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# E-CONTENT

**Prepared for UG (Botany Hons. Courses under CBCS)**

| Course Name | Course Code | Credits | System | Syllabus |
|---|---|---|---|---|
| CORE COURSE- 7 PLANT SYSTEMATICS | BOT-A-CC-3-7-TH | THEORETICAL (Credits 4, Lectures 60) | CBCS | University of Calcutta |

## TAXONOMY OF ANGIOSPERMS

1. Introduction:
1.1. Components of Systematic: Nomenclature, Identification, Classification; 1.2. Taxonomy and its phases - Pioneer, Consolidation, Biosystematic and Encyclopaedic; alpha- and omega- taxonomy

2. Nomenclature: Type method, Publication, Rank of taxa, Rules of priority, Retention and rejection of names, Author Citation, Effective and valid publication, Elementary knowledge of ICN- Principles.

3. Systems of classification: Broad outline of Bentham & Hooker (1862-1883), Cronquist (1988), Takhatajan (1991) - system of classification with merits and demerits. Brief reference of angiosperm phylogeny group (APG III) classification. 3.1. Systematics in Practice: Herbaria and Botanical Gardens – their role in teaching and research; important Herbaria and Botanical Gardens of India and world (3 each); 3.2. Dichotomous keys – indented and bracketed.

4. Phenetics and Cladistics: Brief idea on Phenetics, Numerical taxonomy- methods and significance; Cladistics- construction of dendrogram and primary analysis; Monophyletic, polyphyletic and paraphyletic groups; Plesiomorphy and apomorphy.
5. Data sources in Taxonomy: Supportive evidences from: 5.1. Phytochemistry, 5.2. Cytology, 5.3. Palynology and 5.4. Molecular biology data (Protein and Nucleic acid homology).

6. Diagnostic features, Systematic position (Bentham & Hooker and Cronquist), Economically important plants (parts used and uses) of the following families: 6.1. Monocotyledons: Alismataceae, Gramineae (Poaceae), Cyperaceae, Palmae (Arecaceae), Liliaceae, Musaceae, Zingiberaceae, Cannaceae, Orchidaceae. 6.2. Dicotyledons: Nymphaeaceae, Magnoliaceae, Leguminosae (subfamilies), Polygonaceae, Euphorbiaceae, Malvaceae, Umbelliferae (Apiaceae), Labiatae (Lamiaceae), Solanaceae, Scrophulariaceae, Acanthaceae, Rubiaceae, Cucurbitaceae, Compositae (Asteraceae).

Topics covered in this E-Content (Components of Systematics, Phases In Taxonomy, Botanical Names, Contents of Botanical Code, Principles of ICBN, The Type method, Author Citation, Typification , Publication & Rejection Of Names, Principles Of Priority)

## Components (Principles) of Systematics

Various systematic activities are directed towards the singular goal of constructing an ideal system of classification that necessitates the procedures of identification, description, nomenclature and constructing affinities. This enables a better management of information to be utilized by different workers, investigating different aspects, structure and functioning of different species of plant.

### *A. Identification*

Identification or determination is recognizing an unknown specimen with an already known taxon, and assigning a correct rank and position in an extant classification. In practice, it involves finding a name for an unknown specimen. This may be achieved by visiting a herbarium and comparing unknown specimen with duly identified specimens stored in the herbarium. Alternately, the specimen may also be sent to an expert in the field who can help in the identification. Identification can also be achieved using various types of literature such as Floras, Monographs or Manuals and making use of identification keys provided in these sources of literature. After the unknown specimen has been provisionally identified with the help of a key, the identification can be further confirmed by comparison with the detailed description of the taxon provided in the literature source.

A method that is becoming popular over the recent years involves taking a photograph of the plant and its parts, uploading this picture on the website and informing the members of appropriate electronic Lists or Newsgroups, who can see the photograph at the website and send their comments to the enquirer. Members of the fraternity could thus help each other in identification in a much efficient manner.

### *B. Description*

The description of a taxon involves listing its features by recording the appropriate character states. A shortened description consisting of only those taxonomic characters which help in separating a taxon from other closely related taxa forms the diagnosis, and the characters are termed as diagnostic characters. The diagnostic characters for a taxon determine its circumscription. The description is recorded in a set pattern (habit, stem, leaves, flower, sepals, petals, stamens, carpels, fruit, etc.). For each character, an appropriate character-state is listed. Flower colour (character) may thus be red, yellow, white, etc. (states). The description is recorded in semi-technical language using specific terms for each character state to enable a proper documentation of data.

Whereas the fresh specimens can be described conveniently, the dry specimens need to be softened in boiling water or in a wetting agent before these could be described. Softening is often essential for dissection of flowers in order to study their details.

### *C. Nomenclature*

Nomenclature deals with the determination of a correct name for a taxon. There are different sets of rules for different groups of living organisms.

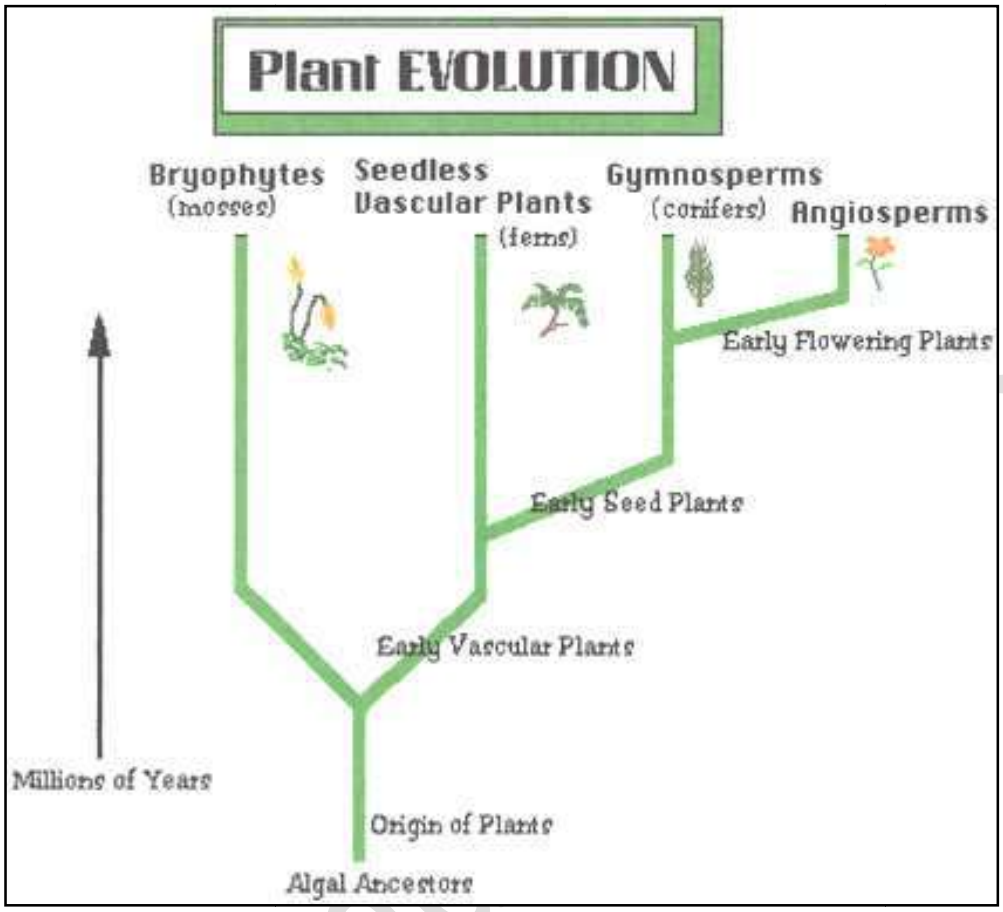
- Nomenclature of plants (including fungi) is governed by the International Code of Botanical Nomenclature (ICBN) through its rules and recommendations.
- Updated every six years or so, the Botanical Code helps in picking up a single correct name out of numerous scientific names available for a taxon, with a particular circumscription, position and rank.
- To avoid inconvenient name changes for certain taxa, a list of conserved names is provided in the Code.
- Cultivated plants are governed by the International Code of Nomenclature for Cultivated Plants (ICNCP), slightly modified from and largely based on the Botanical Code.
- Names of animals are governed by the International Code of Zoological Nomenclature (ICZN); those of bacteria by International Code for the Nomenclature of Bacteria (ICNB), now called Bacteriological Code (BC).
- A separate Code exists for viruses, named the International Code of Virus Classification and Nomenclature (ICVCN).

With the onset of electronic revolution and the need to have a common database for living organisms for global communication a common uniform code is being attempted.
The Draft ***BioCode*** is the first public expression of these objectives. The first draft was prepared in 1995. The last decade of twentieth century also saw the development of rank less ***PhyloCode*** based on the concepts of phylogenetic systematic. It omits all ranks except species and 'clades' based on the concept of recognition of monophyletic groups. The latest version of PhyloCode (PhyloCode4b, 2007) is also available on the web.

**Phylogeny:** Phylogeny is the study of the genealogy and evolutionary history of a taxonomic group. Genealogy is the study of ancestral relationships and lineages.

