The importance of botanical nomenclature and synonymy in taxonomy and biodiversity

M. K. Vasudeva Rao

Nomenclature of organisms provides a means of communication and is an unambiguous reference system about the elements that constitute biodiversity. The nomenclature of plants is governed by the International Code of Botanical Nomenclature that, in principle, aims at having one correct name for a taxon on the basis of priority of publication. The application of the rules of the Code and taxonomic studies involving change of circumscription of taxon result in nomenclature changes and synonyms. More number of synonyms for a taxon reflects only the more confused state it was/is. Yet the rules of nomenclature, notably the principle of priority, cannot be ignored to prevent any confusion in botanical studies. Literature studies and synonyms are imperative and essential elements of taxonomic research. The stability of nomenclature can be possible in future only when 'authoritative lists' of accepted names are prepared and made widely available by an internationally recognized body. Till then, the principle of priority and synonyms in taxonomic publications cannot be relegated to a secondary level, particularly by taxonomic researchers. The ignorance or careless attitude to nomenclature issues by taxonomists themselves does more harm to the subject than non-taxonomists can cause.

PREPARATION of inventories of organisms is a basic requirement for all activities concerning biodiversity and indisputably needs necessarily correct nomenclature. In an atmosphere wherein the nomenclature aspects in Indian biosystematics literature are considered weak[1] it is imperative to pay adequate attention to nomenclature in taxonomic research. Venu[2] points out that out of 217 articles published in *Current Science* during 1990–99, only 60 had correct names rendered in them. According to him and also in reality, the situation is that 'the modern biologists neither give attention nor importance when it comes to the correct names of the subjects they work on'. The lack of accuracy in floristic surveys and any inadequacy of base information, which also entails nomenclature, may 'cause gross errors of correlation and extrapolation of even small errors to larger dimensions while digitalizing data for species distribution maps'[3]. Nomenclature as well as conceptualization and delimitation of taxa have far-reaching implications for diversity assessment, conservation and phytogeographic conclusions. It is in this context that the attention of the taxonomy researchers and students on the following issues are drawn.

Venu[2], in an otherwise well focused article, raised some issues which send wrong signals and may lead astray the researchers and students of taxonomy, an already dwindling tribe. These issues need to be attended to by the taxonomy teachers and students before it is too late. He states: 'synonymy and the rule of priority are known hindrances to the progress of taxonomic research', and 'deciding synonymy is now the greatest hindrance to the progress of systematic botany and it has been on the increase burdening the taxonomic research'. According to him, 'the synonyms have been a source of trouble and confusion ever since plant names were given'. He laments that at least 600 to 800 species in Indian floras each have close to ten synonyms. He also makes a sweeping statement that 'the principle of priority has (thus) become a serious cause of instability in plant nomenclature' and the 'principle (of priority) sounds well in theory, but its practical application was complicated that many names published in obscure books and journals were not discovered until several years afterwards, when well-known names had to be rejected in their favour' because, he states that 'diggings are endless and will result in endless name changes'.

In the study of organisms, including plants, the correct name attributable to a group is the basic requirement. Nomenclature is to render a name to a taxonomic group, which is a means of referring to it and key to its literature. Nomenclature does have impact on the studies of biodiversity and biogeography and it is well recorded that nomenclature is a mechanism for unambiguous communication about elements of taxonomy. Elements of taxonomy render information on patterns of biodiversity. It is a

M. K. Vasudeva Rao lives at A-12, Shiv Ranjani Society, Pune 411 014, India
e-mail: mkvasudevarao@hotmail.com

means of communication about distinguishable components which constitute biodiversity. It is rendered in the Preface of the International Code of Botanical Nomenclature (referred to as ICBN or simply Code) published after the Congress in 1999 at St. Louis[4], that 'Biological nomenclature is the means of channelling the outputs of systematic research for general consumption. It is not only the taxonomists' concern, but it is of relevance for all those who need to communicate about organisms. Nomenclature Sections at preceding Congresses had been increasingly *aware* of this fact and of the consequent need to make organismal nomenclature and the rules governing it subservient to the needs of the world at large'.

