



A zoologist's viewpoint on the *Draft BioCode*

Alain DUBOIS

Reptiles & Amphibiens, UMR 7205 OSEB, Département de Systématique & Evolution, Muséum national d'Histoire naturelle, CP 30, 25 rue Cuvier, 75005 Paris, France. <adubois@mnhn.fr>.

Table of contents

Abstract	45
Key words	45
Introduction	46
Plan and terminology	47
Ranks and nominal-series	51
Higher nomenclature	54
Creation and registration of nomina	57
Language	58
Miscellanea	58
Conclusion	59
Acknowledgements	60
References	60

Abstract

The *Draft BioCode (DBC)* is the result of an attempt at unifying the nomenclatural Rules currently in force in different taxonomic domains (mostly zoology and botany), which are the result of a long historical process during which they have widely diverged in several important respects. The proposals of the *DBC* tend to extend several basic concepts and idiosyncrasies of botanical nomenclature to other fields, mostly zoological nomenclature. This is unfortunate, as in several cases the zoological Rules can be argued to be more appropriate, especially to meet the new challenges that biological nomenclature will be facing in the 21st century. The *DBC* is not ripe and its implementation in its present form should not be accepted by the international community of taxonomists, and particularly by zoologists. Among the many problems that would remain to solve before considering this possibility, the following ones are particularly stressed here: (1) the need of a better plan for this document and of a better technical terminology for nomenclatural concepts and tools; (2) the abandonment of absolute ranks and their replacement by relative ranks in the frame of a small number of nominal-series within which a Principle of Coordination is in force; (3) the adoption of more precise, stringent and unambiguous Rules for the nomenclature of higher taxa of the class-series; (4) the dissociation, in the nomenclatural process, between the stage of creation of nomina and that of their registration, which should not be compulsory; (5) the suppression of all prescriptions regarding the use of any language in taxonomic and nomenclatural publications; (6) the need of more stringent Rules for homonymy between “similar” nomina.

Key words: *BioCode*, nomenclature, nomenclatural process, zoology, botany, bacteriology, plan, terminology, ranks, nominal-series, coordination, higher taxa, registration, language, homonymy

Introduction

During its long history, biology has seen the development of various systems for the naming of organisms. The rationales for these different systems were either based on different approaches to the epistemological bases of nomenclatural Rules (e.g., “*theory-free*” vs. “*theory-bound*” systems: Dubois 2007a–b, 2011a), or, more prosaically, on their application to different “groups” of organisms, such as “animals”, “plants” or “bacteria”. Whereas the former distinction has a philosophical basis, the latter has none, especially since all living beings on earth appear to belong in a single “network of life” and share a common origin. Although taxonomic concepts, methods and paradigms have drastically changed, on several occasions, since the early days of “natural history” in the 18th century, the so-called “Linnaean” nomenclatural systems used by most biologists to designate organisms have remained remarkably stable. This is mostly due to the fact that these systems have all been theory-free regarding taxonomy, allowing them to adapt progressively to subsequent taxonomic paradigms. This situation has been challenged only recently, with the proposal of alternative “phylogenetic” nomenclatural systems that are theory-bound. Because they can be used under any taxonomic paradigm, and therefore do not interfere with taxonomic thought and action, so-called “Linnaean”, theory-free systems are to be recommended (Dubois 2005b).

To be efficient and useful to all biologists, nomenclatural systems must have a number of properties (Dubois 2005b), among which unicity and homogeneity can be particularly stressed. Strictly speaking, unicity would mean the existence of a single nomenclatural system for all organisms, whereas homogeneity would mean that, although regulated by partly different systems, the nomenclatures of all organisms would follow similar concepts, Principles and main Rules. The latter situation is currently in force, with several “special *Codes*” dealing with different kinds of organisms (animals; plants and fungi; bacteria; viruses; cultivated plants; pathovars of pathogenetic bacteria). This multiplicity of *Codes* is intellectually unsatisfying and can be argued to be a nuisance to the unicity of biology. This explains the attempts to unify them under a single “*BioCode*”¹, a draft of which was recently written by Greuter *et al.* (2011).

The problem with such attempts, which explains their failure in the past, is that the to-be-unified *Codes* have had long or rather long histories and have been applied to thousands or millions of *nomina* (“*scientific names*”; Dubois 2000) in as many publications and over decades. Because of the differences between the Rules in force in the different *Codes*, particularly in zoology and botany, their combination in a single *Code* would create new problems: “*For example, subjecting zoological and botanical nomina to the same Rules would unavoidably lead to change the nomina of many taxa either in one or in both these groups of organisms.*” (Dubois 2010d: 5). This is a simple consequence of the fact that the attempt at unifying the *Codes* comes too late in the history of biology. The different *Codes* have had the time to diverge substantially in several respects. These *Codes* are the product of historical processes of successive adjustments, not of an *a priori* theoretical approach. However, one of their stated basic purposes is to maintain a high, or at least reasonable, *stability*, or at least *robustness* (for the distinction between these two terms, see Dubois 2005b, 2011a), in the *nomina* of taxa. Although a certain amount of change is certainly acceptable, a change of Rules that would entail a change in a high proportion (e.g., higher than 20 %) of *nomina* of taxa could by no means be considered as a progress.

Therefore, whereas the first sentence of the “Preamble” of the *Draft BioCode* (“*Biology requires a precise, coherent and simple system for the naming of organisms used internationally*”) certainly expresses a wish that can be shared by all biologists, its implementation is much more problematic.

The following comments of the *Draft BioCode* (DBC) are from a zoologist. As will be shown below, in several crucial cases, the choice between the Rules, concepts and terms of the zoological *Code* (Anonymous 1999; “*Zoocode*” or ZC below) and those of the botanical *Code* (McNeill *et al.* 2006; “*Phytocode*” or PC

1. Although fashionable nowadays (e.g., *BioScience*, *PhyloCode*, *ZooBank*), the capitalization of a letter inside a compound word to denote its multi-word etymology is not justified, in my opinion: no one writes “AutoMobile”, “PhyloGenetic”, “HippoPotamus”, “MetaZoa” or “AutoBioGraphy”. Note furthermore that, just like the term *Bionomina*, the term *Biocode* is of composite Greek and Latin etymology.

below) have been made favouring the latter. This could be the best solution if these Rules could be demonstrated to be “better”, by some standard or criterion, than those of the *ZC*, but it will be argued below that it is far from being the case and that the *ZC* has important superiorities, especially regarding the way it deals with ranks. Even if the two *Codes* could be considered equivalent in intrinsic merits, an important practical point must be considered: as of today, zootaxonomy has described and named about 2 millions taxa, and millions or dozens of millions remain unknown to science, whereas phytotaxonomy has “only” described some hundred thousands taxa and can be expected to describe additional hundred thousands ones, but probably not dozens of millions (Hammond 1992; Dirzo & Raven 2003; Chapman 2009). Therefore the amount of “disturbance” of any change of the Rules that can be expected to have consequences on the nomina of taxa would be much higher if the *ZC* had to adopt the Rules of the *PC* than in the reverse case. In consequence, if no set of Rules could be demonstrated to be “better”, it would be preferable to keep the *ZC* Rules unchanged and to modify the *PC* Rules if necessary.

The following comments on the *DBC* do not address all the details of all articles of this text, but focus on some major points. As will be shown, several of the problems raised by this project are severe, and this draft should be considerably modified to become eventually the basis for a real progress in the nomenclature of organisms.

Plan and terminology

Part of the discussion of this point already appears in Dubois (2011a: 9–15) and does not need to be repeated here. As for the plan, not only the *ZC*, but also the *PC*, the *DBC*, the “*Bacteriocode*” (Lapage *et al.* 1992, Euzéby 2007; *BC* below) and the “*Viridocode*” (Fauquet *et al.* 2005) would benefit much in adopting a more logical plan, following the three or four stages or steps of the nomenclatural process described by Dubois (2005b, 2011a): (S1) creation of the nomen; (S2) allocation of the nomen to one or several taxa; (S3) identification of the proper nomen (S3a) that must be used for a given taxon in a given taxonomy, and of its proper spelling (S3b); and (S4) registration of nomina and nomenclatural acts in online databases. This is not so in the *DBC*, which does not acknowledge the existence of these stages and presents them in an order that does not follow the logic of these successive steps.

The problem of terminology needs more comments here. In all scientific domains, the current usage carries some testimony of the past of the discipline. Periods of overall re-examination of the discipline are good opportunities to “clear” some of these, sometimes quite heavy, memories. Terminology is fully concerned by this process. Often, terms continue to be used “by tradition” although they have been shown to be unclear, misleading or inappropriate. Times like those of the writing of new texts, such as a new nomenclatural *Code*, may be appropriate opportunities to update the terminology. Terminology is important in science, especially when one deals with material or intellectual techniques (concepts or methodological tools), and any scientific discipline is bound to have its own specialised language, using terms that are not “transparent” and immediately understandable by outsiders of the discipline without making the effort to learn their meaning (Dubois 2005b, 2010b, 2011a; Kuhn & Wahl-Jensen 2010).

