CURRENT STATE OF Botanical Nomenclature

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The prairie crabapple, *Malus ioensis* (Alph.Wood) Britton by Maud H. Purdy, 1934, watercolor. Courtesy Brooklyn Botanic Garden. More work by this early 20th century botanical artist can be found at www.bbg.org/lib/specialcollections/purdy/.

In July 2005, changes to the 13th edition of the *International Code of Botanical Nomenclature (ICBN,* Greuter et al., 2000) were authorized at the Nomenclature Section assembly at the Seventeenth International Botanical Congress in Vienna, Austria. One hundred years ago (1905), the first international code of botanical nomenclature was prepared at the Second International Botanical Congress in Vienna.

Development of Botanical Nomenclature

The early development of botanical nomenclature was essentially a struggle to tease apart the two primary elements of plant taxonomy—classification and nomenclature. Most significant was the development of the type concept, not fully recognized in the botanical code until 1935 (Briquet, 1935; see also Nicolson, 1991). A type (the cultivated code uses the term *nomenclatural standard*) refers to the one element that remains permanently attached to a taxon name. The type method allows for a clear distinction between an organism's name and the taxon (i.e., a taxonomic group at any rank) represented by that name. With the type method, names are assigned types while taxa are circumscribed. Prior to the type method, many taxonomists applied a circumscription method when applying names. Such an approach was unsatisfactory because it was often not clear when revisions in a taxon's circumscription justified the changing of the taxon's name.

The other major debate in the early development of botanical nomenclature was determining to what extent priority should be limited. This led to the establishment of Linnaeus's 1753 publication *Species Plantarum* as a starting point in botanical nomenclature (some bryophytes, fungi, algae and all fossils have later starting points). (In 2003, the University of Uppsala celebrated the 250th anniversary of *Species Plantarum* with a symposium on Linnaeus and botanical nomenclature; see *Symbolae Botanicae Upsalienses* 33:3 for proceedings.)

Combining the type method and the principle of priority makes the process of applying names clear. Revisions in a taxon's circumscription, no matter how large or small, that result in the inclusion of a type of a name at the same rank with priority over the name in use will result in a change in that taxon's name. For example, if the genus, *Malus* Mill. (type: *Malus sylvestris* Mill.), apples, were circumscribed broadly so as to include the type of the genus name *Pyrus L., P. communis* L., the pear, then this broadly circumscribed

genus would go by the name *Pyrus,* because this name was published prior to the publication of the genus name *Malus.* Changes in a taxon's circumscription that do not result in the inclusion of a type of an earlier name at the same rank do not result in a change in the taxon's name. For example, the name of the taxon *Rhododendron* L. does not change when it is broadly circumscribed to include the types of later generic names, such as *Rhodora* L. In this latter case, authors have applied different taxon concepts under the same taxon name (e.g., *Rhododendron* circumscribed broadly to include species formerly recognized in other genera; *Rhododendron* circumscribed narrowly so as not to include these species).

Besides circumscription, the other two components of defining a taxon's limits are rank and position. Ranking a taxon involves assigning it to one of the categories (e.g., kingdom, division/phylum, class, order, family, genus, species) of the taxonomic hierarchy. This determination will affect the form the name will take (e.g., mandatory endings for ranks above the rank of genus; binominal nomenclature for species). Determining a taxon's position involves working across the taxonomy (e.g., determining to which genus a species belongs). This ordering process increases the value of the system with respect to information retrieval.

The prairie crabapple provides an excellent example of how a plant can go by multiple names when there are disagreements regarding circumscription, rank, and position. This apple was first described by Alphonso Wood in 1860 as a variety of *Malus coronaria* L. under the name *M. cornaria* var. *ioensis*. Differences of opinion as to this plant's generic position (i.e., in *Malus* or *Pyrus*) and rank (i.e., species, subspecies, or variety) has resulted in the prairie crabapple going under four different names besides Wood's original designation: *Malus ioensis* (Alph. Wood) Britton, *M. coronaria* subsp. *ioenesis* (Alph. Wood) Likhonos, *M. coronaria* var. *ioensis* (Alph. Wood) C.K. Schneid., *Pyrus ioensis* (Alph. Wood) Carruth.

Occasionally this method of nomenclature can be destabilizing to current usage even when there is agreement with respect to the taxon's circumscription, position, and rank. In order to prevent this, there are official mechanisms whereby names of families, genera, or species can be officially conserved or rejected in order to maintain usage. For example, the commonly used name for the tomato, *Lycopersicon esculentum* Mill., has been conserved, otherwise the correct name for this species would be the little-used *Lycopersicon lycopersicum* (L.) H.Karst.

