambridge Illustrated Glossary of Botanical Terms*, CUP, 2000. This has pages and pages of pictures to supplement the fairly brief text entries. Strongly recommended but £30 new. Second hand copies are often not much less, but the time to look is just after the academic year ends.

Wikipedia glossary of botanical terms

http://en.wikipedia.org/wiki/Glossary_of_botanical_terms

Good text and cross-referencing but unfortunately few illustrations.

Wikipedia list of plant morphology terms

http://en.wikipedia.org/wiki/List_of_plant_morphology_terms

Rather terse and incomplete but sometimes a useful adjunct to the above.

For a very full and well-illustrated account of inflorescence types, see:

http://en.wikipedia.org/wiki/Inflorescence

Tools

The two most important tools to take into the field are a notebook and pen or pencil. After that comes a field Flora, and we deal with that later; but with just the first two, you can make notes for consulting the Flora later.

Hand lenses

The next most valuable thing is a hand lens, or loupe. There are a number of things to consider when choosing a loupe.

- The magnifying power. For most purposes, a 10x lens is adequate. But for fine detail such as hair and gland structure, a 20x may be needed.
- The size. A larger lens potentially gives you a broader field of view, which makes it easier to see detail in context. However you need to take into account:
- The effective field of view. You will notice that all lenses distort at their edges, and this limits the field of view actually available. This distortion is more of a problem at higher magnifications. To reduce this effect lenses are usually made up of several elements which combine to correct for distortion. A 10x lens typically has 3 elements (a 'triplet'), and a good 20x will have 5 elements. Taking this into account, a decent 10x lens will typically be 18mm or 21mm with an effective field of view of at least half of that; a decent 20x lens will be at least 12mm with a similar field of view.
- The lens material. Plastic lenses are available very cheaply but are less clear, and tend to scratch. The extra cost for a decent basic glass lens is so small that it's not worth considering plastic.
- The robustness of the housing. Loupes suitable for fieldwork have the lens hinged inside a protective shell of plastic, rubber or metal. Make sure that the casing and the hinge is robust. The hinge post will either be screwed or riveted into the casing. I prefer a screw fixing as it can be tightened up again if it loosens, but you may not have a choice in the model you prefer.
- Portability. One usually wants to keep the loupe rounds one's neck. Either the casing should have a place for threading a lanyard, or there should be enough room on the hinge post for threading a lanyard without straining the hinge.

When using a loupe, it's important to realise that you will not get the best out of your lens if you hold it a foot or more away from your eye. The magnification may be OK, but your field of view will be tiny and difficult to control. My 'rule of thumb' is:

- Unfold your lens from its casing and stick your forefinger through the casing, resting your thumb on the outside to grip it firmly.
- Now bring your forefinger and thumb to rest on either side of the tip of your nose, with the lens in line with your eye.
- Bring the material you want to examine up to the lens until it is clearly in focus.

- You may find this position is not the most comfortable for you, especially if you are long-sighted, but you should be able to make minor adjustments in position to suit.

Measuring devices

Most field guides and Floras have a metric measure printed along an end-paper, and this is adequate for measuring to about 1mm accuracy and estimating to about 0.5mm.

A cabinet-maker's tool such as a 150mm Rabone steel rule costs about £5 and slips into a pocket, or can be put on a lanyard. It is dimensionally very stable, waterproof and rustproof, and one can measure accurately to 0.5mm and estimate by interpolation to 0.25mm.

Beyond this one really needs a magnifying device fitted with a scale or graticule. There are various pocket microscopes available, but the most convenient and compact device is a Peak measuring loupe. These come in various magnifications, but the most practical is a 10x device fitted with a 0.1mm linear scale. It has a good quality lens with an astonishingly broad field of view and, fairly obviously, will measure to an accuracy of 0.1mm. Unfortunately it is quite expensive (£40-£50); and it can't be hung around one's neck, though it comes with a leather case.

Measuring beyond this requires a bench microscope; see the next sections.

Dissecting microscopes

Most identification can be done in the field using good 10x and 20x loupes. However, if you are going to take an interest in a critical plant group, or if you merely want to increase your knowledge and pleasure by examining plants in greater detail, you may want to invest in a dissecting microscope.

These are relatively low-powered microscopes (50x – 60x is about the maximum), but they don't require the preparation of slides; they are intended for examining the material "as is". They are typically binocular, though expensive models may have a camera attachment as well, and there is at least one monocular on the market.

The advantage of a dissecting microscope over a loupe, as well as the ability to go to higher magnifications, is the clarity of magnified image (in stereo) and the broad field of view; so that even at 10x magnification detail is much easier to observe.

Dissecting microscopes come with eyepiece lenses in the conventional range for a microscope (5x – 20x), and a low power objective lens (typically 1x – 4x). The cheapest models (at £50-£90) have a single objective, typically giving about 20x magnification with the supplied eyepiece, although eyepieces are usually interchangeable. More expensive models (£200-£250) have objectives that are interchangeable or mounted on a rotating turret. More expensive still (£400 up) are models with zoom lenses.

If you intend to use your microscope for any period of time, a model with angled eyepieces is much less of a strain than one with vertically mounted eyepieces (as found on the cheapest models).

The cheapest models come with no built-in lighting, or nowadays sometimes with a battery-powered LED array. The latter has the advantage that it can be used away from mains power, and gives a cold light in both senses of the word.

More expensive models usually have lighting both above the stage (incident) and below the stage (transmitted). The latter is an obvious advantage for looking at detail in translucent structures, which you will not get with external lighting. The drawback (unless the lighting is an LED array) is that your material will get gently toasted if left too long on the stage.

For measuring purposes you can get stage micrometers for about £15, which are slides with a graduated scale (usually 0.1mm) marked on them. Some suppliers provide graduated eyepieces; to use one of these, you will also need to obtain a stage micrometer and calibrate the eyepiece against the micrometer. With a dissecting microscope you may consider whether it's worth the extra expense and trouble, as you can use the micrometer directly on the stage next to the specimen. The only advantage is that your micrometer is not exposed to the hazards of life on the stage after you have set up your eyepiece.

Compound microscopes

Not many people will want to invest in a compound microscope for work with vascular plants unless they are taking up a specialist interest. Apart from a few critical genera like Fescues (*Festuca*), cell anatomy is not necessary as it is for, say, bryophytes. If you are studying hybrids, then a compound microscope is useful for pollen and spore examination; and real devotees can take up chromosome counting!

Compound microscopes for general use have a typical magnification range of 40x – 1000x; for most purposes to do with vascular plants, a combination of 100x and 400x is adequate. Multiple magnifications are usually achieved with a single eyepiece and a rotating turret of objectives of different powers.

Some microscopes come with built-in substage illumination; some provide a simple reflective lens for use with an external light source. In either case, expect to find a **condenser** fitted below the stage; this directs and controls the light transmitted to the objective, allowing one to control illumination and contrast and avoid refractive blurring of the image.

If you are measuring dimensions of material, you will need a graduated eyepiece and a stage micrometer. Since you can't use the stage micrometer when viewing the material as you can with a dissecting microscope, you will need to calibrate the graduations on your eyepiece at each magnification. Place the stage micrometer on the microscope stage, align the scale on the eyepiece with the scale on the micrometer, and count off the ticks on the eyepiece against a standard length of the micrometer scale. This will allow you to calculate a ratio of "1 eyepiece tick = x.xx microns" for each magnification, which you should fix to your microscope or case.

If you are counting material (for instance, ratios of viable pollen grains or spores), a mechanical stage is almost essential. This allows you to move the slide independently in two axes, so that one can make methodical sweeps over the material.

A new basic microscope with a lighting system will cost you about £100 - £200. Measuring eyepieces, stage micrometers and mechanical stages will all cost extra. It is worth shopping around for second hand items, when you may pay as little as £25 for a decent student microscope with no built-in illumination. If you are not buying from one of the main dealers with a reputation to maintain, make sure you examine the instrument first.

There is an art to the preparation of microscope slides, especially for preserving specimens, which is well beyond the scope of this course to explore. However, "quick and dirty" examinations of pollen grains, spores and (in some cases) leaf cell structures can be done with a couple of simple stains and minimal technique.

Dissecting instruments

One can buy sets of dissecting instruments for £15-£20, but for using a dissecting microscope with vascular plants one really needs only a pair of forceps, a couple of probes for teasing material apart, and a scalpel for slicing and making incisions.

Using a camera with a microscope

There are various systems that allow one to capture images from the microscope. More expensive microscopes come with a separate "eyepiece" for camera attachment. For others there are systems that allow a camera to be attached to the normal eyepiece of the microscope, with the obvious disadvantage that one can't look at the specimen at the same time. These rely on the camera having an SLR mounting or, in the case of digital compacts, a screw thread for filter or macro attachment on the lens mounting.

An alternative method is to use a PC camera device that captures images directly to the computer, usually through a USB port. These are simple to set up but usually only offer a rather low resolution – typically 640 x 480 pixels.

On all camera capture the very shallow depth of field is a problem. There is software available that allows one to take a series of pictures, progressively adjusting the focus, and then synthesise these into one sharp image.

A note on collecting

Use of some of the tools and techniques in this section demands that you collect material from the field to examine at home. You will hear "Take the book to the plant, not the plant to the book" but this is a common-sense principle, not an immutable law. Sometimes one has to collect material to make an accurate determination and provide reference material.

Remember:

- It is against the law to collect **any part** of a plant on Schedule 8 of the Wildlife and Countryside Act.
- It is against the law to collect on a National Nature Reserve or Site of Special Scientific Interest without a license from Natural England.
- It is against the law to **uproot** any wild plant without the landowner's permission.
- It is a matter of common courtesy to seek permission before collecting on other areas managed for conservation ends.

