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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

Details of the topics

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), Takhtajan (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: Plant Nomenclature, Botanical Names and Phylocode and ICBN-Principles, Rules and Regulations

PLANT NOMENCLATURE, BOTANICAL NAMES AND PHYLOCODE

FUNDAMENTALS OF PLANT NOMENCLATURE

Definitions

Assignment of definite names to plants is called *plant nomenclature*.

In the present botanical world, the nomenclature involves the principles governed by rules formulated and adopted by International Botanical Congress. The rules developed by IBC are listed formally in a code called International Code of Botanical Nomenclature (Voss et al., 1983), abbreviated as ICBN. The major goal of ICBN is to provide one correct name for each taxon.

Taxa (singular, taxon) are the taxonomic groups of any rank. The ascending hierarchy of taxa include species, genus, family, order, class and division.

Who is a Nomenclaturist?

A nomenclaturist is a taxonomist who assigns names to new taxa, determines the right names for old taxa according to the rules of International Code of Botanical Nomenclature, and finalises the right name for a specimen to an established system of classification.

Why is Nomenclature Needed?

Imagine for a few moments about the state of affairs if there are no names for all the things we see, make or handle. How strange and chaotic the life would be in such a condition? The entire business affairs of the world would stop and practically there will be no “give and take” of knowledge. It would also be impossible for all of us to communicate our feelings to others. Practically, the life would stop. Therefore, nomenclature for everything is needed.

COMMON NAMES AND SCIENTIFIC NAMES

Vernacular or common names are made up of words from the native language of the country or the region. They may vary in different countries as well as in different regions of the same country. They may be Portuguese words in Portugal; Spanish in Spain; English in England, U.S.A. and Australia; and Hindi, Bangla, Oriya or Tamil, etc. in U.P., West Bengal, Orissa and Tamil Nadu, respectively. ‘Papita’, ‘Kela’, ‘Gazar’ and ‘Tamatar’, of India are known in U.S.A. as papaya, banana, carrot and tomato, and by other names in Spain. There is therefore no international uniformity in common names.

On the other hand, *scientific names* which are based mainly on Latin language have international uniformity. By the name *Saccharum officinarum*, all botanists of the world would understand that it is sugarcane.

Jones and Luchsinger (1987) have stated that common names present five major problems mentioned in the following table:

S.No.	Common Names	Scientific Names
1.	These are not universal. They vary in different languages.	These are universal and are recognised throughout the world.
2.	They do not provide information indicating generic and family relationships.	They provide information regarding these relationships.
3.	A well-known plant may have hundreds of common names.	A well-known plant has only one scientific name.
4.	Sometimes, two or more plants have the same common name.	Two or more plants always have different scientific names.
5.	Many species do not have any common names.	All known plants have a scientific name.

The scientific name of a plant consists of two separate words. The first word designates the genus of the organism and the second word designates the species. Details of this two-name system were first given by Linnaeus (1753) in his famous *binomial system of nomenclature*.

BINOMIAL NOMENCLATURE

What is Binomial Nomenclature?

In the earlier days plant names were long and descriptive e.g. in the herbal of Clusius (1583) a species of willow is named *Salix pumilaangustifoliaaltera*. Then, in 1623, Gaspar Bauhin (1560-1624) devised a plan of adopting two names for each plant in his *PinaxTheatriBotanici*. But it was Carlous Linnaeus (1707-1778), the great Swedish naturalist, to whom the actual credit goes for devising and methodically employing the binomial system of nomenclature. Linnacus employed this system in the first edition of his *Species Plantarum* in 1753. According to this system the scientific name of a plant consists of two Latin or latinized words: (1) The first is the name of genus, i.e. generic name or *generic epithet*, and (2) the second is the name of the species, i.e. *specific epithet*. For example, the botanical name of sugarcane is *Saccharumofficinarum*. The first word (*Saccharum*) designates the genus of the plant and the second word (*officinarum*) designates the species of this genus.

Generic Name

It is always a noun, and written with a capitalised initial letter and the remainder small. The generic name is also always singular in number. It may have following types of origin:

1. Several generic names may be in honour of the names of well-known persons, e.g. *Theophrasta* in honour of Theophrastus and *Candollea* in honour of A.P. de Candolle.
2. They may be descriptive, with reference to some common characteristics of the included species, e.g. *Cercocarpus* (coiled fruit), *Xanthoxylum* (yellow wood), etc.
3. They may be of poetic or mythological origin, e.g. *Theobroma* (god's food).
4. They may also be the aboriginal name of the plants, e.g. *Betula* and *Quercus* which were the old Greek names for Birch and Oak.

Specific Epithet

According to the 1983 recommendations of the International Code of Botanical Nomenclature (Voss et al., 1983), all specific epithets be written with a small initial letter. But if the specific epithet is derived from common names, or from former generic names, or from a person's name, the initial letter of the epithet may be a capital letter. In the typed or handwritten matter, both the specific epithet and generic names should be underlined. They should be printed in *italics* or *boldface*. The authority, written after the specific epithet, is never underlined.

