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Biological Nomenclature

Third edition

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For the Systematics Association

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*** Note**

Certain additional information, supplementing but not essential to the main thesis, is given in a section 'Notes to the Text' (p. 56). The small 'superior' figures (¹, ², . . .) given in the main text refer to the corresponding numbers of these notes.

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1.3 The taxonomic hierarchy

If we study the living organisms existing in a particular place at a particular time, we find that they occur as series of similar individuals showing certain common features. Such series of recognizably similar individuals, recognizably distinct from other such series, are in general what the systematists call *species*. In sexually reproducing organisms it is also found, in general, that individuals of a species are inter-fertile with one another but reproductively isolated from individuals of other species. When species are compared with one another, it is found convenient to group together those which show common group-defining features into larger, more inclusive taxa which are called *genera*. Genera are in their turn grouped likewise into yet more inclusive taxa called *families*, and so on. Such an arrangement of taxa into an ascending series of ever-increasing inclusiveness forms what is known as an *hierarchical*³ system of classification. In an hierarchical system we start at the bottom with individuals and end up at the top with one all-embracing taxon. In between we have various taxa of organisms at different levels of the hierarchy, each of which is subordinate to one and only one immediately higher taxon and each of which (except the lowest) includes one or more subordinate lower taxa.

The arrangement of taxa into an hierarchical system had its origin in the logical theory of classification. It functions primarily as an aid to memory, but it also has a biological basis, in that it reflects the hierarchical nature of variation in the living world. The number of levels in the hierarchy, needed conveniently to accommodate the variation of the living world, has none the less been decided quite arbitrarily as a result of practical experience over the past two hundred years. Those generally employed are shown in Table 1.1. Additional levels may be employed if required. The levels are given conventional names and arranged in a conventional order which must be strictly adhered to. The framework thus formed is known as the *taxonomic hierarchy*. The different levels are known as *taxonomic ranks*. All such taxa as stand at any given level (or rank) in the hierarchy are said to belong to the same *taxonomic category*.

The taxonomic hierarchy can be envisaged as a series of containers, with adjacent walls and bases, placed one inside another, and differing only in height. The containers themselves then represent the taxonomic categories. The levels of the roofs of the containers represent the taxonomic ranks. The contents of the containers — the groups of organisms we place in them — represent the taxa. This analogy also makes it easier to appreciate that taxonomic categories and ranks are purely abstract

Table 1.1 The categories of the taxonomic hierarchy

This shows the categories of the taxonomic hierarchy usually employed in Botany, Bacteriology and Zoology. They are given their recognized Latin names (often anglicized as in the right-hand column) and are arranged in the relative order in which they must be employed. The most important categories are given in CAPITALS, those seldom used are enclosed in parentheses (Divisio). The categories *Divisio* and *Subdivisio* of the Botanical and Bacteriological Codes correspond to, and are used in place of, the categories *Phylum* and *Subphylum* respectively of zoological usage

Botanical	Bacteriological	Zoological	English Equivalent
REGNUM	REGNUM	REGNUM Subregnum (Superphylum)	Kingdom Subkingdom Superphylum
DIVISIO Subdivisio	(Divisio) (Subdivisio)	PHYLUM Subphylum	Division/Phylum Subdivision/ Subphylum
CLASSIS Subclassis	CLASSIS (Subclassis)	Superclassis CLASSIS Subclassis Infraclassis	Superclass Class Subclass Infraclass
(Superordo) ORDO (Subordo)	ORDO (Subordo)	Superordo ORDO Subordo Infraordo	Superorder Order Suborder Infraorder
FAMILIA Subfamilia	FAMILIA (Subfamilia)	Superfamilia FAMILIA Subfamilia (Supertribus)	Superfamily Family Subfamily Supertribe
Tribus Subtribus	Tribus (Subtribus)	Tribus Subtribus	Tribe Subtribe
GENUS Subgenus	GENUS (Subgenus)	GENUS Subgenus	Genus Subgenus
Sectio Subsectio Series Subseries			Section Subsection Series Subseries
SPECIES Subspecies	SPECIES (Subspecies) (= Varietas)	SPECIES Subspecies	Species Subspecies
Varietas (Subvarietas) Forma (Subforma)			Variety Subvariety Form Subform

concepts. It is the taxa — groups consisting ultimately of individual living organisms — that alone have any concrete basis.⁴ Thus all the primroses form a taxon which is considered to be of specific rank and is therefore assigned to the category species. This taxon is the species known as

