SYSTEMS OF CLASSIFICATION

INTRODUCTION

Man classified things, as good-bad, useful-useless, edible -non-edible etc. quite early, since he started living on earth. Science of classification originated with man and evolved with man. Plants are also classified by man. The arrangement of plants into groups and subgroups is commonly spoken of as classification. The object of classification is to arrange plants in such a way that, they will give a idea of sequence of their evolution.

A system of classification is a particular way of delimiting and arranging taxonomic groups. In other words, a system is a particular way of filling the empty categories of the taxonomic levels. In the history of taxonomic botany, numerous systems of classification have been proposed for the flowering plants. Some of these are followed in world herbaria and botanic gardens in arranging collected plants.

Classification is the assignment of like objects to recognizable groups. Basic biological studies were started in Greece. Some of the founders of biology were from Greece. They include Aristotle and Theophrastus. Aristotle (384-322 B.C.) was one of the greatest biologist who ever lived. **Theophrastus** continued Aristotles policies and we call him as "Father of Botany". He made his basic contributions to plant world. He classified plants as monocotyledons and dicotyledons. He also classed plants as Herbs, Shrubs and Trees. He also made classes of plants as Annuals, Biennials and Perennials. This is most oldest classifications of plants. **Albertus Magnus**, (1193-1280) agreed with work of Theophrastus for classifying plants into Dicotyledons and Monocotyledones on the basis of anatomical characters.

Carolus Linnaeus (1707 -1778) proposed novel ideas of plant classification. He is considered as "Father of Modern Taxonomy". He classified plants into 24 classes in ' Genera PlantarunV (1754) based on staminal characters. This system is called artificial system.

G. Bentham and J.D. Hooker, in 1883 published system of plants classification based on differences and similarities in plants and hence called as 'Natural system of classification'. Adolf Engler and K Prantl, presented 20 volume work with original descriptions of plants from algae to angiosperms, with keys for identifications. They have arranged plants on the basis of their

understanding on the process of evolution. According to them both dicotyledones and monocotyledones are developed independently from hypothetical extinct Gymnosperms. Hence this system is called Phylogenetic system of classification of plants.

SYSTEMS OF CLASSIFICATION

As already mentioned systems of classification are of three types -

Artificial Systems

The earliest systems of classification were artificial systems. The systems of this nature remained dominant from 300 B.C. -1830. Since little information was available at that time, these systems were based on one or few convenient characters.

According to the principle of this system, the plants are classified on the basis of readily observed or only few characters of plants. It does not takes into account affinities or relationship of plants with one another. Because of this closely related plants being placed in different groups due to presence or absence of a particular character.

Examples -

i) **Theophrastus** (370 - 287 B. C.) who is called as "Father of Botany". He classified plants on the basis of habit into-herbs, under shrubs, shrubs and trees.

ii) **Andrea Caesalpino** (1519-1603) - He classified plants into two major groups on the basis of habit into woody and herbaceous plants. He also recognized the characters of fruit, seed and embryo in further grouping of plants.

iii) **Carl Linnaeus** (1707-1778) Also known as Carl Von Linne. Linnaeus contributed towards most popular system of eighteenth century. Linnaeus was born on 23rd May 1707 in Rashult (South Sweden) as son of a Swedish Clergyman. In 1727 he joined University of Lund to study medicine and University of Uppsala in 1728.

In 1729, he published his first research paper on sexuality of plants. **Systema Naturae** in 1735. Then he was appointed as personal physician to a wealthy banker George Clifford. Linnaeus was first to use consistently the "Binomial nomenclature' in his publication 'Species Plantarum' (1753). He gave scientific names to several plants. Artificial sexual system proposed by Linnaeus is based on characters of reproductive organs. He classified entire plant kingdom

into 24 classes on the basis of number, length, union and other characters of stamens and cerpels in **Genera Plantarum** (1737). In 1738 he also published **"Classes plantarum". As** per this system First 23 classes cover flowering plants and last 24th class includes Algae, Fungi, Bryophytes and Pteridophytes.

Class 1 - Monandria - flowers having one stamen Ex.**Lemna, Scirpus**.

Class 2 - Diandria - Flowers having two stamens Ex. **Salvia, Veronica**.

Class 3 - Triandria- Flowers having three stamens Ex. Iris, Grasses

Class 4 - Tetrandria - Flowers having four stamens Ex. **Mentha, Ulmus, Cornus**

Class 5- Pentandria - Flowers having five stamens Ex. **Primula, Myosotis, Ipomoea**

Class 6 - Hexandria - Flowers having six stamens Ex. **Rumex, Berberis, Alisma**

Class 7 - Heptandria – Flowers having seven stamens Ex. **Eesculus**

Class 8 - Octandria – Flowers having eight stamens Ex. **Fagopyrum**

Class 9 - Enneandria – Flowers having nine stamens Ex. **Rheum**, **Ranunculus**.