The specific epithet is often an adjective. According to Article 23 of ICBN, a specific epithet (i) may be a name in honour of person, or (ii) may be derived from a geographical location, or (iii) may originate from an old common name, or (iv) may be derived from some characteristics of the plant, or (v) it may also be named arbitrarily.

Authority

The name of the species is incomplete if it is not followed by full or abbreviated name(s) of the author(s). For example, *Pyrusmalus* is incomplete. The complete name is *Pyrusmalus* L, where L, is abbreviated for Linnacus. Citation of the full or abbreviated form of the author is necessary because this will verify the date or time of the first valid publication of the name of a particular taxon.

INTERNATIONAL CODE OF BOTANICAL NOMENCLATURE (ICBN)

What is ICBN?

The *International Code of Botanical Nomenclature* (ICBN) is the set of rules and recommendations dealing with the formal *botanical names* that are given to plants. Its main aim is that each *taxon* or *taxonomic* group of plants has only one *correct botanical name* and that is accepted throughout the world. Two main principles of ICBN are listed below:

- (1) *Priority* is the guiding principle in botanical nomenclature. The ICBN sets the formal starting date of plant nomenclature at 1 May, 1753, which is the publication date of *Species Plantarum* by Linnacus.
- (2) Each botanical name is fixed to a taxon by a *type*, which is almost invariably dried plant material usually deposited and preserved in a herbarium.

Very few hard rules of ICBN apply above the taxonomic rank of family. Each new edition of ICBN supersedes the earlier editions and is retroactive back to 1753.

Who can change ICBN?

The ICBN can only be changed by an International Botanical Congress (IBC), with the International Association for Plant Taxonomy providing the supporting infrastructure.

To which Organisms does ICBN Apply?

The ICBN applies not only to plants, as they are now defined, but it also applies to other organisms studied traditionally by botanists, e.g., Cyanobacteria (blue-green algae), fungi, photosynthetic protists and taxonomically related non-photosynthetic groups. For fossils, there are special provisions in ICBN.

Whether ICBN is Applicable to Cultivated Plants?

No. For naming of cultivated plants, there is a separate code called the International Code of Nomenclature for Cultivated Plants (ICNCP).

History of ICBN

Linnacus in 1737 and again in 1751 proposed the elementary rules of naming plants in his *Philosophia Botanica*. Then in 1813, A.P. de Candolle set forth a detailed set of rules regarding plant nomenclature in his *Theoricelementaire de la botanique*. The same rules of Linnacus, A.P. de Candolle and his son Alphonse de Candolle were later evolved into our present *International Code of Botanical Nomenclature* (ICBN).

Alphonse de Candolle convened the *First International Botanical Congress* in 1867 in Paris. It was attended by the botanists of several countries. They adopted a set of rules of plant nomenclature, most of which were proposed by A. de Candolle. These excellent rules of plant nomenclature are known as *de Candolle rules or Paris Code* of 1867. Subsequent meetings of the International Botanical Congress were held in 1892 (*Rochester Code*), 1905 (*Vienna Code*), 1907 (*American Code*) and 1910, but a general agreement, regarding the internationally acceptable rules of plant nomenclature, was reached in the meeting of the IBC at Cambridge in 1930. Lawrence (1951) has discussed the detailed history of the Code and may be quoted that in 1930 at the Cambridge Congress “for the first time in botanical history, a code of nomenclature came into being that was international in function as well as in name.” This code is called the *International Code of Botanical Nomenclature*. Scientists in the International Botanical Congress suggest the modifications or amendments which are incorporated in the ICBN on a regular basis.

The International Code of Botanical Nomenclature, 1983, was adopted by the Thirteenth International Botanical Congress, Sydney (Australia) in August 1981, and the Chairman of the editorial committee was E.G. Voss. ICBN is divided into three parts, i.e. *Principles, Rules and Recommendations*.

Principles of ICBN

The philosophical basis of the Code is formed by the following six principles:

1. Botanical nomenclature is independent of zoological nomenclature.
2. The application of names of taxonomic groups is determined by means of nomenclatural types.
3. The 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, except in specific cases.
5. Scientific names of taxonomic groups are treated as Latin regardless of their derivation.
6. The Rules of nomenclature are retroactive unless expressly limited.

Rules and Recommendations of ICBN

According to the ICBN (1983), the detailed provisions of the Code “are divided into *Rules*, set out in *Articles*, and *Recommendations*”. As mentioned under point No. 4 of the *Preamble* of 1983 ICBN “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”.

As mentioned under point No. 5 of the *Preamble* of 1983 ICBN “The *Recommendations* deal with subsidiary points, their object being to bring about greater uniformity and clearness, especially in future nomenclature; names contrary to a recommendation cannot, on that account, be rejected, but they are not examples to be followed”.