Terminological problems in the *DBC* are numerous and their detailed discussion would require a full paper like this one. As this matter will hopefully be discussed in details before any possible implementation of this *Code*, only general ideas, supported by a few examples, are presented here. Two kinds of terminological problems can be identified in the *DBC*: (P1) the use of confusing terms present in all the *Codes* currently in force; (P2) questionable choices between the terminologies of different *Codes* currently in force. The problem (P1) was already addressed in detail elsewhere (Dubois 2005b, 2011a) and needs no further comment. In particular, and once again, I think that all the nomenclatural *Codes* would gain much in clarity in replacing the term “*name*”, in the sense of “*scientific name*”, by “*nomen*”, and “*type*”, in the sense of “*name-bearer*”, by “*onomatophore*” (as well as all other terms based on the root “*type*” by other terms). As the *DBC* is a new text, it could well have introduced these two changes, foreshadowing their hopeful implementation in future

editions of the other *Codes*. In fact, the continued use of the term “type” and its derivatives in the *DBC* shows an absence of consideration for the arguments against this use, and lends support to the idea promoted by some, including advocates of the *Phylocode*, that the users of the “Linnaean” *Codes* are still embedded into a typological, non-evolutionary, taxonomic thinking. This idea is also supported by the recognition of “types” that are not “nomen-bearers”, such as “*paratypes*”, in the *DBC*, and above all by the use in this *Code* of absolute ranks, as discussed in detail below.

The second problem, (P2), needs a discussion here. All the *Codes* mentioned above follow similar nomenclatural processes, which require going through the four stages or steps outlined above to ascertain the proper nomen that will have to be used, in order to be compliant with their Rules, for any given taxon in any given taxonomy. These steps need specific, technical designations. Strangely enough, the different *Codes* often use different terms for the same concept. This supports the idea expressed above that these *Codes* have long had independent histories, with little communication between their conceivers and users. The problem would be of moderate importance if these different *Codes* used fully different terms for the same ideas, but it becomes stronger when one realizes that the same terms may be used in different *Codes* with different meanings.

The most extreme case is that of the terms “*valid*” and “*correct*”, which have different and incompatible meanings in the *ZC* and *PC*. In botany, a nomen is “*validly published*” if published in a way complying with the requirements of the *PC*. This corresponds to the step (S1) of the nomenclatural process. For the same concept, the term used in the *ZC* is “*available*”. In zoology, the term “*valid*” is also used, but to designate a nomen that must be used in a given taxonomy for a given taxon, i.e., the step (S3) of the nomenclatural process. For this second concept, the *PC* uses the term “*correct*”. In its turn, the latter term is also used in zoological nomenclature, but to designate the proper spelling that must be used for a “*valid*” nomen. Few terminological situations may be more confusing for candid users. Probably this situation remained possible only because few biologists until now have been practising both zoological and botanical taxonomies and nomenclatures. For someone who has taught both disciplines to hundreds of students for many years, this is a real problem. Many of these students find impossible to understand how such a confusing terminological situation could have persisted for so long, and they rightfully complain about it. To tell the truth, this fact does not support in their eyes the idea that the authors of these *Codes* were careful and consistent. However, “*the terminological differences regarding the formulation of the Rules [...] could easily be suppressed or greatly reduced by adopting a common terminology for the same concepts, if not a common Code.*” (Dubois 2010d: 5). For this reason, it would seem that solving this problem would have been the first (and perhaps the main) novelty proposed by the *DBC*. It was so in some cases, but it is quite disappointing to observe that it was not in others.

A terminological homogenization between the different *Codes* could be obtained by different ways, but the two main options would be (O1) either to impose, for each nomenclatural concept, the terminology of one of the existing *Codes*, or (O2) to adopt a new terminology for all *Codes*. The solution (O1) would seem to be applicable in a few cases when the term chosen appears to be the most appropriate for the concept and is not used in the other *Code(s)* for different concepts, whereas the solution (O2) would appear to be preferable in all cases where the same term is used in different senses in different *Codes*, or when none of the terms in use appears to be superior to the other(s).

Let us consider the first stage (S1) of the nomenclatural process, which results in the creation of a scientific nomen complying with the Rules of the concerned *Code* and allowing the potential use of this nomen in scientific literature. The *ZC* calls the result of this act “*availability*”, and the resulting nomina “*available*” (complying) and “*unavailable*” (not complying). The *PC* and the *BC* call the result of this act “*valid publication*” and the resulting nomina “*validly published*” and “*not validly published*”. As we have seen, this latter designation is open to confusion as the term “*valid*” has a fully different meaning in the *ZC*. This is acknowledged as follows in the *PC*: “*Given the very different meaning of ‘valid’ and ‘invalid’ applied to names in zoological nomenclature (equivalent to the botanical ‘correct’ and ‘incorrect’), it is convenient that neither ‘valid name’ nor ‘invalid name’ need be used in botanical nomenclature: either a name is validly published or else it is not a validly published name, i.e. not a name under the Code.*”²

The contributors to the writing of the *DBC* proposed to abandon both terms “*availability*” and “*valid publication*” and to replace them by the term “*establishment*”. They used the term “*established*” for a nomen complying with the regulations of the *Code* at stake, but provided no term (such as “*unavailable*” in the *ZC*) for a nomen published but not complying with these regulations. Finally, none of these *Codes* proposes a technical term to designate a nomen once “*established*” under the Rules but the “*establishment*” of which was later cancelled or nullified for some reason³.

An additional confusion must be pointed out here. The *DBC* (Articles 5, 6, 8, 13, 19) uses the terms “*to establish*” and “*establishment*” not only for the introduction in taxonomic literature of a new nomen or nomenclatural act, but also for the first use of a new combination of the same specific nomen and, although not clearly, of a new rank and spelling for the same nomen. This is based on a confusion between the concepts of *nomen* and of *paronym* (Dubois 2000, 2011a). For example, Article 8.1 puts on the same level “*new combinations*” and “*replacement names*”, stating that both can be “*established*”. This is improper. A new combination is not a new nomen, but a new avatar of an existing nomen, one of its “*paronyms*” (which include the original “*protonym*” and all its subsequent “*aponyms*”). It has no nomenclatural existence independent from that of the original nomen: it has the same author, date and onomatophore as the latter. It cannot therefore be “*established*”, according to the definition of this term in the *DBC*, where it means the proper introduction of a nomen into the world of bionomenclature. The same applies to the use of a different rank for a nomen, e.g., a superfamilial aponym derived from a familial protonym. In contrast, a “*replacement name*” or “*neonym*” (Dubois 2000) is indeed a new nomen, with its own author and date (although the same onomatophore) as the *archaeonym* (Dubois 2005a, 2006a) which it replaced. The “*basionym*” of a nomen modified in its combination or rank is not a “*synonym*” of the latter, it is just a different paronym of the *same* nomen, whereas a neonym is indeed a junior objective synonym, more shortly an *isonym* (Dubois 2000) of the original nomen, i.e., a *distinct* nomen. The same confusion appears in Article 14.3, which states that a new combination “*is typified by the type of the older name*”. This is incorrect, as the protonym and any of its aponyms (such as a new combination) are the *same nomen* and therefore cannot be “*typified*” independently.

Beside this important confusion, the *DBC* also uses the two terms “*to establish*” and “*establishment*” with various other meanings (“Preamble”: Articles 4 and 5; Division I: Principle VIII; Division II: Articles 19.5 and 34.1, Recommendations 18A3 and 19A1; Division III: Articles 1 and 5). The use of these two terms is therefore highly confusing in the *DBC* and should better be abandoned. For the step (S1) of the nomenclatural process, other couples of terms, like “*create*”/“*creation*”, “*initiate*”/“*initiation*” or “*originate*”/“*origination*”, could rather be employed. Dubois (2011a) proposed the terms “*create*” and “*creation*”, which are fully appropriate as, before this nomenclatural act, a nomen “does not exist” in nomenclature and cannot be used in scientific taxonomy. As for the first usage of a new aponym for an already created nomen (e.g., a new combination or a new rank), for which Dubois (2011a) had independently proposed the terms “*to establish*” and “*establishment*”, in order to avoid the confusion created by the *DBC*, I here propose to simply use the terms “*to use first*” and “*first-usage*”, parallel to the term “*first-user*” introduced by Dubois (2000) and employed in various publications since then.

Technical terms are available for the three concepts outlined above (Dubois 2000): “*hoplonym*” for a nomen properly created, “*anoplonym*” for a nomen published but not complying with the Rules for the creation of nomina, and “*exoplonym*” for a nomen once created complying with the Rules but later expelled from nomenclature for some reason. For this latter act, rather than “*to invalidate*”/“*invalidation*” or “*to suppress*”/“*suppression*”, the terms “*to cancel*”/“*cancellation*” could be used⁴. The use of these short and clear terms would be beneficial not only to the *DBC* but also to all other nomenclatural *Codes*.

Another case where the *DBC* proposes a term different from those of the other *Codes* is stage (S3) of the nomenclatural process. As we have seen, the *ZC* uses the terms “*valid*” and “*invalid*” for the nomina resulting

2. Strangely however, the *PC* uses the term “*invalid name*” once, in the second paragraph of its Appendix V.B.

3. An exception is the unique use for this concept of the strange neologism “*devalidating*” in the 17th paragraph of the “Preface” to the *PC*.

