

**B.Sc. CORE COURSE X - PLANT SYSTEMATICS
UNIT - 4 : CLASSIFICATION**

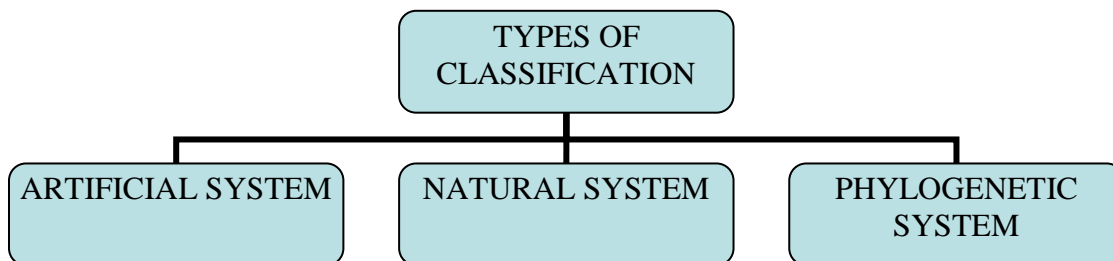
Classification is the arrangement of groups of plants with definite characters by position and rank according to artificial, natural or phylogenetic systems.

In its simplest form, classification is the placement of plants, animals and objects into groups and categories for a clear understanding, proper study and effective organization.

RANKS OR HIERRARCHIAL LEVELS OF PLANT CLASSIFICATION AND SUFFIXES PROVIDED TO EACH TAXA BY INTERNATIONAL CODE OF BOTANICAL NOMENCLATURE (ICBN)

RANK OR TAXA	SUBCATEGORIES	SUFFIXES
Division		-phyta
	Subdivision	-phytina
Class		-opsida
	Subclass	-idae
Order		-ales
	Suborder	-ineae
Family		-aceae
	Subfamily	-oideae
	Tribe	-eae
	Subtribe	-inae
Genus		
	Subgenus	
	Section	
	Subsection	
Species		
	Subspecies	
	Varieties	
	Subvarieties	
	Form	
	Subform	

TYPES OF SYSTEMS OF CLASSIFICATION

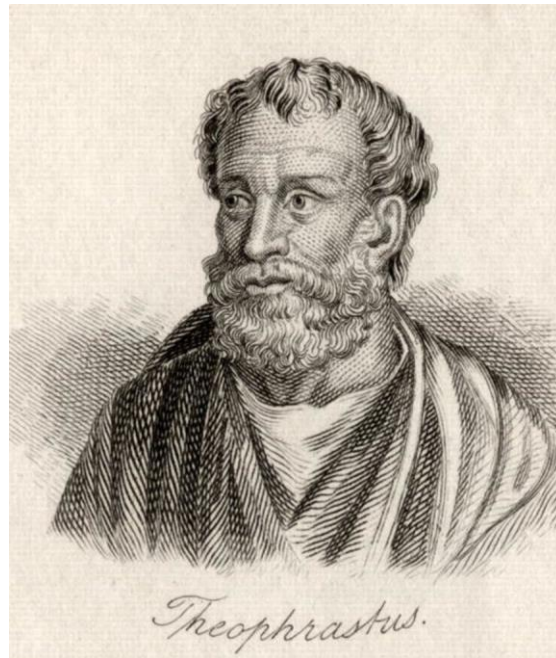


There are three basic categories of systems of classification:

