

# SEMESTER-II

## UNIT-III

The **Asclepiadoideae** are a [subfamily](#) of plants in the family [Apocynaceae](#). Formerly, it was treated as a separate family under the name **Asclepiadaceae**, e.g. by [APG II](#), and known as the milkweed family.<sup>[2][3]</sup>

They form a group of perennial [herbs](#), twining [shrubs](#), [lianas](#) or rarely [trees](#) but notably also contain a significant number of leafless [stem succulents](#). The name comes from the [type genus](#) [Asclepias](#) (milkweeds).

There are 348 genera, with about 2,900 [species](#). They are mainly located in the tropics to subtropics,<sup>[4]</sup> especially in Africa and South America.

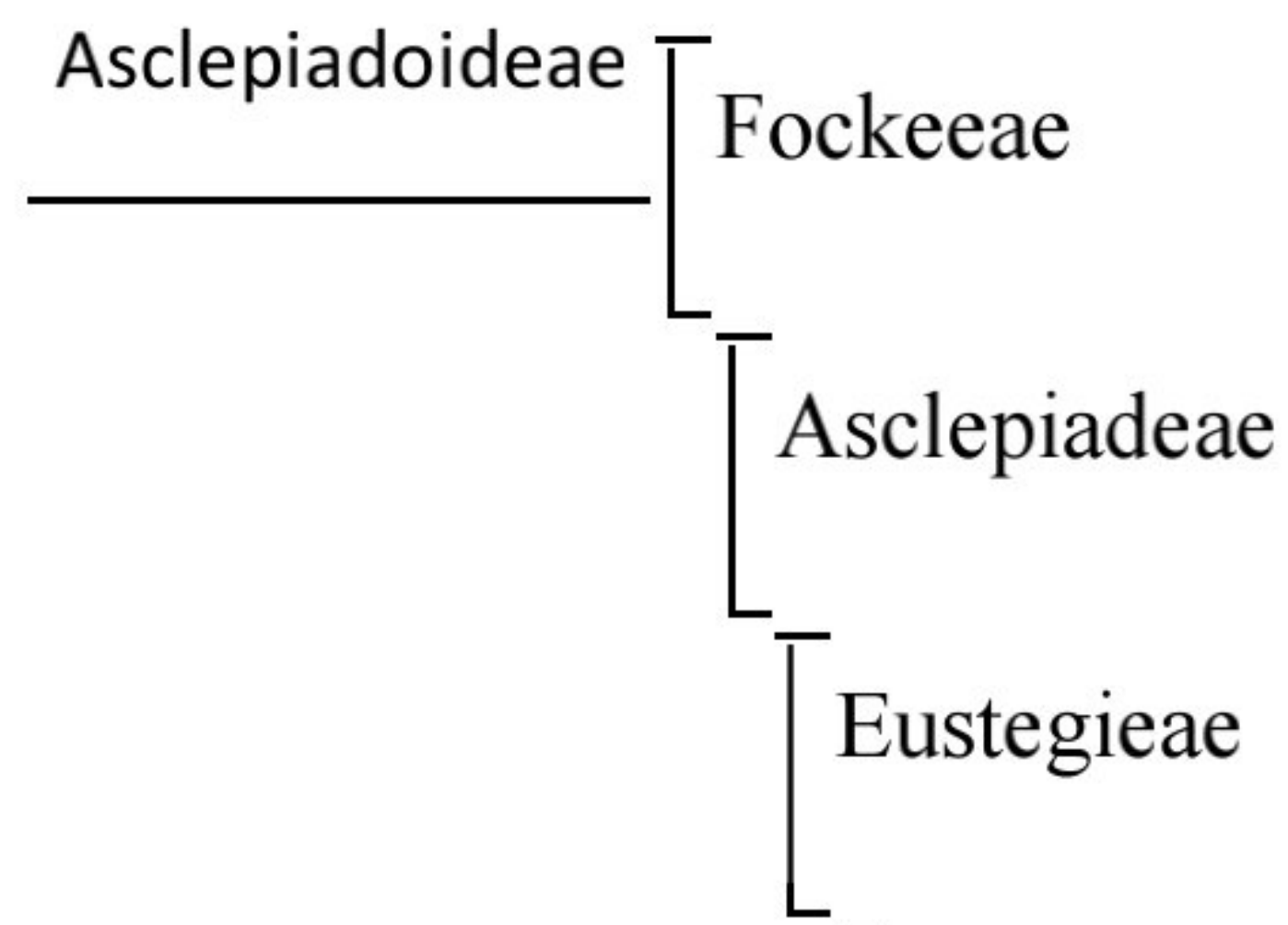
The florally-advanced tribe [Stapelieae](#) within this family contains several relatively familiar stem [succulent](#) genera, such as [Orbea](#), [Huernia](#), [Stapelia](#) and [Hoodia](#). They are remarkable for the complex mechanisms which they have developed for [pollination](#), independently parallel to the unrelated [Orchidaceae](#), such as the grouping of their pollen into [pollinia](#). The "fragrance" (or odor) of the flowers, often called "carrion flowers", attracts flies, the chief pollinators for these plants. Additionally, the color, appearance and texture of the flowers often is thought to resemble decaying flesh or raw meat to further entice pollination by flies.