4. See Dubois (2000: 45–48) for a clarification of the reasons why not to use the terms “*protection*”, “*conservation*”, “*suppression*” or “*resurrection*” in bionomenclature.

from this step, and “*validity*” and “*invalidity*” for their status, whereas the *PC* uses the term “*correct*”, “*incorrect*” and “*correctness*” (but not “*incorrectness*”) for these concepts. As for the *BC*, it only mentions the term “*correct*”. The *DBC* uses the term “*accepted*” for the nomen retained by the Rules for the taxon, but has no term for the nomina rejected and for the fact itself. The term “*acceptance*” could possibly be used for the latter, but “*unaccepted*” would be a neologism and the longer formula “*not accepted*” might be better.

However, there is a problem of connotation with the use of the root “*accept*” for this concept. The idea of “*accepting*” a nomen unavoidably carries the meaning that this is a choice, a decision, that a taxonomist is free to take, or not. However, this is not so. The nomen that must be retained and used for any taxon under any taxonomy does not result from an individual (or collective) decision or choice, but from the *automatic* application of the *binding* nomenclatural Rules at stake for a particular group of taxa. This is the basic prerequisite for a *Code* to act as a solid reference for the application of nomina to taxa and not as a mere set of “*suggestions*” that one is free to follow or not (for details, see Dubois 2011a).

For this reason, I think a term like “*good*”, “*proper*”, “*apt*”, “*suitable*”, “*adequate*” or “*appropriate*” would be better for this concept than the term “*accepted*”. As there are two different “*substages*” in the stage (S3), two of these terms could be used to distinguish them. The term “*adequate*” could be retained to designate the proper nomen that should be retained for a given taxon under the Rules, i.e., substage (S3a). Companion to this term are its antonym “*inadequate*”, and the substantives “*adequacy*” and “*inadequacy*” for the result of the statement (and not decision) that a given nomen is the adequate one for a taxon, or not. For a shorter technical designation of the nomina, the terms “*kyronym*”, for an adequate nomen, and “*akyronym*”, for an inadequate nomen, are available (Dubois 2000). Then, in substage (S3b), among the several spellings of a given nomen (its “*parographs*”; Dubois 2010b), only one of them should be retained as proper under the Rules in force: this could be called the “*appropriate*” spelling, with the antonym “*inappropriate*” and the substantives “*appropriateness*” and “*inappropriateness*”. For a uninominal technical designation of the nomina, the terms “*eugraph*”, for an appropriate spelling, and “*nothograph*”, for an inappropriate spelling, are available (Dubois 2010b).

In several cases, the *DBC* uses terms borrowed from the *PC*, although the terms used in other *Codes* may be argued to be better. The reverse situation never occurs, which seems to point to a predominance of botanists among the authors of this text. For example, to point to priority of publication, the *DBC* uses the terms “*earlier*” and “*later*”, borrowed from the *PC*, instead of “*senior*” and “*junior*”, used in both the *ZC* and the *BC*, although the latter terms, which are much less frequently used in common language than the former, more clearly point to “*technical*” concepts of nomenclature and for this reason would seem more appropriate in a *Code*.

Finally, a number of terms appear in the *DBC* which have equivalents in the *PC* but not in the *ZC*, as the concepts that they designate have not appeared useful until now in zoological nomenclature. For example, the term “*acceptable*” used in the *DBC* corresponds to “*legitimate*” in the *PC* and in the *BC* but has no real equivalent in the *ZC*. The term “*potentially valid*” which appears only twice in the “*Index*” of the latter (p. 109 and 123), but nowhere in its text, implies no genuine distinction from the term “*available*”: the statement that a potentially valid name is “*an available name which is not objectively invalid*” (p. 109) is of no practical consequence in zoological nomenclature as no Rule of the *ZC* relies on this concept. For this reason, it was suggested (Dubois 2011a: 90) that, in zoological nomenclature, the category of nomina called “*potentially valid*” was useless as redundant with that of “*available*”. Its use, under the designation of “*acceptable*”, in the *DBC*, does not seem to have practical advantages, but rather complicates the nomenclatural process in four steps as described by Dubois (2005b, 2011a). Its recognition would require to recognize an additional step or stage, “*acceptability*”, between those of “*allocation*” and “*adequacy*” (as defined here). There exists no real advantage in dissociating junior homonymy from the other reasons that can make a nomen inadequate for a taxon to which it applies. If so, why not also separate objective synonymy, secondary homonymy, etc.? All these situations (and their opposites) could be very formally recognized as distinct steps of the nomenclatural process, which would only make the latter more undecipherable for newcomers to the discipline of nomenclature and even for its regular users. For the same reason, Dubois (2011a) suggested that, in the

zoological nomenclatural process, a single stage should be recognized for “*validity*” (here “*adequacy*”) and “*correctness*” (here “*appropriateness*”).

Another example of concept and term borrowed from botanical nomenclature is that of the term “*epitype*”, although its use is superfluous and even questionable, at least in zoology where it has not been recognized so far (see Dubois 2011a: 55). This term implies a confusion between the nomenclatural function of onomatophores and the taxonomic function of *taxonts* or members of the *hypodigm* (see Dubois 2011a).

In contrast with this case where the *DBC* uses a concept that appeared superfluous to zootaxonomists, this *Code* does not recognize several concepts (and therefore terms) present in the *ZC*, such as those of *first-reviser* or of *primary* and *secondary homonymy*, although they are very useful to clarify the nomenclatural process.

As shown by the examples discussed above, terminological problems are often not only terminological, but testify to the existence of conceptual and methodological problems. More detailed discussions of some such issues in the *DBC* are given below. Such discussions would be made easier if the *DBC* included a glossary of the technical terms it recognizes, and their equivalents in the other *Codes* currently in force. To be complete and fully useful, such a glossary should not only provide the terms and their definitions, but also their etymology, the reference to their creation and several references documenting their actual uses in taxonomic publications (see Dubois 2011c).

Ranks and nominal-series

Ranks are levels in a taxonomic and nomenclatural hierarchy, or more shortly *taxonomical hierarchy* (species, genus, family, order, class, etc.). One of the main differences between the *ZC* and the *PC* lies in the way they deal with ranks. The *PC* recognizes a rather high (23) and fixed number of ranks, which are all listed in the *Code* (no further ranks being allowed), and which cover the whole taxonomical hierarchy from the rank reign to the rank subform. For all questions relating to homonymy, synonymy and priority, nomina are treated independently in each rank. Thus, for example, a nomen of rank genus can be homonymous or synonymous with another nomen of same rank (Article 53.1), but not with a nomen of rank subgenus, except if it is a subgenus of the same genus (Article 53.4). Whenever a taxon is altered in rank, either raised to an upper rank (e.g., a subgenus raised to the rank of genus) or downgraded to a lower rank (e.g., a genus downgraded to the rank of subgenus), this results in fact in the creation of a new nomen, with its own author and date, which will compete for priority, homonymy and synonymy with all other nomina in its new rank. The statement “*In no case does a name have priority outside its own rank*” (Article 11.2) clearly means that the rank is part of the nomen itself, is permanently attached to it and qualifies it permanently.

The *ZC* is different. Its Rules deal only with the nomina of part of the taxonomical hierarchy, from superfamily down to subspecies. They do not deal with the nomina of higher taxa (orders, classes), which are supposed to be a matter of “consensus” among zootaxonomists, nor with the nomina at ranks lower than subspecies (variety, form, etc.), which are “forbidden” by the *ZC*. The ranks covered by the *ZC* are distributed in three sets of nomina, designated in the English text as “*groups of names*” and in the French text as “*levels of names*” [“*niveaux de noms*”]—two terms that are not equivalent—, and which are better called *nominal-series* (Dubois 2000): the *family-series* (with the ranks superfamily, family, subfamily, tribe and subtribe, “*and any other rank below superfamily and above genus that may be desired*”; Article 35.1), the *genus-series* (with only two ranks, genus and subgenus) and the *species-series* (with four ranks, “*aggregate of species*”, species, “*aggregate of subspecies*” and subspecies).

The important difference between the zoological and botanical Rules is that, in zoology, all nomina of a given nominal-series can interact for homonymy, synonymy and priority, with their original date and author, whenever they are referred to the same rank. This is a consequence of the *Principle of Coordination*, a basic Principle of the *ZC*, which states that any nomen created at a given rank within a nominal-series is “*deemed to*

have been simultaneously established for nominal taxa at all other ranks” in the same nominal-series (Articles 36.1, 43.1 and 46.1).

These two nomenclatural systems are fully different and incompatible. This is doubtless the main difference between the two *Codes*, and it poses major problems for the, even partial, unification of both *Codes* into a single *Biocode*. The question can be put bluntly as follows: will zoologists have to abandon the nominal-series, or botanists have to adopt them?

