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## A SKETCH OF PLANT CLASSIFICATION FROM THEOPHRASTUS TO THE PRESENT


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(Continued from November Torreya)



### Nineteenth Century

Augustin Pyrame de Candolle, of Geneva, greatly improved the limits and arrangement of families (then called orders). He increased their number to 161, as compared with Linnaeus's 67 and Jussieu's 100. Related families were called cohorts. As the conifers have more than two cotyledons, he adopted the term exogens instead of dicotyledons. His classification proposed in 1813 was:

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| Vasculares | Exogenae (Diplochlamydeae and Monochlamydeae) |
| | Endogenae (Phanerogamae and Cryptogamae) |
| Cellulares | (Mosses, Algae, Fungi) |

The Monochlamydeae included the present gymnosperms and catkin-bearing dicotyledons. "I place dicotyledons first," he writes, "because they have the greatest number of distinct and separate organs. Then as I find families where some of these organs become consolidated, and consequently seem to disappear, I refer them to a lower rank. But let no one imagine I attach the least importance to the arrangement." The publication of the great *Prodromus* was continued for fifty years.

In Germany the Linnaean system was opposed by Schleiden, who called the productions of the Linnaean school "hay." Nägeli urged that the important thing is to make every conception find its place in connection with the rest of knowledge; he


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made algae and fungi the starting point in the study of plant forms.

Robert Brown, called by Humboldt "easily the foremost of botanists," cared less about making collections than about the solution of problems. After travelling in Australia he published researches on cycads and conifers (1827), pointing out the character of gymnospermy, and the fact that the endosperm in these plants is formed before fertilization. They are thus entirely distinct from dicotyledons; a fact strongly confirmed by the antiquity of their fossils.

About this time numerous systems were proposed. In Bartling's *Ordines Naturales Plantarum* (1830) small groups of families are called classes, and their characters are given. The main groups are:

| | | |
|---|---|---|
| CELLULAR | (Fungi, Lichens, Algae, Musci) | |
| VASCULAR | Cryptogamic | |
| | Phanerogamic | Monocotyledons |
| | | Dicotyledons |

The monocotyledonous families are in ten classes, beginning with Gramineae and Cyperaceae. The dicotyledons are in four divisions: first, plants "with embryo in a vitellus," *Aristolochia*, Piperaceae, Nymphaeaceae, and others. The apetalous plants include Coniferae, with four families, Amentaceae, with five families (Casuarinaceae, Myricaceae, etc.), and ending with Salicaceae as a separate "class." The Monopetalae begin with Aggregatae and Compositae, the Polypetalae with Loranthеae and Umbelliflorae.

Endlicher's extensive *Genera Plantarum* (1836–1840) also begins with the lower plants, thus:

| | | |
|---|---|---|
| THALLOPHYTA | (Algae, Lichens, Fungi) | |
| CORMOPHYTA | Acrobrya | (Mosses, Ferns, Cycads) |
| | Amphibrya | (Gramineae to Palmae) |
| | Acramphibrya | Gymnospermae |
| | | Apetala |
| | | Gamopetala |
| | | Dialypetala |

The Apetala begin with Chloranthaceae and Piperaceae. He considers the Leguminosae as the most advanced type of all. Endlicher's system became much used in Germany.

Adolphe Brongniart, one of the first to study fossil plants, in 1843 introduced gymnosperms as a group of dicotyledons, thus:

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|---|---|
| Cryptogamae | (Amphigenae and Acrogenae) |
| Phanerogamae | Monocotyledonae<br>Dicotyledonae (Angiospermae and Gymnospermae) |

His two main divisions of flowerless and flowering plants have come into general use; these groups now appear less natural than those of de Candolle. Many botanic gardens in France, including that of Paris, are laid out by his system. Lindley arranged families into alliances, terminating uniformly in *-ales;* his main groups, Thallogens, Acrogens, Rhizogens, Endogens, Dictyogens, Gymnogens, and Exogens were unfortunate. His system was used for some time in England.

The far-reaching studies of Hofmeister, who was, according to Bonnier, perhaps the greatest genius of botanical science, were begun when he was a music dealer in Leipzig. He followed in detail the development of mosses, ferns, and seed plants, and for the first time made clear the importance of the phenomenon of alternation of generations, and the essential unity running through the various groups of plants. From this time more attention is given to the structure of flowerless plants.

The early system-makers seized upon more or less arbitrary characters which they considered fundamental. Their systems emphasized differences, and were often very effective to find the names of plants. The work of Hofmeister emphasized resemblances, implying, though not stating, the doctrine of evolution. The growth of knowledge in other sciences of nature also gradually prepared the way for acceptance of evolution instead of special creation. Darwin's famous work on the "Origin of Species" (1859) became a subject of general controversy. "Although fully convinced of the truth of these views," says Darwin, "I by no means expect to convince experienced naturalists." His ideas were defended in this country by Asa Gray, and strenuously opposed by Agassiz. Schimper, whose name is associated with the doctrine of phyllotaxis, says "Darwin's doctrine of breeding is the most short-sighted possible, most stupidly mean and brutal." Of species-making Darwin says he does not think more credit should be given to a naturalist for describing a species than to a carpenter for making a box. Impressed by the difficulties of nomenclature, he left a provision in his will which resulted in the preparation of the "*Index Kewensis*" of flowering plants (1885).