The Taxonomic Hierarchy 5

Primula vulgaris. Similarly, *Primula* is a genus, a taxon of generic rank, assigned to the category genus; and *Primulaceae* is a family, a taxon of family rank, assigned to the category family.⁵

Operative Principles of Nomenclature

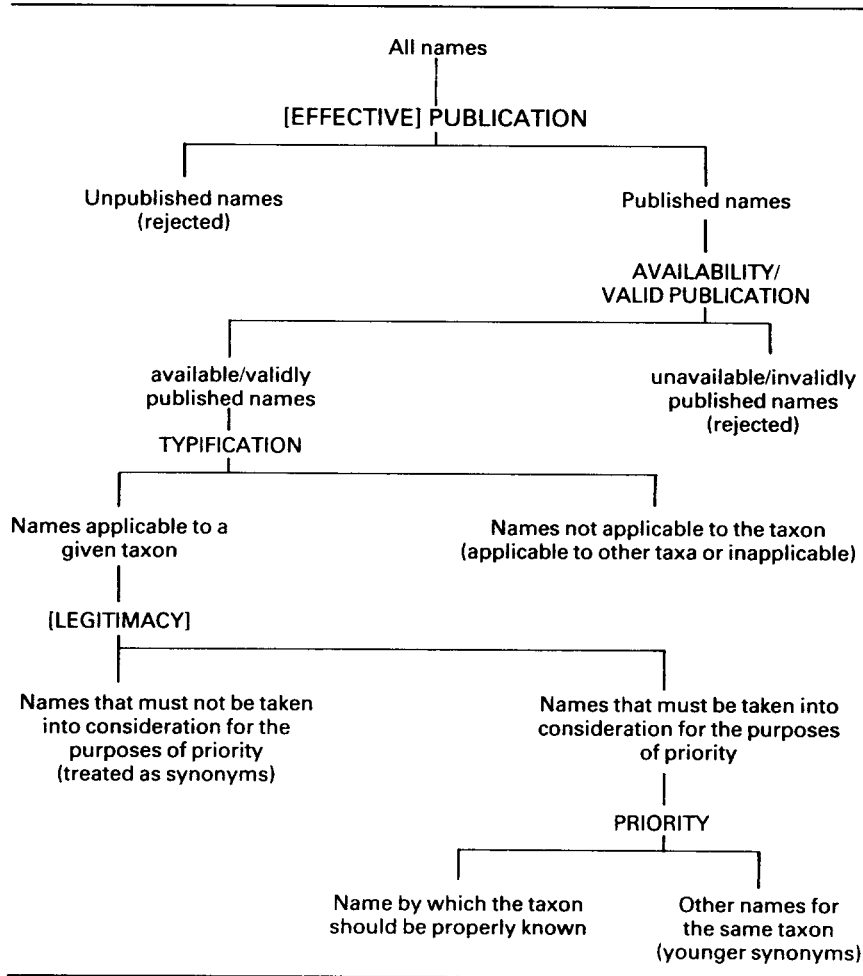
5.1 The aims of the Codes

The Codes of Nomenclature try to ensure, that *with any given circumscription, position and rank*, a taxon can have one, and only one, name by which it may properly be known. This is the nearest approach to nomenclatural stability that can be achieved in systematics. They also try to avoid, or reject, the use of names likely to cause ambiguity or confusion. To achieve these aims, the Codes lay down certain provisions which must be followed in the giving of names to taxa and in the use of names. These provisions are based on a number of what may be called *operative principles*, of which the chief are *publication, typification and priority*. The requirement of *legitimacy* (§5.11, p. 26) is also operative, except under the Zoological Code. The way in which these principles are employed to determine the name by which a taxon should properly be known is indicated in Table 5.1.

5.2 Publication

Since the circumscriptions and definitions of taxa are liable to change, it is essential to be able to check back, when necessary, and find out what kind of organism the author of a name had in mind when he or she first used the name. For this reason the Codes require that some descriptive matter, available for consultation by others, should be associated with a name when it is first given to a taxon. Two basic conditions must be fulfilled before a properly formulated name can have any status in biological nomenclature; it must be published in a *medium* that con-

Table 5.1 The Nomenclatural Filter (For explanation see text)



forms to the requirements of the appropriate Code, and must be accompanied by *information* conforming to the requirements of the Code.

If the first condition is satisfied, the name is regarded as *published* (by the Zoological Code) or *effectively published* (by the Botanical and Bacteriological Codes). Essentially the Codes require publication in works that are printed, reasonably permanent, and made generally available to the interested public. For example, the spoken word, microfilm made from typescripts and single documents deposited in libraries are not regarded by the Codes as media of publication.