But one can learn a great deal by close, leisurely examination out of the weather, and it's a pity that everyone is now discouraged from any form of picking even of the most abundant plants. Here are some common-sense guidelines over and above the strictures given above.

- Collect for a purpose, to increase your own knowledge or the general store of knowledge.

- If you are uncertain whether the plant is an extreme rarity, leave it in place. (Call your vice-county recorder instead!)
- Never deplete a population. If your collecting will have a significant impact, better to leave it in place.
- Take no more than will satisfy your needs for identification. Take care to read the Flora and understand what are the diagnostic features of the plant. You may need only a single leafy stem or one fruiting capsule. Make notes about all the other features that are obvious enough in the field.
- Collect in a non-destructive manner where possible. For instance, it is not really possible to get identifications for many Hawkweeds and Dandelions without taking all the upper parts of the plant; but by cutting them off at the top of the tap-root you will allow them to grow another year.
- By all means use a camera to supplement your field observations and collections, but remember that crisp shots showing the fine structure are usually necessary.
- Take no more than you can deal with in a timely way, either by examining fresh or by putting into preservation. Remember that some features (colour, many glands) can't be observed on dried specimens and must be noted straight away.
- If you are building up a reference collection either for yourself or for general use, learn the techniques of drying and preserving specimens.

Suppliers

Hand Lenses

Some major manufacturers are:

Silver Geo: a range of decent quality loupes at very competitive prices, including an illuminated 10x lens for difficult lighting conditions. Badged by a number of different suppliers, but UKGE (United Kingdom Geologists' Equipment) have some of the keenest prices. The author also carries stock of one or two items of their range.

Hilkinson / Ruper: probably the most popular range of lenses; optically good, although the author finds some of their lens diameters fussily small especially at higher magnifications. Widely available, worth shopping around.

Opticron: lenses are reasonable quality but rather expensive for what they are. I haven't found the casings to be that robust.

Eyemagnify: make a very good quality 30x 21mm lens which they sell direct (http://www.eyemagnify.com/) for £17 + £3 delivery charge. The author's favourite!

Some suppliers:

Summerfield Books (www.summerfieldbooks.com) are the BSBI's stockists and carry a range of mostly Hilkinson / Ruper lenses.

UKGE (www.ukge.co.uk) stock Silver Geo and Hilkinson / Ruper lenses at competitive prices.

Alana Ecology (www.alanaecology.com) stock Opticron, Hilkinson / Ruper, Belomo and some Silver Geo lenses.

The Loupe Store (http://www.theloupestore.co.uk) also has the Silver Geo 10x loupe. They claim to have exclusive distribution rights but they don't.

Lanyards for hand lenses can be bought for £1 from Alana Ecology and for slightly more from The Loupe Store.

Measuring Devices

Rabone and Stanley steel 6" / 150mm rules are available from a number of online tool suppliers; search for a good price. Make sure you get a rule graduated to 0.5mm.

The Peak measuring loupe can be ordered direct from the States It used also to be available from Edward Marcus Ltd via IC Online's website:

(http://www.ic-online.co.uk/em/Detail/it160001.htm)

but it no longer seems to be there. However the Loupe Store (http://www.theloupestore.co.uk) also has it.

Microscopes

Some suppliers for reasonably priced microscopes (dissecting and compound) and accessories are:

Brunel Micro (www.brunelmicroscopes.co.uk) based in Chippenham, Wiltshire where you can arrange for a demo. Good for second-hand microscopes.

UKGE (www.ukge.co.uk) selling some of the same range and also some budget low-end items.

Alana Ecology (www.alanaecology.com) also have a range of microscopes including many of the same models.

Dissecting tools and kits can be obtained from any of these suppliers.

Keys

Many people moving from popular field guides to technical Floras hate keys. At the end of this session you may still hate them, but hopefully you will understand them a bit better and feel more confident in using them. They are an unavoidable fact of life, and can be a powerful tool when you have mastered them.

Dichotomous keys

This is the commonest kind of key you are likely to encounter. One of the problems with dichotomous keys is that although they all do the same job, they come in a surprising variety of different formats and you need to familiarise yourself with these.

The basic procedure of a dichotomous key is this:

- At the start of the key, you are offered a choice between two sets of features. (Some keys offer more than two sets in places, so they should strictly be called polychotomous, but the principle is the same.)
- You make a decision as to which set of features matches your plant.
- The chosen option ends either in the name of a plant, or in a pointer to another choice.
- If it ends in another choice, you then go through the process again. And keep doing it until you come to the name of a plant.

And that's it! Be sure to read the full description of the named plant, if one is provided, and check that it matches yours in all salient details. (Don't be too hard and fast on overall sizes, which often go outside the ranges stated.) If you don't get a good match, you probably made a wrong decision and may need to backtrack.

If you arrive at a plant that's completely unfamiliar to you, a "sanity check" against good illustrations is always worthwhile.

Example 1: the Stace model

5. LAMIUM L. - *Dead-nettles*

Annuals or herbaceous perennials; leaves serrate to deeply so, rarely ± entire, calyx with 5 ± equal narrowly triangular-acuminate lobes; corolla white, or pink to purple or mauve, with hooded upper lip, with ± 1-lobed lower lip of which lateral lobes are much reduced and pointed or rounded; stamens 4, shorter than upper lip of corolla; whorls distant in leaf-axils, or ± congested in axils of modified leaves.

1 Perennials with rhizomes and/or stolons; corolla-tube curved 2
1 Annuals; corolla-tube straight 3
2 Corolla white; leaves never blotched whitish; lower lip of corolla with 2-3 teeth each side **1. L. album**
2 Corolla usually pinkish-purple; leaves usually blotched whitish; lower lip of corolla with 1 tooth on each side **2. L. maculatum**
3 ± all leaves petiolate 4
3 Middle and upper leaves subtending whorls sessile 5
4 Leaves subtending whorls serrate to crenate-serrate, with teeth <2mm long **3. L. purpureum**
4 Leaves subtending whorls deeply serrate, with many teeth >2mm long **4. L. hybridum**
5 Calyx 5-7mm at flowering, densely white- ± patent-pubescent, the teeth erect to convergent at fruiting; lower lip of corolla <3mm **6. L. amplexicaule**
5 Calyx 8-12mm at flowering, ± appressed-pubescent, the teeth divergent at fruiting; lower lip of corolla >3mm **5. L. confertum**

This is the format found in both the Stace *New Flora* and the Stace *Field Flora*. The main difference is that there are no supporting separate descriptions in the *Field Flora*; instead, a brief description is rolled into the key itself.

5. LAMIUM L. - ***Dead-nettles***

Annuals or herbaceous perennials; leaves serrate to deeply so, rarely ± entire, calyx with 5 ± equal narrowly triangular-acuminate lobes; corolla white, or pink to purple or mauve, with hooded upper lip, with ± 1-lobed lower lip of which lateral lobes are much reduced and pointed or rounded; stamens 4, shorter than upper lip of corolla; whorls distant in leaf-axils, or ± congested in axils of modified leaves.

1 Perennials with rhizomes and/or stolons; corolla-tube curved 2
1 Annuals; corolla-tube straight 3
  2 Corolla white; leaves never blotched whitish; lower lip of corolla with 2-3 teeth each side. Rhizomatous or sometimes stoloniferous perennial to 60cm. Native; hedgebanks, waysides, rough ground; common in most of lowland Br, rare in CI and Ir ***White Dead-nettle*** - **L. album** L.
  2 Corolla usually pinkish-purple; leaves usually blotched whitish; lower lip of corolla with 1 tooth on each side. Rhizomatous and/or stoloniferous perennial to 60cm. Intrd-natd; rough ground and tips; scattered in Br and CI ***Spotted Dead-nettle*** - **L. maculatum** (L.) L.
3 Plant with ± all leaves petiolate 4
3 Middle and upper leaves subtending whorls sessile 5
  4 Leaves subtending whorls serrate to crenate-serrate, with teeth <2mm long. Annual to 25cm. Native; cultivated and waste ground; common ***Red Dead-nettle*** - **L. purpureum** L.
  4 Leaves subtending whorls deeply serrate, with many teeth >2mm long. Annual to 25cm. Native; cultivated and waste ground, scattered over lowland BI ***Cut-leaved Dead-nettle*** - **L. hybridum** Vill.
5 Calyx 5-7mm at flowering, densely white- ± patent-pubescent, the teeth erect to convergent at fruiting; lower lip of corolla <3mm. Annual to 25cm. Native, open, cultivated and waste ground; throughout BI, commoner in E ***Henbit Dead-nettle*** - **L. amplexicaule** L.
5 Calyx 8-12mm at flowering, ± appressed-pubescent, the teeth divergent at fruiting; lower lip of corolla >3mm. Annual to 25cm. Native; cultivated and waste ground; local near coast in N, W & E Sc, Man, very scattered in Ir ***Northern Dead-nettle*** - **L. confertum** Fr.

The way in which this works is:

- Each choice has a number.
- All the choices in the same set of choices have the same number, and so must be read and compared.
- The pairs are always shown together, not separated.
- The indentation simply serves to pick out one set of choices from the adjoining ones, and doesn't imply any hierarchy.

If we are looking at a plant of this kind that we have never seen before, the chances are that we can put it in the Dead-nettle family *Lamiaceae* with reasonable confidence but may not know what genus it belongs to. So before we get to this stage, we shall have had to go through a **family key** to narrow it down. Let's take an example. We have in front of us a perennial plant with rather conspicuous large white flowers.

