Plant systematics / Taxonomy

Taxonomy - Science of classification of organism according to their resemblances and difference is called taxonomy.

Systematics - study of diversity of plants and their identification, naming, classification, evolution.

Taxonomy - arrangement by rules

→ coined by French botanist A.P de Candolle in 1813 in his book Theorie Elementaire de la Botaniave!

phylogenetic - diversification of a species.

→ A systematics is a student, researcher and schalar who studies, classifies, identifies, describes, observe, synthesize or analyze the variations within the population, species and higher taxa.

Nomenclature - A simple system under which the individual taxonomic groups of plant are scientifically named.

ex:- Abelmoschus esculentus

Theophrastus - "grandfather of Modern botany"

He classified plants into 3 groups :- herbs, shrubs, trees

Herb - Any seed-bearing plant which does not have woody stem and lies down to the ground after flowering.

ex:- mint, coriander, grass, rice, maize

Shrubs - A woody plant which is smaller than a tree and has several main stems arising at or near the ground.

ex:- tulsi, lemon, pomegranate

Trees - A perennial with elongated stem and trunk.

Some Scientist of Plant taxonomy

i) John Ray - methodus Plantarum Nova, Historia Plantarum

ii) Carl Linnaeus - modern system of nomenclature

John Hutchinson - British botanist
Publishe "the families of flowering plant"
(1884 - 1972)

ICBN -

Division / phylum
class -
order - ales
family - ceae
Genus. ____ } italics
Species ____ }

ex:-

Some Journals

i) Botanical Society of Bengal
ii) Royal Botanic Garden, Kolkata
iii) BSI, Howrah

Ranks of plant classification

several species are included within a genus, several genus within a family, several families within an order, several orders within a class and several class are included within a division.

1.3 OBJECTIVES, GOALS AND AIMS OF PLANT SYSTEMATICS

1.3.1 Objectives

1. To prepare a scheme of classification that provides phenetic, natural or phylogenetic relationships among plants.
2. To establish a suitable method for identification, nomenclature and description of plant taxa.
3. To provide an inventory of plant taxa that suits local, regional, and continental needs.
4. To create an understanding of the evolutionary processes.
5. To train the students of plant sciences in regard to the diversity of organisms and their relationship with other biological branches.

1.3.3 Aims for the Study of Regional Flora

1. To know how to collect specimens.
2. To know how to prepare specimens for future preservation.
3. To know how a manual should be used.
4. To know how to use identification keys.
5. To recognize divisions, classes, orders, families, genera, and species.
6. To know how the plants are described.
7. To know how the diversity in species may be related with the regional habitat diversity.
8. To become familiar with the basic taxonomic principles, and with at least one system of plant classification.

Table 2.1 ◆ Chronology of the major published taxonomic works of India

Year A.D.	Researcher/Explorer	Major published/botanical work
1565	Garcia d'Orta	Published *Os Colquios in Goa*; described common Indian medicinal plants.
1578	C. Acosta	Published *Tractado de las Drogas*
1670	Heinrich van Rheede	Published *Hortus Malabaricus*
1728–1785	John Gerard Koenig	Formed society called "*The United Brothers*" in order to promote and study Indian plants
1746–1793	Robert Kyd	Founded Botanical Gardens of Calcutta
1751–1815	William Roxburgh	Published *Flora Indica* and *Plantae Coromandelianus*; prepared 2382 coloured drawings of Indian plants; popularly called *Linnaeus of India*
1817	Nathaniel Wallich	Published *Plantae Asiaticae Rariores*
1824	J.F. Watson	Published *Flora of Kumaon*
1833	J.F. Royle	*Flora of Kashmir*
1839	J. Grahm	*Flora of Bombay*
1840	J.W. Masters	*Flora of Calcutta*
1844	W. Munro	*Flora of Agra*
1857	J. Long	*Flora of Bengal*
1859	W. Elliot	*Flora of Andhra*
1859	T. Anderson	*Flora of Lucknow*
1869	J.L. Stewart	*Flora of Punjab*
1872–1897	J.D. Hooker	*Flora of British India* published in the form of seven volumes
1887	George King	Started the publication of the journal *The Annals of the Royal Botanic Garden*
1890	George King	Established Botanical Survey of India
1901–1908	T. Cooke	*Flora of Presidency of Bombay*
1902	H. Collett	*Flora Simlensis*

(Contd.)