Many new [hybrids](#) have been formed due to the unique fertilization method of the flowers.

### Taxonomy

[\[edit\]](#)

[Gilbert Thomas Burnett](#) in 1835 is considered to be the first botanist to recognize a primary division of the family Apocynaceae using the name Asclepiadeae,<sup>[5]</sup> an ending now used for tribes rather than subfamilies. In 2014, Endress, Liede-Schumann and Meve recognised five tribes within the subfamily.<sup>[6]</sup> A [molecular phylogenetic](#) study in 2019 confirmed the distinctness of the five tribes, which were related as shown in the following cladogram:<sup>[7]</sup>



L  
Marsdenieae

**Tribes and genera**

[\[edit\]](#)



[Asclepias syriaca](#)



[Microloma](#)

[calycinum](#), Richtersveld, South Africa

The assignment of genera to tribes is based on Endress, Liede-Schumann and Meve (2014),<sup>[6]</sup> with synonyms from [Plants of the World Online](#) as of December 2023.

**Asclepiadeae**

[\[edit\]](#)

- [Araujia](#) Brot.
- [Asclepias](#) L., including *Aidomene* Stopp, *Odontostelma* Rendle, *Trachycalymma* (K.Schum.)
- [Aspidoglossum](#) E.Mey.
- [Aspidonepsis](#) Nicholas
- [Astephanus](#) R.Br.
- [Barjonia](#) Decne.
- [Blepharodon](#) Decne.
- [Calciphila](#) Liede
- [Calotropis](#) R.Br.
- [Cordylogyne](#) E.Mey.
- [Cynanchum](#) L., including *Adelostemma* Hook.f., *Glossonema* Decne., *Metaplexis* R.Br., *Pentarrhinum* E.Mey., *Seshagiria* Ansari, *Sichuania* M.G.Gilbert
- [Diplolepis](#) R.Br.
- [Ditassa](#) R.Br.

**Ceropegieae**

[\[edit\]](#)

