INTRODUCTION

The family is one of the ranks of the taxonomic system, as developed by plant taxonomists over the past two hundred years, that is important in the accurate identification of plants. In fact, it is the first stage (leaving aside the distinction between dicotyledons and monocotyledons) in the process of using the taxonomic hierarchy for the purposes of of identification. Identification means the finding of the correct name for an unknown plant, not as an end in itself, but as a means of access to all the information so far available about that plant. This is the primary purpose of the taxonomic system; later uses of this system, such as that purporting to show evolutionary relationships among the various taxa (phylogeny), are secondary and frequently not particularly helpful in the achieving of the primary aim.

In the flowering plants (Angiospermae), the number of families (often also called natural orders before 1905) was originally quite small (A. L. de Jussieu's *Genera plantarum* of 1789 contained exactly 100 families, although the precise significance of this number is not known), and the original idea was that all of the families could be known by a single person. Further developments in taxonomy, dependent on the increasing exploration of the world and its plants, showed that this small number was untenable and that more families would have to be recognised. There has been a general slow increase in the number of families since; at present, over 750 families have been proposed to cover the information presented by the flowering plants as a whole. The current book takes something of a middle way between these extremes.

Because the family is a complex level of the hierarchy, synthetic in the sense of grouping together genera that are thought to be similar ('related') to each other, and analytic in the sense that the synthetic groups so recognised must be distinguishable from each other in some ways, a difficulty immediately arises: some authors favour the synthetic approach, others the analytic, resulting in the confusing situation that no two authors of taxonomic systems recognise exactly the same families. This problem has been compounded by the rise, in the past 20 years, of molecular taxonomy (the use of DNA sequences as information for classificatory purposes), which has produced an avalanche of new family and other arrangements which have not yet been properly evaluated or absorbed into the broader taxonomic system.

Any taxonomist with the knowledge and enthusiasm can produce his own system; because there is no regulation covering the acceptance of these systems, many co-exist, some older, some newer. Older systems persist, for instance, in the arrangement of herbaria, in which it is expensive and inconvenient to change physically from one system to another: for example, the major herbaria in Britain (Royal Botanic Gardens, Kew; Royal Botanic Garden, Edinburgh; Natural History Museum) are essentially organised according to a system proposed in the second half of the nineteenth century by George Bentham and Joseph Hooker (see entry 4 in the annotated bibliography, p. 262). In practice, this system has been much modified in detail, but the basic organisation remains. On the European continent, however, most herbaria are arranged according to a system developed by A. Engler around the turn of the nineteenth and twentieth centuries (see entry 11 in the annotated bibliography, p. 263); again there has been much modification in the details, but the main organisation persists.

Similarly, Floras are generally written to follow some taxonomic system current when they were being written. Very rarely are they alphabetical or arranged in some other arbitrary way.

This general looseness, though providing flexibility for the taxonomist (and phylogenist), is not particularly helpful to the

general user. It means that, in comparing families from herbarium to herbarium, or book to book, it is necessary to know what system each is following. This often requires careful study of the text and use of indexes and lists of genera for each family.

The present book includes 326 families native or cultivated in north temperate regions (in practice the southern limit of the area is approximately 30° N, thus excluding all of Mexico and Florida in the New World and most of subtropical India and China in the Old World). The system in which they are presented is something of a mongrel; this has been done deliberately to allow for easy comparison with systems old and new. The families recognised, and the genera included in them, are essentially taken from the classification used at the Royal Botanic Gardens, Kew, as published in R. K. Brummitt's *Vascular Plants: Families and Genera* (1992) – entry 6 in the annotated bibliography, p. 263 – which is a complete listing of all the genera in their families as recognised at Kew. The completeness of this volume means that any genus can be found and assigned to its family. In this present book, there are a number of minor divergences from the Brummitt list: these are noted in the text.

The order in which the families are listed, and their numbering, is based on the system proposed by H. Melchior in *Syllabus der Pflanzenfamilien*, edn 12, volume 2, 1964. This system, which is a development of the Engler system mentioned above, was widely influential in the middle years of the twentieth century; many Floras made use of it, including *Flora Europaea* (1964–1980, edn 2, vol. 1, 1995) and *The European Garden Flora* (1984–2000). The families recognised by Melchior are numbered 1–258; families subsequently split off from these families are indicated by a letter after the appropriate number; thus, **229d Aphyllanthaceae** shows that this family was included in family 229 (Liliaceae) in Melchior (and in edn 4 of *The Identification of Flowering Plant Families*). Each family also has a running number.

The 326 families covered by this book are of very varying sizes: a family may consist of a single genus that consists of a

single species, e.g. the Scheuchzeriaceae, which contains the single genus *Scheuchzeria*, which contains the single species *S. palustris*. On the other hand large families contain some hundreds of genera and several thousand species (e.g. Orchidaceae, Compositae, Rubiaceae, Euphorbiaceae, etc.). This variation in size means that some families are considerably more variable than others, and that characters that are diagnostic in some cases are not so in others: hence many families key out more than once in the key.