1903	D. Prain	*Bengal Plants*
1903–1922	J.F. Duthie	*Flora of Upper Gangetic Plains and the Adjacent Siwaliks and Sub-Himalayan Tract*
1908	T.F. Bourdillon	*The Forest Trees of Travancore*
1910	H.H. Haines	*A Forest Flora of Chota Nagpur*
1915–1936	J.S. Gamble and C.E.C. Fisher	*Flora of Presidency of Madras*
1921	K. Rangacharier	*A Handbook of South Indian Grasses*
1921–1925	H.H. Haines	*The Botany of Bihar and Orissa*
1923	C.E. Parkinson	*Forest Flora of Andaman Islands*
1929	P.V. Mayurnathan	*The Flowering Plants of Madras City and its Immediate Neighbourhood*
1929	E. Blatter and W.S. Millard	*Beautiful Indian Trees*
1932	P.F. Fyson	*The Flora of South Indian Hill Stations*
1932–1940	V. Kanjilal	*Flora of Assam*
1940	N.L. Bor	*Common Grasses of United Provinces*
1949	R.L. Bahadur and S. Ghosh	*Poisonous Plants of India*
1953	S.P. Agahakar	*Medicinal Plants*
1960	B.P. Pal	*Beautiful Climbers of India*
1962	H. Santapau	*The Flora of Saurastra*
1962	K. Subramanian	*Aquatic Angiosperms*
1964	P. Maheshwari and U. Singh	*Dictionary of Economic Plants in India*
1964	G.S. Puri *et al.*	*Flora of Rajasthan*
1965	M.S. Randhawa	*Flowering Trees*
1965	J.K. Maheshwari	*Illustrated Flora of Delhi*
1966	B.P. Pal	*The Roses in India*
1966	V.D. Vartak	*Enumeration of Plants from Gomantak (Goa)*
1968	R.K. Gupta	*Flora Nainitalensis*
1968	R. N. Chopra and S.L. Nayyar	*Glossary of Indian Medicinal Plants*
1968	S.L. Jindal	*Ornamental Bulbous Plants*
1973	S.V. Ramaswamy and B.A. Raji	*Flora of Bangalore District*
1973	Santapau and Henry	*Dictionary of Flowering Plants in India*
1974	B.P. Pal and Vishnuswarup	*Bougainvilleas*
1975	M.B. Raizada	*Supplement to the Duthie's Flora of Upper Gangetic Plains*
1975	M.A. Rau	*High Altitude Flowering Plants of Western Himalayas*
1976	T.N. Srivastava	*Flora Gorakhporensis*
1976	C.J. Saldanah and D.H. Nicolson	*Flora of Hasan District, Karnataka*
1976	R. Rao	*Flowering Plants of Travancore*
1977	M.M. Bhandari	*Flora of Rajasthan Desert*

(*Contd.*)

3.3 TYPES OF SYSTEMS OF CLASSIFICATION

The past taxonomic literature described three basic categories of systems of classification viz. *artificial systems, natural systems* and *phylogenetic systems.* But Radford (1986) has described following four types of the systems of classification:

1. *Artificial Classifications* These systems use the habit and importance to man as the taxonomic characters. Some advocates of artificial systems of classifications were Theophrastus (370–285 B.C.), Secundus (23–79 A.D.), Dioscorides (62–128 A.D.), Magnus (1200–1280