1. **Artificial Classification:** In this system of classification only few characters of the plants are being considered, e.g., grouping of plants by habit (herbs, shrubs or trees) or importance to man (medicine, food) etc. There are many drawbacks in this system, plants closely resembling each other are often placed in widely separated groups, while those quite different from each other are being placed in the same group. This system is just like alphabetical arrangement of words in a dictionary, where two words arranged one after the other have nothing to do with each other. This system is not commonly in current use. Some examples of artificial system are the classifications proposed by Theophrastus (370-285 B.C.), Bauhin (1560-1624), Tournefort (1656-1708) and Linnaeus (1707-1778).
2. **Natural Classification:** In this system all the important characters of the plant are considered and they are classified according to their related affinities. Some examples of natural system are the classifications proposed by Adanson (1727-1806), A.P. de Candolle (1778-1841) and his son Alphonse (1806-1893), and Bentham (1800-1884) and Hooker (1817-1911).
3. **Phylogenetic Classification:** In this system as many as possible taxonomic characters are taken into consideration and the plants are classified according to their evolutionary and genetic affinities. But it is a bit difficult to classify plants perfectly on the basis of evolutionary tendencies due to imperfection of fossil records, and therefore, at present the plants are classified partly according to natural and partly according to phylogenetic basis. Some examples of phylogenetic system are the classifications proposed by Engler (1844-1930) and Prantl (1849-1893), Bessey (1845-1915), Hutchinson (1884-1972), Takhtajan (1910-2009), Cronquist (1919-1992).

Current system of classification: APG IV system of classification of flowering plants published in 2016, by Angiosperm Phylogeny Group, is the most advance or modern version of classification, is mostly based on molecular data.

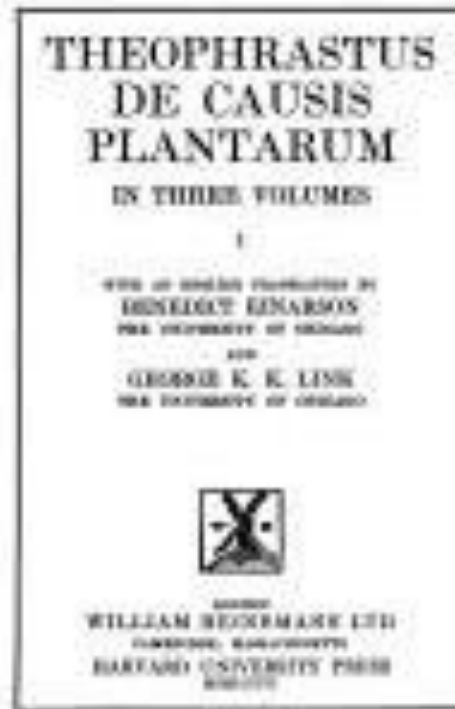
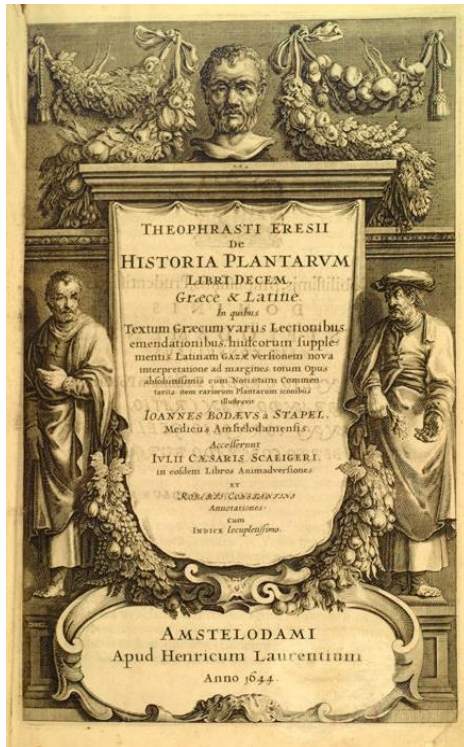
THEOPHRASTUS



Theophrastus (371-286 BC), a Greek native of Eresos in Lesbos is widely recognised as the founder of Botany and the co-founder, together with Aristotle, of the science of Biology. He was the greatest botanical writer of the distant past. Theophrastus studied at a young age in Plato's Academy in Athens where he was acquainted with Aristotle. It is suggested that since then (355 BC) the two friends and colleagues were never separated. They travelled to Assos, Lesbos, Macedonia (Pella, Mieza and Stagira) and returned to Athens in 335 BC, to found the Peripatetic School in Lyceum.