The short descriptions of the families are intended both as a check on identification and as a terse presentation of the important family characters. These descriptions refer to the families as wholes, not just to those representatives covered by the key. The distribution of each family is given, although without great detail. For each family a list of all the genera meeting the criteria for inclusion in this book (see above) is given. This should help the user to understand the limits of the families as recognised here, and to make comparisons with other books. For further details on the various genera, see the book by Brummitt mentioned above.

The long chapter on plant structure (*Examining the plant*, pp. 5–50) provides a brief survey of plant structure and its associated terminology, as used in the key and descriptions. This should be studied carefully by inexperienced users. The short section entitled *Further identification and annotated bibliography* (pp. 260–268) is intended to help the user to proceed further with the identification process.

It remains to be stressed, yet again, that the purpose of accurate identification is the finding of a name, which leads on to all the information available about the plant bearing that name; if the identification is accurate, then the information found will generally be accurate as well.

Examining the plant: a brief survey of plant structure and its associated terminology

The identification of plants is carried out on the basis of the information available about the plant in each particular case. In most situations this information will be derived from a specimen of the plant itself, either whole (if the plant is small, or if it is being examined *in situ* while growing) or a part (generally a stem or twig, with or without flowers or fruits), and consists of the structure displayed by the specimen (its morphology) together with other information that might be available (e.g. where the plant came from originally). On the basis of this information one can make use of the keys in this book to obtain an accurate identification of the family to which the specimen belongs. In order to do this, the specimen has to be observed carefully, so that the structure it displays, and the terminology needed to describe it, are properly understood. The rest of this chapter provides a very brief survey of flowering plant morphology in so far as it is needed for family identification. Each new term is italicised at its first appearance, and appears in the Glossary (p. 269). Further information can be found in textbooks of botany, in Bell, A. D., *Plant Form*, Oxford (1991), which is extremely well illustrated with fine photographs, and in other glossaries, such as Hickey and King, *The Cambridge Illustrated Glossary of Botanical Terms*, No. 19 in the annotated bibliography (p. 264).

The level of detail included here covers what can be seen with the naked eye or with the aid of a hand-lens magnifying 10–15 times, or other directly perceptible characteristics (e.g. scent). In making classifications, plant taxonomists may use not only these characteristics but also others that require more complex

equipment: both light and electron microscopes, as well as various pieces of laboratory equipment. The classifications so produced, however, are generally expressible at the simple naked-eye morphological level, even though their information base is much wider than this.

I Duration and habit

Plants may be *herbaceous*, that is, they produce little or no persistent, woody tissue above ground and their stems are soft and without obvious bark, or *woody*, with persistent, hard, aerial twigs, which usually possess obvious bark.

Herbaceous plants may persist for just one growing season: the seed germinates, grows into a plant which produces flowers, fruits and seeds, and then dies off, all within one continuous span of a year or less. Such plants are known as *annuals*. In north temperate areas, most annuals germinate in the spring and die off in the autumn or early winter. A few, such as *Arabidopsis thaliana* (thale cress) or *Capsella bursa-pastoris* (shepherd's purse), both fairly common garden weeds, germinate in autumn, pass the winter as small rosettes of leaves near the ground, and flower in the following spring; such plants are known as *winter-annuals*. Annuals may be recognised by the following features: they have small, slender roots (often surprisingly small for the bulk of the plant above ground), and almost all the branches produce flowers or inflorescences, particularly towards the end of the growing season.

Herbaceous plants that last for two seasons are callen *biennials*; they usually germinate in the spring and produce a rosette of leaves during the first year, which persists through the subsequent winter and then produces flowering shoots, fruits and seeds during the following spring and summer, after which the whole plant dies off. As in annual plants, most of the shoots eventually produce flowers and fruits. The distinction between annuals and biennials is not always clear-cut, especially with plants seen on only one

occasion in the wild (in a garden, of course, plants can theoretically be observed through their life-cycles). Biennials can, however, usually be recognised by the co-existence of 1-year-old non-flowering rosettes growing among flowering plants of the same kind.

There are some plants that act like biennials in that they first produce a rosette of leaves, which does not flower immediately; this rosette may persist for several years, 5 or 6 in some species of *Meconopsis* (the Himalayan poppy), 50–100 in some species of *Agave*. Such plants are described as *monocarpic*.

Herbaceous plants that persist for several seasons, flowering every year (except sometimes their first), are called *herbaceous perennials*. Their flowering stems die back to ground level (or near it) every winter, and the plant persists as underground parts, which can become quite woody. Occasionally, in some species of herbaceous perennials, leaf rosettes persist at ground-level through the winter. In all, however, some shoots in each year do not produce flowers and fruits, but form the basis of growth for the subsequent season.

Woody plants have aerial, woody stems and twigs, which persist through several to very many winters. The shoots may be thin and wiry or thick and massive, but whatever their size they bear buds (often protected by waxy or shiny scales), which allow for further growth during favourable seasons, and often have noticeable bark (in plants from areas where growth is possible throughout the year, buds as such are strictly not present, the growing points producing new leaves as and when appropriate).