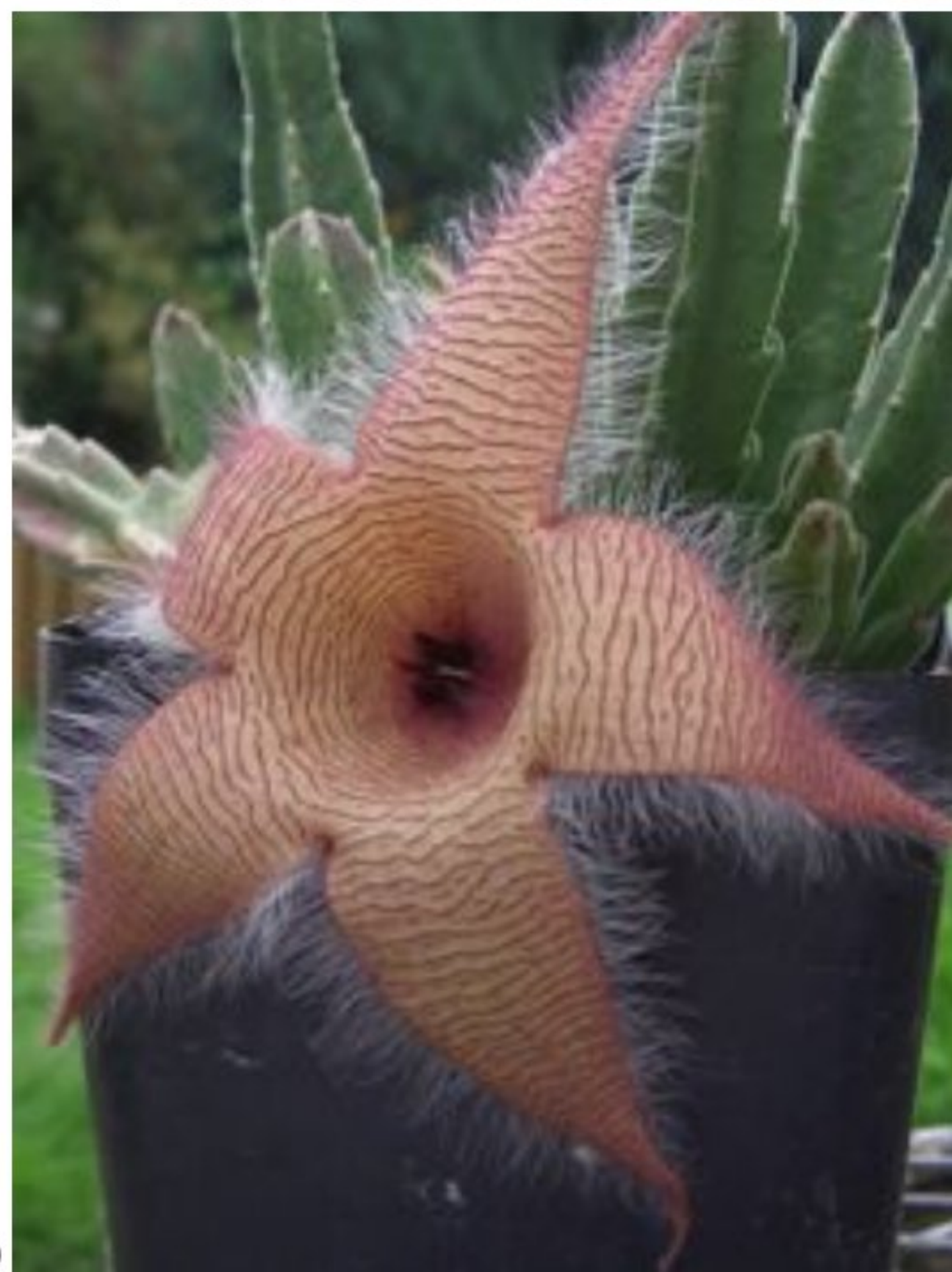


*Ceropegia candelabrum*



*Caralluma acutangula*, Burkina Faso

*Leptadenia*



*pyrotechnica*, Burkina Faso

*Stapelia gigantea*

- *Anisotoma* Fenzl
- *Apteranthes* J.C.Mikan

- [Australuma](#) Plowes
- [Baynesia](#) Bruyns
- [Boucerosia](#) Wight
- [Brachystelma](#) Sims
- [Caralluma](#) R.Br.
- [Caudanthera](#) Plowes
- [Ceropegia](#) L.
- [Conomitra](#) Fenzl
- [Desmidorchis](#) Ehrenb.
- [Duvalia](#) Haw.
- [Duvaliandra](#) M.G.Gilbert
- [Echidnopsis](#) Hook.f.
- [Edithcolea](#) N.E.Br.
- [Emplectanthus](#) N.E.Br.
- [Heterostemma](#) Wight
- [Hoodia](#) Sweet
- [Huernia](#) R.Br.
- [Laryleachia](#) Plowes
- [Lavrania](#) Plowes
- [Leptadenia](#) R.Br.
- [Monolluma](#) Plowes
- [Neoschumannia](#) Schltr.
- [Notechidnopsis](#) Lavranos
- [Ophionella](#) Bruyns

### **Eustegieae**

[[edit](#)]

- [Emicocarpus](#) R.Br.
- [Eustegia](#) K.Schum. & Schltr.

### **Fockeeae**

[[edit](#)]

- [Cibirhiza](#) Bruyns
- [Fockea](#) Endl.