Nomenclature

The 'why' or the need for correct nomenclature is well answered by Davis and Heywood[5]: 'Biologists must know what organisms they are working with before they can pass on information about them to other people – a function of taxonomy which makes stability of nomenclature an important consideration. Taxonomy, the science of classification – the orderly arrangements of phenomena – to facilitate the efforts of human mind to understand them, is referring to discrimination of species and other groups, and arranging them in a system (of classification)[6]. Nomenclature is a process of determining the correct names for units according to the Code. To some, taxonomy includes identification, nomenclature and classification[7]. But nomenclature is, and should be, independent of taxonomy. As quoted by McNeill[8] from Ramsbottom[9], nomenclature is 'handmaiden of taxonomy and not the mistress'. It is not the same as identification. Nomenclature is to 'name' the plants and taxonomy is to 'nest' these taxa in a ranked hierarchy, however arbitrary it may be. As McNeill[8] states: 'the key point I would make on the principles of nomenclature is that its function is to serve taxonomy. If the taxonomy of a particular group is in a state of flux, the nomenclature will also be; nomenclature rules cannot solve the problems of taxonomy. But it also means that there is no right or wrong in the formulation of nomenclatural rules, although, of course, there generally is in their application'. More number of synonymies for a taxon denote the state of flux it was in. If critical studies are impossible at the time of writing a flora, it is wise to take nomenclature decisions arrived at by others and incorporate them; else that would cause more confusion in the literature. Taxonomists, all through the time of history, have been striving for stability of nomenclature. Nomenclature of plants is determined for a stable and universal acceptability on applying the Code, which is evolved based on sound scholarship and nearly three centuries of input by leading taxonomic researchers, 'tinkering' and refining the rules in every International Botanical Congress, which is followed by the publication of the Code preceded by the previous one.

Principle of priority – fundamental to nomenclature

Chronologically, the binomial system of botanical nomenclature is about 250 years old and the principle of priority, which is enforced in the Code, is about 150 years old. Moore[10] rightly states that the principle of priority is the three major significant and fundamental strides that have taken place in botanical nomenclature, the other two being the binomial system and type method. The rule of priority though, without specifying date to be taken into account, was treated fundamental to botanical nomenclature (no exceptions) in the First Botanical Congress at Paris in 1867. The Rochester Code (1892) incorporated the strict application of priority. In 1905, Linne's Species Plantarum of 1753 was prescribed as a starting point for vascular plants and the date of publication alone accepted as priority. Thus it was decided about more than a century and half ago that a single taxon should have a single, correct name on the basis of priority of publication. One of the six principles of the Code is: 'nomenclature of a taxonomic group is based upon priority of publication'. McNeill[8] justly states, 'Priority, of course, remains the appropriate tool to determine correct usage when two taxa are merged and different botanists, sometimes in different parts of the world, would be discomfited whichever name is adopted'. As an example of application of the principle of priority, the nomenclature of the genus *Burkilliodendron* (Ridley) Sastry may be considered. Ridley published a leguminous genus *Burkillia* with the type species *B. alba* in 1925. Sastry rendered a new name *Burkilliodendron* in 1969, since this generic name was already available for an algal genus (*Burkillia* West & West, 1907). Whitmore independently proposed the name *Alloburkillia* for Ridley's *Burkillia* for the same reason in the same year. But the nomenclature proposed by Sastry has been given priority because of the date of publication (being 23 January 1969 and that of Whitmore being 9 August 1969)[11]. Has the application of the principle of priority caused instability and hindrance to taxonomic studies as considered by Venu[2] or otherwise? Priority, of course, remains the appropriate tool to determine correct usage when two taxa of the same rank are combined. If application of the principle of priority turns to be disruptive to stability, there are provisions in the Code to conserve widely used names over earlier little used ones or reject the latter entirely (*nomina utique rejicienda*). There are provisions in the Code to conserve any name that may cause disadvantageous changes. Again, to quote McNeill[8]: 'Even the principle of priority of publication, adopted throughout bionomenclature since the middle of the last century, is simply a convenient tool to determine in an unbiased manner which of the two or more competing names should take precedence for a particular taxon. When applying the principle of priority is disruptive to nomenclature stability, it should be readily abandoned, a position well demonstrated by the very many proposals that have been accep-

ted over the years to conserve widely used names over earlier little used ones, or else to reject the latter entirely (*nomina utique rejicienda*)'. The choice of botanical nomenclature, *Triticum aestivum* L. against *T. hybernum* L., both of equal priority, for the common bread wheat plant is a famous example for the application of the *nomina conservanda et rejicienda*.

Another apt example is of Nymphaeaceae genera *Barclaya* and *Hydrostemma*, both published by Wallich in 1827, the former in December and the latter in June based on one and the same type (species: *longifolia*). Mabberley[12] on 'digging out the literature' and applying the principle of priority accepted the generic name *Hydrostemma* and rendered the combination *Hydrostemma longifolium* for the species. Since this and other species of the genus are well-known aquarium plants in Europe and the name change may cause disadvantage to the users, the generic name *Barclaya* and the specific epithet were conserved, and the name *Hydrostemma* was consequently rejected *(nomina rejicienda)* on application of provisions in the Code. Article 14 of the Code provides conservation of names to avoid disadvantageous nomenclature changes entailed by the strict application of the rules and especially of the principle of priority. Thus exceptions are made to conserve and legitimate later homonyms which otherwise are illegitimate on strict application of the rules, especially the principle of priority. Conservation of names, *Nomina Conservanda* provided in the Code since the Botanical Congress at Vienna in 1905, aims at retention of names that have long usage and serve the purpose of stability. The proposals for *Nomina Conservanda* are laid before the General Committee of the concerned group, which receive approval by voting in the ensuing Congress – a procedure to be waited for.