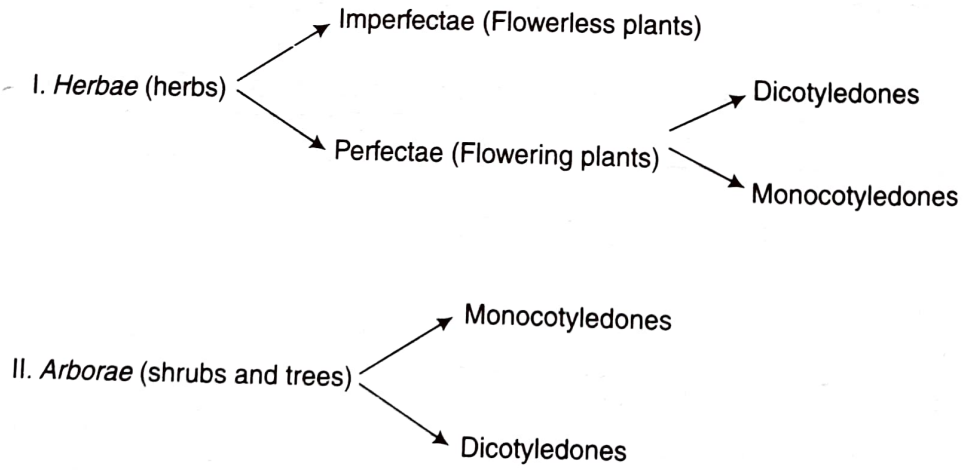
A.D.), Brunfels (1464–1534), Bock (1489–1554) and Fuchs (1501–1566). Details of the wor of these workers are mentioned in Chapter 2 (Articles No. 2.1.2–2.1.4).

2. *Mechanical Classifications* These systems used one or a few selected taxonomic characte to group taxa. Some mechanical classifications were given by Caesalpino (1519–1603), Bauh (1560–1624), Ray (1627–1705), Tournefort (1656–1708) and Linnaeus (1707–1778). Details the works of these workers are mentioned in Chapter 2 (Articles No. 2.1.5 and 2.1.6).
3. *Natural Classifications* These systems of classifications used as many taxonomic chara ters as possible to group taxa. Some of the natural systems of classification were given Adanson (1727–1806), A.L. de Jussieu (1748–1836) and his three family members (Antoin Bernard, and Joseph), A.P. de Candolle (1778–1841) and his son Alphonse (1806–1893), a Bentham (1800–1884) and Hooker (1817–1911). Some details of the works of these worke are mentioned in Chapter 2 (Article No. 2.1.7).
4. *Phylogenetic Classifications* These systems of classification used as many taxonom characters as possible in addition to the phylogenetic (evolutionary) interpretations. Som of the phylogenetic systems of classification were proposed by Eichler (1839–1889), Engl (1844–1930) and Prantl (1849–1893), Bessey (1845–1915), Wettstein (1862–1931), Hallie (1868–1938), Hutchinson (1884–1972), Takhtajan (1980), Cronquist (1981), Dahlgren (198 and Thorne (1983). Some historical details of the works of these workers are mentioned i Chapter 2 (Articles No. 2.1.8 and 2.1.9).

3.4 SOME IMPORTANT SYSTEMS OF CLASSIFICATION

3.4.1 John Ray (1627–1725)

An English biologist, John Ray[1] treated over 18,000 species in the last edition of his book *Methodu Plantarum Nova* published in 1703. He developed a classification system on the basis of the form relationships by grouping together the plants that resembled one another. Ray was the first to divide herbs, shrubs and trees into Dicotyledons and Monocotyledons on the basis of the presence of two or one cotyledons. Broadly, he divided the plants as under:



[1] For historical details, see Chapter 2 (Article No. 2.1.5).

3.4.2 Carl Linnaeus[1] (1707–1778)

Linnaeus,[2] the *father of taxonomy* and creator of binomial system of nomenclature is considered as "the most prodigious systematist of all times" (Lawrence, 1951). He was born on May 23, 1707 in Rashult, southern Sweden.

In 1727, at the age of twenty, Linnaeus entered the University of Lund to study medicine. In 1728 he was transferred to the University of Uppasala, and published his first research paper on sexuality of plants in 1729. In 1737 he received M.D. degree from the University of Harderwijk of Netherlands. In Netherlands, he became the personal physician of a wealthy banker George Clifford. Clifford was interested in plants. Linnaeus remained for three years in Netherlands, travelled extensively through Europe, and collected plants. These three years were the most creative years of his life. In 1741, he returned to Sweden, became the Professor of botany and medicine at the University of Uppasala, and continued in the same position till his death on January 10, 1778.