General key

1 Corolla with well-developed lower lip; upper lip 0 or represented by 1-2 short lobes 2
1 Corolla with upper and lower lips well developed, or ± actinomorphic (4-5-lobed) 3
2 Corolla with ring of hairs inside tube; lower lip 3-lobed (central lobe often ± bifid); upper lip of 1-2 short lobes **12. AJUGA**
2 Corolla without ring of hairs inside tube; lower lip 5-lobed (central lobe sometimes slightly bifid); upper lip 0 **11. TEUCRIUM**
3 Stamens 2 4
3 Stamens 4 (often very reduced in female flowers) 6
4 Shrub; leaves entire **25. ROSMARINUS**
4 Herbaceous annual or perennial; leaves crenate to pinnately lobed, rarely some entire 5
5 Calyx and corolla both distinctly 2-lipped **26. SALVIA**
5 Calyx with 5 equal lobes; corolla with 4 subequal lobes (the uppermost slightly wider and emarginate) **22. LYCOPUS**
6 Calyx with 2 entire lips, the upper with a dorsal outgrowth **10. SCUTELLARIA**
6 Calyx with 5-10 lobes or teeth, often 3 forming upper and 2 lower lip, without dorsal outgrowth 7
7 Calyx-teeth 10, hooked at apex **9. MARRUBIUM**
7 Calyx-teeth (4-)5, not hooked at apex 8
8 Corolla ± actinomorphic, indistinctly 2-lipped, or distinctly 2-lipped with upper lip ± flat; stamens (except in female flowers) usually fully exposed from front view of flower, sometimes longer than corolla ***Key A***
8 Corolla distinctly 2-lipped, with upper lip distinctly hooded and usually at least partially concealing stamens from front view ***Key B***

We can see that the corolla has a well-developed upper lip, so we go to 3.

We count the stamens; yes, there are four, so we go to 6.

We see that the calyx has five teeth, so we go to 7.

They are definitely five, not ten, and not hooked at the tip; so we go to 8.

The corolla is distinctly two-lipped with a hooded upper lip, so now we are directed to Key B.

Key B - Calyx with 5 teeth or lobes; stamens 4, not included within corolla-tube (but often very reduced in female flowers); corolla distinctly 2-lipped, with upper lip distinctly hooded and often at least partially concealing stamens from front view.

1 Plant with stolons >10cm 2
1 Plant without stolons 5
2 Corolla yellow **4. LAMIASTRUM**
2 Corolla variously bluish, purplish or white 3
3 Flowers few in axillary clusters; bracts all leaf-like **14. GLECHOMA**
3 Flowers in dense whorls forming terminal inflorescence; at least upper bracts much reduced 4
4 Lateral lobes of lower lip of corolla obscure or pointed, if rounded much <1/2 as large as terminal lobe; terminal lobe bifid for ≥1/3 length; carpels and mericarps truncate at apex **5. LAMIUM**
4 Lateral lobes of lower lip of corolla conspicuous, rounded, usually c.1/2 as large as terminal lobe; terminal lobe not bifid or bifid for <1/3 length; carpels and mericarps rounded at apex **1. STACHYS**
5 Calyx-teeth unequal, the upper 3 differing markedly in length and/or breadth from lower 2 6
5 Calyx-teeth ± equal, not forming 2 lips 8
6 Corolla >2cm; calyx ≥12mm **8. MELITTIS**
6 Corolla <2cm; calyx <12mm 7
7 Flowers forming dense terminal head; upper lip of calyx nearly entire, with 3 small teeth; fresh plant not strongly scented **15. PRUNELLA**
7 Flowers in axillary whorls, only the uppermost of which merge; upper lip of calyx with 3 distinct lobes; fresh plant strongly lemon-scented **16. MELISSA**
8 Lower leaves lobed >1/2 way to midrib **3. LEONURUS**
8 Leaves entire to serrate 9
9 Calyx-teeth and associated bracteoles spine-tipped; lower lip of corolla with conical projection at base of each of 2 lateral lobes **6. GALEOPSIS**
9 Calyx-teeth and bracteoles not spine-tipped, or former sometimes so; lower lip of corolla without 2 conical projections 10
10 Stigmas distinctly unequal; leaves whitish-tomentose on lowerside **7. PHLOMIS**
10 Stigmas ± equal; leaves rarely white-tomentose on lowerside 11
11 Lateral lobes of lower lip of corolla obscure or pointed, if rounded much <1/2 as large as terminal lobe; terminal lobe bifid for ≥1/3 length; carpels and mericarps truncate at apex **5. LAMIUM**
11 Lateral lobes of lower lip of corolla conspicuous, rounded, usually c.1/2 as large as terminal lobe; terminal lobe not bifid or bifid for <1/3 length; carpels and mericarps rounded at apex 12
12 Upper lip of corolla scarcely hooded; calyx 15-veined **13. NEPETA**
12 Upper lip of corolla strongly hooded; calyx 5-10-veined 13
13 Calyx-teeth c. as long as wide; calyx-tube trumpet-shaped (cylindrical or ± so for most part but conspicuously expanded in distal 1/2) **2. BALLOTA**
13 Calyx-teeth usually distinctly longer than wide; calyx-tube cylindrical to obconical, not conspicuously expanded in distal 1/2 **1. STACHYS**

We poke around at the bottom of the plant and find it is well-rooted and has runners; so we go to 2.

The corolla is white, so we go to 3.

Now we come to a bit of a challenge. The flowers are definitely in dense whorls, but it isn't altogether clear that they form a "terminal" inflorescence as there are more bracts above the open flowers; and the upper bracts still look pretty leaf-like. We decide that the second option is more likely, so we go to 4. But we mentally "bookmark" key 3 in case we made the wrong choice. Or we might decide to go straight to the first option to see if we can eliminate *Glechoma*. (As the number of flowers in a group and the leaf shape are both wrong, we can quickly do so.)

An examination of the lip shape of the corolla then gets us to *Lamium*. We may scratch our heads a bit on the way, deciding which bit is the lateral lobe.

Now we go to the *Lamium* key. We already know that it's a perennial, so we go to couplet 2. And it's white, so we've reached *Lamium album*!

You may have noticed that there are often several ways to the same genus in this key. For instance, we might well have decided that our plant had no stolons but only rhizomes. In that case we would have gone through several extra steps to arrive at *Lamium*. Field keys based on recognition characters like this rather than on genetic affinities are often called **artificial keys**, and a great part of the usefulness of a Flora lies in how artfully these are constructed, as there is always more than one way to do it. If you are totally puzzled by arriving at a particular point in a key that leaves you no choices, it's not necessarily you who is to blame!

Example 2: the Clapham, Tutin and Warburg model

13. LAMIUM L.

Annual or perennial herbs. Fls in dense axillary whorls, the bracts lf-like. Calyx tubular or tubular-campanulate with 5 nearly equal mucronate teeth. Corolla 2-lipped, the upper lip laterally compressed, forming a hood; lower lip 3-lobed, the lateral lobes very small, each with a small tooth (thus differing from all the other genera); tube dilated above. Anther-cells divaricate, hairy.

1 Annuals; corolla 15 mm or less; tube not suddenly contracted near base. *2*
Perennials; corolla 2 cm or more; tube suddenly contracted near base. *5*

2 Bracts, at least the upper, sessile, differing somewhat from the lvs. *3*
Bracts stalked, resembling the lvs. *4*

3 Calyx in fl. 7 mm or less, tube densely clothed with somewhat spreading white hairs, teeth connivent in fr. **1. amplexicaule**
Calyx in fl. 8 mm or more, tube with a moderate number of stiff appressed hairs, teeth spreading in fr. **2. molucellifolium**

4 Lvs irregularly cut; corolla-tube without or with a faint ring of hairs within. **3. hybridum**
Lvs crenate-serrate; corolla-tube with a conspicuous ring of hairs towards the base within. **4. purpureum**

5 Corolla white; tube with an oblique ring of hairs within towards the base. **5. album**
Corolla purple; tube with a transverse ring of hairs towards the base; lvs usually with large whitish blotch. Garden escape, sometimes ±naturalized. Spotted Dead-nettle. **L. *maculatum* L.*

This is really no different from the Stace model except that the second choice is not explicitly numbered, making it essential that each item in the pair is next to its friend.

Example 3: the *Flora Europaea* model

1 Upper lip of corolla 2-fid
2 Annual; corolla 12–25 mm; leaves mostly irregularly incised **9. bifidum**
2 Perennial; corolla (22–)25–40 mm
3 Lower leaves crenate or variously toothed **2. garganicum**
3 Lower leaves deeply divided into (3–)5 segments which are themselves lobed **4. glaberrimum**
1 Upper lip of corolla entire, minutely toothed or emarginate
4 Anthers glabrous
5 Calyx 12–20 mm; corolla-tube straight, much longer than calyx **1. orvala**
5 Calyx 7–12 mm; corolla-tube curved at base, shorter than or about as long as calyx **5. flexuosum**
4 Anthers hairy
6 Corolla-tube curved at base
7 Annual; corolla with conspicuous, triangular lateral lobes **8. moschatum**
7 Perennial; corolla with minute, linear or narrowly subulate lateral lobes
8 Lateral lobes of the corolla composed of 1 tooth; corolla pink, purple or brownish-purple, rarely white **6. maculatum**
8 Lateral lobes of the corolla composed of 2–3 teeth; corolla white **7. album**
6 Corolla-tube straight
9 Corolla 25–40 mm; perennial **2. garganicum**
9 Corolla not more than 20(–25) mm
10 Perennial; calyx-teeth *c.* ½ as long as tube **3. corsicum**
10 Annual; calyx-teeth about as long as or longer than tube
11 Calyx 8–12 mm, the teeth longer than the tube; lower lip of corolla *c.* 4 mm **12. moluccellifolium**
11 Calyx 5–7 mm, the teeth not longer than the tube; lower lip of corolla 1·5–2·5 mm
12 Bracts ±amplexicaul, usually wider than long **13. amplexicaule**
12 Bracts not amplexicaul, longer than wide
13 Leaves and bracts crenate or crenate-serrate, not decurrent along petiole **10. purpureum**
13 Leaves and bracts incise-dentate, the upper ±decurrent along petiole **11. hybridum**

This is like the Stace model, but the difference here is that the choices are explicitly separated by all the sub-choices that relate to that choice. (Actually, if you look at the Stace keys, they are organised like that, too; but it isn't visually obvious.) This makes the indenting important, because it's the way to scan for the next choice in a set. The advantage of this is that you can easily see all the species that share one set of diagnostic features, making backtracking easier. In a big key, the disadvantage is that you may have to go hunting a long way down for the second choice in a pair of choices, with no way to predict when you're getting close.