Cultivated Code

In 1952, an international code of nomenclature for cultivated plants was developed because it had become apparent that plants in cultivation had unique needs that were not readily addressed by the botanical code. In 2004, the seventh edition of the *International Code of Nomenclature for Cultivated Plants (ICNCP,* Brickell et al., 2004) was published. The cultivated code, unlike the codes of nomenclature for animals, bacteria, and viruses, is not independent of the botanical code. Any plant taxon whether it occurs in the wild or is cultivated is to be named under the botanical code if it is assigned a rank recognized in that code. The cultivated code covers special groupings unique to plants in cultivation not covered in the botanical code.

The two primary categories of plants whose names are regulated by the cultivated code are *cultivar* and *Group.* The cultivar is the basic taxonomic unit of the cultivated code and is defined as "an assemblage of plants that has been selected for a particular attribute or combination of attributes, and that is clearly distinct, uniform, and stable in these characteristics, and that, when propagated by appropriate means retains those characteristics." Entities that may be recognized as cultivars include clones, graft-chimaeras, lines, hybrids, topovariants (plants grown from seed from a particular area that are clearly distinguishable by one or more characters), and genetically modified plants. The Group category is used for grouping together cultivars, individual plants, or groups of plants based on their similarity. Cultivar and Group epithets are placed after the Latin name in Roman type, with cultivar names in single quotation marks (e.g., *Picea abies* 'Little Gem', *Daphne xburkwoodii* 'Carol Mackie', *Rhododendron boothii* Mishmiense Group, *Tulipa* Breeders Group).

Two other categories recognized in the cultivated code are the *graft-chimaera* and *grex.* A graft-chimaera is made up of tissues from two or more different plants which originated through grafting. Whereas hybrids are indicated by the multiplication symbol (x), graft-chimaeras are indicated using the addition symbol (+). For example, *+Crataegomespilus* represents the graft-chimaeras between *Crataegus* and *Mespilus,* whereas Crataemespilus represents intergeneric hybrids between these two genera. The grex category is limited to orchids and is used to denote an assemblage of individuals produced through artificial hybridization with known parentage. For example, *Aerides* Renades Arunoday grex represents a cross between *Aerides roseum* and *Renanthera imschootiana.* Details on the naming of grexes can be found in *The Handbook on Orchid Nomenclature and Registration* (Greatwood et al., 1993).

Changes in Classification

The two codes of nomenclature (botanical, cultivated) do an excellent job of accomplishing their primary goal of ensuring that each taxonomic group with a particular circumscription, position, and rank bear only one correct name. In cases where application of the codes are ambiguous or would create a disadvantageous nomenclatural change, the various nomenclatural committees for the botanical code and the Commission for the Nomenclature of Cultivated Plants for the cultivated code can provide assistance.

However, our current system of nomenclature does not assist with the greatest source of nomenclatural instability of plants —changes in classification. The codes state that there is only one correct name for a taxon only when there is an agreed upon circumscription, rank, and position. However, disagreements regarding circumscription, position, and rank will oftentimes lead to different workers using different names for the same plant. Similarly authors may apply broad or narrow concepts (sensu lato, sensu stricto) under the same taxon name. In other words, the codes say nothing with respect to taxonomy.

And these are indeed times of change for plant taxonomy. Modern methods of phylogenetic reconstruction and new sources of data (e.g., DNA) have led to profound changes in our basic understanding of the relationships of major plant groups. These new insights are resulting in significant changes to plant classifications. They are also leading to significant disagreements among taxonomists regarding how plants should be classified. The core of these disagreements has to do with legitimate debates about how plant phylogenies should be reconstructed and how plant classifications should be constructed. No rank is immune from these debates: some taxonomists proposing different concepts for species definitions, while others debate how many kingdoms of life should be recognized.

Some of the striking changes in plant taxonomy that have recently been proposed include the splitting up of the genus *Aster* into several smaller genera, the approximately 165 species native to North America now being placed in 13 separate genera—*Almutaster, Ampelaster, Canadanthus, Chloracantha, Doellingeria, Eucephalus, Eurybia, Ionactis, Oclemena, Oreostemma, Psilactis, Seriocarpus,* and *Symphyotrichum* (Nesom, 1994)—while 180+ species from Europe and Asia remain in *Aster*. The Angiosperm Phylogeny Group (1998, 2003) has recently proposed changes in the circumscriptions of many families, including Araceae, Ericaceae, Plantaginaceae, Scrophulariaceae. Despite formal conservation of the name *Lycopersicon esculentum* Mill., dual usage for the name of tomato persists, as some have proposed that the genus *Lycopersicon* should be merged into Solanum, the correct name for the tomato consequently being *Solanum lycopersicum* L.