Alexander Braun, nature-philosopher and botanist, combined suggestions from Brown, Endlicher and others and in 1864 proposed the groups:

| | |
|---|---|
| BRYOPHYTA | (Algae, Fungi and Moss-like Plants) |
| CORMOPHYTA | (Ferns and Club-mosses) |
| ANTHOPHYTA | Gymnospermae (Frondosae and Acerosae)<br>Angiospermae (Monocotyledons and Dicotyledons) |

Thus the old groups based on cotyledons were subordinated to the division gymnosperms and angiosperms, and the importance of Robert Brown's discovery at last recognized.

Sachs, in the first edition of his *Lehrbuch* (1868), adopted five principal groups—Thallophyta, Characeae, Muscineae, Vascular Cryptogams, Phanerogams. His idea of the Linnaean school is expressed in his "History of Botany": "A mass of lifeless phrases was the instruction offered to the majority of students under the name of botany, with the inevitable effect of repelling the more gifted natures from the study. This was the evil result of the old notion that the sole or chief business of every botanist is to trifle away time in plant collecting in wood and meadow, and in rummaging in herbaria. Even the better sort lost the sense for higher knowledge while occupying themselves in this way with the vegetable world. The powers of the mind could not fail after a time to deteriorate and every textbook of the period supplies proof of this deterioration."

Following a series of colonial floras, Bentham and Hooker prepared their great work, *Genera Plantarum* (1862–1881). It describes with great detail all genera of seed plants, "the greater portion," Hooker writes, "being the product of Bentham's indefatigable industry." The arrangement is in the main that of de Candolle, the main divisions being:

Dicotyledones (Polypetalae, Gamopetalae and Monochlamydeae).

Gymnospermeae.

Monocotyledones.

It is interesting to note that while in the text gymnosperms are implied to be included in dicotyledons, in the list of contests they are put up as a separate group. Bentham and Hooker's system was followed in Gray's "Manual," including the sixth edition. There gymnosperms are retained under dicotyledons, but the interesting suggestion is made that it would be more natural to place endogens at the beginning, that is, dicotyledons between monocotyledons and gymnosperms.

Eichler's studies on the structure of flowers made more definite groups of related families, now called orders. His classification was a combination of previous systems, thus:

- Cryptogamae
  - Thallophyta
  - Bryophyta
  - Pteridophyta
- Phanerogamae
  - Gymnospermae
  - Angiospermae
    - Monocotyleae
    - Dicotyleae (Choripetalae and Sympetalae)

The Choripetalae begin with catkin-bearing trees and end with the pea family; the Sympetalae end with the composites. The last family with its condensed inflorescence, united petals and anthers, and inferior ovary, is considered as the culmination of evolution of the dicotyledons.

*Die Naturlichen Pflanzenfamilien*, the great coöperative work edited by Engler and Prantl, appeared in the last decade of the nineteenth century and is as yet the most complete exposition of the plants of the world as a whole. The main groups adopted were Myxothallophyta, Euthallophyta, Embryophyta zoidiogama (Bryophyta and Pteridophyta), and Embryophyta siphonogama (Gymnospermae and Angiospermae). Later in the *Syllabus der Pflanzenfamilien* the Thallophyta have been broken up into many groups. The angiosperms are arranged as follows:

MONOCOTYLEDONEAE: First, plants with the number of floral parts indefinite, as in the arrowhead; then those with the number definite, as in the lily.

DICOTYLEDONEAE: *Archichlamydeae*, petals none or separate. First, Casuarina and other plants with perianth absent or single: mostly catkin-bearing, wind-pollinated trees, as oak. Under flowers with distinct calyx and corolla come those with axis-like receptacle, such as buttercup, and those with cup-like receptacle, as rose; last, those with inferior ovary, as evening primrose.

*Metachlamydeae*, petals united, grouped by the number of staminate whorls and the position of the ovary.

"Engler has evidently abandoned the attempt to produce a phylogenetic system," says Lotsy, " and has been content to establish a readily understood morphological system of the plant world which may be the least affected by constantly changing phylogenetic views."

With the completion of the *Pflanzenfamilien* botanists had for the first time available an extensive connected account of all groups of plants, a fact which has brought to the system there adopted wide international sanction. Minor changes have been introduced in successive editions of the *Syllabus*.

## RECENT STUDIES

A few developments of recent years, of special interest, may be mentioned. With the spread of the doctrine of evolution has grown the ideal of a single system, a truly natural classification of plants and animals which shall exhibit the course of evolution of the forms of life on the earth.