Theophrastus' botanical works are *HISTORIA PLANTARUM* (*ENQUIRY INTO PLANTS*) and *DE CAUSIS PLANTARUM* (*CAUSES OF PLANTS*). Some important features of his classification are:

- He classified the plants into four groups: herbs, subshrubs, shrubs and trees.
- He considered the trees to be highest evolved and herbs as primitive.
- He established fundamental differences between dicotyledons and monocotyledons.
- He also distinguished between annual, biennial and perennial plants.
- He noted the differences between centripetal (racemose) and centrifugal (cymose) inflorescences.
- He showed the differences between polypetalous and gamopetalous corolla.
- He noted the differences between superior and inferior ovary.
- He described nearly 500 plants in detail and certain names like, *Asparagus*, *Daucus* and *Narcissus* etc. are used even today.
- His classification was strictly artificial.



GASPARD BAUHIN



Gaspard Bauhin or Caspar Bauhin (1560-1624) was a Swiss botanist, physician and anatomist. He was the younger brother of Jean Bauhin (1541-1613), a physician and botanist, and son of Jean Bauhin (1511-1582), a French protestant physician and surgeon from Amiens, who sought refuge from religious persecution by settling in Basel in 1541 and became attached to the university. From childhood he was taught anatomy by his father and botany by his brother Jean – almost twenty year his senior – who became a botanist of some repute.

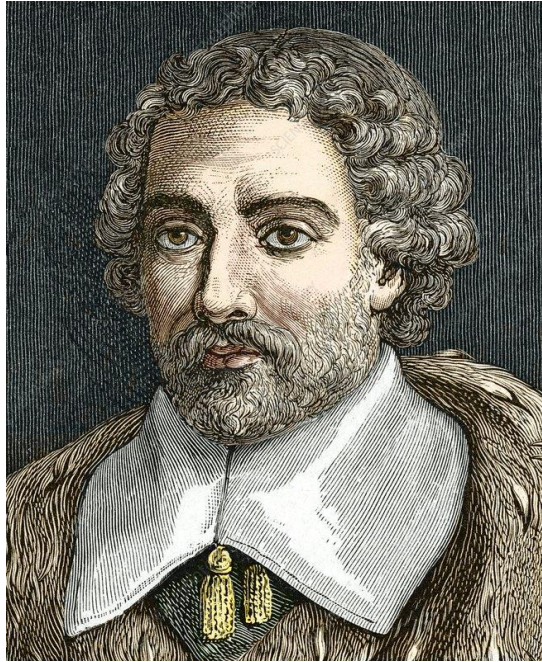
In 1572 Gaspard entered the University of Basel, where Felix Platter (1536-1614) and Theodor Zwinger the Elder (1533-1588) were among his teachers, studying botany besides anatomy/medicine. He received the degree of Bachelor of Philosophy in 1575, and conducted his first medical disputation in 1577. In 1580, he was admitted to the degree of doctor, and gave private lectures in botany and anatomy. In 1582 he was appointed to the Greek professorship in the University of Basel, and in 1588 to the chair of anatomy and botany. He was later made city physician, professor of the practice of medicine, rector of the university, and dean of his faculty.

The *Pinax theatri botanici* (English, *Illustrated exposition of plants*) is a landmark of botanical history, describing some 6,000 species and classifying them. The classification system was not particularly innovative, using traditional groups such as "trees", "shrubs", and "herbs", and using other characteristics such as utilization, for instance grouping spices into the *Aromata*. He did correctly group grasses, legumes, and several others. His most important contribution is in the description of genera and species. He introduced many names of genera that were later adopted by Linnaeus, and remain in use. For species he carefully pruned the descriptions down to as few words as possible; in many cases a single word sufficed as description, thus giving the appearance of a two-part name.

In addition to *Pinax Theatri Botanici*, Gaspard planned another work, a *Theatrum Botanicum*, meant to be comprised in twelve parts folio, of which he finished three; only one, however, was published (1658), long after his death. He also gave a copious catalogue of the plants growing in the environs of Basel, its *flora*, and edited the works of Pietro Andrea Mattioli (1500–1577) with considerable additions. His principal work on anatomy was *Theatrum Anatomicum infinitis locis auctum* (1592). Linnaeus honored the Bauhin brothers Gaspard and Jean in the genus name *Bauhinia*.