Subshrubs are generally small, low plants with thin, wiry, woody stems; they can be easily mistaken for herbaceous perennials, but are distinguished by the persistent, woody shoots above ground, as seen, for example, in many species of heather (*Erica*). In Latin, such plants are known as *suffrutices*, and the adjective derived from this, *suffrutescent*, is sometimes used in the botanical literature to describe them.

Shrubs are larger woody plants with obvious, persistent branches. Generally they have several main stems which tend to arise at, or from near, ground level. There is no sharp distinction between shrubs and trees; the latter are generally larger and usually have a distinct trunk or *bole* (sometimes several) which tends to raise the branches well above ground level (although trunks may well branch near the base when the plant is older). These usages of the terms shrub and tree correspond fairly well with the terms as used in common speech, but the degree of precision is somewhat greater.

A few woody plants behave *monocarpically* (see above) in that they build up not a rosette of leaves, but a plant-body that is a tree or shrub; this bears flowers only once, and then the whole plant dies, at least to the level of the underground parts (flowering itself may last for several years). Such behaviour is described as *hapaxanthic* and is seen in some palms and bamboos.

Climbers, which climb by structural means (*tendrils*, etc.), may be either herbaceous or woody. A few (mainly tropical) plants can be shrubs if no support is available, or climbers if it is; such species, if support becomes available during the lifetime of the plant, can begin as a shrub, continue as a climber and finally succeed as a tree.

A small number of plants are *parasitic* on other plants; that is, they draw all or most of their nutrition from the host plant. Such parasites tend to have very reduced plant-bodies, lack chlorophyll and generally have a rather simplified vegetative morphology. They should not be confused with *epiphytes*, plants that grow on other plants without extracting any nourishment from the plants they grow on. Epiphytes tend to have 'normal' (i.e. not reduced) vegetative morphology. A small number of plants are *half-parasites* in that they draw nutrients from host plants but also support themselves to some extent by photosynthesis (e.g. species of *Melampyrum*). Again, a small number of plants are *saprophytes*, absorbing complex chemicals from the soil and its fungal contents rather than making them themselves.

II Underground parts

These are not extensively used in plant identification, because they are not often seen, but their importance in the distinction between the various kinds of herbaceous plant has already been noted. There are several distinct types of underground part.

Roots anchor the plant in the soil and absorb water and minerals. They generally grow downwards and outwards, are never green, and never bear leaves or buds. The first root of the seedling, the primary root, may persist, growing in length and thickness and bearing many branches, forming a taproot system (as in most dicotyledons), or the primary root may not last long, its functions being taken over by roots produced from buds at the bases of the stems (*adventitious* roots), forming a fibrous root-system (as in most monocotyledons). Some plants bear roots that become swollen and act as food-storage organs (e.g. the carrot); such organs are known as *root-tubers*.

Some plants, mainly those that grow epiphytically, produce aerial roots from adventitious buds on the stems. These roots may descend to the soil where they absorb nutrients and water, as in some tropical orchids and the familiar Swiss-cheese plant (*Monstera pertusa*), or they may simply hang in the damp atmosphere and absorb moisture (as in many tropical orchids). In a few cases, aerial roots have other functions (e.g. the climbing roots of ivy, *Hedera helix*).

Underground stems look superficially like roots, but they bear buds and small reduced leaves (*scale-leaves*) and frequently grow horizontally or almost so; the buds may produce branches or may produce upwardly growing shoots. Such underground stems are known as *rhizomes*; they may become swollen for food-storage, when they are known as *tubers* (as in the potato, *Solanum tuberosum*). Rhizomes occasionally extend above ground, looping and then rooting at a point some distance from the base

of the parent plant. Such aerial rhizomes are known as *stolons* or *runners*; the strawberry plant (*Fragaria*) provides a familiar example.

Rhizomes that are very short, swollen, bulb-like and upright are known as *corms*, as seen in the species of *Crocus*. *Bulbs* are complex organs made up of modified roots, stems and leaf-bases. Most of the bulb consists of the swollen bases of leaves, which overlap and enfold each other (as in the onion, *Allium cepa*) and are attached at the base to a flat or broadly pyramidal plate, which is the effective stem (bearing roots on its outer side). The outermost leaf-bases tend to be fibrous or papery, and serve as protection for the more delicate tissues within.

III Above-ground parts

These are the most conspicuous parts of the plant and indeed form what is commonly thought of as 'the plant' itself. They are attached to the root, mostly at or near soil level, by a transitional zone that is sometimes called the *stock* or *caudex*. The aerial parts may be very extensive, consisting of various organs, which will be described here serially from the base upwards.

1 Stems

These are the main supporting structures of the plant above ground, bearing the buds, leaves, flowers and fruits. They are generally *terete* (circular in section), although square sections are found in the Labiatae and a few other families, and the stems can be winged or with other outgrowths. They may be erect to horizontal, sometimes erect near the base and then arching over so that the tips are pendulous. With woody plants the term 'stem' is rarely used, the words 'trunk', 'branch', 'twig' or 'shoot' being used depending on the size of the part in question. The term 'stem' is used here in a more precise sense than it is in general English. For instance, the stalk on which a dandelion (*Taraxacum*)