**Phylogram:** A phylogram is a branching diagram based on the degree of advancement (apomorphy) in the descendants, the longest branch representing the most advanced group. This is distinct from a phylogenetic tree.

**Phylogenetic tree:** The vertical scale represents a geological time-scale and all living groups reach the top, with primitive ones near the centre and advanced ones near the periphery. *Monophyletic groups*, including all the descendants of a common ancestor, are recognized and form entities in a classification system. *Paraphyletic groups*, wherein some descendants of a common ancestor are left out, are reunited. *Polyphyletic groups*, with more than one common ancestor, are split to form monophyletic groups. Phenetic information may often help in determining a phylogenetic relationship.




*Source: https://6-kingdoms.weebly.com/plantae.html*

### *D. Classification*

Classification is an arrangement of organisms into groups on the basis of similarities. The groups are, in turn, assembled into more inclusive groups, until all the organisms have been assembled into a single most inclusive group. In sequence of increasing inclusiveness, the groups are assigned to a fixed hierarchy of categories such as species, genus, family, order, class and division, the final arrangement constituting a system of classification.

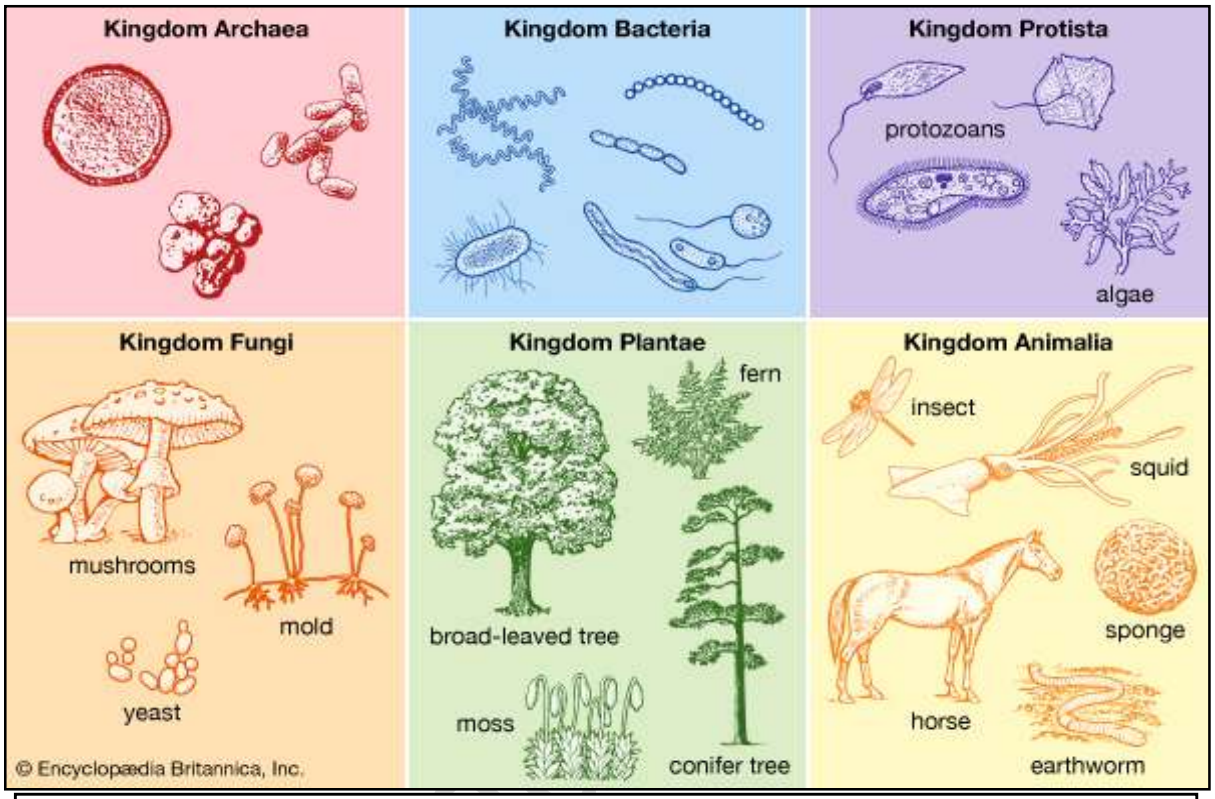
The process of classification includes:

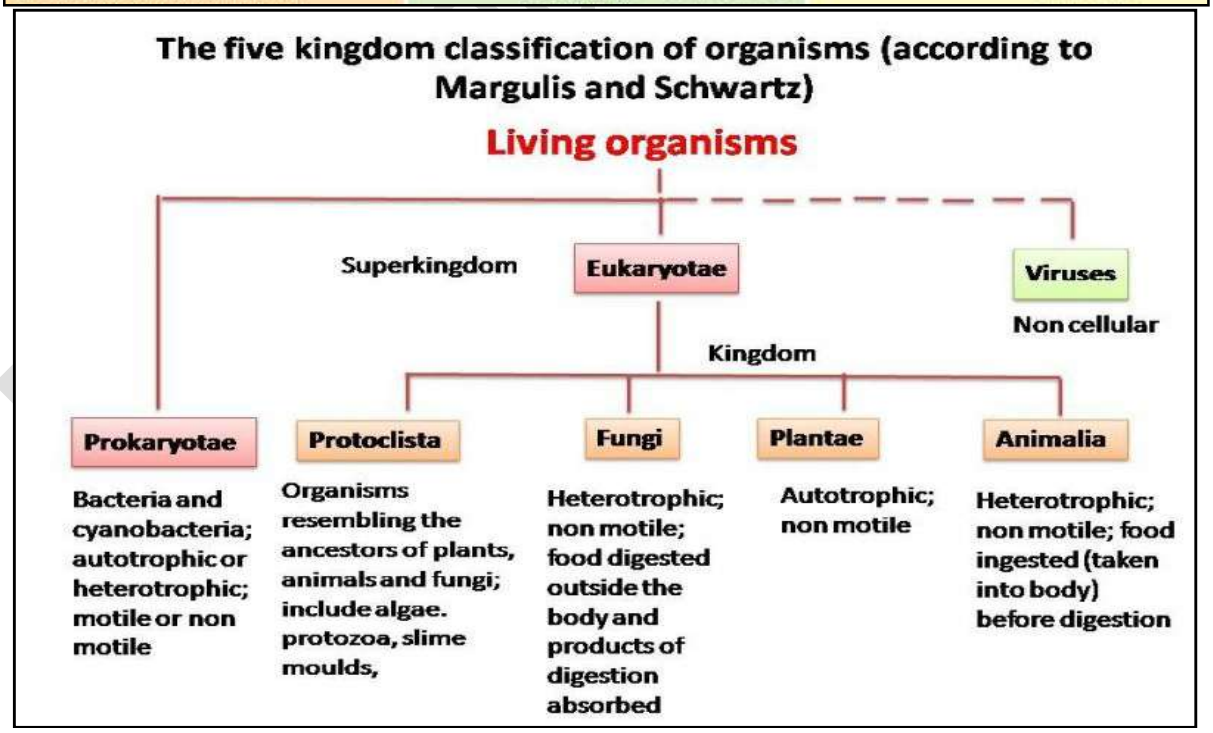
- assigning appropriate position and rank to a new taxon (a taxonomic group assigned to any rank; pl. taxa),
- dividing a taxon into smaller units, uniting two or more taxa into one,
- transferring its position from one group to another and altering its rank.

Once established, a classification provides an important mechanism of information storage, retrieval and usage. This ranked system of classification is popularly known as the Linnaean system.

# Taxonomic entities are classified in different fashions:

First Example of a simple classification (Kingdom):



***1. Artificial classification*** is utilitarian, based on arbitrary, easily observable characters such as habit, colour, number, form or similar features. The sexual system of Linnaeus, which fits in this category, utilized the number of stamens for primary classification of the flowering plants.

***2. Natural classification*** uses overall similarity in grouping taxa, a concept initiated by M. Adanson and culminating in the extensively used classification of Bentham and Hooker. Natural systems of the eighteenth and nineteenth centuries used morphology in delimiting the overall similarity. The concept of overall similarity has undergone considerable refinement in recent years. As against the sole morphological features as indicators of similarity in natural systems, overall similarity is now judged on the basis of features derived from all the available fields of taxonomic information (phenetic relationship).