Even if these requirements are met, unless the name be accompanied by some information it will still be impossible to ascertain what kind of organism it was applied to. The Codes therefore require that certain information must accompany the original publication of a name. The requirements vary in detail from Code to Code and with the rank of the taxon concerned, but a general requirement is the provision of a *description* (or recognized equivalent) of the taxon to which the name is being given, or at least of some kind of reference to such a description. Names must also be in accordance with the conventions of *formulation* already dealt with in Chapter 3. These which are not in Latin form, or are otherwise inappropriate to the rank of the taxon concerned, are excluded from use. Under the Botanical and Zoological Codes, correct formulation is itself a condition respectively of valid publication or availability. If these and the other pertinent requirements of the appropriate Code are met, then the name becomes *available* (under the Zoological Code), *valid* or *validly published* (under the Bacteriological Code) or *validly published* (under the Botanical Code). It thereby acquires nomenclatural status and must be taken into account for the purposes of biological nomenclature. Under the Bacteriological Code, it is a condition of valid publication of a name that the name be entered into an official *register* of names. A name may be effectively published in any appropriate publication, but has standing and priority only from the date of its publication in the official register. At present, the only official organ for the registration of bacterial names is the International Journal of Systematic Bacteriology, and publication therein is a condition of valid publication under the Bacteriological Code.

Although the requirement of publication in an approved organ (register) is not a condition of availability or valid publication respectively under the Zoological and Botanical Codes, the making of registration a necessary condition for the purposes of biological nomenclature.

5.3 Typification

Under all three Codes, the application of names is determined by means of *nomenclatural* or *name-bearing types*. *Typification* is the process of designating a nomenclatural or name-bearing type. Publication is the means by which names enter biological nomenclature; typification is the means by which they are allocated to taxa.

The type method is fundamental to the application of names to taxa under all three Codes. The Zoological and Botanical Codes differ only in their conception of the way in which it acts as a link between nomencla-

ture and classification. The Zoological Code regards the nominal taxon as the nomenclatural concept, objectively defined by its type and denoted by an available name, which is common to all taxonomic concepts to which that name can properly be applied, either as the valid name or as a synonym. The Botanical Code regards the type as the concept common to all applications of a given name. In consequence, under the Zoological Code we speak of 'the type of a taxon', i.e. of the thing named (as we do under the Bacteriological Code), while under the Botanical Code, of 'the type of a name', i.e. of the name itself. The difference however is conceptual only; throughout biological nomenclature, the type is the objective basis to which a given name is permanently linked and it is by the type method that the correct application of names to taxa is objectively and unequivocally determined however much classification may change.

5.4 What is a type?

A type is an element on which the description associated with the original publication of a name was based, or is considered to have been based. The term 'element' here means different things according to the rank of the taxon concerned. Under the Zoological Code, the type of a family-group taxon is a nominal genus, the type of a genus-group taxon is a nominal species, and the type of a species-group taxon is a specimen. Under the Botanical Code, the type of a name of any taxon of the rank of family and below is a specimen (or sometimes an illustration of a specimen). The type of the name of a family or lower taxon above the rank of genus is the type of generic name on which that name is based; however, for the purposes of citation of a type, it is sufficient to cite the generic name itself. The type of the name of a genus or lower taxon above the rank of species is the type of the name of an included species; for the purposes of citation of a type, it is sufficient to cite the name of the species itself. Under the Bacteriological Code, the type of a class or subclass is an order, the type of an order, suborder, family, subfamily, tribe or subtribe is the genus on the name of which the name of the higher taxon is based, the type of a genus or subgenus is a species, and the type of a species or subspecies is preferably a living strain (and now must be a living culture for organisms that can be grown in pure culture) but otherwise may be a preserved specimen or preparation, an illustration or a description. Living types are not permitted by the Botanical Code.

A type is purely a nomenclatural concept, and has no significance for

classification. For example, specimens that are types are merely those which happen to have had names associated with them, and for the purposes of classification are treated like any others. As a result, a type falling within the range of variation of a taxon may stand at one extreme of that range. Nevertheless, the name to which that type is linked will apply to the taxon and may well be the name by which it should be properly known. In other words, the nomenclatural type associated with the name by which a taxon is properly known is not necessarily typical of the taxon in terms of range of variation. It is not the purpose of a type to be typical in the variational sense; the purpose of a type is to provide a fixed point associated with a name in the range of variation of organisms so that no matter where discontinuities are found to occur and boundaries between taxa drawn, the application of the name can be objectively and unequivocally decided.