### **Marsdenieae**

[[edit](#)]



*Stephanotis floribunda*

- *Anatropanthus* Schltr.
- *Anisopus* N.E.Br.
- *Asterostemma* Decne.
- *Campestigma* Pierre
- *Cionura* Griseb.
- *Cosmostigma* Wight
- *Dischidia* R.Br.
- *Dolichopetalum* Tsiang
- *Gongronema* (Endl.)
- *Gunnessia* P.I.Forst.
- *Gymnema* R.Br.
- *Heynella* Backer
- *Hoya* R.Br., including *Cathetostemma* Blume, *Clemensiella* Schltr.
- *Jasminanthes* Blume
- *Lygisma* Hook.f.
- *Marsdenia* R.Br.
- *Oreosparte* Schltr.
- *Pycnorhachis* Benth.
- *Rhyssolobium* E.Mey.
- *Sarcolobus* R.Br., including *Quisumbingia* Merr.
- *Stephanotis* Thouars, including *Dregea* E.Mey., *Wattakaka* Hassk.
- *Stigmatorhynchus* Schltr.
- *Telosma* Coville
- *Treutlera* Hook.f.

**Other genera**

[[edit](#)]

These genera are not accepted within Asclepiadoideae by Endress *et al.* (2014),<sup>[6]</sup> but are accepted by Plants of the World Online. Tribal placements below are from [GRIN-Global](#), where given.

- *Dalzielia* Turrill – Marsdenieae (possible synonym of *Marsdenia*)<sup>[8]</sup>
- *Decanema* Decne. – Asclepiadeae (possible synonym of *Cynanchum*)<sup>[9]</sup>
- *Dischidanthus* Tsiang – Marsdenieae (possible synonym of *Marsdenia*)<sup>[10]</sup>
- *Gymnemopsis* Costantin – Marsdenieae (possible synonym of *Marsdenia*)<sup>[11]</sup>
- *Kerbera* E.Fourn. – Asclepiadeae<sup>[12]</sup>
- *Leichhardtia* R.Br.
- *Manothis* Miers
- *Periglossum* Decne. – Asclepiadeae<sup>[13]</sup>
- *Polystemma* Decne., including *Microdactylon*<sup>[14]</sup> – Asclepiadeae (possible synonym of *Matelea*)<sup>[15]</sup>
- *Ptycanthera* Decne. – Asclepiadeae (possible synonym of *Matelea*)<sup>[16]</sup>
- *Ruehssia* H.Karst. ex Schldl. – Marsdenieae (possible synonym of *Marsdenia*)<sup>[17]</sup>
- *Schistonema* Schltr. – Asclepiadeae (possible synonym of *Tweedia*)<sup>[18]</sup>
- *Vailia* Rusby – Asclepiadeae (possible synonym of *Blepharodon*)<sup>[19]</sup>

**Paleobotany**, also spelled as **palaeobotany**, is the branch of [botany](#) dealing with the recovery and identification of [plant](#) remains from [geological](#) contexts, and their use for the biological reconstruction of past environments ([paleogeography](#)), and the [evolutionary history of plants](#), with a bearing upon the [evolution of life](#) in general. A synonym is **paleophytology**. It is a component of [paleontology](#) and [paleobiology](#). The prefix *palaeo-* or *paleo-* means "ancient, old",<sup>[1]</sup> and is derived from the [Greek](#) adjective παλαιός, *palaios*.<sup>[2]</sup> Paleobotany includes the study of [terrestrial plant fossils](#), as well as the study of [prehistoric](#) marine [photoautotrophs](#), such as [photosynthetic algae](#), [seaweeds](#) or [kelp](#). A closely related field is [palynology](#), which is the study of fossilized and [extant spores](#) and [pollen](#).

Paleobotany is important in the reconstruction of ancient [ecological](#) systems and [climate](#), known as [paleoecology](#) and [paleoclimatology](#) respectively. It is fundamental to the study of green plant [development](#) and [evolution](#). Paleobotany is a historical science much like its adjacent, paleontology. Because of the understanding that paleobotany gives to archeologists, it has become important to the field of [archaeology](#) as a whole. primarily for the use of [phytoliths](#) in [relative dating](#) and in [paleoethnobotany](#).<sup>[3]</sup>