Linnaeus was so popular as a teacher that his classes on field trips were attended often by 200 or more students. He was buried in the Cathedral at Uppasala "unshaven, unwashed, unclad, enveloped with a sheet" as per his own wish and request.

Three universally known works of Linnaeus are the *Systema Naturae* published in 1735, which contains the outline of his system of classification; *Genera Plantarum* published in 1737 that contains the description of several genera; and *Species Plantarum* published in 1753 in two volumes, which contains his detailed views on plant identification and description of species.

Plant collections of Linnaeus were sold by his wife in 1783 to J.E. Smith, a British botanist, who was one of the founders of Linnean Society of London. The entire plant collection is now housed in the office of the Linnean Society in Burlington House, Piccadilly, London.

The Linnaeus's system of classification is an artificial sexual system. However, Radford (1986) described it as a mechanical system of classification. Linnaeus divided plants into 24 classes, mainly on the bases of number, union, and length of stamens. The classes were divided into orders. On the basis of the number of stamens in each flower Linnaeus placed all algae, fungi, mosses and ferns under one class Cryptogamia.

All the 24 classes of the classification of Linnaeus are undermentioned:

1. *Monandria* (with 1 stamen), e.g. *Scirpus.*
2. *Diandria* (with 2 stamens), e.g. *Veronica.*
3. *Triandria* (with 3 stamens), e.g. *Iris.*
4. *Tetrandria* (with 4 stamens), e.g. *Ulmus, Mentha.*
5. *Pentandria* (with 5 stamens), e.g. *Primula.*
6. *Hexandria* (with 6 stamens), e.g. *Berberis, Rumex.*
7. *Heptandria* (with 7 stamens), e.g. *Aesculus.*

8. *Octandria* (with 8 stamens), e.g. *Fagopyrum.*
9. *Enneandria* (with 9 stamens), e.g. *Ranunculus.*
10. *Decandria* (with 10 stamens), e.g. *Acer.*
11. *Dodecandria* (with 11–19 stamens), e.g. *Euphorbia.*
12. *Icasandria* (with 20 or more stamens, episepalous), e.g. *Rosa.*
13. *Polyandria* (with 20 or more stamens, attached to axis), e.g. *Papaver.*
14. *Didynamia* (stamens didynamous), e.g. *Linnaea.*
15. *Tetradynamia* (stamens tetradynamous), e.g. Cruciferae.
16. *Monadelphia* (stamens monadelphous), e.g. Malvaceae.
17. *Diadelphia* (stamens diadelphous), e.g. *Trifolia.*
18. *Polyadelphia* (stamens polyadelphous), e.g. *Hypericum.*
19. *Syngenesia* (syngenesious condition), e.g. Compositae.
20. *Gynandria* (stamens adnate to gynoecium), e.g. Orchidaceae.
21. *Monoecia* (plants monoecious), e.g. *Typha.*
22. *Dioecia* (plants dioecious), e.g. *Salix, Urtica.*
23. *Polygamia* (plants polygamous), e.g. *Empetrum.*
24. *Cryptogamia* (flowers concealed), e.g. algae, fungi, mosses, ferns.

The classification system of Linnaeus dominated the botanical scene for over seven decades and was replaced by natural classification systems of A.L. de Jussieu and A.P. de Candolle based on form relationships.

3.4.3 Antoine-Laurent de Jussieu (1748–1836)[1]

A natural system of classification was proposed by A.L. de Jussieu in 1789 in his *Genera Plantarum Secundus Ordines Naturales Disposita.* He recognized one hundred *orders* of the plants which are now called *families.* He divided the plants into three main groups, i.e. Acotyledones, Monocotyledones and Dicotyledones. He mainly emphasized on the number of cotyledons and their presence or absence, number of petals and their presence or absence, and position of stamens. This system firmly established the philosophy of the natural system among the botanical community. All the hundred *orders* (now called *families*) were arranged by A.L. de Jussieu into following 15 classes:

Groups *Class*

1. *Acotyledones* (plants without cotyledons, i.e. algae, fungi, mosses, etc.) I
2. *Monocotyledones* (plants with one cotyledon)
   - Stamina hypogyna (stamens hypogynous) II
   - Stamina perigyna (stamens perigynous) III
   - Stamina epigyna (stamens epigynous) IV
3. *Dicotyledones* (plants with two cotyledons)
   - Stamina hypogyna (stamens hypogynous) V

[1] For historical details see Chapter 2 (Article No. 2.1.7).