5.5 How the type method works

The operation of the type method in deciding the application of names can be illustrated by considering the pine genus *Pinus*. When Linnaeus first published the name in 1753, he included within the genus the following species: *P. sylvestris*, *P. pinea*, *P. taeda*, *P. cembra*, *P. strobus*, *P. cedrus*, *P. larix*, *P. picea*, *P. balsamea* and *P. abies*. Later, with increased knowledge, it became apparent that Linnaeus's concept of the genus was far too wide, and that his species were better classified into five distinct genera, as follows:

Genus 1: *P. cedrus*

Genus 2: *P. larix*

Genus 3: *P. picea*, *P. balsamea*

Genus 4: *P. abies*

Genus 5: *P. sylvestris*, *P. pinea*, *P. cembra*, *P. strobus*, *P. taeda*

Classification being completed, nomenclature can now be considered. To which of these five genera is the name *Pinus* to be applied? The type method requires that it be the one in which the type of the name of the name *Pinus* falls. The type of a generic name is the type of an included species, and in the case of the name *Pinus* it is the type of the name *P. sylvestris*. This species falls into genus 5, and it is to this genus that the name *Pinus* must be applied. The other four genera must therefore be known by other names (which are, respectively, *Cedrus*, *Larix*, *Abies* and *Picea*).

5.6 Kinds of types

The Codes recognize several kinds of types, of which the following are the more important. A *holotype* is either the sole element used by the author of a name or the one element designated by him as the type. A *syntype* is either any one of two or more elements used by the author of a name who did not designate a holotype or any one of two or more elements designated by him simultaneously as types. A *lectotype* is an element selected subsequently from amongst syntypes to serve as the nomenclatural type. The designation of a lectotype must be based on careful consideration of all the evidence provided by the author of a name in the place of original publication. Each Code provides guidance as to the procedure that must be followed. A *neotype* is an element selected to serve as the nomenclatural type when through loss or destruction no holotype, lectotype or syntype exists. In the selection of neotypes similar care is needed and guidance is again given by the Codes. In bacteriology, where the type of a species or subspecies is often a living culture, many types are of necessity neotypes, although many so-called 'type cultures' may not in fact be types in the nomenclatural sense at all.

If it proves impossible to typify a name satisfactorily, either through lack of information or because the type has been lost or is a mixture of discordant elements, then obviously the name cannot be applied to any taxon.

5.7 Priority

If two or more types fall within the range of variation of a taxon then there will be as many names that apply to the taxon, and some way of deciding by which it should be known will be necessary. The decision is made according to *priority*. The principle of priority requires that *when two or more names apply to the same taxon, in general it is by the oldest one that it should properly be known*. By oldest is meant the oldest available (Zoological Code) or the first validly published (Botanical and Bacteriological Codes). The name by which a taxon is properly known is called its *correct name* by the Botanical and Bacteriological Codes and its *valid name* by the Zoological Code.¹⁷ In the case of a taxon of the rank of species and below,¹⁸ the term of the name peculiar to the taxon dates from the place of its original publication, irrespective of the combination in which it was originally published. Thus the name *Raphidiocystis chrysocoma* although first published in 1962 as such, is the name by which the taxon to which it refers is properly known, in spite of the

existence of the name *R. welwitschii*, applicable to the same taxon and published in 1871, because the term *chrysocoma* was originally published in the combination *Cucumis chrysocomus* in 1827.

5.8 Limitations of priority

Certain limitations are set to the operation of the principle of priority. They include starting-point dates, limitations associated with rank, the exclusion of certain classes of names from consideration for the purposes of priority, and procedures for the conservation and rejection of names.

5.9 Starting-point dates

A starting-point date is the date of publication of a work previous to which no name is considered to have been made available (Zoological Code) or validly published (Botanical and Bacteriological Codes). Different groups of organisms have different starting-points, depending upon which systematic work is considered to have laid the foundation of the modern nomenclature of the group concerned. The following are the main starting-point works and the dates on which they are treated as having been published. Linnaeus, *Systema Naturae*, edition 10, 1 January 1758: *Animalia*. Linnaeus, *Species Plantarum*, edition 1, 1 May 1753: recent *Spermatophyta*, *Pteridophyta*, *Hepaticae*, *Sphagnaceae*, *Fungi* (including lichenized fungi and oomycetes), *Myxomycetes*, and most *Algae*. Sternberg, *Flora der Vorwelt*, *Versuch* 1:1–24, t. 1–13, 31 December 1820: fossil plants, all groups. Other *Musci*, *Nostocaceae*, *Desmidiaceae* and *Oedogoniaceae* have their own starting-points, for details of which the Botanical Code should be consulted. Until 1981, there were later dated starting-point works for certain fungal groups. This change has necessitated the granting of a protected status to names (except those of myxomycetes) which were accepted in the former later starting-point works. Such names are said to be *sanctioned* and are treated as if conserved (see p. 28) over all earlier homonyms and synonyms. Sanctioning applies to names of taxa of all ranks but since under the Botanical Code priority is always rank restricted, a sanctioned name is protected only at the rank at which it was originally employed by its sanctioning author.