The study and discipline of paleobotany was seen as far back as the 19th century. Known as the "Father of Paleobotany", French botanist [Adolphe-Theodore Brongniart](#) was a sufficient figure in this emergence of Paleobotany, known for his work on the relationship between the living and extinct plant life. This work not only progressed paleobotany but also the understanding of the earth and its longevity in actuality and the [organic matter](#) that existed over the earth's timeline. Paleobotany also succeeded in the hands of German paleontologist [Ernst Friedrich von Schlothiem](#), and Czech nobleman and scholar, [Kaspar Maria von Sternberg](#).<sup>[4][5]</sup>

## Related Sciences

[\[edit\]](#)

### Paleoecology

[\[edit\]](#)

As paleobotany is the specification of fossilized [plant life](#) and the environment in which they thrived in, [paleoecology](#) is the study of all once-living [organisms](#) and the interactions held in the environments they once existed in, before becoming [extinct](#).<sup>[6]</sup>

Paleoecology is a similar study to that of [paleontology](#), but paleoecology uses more [methodology](#) from the [biological sciences](#) and [geological sciences](#)<sup>[7]</sup> rather than from an [anthropological](#) standpoint as paleontologists do.

### Paleopalynology

[\[edit\]](#)

[Paleopalynology](#), more commonly known as [palynology](#), is the science and study of ancient palynomorphs: particles sized between 5 and 500 micrometers.<sup>[8]</sup> This would be an inclusion of [pollen](#) and [spores](#) and any other micro-organic matter. Paleopalynology is simply paleobotany on a much smaller scale, the two in close association with each other.

Similar to paleobotany, we can tell a great deal of information about the environment and [biome](#) at the time these [particles](#) existed prehistorically. These particles also help geologists identify and date the [rock strata](#) of [sedimentary rocks](#). It is also used to find natural oils and [gas](#) within these rock layers for [extraction](#).<sup>[9]</sup> Besides uncovering documentation of our past environmental conditions, palynology can also tell us about animal diets, historical standings of human [allergies](#), and reveal evidence in crime cases.<sup>[citation needed]</sup>

## Overview of the paleobotanical record

[edit]

[Macroscopic remains](#) of true [vascular plants](#) are first found in the fossil record during the [Silurian](#) Period of the [Paleozoic](#) era. Some dispersed, fragmentary fossils of disputed affinity, primarily spores and [cuticles](#), have been found in rocks from the [Ordovician](#) Period in [Oman](#), and are thought to derive from [liverwort](#)- or [moss](#)-grade fossil plants.<sup>[10]</sup>



An unpolished hand sample of the Lower Devonian [Rhynie](#)

[Chert](#) from Scotland

An important early land plant fossil locality is the [Rhynie chert](#), found outside the village of [Rhynie](#) in [Scotland](#). The Rhynie chert is an Early [Devonian](#) sinter ([hot spring](#)) deposit composed primarily of [silica](#). It is exceptional due to its preservation of several different [clades](#) of plants, from mosses and [lycophytes](#) to more unusual, problematic forms. Many fossil animals, including [arthropods](#) and [arachnids](#), are also found in the Rhynie chert, and it offers a unique window into the history of early terrestrial life.

Plant-derived macrofossils become abundant in the Late Devonian including [tree](#) trunks, [fronds](#), and [roots](#). The earliest tree was once thought to be [Archaeopteris](#), which bears simple, [fern](#)-like [leaves](#) spirally arranged on branches atop a [conifer](#)-like [trunk](#),<sup>[11]</sup> although it is now known to be the recently discovered [Wattieza](#).<sup>[12]</sup>

Widespread [coal](#) swamp deposits across North America and Europe during the [Carboniferous](#) Period contain a wealth of fossils containing [arborescent lycopods](#) up to 30 m tall, abundant [seed plants](#), such as conifers and [seed ferns](#), and countless smaller, [herbaceous plants](#).

Angiosperms ([flowering plants](#)) evolved during the [Mesozoic](#), and flowering plant pollen and leaves first appeared during the Early [Cretaceous](#), approximately 130 million years ago.

## Plant fossils

[\[edit\]](#)



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A plant fossil is any preserved part of a plant that has long since died. Such fossils may be prehistoric impressions that are many millions of years old, or bits of [charcoal](#) that are only a few hundred years old. Prehistoric plants are various groups of plants that lived before recorded [history](#) (before about [3500 BC](#)).

### Preservation of plant fossils

[\[edit\]](#)



[Ginkgoites huttonii](#), Middle Jurassic, Yorkshire, UK. Leaves preserved as compressions. Specimen in Munich Palaeontological Museum, Germany.