Example 4: the *really annoying* model

MENTHA

—Bracteolas lobuladas. Cáliz con 4 dientes. (De 10-40 cm., con olor fuerte. Tallos tumbados por abajo y erectos por arriba. Hojas de 1-2,5 cm. × × 1-4 mm., lampiñas, sentadas, linear-lanceoladas. Dientes del cáliz con espina apical blanquecina. Corola lila o blanca. Pen. F.) (*Preslia cervina* (L.) Fresen.) 2.290 **M. cervina** L.

—Cáliz con 5 dientes. Bracteolas simples 1

1 —Cáliz de garganta pelosa, con dientes claramente desiguales. (De 10-50 cm., con olor fuerte y tallos tumbados o inclinados, a veces tomentosa. Hojas de hasta 30 mm., estrechamente elípticas y atenuadas en la base, rara vez redondeadas, enteras o con menos de 7 dientes en cada lado, pelosas al menos en el envés. Numerosos verticilos compactos y redondeados. Corola de 4-6 mm., lila o rosada, rara vez blanca. Muy variable. En prados y lugares húmedos. Pen. y Bal. F.) (*Pulegium vulgare* Miller, poleo) ..... 2.291 **M. pulegium** L.

1 —Cáliz de garganta lampiña y dientes más o menos iguales 2

2 —Brácteas como hojas. Inflorescencia acabada en hojas, o en pseudoverticilos muy pequeños 3

2 —La mayoría de las brácteas son pequeñas y apenas notorias, no como hojas. Flores en espigas finales o cabezuelas..... 4

3 —Generalmente fértil. Cáliz de 1,5-2,5 mm., anchamente acampanado, con dientes anchamente triangulares. (De hasta 60 cm., pelosa, con olor nauseabundo. Hojas de 2-7 cm., lanceolado-elípticas u ovoideas, con la base estrechada hacia el peciolo, ligeramente dentadas. Flores en verticilos numerosos, densos, sentados y distanciados, teniendo hojas en el extremo. Cáliz peloso. Corola lila, blanca o rosa. Muy variable. En campos y lugares húmedos. Pen. F. Con *M. suaveolens* forma el híbrido denominado *M. muellerana* F. W. Schultz, y con *M. longifolia* el llamado *M. dalmatica* Tausch, de brácteas estrechas.) (*M. austriaca* Jacq., menta) .....2.292 **M. arvensis** L.

3 —Generalmente estériles. Cáliz de 2-4 mm., estrechamente acampanado o tubular, con dientes estrechamente triangulares o en lezna 5

4 —Hojas sentadas (las inferiores a veces están algo pecioladas). Flores en espiga de 5-15 mm. de diam. 6

4 —Hojas pecioladas. Flores en cabezuela o espiga oblonga de 12-20 mm. de diámetro 7

5 —Cáliz acampanado, con dientes rara vez mayores de 1 mm. Generalmente lampiña. (En realidad es un híbrido de *M. arvensis* y *M. spicata*. De 30-90 cm., con olor suave y a menudo teñida de rojo. Hojas de 2-9 cm., lanceoladas o algo oblongas, con peciolo corto y pelos dispersos. Flores

No, it's not the fact that it's in Spanish that makes this really annoying, It looks like a Stace key (apart from the fact that the top couplet isn't numbered), but look what happens at couplets 2, 3 and 4. One choice keys out at couplet 3, but you then have to play leapfrog over couplet 4, the next two choices that came from the other half of couplet 2. As the key goes on for another page, this game of leapfrog just gets more and more contorted. There is **no** way to see at a glance which species share a common diagnostic feature.

Multi-access keys

Dichotomous keys work fine for plants that can be distinguished on a small number of clear-cut diagnostic features. They work less well when there are subtle overlaps and a combination of characters needs to be taken into account; or when some of the main distinguishing characters may be difficult to observe.

The principle behind a multi-access key is that one makes a choice from several different sets of attributes, and this gives one a code made up of a string of these choices. One then looks through a table to match the code as closely as possible to a plant species. One can't always get a complete code, but having just a few uncertain

characters can narrow the search down to a small number of options to look at in detail.

This is easier to explain with an example, so here is part of the key in the BSBI *Umbellifers* Handbook.

Table of alternative states

A	Flowers yellow or greenish-yellow
B	Flowers not yellow
C	Lowest leaves simple, entire or toothed
D	Lowest leaves lobed, 1-pinnate or 1-ternate
E	Lowest leaves at least 2-pinnate or 2-ternate
F	Fruit at least 3 times as long as wide
G	Fruit less than 3 times as long as wide
H	Fruit and ovary with hairs, spines, scales or papillae
I	Fruit and ovary without hairs, spines, scales or papillae
J	Fibres present and conspicuous around base of stem
K	Fibres absent
L	Umbel simple or flowers in whorls or a dense head
M	Umbel compound; bracteoles present
N	Umbel compound; bracteoles absent, rarely 1–2 and caducous
O	Annual
P	Biennial or perennial
Q	Stem with deflexed, closely appressed hairs
R	Stem glabrous or with hairs not deflexed and closely appressed
S	Fruit not winged
T	Fruit winged

Notes

It is sometimes difficult to distinguish between D and E, but doubtful species have been keyed out under both. S and T can present difficulties if the fruit is not fully ripe. In *Peucedanum* in particular the wings develop late, so if the fruit is unripe both alternatives should be tried.

Let's say we have a yellow-flowered Umbellifer before us. So from the first set we choose A. Its lower leaves are at least 2-pinnate, so we choose E.

Now we have a problem. It's just coming into flower so we have no fruits. So we can't do anything with the next two sets of features. We'll ignore these for now and have a look at the base of the stem; there are no fibres, so we choose K. It has a compound umbel with bracteoles, so we go for M, and it's not an annual, so we choose P. The stem is glabrous, which gives us R; and we can't do the last one without fruits.

This gives us an incomplete code AE__KMPR_.

Now we look at the code table. Here is the bit that covers just yellow-flowered species (A).

Main Key

ACGIKMORS		BUPLEURUM (Key A)
ACGIKMPRS		BUPLEURUM (Key A)
ADGIKNPRT	Smelling of parsnip when crushed	**66. Pastinaca sativa**
AEGIJMPRT		**63. Peucedanum officinale**
AEGIKMPRS	Leaf-lobes subulate to linear-lanceolate	**22. Crithmum maritimum**
	Lobes of lower leaves crenate or serrate, obtuse	**13. Smyrnium olusatrum**
	Lobes of lower leaves pinnatifid, acute	**50. Petroselinum crispum**
AEGIKMPRT	Leaf-lobes 10–15 mm	**34. Silaum silaus**
	Leaf-lobes usually 40–80 mm; bracteoles connate below	**62. Levisticum officinale**
AEGIKNORS	Strongly aromatic	**33. Anethum graveolens**
AEGIKNPRS	Leaf-lobes filiform	**32. Foeniculum officinale**
	Leaf-lobes not filiform	SMYRNIUM (Key B)

We see that our code AE__KMPR_ matches only two codes in this table: AEGIKMPRS and AEGIKMPRT. So we'll try both of these. Now we are down to making a "dichotomous key" choice.

None of the leaf descriptions for AEGIKMPRS really seem to fit that well, but the first one is a possibility. So we look up the species account and find that it's a succulent plant of the seaside, whereas we're standing in an old meadow in Worcestershire looking at a very different-looking plant. (Would that it were always that easy!)

We move on to AEGIKMPRT, and find that our leaf-lobes fit the first measurement. So we check out the description for *Silaum silaus*, Pepper-saxifrage, and find that it fits perfectly for all the features we can see, and the distribution and habitat is plausible as well.

This demonstrates the big advantage of multi-access keys – that without having all the characters to hand, one can get close to a small number of candidate species to check out. In a similar situation in a dichotomous key, one would go through a laborious process of backtracking at every point of uncertainty to make sure one had considered all the possibilities.

The disadvantage, at least on paper, is that people don't seem to find them very intuitive to use and so the possibility of mistakes is high. Where they really come into their own is on computers. One doesn't have to worry about the "coding up" of features – the computer can do that, and it can also display interactively the candidate species that remain, as one makes each choice. Most importantly, it can immediately highlight where one has made an "impossible" combination of features. With these aids one can trade off the comfort one feels in positively identifying a feature with the effort one is prepared to put in looking up a numer of detailed descriptions.

Comparison tables

When one has only a small number of taxa to consider, a better alternative to a multi-access key is often the comparison table. Here, all the different feature sets are

marshalled and tabulated side by side. This example is taken from the BSBI *Plant Crib*.

	Cerastium diffusum Pers.	*C. pumilum* Curtis	*C. semidecandrum* L.
Bracts	Entirely herbaceous	Narrow scarious margin and tip	At least upper bracts with broad scarious margins and tips
Flowers	Usually 4-merous, sometimes 5-merous	5-merous	5-merous
Petals	About 1/5 bifid, ¾ as long as sepals	About ¼ bifid, as long as sepals	Slightly notched, 2/3 as long as sepals
Pedicels	Much longer than sepals throughout, erect in fruit	Larger than sepals, at first recurved then nearly erect with slight curve just below capsule	Usually equalling or slightly exceeding sepals, at first sharply deflexed from base, later erect
Sepals	Scarious margin narrow	Scarious margin fairly broad	Scarious margin broad
General habit	Often very sticky glandular, dark green	Glandular, usually reddish-tinged	Glandular, green

Comparison tables are most commonly used to distinguish hybrids from their parents. This obviously limits the number of taxa one is comparing: anything above 5 or 6 becomes very laborious. There is a key to forms of *Dryopteris affinis* (Golden-scaled Male Fern) with 9 entries, and it's very hard work! On the other hand, using a radically different layout, Sue Webster has constructed a table for Water-crowfoots that is much easier to look up, despite extending to two A4 pages of the BSBI *Plant Crib*.