For *Bacteria*, the starting-point date is 1 January 1980. Names published prior to that date but not included in Skerman, McGovern & Sneath (eds), *Approved List of Bacterial Names* (*Int. J. Syst. Bacteriol.* 30:225–420, 1980) have no standing in bacteriological nomenclature and

must be treated as if they do not exist. Such names may therefore be used anew or revived in their original sense, but such revived names must be attributed to the reviver who must validly publish a new description and type. If names compete for priority and date from 1 Jan. 1980 on the approved list, then priority is determined by the dates of the original publication of the names before 1 Jan. 1980. The vastly greater number of names in Zoology and Botany, as compared with Bacteriology, makes the adoption likewise in those disciplines of such approved lists of names based on a new, later starting-point date, much more difficult and unlikely to be cost-effective, at least in the case of higher plants and animals, where the proportion of future name-changes due to purely nomenclatural reasons is likely to be very small. Such money would be better spent supporting the establishment of robust, maximally informative and explanatory classifications.

5.10 Limitations of priority with respect to rank

Under the Botanical Code, priority does not apply to names of taxa above the rank of family. For taxa of family rank or below, priority is restricted to within each rank and in no case does a name have priority outside the rank of the taxon to which it applies. Thus the taxon *Campanula* sect. *Campanopsis* (1810) when raised to generic rank must be called *Wahlenbergia* (1821) which is the earliest name for the taxon at generic rank.

Under the Zoological Code, priority is not so severely restricted with respect to rank. Priority is operative within each of the three name-groups (see p. 28) irrespective of difference in rank within the group. Thus the name given to a taxon within, say, the family-group is available from its original date of publication at any rank within the family-group irrespective of the rank of the taxon to which it was applied when it was first published. For species-group names and genus-group names the same applies.

The Bacteriological Code is intermediate in this respect between the Botanical and Zoological Codes. Specific and subspecific names, and generic and subgeneric names, form two name-groups corresponding respectively to the species-group and genus-group of the Zoological Code, and within each group priority is likewise operative irrespective of differences in rank. On the other hand, there is nothing corresponding to the family-group and for taxa above the rank of genus priority is restricted, as under the Botanical Code, to within each rank. Under the Bacteriological Code, priority does not apply to names of taxa above the rank of order.

5.11 Names excluded from consideration for the purposes of priority when the name by which a taxon should properly be known is being decided

There are several kinds of names which although available (Zoological Code) or validly published (Bacteriological and Botanical Codes) are excluded from consideration for the purposes of priority when the name by which a taxon should properly be known is being decided. The exclusion may be absolute or may operate only under certain circumstances as prescribed by the appropriate Code. Names that are not in accordance with the provisions of the Code such that they must not be taken into consideration for the purposes of priority when the correct name of a taxon is being decided are those termed *illegitimate* by the Botanical and Bacteriological Codes,¹⁹ but this term is not employed by the Zoological Code, which, unlike the Bacteriological and Botanical Codes, does not make use of the concepts of legitimacy and illegitimacy.

The most important of such names are names which are later (junior) homonyms, which must be rejected under all three Codes. Others include certain genus-group names ending in *-ites*, *-ytes* or *-ithes* and given only to fossils (Zoological Code), nomenclaturally superfluous names (Botanical and Bacteriological Codes), tautonyms (Botanical Code), names of fossil taxa (except algae) when in competition with names of recent taxa (Botanical Code) and names the types of which are imperfect states of fungi (see §8.3, p. 45) when in competition with names the types of which are perfect states (Botanical Code). Also not to be used are names rejected under the procedure for the conservation and/or rejection of names provided for by the appropriate Code (see §5.15, p. 28).

5.12 Homonyms

Homonyms are names spelt in an identical manner²⁰ but based on different types or, under the Zoological Code, established for different nominal taxa. Clearly, confusion would result if such names came into widespread use; the need for unambiguity in scientific names would not be met. The Codes therefore rule generally that of two or more homonyms, all except the oldest are excluded from use.²¹ Later (or junior) homonyms can therefore in general never be names by which taxa can properly be known and the possibility of confusion resulting from the same name meaning different taxa to different people is thus minimized.