3.4.4 Augustin Pyramus de Candolle (1778–1841)[1]

One more natural system of classification was proposed by A.P. de Candolle in 1813 in his book *Theorie Elementaire de la Botanique*. He divided plants into two major groups i.e. Cellulares (non-vascular plants), and Vasculares (vascular plants). In his another work, *Prodromus*, he described all the species of the vascular plants known to the world then. In this work he described 58,000 species of dicotyledons belonging to 161 families.

A brief outline of his plan is undermentioned:

1. *Vasculares* (plants with vascular bundles)

Class 1. Exogenae (Dicotyledoneae: vascular bundles in ring; 2 cotyledons)

(A) Diplochlamydeae (both calyx and corolla present)

(a) Thalamiflorae (polypetalous, hypogynous)—Orders 1–46.

(b) Caliciflorae (perigynous or epigynous)—Orders 47–84.

(c) Corolliflorae (gamopetalous and hypogynous)—Orders 85–108.

(B) Monochlamydeae (only calyx present)—Orders 109–128.

Class 2. Endogenae (Monocotyledoneae; vascular bundles scattered; cotyledon one)

(A) Phanerogamae (flowers present)—Orders 129–150.

(B) Cryptogamae (flowers absent or hidden)—Orders 151–155.

2. *Cellulares* (Plants without vascular bundles or cotyledons)

Class 1. Foliaceae (leafy and sexual)—Orders 156–157.

Class 2. Aphyllae (nonleafy and without known sexes)—Orders 158–161.

The system of A.P. de Candolle was easy and simple, and surpassed all other systems. But its major drawback was the inclusion of vascular cryptogams among the monocots.

3.4.5 George Bentham (1800–1884) and Joseph Dalton Hooker (1817–1911)

The most accepted natural system of classification was proposed by Bentham and Hooker in their *Genera Plantarum* published during July 1862 and April 1883. Bentham, a self-trained British botanist, and Hooker, the Director of the Royal Botanic Gardens, Kew (England), described all known genera of seed plants in three volumes of their *Genera Plantarum*, published in Latin.

Bentham and Hooker's system of classification is still used and followed in several herbaria of the world. In most of the Indian herbaria too, the plants are arranged according to this system of classification. It is supposed to be the best system for the students to identify plants in the laboratories. This is so because Bentham and Hooker prepared the generic descriptions of the plants from their own observations and not by copying from the available literature. Large genera are divided into sections and sub-sections, and the description of genera is complete and accurate.

In all, they described 97,205 species belonging to 7,569 genera of 200 families of flowering plants in three volumes of *Genera Plantarum* as shown in Table 3.1.

Table 3.1 Number of orders, genera and families described by Bentham and Hooker

Groups	Orders (families)	Genera	Species
Dicotyledons			
(a) Polypetalae	82	2,610	31,874
(b) Gamopetalae	45	2,619	34,556
(c) Monochlamydeae	36	801	11,784
Gymnosperms	3	44	415
Monocotyledons	34	1,495	18,576
Total	200	7,569	97,205

The Bentham and Hooker's system of classification is clearly derived from the systems of de Jussieu and de Candolle. Bentham and Hooker divided all Phanerogams or seed plants into Dicotyledons, Gymnosperms and Monocotyledons. Ranales were placed in the beginning and grasses at the end in this classification. A summary outline of their classification is mentioned below:

(A) *Dicotyledons* (Reticulate venation; two cotyledons; pentamerous flowers).

1. Polypetalae (Corolla of separate petals)

Series I. Thalamiflorae (stamens many; hypogynous; disc absent).