The solution which was retained by the authors of the *DBC* is in some way intermediate between the two possibilities—but is arguably worse than both. In its Article 3.3, the *DBC* recognizes seven “rank groups”. Although unified under this single designation, these seven sets of ranks are in fact of two kinds. Three of them are submitted to an (untold in the *DBC*)⁵ Principle of Coordination: the “family-group”, the “genus-group” and the “species-group”. The strange peculiarity of these rank-groups is that each of them includes only two ranks, i.e., respectively: family and profamily, genus and progenus, species and prospecies. In these three rank-groups, according to Article 6, the “establishment” of a nomen for a taxon in a rank “is deemed to automatically establish” a coordinate nomen in the other rank. The ranks profamily, progenus and prospecies are novelties introduced in the *DBC*. In zoology, taxa “established” at the ranks subfamily, subgenus and subspecies are “treated as simultaneously established” nomina of the three new ranks in “pro–”, respectively (Article 8). But this does not apply to botanical (and bacteriological) nomina: in this case, nomina “established” in “sub–” remain in this rank, are not equivalent to nomina in “pro–” and remain outside the corresponding rank-groups (Notes 24.1.1, 26.2.1, 28.3.1). The reason behind these very strange Rules is easy to understand: it is to maintain the possibility for phytotaxonomists to keep a high number of independent (i.e., not coordinated) ranks, while pretending to also allow zootaxonomists to use coordinated ranks and nominal-series.

But this aim is not attained, because of the limitation to two of the number of ranks in these three name-groups, and because of the existence of four other so-called “rank groups” which are not nominal-series of coordinated ranks: “‘suprafamilial ranks’ (all ranks above the family group); [...] ‘infrafamilial ranks’ (all ranks between family group and genus group); [...] ‘infrageneric ranks’ (all ranks between genus group and species group); [...] and ‘infraspecific ranks’ (any rank below the species group)” (Article 3.3). These “rank groups” are in fact sets of nomina at various ranks which are put largely outside the basic Rules of the *DBC*, as they do not interact among themselves and “The principle of priority is not mandatory for names of taxa not belonging to the family group, genus group or species group” (Article 19.7).

Compared with the *PC*, the *DBC* results in keeping the 23 independent ranks in force in the *PC*, and in adding them three coordinated ranks, i.e., in introducing a limited Principle of Coordination, that applies to 6 of the 26 ranks. Compared with the *ZC*, the *DBC* results in reducing the number of ranks in two of the three coordinated nominal-series (2 instead of an unlimited number in the family-series; 2 instead of 4 in the species-series), and in rejecting a number of ranks outside coordinated nominal-species. The change is therefore much more drastic in zootaxonomy than in phytotaxonomy, even if the botanical Rules are also modified. Is this “mixed” solution a good one?

The reply to this question requires to wonder what is the meaning and usefulness of ranks in the taxonomy and nomenclature of organisms. This question was addressed by a number of authors in the recent decades. It appears that two different approaches of ranks are supported by different authors: *absolute* and *relative* ranks.

Under an absolute ranks approach, ranks appear to have a *meaning* by themselves. Some taxa would be referable, by some criteria, to precise ranks: some would *be* families, others genera, others species. This approach has been particularly used for taxa of the latter rank. For many authors, taxa of rank species are of a *nature* different from that of taxa at other ranks, even circumspecific (“close” to species), such as subspecies, supraspecies or species-group (“aggregates of species” in the *ZC*; see Dubois 2006a). The quest for a so-

5. More exactly, “almost untold”, as this Principle is briefly and surreptitiously designated as “principle of co-ordinate status” in Note 19.2.1 of the *DBC*, but this term does not appear in any Article of this *Code* itself, and this Principle does not appear among the nine Principles listed in “Division I” of this text.

called “*unified species concept*” (de Queiroz 1998; Samadi & Barberousse 2006) relies on such an “essentialistic” conception of species, but is highly questionable in view of the complexity of real evolutionary phenomena (Dubois 2011*b*). This approach has also been advocated for taxa at the rank genus, as compared to taxa at circumgeneric ranks such as subtribe, subgenus and supraspecies (Dubois 1988). Some authors have even supported an “essentialistic” approach to the whole taxonomic hierarchy, the rationale of which relies on a desirable correspondence between a given rank and a given geological age (Hennig 1950, 1966; Avise & Johns 1999).

This absolute ranks approach has met considerable, and justified, criticism in the recent decades (e.g., Smith 1988; Sundberg & Pleijel 1994; Minelli 2000; Pleijel & Rouse 2003; Kluge 2005; Bertrand *et al.* 2006; Laurin 2010). To qualify as a scientific approach, it would require that some *criteria of equivalence* could be identified between various taxa in widely different groups referred to the same rank. Such criteria could be looked for in biological data, such as morphological, behavioural, genetic or other *characters*, but then they could be used only among closely related taxa, as “*common criteria need common characters*” (Schaefer 1976; Dubois 1988), and can therefore have no generality. They can be *relational taxonomic criteria* (Dubois 1988) or *relacters* (Dubois 2004), such as mixiological criteria (existence or absence of gene flow between populations at circumspecific levels; hybridizability between species, even in artificial conditions, at circumgeneric levels), or even geographical criteria (mere separation between entities in nature, irrespective of their potential “hybridizability”; de Queiroz 1998), but then they can only apply at low taxonomic levels and such an approach cannot have generality among all organisms and at all taxonomical ranks (Dubois 2008*d*). They can be *historical*, e.g., based on the age of taxa, but this approach also raises several seemingly unsolvable problems (Dubois 2008*d*). They can be *metataxonomic*, i.e., based on purely quantitative data about the number of taxa at each rank included in taxa at the next higher rank (Van Valen 1973), but such a mechanistic approach would erase all evolutionary meaning to the use of ranks (see Dubois 1988). The same would apply to what could be called a *metacladistic* approach to the use of ranks, based for example simply on the number of identified nodes in a phylogenetic tree between any two taxa. These two latter approaches would be particularly irrelevant in many groups of organisms, given the *taxonomic gap*, i.e., the dramatically incomplete (and unbalanced between groups) sampling of the existing biodiversity of the planet that is currently available to biologists (Dubois 2010*c*).

Part of this problem however is artificial, as it results from a confusion that has long been entertained between the taxonomic concept of *category* and the nomenclatural concept of *rank* (Dubois 2005*b*, 2008*d*). All the statements above apply to taxonomic concepts. They point to classes or groups of taxa that share certain “particularities”, whether biological, historical or merely quantitative. As such, they qualify as *taxonomic categories*. These categories can be *defined* intensionally, they have a meaning *by themselves*, hence the term *absolute ranks* that can be used to designate them.

As for the concept of *nomenclatural rank*, as strictly defined by Dubois (2005*b*, 2008*d*), it only refers to the place of a taxon in a taxonomic hierarchy, whether based on a phylogenetic hypothesis or not. Unlike absolute ranks (or taxonomic categories), relative ranks are very useful in taxonomy, especially in a phylogenetic framework, where “*they are employed to communicate information about inclusiveness and/or exclusiveness*” (Bertrand *et al.* 2006: 152). The information provided by ranks is very limited but very useful. Ranks do not tell us anything about the biological, historical or other particularities of the taxa. They only inform us on the internal structure of the taxonomic arrangement. The fact that two taxa are treated as two subfamilies of a family points to the fact that they are sister-taxa—i.e., in a phylogenetic taxonomy, that they are the result of a cladogenesis which gave rise to two lineages. But the “tree of life” is by no means symmetrical, and the number of cladogeneses in different lineages may be widely different, and so are the numbers of ranks in different branches. No taxonomy recognizes all nodes of a tree as taxa, and arbitrary decisions must be taken to decide which of these nodes are to be so. Therefore, the same rank in different branches of a tree does not have the same “meaning”: a subfamily of birds is by no criterion equivalent to a subfamily of flies or of snails. However, the question of equivalence of criteria discussed above is irrelevant here, as ranks express the hierarchical *relationships* between taxa but have no further function and carry no meaning or information by themselves, being *relative*. This is the appropriate reply to the authors who suggest

abandoning nomenclatural ranks as a result of their confusion between the latter and taxonomic categories: “*The question is not to suppress ranks, but to realize that they only have a relative meaning, informing us on the hierarchical structure of the taxonomy, i.e., on hypothesized phylogenetic relationships, but carry no further information. This is a matter of pedagogy, not of taxonomic theory. Ranks are a useful tool for taxonomy and for biology as a whole, but their role and meaning should be ‘de-dramatized’ and minimized in the eyes of all users of taxonomies.*” (Dubois 2011a: 8).

What is the meaning of the formula “de-dramatization of ranks” in this context? It means that, every time the hypotheses of relationships between taxa change, the ranks of some taxa may have to change, even if the contents and definition of the taxa themselves are not modified. Such a change is not to be considered a modification of the taxa by themselves, only of their relationships with the other closely related taxa. In such conditions, there would be no point in requiring that the change of rank for a taxon should be followed by a significant change in its nomen. And this is exactly what the system of the nominal-series allows. Under this system, if a taxon of rank family is downgraded to the rank subfamily, or tribe or subtribe, it keeps its nomen, author, date and onomatophore. The same applies to a subspecies raised to the rank species, to an order raised to the rank class, to a subclass downgraded to the rank superorder, etc. The only changes in nomina following changes in hierarchical relationships between taxa are those which involve a change of nominal-series: e.g., a genus raised to the rank subtribe or a superfamily raised to the rank suborder. In such cases, the change in the position in hierarchy results in a change of nomen, author, date and onomatophore. Such difficulties are the unavoidable consequence of the very long use of nominal-series during the history of zoological taxonomy, which has resulted in strong traditions that cannot be swept aside without consequences.