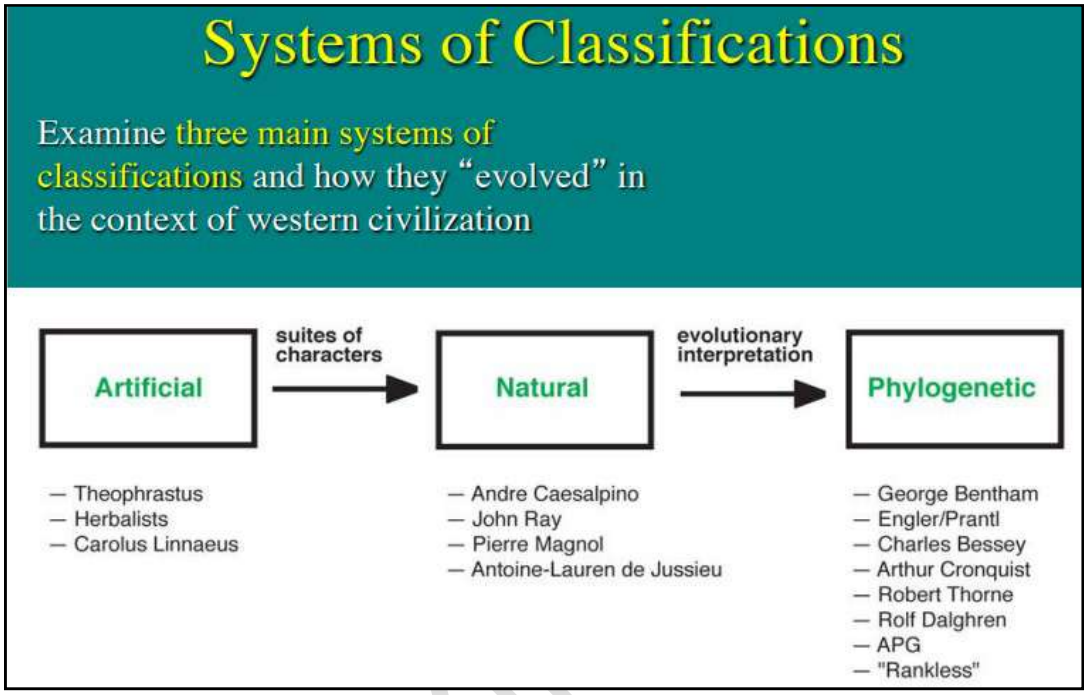
***3. Phenetic Classification*** makes the use of overall similarity in terms of a phenetic relationship based on data from all available sources such as morphology, anatomy, embryology, phytochemistry, ultrastructure and, in fact, all other fields of study. Phenetic classifications were strongly advocated by Sneath and Sokal (1973) but did not find much favour with major systems of classification of higher plants. Phenetic relationship has, however, been very prominently used in modern phylogenetic systems to decide the realignments within the system of classification.

***4. Phylogenetic classification*** is based on the evolutionary descent of a group of organisms, the relationship depicted either through a phylogram, phylogenetic tree or a cladogram.
Classification is constructed with this premise in mind, that all the descendants of a common ancestor should be placed in the same group (i.e., group should be monophyletic). If some descendents have been left out, rendering the group paraphyletic, these are brought back into the group to make it monophyletic (merger of Asclepiadaceae with Apocynaceae, and the merger of Capparaceae with Brassicaceae in recent classifications). Similarly, if the group is polyphyletic (with members from more than one phyletic lines, it is split to create monophyletic taxa (Genus Arenaria split into Arenaria and Minuartia). This approach, known as cladistics, is practiced by cladists.

***5. Evolutionary taxonomic classification*** differs from a phylogenetic classification in that the gaps in the variation pattern of phylogenetically adjacent groups are regarded as more important in recognizing groups. It accepts leaving out certain descendants of a common ancestor (i.e. recognizing paraphyletic groups) if the gaps are not significant, thus failing to provide a true picture of the genealogical history.

The characters considered to be of significance in the evolution (and the classification based on these) are dependent on expertise, authority and intuition of systematists. Such classifications have been advocated by Simpson (1961), Ashlock (1979), Mayr and Ashlock (1991) and Stuessy (1990). The approach, known as eclecticism, is practiced by **eclecticists.**

The contemporary phylogenetic systems of classification, including those of Takhtajan, Cronquist, Thorne and Dahlgren, are largely based on decisions in which phenetic information is liberally used in deciding the phylogenetic relationship between groups, differing largely on the weightage given to the cladistic or phenetic relationship.




***Classification helps in:***

- Classification not only helps in the placement of an entity in a logically organized scheme of relationships, it also has a great predictive value.
- The presence of a valuable chemical component in one species of a particular genus may prompt its search in other related species.
- The more a classification reflects phylogenetic relationships, the more predictive it is supposed to be.

**Aims of Systematics**

The activities of plant systematic are basic to all other biological sciences and, in turn, depend on the same for any additional information that might prove useful in constructing a classification.

These activities are directed towards achieving the under mentioned aims:

a) To provide a convenient method of identification and communication. A workable classification having the taxa arranged in hierarchy, detailed and diagnostic descriptions are essential 12 Plant Systematics for identification. Properly identified and arranged herbarium specimens, dichotomous keys, polyclaves and computer-aided identification are important

aids for identification. The Code (ICBN), written and documented through the efforts of IAPT (International Association of Plant Taxonomy), helps in deciding the single correct name acceptable to the whole botanical community.

b) To provide an inventory of the world's flora. Although a single world Flora is difficult to come by, floristic records of continents (*Continental Floras; cf. Flora Europaea by Tutin et al*.), regions or countries (*Regional Floras; cf. Flora of British India by J. D. Hooker*) and states or even counties (*Local Floras; cf. Flora of Delhi by J. K. Maheshwari*) are well documented. In addition, World Monographs for selected genera (*e.g., the genus Crepis by Babcock*) and families (*e.g., Das pflanzenreich ed. by A. Engler*) are also available.

c) To detect evolution at work; to reconstruct the evolutionary history of the plant kingdom, determining the sequence of evolutionary change and character modification.

d) To provide a system of classification which depicts the evolution within the group? The phylogenetic relationship between the groups is commonly depicted with the help of a phylogram, wherein the longest branches represent more advanced groups and the shorter, nearer the base, primitive ones. In addition, the groups are represented by balloons of different sizes that are proportional to the number of species in the respective groups. Such a phylogram is popularly known as a bubble diagram. The phylogenetic relationship could also be presented in the form of a phylogenetic tree (with vertical axis representing the geological time scale), where existing species reach the top and the bubble diagram may be a cross-section of the top with primitive groups towards the centre and the advanced ones towards the periphery.

e) To provide an integration of all available information. To gather information from all the fields of study, analyzing this information using statistical procedures with the help of computers, providing a synthesis of this information and developing a classification based on overall similarity. This synthesis is unending, however, since scientific progress will continue and new information will continue to pour and pose new challenges for taxonomists.

f) To provide an information reference, supplying the methodology for information storage, retrieval, exchange and utilization. To provide significantly valuable information concerning endangered species, unique elements, genetic and ecological diversity.

g) To provide new concepts, reinterpret the old, and develop new procedures for correct determination of taxonomic affinities, in terms of phylogeny and phenetics.

h) To provide integrated databases including all species of plants (and possibly all organisms) across the globe. Several big organizations have come together to establish online

searchable databases of taxon names, images, descriptions, synonyms and molecular information.

## Advancement Levels in Systematics

Plant systematics has made considerable strides from herbarium records to databanks, recording information on every possible attribute of a plant. Because of extreme climatic diversity, floristic variability, inaccessibility of certain regions and economic disparity of different regions, the present-day systematics finds itself in different stages of advancement in different parts of the world.

***For a general idea/reason about the disparity in the level of advancement concerning knowledge about respective floras:***

*Africa is amongst the richest areas of the world in terms of floristic diversity but amongst the poorest as far as the economic resources to pursue complete documentation of systematic information. The whole of Europe, with more than 30 m square kilometers of landscape and numerous rich nations with their vast economic resources, have to account for slightly more than 6 thousand species of vascular plants. India, on the other hand, with meager resources, less than one tenth of landscape, has to account for the study of at least four times more of the vascular plants. A small country like Colombia, similarly, has estimated 45000 different species, with only a few botanists to study the flora. Great Britain, on the other hand, has approximately 1370 taxa (Woodland, 1991), with thousands of professional and amateur botanists available to document the information. It is not strange, as such, that there is lot of disparity in the level of advancement concerning knowledge about respective floras*

# Phases in Taxonomy

Taxonomic advancement today can be conveniently divided into four distinct phases encountered in different parts of the world:

**A. Exploratory or Pioneer Phase:** This phase marks the beginning of plant taxonomy, collecting specimens and building herbarium records. The few specimens of a species in the herbarium are the only record of its variation. These specimens are, however, useful in a preliminary inventory of flora through discovery, description, naming and identification of plants. Here, morphology and distribution provide the data on which the systematists must rely. Taxonomic experience and judgment are particularly important in this phase. Most areas of tropical Africa and tropical Asia are passing through this phase.

**B. Consolidation or Systematic Phase**: During this phase, herbarium records are ample and enough information is available concerning variation from field studies. This development is helpful in the preparation of Floras and Monographs. It also aids in better understanding of the degree of variation within a species.

Two or more herbarium specimens may appear to be sufficiently different and regarded as belonging to different species on the basis of a few available herbarium records, but only a field study of populations involving thousands of specimens can help in reaching at a better understanding of their status. If there are enough field specimens to fill in the gaps in

variation pattern, there is no justification in regarding them as separate species. On the other hand, if there are distinct gaps in the variation pattern, it strengthens their separate identity. In fact, many plants, described as species on the basis of limited material in the pioneer phase, are found to be variants of other species in the consolidation phase. Most parts of central Europe, North America and Japan are experiencing this phase.

