LEAF TYPE

The pattern of division of a leaf into discrete components or segments is termed **leaf type**. A **simple** leaf is one bearing a single, continuous blade. A **compound** leaf is one divided in to two or more, discrete **leaflets**. Leaf type should not be confused with leaf division; a simple leaf may be highly divided, but as long as the divisions are not discrete leaflets, it is still technically a simple leaf. For either compound or divided leaves of ferns, the first (largest) division of a leaf is termed a **pinna**; the ultimate divisions are termed **pinnules**. If the leaves are compound or divided into more than two orders, the terms primary pinna, secondary pinna, etc. can be used, with the ultimate divisions or leaflets always being pinnules.

Simple leaves were the ancestral condition in the vascular plants, as in the lycophylls of the lycopods. Simple leaves are also the norm among the psilophytes, equisetophytes, *Ginkgo*, and conifers (including the Gnetales).

Compound leaves are characteristic of many ferns, and all of the cycads. Angiosperms have the greatest diversity of leaves, ranging from simple to highly compound. Various types of compound leaves have evolved, perhaps as a means of increasing total blade area without sacrificing structural integrity. For example, the blade tissue of a compound leaf generally may have better structural support (e.g., under windy conditions) than that of a comparably sized simple leaf. Compound leaves tend to be more common in mesic to wet environments and simple leaves in dry environments, but there are many exceptions to this and no clear trends.

Compound leaves are defined based on the number and arrangement of leaflets. A **pinnately compound** or **pinnate** leaf is one with leaflets arranged (either oppositely or alternately) along a central axis, the **rachis**. If a pinnate leaf has a terminal leaflet (and typically an odd number of leaflets), it is **imparipinnate**; if it lacks a terminal leaflet (and has an even number of leaflets), it is **paripinnate**. A **bipinnately compound** or **bipinnate** leaf is with two orders

of axes, each of which is pinnate (equivalent to a compound leaf of compound leaves). The central axis of a bipinnate leaf is still termed the **rachis**; the lateral axes that bear leaflets are termed **rachillae** (singular **rachilla**). Similarly, a compound leaf with three orders of axes, each pinnate, is termed **tripinnately compound** or **tripinnate**; etc.

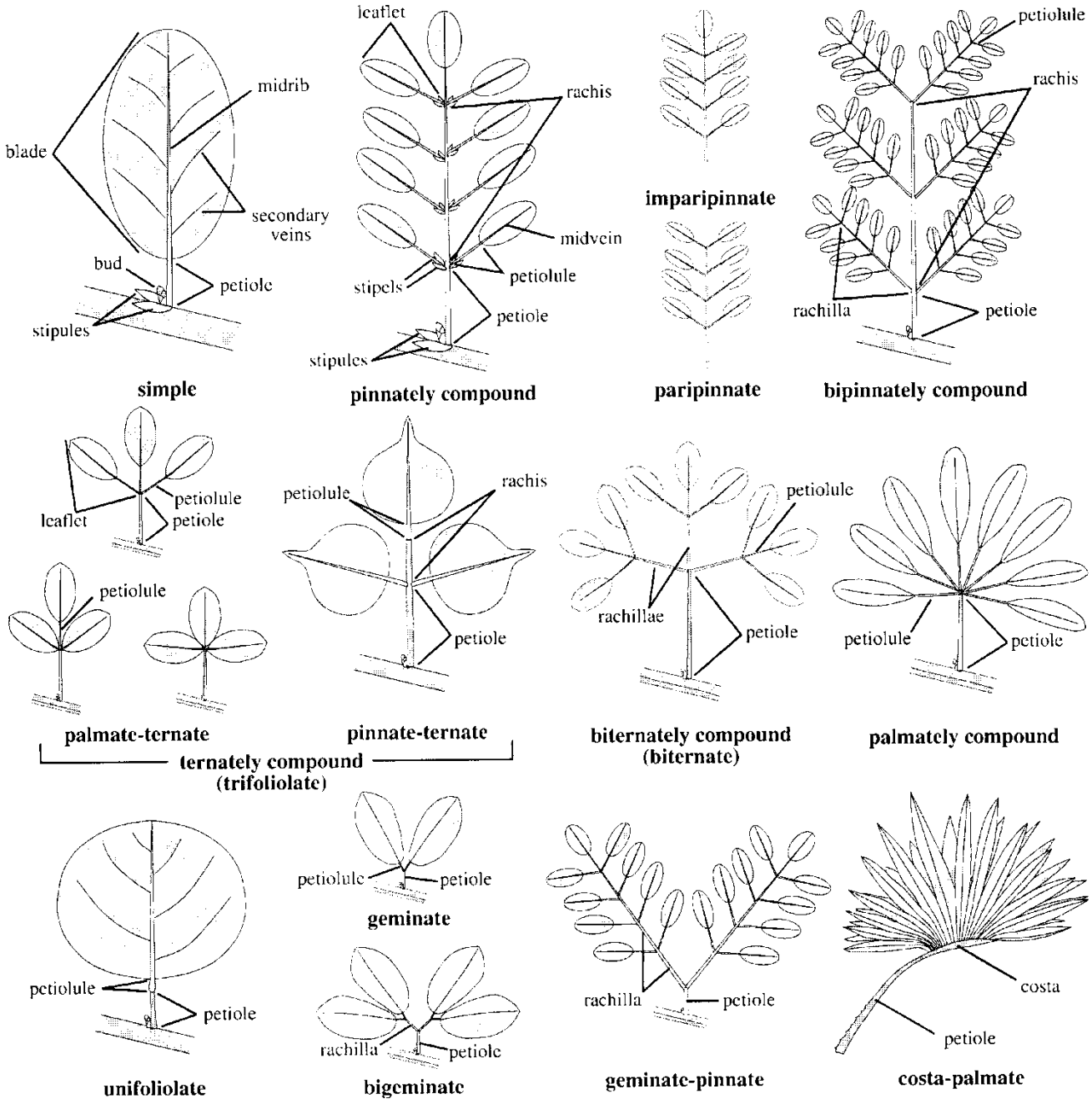
A compound leaf, in which four or more leaflets arise from a common point, typically at the end of the petiole, is termed **palmately compound** or **palmate**. A **costa-palmate** leaf type is one that is essentially palmately compound to divided, but has an elongate, rachis like extension of the petiole (termed the **costa**), as occurs in some palms.