Reducing the number of nominal-series, e.g. by lumping the class-series with the family-series as suggested by some (e.g., Alonso-Zarazaga 2005), would result in a considerable modification of higher zoological nomenclature, with many changes in long-used nomina, for no real benefit (Dubois 2006b). The best solution to this problem is to maintain four nominal-series (class-, family-, genus- and species-series) in zoological nomenclature (possibly with a fifth one for the lowest taxa, the variety-series; see Dubois 2011a: 20–21). However, all that precedes strongly supports the idea that it would be a very bad idea to increase the number of nominal-series above the species-series, passing from 3 series nowadays to 5, with 3 of these 5 series being so to speak outside the Rules, as priority would not be compulsory within them. This proposal of the *DBC*, clearly inspired by the *PC*, amounts at considering ranks as having a value and meaning by themselves, i.e., it supports the idea of absolute ranks. For this reason, zoologists should refuse the new system of “*rank groups*” as proposed in the *DBC*.

Higher nomenclature

A major problem of the *ZC* so far is its absence of Rules for the nomenclature of higher taxa, above the rank superfamily. This problem was discussed at length elsewhere (Dubois 2005b, 2006a–b, 2011a) and does not need to be so again. In this respect, the authors of the *DBC* cannot be blamed for having proposed Rules largely inspired of those of the *PC*, as the *ZC* has so far failed to propose any alternative ones! However, these proposals fall down in ignoring some problems and difficulties. The following discussion concentrates on the problems that would be posed in zoological nomenclature by the adoption of the *DBC* for taxa of the class-series as defined by Dubois (2000), i.e., for taxa above the rank superfamily.

For these taxa, the *DBC* (Article 23) recognizes two categories of nomina, “*typified*” and “*typeless*” ones. In this respect, this heterogeneous system of the *DBC* is similar to the “*circumscriptional nomenclature*” system of Kluge (2010). Both these systems allow the same taxon to be designated by two, or even more, different nomina (*allelonyms*; Dubois 2011a: 77). This is certainly not a good idea. It may derive from the existence of a similar situation for a limited number of family nomina in botanical nomenclature (Articles 18.5–18.6), where it is a survivance of the past, but it would certainly not be advisable to extend it to new Rules implemented nowadays (Dubois 2011a: 41). As we have seen, unicity is a major desirable property for

a nomenclatural system, and this property requires that: (1) any given taxon can have only one adequate nomen; (2) all nomina in a given nominal-series be regulated by the same Rules, especially as regards allocation to taxa and adequacy (as defined here). This is not the case in the systems proposed by the *DBC* and by Kluge, as some taxa above the rank family can have two different nomina, and the allocation of the two “kinds” of nomina to taxa follows different logics. In these systems, “*typified*” nomina are allocated to taxa through their onomatophores which are “*type-genera*” or *nucleogenera* (Dubois 2005b), whereas “*typeless*” nomina “*apply to taxa defined by circumscription*” (Article 23.1 of the *DBC*). The *DBC* does not provide more details regarding the latter point, but, as shown below, this qualification is not enough to allocate unambiguously and automatically a nomen to a given taxon, and arbitrary decisions must be taken at one stage in both categories of nomina.

Dubois (2006b, 2007a, 2008d) identified three main possible systems for the allocation of nomina to taxa: (S1) extensional definitions of nomina; (S2) intensional definitions of nomina; (S3) ostensional allocation of nomina to taxa. Furthermore, two of these systems can be divided in several subsystems. The system (S1) has two possible subsystems, (S1a) closed extension and (S1b) open extension. As for the system (S3), it can have five different subsystems: (S3a) onomatophores with a Principle of Coordination; (S3b) onomatophores with absolute ranks; (S3c) additivity of onomatophores; (S3d) indissoluble sets of taxa as onomatophores; and (S3e) combination of indissoluble sets of taxa as onomatophores and onomatostases. The system (S2), used in alternative “phylogenetic” nomenclatural systems like the *Phylocode*, is certainly not advisable, being theory-bound. The other two systems are theory-free and could *a priori* be retained, but they have different advantages according to whether a Principle of Coordination within nominal-series is implemented, or not.

It would be too long to discuss these questions in detail again here, so the previous publications on this matter (Dubois 2006a–b, 2007a, 2008d) should be consulted for a full understanding of what follows. For “*typified*” nomina, the *DBC*, as it does not recognize a Principle of Coordination for nomina above the rank family, is bound to use the system (S3b), whereas for “*typeless*” nomina, it follows the system (S1). No precision is given in Article 23.1 of the *DBC* about which of its two subsystems is favoured, but, given the support brought to absolute ranks by the choice of system (S3b) for “*typified*” nomina, it is logical to suppose that (S1a) is favoured by the authors of the *DBC*. This system (S1a) is very rigid and inappropriate in biological nomenclature, because it does not allow any change in the content of the original taxon for which the nomen had been created: i.e., not only *removing* a member (specimen or taxon) from the taxon requires to abandon the nomen for the latter (which has a logical justification), but also any *addition* of a member to the taxon requires the same operation (which is not logical and would result in the unended replacement of nomina by others whenever the progress of research discloses the existence of new species and other lower taxa). Both systems (S3b) and (S1a) are unadvisable for a nomenclature of taxa because they give an undue importance to the original content and to the original rank of a taxon and require to change the nomen whenever either is changed. This is not compatible with a *robust* nomenclatural system as defined by Dubois (2005b, 2011a), i.e., one where nomina of taxa do not change everytime a slight taxonomic change is implemented—as it the case in the current *ZC* in the nominal-series which it covers.

By lumping together all nomina above the rank family into a single rank group of “*suprafamilial ranks*”, the *DBC* ignores a basic difference between nomina of the family-series and nomina of higher taxa (class-series) in zoology. In the family-series, up to the rank superfamily, nomina are submitted to the Principle of Coordination. This means that the allocation and validity (here adequacy) of nomina for given taxa is automatic: the allocation of these nomina to taxa is imposed by the onomatophore and rank of each nomen, and their validity (adequacy) at each rank is given by priority. But for nomina of taxa above the family-series, the hierarchical relationship between nomina cannot be provided by this system, as these nomina are not connected by coordination. As discussed in detail by Dubois (2006b, 2007a), only two systems, (S3d) and (S3e), have properties allowing an unambiguous allocation of these nomina to taxa in a hierarchical taxonomy and automatic statement about the adequate nomen of each taxon. The Rules proposed by Dubois (2006a) for class-series nomenclature in zoology are the only ones so far proposed that allow both to obtain an

unambiguous and automatic allocation of nomina to taxa in this nominal-series, and to maintain as valid the nomina that have been traditionally used for some taxa in the zoological literature (*sozonyms*; Dubois 2006a).

Both the *DBC* and Kluge's (2010) Rules show an important weakness, namely their recognition of the possibility to use two different kinds of allocation systems for class-series nomina in zoology: (S3b) onomatophores for "typified" nomina and (S1a) closed extensional definitions of nomina for "typeless" nomina. This is not compatible with the requirement of unicity of the Rules applied to any given set of nomina and it is a source of ambiguity and confusion as it allows the same taxon to have several possible allelonyms, which should not be possible. This problem comes from the fact that, in higher zoological nomenclature, some nomina are based on the stem of an available genus-series nomen, whereas others are not. Rather than the terms "typified" and "typeless", in what follows I use the terms *rhizonym* ("nomen based on a root"; Dubois 2006b) for the former and *arhizonym* (Dubois 2006a) for the latter.

In the Rules proposed by Dubois (2006a) for class-series nomenclature, both kinds of nomina were treated as acceptable in class-series nomenclature, but they were submitted to the same Rules for their allocation to taxa, i.e., the *ambiostensional Rules* (Dubois 2006a, 2011a). However, Dubois (2006a) had identified a problem with the use of rhizonyms in the class-series: any such nomen, being in the nominative plural and based on the stem of an available (established) generic nomen, was virtually undistinguishable from a family-series nomen. The *ZC* states that any such nomen, if established for a family-series nomen, is available in the family-series, even if its ending is not one of those recognized by the *ZC* for the five "standard ranks" specifically mentioned in this *Code* (superfamily, family, subfamily, tribe and subtribe): this ending just has then to be corrected. As for the ranks not specifically allowed by the *ZC*, but explicitly accepted as possible under Article 35.1 of this *Code*, no prescription is given in the *ZC* for their endings, except that they must have Latin endings in the nominative plural. There exists therefore a risk of confusion between family-series and class-series rhizonyms in zoological nomenclature.