C. **Experimental or Biosystematic Phase:** During this phase, the herbarium records and variation studies are complete. In addition, information on biosystematics (studies on transplant experiments, breeding behaviour and chromosomes) is also available. Transplant experiments involve collecting seeds, saplings or other propagules from morphologically distinct populations from different habitats and growing them under common environmental conditions.

If the differences between the original populations were purely ecological, the differences would disappear under a common environment, and there is no justification in regarding them as distinct taxonomic entities. On the other hand, if the differences still persist, these are evidently genetically fixed. If these populations are allowed to grow together for several years, their breeding behaviours would further establish their status. If there are complete reproductive barriers between the populations, they will fail to interbreed, and maintain their separate 14 Plant Systematics identity. These evidently belong to different species.

On the other hand, if there is no reproductive isolation between them, over the years, they would interbreed, form intermediate hybrids, which will soon fill the gaps in their variation. Such populations evidently belong to the same species and better distinguished as ecotypes, subspecies or varieties. Further chromosomal studies can throw more light on their affinities and status. Central Europe has reached this phase of plant systematics.

D. **Encyclopaedic or Holotaxonomic Phase:** Here, not only the previous three phases are attained, but information on all the botanical fields is also available. This information is assembled, analyzed, and a meaningful synthesis of analysis is provided for understanding phylogeny. Collection of data, analysis and synthesis are the jobs of an independent discipline of systematics, referred to as numerical taxonomy.

**Alpha-Taxonomy and Omega-Taxonomy:** The first two phases of systematics are often considered under alpha-taxonomy and the last phase under omega-taxonomy. At present, only a few persons are involved in encyclopaedic work and that too, in a few isolated taxa. It may thus be safe to conclude that though in a few groups omega-taxonomy is within reach, for the great majority of plants, mainly in the tropics; even the ‘alpha’ stage has not been crossed. The total integration of available information for the plant kingdom is, thus, only a distant dream at present.

# BOTANICAL NAMES

**Why there is a NEED FOR SCIENTIFIC NAMES?**

Scientific names formulated in Latin are preferred over vernacular or common names since the latter pose a number of problems:

1. Vernacular names are not available for all the species known to man.
2. Vernacular names are restricted in their usage and are applicable in a single or a few languages only. They are not universal in their application.
3. Common names usually do not provide information indicating family or generic relationship. Roses belong to the genus *Rosa*; woodrose is a member of the genus *Ipomoea* and primrose belongs to the genus *Primula*. The three genera, in turn, belong to three different families—Rosaceae, Convolvulaceae and Primulaceae, respectively. Oak is similarly common name for the species of genus *Quercus*, but Tanbark oak is *Lithocarpus*, poison oak a *Rhus*, silver oak a *Grevillea* and Jerusalem oak a *Chenopodium*.
4. Frequently, especially in widely distributed plants, many common names may exist for the same species in the same language in the same or different localities. Cornflower, bluebottle, bachelor‘s button and ragged robin all refer to the same species *Centaurea cyanus*.
5. Often, two or more unrelated species are known by the same common name. Bachelor‘s button, may thus be *Tanacetum vulgare*, *Knautia arvensis* or *Centaurea cyanus*. Cockscomb, is similarly, a common name for *Celosia cristata* but is also applied to a seaweed *Ploca-mium coccinium* or to *Rhinanthus minor*.

**Why Latin?**

Scientific names are treated as Latin regardless of their origin. It is also mandatory to have a Latin diagnosis for any new taxon published 1 January 1935 onwards. The custom of Latinized names and texts originates from medieval scholarship and custom continued in most botanical publications until the middle of nineteenth century. Descriptions of plants are not written in classical *Latin of Cicero* or of *Horace*, but in the ‘*lingua franca’* spoken and written by scholars during middle ages, based on popular Latin spoken by ordinary people in the classical times.

<u>The selection has several advantages over modern languages:</u>

i) Latin is a dead language and as such meanings and interpretation are not subject to changes unlike, English and other languages;
ii) Latin is specific and exact in meaning;
iii) grammatical sense of the word is commonly obvious (white translated as album-neuter, alba-feminine or albus- masculine); and
iv) Latin language employs the Roman alphabet, which fits well in the text of most languages.

## DEVELOPMENT OF BOTANICAL CODE

- For several centuries, the names of plants appeared as polynomials—long descriptive phrases, often difficult to remember. A species of willow, for example, was named *Salix pumila angustifolia altera* by Clusius in his herbal (1583).
- *Casper Bauhin (1623)* introduced the concept of Binomial nomenclature under which the name of a species consists of two parts, the first the name of the genus to which it belongs and the second the specific epithet. Onion is thus appropriately named *Allium cepa*, Allium being the generic name and *cepa* the specific epithet. Bauhin, however, did not use binomial nomenclature for all the species and it was left to Carolus Linnaeus to firmly establish this system of naming in his *Species plantarum* (1753).
- The early rules of nomenclature were set forth by Linnaeus in his *Critica botanica* (1737) and further amplified in *Philosophica botanica* (1751). A. P. de Candolle, in his Theorie elementaire de la botanique (1813), gave explicit instructions on nomenclatural procedures, many taken from Linnaeus.
- Steudel, in *Nomenclator botanicus* (1821), provided Latin names for all flowering plants known to the author together with their synonyms.
- The first organized effort towards the development of uniform botanical nomenclature was made by Alphonse de Candolle, who circulated a copy of his manuscript Lois de la nomenclature botanique. After deliberations of the First International Botanical Congress at Paris (1867), the Paris Code, also known as '*de Candolle rules*' was adopted.
- Linnaeus (1753) was made the starting point for plant nomenclature and the rule of priority was made fundamental.
- Not satisfied with the Paris Code, the American botanists adopted a separate Rochester Code (1892), which introduced the concept of types, strict application of rules of priority even if the name was a ***tautonym*** (specific epithet repeating the generic name, e.g. *Malus malus*).
- The Paris Code was replaced by the Vienna Code (1905), which established Species plantarum (1753) of Linnaeus as the starting Botanical Nomenclature; tautonym was not accepted, and Latin diagnosis was made essential for new species. In addition, a list of conserved generic names (*Nomina generic conservanda*) was approved.
- Not satisfied with the Vienna Code also, adherents of the Rochester Code adopted the American Code (1907), which did not accept the list of conserved names and the requirement for Latin diagnosis.
- It was not until the 5th International Botanical Congress (IBC) at Cambridge (1930) that the differences were finally resolved and a truly International Code evolved, ***accepting the concept of type method, rejecting the tautonyms, making Latin diagnosis mandatory for new groups and approving conserved generic names.***
- The Code has since been constantly amended at each International Botanical Congress. The 15th IBC was held at Tokyo in 1993, 16th at St Louis in 1999 (published by Greuter et al., 2000).

➢ The Code discussed in the following pages is based on the 17th International Botanical Congress held at Vienna in 2005 (Published by McNeill et al., 2006- Code is generally published one year after the Congress). The current numbering system for the congresses starts from the year 1900; the XVIII IBC (18th International Botanical Congress) was held in Melbourne, Australia, 24–30 July 2011, and the **XIX IBC** was held in Shenzhen, China, 23–29 July 2017 *(**updated till the date of preparation of this notes**)*.

## CONTENTS OF BOTANICAL CODE

Publication of the Code is based on the realization that botany requires a precise and simple system of nomenclature used by botanists in all countries.

Aim: The Code aims at provision of a stable method of naming taxonomic groups, avoiding and rejecting the use of names which may cause error or ambiguity or throw science into confusion. Preamble highlights the philosophy of the botanical Code.

The Code is divided into 3 divisions:

***I. Principles***
***II. Rules and recommendations***
***III. Provisions for the governance of the Code***

In addition, the Code includes the following appendices:

I. Names of hybrids

IIA. *Nomina familiarum algarum, fungorum, pteridophytorum et fossilium conservanda et rejicienda*

IIB. *Nomina familiarum bryophytorum et spermatophytorum conservanda IIIA. Nomina generica conservanda et rejicienda*

IIIB. *Nomina specifica conservanda et rejicienda*

IV. *Nomina utique rejicienda (A. Algae, B. Fungi, C. Bryophyta, D. Pteridophyta, E. Spermatophyta)*

*IV. Opera utique oppressa*

*The last three useful appendices were included for the first time in the Tokyo Code. The first (IIIB) includes the names of conserved and rejected specific names; the second (IV) lists the names and all combinations based on these names, which are ruled as rejected under Art. 56, and none is to be used; and the last (V) the list of publications (and the category of taxa therein) which are not validly published according to the Code.*

## *PRINCIPLES*

Principles form the basis of the system of botanical nomenclature. There are 62 main rules (set out as articles) and associated recommendations. The object of the rules is to put the nomenclature of the past into order and provide for that of the future; names contrary to the rules cannot be maintained. Recommendations deal with subsidiary points, and are meant for

uniformity and clarity. Names contrary to the recommendations cannot, on that account, be rejected, but they are not examples to be followed. Conserved names include those that do not satisfy the principle of priority but are sanctioned for use. The various rules and recommendations are discussed here under relevant headings.