Key to success with keys

Here are some tips to getting the best out of keys.

Start as low as you can. It can be a dispiriting process to start with "A Vascular Plant" and have to run through scores or hundreds of choices – especially as you will almost certainly have trouble with some on the way.

This really means learning the characteristics of the main families – you probably have a fair idea of these already, but look at the family descriptions in one of the main Floras and you will pick up extra tips. For instance, if you have trouble deciding whether you have a *Scrophulariaceae* (Figwort family) or a *Lamiaceae* (Dead-nettle family) plant, and you can see fruits at least starting to form, then sorting them out is a dead cinch. And even if you don't have fruit, there are a couple of good guide features that may help you get to *Lamiaceae* quickly. Examine some common plants and see how they fit into the family and genus descriptions. Inevitably this isn't a fast learning path, but you will gain in skills and confidence over time.

Sometimes you really won't have an idea what family to place your plant into, or your idea turns out to be a dead end. Use any means you can to find other candidates – illustrations, popular guides etc. Then follow each one up methodically – don't just jump to conclusions.

When you are in doubt, make a note of the fact and return to that point in the key when you have checked out the alternatives. Even if you feel utterly confident that your first assumption has led you to a successful ID, go back and check the other path. One should never underestimate one's own talent for being optimistic and ignoring inconvenient discrepancies.

Make sure you understand the technical terms used in the key. Good Flora writers should have provided you with a glossary to explain all such terms they use, so that you know what **they** meant by the term.

Don't stop with the plant name at the end of the key line, especially if this is a plant new to you. Go on and check out its full description, and use good illustrations for corroboration.

Remember that keys are constructed by humans, and some humans are better key-makers than others!

One never grows out of keys. At first, improving one's ID skills seems like a horribly laborious and technical process because one is having to check out so much detail. Eventually one comes to a point where many plants are obvious through their "jizz" – something a technical Flora can't describe. But then there is a tendency to get lazy, and there are still plenty of taxa where "jizz" is not enough, and no-one can be expected to carry around the whole Flora even of one country in their head. Experience tells you which plants you can glance at and which you need to scrutinize closely.

Illustrations

The illustrations one usually first encounters are colour paintings or photographs in a popular field guide. These can be both useful and beautiful, but they have their limitations. Technical line drawings also have their limitations, but they can often convey much more structural information.

Here are some of the pros and cons of each format of illustration.

Photographs

- Can convey 'jizz' well.
- Can convey colour well.
- Can convey a plant in its natural setting.

But:

- Colour reproduction is not always accurate.
- Plant is not always easy to separate from its background. Publishers are not usually keen on displaying material laid out artificially on a neutral background.
- Rarely conveys detail well – would typically require several photographs, which publishers will not often countenance. Even then, some details do not photograph well.

Colour paintings

- Can convey 'jizz' well.
- Can convey colour well.
- Can give a reasonable impression of textures.
- Allow the plant to be isolated from its surroundings.
- Allow for detail to be highlighted and enlarged.

But:

- Can also be awful at conveying 'jizz', colour and textures.
- Subtler detail is often lost because the reproduction is much smaller than the artwork, and because of losses in the printing process.
- Sometimes gives a good idea of the plant in its natural setting.
- Publishing costs often militate against sufficient illustration of detail.

Line drawings

- Can be excellent at showing textures.
- Allow the plant to be isolated from its surroundings.
- Allow for detail to be considerably highlighted, emphasized and enlarged.

But:

- Tend not to convey 'jizz' well (although some are much better than others).
- Don't convey colour.

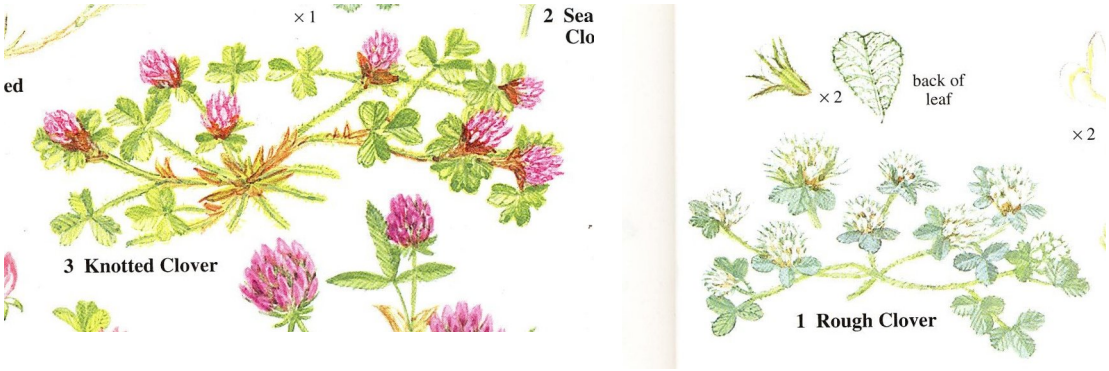
- Don't show the plant in its natural setting.

A critique of some illustrations

We'll take as an example two clovers that are small in stature, often grow together, and can give beginners some problems. Actually they separate out on a considerable number of mostly well-defined characters, all of which can be observed in the field, as follows.

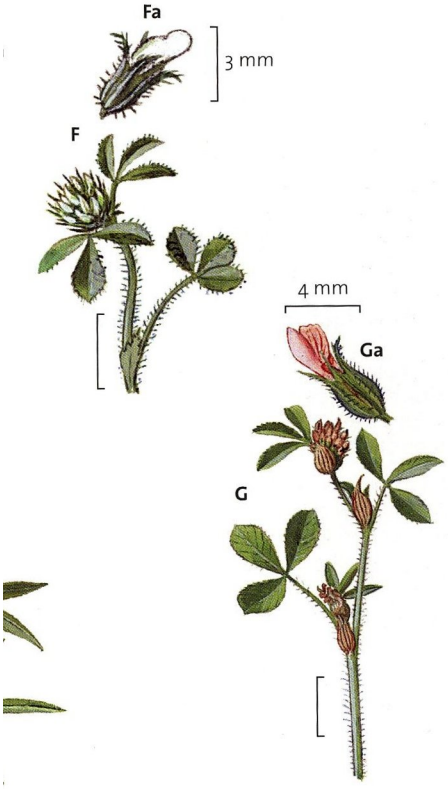
***Trifolium striatum* (Knotted Clover)**	***Trifolium scabrum* (Rough Clover)**
Stems tend not to zigzag	Stems tend to zigzag at least by fruiting time
Leaf veins tend to thin towards margin of leaf, running straight out	Leaf veins remain thick or even thicken towards margin of leaf, bending backwards
Stipules end in a fine bristly point (aristate)	Stipules end in a concave-sided acute point (acuminate)
Calyx tends to be swollen nearer base (especially in fruit) or at least parallel-sided	Calyx tends to be narrowly bell-shaped
Calyx teeth spread little in fruit	Calyx teeth tend to turn out or backward in fruit
Corolla pink	Corolla white (very rarely pink)

Blamey, Fitter and Fitter (2003)



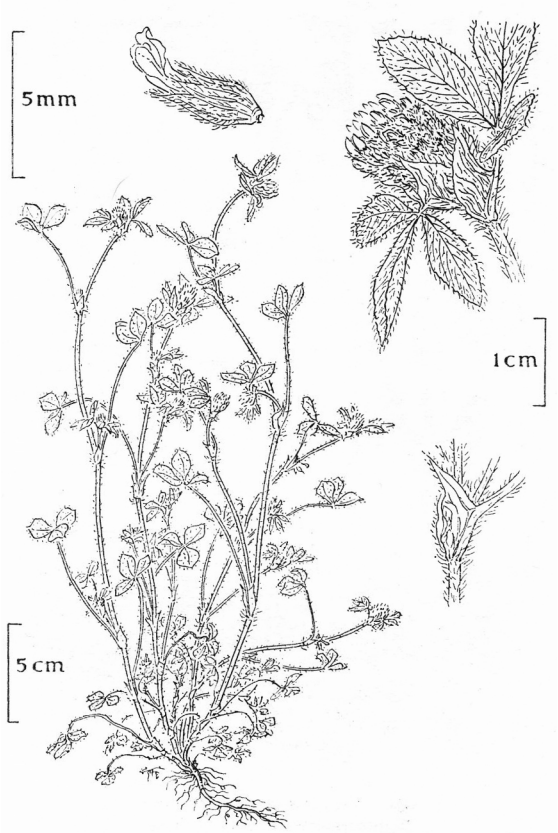
These pictures don't show the zigzag stem habit of Rough Clover at all. There is a detail illustration of the leaf veins for one species, but unfortunately no comparison for the other. Stipules don't feature at all, and although the calyx of one is illustrated, there is again no comparison and fruiting specimens aren't shown. The very vivid pink colour shown for Knotted Clover, and the rather exaggerated size of the flower heads, could be misleading. Note that this illustration has magnification indicators for detail – less useful if the illustration is reproduced at a different scale.