This is exemplified for example by the fact that, in the class **AMPHIBIA**, nomina in "–*oidea*" have traditionally be used as suprafamilial nomina in the order **ANURA** (e.g., superfamily *RANOIDEA*), whereas in the order **URODELA**, similar nomina are traditionally used for suborders (e.g., suborder **SALAMANDROIDEA**). In order to try and solve this problem, Dubois (2006a: 232), in Rule (R22) of his proposed Rules for class-series nomina, had provided a list of endings that should be banned from class-series rhizonyms: "In the particular case of class-series nomina that are based on the stem of an available generic nomen, in order to avoid possible confusion with family-series nomina, the endings of such nomina should not be composed of a combination of a first part (connector) being either –*AID*, –*OID*, –*ID*, –*IN*, –*IT*, –*IL* or –*IS*, and of a second part (ending proper) being either –*AI*, –*IA*, –*EA*, –*AE*, –*EI*, –*I*, –*A*, –*OI* or –*OA*." This proposed Rule was meant at "saving" the possibility for class-series nomina to be rhizonyms, but the least that can be said is that it is not of simple and straightforward use! Furthermore, the discussion above shows that, despite these precautions, following such a Rule will make it very difficult to avoid the confusion with "typified" rhizonyms as recognized in the *DBC* and in Kluge's system. This was argued above to be a potential source of heterogeneity and ambiguity in higher zoological nomenclature. These new facts require to reconsider the Rule (R22) of Dubois (2006a) in order to remove any possibility of ambiguity and doubt.

Taking all these points into account, I here suggest that, in zoology, rhizonyms be forbidden for nomina of the class-series. This will leave all possibilities of endings for family-series nomina, using all imaginable endings for nomina at ranks other than the five standard ones (more precise suggestions in this respect were offered by Bour & Dubois 1985, 1986 and Dubois 2006a). There is still one possibility to "save", after emendation, the class-series nomina once created for class-series taxa, and based on available generic nomina—some of which have been in long use in the general literature and should be conserved as *sozonyms*. This is to emend them by addition of a special suffix that makes these nomina *compound* terms, therefore not acceptable as family-series nomina.

In this system, the *ending proper* (in –*A*, –*AE*, –*ES*, –*I*, etc.) would be preceded by a *connector* being derived from a full Greek or Latin word. Four such connectors have traditionally been used in zoological class-series nomenclature for two centuries or more, and their use was advocated recently either by Alonso-Zarazaga (2005) (–**OMORPH**–, derived from the Greek μορφή, "form, shape"; and –**IFORM**–, derived from the

Latin *forma*, “form, shape”), by the *DBC* (–**OPS**–, derived from the Greek ὄψις, “sight, “appearance”) or by both (–**OZO**–, derived from the Greek ζῶον, “living being, animal”). As I do not think absolute ranks should be used in zoological nomenclature, and as I recommend not to use the Principle of Coordination in the class-series (for reasons explained by Dubois 2006a–b, 2007a, 2008d), I do not support the proposal to attach these endings to definite ranks, but I support the idea to follow a strict and fixed hierarchy between them, with any of them being always subordinate to another one, if both exist. I suggest the following updown order: –**OZO**– > –**OPS**– > –**OMORPH**– > –**IFORM**–. My new proposal is therefore that, whenever a class-series nomen has been created as a rhizonym, it should remain available (created) and therefore possibly valid (adequate), but should be emended through adding one of these composed endings, and respecting this order if other class-series nomina based on the same generic nomen are also available in this group. I propose the new term *metarhizonym* (from the Greek μετά (*meta*), “after”, ρίζα (*rhiza*), “root, stem” and ὄνομα (*onoma*), “name”), for this kind of nomina. Examples of metarhizonyms would be **RANIFORMES** Wilbrand, 1814 for the class-series taxon of **ANURA** originally established as **RANACEA** and sometimes recognized as a suborder **RANOIDEI**, or **SALAMANDRIFORMES** Müller, 1831 for the class-series taxon of **URODELA** originally established as **SALAMANDRINA** and sometimes recognized as a suborder **SALAMANDROIDEA** (see Dubois 1985).

In the ambiostensional class-series nomenclatural system, in contrast with family-series nomina which are true rhizonyms, metarhizonyms, although based on the root of a generic nomen, are not “*typified*” nomina, but are allocated to taxa through the normal ambiostensional Rules of allocation. Another difference with true rhizonyms is that they do not require for their availability (creation) that the generic nomen from which they are derived be itself available (created): a class-series metarhizonym can well be established even if the generic nomen on which it is based is a *nomen nudum* (*gymnonym*; Dubois 2000).

As a consequence of this discussion, I here propose a new writing of Rule (R22) of the ambiostensional Rules for class-series nomenclature in zoology (Dubois 2006a): “*In the particular case of class-series nomina that are based on the stem of a generic nomen (either available or unavailable), in order to avoid possible confusion with family-series nomina, the endings of such nomina should be emended through the use of a connector derived from a full Greek or Latin word (e.g., –OZO–, –OPS–, –OMORPH–, –IFORM–), followed by an ending proper denoting the nominative plural (e.g., –A, –AE, –AI, –EA, –EI, –ES, –I, –IA, –IS, –OA, –OI). If several such nomina are used for taxa in a situation of hierarchical relationship, both connectors and ending proper should be used in a fixed updown order that will have to be fixed later on by collective international decision.*”

These proposals are clearly incompatible with those of the *DBC* regarding the use of rhizonyms (“*typified*” nomina) in higher zoological nomenclature, and I recommend to reject the latter proposals.

Creation and registration of nomina

This point is not discussed further here, as it was already so in several publications (Dubois 2007c, 2008a,c, 2010a, 2011a; Carlos & Voisin, 2009; Welter-Schultes *et al.* 2009; Löbl 2009; Michel *et al.* 2010). Once again, I think it would be most inappropriate to link *availability* of nomina and nomenclatural acts to online *registration*. Registration should be a distinct nomenclatural step, independent from the three already existing ones (here called creation, allocation and adequacy–appropriateness) of the nomenclatural process. As rightly stressed, e.g., by Funk *et al.* (2005), access to internet in some parts of the world is not as straightforward and costless as in Europe in North America, and imposing such a constraint for all countries would create an imbalanced situation regarding the possibility of taxonomists of all countries to contribute to the discipline of taxonomy.

Language

For the same reason, the proposal of the 11 writers the *DBC* to make the use of Latin or English language compulsory for the availability of new nomina and nomenclatural acts is unacceptable. This would impose the use of one of these language to many zoologists who until now used to publish such nomina and nomenclatural acts in their own language, often in local journals which provide a significant contribution to the overall taxonomic publication corpus, and which for some of them are already threatened by the spread of online publications but would be even more so if they were so to speak “expelled” from zoological nomenclature (Dubois 2008b). The recent trends of zootaxonomy show that some countries, like Brazil and China, where many taxonomic publications are in the national language, are playing a growing role in the description of new taxa (Tancoigne *et al.* 2011), and this trend can be predicted to increase in the coming decades, particularly in South American countries but also in other parts of the world. Zootaxonomists of these countries should be allowed to continue doing so.

Although in zoological nomenclature there has been until now, and since the beginnings of systematics, no limitation in the use of languages for nomenclatural acts, it could be argued that in botanical nomenclature such a constraint has always existed, with Latin being imposed for the description of new taxa, so that in botany the change would not be important, and would even be beneficial, as more people worldwide can read or even write English than Latin. But there is a strong difference between the two situations. Latin is a dead language, and its technical use in taxonomic diagnoses did not have any connotation of “superiority” of one current living language over the others—which the choice of English would have. There is strictly no correlation between the use of a given language and the quality of a taxonomic (or other) work. Who could argue that the ability to write a diagnosis in Latin or English is a guarantee of serious, rigorous taxonomic and nomenclatural work? This suggestion proceeds from a general trend towards the globalization of culture worldwide that should be opposed, in the name of cultural diversity and against linguistic discrimination.

Rather than this hegemonic proposal, the solution to the language problem in taxonomic and nomenclatural publications is in the suppression of any prescription regarding the use of any language, including Latin. This certainly could be associated with a Recommendation to provide at least a diagnosis in Latin or English, but this should by no means become a Rule. Such a Rule would carry the risk of a split between different countries using different languages. What would happen of a new nomen published in Chinese language with all criteria of good taxonomic and nomenclatural work but without an English abstract? Under such a Rule, it would not be properly created, and could be made so by any taxonomist in any other country of the world who would publish it again as new but with an Latin or English diagnosis. Much care and attention should be given to such problems if we do not want to break the international unity of biological nomenclature, and of biological science as a whole. It would be a catastrophe for our whole community if taxonomists of some countries refused such a hegemonic Rule and decided to have their own *Codes*, which would prescribe (why not?) the publication of new nomina and nomenclatural acts in their own languages.

Miscellanea

In what follows, I simply provide some various other comments (C1) to (C4), which came to me during a quicker and more superficial reading of the other articles of the *DBC*. They certainly do not cover all the remaining problems in this text.