Venu[2] feels sorry for the taxonomists and bibliographers who spend their time digging out the literature for publication dates and in finding out that a name was published two months or two days earlier than another. According to him, these will result in endless name changes; hence such activities are to be discouraged. As far as vascular plants are concerned, any name published earlier to Linne's Species Plantarum, 1 May 1753, has no priority (Article 13 of the ICBN). The dates are similarly prescribed in the Code for other groups of plants. As once said by a leading taxonomist, digging of the literature cannot be endless, but should become lesser and lesser leading to nil in the course of time, once all the taxonomic literature is scanned. Literature survey is an essential element of taxonomic revision and aids in clear delimitation of taxon by bringing out the taxonomic history of the taxon being studied and clarifying the taxonomic problems within the group[13]. The well thought of principle of priority does not deal with only names 'dug out', but also merging of taxa whose names will be vying with each other to be selected. He admits that there are many instances of taxa described and named more than once and, if so, which correct name he would prefer to retain for such resulting taxon and treat the other name? Contradictingly, he also states that the competence of a taxonomist and the quality of work he produces increase with (other inputs rendered by him) his awareness of the literature. While he appreciates the worth of monographic studies which deal with a taxonomic group over the whole range of its distribution to bring in universal acceptance to the concerned taxon and its elements in their placement and nomenclature, he shuns the application of the principle of priority and multitude of synonymies which are a natural outcome.

Synonyms

Regarding synonyms, one should realize the causes for them. The Code is amply clear and in its principles itself (Principle IV) states that any taxonomic group of the classified organisms with a particular circumscription, position and rank can bear only one correct scientific name, the earliest that is in accordance with the rules, except in specified cases. But inevitable nomenclature changes do occur in taxonomic studies and thereby synonymy, even by sheer, strict application of the Code. The following situations are rendered to exemplify the causes for synonymy.

Later homonyms

A name for a taxon is illegitimate according to the Code, if that name (with the same spelling) is already validly published for the same rank, based on a different type. For example, Kurz named a species of Andaman and Nicobar Islands *Psychotria polyneura*, in 1875 unaware that the same name with the same spelling was rendered for a different species in 1830 by deCandolle. Thereby, Kurz's *P. polyneura* is a later homonym and is to be rejected according to the Code. A new name is to be given, and Deb and Gangopadhyay[14] rendered the name *Psychotria kurzii* for this species. If the name of Kurz is not referred to in synonymy, the status of this taxon will not be known and that will only be a source of trouble and confusion, and not by synonymizing!

Critical taxonomic studies

Critical studies may bring about nomenclature changes due to 'lumping' or 'splitting' of taxa, changing the circumscription of the taxon and correcting mistaken identities. *Eulophia andamanensis* was described by H. G. Reichenbach in 1872 and until about some decades ago, was considered to be endemic to the Andaman and Nicobar Islands. On examining the type specimens it was found that the Malayan species, *Eulophia keithii* of Ridley (1896)

is the same, with distribution in Malaya, Sumatra, Laos, Cambodia, Vietnam and Myanmar[15]. So also is the case of the monotypic genus *Jainia* Balakr. (1980), based on *J. nicobarica*, endemic to the Andaman and Nicobar Islands. It was resolved to belong to *Coptophyllum* Korth. of Malaysia and the species *J. nicobarica* was transferred to it[16]. There are innumerable examples and such decisions on nomenclature are not a 'hindrance to the progress of systematic botany' and do not 'increase the burdening taxonomic research', but aid in improving our knowledge on taxonomy, phytogeography and biodiversity.