A compound leaf with only three leaflets is termed **trifoliolate** or **ternately compound**. (A leaf with two orders of axes, each ternately compound, is termed **biternately compound**. Further orders, e.g., **triternately compound**, can also occur.) Most ternately compound leaves are **palmate-ternate**, in which the three leaflets join at a common point (whether petiolulate or sessile). Rarely, ternately compound leaves can be **pinnate-ternate**, in which the terminal leaflet arises from the tip of a rachis. Pinnate-ternate leaves are actually derived (by reduction) from an ancestral pinnately compound leaf; they are found, e.g., in some members of the Fabaceae.

Decompound is a general term for a leaf that is more than once compound, i.e., with two or more orders, being bi-, tri-, etc. pinnately, palmately, or ternately, compound. However, decompound is also used for a highly divided leaf).

A compound leaf consisting of only two leaflets is termed **geminate** (Gemini, the twins, in Greek mythology). A compound leaf with two rachillae, each bearing two leaflets, is termed **bigeminate**. A compound leaf with two rachillae, each of these bearing a pinnate arrangement of leaflets, is termed **geminate-pinnate**. Finally, a very specialized type of leaf is one that appears superficially to be simple, but actually consists of a single leaftlet attached to the apex of a petiole, the junction between them clearly defined. This leaf type,

known as **unifoliolate**, is interpreted as being derived by reduction of an ancestrally compound leaf. In some taxa, e.g., many Araceae, the leaves exhibit **heteroblasty** (adjective, **heteroblastic**), in which the juvenile leaves are distinctly different in size or shape from the adult leaves (making species identification difficult).



LEAF ATTACHMENT

The nature of the joining of the leaf to the stem is termed leaf attachment (sometimes treated under Base). In general, leaves may be **petiolate**, with a petiole, or **sessile**, without a petiole. Leaflets of a compound leaf are, correspondingly, either **petiolulate** or **sessile**. (The term **subsessile** is sometimes used for a leaf/leaflet with a small, rudimentary petiole/petiolule). Sessile or petiolate leaves can also have a **sheathing** leaf attachment, in which a flattened leaf base (the sheath) partially or wholly clasps the stem, typical of the Poaceae (grasses) and many Apiaceae.

If a leaf appears to extend down the stem from the point of attachment, as if fused to the stem, the leaf attachment is **decurrent** (e.g., as in many Cupressaceae). A decurrent leaf base is not actually caused by later fusion of the leaf to the stem, but by extension growth of actively dividing cells of the leaf primordium at the leaf stem junction. Last, specializations of sessile leaves may occur. If a leaf is sessile and clasps the stem most, but not all, of its circumference, the attachment is termed **amplexicaul**. If the leaf is sessile
with the base of the blade completely surrounding the stem, it is termed **perfoliolate**. A special case of the latter (involving fusion of leaves) is **connate-perfoliate**, whereby typically two opposite leaves fuse basally, such that the blade bases of the fusion product completely surrounds the stem.