The *Rules and Recommendations* of ICBN apply to all organisms treated as plants (including fungi but excluding bacteria), whether fossil or non-fossil. Nomenclature of bacteria is governed by a separate code called *International Code of Nomenclature of Bacteria* (ICNB).

It is stated under point No. 10 of ICBN (1983) that the latest “edition of the Code supersedes all previous editions.”

Some Later Codes

St. Louis Code (1999)

The 16th International Botanical Congress was held at St. Louis, Missouri, USA in August 1999, and the International Code of Botanical Nomenclature adopted in this Congress is called *St. Louis Code*. Botanists of 85 nations attended this Congress. Hectic discussions were made mainly in view of the facts that “as many as two-thirds of the world’s 3,00,000 plant species are in danger of extinction in nature during course of the 21st century”, and almost every aspect of the life of human beings depends on plants. Botanists made some *resolutions and recommendations*, of which some major ones are undermentioned:

- (A) **Resolutions** : Six resolutions were passed in this International Botanical Congress at St. Louis.

- (1) **Resolution I** : Botanists agreed on 10 major aspects in this resolution, of which some are mentioned below. They call for:
- (i) “the establishment of a new coordinating body associated with United Nations to monitor the status of plants throughout the world, detect those in most danger, and take steps to conserve them in nature, in botanic gardens, or in gene banks”;
 - (ii) “securing additional funds for study of plants throughout the world”;
 - (iii) “making all the information about plants generally available on the Internet”;
 - (iv) placing additional emphasis on the importance of the “survival of biodiversity throughout the world”;
 - (v) maintaining “an active census of the status of each country’s plants” at national level;
 - (vi) “actively developing and implementing plans to conserve the world’s economic plants.....”;
 - (vii) “devoting special attention to the conservation of medicinal plants....”;
 - (viii) “funding internationally an ongoing programme of research on plant population biology....”
- (2) **Resolution II** : Botanists of the 85 nations attending this Congress call on governments and policy makers to:
- (i) “recognize the importance of developing and maintaining scientific expertise, provide resources for the education and training of scientists, and maintain career opportunities”... especially in biological sciences;
 - (ii) “actively develop floras and detailed accounts of plants of all regions....”;
 - (iii) “support collaborative programmes between and among developed and developing countries”;
 - (iv) “ensure high priority be given to the maintenance of botanical museums, herbaria, libraries, gardens, living plant collections and gene banks ...”;
- (3) **Resolution III** : Botanists in this resolution resolved to:
- (i) “increase our knowledge of diversity and relationships of plants ...” and “to make that knowledge accessible to all”;
 - (ii) “advocate to policy makers the relevance of plant species ...”, and thus “maintain the quality of human life on earth”;
- (4) **Resolution IV to VI** : These three resolutions are regarding the (i) importance and programmes of biodiversity (Resolution IV); acceptance of the decisions of Nomenclature Section of the Congress ((Resolution V); and selection of sites for future Congresses to facilitate the “attendance of botanists from all regions of the world” (Resolution VI).
- (B) **Recommendations** : Several recommendations have been made in ICBN in the *St. Louis Code* by botanists attending the XVI International Botanical Congress, of which only some are undermentioned:

1. The scientific names under the jurisdiction of the Code, irrespective of rank, “are consistently printed in *italic type*. The Code sets no binding standard in this respect, as typography is a matter of editorial style and tradition, not of nomenclature.”
2. To set off scientific names even better, the use of *italics* for technical terms and other words in Latin “has now been abandoned.”
3. For style of bibliography, the titles of the books are “abbreviated in conformity with *Taxonomic Literature*, ed. 2 by Stafleu & Cowan (1976-1988; with supplements by Stafleu & Mennega, 1999-2000).”
4. For style of bibliography the *journal titles* are abbreviated in conformity with *Botanico-periodicum-huntianum* (1968) and its supplement (1991).
5. Author citations of scientific names are standardized in conformity with *Authors of Plant Names* by Brummitt and Powell (1992).
6. The single largest area of change in *St. Louis Code* concerns typification, where many proposals have been made on *Lectotypification* (for details refer to original code).
7. All reference to registration of new botanical names, to become “mandatory from a future date, be deleted from the Code ...”
8. Fossil plant nomenclature underwent profound changes in *St. Louis Code* (for details refer to original code).
9. Fungal nomenclature was only affected in a marginal way by decisions of the *St. Louis Congress*.
10. One new term “isonym” has been introduced into the Code, “defined to mean the same name used independently by different authors at different times ...”
11. In the field of terminology, the term “homotypic synonym”, “heterotypic synonym” and “replacement names” were accepted as optional equivalents of the earlier “nomenclatural synonym”, “taxonomic synonym” and “avowed substitute”.
12. The terminations *-viridae*, *-virales*, *-virinae*, and *-virus* were “outlawed for names of sub-classes, orders, subtribes and genera, respectively.