Class 10- Decandria -Flower having ten stamens Ex. *Acer*, **Kalmia**, **Oxalis**

Class 11- Dodecandria. Flowers having eleven to nineteen stamens. Ex. **Euphorbia**, **Calla**

Class 12- Icosandria - Flowers having stamens more than twenty, attached to sepals. Ex. **Rosa**, **Rubus**.

Class 13- Polyandria - Flowers having stamens more than twenty attached to the receptacle.Ex. **Tilia**, **Nymphaea**.

Class 14- Didynamia - Flowers having 2 long and 2 short stamens attached to petals. Ex. **Linaria**, **Ocimum**.

Class 15- Tetradynamia - Flowers having Six stamens of which 4 are long and 2 are short.Ex. **Brassica**,

Class 16- Monadelphia - Flowers having stamens united by filaments to form single bundle.eg. **Hibiscus**

Class 17- Diadelphia - Flowers having stamens in two bundles. Ex. **Clitoria**, *Pea*.

Class 18- Polyadelphia-flowers having stamens in more than two bundles. Ex. **Bombax**, **Hypericum**

Class 19- Syngenesia - Flowers with stamens attached by anther lobes and filaments are free and epipetalous i.e. Syngeneseous. Ex. **Helianthus**, **Lobelia**

Class 20- Gynandria- Flowers with stamens attached to gynoecium. Ex. **Calotdropis**, **Aristolochia**

Class 21 - Monoecia. Flowers are unisexual, and developed on the same plant - (i.e. male and female flower on the same plant.)Ex. **Typha**, **Thuja**, **Coccinia**.

Class 22- Dioecia - Flower are unisexual and develop on different plants, (i.e. male and female plants are separate) Ex. **Salix**, **Cycas**.

Class 23- Polygamia - male or female and bisexual flowers developed on same plant. Ex. Mango, **Sapindus**

Class 24- Cryptogamia - non flowering plants (Reproductive structures concealed) Ex. Algae, Fungi, Bryophytes, Pteridophytes.

Linnaeus's system of plant classification was in use for about 7 decades. It was then replaced by deJussieu and Candolle.

Merits and Limitations of Artificial system:

Merits of artificial system -

i) Identifications can be made easy.

ii) Poorly known plants may be definitely placed.

iii) It is most stable system and is not changed by increase in our knowledge.

Limitations of artificial system -

1) Plants having like hereditory constitution placed in different groups.
2) It gives limited information about plant members.
3) Phylogenetically closely related plants are kept far away from one another.
4) This system has little or no predictive value.
5) This system is based on differences rather than similarities.
6) Affinities and relationships among the taxa have not been considered.
7) Gymnosperms have been placed in **Didyon** with angiosperms

NATURAL SYSTEM

With increasing knowledge of world flora taxonomists realised that there were natural affinities between plants. It has helped in the development ol "natural systems" in the later part of

eighteenth century. Michel Adanson (1727-1806), French botanist was first to give "Natural system of clasification." In 1763, he arranged genera in 58 families.

The natural systems are not based only on the characters of reproductive organs but it also takes into account other details of the plant. All the plants then are classified according to their related characters. Thus when plants are classified by sum total of characters of its members the system is known as natural system.

Merits of natural system -

i) It groups plants most alike in their genetic constitutions.

ii) Phylogenetically closely related plants are kept in one group,

iii) It contains a great deal of information about its members and has high predictive value.

Limitations of natural system –

i) Identification of plants may become difficult

ii) With increase in knowledge, the system is liable to change.

Examples:

Benthnam and Hooker's system-

The best and highly recognised natural system of classification was proposed by George Bentham (1800-1884) and Joseph Dalton Hooker (1817-1911). "Genera Plantarum published in Latin gives this system.

George Bentham (1800-1884) was English fellow. Bentham was most critical and analytical systematist. He was expert linguist and Latinist. He published world monographs of families Labiatae, Ericaceae, Polygonaceae, Scrophulariaceae and Polygonaceae. He was author of a 7 volume **Flora of Australia**.

Sir Joseph Dalton Hooker (1817-1911), was son of the botanist Sir William J. Hooker. J.D. Hooker was Director of Kew Gardens, England. He was more plant explorer and plant geographer and then he become brilliant systematist among European taxonomists. Sir J.D. Hooker visited India and published **"Flora of British India"** in 7 volumes. Bentham and Hooker's system, in table give idea of Bentham and Hookers work.