Bower has given reasons to show that eusporangiate ferns, such as *Marattia* and *Botrychium*, must be considered more primitive than the leptosporangiate forms, such as Polypodiaceae, a view that has gained wide acceptance though not adopted by Engler and Gilg.

The relation of gymnosperms to ferns was supported by the discovery of ciliated sperm-cells in *Ginkgo*, by Hirase, in 1895; later similar discoveries were made in cycads. This relation was confirmed by the finding of fossil seed-bearing ferns by Oliver and Scott, in 1903. The ferns now connect so closely with the higher plants that the old grouping Pteridophyta and Spermatophyta is no longer justified.

In 1900 Jeffrey proposed two main groups of vascular plants: *Lycopsida* (club-mosses and horsetails) with continuous woody cylinder and sporangia on the ventral surface of the sporophylls, and *Pteropsida* (ferns, gymnosperms, and angiosperms), having woody cylinder with foliar gaps and sporangia on the dorsal surface of the sporophylls. Since the club mosses differ more from the horsetails than do the groups of the Pteropsida among themselves, Scott proposes three groups: Lycopsida, Sphenopsida (horsetails and sphenophylls), and Pteropsida. C. E. Bessey makes six groups of vascular plants, Lepidophyta, Calamophyta, and Pteridophyta, Cycadophyta, Strobilophyta (conifers) and Anthophyta (flowering plants). Following in part along lines suggested by Hallier, Bessey considers the monocotyledons as derived from dicotyledons, the latter forming two main lines: buttercup series, with receptacle an axis; and rose series, with receptacle more or less cup-shaped. Apetalous flowers are considered as reduced forms.

Van Tieghem has proposed a number of morphological systems in which the structure of the ovule is emphasized. "We may question, says Rendle in his "Classification of Flowering Plants," whether in view of the ephemeral nature of such systems, an author is justified in proposing so large a number of new terms."

Evidence appears increasingly conclusive that monocotyledons are derived from dicotyledons, and therefore should be placed after these. This view was already suggested by Strasburger, and has been developed by Miss Sargant, Hallier, and others. The probable line of development appears to be Ranunculaceae to Alismaceae. Another possible connection may be Piperaceae to Araceae, a view adopted by Lotsy. The Bentham-Hooker sequence is (1) dicotyledons, (2) gymnosperms, (3) monocotyledons; Engler's is (1) gymnosperms, (2) monocotyledons, (3) dicotyledons, while the right sequence appears now to be (1) gymnosperms, (2) dicotyledons, (3) monocotyledons.

This evidence has stimulated search for primitive angiosperms among the dicotyledons. According to one view, dicotyledons have arisen by the way of Gnetales to catkin-bearing trees, such as oak, the early dicotyledons being wind-pollinated, like the conifers. According to another view, forms like the fossil *Bennettites* gave rise to trees like magnolia; on this view the beginning of angiospermy is a response to insect pollination. It is not impossible that both of these lines may have been followed, in which case dicotyledons as a natural group would disappear. Herbaceous plants appear to have been derived from woody ancestors, following the coming of distinct seasonal changes on the earth.

The group Sympetalae seems likely later to be broken up to connect with various lower groups, some of the possible lines of connection being Caryophyllaceae—Gentianaceae, Cornaceae—Caprifoliaceae, Passifloraceae—Cucurbitaceae.

A general appearance of the great tree of plant evolution is thus gradually taking form, strongly supported in the case of vascular plants from fossil evidence. "The reconstruction of the pedigree of the vegetable kingdom," says Scott, "is a pious desire, which will certainly not be realized in our time."

Meanwhile must the confusion from an increasing multiplicity of systems in the various countries continue indefinitely? A complete natural system may indeed be distant, but for the progress of science, as well as for practical purposes, some degree of international uniformity is greatly to be desired.

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# LABRADOR TEA IN NEW JERSEY

By Kenneth K. Mackenzie.

On June 19, 1918, while going along the road at the northwesterly corner of Budd's Lake, I was joined by a resident of one of the houses along the road, Mr. M. E. Palmer. Conversation developed the fact that Mr. Palmer had made a business of collecting Sphagnum moss, and was well acquainted with a number of bogs in Morris County, New Jersey, and especially with the large one at the westerly end of Budd's Lake. Much to my satisfaction he joined me for the day, and under his guidance I got into the bog from the land side in several different places. There are some four or five separate open places on the westerly side of the lake which are separated from one another by small streams lined by very dense swampy thickets through which it is almost impossible to go. The easiest way of visiting the various open bogs is by way of a boat from the lake side, but it is possible to reach them all successively from the land side by obscure trails through the dense thickets. To get from one to the other, a person has however to go back each time a very considerable way from the lake margin in order to avoid the troublesome thickets above referred to.

This bog at Budd's Lake is by far the best open sphagnum bog which we have in northern New Jersey and contains in abundance a number of northern species which are either unknown in the State elsewhere or are very local. One of these local species is *Andromeda glaucophylla* Link., which is abundant in some of the openings. While looking at this Mr. Palmer asked me what