Under the Bacteriological Code, a name must be rejected if it is a later

homonym of the name of a taxon of bacteria, algae, fungi, viruses or protozoa, i.e. if it duplicates a name previously validly published for a taxon of the same rank and based on a different type.²² The Botanical Code rules similarly, except that names of animal taxa need be considered only if the taxa were once included in the plant kingdom; otherwise the names of plants and animals are independent. The Zoological Code likewise excludes from homonymy names that have never been used for taxa in the animal kingdom. It defines homonymy as the identity in spelling of names (whether based on the same type or on different types) within a genus, the genus-group or the family-group. Family-group names differing only in suffix are also considered to be homonyms. Unlike the Botanical and Bacteriological Codes, the Zoological Code explicitly states that two identical species-group names placed in different genera that have homonymous names are not to be considered as homonyms. Thus *Noctua variegata* (*Insecta*) and *Noctua variegata* (*Aves*) are not to be considered as homonyms.

The application of the homonymy rule at the rank of species differs profoundly between, on the one hand, the Bacteriological and Botanical Codes and, on the other, the Zoological Code. In botany and bacteriology the different combinations formed by the same specific epithet with different generic names are considered to be different species names, whereas in zoology, the different binomina formed by the allocation of the same specific name to different generic names are considered only as different combinations, not as different species names. This difference means that in zoology, unlike in botany and bacteriology, homonyms in the species-group can be either primary (originally combined with the same generic name) or secondary (originally combined with different generic names and later brought together into combination with the same generic name). A junior secondary homonym not replaced before 1961 is not to be replaced (or is to be reinstated if replaced after 1960) when the taxa in question are no longer considered congeneric. Furthermore, in bacteriology and botany, it is the date of valid publication of a given combination (binomial) which decides priority for the purposes of homonymy, whereas in zoology, it is the date of availability of a given specific name.

5.13 Superfluous names

A name is nomenclaturally superfluous when published (*nomen superfluum*) if the taxon to which it was applied, as circumscribed by its author, included the type of another name which ought to have been

adopted under the rules. The details of this Rule and its interpretation are matters of some complexity and are beyond the scope of this Handbook. The appropriate Code (Bacteriological or Botanical) should be consulted. The purpose of this rule is to prevent the needless multiplication of names.

5.14 Tautonyms

A *tautonym* is a name of a species in which the second term exactly repeats the generic name, e.g. *Bison bison*. Tautonyms are illegitimate under the Botanical Code.²³ In contrast, the Zoological and Bacteriological Codes permit the use of tautonyms.

5.15 Conservation and rejection of names

In order to promote stability and continuity in nomenclature, all three Codes provide for the making of exceptions to the Rules, so that disadvantageous changes that would be caused by their strict application can be avoided.

Under the Zoological Code, the International Commission on Zoological Nomenclature has power to suspend the application of any provision of the Code, to suppress or validate any name, and to annul or validate any typification, publication or any published nomenclatural act. The decision of the Commission on any particular case referred to it is termed an *opinion*. Opinions are published by the International Trust for Zoological Nomenclature and become operative on publication. The Trust also publishes *declarations*, i.e. provisional modifications of the Code the Commission is empowered to make between Congresses, the official indexes of rejected and invalid names and works, and the official lists of validated names and approved works.

The Bacteriological Code also provides for the rejection and retention of names. It permits the conservation of names of taxa of any rank, and makes provision for exceptions to be made to any Rule by means of official opinions. Names to be retained are called *nomina conservanda*, those to be rejected, *nomina rejicienda*. Proposals for the conservation and rejection of names must be submitted to the Judicial Commission which gives an opinion upon each proposal. The Judicial Commission can also issue opinions relative to the interpretation of any of the provisions of the Code if so requested. The opinions of the Judicial Commission become operative unless rescinded by a majority vote of the

International Committee. Only the Judicial Commission can place names on the lists of conserved and rejected names. Provision is made by the Code for the rejection, amongst others, of ambiguous names (*nomina ambigua*), doubtful names (*nomina dubia*), names causing confusion (*nomina confusa*) and perplexing names (*nomina perplexa*). Definitions of these will be found in the glossary/index. Currently conserved family and generic names, conserved specific epithets, rejected generic and subgeneric names and rejected specific epithets are listed in an appendix to the Code.