Plant fossils can be preserved in a variety of ways, each of which can give different types of information about the original parent plant. These modes of preservation may be summarised in a paleobotanical context as follows.

1. **Adpressions (compressions – impressions).** These are the most commonly found type of plant fossil. They provide good morphological detail, especially of dorsiventral (flattened) plant parts such as leaves. If the cuticle is preserved, they can also yield fine anatomical detail of the epidermis. Little other detail of cellular anatomy is normally



preserved. [Rhynia](#), Lower Devonian Rhynie Chert, Scotland, UK. Transverse section through a stem preserved as a silica petrifaction, showing preservation of cellular structure.

2. **Petrifactions (permineralisations or anatomically preserved fossils).** These provide fine detail of the cell anatomy of the plant tissue. Morphological detail can also be determined by serial sectioning, but this is both time consuming and difficult.
3. **Moulds and casts.** These only tend to preserve the more robust plant parts such as seeds or woody stems. They can provide information about the three-dimensional form of the plant, and in the case of casts of tree stumps can provide evidence of the density of the original vegetation. However, they rarely preserve any fine morphological detail or cell anatomy. A subset of such fossils are **pith casts**, where the centre of a stem is either hollow or has delicate pith. After death, sediment enters and forms a cast of the central cavity of the stem. The best known examples of pith casts are in the Carboniferous Sphenophyta (*Calamites*) and cordaites (*Artisia*).



[Crossotheca hughesiana](#) Kidston, Middle Pennsylvanian, Coseley, near Dudley, UK. A lyginopteridalean pollen organ preserved as an authigenic mineralization (mineralized *in situ*). Specimen in Sedgwick Museum, Cambridge, UK.

4. **Authigenic mineralisations.** These can provide very fine, three-dimensional morphological detail, and have proved especially important in the study of reproductive structures that can be severely distorted in adpressions. However, as they are formed in mineral nodules, such fossils can rarely be of large size.
5. **Fusain.** Fire normally destroys plant tissue but sometimes charcoalfied remains can preserve fine morphological detail that is lost in other modes of preservation; some of the best evidence of early flowers has been preserved in fusain. Fusain fossils are

delicate and often small, but because of their buoyancy can often drift for long distances and can thus provide evidence of vegetation away from areas of sedimentation.

## Fossil-taxa

[\[edit\]](#)

Plant fossils almost always represent disarticulated parts of plants; even small herbaceous plants are rarely preserved whole. The few examples of plant fossils that appear to be the remains of whole plants are in fact incomplete as the internal cellular tissue and fine micromorphological detail is normally lost during fossilization. Plant remains can be preserved in a variety of ways, each revealing different features of the original parent plant.<sup>[13]</sup>

Because of this, paleobotanists usually assign different taxonomic names to different parts of the plant in different modes of preservation. For instance, in the subarborescent Palaeozoic [sphenophytes](#), an impression of a leaf might be assigned to the genus *Annularia*, a compression of a cone assigned to *Palaeostachya*, and the stem assigned to either *Calamites* or *Arthroxylon* depending on whether it is preserved as a cast or a petrification. All of these fossils may have originated from the same parent plant but they are each given their own taxonomic name. This approach to naming plant fossils originated with the work of [Adolphe-Théodore Brongniart](#).<sup>[14]</sup>

For many years this approach to naming plant fossils was accepted by paleobotanists but not formalised within the *International Rules of Botanical Nomenclature*.<sup>[15]</sup> Eventually, [Thomas \(1935\)](#) and [Jongmans, Halle & Gothan \(1935\)](#) proposed a set of formal provisions, the essence of which was introduced into the 1952 [International Code of Botanical Nomenclature](#).<sup>[16]</sup> These early provisions allowed fossils representing particular parts of plants in a particular state of preservation to be placed in organ-genera. In addition, a small subset of organ-genera, to be known as form-genera, were recognised based on the artificial taxa introduced by Brongniart mainly for foliage fossils. The concepts and regulations surrounding organ- and form-genera were modified within successive codes of nomenclature, reflecting a failure of the paleobotanical community to agree on how this aspect of plant taxonomic nomenclature should work (a history reviewed by Cleal and Thomas in 2020<sup>[17]</sup>). The use of organ- and fossil-genera was abandoned with the *St Louis Code*, and replaced by "morphotaxa".<sup>[18]</sup>