(C1) Article 7.1 of the *DBC* requires a “*description of the taxon*” for the availability of the nomen. This formula is inadequate. The term “description” applies to a specimen or a set of specimens but not to a taxon,

as a taxon is a concept, not an organism or an object. A taxon may be “defined”, “diagnosed” or “apognosed” (Dubois 2011a), but not “described”.

(C2) The *DBC* does not make the difference between the nomenclatural terms of *combination* and of *onymorph* (Smith & Pérez-Higareda 1986). Article 35.3 of the *DBC* requires to place the author and date in parentheses *not only* in case of new combination, but also of new onymorph (whenever a species-series taxon is “*altered in rank*” but not transferred to another genus). This would modify the use of parentheses in zootaxonomy. In zoology, *Rana temporaria* and *Rana temporaria temporaria* are two different onymorphs of the same combination (Dubois 2011a), so that the author and date, “Linnaeus, 1758”, do not have to be placed in parentheses for the subspecies, whereas it would have to be so under the *DBC*.

(C3) Contrary to what is stated in Example 20.1.2, the nomina placed by the International Commission on Zoological Nomenclature on the *List of Available Names in Zoology* are not automatically protected against senior synonyms or homonyms that may be discovered after their placement on this list. This requires a new action of the ICZN, and this should remain so.

(C4) Article 18.6 presents a concept, that of *parahomonym*, which is useless as it is not associated with a rigorous definition. What is the meaning of the phrase “*so similar that they are likely to be confused*”? Such a vague definition allows a wide variety of interpretations and has no place in a *Code*. Article 18.7 then adds: “*When it is doubtful whether species-group or genus-group names are parahomonyms [...] they may be submitted to the appropriate committee(s) [...] to obtain a binding decision.*” Why “*may*” and not “*must*”? Are we here in a binding *Code* or in a set of advices than one is free to follow or not? Similar Rules exist in Articles 53.3 and 53.5 of the *PC*. In contrast, the Rules of the *ZC* are much clearer and do not allow any discussion or require to call on a committee for decision. In zoology, in the genus- and family-series, any one-letter difference between two nomina or between their stems is enough to prevent homonymy (Articles 55.4 and 56.2); in the species-series, a closed list of variant spellings of nomina “*deemed to be identical*” despite slight differences is provided in Article 58. In this case, the Rules of the *ZC* are clearly much better than those of the *PC*, being fully objective and automatic, and it is very strange and enlightening that the authors of the *DBC* chose nevertheless to follow the vague philosophy of the latter *Code*.

Conclusion

The *Draft BioCode* is the result of an important collaborative work between 11 colleagues from three countries specialised in different groups of organisms and fields of taxonomy. It presents an interesting attempt at unifying the nomenclatural Rules currently in force in different taxonomic domains (zoology, botany, bacteriology, etc.). However, the different nomenclatural Rules currently in force in these groups of organisms are the result of a long historical process during which they have widely diverged in several important respects. Unifying them could be done only at the expense of moderate to major changes in the nomina of taxa in some or all of these groups. The proposals of the *DBC* tend largely to extend several basic concepts and mode of functioning of botanical nomenclature to other fields, mostly zoological nomenclature. This is all the more unfortunate that in several of these cases the zoological Rules can be argued to be more appropriate than the botanical ones, especially to meet the new challenges that biological nomenclature will be facing in the 21st century (Dubois 2011a).

The *DBC* is not ripe and its implementation in its present form, or in a slightly modified one, should not be accepted by the international community of taxonomists, and particularly by zoologists. Among the many problems that would remain to solve before considering this possibility, the following ones are particularly stressed in the present contribution: (1) the need of implementation of a better plan for this document and of a

better technical terminology for nomenclatural concepts and tools; (2) the abandonment of absolute ranks and their replacement by relative ranks in the frame of a limited number of nominal-series, within which a Principle of Coordination is in force (except in the class-series); (3) the adoption of more precise, stringent and unambiguous Rules for the nomenclature of higher taxa of the class-series, relying on an ostensional system of allocation of nomina to taxa and avoiding any possible confusion with nomina of the family-series; (4) the dissociation, in the nomenclatural process, between the stage of creation of nomina and nomenclatural acts and that of their registration, which should not be compulsory; (5) the suppression of all prescriptions regarding the use of any language in taxonomic and nomenclatural publications; (6) the need of more stringent Rules for homonymy between nomina having “similar” spellings.

Acknowledgements

I am most grateful to Alessandro Minelli (Padova) for his useful suggestions on a previous version of this paper.

References

- Anonymous [International Commission on Zoological Nomenclature] (1999) *International code of zoological nomenclature*. Fourth edition. London (International Trust for zoological Nomenclature): i–xxix + 1–306.
- Alonso-Zarazaga, M.A. (2005) Nomenclature of higher taxa: a new approach. *Bulletin of zoological Nomenclature*, **62**: 189–199.
- Avise, J.C. & Johns, G.C. (1999) Proposal for a standardized temporal scheme of biological classification for extant species. *Proceeding of the national Academy of Sciences of the USA*, **96**: 7358–7363.
- Bertrand, Y., Pleijel, F., & Rouse G. W. (2006) Taxonomic surrogacy in biodiversity assessments, and the meaning of Linnaean ranks. *Systematics & Biodiversity*, **4**: 149–159.
- Bour, R. & Dubois, A. (1985) Nomenclature ordinale et familiale des Tortues (Reptilia). *Studia geologica salmanticensia*, vol. especial **1**, *Studia palaeocheloniologica*, **1**, Salamanca (Ediciones Universidad): 77–86.
- Bour, R. & Dubois, A. (1986) Nomenclature ordinale et familiale des Tortues (Reptilia). Note complémentaire. *Bulletin mensuel de la Société linnéenne de Lyon*, **55**: 87–90.
- Carlos, C. J. & Voisin, J.-F. (2009) A few remarks on the proposed amendment of the *International Code of Zoological Nomenclature* to expand and refine methods of publication. *Zootaxa*, **2198**: 67–68.
- Chapman, A.D. (2009) *Numbers of living species in Australia and the world*. Second edition. Canberra (Australian Biological Resource Study): [i–ii] +1–80 + [i–ii]. <www.environment.gov.au/biodiversity/abrs/publications/other/species-numbers/2009/index.html>.
- De Queiroz, K. (1998) The general lineage concept of species, species criteria, and the process of speciation: a conceptual unification and terminological recommendations. In: D.J. Howard & S.H. Berlocher (ed.), *Endless forms: species and speciation*, New York (Oxford University Press, 1998): 57–75.
- Dirzo, R. & Raven, P. H. (2003) Global state of biodiversity and loss. *Annual Review of environmental Resources*, **28**: 137–167.
- Dubois, A. (1985) Miscellanea nomenclatorica batrachologica (VII). *Alytes*, **4** (2): 61–78.
- Dubois, A. (1988) The genus in zoology: a contribution to the theory of evolutionary systematics. *Mémoires du Muséum national d’Histoire naturelle*, (A), **140**: 1–123.
- Dubois, A. (2000) Synonymies and related lists in zoology: general proposals, with examples in herpetology. *Dumerilia*, **4** (2): 33–98.
- Dubois, A. (2004) Developmental pathway, speciation and supraspecific taxonomy in amphibians. 2. Developmental pathway, hybridizability and generic taxonomy. *Alytes*, **22** (1–2): 38–52.
- Dubois, A. (2005a) Les règles de la nomenclature familiale en zoologie. In: A. Dubois, O. Poncy, V. Malécot & N. Léger (ed.), *Comment nommer les taxons de rang supérieur en zoologie et en botanique?*, *Biosystema*, **23**: 17–40.