**Preamble (Introduction)**

1. Botany requires a precise and simple system of nomenclature used by botanists in all countries, dealing on the one hand with the terms which denote the ranks of taxonomic groups or units, and on the other hand with the scientific names which are applied to the individual taxonomic groups of plants. The purpose of giving a name to a taxonomic group is not to indicate its characters or history, but to supply a means of referring to it and to indicate its taxonomic rank.
   This Code aims at the provision of a stable method of naming taxonomic groups, avoiding and rejecting the use of names which may cause error or ambiguity or throw science into confusion. Next in importance is the avoidance of the useless creation of names. Other considerations, such as absolute grammatical correctness, regularity or euphony of names, more or less prevailing custom, regard for persons, etc., notwithstanding their undeniable importance, are relatively accessory.
2. The Principles form the basis of the system of botanical nomenclature.
3. The detailed Provisions are divided into Rules, set out in the Articles, and Recommendations. Examples (Ex.) are added to the rules and recommendations to illustrate them.
4. The object of the Rules is to put the nomenclature of the past into order and to provide for that of the future; names contrary to a rule cannot be maintained.
5. The Recommendations deal with subsidiary points, their object being to bring about greater uniformity and clarity, especially in future nomenclature; names contrary to a recommendation cannot, on that account, be rejected, but they are not examples to be followed.
6. The provisions regulating the governance of this Code form its last division.
7. The rules and recommendations apply to all organisms traditionally treated as plants, whether fossil or non-fossil, e.g., blue-green algae, Cyanobacteria, fungi, including chytrids, oomycetes, and slime moulds, photosynthetic protists and taxonomically related non photosynthetic groups.
8. The International code of nomenclature for cultivated plants is prepared under the authority of the International Commission for the Nomenclature of Cultivated Plants and deals with the use and formation of names for special plant categories in agricultural, forestry, and horticultural nomenclature.
9. The only proper reasons for changing a name are either a more profound knowledge of the facts resulting from adequate taxonomic study or the necessity of giving up a nomenclature that is contrary to the rules.

10. In the absence of a relevant rule or where the consequences of rules are doubtful, established custom is followed.
11. This edition of the Code supersedes all previous editions.

## Principles of ICBN

The International Code of Botanical Nomenclature is based on the following set of six principles, which are the philosophical basis of the Code and provide guidelines for the taxonomists who propose amendments or deliberate on the suggestions for modification of the Code:

1. Botanical Nomenclature is independent of Zoological Nomenclature. The Code applies equally to the names of taxonomic groups treated as plants whether or not these groups were originally so treated.
2. The application of names of taxonomic groups is determined by means of nomenclatural types.
3. Nomenclature of a taxonomic group is based upon priority of publication.
4. Each taxonomic group with a particular circumscription, position and rank can bear only one correct name, the earliest that is in accordance with the rules.
5. Scientific names of taxonomic groups are treated as Latin, regardless of derivation.
6. The rules of nomenclature are retroactive, unless expressly limited.

Names of Taxa Taxon (pl. taxa) refer to a taxonomic group belonging to any rank. The system of nomenclature provides a hierarchical arrangement of ranks. Every plant is treated as belonging to a number of taxa, each assigned a particular rank. Onion thus belongs to *Allium* cepa (species rank), *Allium* (genus rank), Alliaceae (family rank) and so on.

The seven principal obligatory ranks of taxa in descending sequence are: kingdom (regnum), division or phylum (divisio, phylum), class (classis), order (ordo), family (familia), genus (genus), and species (species). The ending of the name indicates its rank: ending -bionta denotes a kingdom, -phyta a division, -phytina a sub division, -opsida a class, -opsidae or -idae a subclass, -ales an order, -ineae a suborder and -aceae a family. The detailed hierarchy of ranks and endings with examples is given in the given image.

| | | |
|---|---|---|
| Kingdom | : | Plantae – plantes, Planta, Vegetal, plants |
| Subkingdom | : | Viridiplantae |
| Infrakingdom | : | Streptophyta – land plants |
| Superdivision | : | Embryophyta |
| Division | : | Tracheophyta – vascular plants, tracheophytes |
| Subdivision | : | Spermatophytina – spermatophytes, seed plants, phanérogames |
| Class | : | Magnoliopsida |
| Superorder | : | Rosanae |
| Order | : | Fagales |
| Family | : | Fagaceae |
| Genus | : | Castanea Mill. – chestnut |
| Species | : | Castanea dentata (Marsh.) Borkh. – American chestnut |

***Table Source-:https://www.researchgate.net/figure/Taxonomic-Hierarchy-of-chestnuts_tbl2_332571185.***

## Taxonomic Hierarchy

Taxonomic hierarchy was introduced by Carolus Linnaeus. It is the arrangement of various taxonomic levels in descending order starting from kingdom up to species.

**Species** is the lowest of classification and shows the high level of similarities among the organisms. For example, *Helianthus annuus* and *Helianthus tuberosus*. These two species differ in their morphology. Both of them are herbs but *Helianthus tuberosus* is a perennial herb.

**Genus** consists of multiple species which have similar characters but differ from the species of another genus. Example: *Helianthus*, *Tridax*

**Family** comprises a number of genera which share some similarities among them. Example: Asteraceae.

**Order** includes group of families which show less similarities among them.

**Class** consists of group of orders which share few similarities.

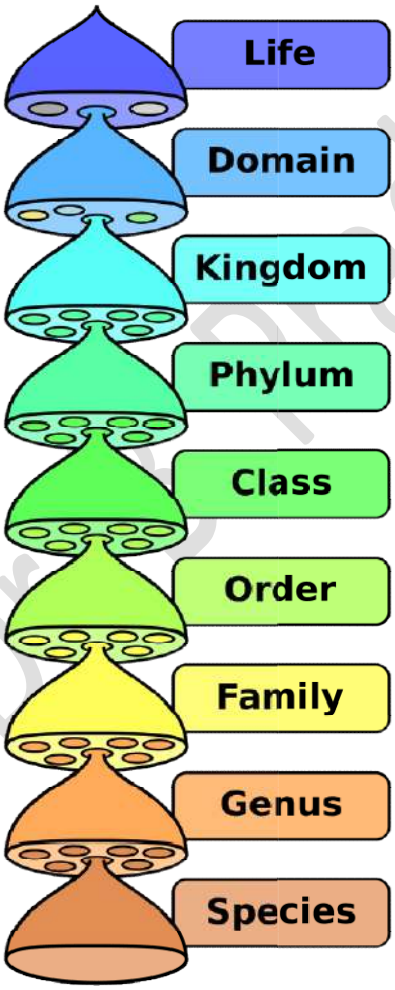
**Division** is the next level of classification that consists of number of classes. Example: Magnoliophyta.

**Kingdom** is the highest level or rank of the classification. Example: Plantae.

Example:

| TAXONOMIC RANKS OF LAND PLANTS | ENDING | EXAMPLE TAXON |
|---|---|---|
| **Kingdom** | **(various)** | **Plantae** |
| **Phylum = Division** | **-phyta** | **Magnoliophyta** |
| Subphylum = Subdivision | -phytina | Magnoliophytina |
| **Class** [cl.] | **-opsida** | **Asteropsida** |
| Subclass [subcl.] | -idae | Asteridae |
| **Order** [ord.] | **-ales** | **Asterales** |
| Suborder [subord.] | -ineae | Asterineae |
| **Family** [fam.] | **-aceae** | **Asteraceae** |
| Subfamily [subfam.] | -oideae | Asteroideae |
| Tribe [tr.] | -eae | Heliantheae |
| Subtribe [subtr.] | -inae | Helianthinae |
| **Genus** [gen.] | (various) | ***Helianthus*** |
| Subgenus [subg.] | (various) | *Helianthus* subg. *Helianthus* |
| Section [sect.] | (various) | *Helianthus* sect. *Helianthus* |
| Series [ser.] | (various) | *Helianthus* ser. *Helianthus* |
| **Species [sp.]** | (various) | ***Helianthus annuus*** |
| Subspecies [subsp.] | (various) | *Helianthus annuus* subsp. *annuus* |
| Variety [var.] | **(various)** | *Helianthus annuus* var. *annuus* |
| Form [f.] | **(various)** | *Helianthus annuus* f. *annuus* |

Table by Michael G. Simpson (2012): *https://www.sciencedirect.com/science/article/pii/B9780123743800500166).*




*Source: https://crazycrittersinc.com/classification-and-taxonomy-of-plants-and-animals/*

## The Type Method

The names of different taxonomic groups are based on the type method, by which a certain representative of the group is the source of the name for the group. This representative is called the nomenclatural type or simply the type, and methodology as typification. The type need not be the most typical member of the group, it only fixes the name of a particular taxon and the two are permanently associated. Type may be correct name or even a synonym. Thus the tea family name (Theaceae) is derived from synonym *Thea* although the correct name for the genus is *Camellia*. Mimosa is the type for family Mimosaceae, but unlike most representatives of the family that have pentamerous flowers, the genus *Mimosa* has tetramerous flowers. The family Urticaceae, similarly, has *Urtica* as its type. When the originally large family was split into a number of smaller natural families, the name Urticaceae was retained for the group containing the genus *Urtica*, since the two cannot be separated.