Vienna Code (2005)

The latest XVII International Botanical Congress was held in Vienna in 2005 (XVI being at St. Louis, Missouri, USA), and the International Code of Botanical Nomenclature accepted in this Congress is called *Vienna Code*. It is written entirely in English and has been translated in several other languages. One of the reasons invoked for the choice of Vienna as the site of XVII Congress was that the second International Botanical Congress had been held there exactly 100 years earlier, i.e., in 1905. It was in this IInd Congress in 1905 that the first internationally developed rules governing nomenclature of plants were accepted, and these rules were recognised as *Vienna Rules*. The XVII IBC held on 12-16 July, 2005 at Vienna was attended by 198 registered members carrying 402 institutional votes. On the other hand, *St. Louis Congress* at Missouri, held six years ago in 1999 was attended by 297 members carrying 494 institutional votes.

The *Vienna Code* does not differ substantially in overall presentation and arrangements from the *St. Louis Code*, and the number of Articles remains the same. Some selected additions and recommendations of *Vienna Code* are listed below:

1. The most notable feature of *Vienna Code* “is the inclusion for the first time a Glossary, which appears in Appendix VII. This Glossary is very tightly linked to the wording of the Code, and “only nomenclatural terms defined in the Code can be included.”
2. The scientific names under the jurisdiction of Code, irrespective of rank, are consistently printed in *italic* type. The “Code sets no binding standard in this respect, as typography is a matter of editorial style and tradition not of nomenclature.”
3. The titles of the books in bibliographic citations are abbreviated in conformity with “*Taxonomic Literature*, ed. 2, by Stafleu & Cowan (1976-1988; with 6 supplements by Stafleu & Mannega, 1992-2000)”, but with capital initial letters.
4. For titles of the journals in bibliographic citations, the abbreviations follow the *Botanico-periodicum-huntianum*, ed. 2 (2004).
5. Author citations of scientific names appearing in the Code are “standardized in conformity with *Authors of Plant Names*, by Brummitt & Powell (1992)”; these are “also adopted and updated by the *International Plant Names Index*.”
6. “Perhaps the most important single decision incorporated into the *Vienna Code* was to deal with what many have recognized as a *bomb waiting to explode*, the publication status of *theses submitted for a higher degree*”. The Code decided that “no independent non-serial publication stated to be a thesis submitted for a higher degree on or after 1 January 1953 would be considered an effectively published work without a statement to that effect or other internal evidence” (*for details, readers should consult the original Code*).
7. Regarding valid publication of names, *Vienna Code* made it clear that “names be composed only of letters of Latin alphabet, except as otherwise provided in the Code.”
8. St. Louis Code accepted that all fossil taxa should be treated as *morphotaxa*. In *Vienna Code*, this has not been considered appropriate. A distinction between a morphotaxon and a regular fossil taxon is now established in *Vienna Code*.
9. In *Vienna Code*, it was agreed that “the starting date for valid publication of suprageneric names of spermatophytes, pteridophytes and bryophytes be 4 August 1789, the date of publication of Jussieu’s *Genera Plantarum*.”
10. *Vienna Code* also established that parenthetic author citation is not permitted as suprageneric ranks.
11. Four family names, previously overlooked in Berchtold and Presl’s rare, later, multivolume work of the same name (1823-1825) have been updated: *Aquifoliaceae*, *Cornaceae*, *Potamogetonaceae* and *Punicaceae*.
12. Under the concept of “minimum invalidity” (Art. 33.10), the “rules determining when a rank is denoted by a misplaced term (and hence not validly published) were clarified and made more practical.”
13. From 1 January, 2007, a new combination, a new generic name with a basionym, or an allowed substitute “is not validly published unless its basionym or replaced synonym is cited.”
14. *Vienna Code* established that only if validly published does a name have any status; indeed, unless otherwise indicated, the word “name” in the Code means a name that has been validly published.”

Future Botanical Congress and Legality of ICBN

The International Code of Botanical Nomenclature (ICBN) is published under the authority of the International Botanical Congress (IBC). The next meeting of the IBC will be held in Melbourne, Australia, from 23-30 July, 2011. Similar to other international codes of nomenclature, ICBN also has no legal status and is dependent on the voluntary acceptance of its rule by scientists in general and botanists in particular.