Rose and O'Reilly (2006)

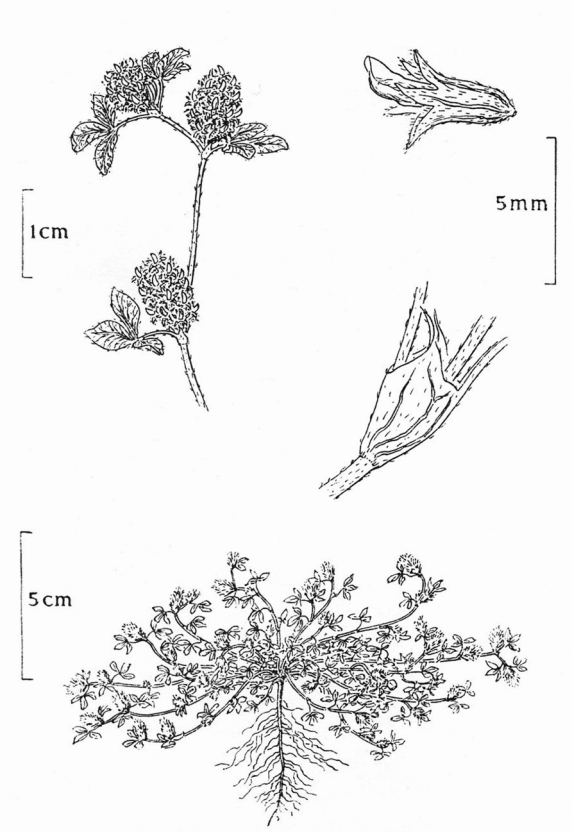


Trifolium striatum is at the bottom right and *T. scabrum* at the top left. There is no attempt to show habit at all, so the zigzagging stems are missed, and one might be misled to think that both species grow upright. The leaf veining is not illustrated, though mentioned in the text. Stipules barely feature, but the differences between the calyces are well shown, including the attitude of the teeth. Colour is reasonably accurate. Note that this illustration has scale markers – these work at whatever size the illustration is viewed.

Roles (1957)



496. *Trifolium striatum* L. 'Soft Trefoil' Pink



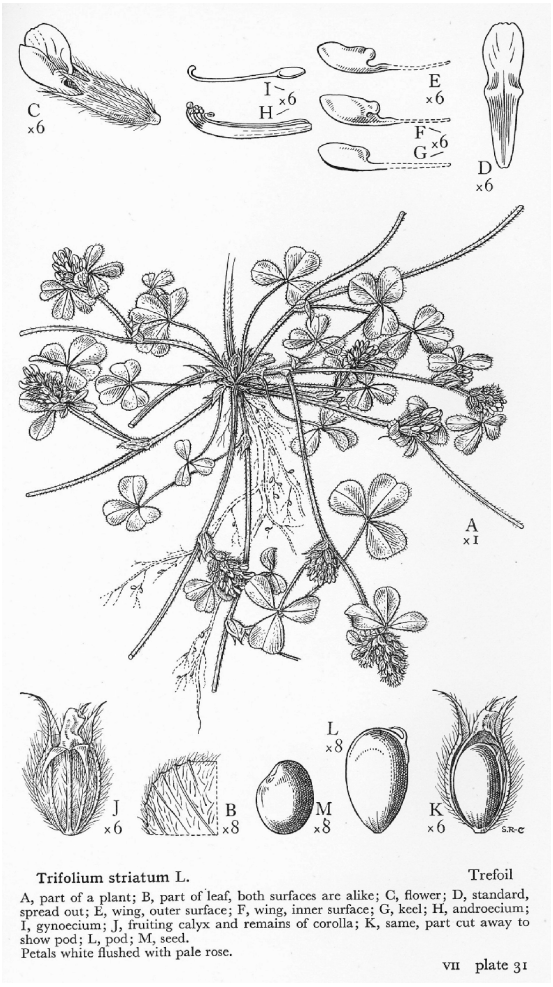
497. *Trifolium scabrum* L. 'Rough Trefoil' White

These are the pictures intended to accompany the Clapham Tutin and Warburg Flora of 1952. Although the habit picture shows no zizagging, it does show that *T. scabrum* tends to be a more prostrate plant than *T. striatum*. However, *T. striatum* would rarely if ever look as upright as that! This shows a disadvantage of illustrating from desk material. The differences in leaf veining are just about apparent but you would have to be looking carefully for them. It is clear that there is a difference in the stipules, although one might argue that the shape of the *T. striatum* ones is not that clear. The calyx features are nicely brought out, and the subtlety of the difference in shape at flowering time is accurate. The colour detail is added as text, and the scales are clear.

Butcher (1961)

This doesn't really bring out any habit differences, and it completely ignores the leaf venation (in the accompanying text also). It does show a difference in stipules, but it's a pity that one is shown in life attitude and the other dissected; and they seem to be the wrong way round! (I.e. *T. striatum* is shown as acuminate, and *T. scabrum* as more or less aristate.) Flowering and fruiting calyxes are shown, and the differences in calyx shape are shown, albeit rather over-emphasised for one species and under-emphasised for the other. The difference in attitude of the calyx teeth is not very clear.

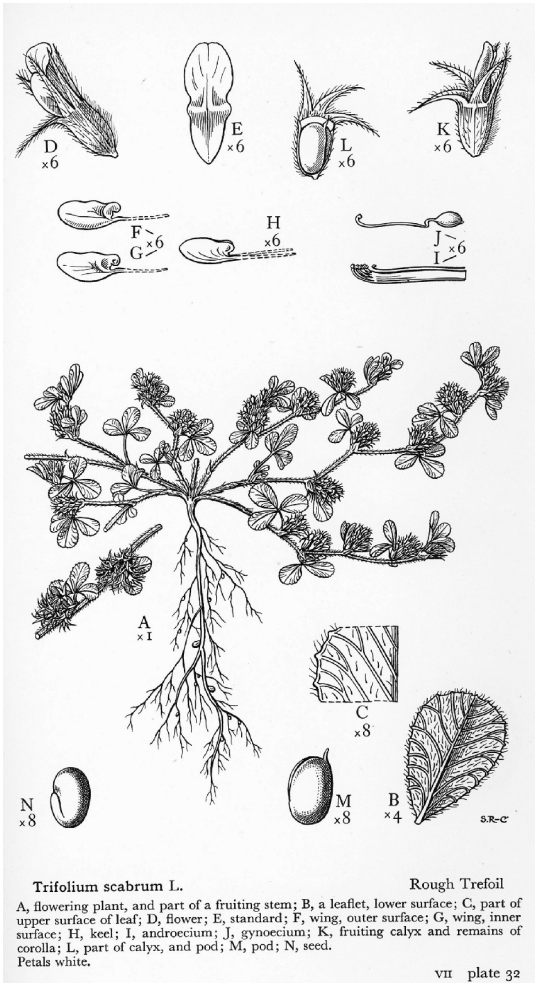
Ross-Craig (1957)



Trifolium striatum L. Trefoil

A, part of a plant; B, part of leaf, both surfaces are alike; C, flower; D, standard, spread out; E, wing, outer surface; F, wing, inner surface; G, keel; H, androecium; I, gynoecium; J, fruiting calyx and remains of corolla; K, same, part cut away to show pod; L, pod; M, seed.
Petals white flushed with pale rose.

VII plate 31



Trifolium scabrum L. Rough Trefoil

A, flowering plant, and part of a fruiting stem; B, a leaflet, lower surface; C, part of upper surface of leaf; D, flower; E, standard; F, wing, outer surface; G, wing, inner surface; H, keel; I, androecium; J, gynoecium; K, fruiting calyx and remains of corolla; L, part of calyx, and pod; M, pod; N, seed.
Petals white.

VII plate 32

These are the "Rolls Royce" of technical botanical illustration of the British flora. Unfortunately, though they are readily available second hand, they tend to be quite expensive. Note that the habit differences (including the zigzagging and the slightly more prostrate habit of *T. scabrum*) are brought out nicely. The leaf venation is perfectly illustrated. Unfortunately the stipules are completely ignored. The calyx details are shown in both flower and fruit, and the fruiting differences made clear, although the teeth here may be more recurved than typical in *T. striatum*. The flower colour is accurately described in the text. Unfortunately magnifications rather than scale bars are used.

Sources of illustrations

Blamey, Fitter and Fitter, *Wildflowers of Britain & Ireland,* A & C Black, 2003

Rose and O'Reilly, *The Wild Flower Key*, revised edition, Warne, 2006

Roles, *Flora of the British Isles: Illustrations*, parts I—IV, Cambridge University Press, 1957

Butcher, *A New Illustrated British Flora*, 2 parts, Leonard Hill, 1961

Ross-Craig, *Drawings of British Plants*, parts I – XXXI, G. Bell & Sons, 1948-1969

Floras and Guides

If you are moving on to using a more technical Flora, the first piece of advice is: don't throw away your old field guides! The best of them remain an invaluable source of illustrations and identification hints that will help give you confidence in using the more technical works.

Popular field guides

We take the view that a decent field guide should be reasonably comprehensive for the range of species it covers, critical genera and infraspecific taxa apart. Several guides, some excellent as far as they go, are advertised as "comprehensive" or "complete" when they are nothing of the sort.

Watch out for the new edition of David Streeter's *Collins Flower Guide*, to be published later this year in the familiar black dust jacket. It is likely to be a strong contender with the two mentioned below.

Rose and O'Reilly, *The Wild Flower Key*, 2006.

This is the author's favourite field guide. It makes extensive use of keys where they are most needed, without over-burdening the text; it has generally excellent descriptions, with the key diagnostic features in bold; there are tips for distinguishing similar species; the illustrations are generally very clear and supported by detail inset where needed. Detail for critical groups is generally omitted, as is appropriate for a book on this level. But illustrations are often of only part of the plant, so the habit is not easy to infer; and the book completely omits grasses, sedges and rushes, for which one must turn to an excellent but expensive and much less convenient companion volume.

Blamey, Fitter and Fitter, *Wild Flowers of Britain and Ireland*, 2003.