The circumstances under which exceptions may be made to the Botanical Code are much more restricted. It is possible to conserve or reject names of taxa only of the ranks of species to family inclusive, and in the case of the species, apart from names that may be conserved or rejected because they have been widely and persistently misapplied (see §5.16) and the special case of sanctioned fungal names (see p. 24), to conserve the names of species of major economic importance only. Proposals for the conservation or rejection of names must be submitted to the General Committee on nomenclature for study and approval by the appropriate Special Committee. If approved, they are submitted to an International Botanical Congress for adoption. Appendices to the Code list currently conserved and rejected names.

5.16 Widely and persistently misapplied names

Under the Botanical Code, a name may be rejected if it has been widely and persistently misapplied, i.e. used for a taxon not including its type. Names thus rejected are to be placed on a list of rejected names.

5.17 Orthographic variants

All three Codes give, in more or less detail, rules and recommendations according to which names must be spelt and transliterations made into biological Latin from other languages. They cannot be considered in detail here, and the Codes should be consulted by the interested reader. It is sufficient for the non-systematist to be aware that two or more orthographic variants — different spellings — of the same name may exist, by only one of which can the taxon be properly known. Such variants are considered to be forms of the same name²⁴ and if one such variant is a later homonym, none of the others may be used in its stead.

Name-changes and Synonymy

6.1 Name-changes

Name-changes not only tend to annoy those who are affected by them but also reduce the efficiency of biological nomenclature as a reference system. To reduce them to a minimum, the Codes of Nomenclature precisely specify the circumstances under which a name must be changed, and in what way. The alteration of names is otherwise not permitted. Under all three Codes, the name of a taxon may not be changed merely because someone happens to think it inappropriate or objectionable, or because another is considered better known, or because it has lost its original meaning. Thus the name *Scilla peruviana* may not be rejected merely because the species to which it refers does not occur in Peru. This is in accordance with the basic principle that a name is primarily an arbitrary symbol the purpose of which is to facilitate communication. A change in the name by which a taxon has become known is permitted by the Codes only if it is necessitated by a correction of nomenclatural error, by a change in classification or by a correction of a past misidentification.

6.2 Nomenclatural reasons

A name that is in common use may have to be changed for nomenclatural reasons, i.e. because it is not in accordance with the requirements of the appropriate Code. Thus the name *Viburnum fragrans* (published in 1831) by which a commonly cultivated shrub became widely known had to be replaced by *V. farreri* (1966), in consequence of its being a later homonym of a *V. fragrans* published in 1824 by another botanist for a

different species. There are four main causes of such purely nomenclatural changes. First, names have often in the past come into use instead of those which should have been adopted under the present Codes. This is mainly because although the Codes are modern most of their provisions are retroactive; unfortunately, there are also some contemporary workers who deliberately or through ignorance do not observe the requirements of the Codes. Secondly, many names have in the past been misapplied, usually through lack of proper typification; only in the 20th century has the type concept been fully developed. Thirdly, many names have come into use in violation of the principle of priority because earlier names were published in more or less obscure works and overlooked by subsequent authors. Fourthly, some name-changes have been made necessary by changes made to the wording of the International Codes in their successive editions. This is to be regretted, and it is of course axiomatic that no proposal should be made to modify a Code without careful consideration of all its possible nomenclatural consequences.

Name-changes for nomenclatural reasons have been particularly troublesome in recent years as systematists have endeavoured to bring nomenclature into line with the requirements of the International Codes. However, the bringing to light of overlooked names in the old literature is perhaps nearing completion. Together with a sustained effort by systematists to achieve general agreement in the typification and application of all names and a strict adherence by all workers to the provisions of the Codes, it is hoped this will lead to name-changes for nomenclatural reasons becoming ever fewer and fewer until eventually they cease to trouble us.

6.3 Taxonomic reasons

Unfortunately, the same cannot be said of name-changes which become necessary for taxonomic reasons. These arise from taxonomic research itself and are inevitable accompaniments of our systems of classification which, as was explained in Chapter 4, are constantly being modified as our knowledge of living organisms increases. The Codes do not, of course, permit the name of a taxon to be changed merely because its diagnostic characters are altered or its circumscription changed. Only if such modifications involve a change in taxonomic position and/or rank, or union with another taxon, may a name-change become necessary under the provisions of the appropriate Code (see p. 16).

6.4 Synonyms and synonymy

Two or more names that are considered to apply to the same taxon are known as *synonyms*. Of a number of synonyms, therefore, according to the principle of priority, only one can be the name by which the taxon may be properly known — in general, the oldest (senior) one. The later (or junior) synonyms then form what is called the *synonymy* of the accepted name of the taxon. It is important in the consultation of taxonomic works clearly to distinguish the names accepted as correct (or valid) from those cited in synonymy. They are usually distinguished typographically; synonyms may also be indicated by being preceded by the abbreviation 'syn'. It is, unfortunately, not always as clearly indicated as it might be which name is the one to be used and which form the synonymy; care on the part of the user is needed.