J.P. DE TOURNEFORT



Joseph Pitton de Tournefort (1656 - 1708) was a French botanist and physician, notable as the first to make a clear definition of the concept of genus for plants. The botanist Charles Plumier had been his pupil and accompanied him on his voyages.

Tournefort was born in Aix-en-Provence and studied at the Jesuit convent there. It was intended that he enter the Church, but the death of his father allowed him to follow his interest in botany. After two years collecting, he studied medicine at Montpellier, but was appointed professor of botany at the Jardin des Plantes in Paris in 1683. During this time he travelled through Western Europe, particularly the Pyrenees, where he made extensive collections.

Between 1700 and 1702 he travelled through the islands of Greece and visited Constantinople, the borders of the Black Sea, Armenia, and Georgia, collecting plants and undertaking other types of observations. He was accompanied by the German botanist Andreas Gundelsheimer (1668–1715) and the artist Claude Aubriet (1651–1742). His description of this journey was published posthumously (*Relation d'un voyage du Levant*), he himself having been killed by a carriage in Paris; the road on which he died now bears his name (Rue de Tournefort in the 5ème arrondissement).

Tournefort's principal work was the 1694 *Eléments de botanique, ou Méthode pour reconnaître les Plantes* (the Latin translation of it *Institutiones rei herbariae* was published twice in 1700 and 1719). The principal artist was Claude Aubriet who later became the principal artist at the Jardin des Plantes. The classification followed was completely artificial, and neglected some important divisions established by earlier botanists, such as John Ray's separation of the phanerogams from the cryptogams, and his division of the flowering plants into monocots and dicots. Overall it was a step backwards in systematics, yet the text was so clearly written and well structured, and

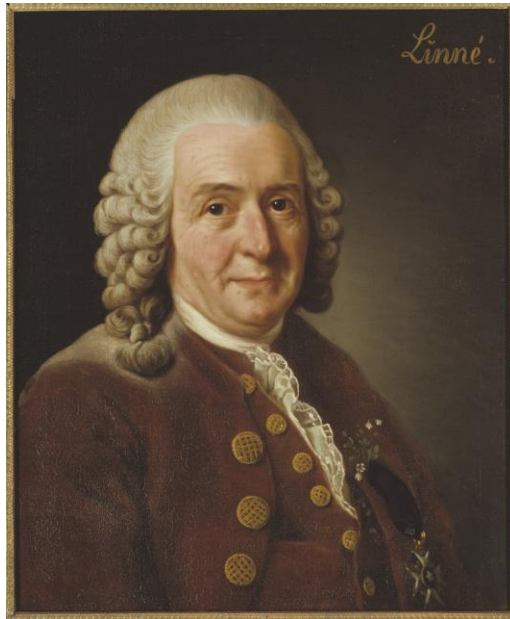
contained so much valuable information on individual species, that it became popular amongst botanists, and nearly all classifications published for the next fifty years were based upon it.

Tournefort is often credited with being the first to make a clear distinction between genus and species. Though he did indeed cluster the 7,000 plant species that he described into around 700 genera, this was not particularly original. Concepts of genus and species had been framed as early as the 16th century, and Kaspar Bauhin in particular consistently distinguished genera and species. Augustus Quirinus Rivinus had even advocated the use of binary nomenclature shortly before Tournefort's work was published.

The word "herbarium" also seems to have been an invention of Tournefort; previously herbaria had been called by a variety of names, such as *Hortus siccus*.

His herbarium collection of 6,963 specimens was housed in Paris, in Jardin du Roi. It is now part of the Muséum national d'histoire naturelle.

CARL LINNAEUS



Carl Linnaeus (1707 - 1778) or Carl von Linné, was a Swedish botanist, zoologist, and physician who formalized binomial nomenclature, the modern system of naming organisms. He is known as the "father of modern taxonomy". Many of his writings were in Latin, and his name is rendered in Latin as Carolus Linnaeus.