The situation in the *Vienna Code* of 2005 was that any plant taxon whose type is a fossil, except [diatoms](#), can be described as a **morphotaxon**, a particular part of a plant preserved in a particular way.<sup>[19]</sup> Although the name is always fixed to the type specimen, the circumscription (i.e. range of specimens that may be included within the taxon) is defined by the taxonomist who uses the name. Such a change in circumscription could result in an expansion of the range of plant parts or preservation states that could be incorporated within the taxon. For instance, a fossil-genus originally based on compressions of ovules could be used to include the multi-ovulate cupules within which the ovules were originally borne. A complication can arise if, in this case, there was an already named fossil-genus for these cupules. If paleobotanists were confident that the type of the ovule fossil-genus and of the cupule fossil-genus could be

included in the same genus, then the two names would compete as to being the correct one for the newly emended genus. In general, there would be competing priority whenever plant parts that had been given different names were discovered to belong to the same species. It appeared that morphotaxa offered no real advantage to paleobotanists over normal fossil-taxa and the concept was abandoned with the 2011 botanical congress and the 2012 [International Code of Nomenclature for algae, fungi, and plants](#).

## Fossil groups of plants

[\[edit\]](#)



Lycopod axis (branch) from the Middle Devonian



of [Wisconsin](#).

*Stigmara*, a common fossil tree root.



Upper [Carboniferous](#) of northeastern [Ohio](#). External mold of [Lepidodendron](#) from the [Upper Carboniferous](#) of [Ohio](#).

Main article: [Evolutionary history of plants](#)

Some plants have remained almost unchanged throughout earth's geological time scale. [Horsetails](#) had evolved by the Late Devonian,<sup>[20]</sup> early ferns had evolved by the [Mississippian](#), [conifers](#) by the [Pennsylvanian](#). Some plants of prehistory are the same ones around today and are thus [living fossils](#), such as [Ginkgo biloba](#) and [Sciadopitys verticillata](#). Other plants have changed radically, or became extinct.

Examples of prehistoric plants are:

- [Araucaria mirabilis](#)
- [Archaeopteris](#)
- [Calamites](#)
- [Dillhoffia](#)
- [Glossopteris](#)
- [Hymenaea protera](#)
- [Nelumbo aureavallis](#)
- [Pachypteris](#)
- [Palaeoraphe](#)
- [Peltandra primaeva](#)
- [Protosalvinia](#)
- [Trochodendron nastae](#)

## Notable paleobotanists

[\[edit\]](#)



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- [Edward W. Berry](#) (1875–1945), [paleoecology](#) and [phytogeography](#)<sup>[21]</sup>
- [William Gilbert Chaloner](#) (1928–2016)<sup>[22]</sup>
- [Isabel Cookson](#) (1893–1973), early vascular plants, [palynology](#)<sup>[23]</sup>
- [Margaret Bryan Davis](#), (1931–), American paleoecologist and palynologist<sup>[24]</sup>
- [Dianne Edwards](#) (1942–), colonization of land by early terrestrial floras<sup>[25][26]</sup>
- [Constantin von Ettingshausen](#) (1826–1897), Tertiary floras
- [Thomas Maxwell Harris](#) (1903–1983), Mesozoic plants of Jameson Land (Greenland) and Yorkshire.<sup>[27]</sup>
- [Robert Kidston](#) (1852–1924), early land plants, Devonian and Carboniferous floras, and their use in stratigraphy
- [Ana María Ragonese](#) (1928–1999), fossil wood morphology, spermatophytes<sup>[28]</sup>
- [Ethel Ida Sanborn](#) (1883–1952), extinct flora of Oregon and the Western United States
- [Birbal Sahni](#) (1891–1949), Revision of Indian Gondwana Plants
- [Dunkinfield Henry Scott](#) (1854–1934), analysis of the structures of fossil plants
- [Kaspar Maria von Sternberg](#) (1761–1838), the "father of paleobotany"
- [Franz Unger](#) (1800–1870), pioneer in plant physiology, phytotomy and soil science
- [Jack A. Wolfe](#) (1936–2005), Tertiary paleoclimate of western North America
- [Gilbert Arthur Leisman](#) (1924–1996), known for work on Carboniferous lycophytes of central North America.