The other splitter groups with family rank got the names Moraceae, Ulmaceae and Cannabaceae with type genera *Morus, Ulmus* and *Cannabis*, respectively. The family Malvaceae has seen a lot of realignments, with Tiliaceae sometimes merged with Malvaceae. Thorne (2003) shifts *Tilia* to Malvaceae, but retains rest of the genera. This necessitates name change for former Tiliaceae (excluding genus *Tilia*) to Grewiaceae, with *Grewia* as the type genus. The type of a family and the higher groups is ultimately a genus, as indicated above.

A type of a particular genus is a species, e.g. *Poa* pratensis for Poa. The type of name of a species or infraspecific taxon, where it exists, is a single type specimen, preserved in a known herbarium and identified by the place of collection, name of the collector and his collection number. It may also be an illustration of the plant.

***{Visit: Calcutta university herbarium at this URL- http://cuhcollections.com/)***

The Code recognizes several kinds of type, depending upon the way in which a type specimen is selected. These include:

1. ***Holotype:*** A particular specimen or illustration designated by the author of the species to represent type of a species. For the purpose of typification, a specimen is a gathering, or part of a gathering, of a single species or infraspecific taxon made at one time, disregarding admixtures. It may consist of a single plant, parts of one or several plants, or of multiple small plants. A specimen is usually mounted either on a single herbarium sheet or in an equivalent preparation, such as a box, packet, jar or microscope slide. Type specimens of names of taxa must be preserved permanently and may not be living plants or cultures. However, cultures of fungi and algae, if preserved in a metabolically inactive state (e.g. by lyophilization or deep-freezing), are acceptable as types. It is now essential to designate a holotype when publishing a new species.

2. ***Isotype:*** A specimen which is a duplicate of the holotype, collected from the same place, at the same time and by the same person. Often the collection number is also the same, differentiated as a, b, c, etc.

3. ***Syntype:*** Any one of the two or more specimens cited by the author when no holotype was designated, or any one of the two or more specimens simultaneously designated as types. Duplicate of a syntype is an isosyntype.

4. ***Paratype:*** A paratype is a specimen cited in the protologue that is neither the holotype nor an isotype, nor one of the syntypes if two or more specimens were simultaneously designated as types.

5. ***Lectotype:*** A specimen or any other element selected from the original material cited by the author when no holotype was originally selected or when it no longer exists. A lectotype is selected from isotypes or syntypes. In lectotype designation, an isotype must be chosen if such exists, or otherwise a syntype if such exists. If no isotype, syntype or isosyntype (duplicate of syntype) is extant, the lectotype must be chosen from among the paratypes if such exist. If no cited specimens exist, the lectotype must be chosen from among the uncited specimens and cited and uncited illustrations which comprise the remaining original material, if such exist.

6. ***Neotype:*** A specimen or illustration selected to serve as nomenclatural type as long as all of the material on which the name of the taxon was based is missing; a specimen or an illustration selected when no holotype, isotype, paratype or syntype exists.

7. ***Epitype:*** A specimen or illustration selected to serve as an interpretative type when the holotype, lectotype or previously designated neotype, or all original material associated with a validly published name, is demonstrably ambiguous and cannot be critically identified for purposes of the precise application of the name of a taxon. When an epitype is designated, the holotype, lectotype or neotype that the epitype supports must be explicitly cited. In most cases in which no holotype was designated there will also be no paratypes, since all the cited specimens will be syntypes. However, when an author has designated two or more specimens as types, any remaining cited specimens are paratypes and not syntypes.

8. ***Topotype*** is often the name given to a specimen collected from the same locality from which the holotype was originally collected. In cases where the type of a name is a culture permanently preserved in a metabolically inactive state, any living isolates obtained from that should be referred to as 'ex-type' (ex typo), 'ex-holotype' (ex holotypo), 'ex-isotype' (ex isotypo), etc., in order to make it clear they are derived from the type but are not themselves the nomenclatural type. When an infraspecific variant is recognized within a species for the first time, it automatically establishes two infraspecific taxa. The one, which includes the type specimen of the species, must have the same epithet as that of the species, e.g. *Acacia nilotica* ssp. *nilotica*. Such a name is called an autonym, and the specimen an autotype. The variant taxon would have its own holotype and is differentiated by an epithet different from the specific epithet, e.g. *Acacia nilotica* ssp. *indica*. It must be borne in mind that the application of the type method or typification is a methodology different from typology, which is a concept based on the idea that does not recognize variation within the taxa, and believes that an idealized specimen or pattern can represent a natural taxon. This concept of typology was very much in vogue before Darwin put forward his ideas about variations.

# Author Citation

For a name to be complete, accurate and readily verifiable, it should be accompanied by the name of the author or authors who first published the name validly. The names of the authors are commonly abbreviated, e.g. L. for Carolus Linnaeus, Benth. for G. Bentham, Hook. for William Hooker, Hook.f. for Sir J. D. Hooker (f. stands for filius, the son; J. D. Hooker was son of William Hooker), R.Br. for Robert Brown, Lam. for J. P. Lamarck, DC. for A. P. de Candolle, Wall. for Wallich, A. DC. for Alphonse de Candolle, Scop. for G. A. Scopoli and Pers. for C. H. Persoon.

***Single author***

The name of a single author follows the name of a species (or any other taxon) when a single author proposed a new name, e.g. *Solanum nigrum* L.

***Multiple authors***

The names of two or more authors may be associated with a name for a variety of reasons. These different situations are exhibited by citing the name of the authors differently:

1. **Use of *et*:** When two or more authors publish a new species or propose a new name, their names are linked by et, e.g. *Delphinium viscosum* Hook.f. *et* Thomson.
2. **Use of parentheses:** The rules of botanical nomenclature specify that whenever the name of a taxon is changed by the transfer from one genus to another, or by upgrading or downgrading the level of the taxon, the original epithet should be retained. The name of the taxon providing the epithet is termed a basionym. The name of the original author or authors whose epithet is being used in the changed name is placed within parentheses, and the author

or authors who made the name change outside the parentheses, e.g. *Cynodon dactylon* (Linn.) Pers., based on the basionym *Panicum dactylon* Linn., the original name for the species.

3. **Use of ex**: The names of two authors are linked by ex when the first author had proposed a name but was validly published only by the second author, the first author failing to satisfy all or some of the requirements of the Code, e.g. *Cerasus cornuta* Wall. ex Royle.

4. **Use of in**: The names of authors are linked using in when the first author published a new species or a name in a publication of another author, e.g. *Carex kashmirensis* Clarke in Hook.f. Clarke published this new species in the Flora of British India whose author was Sir J. D. Hooker.

5. **Use of emend**: The names of two authors are linked using emend. (emendavit: person making the correction) when the second author makes some change in the diagnosis or in circumscription of a taxon without altering the type, e.g. *Phyllanthus* Linn. emend. Mull.

6. **Use of square brackets**: Square brackets are used to indicate prestarting point author. The generic name Lupinus was effectively published by Tournefort in 1719, but as it happens to be earlier than 1753, the starting date for botanical nomenclature based on Species plantarum of Linnaeus, the appropriate citation for the genus is *Lupinus* [Tourne.] L. When naming an infraspecific taxon, the authority is cited both for the specific epithet and the infraspecific epithet, e.g. *Acacia nilotica* (L.) Del. ssp. *indica* (Benth.) Brenan. In the case of an autonym, however, the infraspecific epithet does not bear the author's name since it is based on the same type as the species, e.g. *Acacia nilotica* (L.) Del. ssp. *nilotica*.

## Publication of Names

The name of a taxon, when first published, should meet certain requirements so as to become a legitimate name for consideration when deciding on a correct name. A valid publication should satisfy the following requirements:

**Formulation**

A name should be properly formulated and its nature indicated by a proper abbreviation after the name of the author:

1. *sp. nov.* for species nova, a species new to science; *Tragopogon kashmirianus* G. Singh, sp. *nov*. (published in 1976).

2. *comb. nov*. for *combinatio nova*, a name change involving the epithet of the basionym, name of the original author being kept within parentheses; *Vallisneria* natans (Lour.) Hara comb. nov. (published in 1974 based on Physkium natans Lour., 1790).

3. *comb. et stat. nov*. for combinatio *et status nova*, when a new combination also involves the change of status. Epithet of the basionym will accordingly be used in the combination intended; *Caragana opulens* Kom. var. *licentiana* (Hand.-Mazz.) Yakovl. comb. *et stat*. nov. (published in 1988 based on *C. licentiana* Hand.-Mazz., 1933; new combination also involved change of status from a species *C. licentiana* to a variety of *Caragana opulens* Kom.).

4. *nom. nov*. for *nomen novum*, when the original name is replaced and its epithet cannot be used in the new name; *Myrcia lucida* McVaugh nom. nov. (published in 1969 to replace *M. laevis* O. Berg, 1862, an illegitimate homonym of *M. laevis* G. Don, 1832).