Linnaeus was born in the countryside of Småland in southern Sweden. He received most of his higher education at Uppsala University and began giving lectures in botany there in 1730. He lived abroad between 1735 and 1738, where he studied and also published the first edition of his *Systema Naturae* in the Netherlands. He then returned to Sweden where he became professor of medicine and botany at Uppsala. In the 1740s, he was sent on several journeys through Sweden to find and classify plants and animals. In the 1750s and 1760s, he continued to collect and classify animals, plants, and minerals, while publishing several volumes. He was one of the most acclaimed scientists in Europe at the time of his death. He is also considered as one of the founders of modern ecology.

In botany and zoology, the abbreviation L. is used to indicate Linnaeus as the authority for a species' name. In older publications, the abbreviation "Linn." is found.

The first edition of *Systema Naturae* was printed in the Netherlands in 1735. It was a twelve-page work. By the time it reached its 10th edition in 1758, it classified 4,400 species of animals and 7,700 species of plants. People from all over the world sent their specimens to Linnaeus to be included.

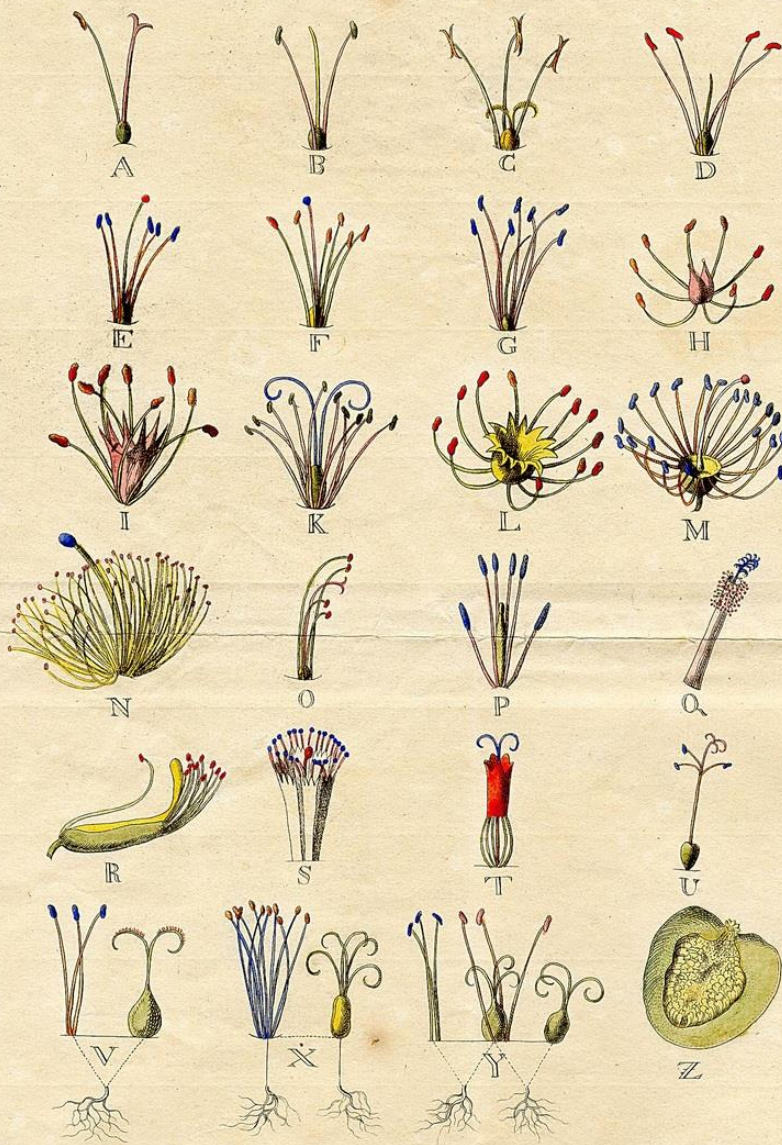
Linnaeus published *Species Plantarum*, the work which is now internationally accepted as the starting point of modern botanical nomenclature, in 1753. The book contained 1,200 pages and was published in two volumes; it described over 7,300 species.

Another important work of Linnaeus was, *Genera plantarum* was first published in 1737, delineating plant genera. Around 10 editions were published, not all of them by Linnaeus himself; the most important is the 1754 fifth edition. In it Linnaeus divided the plant Kingdom into 24 classes. This was an artificial sexual system of classification, in which plants were classified on the basis of number, cohesion, length and certain other characters of stamens. One, Cryptogamia, included all the plants with concealed reproductive parts (algae, fungi, mosses and liverworts and ferns).