Attempts to be reasonably comprehensive, with a good coverage of aliens. A thumbnail distribution map is included for the more widespread and established species. There are no keys, and the distinguishing features of similar species are often described in a rather sketchy, relative and occasionally inaccurate and misleading manner. However there are occasional tables that group species with a common feature together to cut down searching. Whether it was a good idea to include critical genera such as Eyebrights (*Euphrasia*) and Whitebeams (*Sorbus*) is very dubious; neither the descriptions nor the illustrations are up to the job. In fact, the illustrations are a major weakness of this book. Grasses, sedges and rushes are included, and given that there is a reasonable description of how these families differ from one another, the decision to then lump them together on a page based on rather tenuous 'look-alike' characters seems perverse. Trees and shrubs are also separated out from their families, and there are short sections on the floras of the Scillies and Ireland – interesting, but hardly essential to a book of this kind, and why stop at these two regions?

Rose, *Colour Identification Guide to the Grasses, Sedges, Rushes and Ferns of the British Isles and Northern Europe*, 1989.

In content this is the companion volume to the *Wild Flower Key*, and has to be the recommended book for those getting to grips with these plants. It has comprehensive keys for flowering plants and a habitat-based vegetative key for grasses, with an

introduction to the floral structures of each family. Illustrations and text for closely related and similar plants are grouped together on a single two-page spread; descriptions emphasise key diagnostic features in upper-case, and the illustrations are generally excellent in conveying both 'jizz' and technical detail, with supplementary line drawings where appropriate (but the ferns are a bit of a disappointment in this respect).

There has to be a downside, and it is this: it has only ever been published as a rather large format hardback which is unwieldy for field use, and typically sells for between £35 and £50. Even second-hand copies rarely go for much less.

Fitter, Fitter and Farrer, *Grasses, Sedges, Rushes and Ferns of Britain and Northern Europe*, 1984.

If you don't feel able to run to the expense of Rose, or want something for the pocket or rucksack, then this is what you need. It is published in the Collins Pocket Guide series as a 'stiff-back' and also as a larger format hardback. Following the introduction on plant structure, it launches into a set of multi-access keys (one of the most extensive uses of these keys in a field guide). Like Rose, the vegetative key to grasses is grouped by habitat. Groupings of accounts of similar species are logical and show text and illustrations on a two-page spread. The smaller format means that the colour plates are less strong on detail, but to compensate, they are excellent on 'jizz' and supplemented by many marginal line drawings. Unfortunately the main plates lack a scale; the introduction says that they are 'mainly at life size' but in the pocket volume this is not true, scales sometimes varying for different plants on the same page. The text emphasises diagnostic features with italics. It is generally reliable if not quite as authoritative as Rose. A set of small distribution maps appears at the back.

This book is sadly out of print at present, but second-hand copies in good condition can be had for £20 or less.

Blamey and Grey-Wilson, *Cassell's Wild Flowers of Britain and Northern Europe*, 2003.

This is actually an updated reprint of the authors' earlier hardback *Illustrated Flora of Britain and Northern Europe*. The format is unwieldy although it allows illustrations of a decent size. There are keys to families and, in the case of some of the major families, to genera; but not beyond. This leaves one often comparing detailed descriptions, which would matter less if the key diagnostic features were picked out or the descriptions more precise. Main illustrations are beautiful, if a little stylised in habit at times and occasionally a bit fuzzy; they are supplemented by colour paintings of fine detail. New copies can generally be obtained for £10-£15 by shopping around. Recommended as a browsing book rather than a field handbook.

Johnson and More, *Collins Tree Guide*, 2004.

This handbook covers most of the trees you are likely to see in the British landscape, whether native, naturalised or in cultivation. Although it doesn't entirely supplant Alan Mitchell's earlier Collins Field Guide, it is probably the one to take into the field nowadays.

There are no keys, but there are illustrations of twigs, scales, leaves etc. at the beginning that take you to species or groups of species. For many major genera there is an inventory of 'key species' (those most frequently met with), which have full descriptions; other species are then described by differences. This can make for a

laborious identification process, but generally seems to work quite well, although the authors sometimes seem determined to avoid technicalities at the expense of precision. The illustrations typically show tree outlines, foliage, often twigs and sometimes flowering parts.Apart from the number of species dealt with, the book scores well on its coverage of cultivars (often including illustrations).

New copies can be found for £10-£12.

Sterry, *Collins Complete British Trees*, 2007

Unlike Collins Complete British Wildflowers, this book really does live up to its name in scope. It includes every native and alien tree species you are likely to find in the countryside, plus many other ornamental trees that have never left gardens or arboreta. They are all illustrated with top quality photographs and concise, but accurate, descriptions. For example this includes some 26 different Sorbus taxa, most of them natives, with excellent photographs of their leaves, fruit and flowering shoots. For native or widely naturalised species a mini-map is included indicating the British distribution. There are no keys, though the characteristic features of each family are described in simple terms in a separate section from the main species accounts. For the commoner trees there are also separate sections illustrating winter twigs, bark and leaves, each of these with helpful text on the distinguishing features.

New copies are about £15.

The standard Floras

Don't forget that John Poland's *Vegetative Key to the British Flora* is coming soon and destined to become a new standard, unrivalled in its field worldwide!

Stace, *New Flora of the British Isles*, 2nd edition, 1997.

This is now the standard identification handbook for the British flora, and this, or the companion *Field Flora,* is an essential piece of equipment. It differs from all its predecessors in its very full coverage of introduced and naturalised plants; an invaluable asset in these days of rapid floral change. (Coverage of trees, especially conifers, is a bit limited, though.) It gives less detail on many critical groups than some of its predecessors; and for genera where species commonly hybridise, details of the hybrid are often sketchy or reduced to a simple note of its existence.

The book has a very formal structure; one first has to make a decision on whether one is dealing with a pteridophyte (ferns and fern allies), gymnosperm (conifers and confer relatives), or angiosperm (other flowering plant). A key is then provided down to family or genus. At the family level, a further key is provided to genera if appropriate; and in cases where there are more than a couple of non-casual species occurring, at the genus level a key is provided to species. Each species then has a description and brief notes on habitat, distribution and rarity. Flowering times are omitted; these can be a hostage to fortune, but some guide to main flowering periods is surely helpful. Occasionally subspecies are keyed out at this point; more often their differences are merely noted in the text. Most keys are dichotomous but for Willow-herbs (*Epilobium*) a multi-access key is used.

The descriptive text is brief (characters already covered in the keys are generally omitted) and technical (but not dauntingly so), and it can be said that it is less helpful on field recognition characters than its predecessor (Clapham, Tutin and Moore – see

below). This was a deliberate decision of the author, whose aim is to encourage certainty rather than probability in an identification. On the other hand it is remarkable in its precision and accuracy.

Illustrations are used sparingly but to good effect, being mainly used to illustrate tricky technical differences between related species or to give a general impression of an introduced species likely to be unfamiliar to the reader.

The *New Flora* retails new for around £45-£50, and tends to maintain its price second-hand.

Stace, *Field Flora of the British Isles*, 1999.

This is in effect a compressed version of the *New Flora* achieved without reducing the breadth of coverage. The only taxa left out are those given mention, without description, as rare casuals or garden near-escapes. This is achieved by presenting the whole Flora in key format. This may come as a shock to some of you, but it will be familiar enough to Continental field botanists dealing with much larger national Floras.

The hierarchy of keys works in the same way, but species descriptions are removed, or more usually cut down to bare essentials and rolled into the key text, along with habitat and distribution notes. The multi-access keys are replaced by dichotomous keys.

The saddest loss, understandable though it may be, is a high proportion of the illustrations.

This is the book you need to take into the field with you, and it is worth the challenge of acquiring the skills to use it. It sells new for £21-£25, and also holds its price second hand.

Clapham, Tutin and Moore, *Flora of the British Isles*, 3rd edition, 1987 (paperback with corrections 1989).

While this has been supplanted as the main field reference Flora by Stace, it is still a very useful adjunct, chiefly because of the much longer species descriptions, where diagnostic characters are picked out in italics. Coverage of some large critical groups such as Hawkweeds (*Hieracium*) is also fuller, through by no means comprehensive.

Coverage of alien species is nothing like as thorough as Stace, although it is certainly improved on earlier editions.

It is rather bulky for field use. It is out of print and second-hand copies typically sell for £40-£60 or even more.

Clapham, Tutin and Warburg, *Excursion Flora of the British Isles*, 3rd edition, 1981.

This field handbook manages to compress the *Flora* by keeping the acounts of rarer species to diagnostic features and very brief distribution notes presented in the keys, while retaining longer descriptions for the commoner plants. Most hybrid coverage goes; so does the detailed treatment for many critical genera such as Sea-lavenders (*Limonium*), although Hawkweeds (*Hieracium*) are retained. A useful back-up for the terseness of the Stace *Field Flora*.

Second hand copies are available for £15-20.

Sell and Murrell, *Flora of Great Britain and Ireland*, 5 vols, 1996-

Few people are likely to acquire this monumental work in progress, of which three volumes are now in print; the complete set will cost in excess of £500. Yet you should know of its existence. Britain has lacked an encyclopaedic descriptive Flora of the kind that many of our neighbours boast, and has been unfortunate in a number of false starts to produce one over the last century or so.

The virtue of this work is its comprehensiveness. All critical groups are fully covered; all naturalised, introduced and casual species likely to be found in the wild are treated; variation within a species, whether to subspecies, variety or forma level, is detailed; hybrids are given a complete description and sometimes included in the keys where this makes sense.

As the volumes are being published in reverse order, the only key to families so far is to the Monocotyledons. Families contain a key to genera, and genera with more than one taxon described contain a key to taxa. The keys for a genus go right down to subspecies and varieties where these occur.