Group	Families	Genera	Species

Dicots			
Polypetalae	82	2,610	31,874
Gamopetalae	45	2,619	34,556
Monochlamydeae	36	801	11,784
Gynmosperms	3	44	415
Monocots	34	1,495	18,576
Total	200	7,569	97,205

Around 1857, Bentham and Hooker agreed to produce jointly a **'Genera Plantarum'** (1862-1883). It lists 97,205 specimens originally described, latinized with personal observations. About two third of work was done by Bentham, a great task which has required period of nearly 25 years of concentrated effort. They divided plant kingdom into two sub kingdoms. Cryptogamia (flowerless plants and reproduce by spores). They were further subdivided into Thallophyta Bryophyta and Pteridophyta, Phanerogamia / Spermatophyta (seed bearing plants or flowering plants.) These were further divided into two divisions : i) Gymnospermia, ii) Angiospermia, which were further divided into two classes-Dicotyledones and Monocotyledones. Class Dicotyledones was further divided into three subclasses -Polypetalae, Gamopetalae and Apetalae/Monochlamydeae was further subdivided into series.Monocotyledons were directly divided into seven series.

Genera Plantarum, includes names, descriptions and classification of all the seed plants known at that time (97,205 species) arranged according to Bentham and Hooker's system. It was actually extension of de Candolle s work with many differences also, (de Candolle was a close friend of Bentham). They divided large genera into subgenera and sections. The term family of modern systematist was designated as 'order' was named as ' cohort' or' cohor'. All the seed plants were classified into 3 classes, 3 subclasses, 21 series, 25 cohorts and 202 orders. The Gymnosperm were treated as third taxon, collateral with and placed between dicotyledones and monocotyledones.

The system is based on overall similarities and differences. Certain orders named by them are anomalous orders (ordines anomali) which could not be placed by them in any cohort. This

shows that Bentham and Hooker tried to represent a natural system of classification. This system was accepted throughout British Empire, U.S.A. and by some continental botanists. In India most of the Herbaria follow this system.

In this system first cohort is Ranales. Except some drawbacks this is a greatest contribution to the Systematic Botany.' Charles Darwin was a close friend of Hooker. Hooker was inclined to reorganize the whole system but was objected by Bentham. He has not accepted the essentials of Darwin's work. Following is the synopsis of Bentham and Hookers system upto families which are in syllabus.

Merits -

1) It is a masterpiece work of 25 years of concentrated efforts on the systematic botany. Instead of replacing the system it must be elaborated.

2) The placing of Ranales at the begining of system is very reasonable.

3) This is the first natural system of classification. It is easy to follow and very useful for practical purposes.

4) Though this system is not phylogenetic many arrangements in this system match with recent phylogenetic system e.g. Dicots are followed by monocots which is correct from phylogenetic point of view, as monocots are evolved from dicots.

5) ***Discifilorae*** placed in between ***Thalamiflorae*** and ***Calyciflorae*** is very reasonable.

6)System is based on careful, first hand information and keys given are very useful.

7) ***Ordines anomali*** is group of families wherein families with disputed position were included.

Limitations -

1) Great drawback of this system is placing of Gymnospermae in between Dicots and Monocots. Proper consideration is not given to the affinities among these groups.

2) Monochlamydeae is not well defined group, families of which can be related to subclass polypetalae and gamopetalae e.g. Podostemaceae is close to Resales of Calyciflorae.

3) Sometimes arbitrary characters are selected because of which closely related orders are widely separated.

4) Arrangement of monocots is unnatural, e.g. Liliaceae and Amaryllidaceae are set apart from each other on the basis of position of ovary, other wise these two families are

closely related.