SOME IMPORTANT RULES OF NOMENCLATURE

- 1. Ranks and Endings of Taxa :**In an accepted system of classification, each individual plant is treated as belonging to a number of taxa of different ranks. Generally, the species is considered as the basic unit of classification. Other main ranks in the flowering plants in an ascending order are genus, family, order, subclass and class. However, ICBN (Voss et al, 1983) has mentioned 22 different ranks and some standardized grammatical endings (*suffixes*) for the ranks from division down to the level of genus.
- 2. Principles of Priority :**One plant might have been described under different botanical names by various plant nomenclaturists in different parts of the world. But, according to the “principle of priority” each taxon is to be known by its earliest name.” For example *Cleome gynandra* Linn, was first described and named by Linnacus in 1753. Then he himself changed its name as *Cleome pentaphylla* Linn. In 1824 de Candolle recognized three separate genera (*Cleome, Polanisia and Gynandropsis*) and named the Linnaean genus as *Gynandropsispentaphylla* (Linn.) DC. Iltis in 1960 merged *Gynandropsis* and *Cleome* into one genus, i.e. *Cleome*. So according to the “Principle of priority”, the oldest name (*Cleome gynandra* Linn.) is the correct valid name.
Because of Principle of Priority, names of several plants have now been changed.
- 3. Type Method :**The type method is a legal device to provide the correct name for a taxon. A *type specimen* is a herbarium sheet (or rarely a drawing or a photograph) of a specimen which was used by the author to provide its authentic description. According to Article 9 of ICBN the type of a genus is a species (e.g. the type of *genus Vernonia* is *V. noveboracensis* (L.) Michx.), and the type of a family is a genus (e.g. *Aster* is the type genus of *Asteraceae*). Several *kinds of types* designated by ICBN are undermentioned:
 - i. Holotype :**It is a specimen used by the author in the original publication as the nomenclatural type.
 - ii. Isotype :**It is a duplicate specimen of the holotype, i.e. from the same collection, with the same locality, date and number as the holotype.
 - iii. Lectotype :**It is a specimen selected by a competent worker from the original material studied by the author of the species, when no holotype was designated or when the holotype has been destroyed or lost.
 - iv. Neotype :**It is a specimen to serve as a substitute for the holotype when all material, on which the name of the taxon was based, is missing.

- v. **Nomenclatural Type** :It is that element with which the name of a taxon is permanently associated.
- vi. **Syntype** :It is one of the two or more specimens cited by an author of a species when no holotype was designated; or, a syntype is any one of the two or more specimens originally designated as types.
- vii. **Paratype or “Co-types”** :It is a specimen other than isotype or holotype. If two or more specimens have been cited as types by the author, the remaining cited specimens are called “Co-types” or paratypes.
- viii. **Topotype** :It is a specimen collected from the same locality from where the holotype was collected.

4. Synonyms and Related Definitions :A name rejected due to misuse or difference in taxonomic judgement is called *synonym*.

A specific or intraspecific name which has priority and is retained when transferred to a new taxon, is called a *basionym*.

A case in which two or more identical names are based on different types, of which only one can be a legitimate name is called a *homonym*.

An illegitimate binominal, in which the name of the genus and the name of the species is the same, is called a *tautonym*, e.g. *Armoracia armoracia* (L.) Britton.

An automatically created legitimate tautonym for infraspecific or infrageneric taxa is called an *autonym*, e.g. *Hypericum* subgenus *Hypericum* section *Hypericum*.

5. Citation of Author : Some of the rules related to author citation are undermentioned:

i. **Original Author** :The name of a taxon is complete and accurate only when it is followed by a full or abbreviated form of the author(s) who first validly published the concerned name, e.g. *Liliaceae* and *Liliumsuperbum* are incomplete; the complete names are *Liliaceae*Adans and *Liliumsuperbum* Linn.

ii. **Joint Author** :If two authors have jointly published the name of a taxon, the names of both the authors should be cited and linked by the words et or & e.g. *Illiciumgriffithi* Hook &Thoms (or Hook et Thoms).

iii. **Rank Alteration** :When a taxon of a lower rank is upgraded in a higher rank but retains its name, the author’s name who published it first should be cited in the bracket. It is to be followed by the name of the author who made the alteration, e.g. Allioni raised the rank of variety *Medicagopolymorpha* var. *orbicularis* L. to the species rank. Therefore, it becomes *Medicago orbicularis* (L.) All.

iv. **Name Proposal** : When the name of a taxon is proposed but not validly published by one author, and is later on validly published by another, the word ex should be used as a connecting link between the name of the former author and the name of the subsequent author, e.g. *Gossypiumtomentosum* Nutt ex Seem.