Order 1. *Ranales:* Ranunculaceae, Magnoliaceae, Annonaceae, Nymphaeaceae and four more families.

2. *Parietales:* Papaveraceae, Capparidaceae, Cruciferae, Violaceae and five more families.

3. *Polygalineae:* Polygaleae and three more families.

Polypetalae - It is a taxonomic group used in the identification of plants.
Gamopetalae - A artificial group used in the identification of plants based on Bentham and Hooker's classification system.

4. *Caryophyllineae:* Caryophyllaceae, Portulacaceae and two more families.
5. *Guttiferales:* Guttiferae and five more families.
6. *Malvales:* Malvaceae, Tiliaceae and Sterculiaceae.

Series II. Disciflorae (stamens hypogynous; disc present).

Order 1. *Geraniales:* Geraniaceae, Rutaceae, Meliaceae, and eight more families.
2. *Olacales:* Olacineae, and two more families.
3. *Celastrales:* Rhamnaceae, and three more families.
4. *Sapindales:* Sapindaceae, Anacardiaceae and Sabiaceae.

Series III. Calyciflorae (stamens perigynous or epigynous; ovary generally inferior).

Order 1. *Rosales:* Leguminosae, Rosaceae, and seven more families.
2. *Myrtales:* Combretaceae, Myrtaceae, Lythraceae, and three more families.
3. *Passiflorales:* Cucurbitaceae, Begoniaceae, and five more families.
4. *Ficoidales:* Cactaceae, Ficoideae.
5. *Umbellales:* Umbelliferae, and two more families.

2. Gamopetalae (petals of corolla are partially or completely fused).

Series I. Inferae (inferior ovary).

Order 1. *Rubiales:* Rubiaceae and Caprifoliaceae.
2. *Asterales:* Compositae, and three more families.
3. *Campanales:* Campanulaceae, and three more families.

Series II. Heteromerae (ovary superior; androecium of one or two series; carpels more than two).

Order 1. *Ericales:* Ericaceae, and five more families.
2. *Primulales:* Primulaceae, and two more families.
3. *Ebenales:* Sapotaceae, and two more families.

Series III. Bicarpellatae (ovary superior; androecium of one series; carpels two).

Order 1. *Gentianales:* Oleaceae, Apocynaceae, Asclepiadaceae, and three more families.
2. *Polemoniales:* Convolvulaceae, Solanaceae, and three more families.
3. *Personales:* Scrophulariaceae, Pedaliaceae, Bignoniaceae, Acanthaceae, and four more families.
4. *Lamiales:* Labiatae, Verbenaceae, and two more families.

3. Monochlamydeae (Petals absent).

Series I. *Curvembryeae* (embryo coiled, ovule generally one): Amaranthaceae, Chenopodiaceae, Polygonaceae, and four more families.

Series II. *Multiovulatae aquaticae* (ovules many; immersed aquatics): Podostemaceae.

Series III. *Multiovulatae terrestris* (ovules many; plants terrestrial): Nepenthaceae, and two more families.

Series IV. *Microembryeae* (embryo very minute): Piperaceae, and three more families.

3.4.9 John Hutchinson (1884–1972)

An intentional phylogenetic system was produced by John Hutchinson, a British botanist, associated with the Royal Botanic Gardens, Kew. His system is close to that of Bessey, and is published in his *Genera of Flowering Plants* (1964–1967) and *Families of Flowering Plants* (1973).

Hutchinson based his system of classification on the *twenty four principles* mentioned below in a condensed form:

1. Evolution is both downwards and upwards.
2. Evolution does not necessarily involve all organs at the same time.
3. Generally, the evolution has been consistent.
4. Broadly, shrubs and trees are more primitive than herbs in any one genus or family.
5. In comparison with climbers, shrubs and trees are older in any one genus or family.
6. Perennials are older than annuals and biennials.
7. Aquatic flowering plants are derived from terrestrial ancestors.
8. Dicots are primitive compared to monocots.
9. Spiral arrangement of vegetative and floral leaves is primitive to cyclic arrangement.
10. Usually, simple leaves are more primitive than compound leaves.
11. Bisexual flowers are less advanced than unisexual, and dioecious plants are more recent than monoecious.
12. Inflorescence is more advanced than the solitary flowers.
13. Types of aestivation are evolved from contorted to imbricate to valvate.
14. Polymerous flowers (many-parted) precede oligomerous (few-parted) flowers.
15. Apetalous flowers are derived from flowers with petals.
16. Polypetaly is more primitive than gamopetaly.
17. In comparison to zygomorphy, actinomorphy is more primitive.
18. Hypogyny is more primitive than perigyny. The most advanced condition is epigyny.
19. Apocarpy is primitive than syncarpy.
20. Polycarpellary condition precede the condition of a few carpels.
21. Endospermic seeds with a small embryo are primitive to non-endospermic ones with a large embryo.
22. Flowers with many stamens are primitive to flowers with few stamens.
23. Plants with separate anthers are primitive compared to those with fused anthers or filaments.
24. Aggregate fruits are more highly evolved than single fruits.

An outline of the Hutchinson's system of classification, up to the level of orders, is mentioned below. Common families of some of the orders are mentioned in parenthesis.

Table 3.2 Comparison of systems of classification

S. No.	Bentham and Hooker	Engler and Prantl	Hutchinson
1.	It is a natural system of classification.	It is a transitional phylogenetic system.	It is a phylogenetic system.
2.	It is based on de Candolle's system of classification.	It is based on Eichler's system of classification.	It is based on Bessey's system of classification.
3.	Fixity of species is the main idea behind this system.	Darwinian theory of descent is the main idea behind this system.	Considerable knowledge of phylogeny is the basis of this classification.
4.	Dicots ar divided into (i) Polypetalae, (ii) Gamopetalae, and (iii) Monochlamydae.	Dicots are divided into (i) Archichlamydae, and (ii) Metachlamydae.	Dicots are divided into (i) Lignosae, and (ii) Herbaceae in this system.
5.	Gymnosperms are placed in between dicots and monocots.	Gymnosperms are placed before dicots.	Gymnosperms are placed before dicots.
6.	Monocots are treated after dicots.	Monocots are treated before dicots.	Monocots are treated after dicots.
7.	Orchidaceae and some other advanced families are regarded as primitive, and treated in the beginning.	Orchidaceae are treated as advanced.	Orchidaceae are treated as advanced.
8.	Families with free petals are placed in Polypetalae, with fused petals in Gamopetalae, and without petals in Monochlamydeae.	Polypetalae and Monochlamydeae are placed together under a single group Archichlamydeae. Families with fused petals are placed under Metachlamydeae.	Emphasis is on resemblances in place of differences, and so the Gamopetalae and Monochlamydeae are distributed according to their relationship in Polypetalae.
9.	Monocotyledonous families are arranged in 7 series.	Monocotyledons are arranged in 11 orders.	Monocotyledons are arranged in 29 orders.
10.	All flowering plants are placed in 200 families.	280 families of flowering plants have been recognized.	Number of recognised angiospermic families is 411.
11.	Gramineae is the last family of monocots.	Orchidaceae is the last family of monocots.	Gramineae is the last family of monocots.

primitive while those lacking subsidiary cells are advanced; (vi) Unilacunar nodes are derived from trilacunar or pentalacunar nodes; (vii) Xylem fibres evolved from tracheids to libriform fibres, through fibre tracheids; (viii) Cymose inflorescence is primitive while racemose is derived; (ix) Flowers with an indefinite or a variable number of their floral parts are primitive; (x) Pollen grains with their exine lacking any external sculpturing are primitive while those having various types of sculptures are advanced; (xi) Apocarpous gynoecium is the characteristic of primitive taxa; (xii) Unitegmic ovules developed from bitegmic ovules; (xiii) Basic type of ovule is anatropous type; all others are derived ones; (xiv) Basic and most primitive type of female gametophyte is 8-nucleate *Polygonum*-type; (xv) Primitive condition is porogamy, and the derived conditions are mesogamy and chalazogamy;