The species accounts give full descriptive details for each species, and include notes of differences for subspecies and varieties. Flowering period, pollination agents (where known), habitat and distribution notes are included, the latter two given separately for each infraspecific taxon. Inevitably, since so much of the variation described is new to most British botanists, distribution detail at this level is incomplete and biased towards East Anglia (the authors are Cambridge-based). There are extensive literature references and citations of synonyms.

Some of us found the first volume published (vol. 5) a little disappointing, as despite the detailed textual presentation it didn't seem to give a great deal of information not already in Stace. The same cannot be said of the next two volumes; vol. 4 gave us an up to date account of two of the largest critical genera, the Hawkweeds (*Hieracium*) and Dandelions (*Taraxacum*), and both the later volumes appear to contain much more information on infraspecific taxa.

There are blemishes in this work (for instance, keys and descriptions don't always tally properly) and some idiosyncracies (for instance, most readers will be surprised by some novel genus assignments) but it should be a tremendous stimulus to investigating the range of variation in the British flora and its ecological significance.

Biological Flora of the British Isles

This project under the auspices of the British Ecological Society, which began nearly 70 years ago, aims to document the structure, biology and ecology of plants growing wild in Britain in great detail. It proceeds slowly; at the present rate, it will be finished some time in the 24th century.

Many of the earlier papers are available only as rather expensive reprints from the publisher. However in the last few years the majority of new papers have been made available free on the Internet. The British Ecological Society web site (http://www.britishecologicalsociety.org/journals_publications/journalofecology/biologicalflora.php) has a full list of the published parts and identifies those that are available for free download from the Wiley Interscience web site. Note that not all recent issues are available without a subscription, despite what the BES site says.

Other useful identification tools

As well as the resources mentioned here, there are many useful aids to identification published by the Botanical Society of the British Isles, the Wild Flower Society and the British Pteridological Society in their journals and newletters.

Rich and Rich, *Plant Crib 1998*, 2nd edition, 1998.

After Stace, the most useful identification tool to acquire, with lots of detail and hints on difficult taxa and hybrids, and how to observe them.

Currently out of print but second-hand copies (make sure you get the 1998 edition) sell for £15-£25. However, the good news is that large parts of it are available for free download from the BSBI web site (see below).

Stace, van der Meijden & de Kort, *Interactive Flora of the British Isles*, 2004.

If you have a computer with a DVD drive, and you don't want to buy both the Stace *Field Flora* for outings and the *New Flora* for your bookshelf, here is a superior (and cheaper!) alternative: buy the *Field Flora* and this for less than the price of the *New Flora*.

The *Interactive Flora* includes the complete text of the 2nd edition of the *New Flora*, with a few revisions and additions. It also has much more: interactive keys, lots of colour photographs, line illustrations from the BSBI Handbooks and Hubbard's *Grasses*, and a version of the *New Atlas of the British Flora*, giving distribution maps down to 10km resolution.

At less than £26, this has to be one of the botanical publishing bargains of the century.

Handbooks for special plant groups

BSBI Handbooks

The BSBI publish a range of handbooks on some of the more challenging groups of plants, which include identification keys, very full species accounts and very detailed line illustrations. They sell new for £10-£17.50, and include the following titles. Forthcoming titles include Fumitories (*Fumaria*) and a new Grasses handbook.

- Charophytes
- Crucifers (*Brassicaceae*)
- Dandelions (*Taraxacum*)
- Docks and Knotweeds (*Polygonaceae*)
- Pondweeds (*Potamogetonaceae*)
- Roses (*Rosa*)
- Sedges (*Cyperaceae*)
- Umbellifers (*Apiaceae*)
- Water-starworts (*Callitriche*)
- Willows and Poplars (*Salicaceae*)

Hubbard, *Grasses*, 3rd edition, 1992.

This has been the definitive handbook for British grasses for half a century. It's now a bit dated for taxonomy, its coverage of alien species is very incomplete, and its huge "all the way down to species level" key is daunting; but it remains a valuable source of information and understanding, with a full page devoted to the description of each species and another to very detailed technical drawings.

Hutchinson and Thomas, *Welsh Ferns*, 7th edition, 1996.

Don't be put off by the title, this actually covers all species of ferns and their relatives found in Britain. It has good background on biology, keys to genera and species, descriptions of species and their many hybrids, distribution maps for Wales and NW Europe, illustrations of whole fronds and technical details. Available new for about £11.

Jermy and Camus, *The Illustrated Field Guide to Ferns and Allied Plants of the British Isles*, 1991.

A general key leads to genus keys where appropriate. Each species has a very full account, with diagnostic features bolded, supported by outline illustrations of fronds and line drawings of technical detail. No supporting text on biology, and information on hybrids is scant. Out of print: second hand copies often sell for absurd sums, although it's possible to find copies in less than perfect condition for about £20.

Merryweather and Hill, *The Fern Guide*, 1995.

An illustrated key to the main species of ferns and their allies. Concise but useful in the field; a good basic beginner's guide. Sells new for about £7.50.

Page, *The Ferns of Britain and Ireland*, 2nd edition, 1997.

The main technical flora for ferns and fern allies, with all taxa and hybrids very thoroughly described. Each account starts with a general "primary recognition" description, brief notes on occurence and a small (not always very clear) distribution map. Fuller identification notes are followed by an account of variation and of possible sources of confusion with other taxa. A "Technical confirmation" section covers cytology and sometimes spore details. Finally, "Field notes" gives much more detail on appearance in the wild, distribution, habitats and associates. Accompanying illustrations consist mostly of frond silhouettes, from different sources and at different stages, with occasional photographs and line drawings.

This is an essential reference for anyone taking a serious interest in ferns in Britain, but is rather expensive: new copies sell for £45-£50, second hand for £30 upwards.

Haslam, Sinker and Wolseley, *British Water Plants*, 1982

Essentially a large key supported by a glossary, line drawings, and brief details on distribution and ecology. Many beginners (and some more experienced botanists) find water plants particularly challenging, especially as many species are not in flower when sen, and this key with its emphasis on vegetative characters is a useful backup to the main field Flora. Sells new for £7.

Other Resources

Field meetings

There is no better way to improve one's knowledge and confidence than to get out into the field with someone more experienced. Watch out for field meetings organised by the Hampshire Flora Group, or by other local botanical and natural history societies that welcome guests. Better still, join them! Nationally, the Botanical Society of the British Isles (BSBI), the Wild Flower Society, Plantlife and the British Pteridological Society all organise national meetings.

Meetings to look out for are those that are advertised as being to help beginners or improvers, or for attendees to learn about a particular range or group of plants. Obviously if you go on a meeting to conduct a targeted survey, or to monitor populations of particular plant species, you must be prepared to subsume your more general interests and curiosity in the interest of the group's objectives.

It is worth contacting either of the two Hampshire vice-county recorders during the botanising season. They often go out on informal sessions and may welcome company and assistance at times in return for passing on knowledge.

Referees

The BSBI operates a referee system whereby specialists agree to look at specimens of difficult plants and give their informed opinion. To use this system directly, you need to be a BSBI member. However the vice-county recorders are prepared to take a first look at plants, and pass on any they can't deal with.

If you send material to a referee (including the vice-county recorders), it's important that you follow the instructions published by the BSBI for what and how to collect and preserve. These can be downloaded from the BSBI's web site (see below). If you fail to do this, you may well be:

- wasting your postage;
- wasting two people's time;
- pointlessly depleting a wild population.

Also, if you want a reply, please include a stamped addressed envelope, and if you want the material back, say so and make the envelope big enough!

Please also remember that if you don't put the correct postage on the original material, you are asking the referee to pay the extra postage **plus** a £1 surcharge **plus** the expense and time of a trip to the local sorting office, which may not be very local at all!

The Internet

There is a huge amount of botanical information on the Internet, of varying quality. Here are a few of the sites of special interest.

Botanical Society of the British Isles

http://www.bsbi.org.uk/

This site has many useful resources, including downloadable sections of the Plant Crib, species accounts for threatened species, and up to date distribution maps.

Botanical Keys

http://www.botanicalkeys.co.uk/flora/

Amongst other things, this site offers the chance to use an interactive multi-access key.

Wild Flower Society

http://www.thewildflowersociety.com/

Detailing the activities of this society.

Hants Plants

http://hantsplants.net

A site for local botanists offering the opportunity to get involved in recording, surveys and metings. News sections are sporadically updated. There are links to downloadable material for the Hampshire Rare Plant Register, Atlas Updating Project, a Hampshire sedge key etc.

Floral Images

http://www.floralimages.co.uk/

This is one of the better sources of photographic images for plants in the wild. It isn't exhaustive, but the photos are of high quality.

Interactive Flora of NW Europe

http://nlbif.eti.uva.nl/bis/flora.php

This web site includes the textual species accounts with a single illustration for each species, the glossary and index from the Stace *Interactive Flora*, but omits the keys, distribution maps and the rest of the illustrations.

Tela Botanica

http://www.tela-botanica.org/

This is a French site, but the reason for including it here is the enormous resource of botanical photographs residing behind the individual species accounts. Navigate to "Flore electronique", enter a scientific name, follow the link, and then choose the "Illustrations" tab. Many British species are covered.

Wikimedia Commons

http://commons.wikimedia.org/wiki/Main_Page

Another good source of botanical pictures. Type the scientific name into the search box; if there is a match for it, it will appear in the drop-down panel below. One has to be cautious of misidentifications in non-specialist sites like this, but the standard does appear unusually high here; better than some academic sites!

Acknowledgements

Floral parts and inflorescence diagrams are taken from: Hickey, M. and King, C, *The Cambridge Illustrated Glossary of Botanical Terms,* Cambridge, 2000, which contains a much fuller glossary and vastly more illustrations than this booklet, and should be on your bookshelf next to the Stace *Flora* and the *Plant Crib*.

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