6. Names of Cultivated Plants :Wild plants brought under cultivation retain their original names.

- 7. Latin Diagnosis :** The diagnosis, details and description of new taxa published before 1st January, 1995 were accepted by ICBN as valid, irrespective of the language. After this date the description of any new taxa would be considered valid only if accompanied by Latin diagnosis.
- 8. Effective and Valid Publication :** The publication of new names and description are effective and considered valid only when they are distributed in a printed form to the general public or to at least ten well-established botanical institutions.
A validly published names, as specified in the ICBN, is the one in which the basic provisions are (1) effective publication, (2) publication in the form specified for the name of each category of taxa, (3) publication with a description, or a reference to a previously published description, of the taxon to which the name applies, (4) accompanied by a Latin description or by a reference to a previously and effectively published Latin description of the taxon, and (5) an indication of the nomenclatural type. On the other hand, an *effectively published name* is the one published in printed matter generally available to botanists.
- 9. Choice of Names when the Taxon Rank is Changed :** When the rank of a taxon is changed (viz. a species becomes a genus or vice-versa) the earliest legitimate name in its new rank is its correct name.
- 10. Choice of Names when same-rank Taxa are United :** When two or more taxa of the same rank (viz. two or more genera, two or more species, etc.) are united into one, the oldest legitimate name of these taxa would be retained as the name of the united taxon.
- 11. Retention of Names of Divided Taxa :** When a genus or a species is divided into two or more genera or species, respectively, the original name of the genus or species must be retained.
- 12. Retention of Names of Taxa on Transference :** When a subdivision of a genus is transferred to another genus, or a species is transferred to another genus without the change of the rank, the original legitimate name must be retained. For example, *Hydrocotyleasiatica* L., on transference to genus *Centella*, must be named as *Centella asiatica* (L.) Urban.
- 13. Rejection of Names :** Names of taxa must be rejected in the following conditions:
- When the names are illegitimate (i.e. if it is a tautonym, later homonym, rejectable generic name, nomeclaturally superfluous, etc.)
 - When the names give different meanings, and become a permanent source of confusion.
 - When the characters of the name of the taxon are derived from two or more different elements.
 - When the generic names coincide with a morphological term, or are unitary designations to species, or are words not intended as names.

- v. When the specific names are tautonyms, or are published without any consideration of binomial system, or are words not intended as names.

14. Names of Different Taxa : According to the International Code of Botanical Nomenclature (1983) the following should be the pattern of naming different taxa:

- i. Genera and higher ranks should be *monomials*, e.g. *Aesculus* L., *Rosa* L., *Rosaceae* Juss.
- ii. Species should be *binomials*, e.g. *Gossypium tomentosum* Nutt.
- iii. Subspecies should be *trinomials*, e.g. *Hibiscus moscheutos* ssp. *palustris* (L.) Clausen.
- iv. Varieties should be *quadrinomials*, e.g. *Lilium catesbaei* Walter ssp. *catesbaei* var. *longii* Fernald.

BOTANICAL NAMES

Botanical names are either Latin words or words that have been latinized from Greek or some other language.

The name of a species is a binomial and consists of a generic name and a specific epithet. A specific epithet is the second part of the binomial. However, one must be quite clear about the fact that it is wrong to use the specific epithet alone to designate a particular species; it must always be used with a generic name to form the binary combination for that species. The specific epithets are formed from nouns, adjectives, etc. and may join these words with a large number of prefixes and suffixes.

COMMON PREFIXES USED IN SPECIFIC EPITHETS

Some Latin prefixes of numbers are as follows:

1. uni-(L.): uniflorus (one flowered)
2. bi-(L.): bifolius (two-leaved)
3. tri-(L.): triangularis (with 3 angles)
4. quadri-(L.): quadrangularis (with 4 angles)
5. quinque-(L.): quinquefolius (5-leaved)
6. sex-(L.): sexangularis (6-angled)
7. septem-(L.): septemlobus (7-lobed)
8. octo-(L.): octoflorus (8-flowered)
9. noveme-(L.): novemneris (with 9 nerves)
10. decum-(L.): decumlobus (with 10 lobes)

Some of the Greek prefixes of numbers include mon- (for one, e.g. monandra), di- (for 2), tri- (for 3), tetra- (for 4), penta- (for 5), hex- (for 6), hepta- (for 7), octo- (for 8), ennea- (for 9) and deca- (for 10, e.g. decapetalus).

Some of the other common prefixes of numbers are amphi- (Gr.): for two kinds; diplo- (Gr.): for double; haplo- (Gr.): for single; multi- (L.): for many; poly- (Gr.): for many; a- or ab- (L.): away from; ecto- (Gr.): outside; endo- (Gr.): inside; inter- (L.): between, and; intra- (L.): within.

COMMON SUFFIXES USED IN SPECIFIC EPITHETS

Some of the common suffixes along with one example of each of them are undermentioned:
-aceus: crustaceus; -alis: digitalis; -aris: angularis; -arium: aquarium; -actius: aquaticus; -
estris: catapestris; -eus: roseus; -ilis: sextilis; -osus: foliosus.

PLANT PARTS USED AS EPITHETS

Almost all plant parts, including root, stem, leaf, bud, flower, fruit and seeds, have been used as names of specific epithets. Some of the specific epithets, along with the related plant parts in parenthesis, are undermentioned:

receptaculum (for receptacle), sepalum (for sepals), carpellum (for carpel), loculus (for locules), stylus (for style), petalum (for petals), discus (for disc), ovarium (for ovary), ovulum (for ovule), pedicellus (for pedicel), pistillum (for pistil), fructus (for fruit), sperma (for seed), folium and phyllon (for leaf), rhiza (for root), caulos (for stem), etc.