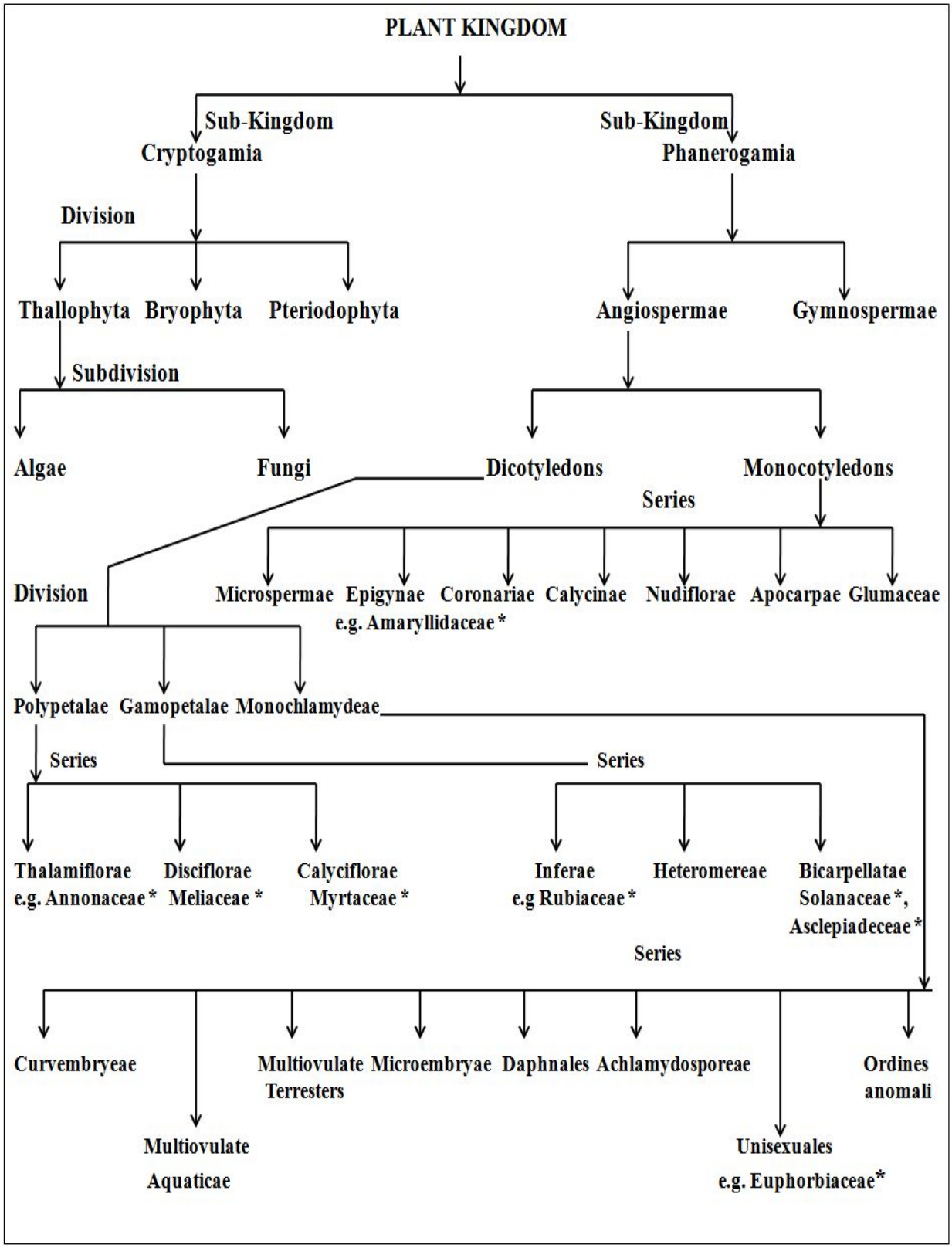
5) Orchidaceae and Scitamineae are considered primitive while Cyperaceae and Gramineae more advanced, which is incorrect.

6) Some important floral characters are neglected and it is based on the belief of fixity of species.

PHYLOGENETIC SYSTEMS

Darwin's theory of evolution and origin of species coincided with Bentham and Hooker's work. Hooker was ready to do change accordingly but Bentham was not convinced. Later after 10 years Bentham accepted Darwin's views but it was too late and Bentham and Hooker's system

Broad Outline of the Classification proposed by Bentham and Hooker



remained as "**Natural system**" and could not called "**phylogenetic system**".

Phylogenetic systems are post - Darwinian systems. New age of Phylogenetic system started after acceptance of Darwin's theory of organic evolution in 1859. Earlier systems were based on stability and fixity of the individuals.

eg. Engler and Prantls system -

Heinrich Gustav Adolf Engler (1844-1930) Prof of Botany at Berlin University with his associate Karl Anton Prantl (1849-1893) classified plant kingdom in their Die

