Bionomina, **2**: 1–104 (2011)
www.mapress.com/bionomina/

Monograph

ISSN 1179-7649 (print edition)
BIONOMINA
ISSN 1179-7657 (online edition)

BIONOMINA

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The *International Code of Zoological Nomenclature* must be drastically improved before it is too late

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Magnolia Press
Auckland, New Zealand

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(*Bionomina* 2)

104 pp.; 30 cm.

18 Feb. 2011

ISBN 978-1-86977-653-4 (paperback)

ISBN 978-1-86977-654-1 (Online edition)

FIRST PUBLISHED IN 2011 BY

Magnolia Press

P.O. Box 41-383

Auckland 1346

New Zealand

e-mail: magnolia@mapress.com

http://www.mapress.com/bionomina/

ISSN 1179-7649 (Print edition)

ISSN 1179-7657 (Online edition)

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Abstract

At the beginning of the century of extinctions, science has only inventoried a very small proportion of the living species of the globe. In order to face the taxonomic urgency that results from this taxonomic gap combined with the biodiversity crisis, zootaxonomy needs efficient, rigorous and automatic nomenclatural Rules, that allow to spend a minimal time on nomenclatural problems—rather than investing time, energy and money in renaming millions of already named taxa in order to follow alternative nomenclatural systems, e.g., "phylogenetic" ones, that furthermore do not show theoretical superiority to the current Linnaean-Stricklandian one. The current *Code*, result of a 250-year improvement process, is based on very sound and healthy Rules, being theory-free regarding taxonomy, relying on objective allocation of nomina to taxa by a system of ostension using onomatophores, and on an objective basic Principle, priority, for recognizing the valid nomen of a taxon in case of synonymy or homonymy. Nevertheless, this nomenclatural system is certainly not perfect. It should be modified at least in nine directions: (1) it should adopt a technical terminology avoiding possible misinterpretations from outsiders of the field and even from specialists, and allowing a precise formalisation of its mode of functioning; (2) its plan should be drastically modified; (3) its Principles should be redefined, and some added; (4) material evidence for the allocation of nomina to taxa through specimens deposited in permanent collections should be given more weight; (5) it should incorporate all nomina of higher taxa, providing clear and strict universal Rules for their naming, whereas conserving the traditional nomina largely used in non-specialized systematic literature; (6) it should allow for the recognition of many more ranks at lower nomenclatural levels, i.e., just above genus, between genus and species, and below species; (7) it should provide much more stringent Rules for the protection against priority of "well-known" nomina or sozonyms; (8) various "details" should be addressed, various Rules and Recommendations changed before a new edition of the *Code* is published; (9) the procedure of implementations of changes in the *Code* should be modified in order to involve zootaxonomists of the whole world in the decisions. In several instances, the Rules of the *Code* should become much more compulsory for all zoologists, editors and publishers, to avoid the publication of endless and sometimes most detrimental discussions among taxonomists which give a poor image of nomenclature and taxonomy among the biological sciences, such as bitter discussions about the "best" nomen to be used under a so-called "usage" philosophy, or about nomina to be applied to higher taxa. *Code*-compliance in zootaxonomic publications should be highlighted, and editors and publishers should require from authors who follow alternative nomenclatural Rules (or no rule at all) to make it clear by using particular modes of writing their nomina. It is argued here that if the *Code* of the 21st century does not evolve to incorporate these changes, it will prove unable to play its role in front of several important recent theoretical and practical developments of taxonomy and run the risk of being abandoned by a part of the international community of zootaxonomists. The latter could then adopt alternative "phylogenetic" nomenclatural Rules, despite the severe practical problems and theoretical flaws posed by such projects. This would be most detrimental for all comparative biological disciplines including systematics, and even for the unity of biology. In the course of this discussion, a few recommendations are given concerning the standards and guidelines suggested by recent authors for a good, modern, integrative taxonomy.