SPECIFIC EPITHETS LINKED WITH COLOUR

Some of the specific epithets linked with colour, along with the name of the colour in the parenthesis, are undermentioned alphabetically:

albicans (whitish), albus (white), atrovirens (dark green), aureus (golden yellow), calcareus (chalky white), candidus (shining white), croceus (saffron yellow), flavidus (slightly yellow), flavus (pale yellow), fulvus (dull yellow), glaucus (grey-green), luteolus (pale yellow), niger (black), niveus (snow white), purpureus (purple), roseus (rosy), violaceus (violet), virens (green) and, viridis (green).

SPECIFIC EPITHETS LINKED WITH GEOGRAPHY

Some of the geography-linked specific epithets, along with their related geographical places in parenthesis, are undermentioned alphabetically:

africanus (of Africa), americanus (of America), arabicus (of Arabia), argentinus (of Argentina), asiaticus (of Asia), australiensis (of Australia), austriacus (of Austria), brasiliensis (of Brazil), canadensis (of Canada), chinensis (of China), cubensis (of Cuba), europaeus (of Europe), germanicus (of Germany), helveticus (of Switzerland), indicus (of India), italicus (of Italy), mexicanus (of Mexico), sinensis (of China), virginicus (of Virginia) and, zeylanicus (of Ceylon).

SPECIFIC EPITHETS LINKED WITH SIZE

Some of size-linked epithets are mentioned below alphabetically:

altus (altitude or tall), exaltatus (very tall), giganteus (gigantic or very large), grandis (large), humilis (dwarf), major (greater), minor (less), minutus (very small), procerus (very tall), pumilus (dwarf) and, robustus (stout or robust).

SPECIFIC EPITHETS LINKED WITH HABIT

Epithets, along with the name of the related habit in parenthesis, are undermentioned alphabetically:

arborescens (arborescent), dichotomus (dichotomous), erectus (erect), furcatus (forked), prostrates (prostrate), ramosus (branched), repens (creeping) and, stoloniferus (stoloniferous).

SPECIFIC EPITHETS LINKED WITH HABITATS

Some of such epithets, along with the name of the related habitat in the parenthesis, are listed below alphabetically:

amphibius (living both on land and in water), aquaticus (living in water), arvensis (growing in ploughed field), campestris (of field), hypogeus (underground), lacustris (of ponds or lakes), littoralis (growing on seashores), maritimus (of sea), montanus (of mountains), palustris (of swamps), rupestris (on rocks), sativus (cultivated), sylvaticus (of woods), sylvestris (growing in woods) and, terrestris (growing in dry soil).

PHYLOCODE: A NEW SYSTEM OF NOMENCLATURE

WHAT IS PHYLOCODE?

Recently, Cantino and de Queiroz (2001) proposed a new code for naming organisms by clear “reference to phylogeny (ancestry and descent), rather than on the basis of the Linnaean hierarchy of taxonomic categories (species, genus, family, and so on)”, as stated by Robinson and Kommedahl (2002), and this “new code” has been named by them as “*Phylocode*”. They also proposed a new term “*clades*” in this code. According to them, “clades” is a “group(s) of species comprising a common ancestor and all its descendants”. Clades are the constituents of the “*tree of life*”. All clades should have explicit and unambiguous names that do not change with time. The current systems of nomenclature are based on Linnaean hierarchy, and they do not “boast such immutability”.

The International Code of Phylogenetic Nomenclature is known in short as “*Phylocode*”. It is a developing “draft for a formal set of rules governing phylogenetic nomenclature”. The current version of Phylocode is specifically designed “to regulate the naming of clades, leaving the governance of species names up to the rank-based codes”.

How has Phylocode Come into Existence?

Phylocode is not a new idea. It is actually “based on ideas presented in the literature since the late 1980s and, more formally, on the outcome of a workshop held at Harvard University in August 1998” (Robinson and Kommedahl, 2002). In this workshop, a draft proposal was put forward, and this draft covers only the naming of clades. It was also decided in this workshop that “rules governing species names will be added later”. However, as a temporary measure, “Linnaean binomial nomenclature is used in the draft Phylocode where species names are needed”.

How are the Species Named in Phylocode?

As mentioned above, the final rules governing species names have not been decided yet. According to Robinson and Kommedahl (2002), “the form that species names should take in the Phylocode” is still controversial. Cantino et al. (1999) earlier presented 13 possibilities for naming species phylogenetically and compared these methods with each other and also with the Linnaean system”. It is, however, for the scientific community to finally decide whether or not the “Phylocode should become the sole code governing the names of the taxa” (Robinson and Kommedahl, 2002).

What is the Basic Difference between Phylocode and Linnaean Binomial Nomenclature?