**Latin diagnosis**

- Names of all new species (or other taxa new to science) published 1 January 1935 onwards should have a Latin diagnosis (Latin translation of diagnostic features).
- Full description of the species in any language can accompany the Latin diagnosis.
- A description in any language, not accompanied by a Latin diagnosis is allowed for publications before 1 January 1935.
- For publications before 1 January 1908, an illustration with analysis without any accompanying description is valid. Thus description in any language is essential from 1 January 1908 onwards and this accompanied by a Latin diagnosis from 1 January 1935.
- For name changes or new names of already known species, a full reference to the original publication should be made.

# Typification

- A holotype should be designated.
- Publication on or after 1 January 1958 of the name of a new taxon of the rank of genus or below is valid only when the type of the name is indicated.
- For the name of a new taxon of the rank of genus or below published on or after 1 January 1990, an indication of the type must include one of the words '*typus*' or '*holotypus*', or its abbreviation, or even its equivalent in a modern language.
- For the name of a new species or infraspecific taxon published on or after 1 January 1990 whose type is a specimen or unpublished illustration, the herbarium or institution in which the type is conserved must be specified.
- Names published on or after 1 January 2007 would require a specimen (and not a mere illustration) as type, except only for microscopic algae or microfungi for which preservation of a type was technically difficult, and where illustration is accepted as type.
- On or after 1 January 2001, lectotypification or neotypification of a name of a species or infraspecific taxon is not affected unless indicated by use of the term '*lectotypus*' or '*neotypus*', its abbreviation, or its equivalent in a modern language.
- The specimen selected as type should belong to a single gathering. '*Echinocereus sanpedroensis*' (Raudonat & Rischer, 1995) was based on a 'holotype' consisting of a complete plant with roots, a detached branch, an entire flower, a flower cut in halves, and two fruits, which according to the label were taken from the same cultivated

individual at different times and preserved, in alcohol, in a single jar. This material belongs to more than one gathering and cannot be accepted as a type. Raudonat & Rischer's name is thus not validly published.

## Effective publication

- The publication becomes effective by distribution in printed form, through sale, exchange or gift to the general public or at least the botanical institutions with libraries accessible to botanists generally.
- It is not affected by communication of new names at a public meeting, by the placing of names in collections or gardens open to the public; by the issue of microfilm made from manuscripts, typescripts or other unpublished material, by publication on-line, or by dissemination of distributable electronic media.
- The publication in newspapers and catalogues (1 January 1953 onwards) and seed exchange lists (1 January 1977 onwards) is not an effective publication.
- A thesis submitted for a higher degree on or after 1 January, 1953 is considered effectively published, only if it carries a statement of its publication or an internal evidence (e.g. an ISBN, or a commercial publisher).
- Publication of handwritten materials, reproduced by some mechanical or graphic process (indelible autograph) such as lithography, offset, or metallic etching before 1 January 1953 is effective.
- The handwritten portions, being indelible autograph published after 1 January 1953, are not effectively published. Intended new combinations ('*Abies koreana* var. *yuanbaoshanensis*', p. 53), for which the *basionym* reference is handwritten, are not validly published. The entirely handwritten account of a new taxon (p. 61: name, Latin description, statement of type) is treated as unpublished.
- The date of a name is that of its valid publication. When the various conditions for valid publication are not simultaneously fulfilled, the date is that on which the last condition was fulfilled. However, the name must always be explicitly accepted in the place of its validation.
- A name published on or after 1 January 1973 for which the various conditions for valid publication are not simultaneously fulfilled is not validly published unless a full and direct reference is given to the places where these requirements were previously fulfilled.
- In order to be accepted, a name of a new taxon of fossil plants published on or after 1 January 1996 must be accompanied by a Latin or English description or diagnosis or by a reference to a previously and effectively published Latin or English description or diagnosis.
- For groups originally not covered by ICBN, the Code accepts them as validly published if they meet the requirements of the pertinent non-botanical Code, but are

now recognized as organisms covered under botanical Code. This provision earlier covered organisms subsequently recognized as algae, but *Vienna Code* extended this provision also to organisms subsequently recognized as fungi. The provision has benefitted the recognition of *Microsporidia*, long considered protozoa and now recognized as fungi. Similarly the species of *Pneumocystis*, not validly published because of lack of Latin diagnosis or description, are now treated as validly published, since Latin requirement is not mandatory under Zoological Code, which originally covered these mammalian pathogens, now treated as fungi.

- The Tokyo Code included a rule (Art. 32. 1-2), subject to ratification by the XVI International Botanical Congress (St Louis, 1999) according to which new names of plants and fungi would have to be registered in order to be validly published after the 1st of January 2000.
- A correction of the original spelling of a name does not affect its date of valid publication.

## Rejection of Names

- The process of selection of correct name for a taxon involves the identification of illegitimate names, those which do not satisfy the rules of botanical nomenclature.
- A legitimate name must not be rejected merely because it, or its epithet, is inappropriate or disagreeable, or because another is preferable or better known or because it has lost its original meaning. The name *Scilla peruviana* L. (1753) is not to be rejected merely because the species does not grow in Peru.

## *Conditions of rejection of a name:*

1. **Nomen nudum (abbreviated *nom. nud.*):** A name with no accompanying description. Many names published by Wallich in his Catalogue (abbreviated Wall. Cat.) published in 1812 were nomen nudum. These were either validated by another author at a later date Botanical Nomenclature 29 by providing a description (e.g. *Cerasus cornuta* Wall. ex Royle) or if by that time the name has already been used for another species by some other author, the nomen nudum even if validated is rejected and a new name has to be found (e.g. *Quercus dilatata* Wall., a nom. nud. rejected and replaced by *Q. himalayana* Bahadur, 1972).

2. Name not effectively published, not properly formulated, lacking typification or without a Latin diagnosis.

3. **Tautonym:** Whereas the Zoological Code allows binomials with identical generic name and specific epithet (e.g. *Bison bison*), such names in Botanical nomenclature constitute tautonyms (e.g. *Malus Malus*) and are rejected. The words in the tautonym are exactly identical, and evidently names such as *Cajanus cajan* or *Sesbania sesban* are not tautonyms

and thus legitimate. Repetition of a specific epithet in an infraspecific epithet does not constitute a tautonym but a legitimate autonym (e.g. *Acacia nilotica* ssp. *nilotica*).

4. **Later homonym:**

- Just as a taxon should have one correct name, the Code similarly does not allow the same name to be used for two different species (or taxa). Such, if existing, constitute homonyms. The one published at an earlier date is termed the earlier homonym and that at a later date as the later homonym. The Code rejects later homonyms even if the earlier homonym is illegitimate. Example: (a) *Ziziphus jujuba* Lam., 1789 had long been used as the correct name for the cultivated fruit jujube. This, however, was ascertained to be a later homonym of a related species *Z. jujuba* Mill., 1768. The binomial *Z. jujuba* Lam., 1789 is thus rejected and jujube correctly named as *Z. mauritiana* Lam., 1789. (b) Similarly, although the earliest name for almonds is *Amygdalus communis* L., 1753 when transferred to the genus *Prunus* the name *Prunus communis* (L.) Archangeli 1882 for almond became a later homonym of *Prunus communis* Huds., 1762 which is a species of plums. *P. communis* (L.) Archangeli was as such replaced by *P. dulcis* (Mill.) Webb, 1967 as the name for almonds.
- When two or more generic or specific names based on different types are so similar that they are likely to be confused (because they are applied to related taxa or for any other reason) they are to be treated as homonyms. Names treated as homonyms include: *Asterostemma* Decne. (1838) and *Astrostemma* Benth. (1880); *Pleuropetalum* Hook. f. (1846) and *Pleuripetalum* T. Durand (1888); *Eschweilera* DC. (1828) and *Eschweileria* Boerl. (1887); *Skytanthus* Meyen (1834) and *Scytanthus* Hook. (1844).
- The three generic names *Bradlea* Adans. (1763), *Bradleja* Banks ex Gaertn. (1790), and *Braddleya* Vell. (1827), all commemorating Richard Bradley, are treated as homonyms because only one can be used without serious risk of confusion.
- The following specific epithets under the same genus would also form homonyms *chinensis* and *sinensis*; *ceylanica* and *zeylanica*; *napaulensis, nepalensis*, and *nipalensis*.

5. **Later isonym:** When the same name, based on the same type, has been published independently at different times by different authors, then only the earliest of these so-called '***isonyms'*** has nomenclatural status. The name is always to be cited from its original place of valid publication, and later '*isonyms*' may be disregarded.

Example: Baker (1892) and Christensen (1905) independently published the name *Alsophila kalbreyeri* as a substitute for *A. podophylla* Baker (1891) non Hook. (1857). As published by Christensen, *Alsophila kalbreyeri* is a later 'isonym' of *A. kalbreyeri* Baker, without nomenclatural status.

**6. Nomen superfluum (abbreviated as *nom. superfl.*):**

- A name is illegitimate 30 Plant Systematics and must be rejected when it was nomenclaturally superfluous when published, i.e., if the taxon to which it was applied—as

circumscribed by its author—included the type of a name or epithet which ought to have been adopted under the rules. Example: *Physkium natans* Lour., 1790 thus when transferred to the genus *Vallisneria*, the epithet natans should have been retained but de Jussieu used the name *Vallisneria physkium* Juss., 1826 a name which becomes superfluous. The species has accordingly been named correctly as *Vallisneria natans* (Lour.) Hara, 1974.