- Dubois, A. (2005b) Proposed Rules for the incorporation of nomina of higher-ranked zoological taxa in the *International Code of Zoological Nomenclature*. 1. Some general questions, concepts and terms of biological nomenclature. *Zoosystema*, **27** (2): 365–426.
- Dubois, A. (2006a) Proposed Rules for the incorporation of nomina of higher-ranked zoological taxa in the *International Code of Zoological Nomenclature*. 2. The proposed Rules and their rationale. *Zoosystema*, **28** (1): 165–258.
- Dubois, A. (2006b) Incorporation of nomina of higher-ranked taxa into the *International Code of Zoological Nomenclature*: some basic questions. *Zootaxa*, **1337**: 1–37.
- Dubois, A. (2007a) Phylogeny, taxonomy and nomenclature: the problem of taxonomic categories and of nomenclatural ranks. *Zootaxa*, **1519**: 27–68.
- Dubois, A. (2007b) Naming taxa from cladograms: some confusions, misleading statements, and necessary clarifications. *Cladistics*, **23**: 390–402.
- Dubois, A. (2007c) For or against the mandatory registration of new names of organisms? The case of *Zoobank* in Zoology. *Third Linnean Society Debate on Issues in Systematic Biology*, London, The Linnean Society of London, 29 November 2007. Unpublished, very briefly summarised in Hawksworth (2009). [Powerpoint available at: <http://ohler.club.fr/alaindubois/index.php>].
- Dubois, A. (2008a) Zoological nomenclature: some urgent needs and problems. In: *Future trends in taxonomy*, EDIT Symposium, Carvoeiro (Portugal), 21–23 January 2008: 15–18.
- Dubois, A. (2008b) Should we care about taxonomic journals? A plea for *Biotaxa*, a new kind of online subscription package. *Newsletter (European Distributed Institute of Taxonomy)*, **9**: 12–14.
- Dubois, A. (2008c) Le *Code international de nomenclature zoologique*: présentation, philosophie, règles majeures, problèmes actuels. In: D. Prat, A. Raynal-Roques & A. Roguenant (ed.), *Peut-on classer le vivant? Linné et la systématique aujourd'hui*, Paris, Belin: 355–402.
- Dubois, A. (2008d) Phylogenetic hypotheses, taxa and nomina in zoology. In: A. Minelli, L. Bonato & G. Fusco (ed.), *Updating the Linnaean heritage: names as tools for thinking about animals and plants*, *Zootaxa*, **1950**: 51–86.
- Dubois, A. (2010a) Contributions to the discussion on electronic publication IV. (6) Registration as a fourth floor of the nomenclatural process. *Bulletin of zoological Nomenclature*, **67** (1): 11–23.
- Dubois, A. (2010b) Retroactive changes should be introduced in the *Code* only with great care: problems related to the spellings of nomina. *Zootaxa*, **2426**: 1–42.
- Dubois, A. (2010c) Zoological nomenclature in the century of extinctions: priority vs. “usage”. *Organisms, Diversity & Evolution*, **10**: 259–274.
- Dubois, A. (2010d) *Bionomina*, a forum for the discussion of nomenclatural and terminological issues in biology. *Bionomina*, **1**: 1–10.
- Dubois, A. (2011a) The *International Code of Zoological Nomenclature* must be drastically improved before it is too late. *Bionomina*, **2**: 1–104.
- Dubois, A. (2011b) Species and “strange species” in zoology: do we need a “unified concept of species”? *Comptes rendus Palevol*, **10**: 77–94.
- Dubois, A. (2011c) The rich but confusing terminology of biological nomenclature: a first step towards a comprehensive glossary. *Bionomina*, **3**: 71–76.
- Euzéby, J. P. (2007) *Alterations to the bacteriological code (1990 revision)*. <<http://www.bacterio.cict.fr/code.html>>.
- Fauquet, C. M., Mayo, M. A., Maniloff, J., Desselberger, U. & Ball, L. A. (2005) *Virus taxonomy. Classification and nomenclature of viruses*. Eighth Report of the ICTV. San Diego (Elsevier): 566–567.
- Funk, V. A., Hoch, P. C., Prather, L. A. & Wagner, W. L. (2005) The importance of vouchers. *Taxon*, **54**: 127–129.
- Greuter, W., Garrity, G., Hawksworth, D. L., Jahn, R., Kirk, P. M., Knapp, S., McNeill, S., Michel, E., Patterson, D. J., Pyle, R. & Tindall, B. J. (2011) Draft BioCode (2011). Principles and Rules regarding the naming of organisms. New draft, revised in November 2010. *Bionomina*, **3**: 26–44.
- Hammond, P. (1992) Species inventory. In: B. Groombridge (ed.), *Global biodiversity—Status of the earth living resources*, London (Chapman & Hall): 17–39.
- Hawksworth, D. L. (ed.) (2009) Registration of scientific names of plants, fungi, bacteria, cultivated plants, and animals: approaches and experiences across disciplines. *Bulletin of zoological Nomenclature*, **66** (2): 109–124.
- Hawksworth, D. L. (2010) *Terms used in bionomenclature: the naming of organisms (and plant communities)*. Copenhagen (Global Biodiversity Information Facility): 1–216.
- Hennig, W. (1950) *Grundzüge einer Theorie der phylogenetischen Systematik*. Berlin (Deutscher Zentralverlag): i–vii + 1–370.
- Hennig, W. (1966) *Phylogenetic systematics*. Urbana, Chicago & London (University of Illinois Press): i–vii + 1–263.

- Kluge, A. G. (2005) Taxonomy in theory and practice, with arguments for a new phylogenetic system of taxonomy. In: M. H. Donnelly, B. I. Crother, C. Guyer, M. H. Wake, & M. E. White (ed.), *Ecology and evolution in the tropics: a herpetological perspective*, Chicago (University of Chicago Press): 7–47.
- Kluge, N. J. (2010) Circumscriptional names of higher taxa in Hexapoda. *Bionomina*, **1**: 15–55.
- Kuhn, J. H. & Wahl-Jensen, V. (2010) Being obsessive-compulsive about terminology and nomenclature is not a vice, but a virtue. *Bionomina*, **1**: 11–14.
- Lapage, S. P., Sneath, P. H. A., Lessel, E. F., Skerman, V. B. D., Seeliger, H. P. R. & Clark, W.A. (ed.) (1992) *International code of nomenclature of Bacteria (Bacteriological code 1990 revision)*. Washington, D.C. (American Society of Microbiology): i–xlii + 1–189.
- Laurin, M. (2010) The subjective nature of Linnaean categories and its impact in evolutionary biology and biodiversity studies. *Contributions to Zoology*, **79** (4): 131–146.
- Löbl, I. (2009) Contributions to the discussion on electronic publication III. (4). *Bulletin of zoological Nomenclature*, **66** (4): 307–308.
- McNeill, J., Barrie, F. R., Burdet, H. M., Demoulin, V., Hawksworth, D. L., Marhold, K., Nicolson, D. H., Prado, J., Silva, P. C., Skog, J. E., Wiersema, J. H. & Turland, N. J., (ed.) (2006) *International code of botanical nomenclature (Vienna Code) adopted by the Seventeenth International Botanical Congress, Vienna, Austria, July 2005*. Königstein (Koeltz): i–viii + 1–568.
- Michel, E., Nikolaeva, S., Dale-Skey, N. & Tracey, S. (ed.) (2010) Contributions to the discussion on electronic publication IV. *Bulletin of zoological Nomenclature*, **67** (1): 4–23.
- Minelli, A. (2000) The ranks and the names of species and higher taxa, or a dangerous inertia of the language of natural history. In: M. T. Ghiselin & A. E. Leviton (ed.), *Cultures and institutions of natural history: essays in the history and philosophy of sciences*, San Francisco (California Academy of Sciences): 339–351.
- Pleijel, F. & Rouse, G. W. (2003) Ceci n'est pas une pipe: names, clades and phylogenetic nomenclature *Journal of zoological systematic and evolutionary Research*, **41**: 162–174.
- Samadi, S. & Barberousse, A. (2006) The tree, the network, and the species. *Biological Journal of the Linnean Society*, **89**: 509–521.
- Schaefer, W.W. (1976) The reality of the higher taxonomic categories. *Zeitschrift für zoologischer Systematik und Evolutions-Forschung*, **14**: 1–10.
- Smith, A. B. (1988) Patterns of diversification and extinction in early Palaeozoic echnioderms. *Palaeontology*, **31**: 799–828.
- Smith, H. M. & Pérez-Higareda, G. (1986) Nomenclatural name-forms. *Systematic Zoology*, **35** (3): 421–422.
- Sundberg, P. & Pleijel, F. (1994) Phylogenetic classification and the definition of taxon names. *Zoologica scripta*, **23**: 19–25.
- Tancoigne, E., Bole, C., Sigogneau, A. & Dubois, A. (2011) Insight from *Zootaxa* on potential trends in taxonomic activity. *Frontiers in Zoology*, in press.
- Van Valen, L. (1973) Are categories in different phyla comparable? *Taxon*, **22**: 333–373.
- Welter-Schultes, F., Eikel, O., Feuerstein, V., Hörschemeyer, T., Klug, R., Lutze, A., Tröster, G., Wieland, F., Willmann, R., Antezana Jerez, T., Baiocchi, D., Caldara, R., Núñez Cortés, C., Fenzan, W. J., Fery, H., Filmer, M., Gittenberger, E., Giusti, F., Horro González, J., Groh, K., Guerra, A., Hendrich, L., Jäch, M., Janssen, R., Jimenez Tenorio, M., Johanson, K. A., Kanase, Aruna A., Kenner, R. D., Koch, A., Lindner, N., Lorenz, F., Maehr, M. D., Manganelli, G., Martínez, S., Meregalli, M., Monteiro, A., Nielsen, S. N., de Oliveira, Á., Pearce, T. A., Pederzani, F., Petrov, P. N., Pola Perez, M., Poppe, G. T., Richling, I., Rolán, E., Sahlmann, B., Sama, G., Savage, J. M., Smetana, A., Stuardo, J., Sturm, C., Suárez Bustabad, M., Subai, P., Szekeres, M., Trigo, J. E., Tucker, J. K., van Vondel, B. J., Watts, C., Wiese, V. & von Wirth, V. (2009) Comment on the proposed amendment of articles of the *International Code of Zoological Nomenclature* to expand and refine methods of publication. *Bulletin of zoological Nomenclature*, **66** (3): 215–219.

Submitted: 19 February 2011. Accepted: 15 March 2011. Published: 21 April 2011.

Corresponding Editor: Alessandro Minelli.