The fundamental characteristic “that distinguish the Phylocode from the conventional hierarchic nomenclature systems is its *ranklessness*” according to Robinson and Kommedahl (2002). The proposed Phylocode will cover the naming of clades and species, but in this Code, these terms will refer not to ranks but to different kinds of biological entities. It is so because in Phylocode “both (clades and species) are the products of evaluation that are discovered, rather than created, by systematists, and both have an objective existence regardless of whether they are named” (Cantino and de Queiroz, 2001).

What would be the Starting Date for Phylocode?

Regarding the starting date for Phylocode, Robinson and Kommedahl (2002), stated that the “starting date for the new Code, which has not yet been decided, will coincide with the publication of a companion volume providing definitions of widely used clade names”.

What does Phylocode Advisory Group now want from the Scientific Community?

There is an advisory group which is now working on formulation and implementation of Phylocode. This group is now coordinating work and seeking comments and ideas concerning this proposal from as many people as possible. Anybody interested is welcome to review the current draft of Phylocode and communicate it to the Phylocode Advisory Committee.

PRINCIPLES OF THE PHYLOCODE

The proposed Phylocode is based on certain principles. It allows freedom of taxonomic opinion with reference to hypotheses about relationships. It only deals how the names are to be applied with reference to a given phylogenetic hypothesis. As published in Division 1 (Principles) of Phylocode, the five basic principles of Phylocode are reference, clarity, uniqueness, stability, and phylogenetic context.

1. **Reference** :The most basic purpose of names of taxon is to “provide a means of referring to taxa, as opposed to indicating their characters, relationships, or membership”.
2. **Clarity** : The names of taxon should be “unambiguous in their designation of particular taxa. Clarity in nomenclature is achieved through explicit definitions.

3. **Uniqueness** : For promoting clarity, “each taxon should have only one accepted name, and each accepted name should refer to only one taxon”.
4. **Stability** : During course of time, the names of taxa should not change. “As a corollary, it must be possible to name newly discovered taxa without changing the names of previously discovered taxa”. There should, therefore, be a complete stability in the names of taxa.
5. **Phylogenetic context** : The concern of Phylocode is only with the “naming of taxa and the application of taxon within a phylogenetic context”.

PHYLOCODE: AN OVERVIEW

The phylogenetic nomenclature will be regulated by the Phylocode because the latter will provide rules for the following:

1. How to decide which combinations of names and definitions will be considered validly published?
2. Which of the names and definitions will be considered homonyms or synonyms?
3. Which one of a set of homonyms or synonyms will be finally considered valid?

Furthermore, the Phylocode will only allow:

- (i) the naming of clades, and
- (ii) the use of specimens, species, and amorphies as specifiers.

REGISTRATION DATABASE OF PHYLOCODE

RegNum

The future of the Phylocode is still undecided. If and when it is finally implemented, the “Phylocode will be associated with a registration database called *RegNum*. The *RegNum* will store the names of all clades and definitions that will be considered potentially valid”.

The utility of *RegNum* will be to “provide a publicly-usable tool for associating clade names with definitions”. In the latter stages, this will be “associated with sets of subtaxa or specimens through phylogenetic tree databases (such as *TreeBASE*)”. *RegNum* will also be an important tool in taking a decision that “which one of a number of synonyms or homonyms will be considered valid”.

MAIN EVENTS IN THE HISTORY OF PHYLOCODE

1. As mentioned earlier, the idea of Phylocode came as an outcome of a workshop of systematists held at Harvard University in August 1998. An advisory group of leading systematists was formed in this workshop.
2. In April 2000, these systematists prepared a draft of Phylocode and made it public on the web. They also invited comments from the systematists globally.
3. In July 2002, a second workshop on Phylocode was held at Yale University, USA. Several modifications were made in the rules and recommendations of Phylocode in this workshop.
4. From July 6, 2004 to July 9, 2004, the First International Phylogenetic Nomenclature Meeting took place in Paris (France). It was attended by about 70 systematists and evolutionary biologists from 11 nations. A society was formed, namely *International*

Society for Phylogenetic Nomenclature (ISPN). An advisory group was formed to have a complete control on the development of Phylocode.

5. From June 28, 2006 to July 2, 2006, the Second International Phylogenetic Nomenclature meeting took place at Yale University, USA.
6. From July 21, 2008 to July 23, 2008, the Third International Phylogenetic Nomenclature meeting was held at Dalhousie University, Halifax, Nova Scotia, Canada.

FUTURE OF PHYLOCODE

Still there exists some definite criticism of the Phylocode, and therefore, the Code as such is still controversial. Till the late 2007, the “number of supporters for the official adoption of Phylocode is still small”, and it is still uncertain when, actually, “the Code will be implemented, and how widely it will be followed”. Majority of its supporters believe that the registration database or RegNum should be made popularised as much as possible among the scientific community, as a first major step in this direction. A lot, however, depends on following the recommendations of the Third International Phylogenetic Nomenclature meeting held at Dalhousie University, Canada between July 21, 2008 and July 23, 2008.

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