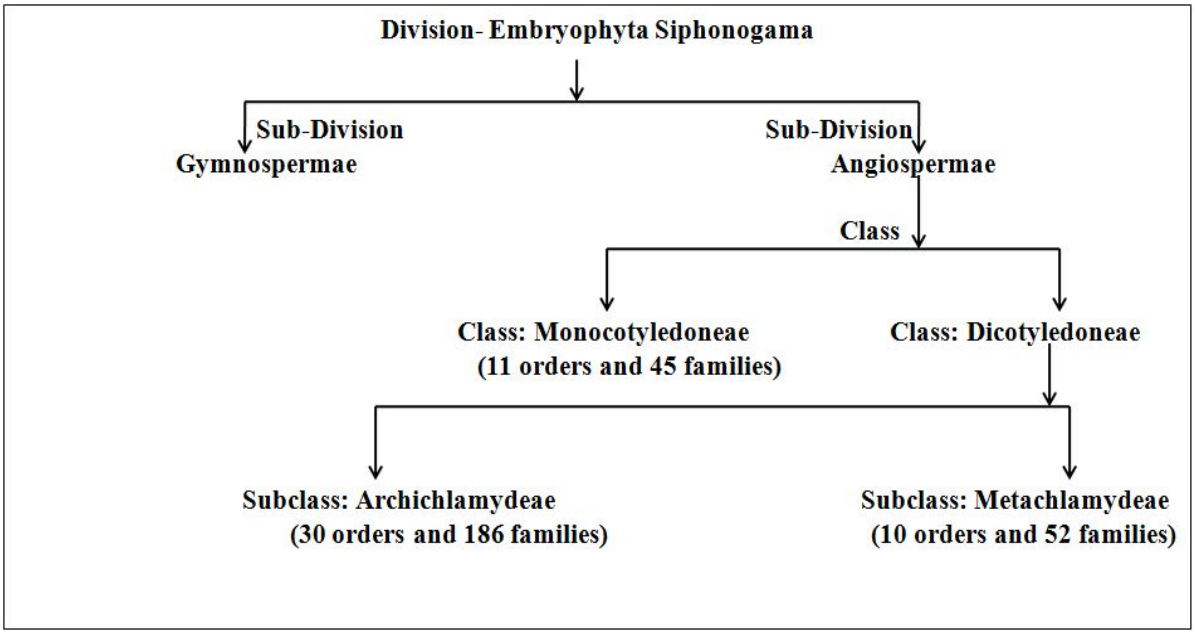
Naturlichen Pflanzenfamilien (1887 - 1915). This is monumental work in Taxonomy published in 23 volumes in German. They divided entire plant kingdom into 14 divisions. The first division is Schizophyta and last division is Embryophyta Siphonogamia or seed plants. According to evolution thus bacteria (Schizophyta), then myxomycetes, algae (flagellated first) then fungi (Eumycetes) as 12^{th} division, 13^{th} division was Archegoniatae or Embryophyta Asiphonogama which includes Bryophyta and Pteridophyta as two subdivisions and 14^{th} division Embryophyta -Siphonogamia which includes two subdivisions **Gymnospermae** and **Angiospermae**.

In this system the monocots are placed before Dicots. Orchids are considered to be more evolved than grasses. Thay recognized 300 families of flowering plants including those of gymnosperms. They divided dicots into two subclasses first, with sub class Archichlamydeae (33 orders) and Metachlamydeae/ Sympetalae (11 orders). Thus this is first exhaustive system of classification which has taken phylogenetical char -acters, summarized embryological, morphological, anatomical characters of families.

Thus Engler and Prantl's system is made up of 2 classes, 2 subclasses, 55 orders and 300 families. Engler and Prantl's system was based on Eichler's system. Angiosperms are arranged according to their increasing complexity of reproductive structure in this system.

These families are arranged according to the increasing complexicity of the flower. Naked flowers, which possess a bract like perianth are considered most primitive while the flower with calyx and corolla are more advanced. The fusion of petals is evolved stage. Casurinaceae is most primitive in Dicots and Compositae is most advanced.

Outline of Engler and Prantl's System



Merits:-

1) They proposed broad description of whole plant kingdom on the basis of phylogenetic characters
2) The system is most convenient, well known and accepted by many experts.
3) The gymnosperms have given separate status before angioseperms.
4) The placing and construction of archichlamydeae is most acceptable.
5) Orchids are more advanced than grasses is most correct.
6) The system is more illustrious with exhaustive keys, summary of embryology. Morphology, anatomy and geographical distribution also.

Limitations: -

1) Engler and Prantl's system consider of monocots are more primitive than dicots which is not acceptable as per present knowledge.
2) The derivation bisexual from unisexual flower is unsatisfactory.
3) The position of Amentiferae and Centrospermae at the beginning of dicots before Ranales is unsatisfactory.

4) Angiosperms have polyphyletic origin from an unknown hypothetical taxon of extinct gymnosperms.
5) The acceptance of the derivative of dichlamydous flowers from monochlamydous ones is objectionable.