Key words. Taxonomy, nomenclature, *Code*, Principles, terminology, availability, allocation, specimens, types, onomatophores, collections, validity, registration, ranks, higher taxa, priority, usage, spelling, change in Rules, integrative taxonomy, phylogeny, century of extinctions, taxonomic gap, taxonomic urgency

Abbreviations and printing conventions

In this paper, "ICZN" designates the International Commission on Zoological Nomenclature, "the *Code*" the edition currently in force of the *International Code of Zoological Nomenclature* (Anonymous 1999) and *BZN* the *Bulletin of Zoological Nomenclature*, both publications being in charge of the ICZN. Appendices 1–2 below provides definitions and etymology for many terms and formulae used in this paper. These terms are identified by being followed, on the occasion of their *first* use in the *text*, by the following symbols: * for a term already defined and used in previous publications, again defined in Appendix 1; ** for a new term proposed here, defined in Appendix 1; ° for the name of a Principle of the *Code*, defined in Appendix 2. The nomina belonging to the nominal species-series and genus-series are printed, as usual, in lower case *italics*, whereas the nomina of higher-ranked taxa are printed in small capitals, with the following distinction: family-series nomina are in *ITALICS*, whereas class-series nomina are in **BOLD**. Several expressions written in the *Code* without dashes, such as "first reviser" or "plenary power" are here written with a dash ("first-reviser", "plenary-power"), for the reason explained by Dubois (2000*b*: 39): "*the technical expressions which are used in the* Code *or derived from expressions used therein, will always be written below with dashes, in order to show that they are well defined formulae with a precise technical meaning*".

The need of a *Code*

Our planet is inhabited by a vast diversity of organisms, including millions of animal species, less than 2 millions, i.e., probably less than 10 %, have been described so far (Hammond 1992; Chapman 2009). In order to be able to deal with them, i.e., to study and use them, or to protect ourselves from them, and to predict some of their properties, we need a scientific discipline that allows to discriminate and classify them (*taxonomy**), and another one that allows to designate them (*nomenclature**), both being part of the larger biological discipline of *systematics** (Dubois, 2010*f*).

Nowadays, following Hennig (1950, 1966), most biologists agree that biological *classification** should reflect the hypothesized phylogenetic relationships between organisms, as expressed, e.g., under the form of cladograms or phylogenetic trees. There are however several ways to transfer a tree into a taxonomy, according to the criteria and conventions adopted. This point will not be discussed here, as we will concentrate on the way a given taxonomy is expressed under the form of a nomenclature. In other words, the present paper does not tackle the question "how should we build a taxonomy of organisms?", this question being part of the discipline of taxonomy, but, "given a taxonomy of organisms, how should we name the taxa?", which pertains to *onymology**, the theory of nomenclature (Dubois 2000*b*, 2010*f*).

No universal agreement currently exists concerning the nomenclatural system that should be used to designate the *taxa** (species, genera, families, etc.) recognized by the taxonomy, i.e., to allocate them scientific names or *nomina** (Dubois, 2000*b*). In zoology, the *Code*, that derives from the original Rules of Linnaeus (1758) and of Strickland *et al.* (1843), has been in force, more or less unchanged, for about one century (Melville 1995; Polaszek & Wilson 2005). Its management and updating is currently in the charge of the ICZN, which publishes the *BZN*.

In the recent decades however, several alternative nomenclatural systems have been proposed, which all have in common to call themselves "phylogenetic" (Wiley 1981; Papavero *et al.* 2001; Kluge 2005; Béthoux 2007). Among them, particular attention has been given to the recent project of *Phylocode* (de Queiroz & Gauthier 1990, 1994; Laurin & Cantino 2004, 2006; Laurin & Bryant 2009). The main difference between the two approaches, from which most other differences derive, is that, under the Linnaean-Stricklandian *Code*, the nomenclatural Rules are *theory-free** (Dubois 2007*c*: 396), whereas under "phylogenetic" systems, nomenclature is *theory-bound** (Dubois 2010*f*: 5), being tied to a taxonomic paradigm. Discussions have been raging comparing the respective merits of the *Code* and the *Phylocode*, and no consensus has been reached so far, or appears to be close (Dubois 2005*c*; Pickett 2005*a*-*b*; Laurin *et al.* 2005, 2006; Rieppel 2006). This

situation might appear as a futile quarrel of specialists, if it did not have deep practical implications on the future of systematics, and by way of consequence on the future of biology as a whole.

As a matter of fact, although most of the discussions between specialists have concentrated on the theoretical aspect of this question, attention should be duly given to the practical problems raised by nomenclatural proposals alternative to the *Code*, especially in two respects.