These proposed changes and debates concerning taxonomic treatments are not surprising when one considers other fields of research, such as medicine. Your doctor's treatment of you is probably much different from the treatments your grandparents received, and the name currently used for an ailment may also be different than what was previously used. Such changes are what fuel the progress of any science.

However, it is also true that the increased number and pace of these changes in nomenclature associated with this accelerated pace of scientific discovery is causing confusion and frustration among many users of plant names (Valleau, 2004; Manion, 2006). For example, those researching the common white wood aster of the eastern United States and Canada, now have to search under two plant names *Aster divaricatus* L. and *Euryba divarticata* (L. *Nesom*).

It is unrealistic to expect taxonomists to agree on one classification of plants. Furthermore, taxonomists that are in agreement will collectively agree to change their minds (and their classifications) when presented with new information (e.g., compare treatments of APG in 1993 and 2003). Therefore, it is important to educate the users of plant names on the reasons behind the changes that are taking place.

Nomenclatural indices, such as the International Plant Names Index (www.ipni.org), *Index Nominum Genericorum* (ravenel.si.edu/botany/ing) and Jim Reveal's *Indices Nominum Supragenericorum Plantarum Vascularium* (www.life.umd.edu/emeritus/reveal/pbio/fam/inspv1.html) are excellent resources for getting information about plant names (e.g., author, date and place of publication). However, they will not tell a user what the correct name of a plant taxon is because they do not make taxonomic judgments.

Databases that do make taxonomic judgments include the USDA's *PLANTS Database* (plants.usda.gov), Peter Stevens's *Angiosperm Phylogeny Website* (www.mobot.org/MOBOT/Research/APweb), the *Provisional Global Plant Checklist* maintained by International Organization for Plant Information (plantnet.rbgsyd.nsw.gov.au/iopi/iopigpc1.htm), and the many web-based floras that are becoming available, such as that for *Flora of North America* (hua.huh.harvard.edu/FNA). Users should consult taxonomic databases and websites—and of course recently published monographs, treatments and floras—to get information on the different classifications that taxonomists are constructing. One drawback to databases that make taxonomic judgments is that the information on alternative classifications (i.e., those not accepted) may not be available. This problem has been addressed by a model developed by Walter Berendsohn (1995, 1997) using the concepts of "preferred taxa" and "potential taxa"; IOPI's Provisional Global Plant Checklist uses Berendsohn's model.

Trademark and Patent Names

Trademark and patent names, as regulated in the United States by the U.S. Patent and Trademark Office (www.uspto.gov), have not been addressed in this article because they are not regulated by either the *International Code of Botanical Nomenclature* or the *International Code of Nomenclature for Cultivated Plants.* Over the past 30 years, trademarked names, either unregistered (™) or registered (®), have become quite popular in the horticultural trade. Their use is largely a marketing tool allowing a single company to advertise a given cultivar under a name that

only that company is authorized to use. Only the name (not the plant cultivar itself) is trademarked; therefore, different companies may apply different trademark names to the same cultivar and the same company may also apply the same trademark name that it owns to different cultivars that it sells. Since such names are not published in accordance with the *ICBN* or *ICNCP*—most significantly they are not freely available for use in the scientific community—they are not available for use as cultivar names.

Some growers also obtain patents for a plant cultivar. In order for growers to be granted a plant patent they must have "invented or discovered and asexually reproduced any distinct and new variety of plant, including cultivated sports, mutants, hybrids, and newly found seedlings, other than a tuber-propagated plant or a plant found in an uncultivated state" (U.S.P.T.O., 2005). The patent applies to the whole plant (not the name) and is in effect for twenty years. Patents are the only means available for a developer of a cultivar to maintain proprietary rights over that plant. In the U.S., proprietary protection for cultivars that reproduce sexually (i.e., by seed) can be sought by requesting a Certificate of Protection from the U.S. Department of Agriculture's Plant Variety Protection Office. A patent name or designation may differ from a plant's trademark names or cultivar name. See Avent (1999, 2003) for further discussion of the issues surrounding patents and trademarks.

Conclusion

As long as there are fluctuations in plant classification, name changes are inevitable. However, users of plant names can take solace in that for names governed by the *ICBN* and *ICNCP*, there should be only one correct name for a taxon with a particular circumscription, position and rank. No such solace can be taken for names not governed by the *ICBN* or *ICNCP,* such as trademark names, since the same trademark name can be applied to different taxa and different trademark names to the same taxon.

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