Modern taxonomic research reduces many names that have previously been held to apply to different species to synonymy. This frequent excess of names over taxa has come about in two main ways — through lack of awareness of previously published names, or through insufficient appreciation of the amount of variation that can exist within a species. Mere variants or races of one species have been given different names at specific rank. This was often a result of lack of sufficient specimens, especially of tropical organisms. Nowadays, with more material available and greater opportunities for field and experimental studies, there is better appreciation of the limits of species. Modern communications and international taxonomic associations also reduce the likelihood of the same taxon being described more than once under different names, although keeping abreast of the current literature is still a problem in spite of the advent of computerized abstracting and data-handling services.

6.5 Taxonomic and nomenclatural synonyms

There are two kinds of synonyms, taxonomic and nomenclatural. *Nomenclatural synonyms* are synonyms based upon the same type. Their synonymy is therefore absolute, not a matter of taxonomic opinion. Hence they are also known as *obligate*, *objective* or *homotypic* synonyms. *Taxonomic synonyms*, on the other hand, are synonyms based upon different types, and remain synonyms only as long as their respective types are considered to belong to the same taxon. They are therefore also known as *subjective* or *heterotypic* synonyms. Nomencla-

tural synonymy may be indicated by use of the mathematical sign of congruence, \equiv ; taxonomic synonymy, by the sign of equality, $=$.

6.6 The significance of synonymy

Although the names that an author places in synonymy are not correct (Botanical and Bacteriological Codes) or valid (Zoological Code), this does not imply they are of no significance. A considerable amount of information may be recorded in the literature under one or more of these names. The synonymy of a taxon, therefore, is a key to information about the taxon. It is for this reason that taxonomic research is concerned, among other things, with the correct establishment of synonymies. The establishment of a synonymy represents a synthesis of our knowledge of the organisms concerned.

6.7 Nomenclature and classification

The International Codes are so formulated that in any given classification, a taxon can have only one name by which it may properly be known. The qualification 'in any given classification' is important, for it allows for flexibility in nomenclature when changes are made in classification. The populations of the genus *Raphidiocystis* occurring in Madagascar were considered by Baker in 1890 to belong to two distinct species, which he called *R. brachypoda* (1882) and *R. sakalavensis* (1890). Under Baker's classification, therefore, both these names are correct, *R. brachypoda* for one species, *R. sakalavensis* for the other. On the other hand, Jeffrey and Keraudren in 1967 considered the Madagascan populations all to fall within the limits of a single species. Under their classification, which treats *R. brachypoda* and *R. sakalavensis* as synonyms, only the former name is correct. The latter, if used for the species as circumscribed by these authors, would be incorrect under the Botanical Code. Another example of the dependence of names on classification is afforded by the case of the zonal pelargoniums—the 'geraniums' of the gardener. If like most contemporary botanists, we recognize the genus *Pelargonium* as taxonomically distinct from *Geranium*, then *Pelargonium zonale* is the correct name for the species to which these plants belong and the name *Geranium zonale*, given to it by Linnaeus in 1753, is incorrect and a synonym. But if we so wished we could follow the older classification of Linnaeus under which the two genera were united. If we did this, then *Geranium zonale* would be the

correct name for the species and *Pelargonium zonale* incorrect and a synonym. These examples serve to emphasize that the name by which a taxon should properly be known is determined by the classification adopted as well as by the requirements of the appropriate Code of Nomenclature. Unless a given classification is specified, it is meaningless to ask what is the correct (under the Botanical and Bacteriological Codes) or valid (under the Zoological Code) name of a taxon. The names usually given by systematists in reply to enquiries by others are those correct (or valid) under the currently generally accepted classification of the group of organisms concerned.

6.8 Misidentifications

It sometimes happens that an organism which has become well-known under a certain name is later found to have been misidentified. The name by which it has become known really applies to a different organism. For example, an African species of the orchid *Polystachya* was in 1929 identified as *P. obanensis* and was referred to in the published literature under this name until 1960 when it was shown not to be identical with the true *P. obanensis*. It was in fact a new, undescribed and un-named species. The name *P. bella* was then published for it. As a result, those who had known it as *P. obanensis* had to get used to the fact that it had merely been misidentified as such and was really *P. bella*. Since errors of identification are always possible, such name-changes due to misidentification will occur from time to time, but they are unlikely to be numerous.