The outline of the classes of his system was published in his *Systema Naturae* in 1735, and again in *Genera Plantarum* in 1737 along with all the known plants of that time arranged systematically. The outline of his classification is as follows:

- Classis 1. Monandria: flowers with 1 stamen
- Classis 2. Diandria: flowers with 2 stamens
- Classis 3. Triandria: flowers with 3 stamens
- Classis 4. Tetrandria: flowers with 4 stamens
- Classis 5. Pentandria: flowers with 5 stamens
- Classis 6. Hexandria: flowers with 6 stamens
- Classis 7. Heptandria: flowers with 7 stamens
- Classis 8. Octandria: flowers with 8 stamens
- Classis 9. Enneandria: flowers with 9 stamens
- Classis 10. Decandria: flowers with 10 stamens
- Classis 11. Dodecandria: flowers with 12 stamens
- Classis 12. Icosandria: flowers with 20 (or more) stamens, perigynous
- Classis 13. Polyandria: flowers with many stamens, inserted on the receptacle
- Classis 14. Didynamia: flowers with 4 stamens, 2 long and 2 short
- Classis 15. Tetradynamia: flowers with 6 stamens, 4 long and 2 short
- Classis 16. Monadelphia; flowers with the anthers separate, but the filaments united, at least at the base
- Classis 17. Diadelphia; flowers with the stamens united in two separate groups
- Classis 18. Polyadelphia; flowers with the stamens united in several separate groups
- Classis 19. Syngenesia; flowers with stamens united by their anthers
- Classis 20. Gynandria; flowers with the stamens united to the pistils
- Classis 21. Monoecia: monoecious plants
- Classis 22. Dioecia: dioecious plants
- Classis 23. Polygamia: polygamodioecious plants
- Classis 24. Cryptogamia: the "flowerless" plants, including ferns, fungi, algae, and bryophytes

Clariss: LINNÆI. M. D.
 METHODUS plantarum SEXUALIS
 in SISTEMATE NATURÆ
 descripta



- Monandria.*
- Diandria.*
- Triandria.*
- Tetrandria.*
- Pentandria.*
- Hexandria.*
- Heptandria.*
- Octandria.*
- Enneandria.*
- Decandria.*
- Dodecandria.*
- Scosandria.*
- Polyandria.*
- Didynamia.*
- Tetradynamia.*
- Monadelphica.*
- Diadelphica.*
- Polyadelphica.*
- Syngenesia.*
- Gynandria.*
- Monoccia.*
- Dioecia.*
- Polygamia.*
- Cryptogamia.*

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The merits and demerits of the Linnaeus system are:

Merit:

The only merit of this system is the quick and easy identification of plants based on one or a few characteristics.

Demerits:

1. The system is not at all sexual in proper sense, but based only on numerical relationship of sex organs. Thus, it can be said that this system was developed on differences rather than on similarities of sex organs.
2. The closely related members go apart and the distantly related members become very close to each other for the numerical relation of the sex organs.
3. The Gymnosperms were placed in the 14th class Didynamia along with Labiatae, an angiosperm family.
4. The Monocotyledons, Dicotyledons and Gymnosperms i.e., phanerogamic plants are not considered separately. Thus, the members of Dicotyledons and Monocotyledons become very close, e.g.,
 - i. In the 1st class Monandria (flower having 1 stamen) – Globba (Zingiberaceae of Monocotyledons) and Mangifera (Anacardiaceae of Dicotyledons).
 - ii. In the 6th class Hexandria (flowers having 6 stamens) -Alisma (Alismaceae of Monocotyledons) and Rumex (Polygonaceae of Dicotyledons) come very close. Many other examples are also available.

Benson (1957) made the comment that **“certainly it did not contribute anything directly to knowledge of plant relationships, but it did give a tremendous impetus to study of plant kingdom”**.

5. Thus it can be said that this classification is just like a dictionary where the words are arranged alphabetically without maintaining any relationship.