- A combination based on a superfluous name is also illegitimate. *Picea excelsa* (Lam.) Link is illegitimate since it is based on a superfluous name *Pinus excelsa* Lam., 1778 for Pinus abies Linn., 1753. The legitimate combination under *Picea* is thus *Picea abies* (Linn.) Karst., 1880.

7. **Nomen ambiguum (abbreviated as *nom. ambig.*):** A name is rejected if it is used in a different sense by different authors and has become a source of persistent error. The name *Rosa villosa* L. is rejected because it has been applied to several different species and has become a source of error.

**8. Nomen confusum (abbreviated as *nom. confus.*):** A name is rejected if it is based on a type consisting of two or more entirely discordant elements, so that it is difficult to select a satisfactory lectotype. The characters of the genus Actinotinus, for example, were derived from two genera Viburnum and Aesculus, owing to the insertion of the inflorescence of Viburnum in the terminal bud of an Aesculus by a collector. The name Actinotinus must, therefore, be abandoned.

**9. Nomen dubium (abbreviated as *nom. dub.*):** A name is rejected if it is dubious, i.e. it is of uncertain application because it is impossible to establish the taxon to which it should be referred. Linnaeus (1753) attributed the name *Rhinanthus crista-galli* to a group of several varieties, which he later described under separate names, rejecting the name *R. crista-galli* L. Several later authors, however, continued to use this name for diverse occasions until Schwarz (1939) finally listed this as *Nomen dubium*, and the name was finally rejected.

10. **Name based on monstrosity:** A name must be rejected if it is based on a monstrosity. The generic name *Uropedium* Lindl., 1846 was based on a monstrosity of the species now referred to as *Phragmidium caudatum* (Lindl.) Royle, 1896. The generic name *Uropedium* Lindl. must, therefore, be rejected. The name *Ornithogallum fragiferum* Vill., 1787, is likewise, based on a monstrosity and thus should be rejected.

# Principle of Priority

The principle of priority is concerned with the selection of a single correct name for a taxonomic group. After identifying legitimate and illegitimate names, and rejecting the latter, a correct name has to be selected from among the legitimate ones. If more than one legitimate

names are available for a taxon, the correct name is the earliest legitimate name in the same rank. For taxa at the species level and below the correct name is either the earliest legitimate name or a combination based on the earliest legitimate basionym, unless the combination becomes a tautonym or later homonym, rendering it illegitimate.

**The following examples illustrate the principle of priority**:

1. The three commonly known binomials for the same species of *Nymphaea* are *N. nouchali* Burm.f., 1768, *N. acutiloba* DC., 1824, *N. stellata* Willd., 1799 and *N. malabarica* Poir., 1798. Using the priority criterion, *N. nouchali* Burm.f. is selected as the correct name as it bears the earliest date of publication. The other three names are regarded as synonyms. The citation is written as: Botanical Nomenclature 31 *Nymphaea nouchali* Burm.f., 1768 *N. malabarica* Poir., 1798 *N. stellata* Willd., 1799 *N. acutiloba* DC., 1824 The following binomials for common maize plant exist: *Zea mays* Linn., 1753, *Z. curagua* Molina, 1782, Z. indurata Sturtev., 1885 and *Z. japonica* Von Houtte, 1867. *Zea mays* being the earliest validly published binomial is chosen as correct name, and others cited as its synonyms as under: *Zea mays* L., 1753 *Z. curagua* Molina, 1782 *Z. japonica* Von Houtte, 1867 *Z. indurata* Sturtev., 1885.

2. Loureiro described a species under the name *Physkium natans* in 1790. It was subsequently transferred to the genus *Vallisneria* by A. L. de Jussieu in 1826, but unfortunately, he ignored the epithet *natans* and instead used a binomial *Vallisneria* physkium, a superfluous name. Two Asiatic species with independent typification were described subsequently under the names *V. gigantea* Graebner, 1912 and *V. asiatica* Miki, 1934. Hara on making a detailed study of Asiatic specimens concluded that all these name are synonymous, and also that *V. spiralis* Linn. with which most of the Asiatic specimens were identified does not grow in Asia. As no legitimate combination based on *Physkium natans* Lour. existed, he made one—*V. natans* (Lour.) Hara—in 1974. The synonymy would be cited as under: Vallisneria natans (Lour.) Hara, 1974 *Physkium natans* Lour.,1790— Basionym V. physkium Juss., 1826—nom. superfl. *V. gigantea* Graebner, 1912 *V. asiatica* Miki, 1934 *V. spiralis* auct. (non L., 1753) The correct name of the species in this case, is the most recent name, but it is based on the earliest basionym.

It must be noted that *Physkium natans* and *Vallisneria physkium* are based on the same type as the correct name *V. natans* and are thus known as nomenclatural synonyms or homotypic synonyms. These three would remain together in all citations. The other two names *V. gigantea* and *V. asiatica* are based on separate types and may or may not be regarded as synonyms of *V. natans* depending on taxonomic judgement. Such a synonym, which is based on a type different from the correct name, is known as a **taxonomic synonym or heterotypic synonym.** *V. spiralis* auct. (*auctorumauthors*) is misplaced identification of Asian specimens with *V. spiralis* L.

3. The common apple was first described by Linnaeus under the name *Pyrus Malus* in 1753. The species was subsequently transferred to the genus *Malus* but the combination *Malus Malus* (Linn.) Britt., 1888 cannot be taken as the correct name since it becomes a tautonym. The other binomial under *Malus* available for apple is M. domestica Borkh, 1803 which is accepted as correct name and citation written as: *Malus* domestica Borkh Pyrus *Malus* Linn., 1753 M. *Malus* (Linn.) Britt., 1888— Tautonym *M. pumila* auct. (non Mill.) *M. communis* Desf., 1798— Nom. superfl. *M. communis* Desf. is based on same type as Pyrus *Malus*, and is as such a nomen superfluum. Apple has been assigned by some authors to *M. pumila* Mill., 1768, which however is small fruited Paradise apple.

4. Almond was first described by Linnaeus under the name *Amygdalus communis* in 1753. Miller described another species under the name *A. dulcis* in 1768. The two are now regarded as synonymous. The genus *Amygdalus* was subsequently merged with the genus Prunus and the combination *Prunus communis* (L.) Archangeli made in 1882 32 Plant Systematics based on the earlier name *Amygdalus communis* Linn. It was discovered by Webb that the binomial *Prunus communis* had already been used by Hudson in 1762 for a different species rendering *P. communis* (L.) Archangeli a later homonym which had to be consequently rejected. Webb accordingly used the next available basionym *Amygdalus dulcis* Mill., 1768 and made a combination *Prunus dulcis* (Mill.) Webb, 1967 as the correct name for almond. Another binomial, *Prunus amygdalus* Batsch, 1801, cannot be taken up as it ignores the earlier epithets. The citation for almond would thus be: *Prunus dulcis* (Mill.) Webb, 1967 *Amygdalus dulcis* Mill., 1768— basionym *A. communis* L., 1753 *P. communis* (L.) Arch., 1882 (non Huds., 1762) P. amygdalus Batsch, 1801.

5. When two or more names simultaneously published are united, the first author to make such a merger has the right of choosing the correct name from these. Brown, 1818 was the first to unite *Waltheria americana* L., 1753 and *W. indica* L., 1753. He adopted the name *W. indica* for the combined species, and this name is accordingly treated as having priority over *W. americana*.

6. The generic names *Thea* L. and *Camellia* L. are treated as having been published simultaneously on 1 May 1753. The combined genus bears the *name Camellia*, since Sweet, 1818, who was the first to unite the two genera, chose that name, and cited *Thea* as a synonym.

## Names of Cultivated Plants

- The names of cultivated plants are governed by the International Code of Nomenclature for Cultivated Plants (ICNCP), last published in 1995 (Trehane et al.).

- Most of the rules are taken from ICBN with additional recognition of a rank cultivar (abbreviated cv.) for cultivated varieties.
- The name of a cultivar is not written in Italics, it starts with a capital letter, and is not a Latin but rather a common name. It is either preceded by cv. as in *Rosa floribunda* cv. Blessings or simply within single quotation marks, e.g. *Rosa floribunda* 'Blessings'.
- Cultivars may also be named directly under a genus (e.g. *Hosta* 'Decorata'), under a hybrid (e.g. *Rosa paulii* 'Rosea') or directly under a common name (e.g. Hybrid Tea Rose 'Red Lion').
- The correct **nothogeneric** name for plants derived from the *Triticum secale* crosses is *Triticosecale wittmack* ex *A. Camus*. As no correct name at the species level is available for the common crop triticales, it is recommended that crop triticales be named by appending the cultivar name to the nothogeneric name, e.g. Triticosecale 'Newton'. Since
- 1 January 1959 new cultivar names should have a description published in any language and these names must not be the same as the botanical or common name of a genus or a species. Thus, cultivar names 'Rose', 'Onion', etc., are not permitted as the name of a cultivar.
- It is recommended that cultivar names be registered with proper registering authorities to prevent duplication or misuse of cultivar names. Registering authorities exist separately for roses, orchids and several other groups or genera.

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