What happens if one relegates synonymy to the secondary level, even at the time of writing a local flora, can be evinced by the following examples. Since the editors of the *Flora of Andaman and Nicobar Islands*[17] had probably relegated nomenclature and synonymy to a 'secondary status' the one and the same species is referred to under two different names in the same publication: *Desmodium umbellatum* (p. 6; 10), *Dendrolobium umbellatum* (p. 376); *Dipterocarpus griffithii* (p. 8), *Dipterocarpus grandiflorus* (p. 150); *Dipterocarpus turbinatus* (p. 8) *Dipterocarpus gracilis* (p. 150); *Entada pursaetha* (p. 8 and 10), *Entada rheedii* (p. 453); *Messerschmidia argentea* (p. 6), *Tournefourtia argentea* (p. 10); *Meaoneuron cucullatum* (p. 10), *Caesalpinia cucullata* (p. 425); *Amoora rohituka* (p. 22), *Aphanamixis polystachya* (p. 230); *Dracontomelon mangiferum* (p. 22), *Dracontomelon dao* (p. 332); *Tinospora andamanica* (p. 28), *Tinospora glabra* (p. 105). It is also seen that species that do not occur are included in the floristic account, since published literature on nomenclature and identity are not seen at all; for example, *Erycibe paniculata*, *Porpax reticulata*, *Jasminum unifoliolatum and Phyllochlamys spinosa*. Such deliveries, ignoring nomenclature and synonymy, cause formidable exercise in drawing phytogeographic conclusions and create more confusion in the literature. The rules of nomenclature are at times violated due to unawareness and ignorance by taxonomy researchers themselves! For example, the Code emphasizes that autonyms should not be followed by author(s) name (Articles 26 and 46.1 of the Code), but the *Flora of Andaman and Nicobar Islands*[17] gives author(s) name after the subspecific elements: *Uvaria lurida* var. *lurida*, *Raphanus sativus* var. *sativus*, *Cleome gynandra* var. *gynandra*, *Cleome viscosa* var. *viscosa*, *Canarium denticulatum* ssp. *denticulatuim*, and forma *denticulatum*, *Hibiscus tiliaceous* ssp. *tiliaceous*, *Urena lobata* ssp. *lobata*.

Delimitation of taxa

The problems in delimitation and circumscription of taxa may be certainly assumed to begin at species level, since the species is a morphologically distinct and biologically isolated and distinguishable unit in classification, be it defined under any concept, classical (morphological) or phenetic (phylogenetic) or biological (genetic) concept of species, because plants do not appear with 'labels' but characters are to be picked up, evaluated and prioritized by systematists. The concept of species had been subjected to arguments for ages and much has been written. According to Stevens[18], five books were published on 'species' between 1995 and 2000 alone. He cites the case of *Fagraea* (Loganiaceae) for the problems in delimitation of species. While Leenhouts in 1962 recognized 14 species of this genus occurring in Borneo, with three of them endemic to that island, Wong and Sugau in 1996, with only five additions to the material that was available to Leenhouts, reported 42 species to occur in the islands, with 24 of them endemic to the islands. Such is the difficulty in delimitation of taxa, because the conceptualization and rendering importance or selection of characters differ from taxonomist to taxonomist and are subjective in nature. The change of opinion in delimiting taxa eventually results in nomenclature changes and thereby taxonomists are criticized for 'haggling' over names and are considered as people who argue about names[18]! Taxonomy itself is said to be a 'topsy-turvy' science, and taxonomists work on the principle of 'verdict first' as in *Alice in the Wonderland*, because 'taxa are described, named and typified often on the barest minimum of information and material', but ideally should assemble all morphological, genetic, cytological, ecological and geographical evidences before making taxonomic decisions[19]. Taxonomic research in our country remains mostly morphology-based[1]. The problems that lie before the taxonomists are delimitation of taxa (especially species) and nomenclature. Whenever problems were encountered in delimiting and comprehending taxonomic groups, taxonomists resorted to other fields, such as anatomy, including electron microscopy, cytology and biosystematics. In the past nearly two decades, molecular systematics is emerging as a new tool to be applied to systematic problems.

Authoritative lists

Venu[2] does not delve on the remedies to guide taxonomy researchers and students. By way of concluding remarks, the following useful messages for taxonomic researchers and students are put forth. Reviewing of past literature ('digging') is a primary and essential exercise in the methodology of scientific research on any subject and if taxonomists do not scan the literature on plants on which they work, who else can be expected to do so? In future, the only solution for the formidable nomenclature changes will be making available 'authoritative lists' of names (of various groups) as has been made available for bacteria since 1978 (effectively set in 1980). Such lists are required to be developed through sound scholarship and inputs at international level by application of rules of nomenclature. They need to be widely and readily made available

to meet the user needs, preferably electronically. According to McNeill[8], zoologists are already incorporating provisions in their Code to endorse lists of names. As he states, more and more authoritative lists will become *de facto* and then inevitably *de jure* for plant nomenclature and these will be 'catalysts for authors to ensure that their new names are listed – registered'. He further foretells that these will serve better for unambiguous communication and long-term stability of names. It has also been stated[20] that 'the issue of authoritative lists, rather than sets of rules, might become better standards for application of names. The challenge of dealing with electronic publication of names as more and more biodiversity is discovered is squarely before us'. Although the mandatory registration of new names (from a future date) was envisaged in the Tokyo Congress, it was dropped in the subsequent St. Louis Congress. In future, similar or such activity may be enforced. Such registry may lead to the production of authoritative lists. Implementation of a system for the registration of newly proposed names and principle of protection of names or stabilized lists of names in current use are the means to solve the problems of nomenclature and synonymy. In future, one can turn to contemporary authoritative lists. Until then, taxonomists are left with no choice but to turn to and apply the Code, accept the principle of priority and burdensome synonymies for current research activities.

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