First, the co-existence of several incompatible, competitive systems for the designation of organisms is confusing for all non-specialists of the field of systematics, and even for some actors of this field. It contributes to undermining the image of this discipline in the society, with potential dramatic consequences on its financial support and manpower (Stuessy 1997; Godfray & Knapp 2004*b*; Sluys *et al.* 2004; Dubois 2005*c*). In order to avoid such ambiguities, the international community and editors should persuasively require supporters of alternative nomenclatural systems to use a presentation for their nomina allowing the latter to be clearly distinguished from traditional Linnaean-Stricklandian nomina as they have been used for 250 years (Blackwell 2002; Stevens 2002; Greuter 2004; Dubois 2005*b*-*c*, 2006*d*; Frost *et al.* 2009).

The second problem is one of proper identification of urgencies and priorities for taxonomists and evolutionary biologists. Our epoch is a crucial one for scientific knowledge of the organisms that live on our planet. We are now at the beginning of the "*century of extinctions*" (Dubois 2003, 2007*a*, 2008*a–c*, 2010*d*), and this new paradigm should have major consequences on the re-examination of our research programs (Raven 2004; Wheeler 2004; Wheeler *et al.* 2004; Hołynski 2008*a–c*; Boero 2010). The combination of the *biodiversity crisis* (resulting in mass extinctions) and of the *taxonomic gap* (incompleteness of the taxonomic inventory of our planet) results in *taxonomic urgency* (need to accelerate considerably this work of taxonomic inventory) (Dubois 2010*d*). In this context, great attention should be paid to the nomenclatural Rules helping taxonomists in their urgent task, rather than diverting their time and energy to secondary questions or debates. The project of investing enormous amounts of working time, energy and funds to "redefining" the nomina of millions of living species and other taxa is in conflict with this need of accelerating the study of biodiversity and may be considered as "*a criminal operation against the study of biodiversity*" (Dubois 2005*d*): rather than working on a project of "perfect nomenclature" (a hopeless project by itself), and attaching their names to "newly defined nomina", members of the tiny international community of taxonomists (Wilson 2004) would be better inspired to work hard on collecting, studying and describing the millions of still unknown organisms of our planet before they get extinct (Dubois 2005*c*, 2008*a–c*, 2010*d*). As we will now see, the present *Code* has many properties that make it fully appropriate for this work, but it should also be improved in several important respects.

Excellency of the theoretical bases of the *Code*

As of today, a vast majority of practising zoologists worldwide follow the Rules of the *Code* in their taxonomic works. The present paper is not meant at discussing again the proposals alternative to the *Code*, but to examine whether the *Code* could and should be improved in order to better serve the discipline of *zootaxonomy** but saving a "nomenclatural revolution".

There will never be a "perfect nomenclature", as a static, unidimensional system of taxa and nomina will never be able to capture or represent the complexity of evolutionary phenomena. Although schematic and simplified, phylogenetic trees (or, better, networks; see Dubois 2009*c*) are good, informative ways of expressing evolutionary relationships among organisms. New trees are permanently produced as a result of adding new organisms and new *characters** to our knowledge, and of re-analysing the available data. The aim of taxonomy and nomenclature is not to replace trees, but to work as an efficient, universal, unambiguous and robust system of indexation and retrieval of the information stored in trees and other results of evolutionary research. Unlike taxonomy, nomenclature is not a scientific discipline, but a tool, a technique that should be at the service of taxonomy, not the reverse. In order to play properly its role, which is to provide a universal and unambiguous language to designate taxa as recognized under any taxonomic arrangement, this tool should be

devised in such a way as to fulfill a few requirements and to have a number of properties (Dubois 2005*c*), among which *universality*, *automaticity* and *robustness* must be particularly stressed.

Universality means that, *within the frame of a given classification*, the same nomen must be given to the same taxon by all biologists worldwide, whatever their opinions and tastes. Taxonomy is a discipline in permanent evolution, as any addition of specimens, taxa or characters, or use of new methods of analysis, results in changes in the classifications. Nomenclature cannot therefore refer to a single "taxonomy of organisms" as a final and frozen classification scheme, but to various working taxonomies or *ergotaxonomies** (Dubois 2005*c*: 406).

Automaticity means that the nomenclatural Rules were devised in such a way as to work "by themselves", without the need to have recourse to a board, committee or court, so that two biologists working on opposite sides of the planet can independently come to the same conclusion regarding the valid nomen of a given taxon in a given ergotaxonomy. This automaticity proceeds from the *objectivity* of the Rules governing the *allocation** of nomina to taxa (based on objects, i.e., reference specimens) and the *validity** of nomina, at least as long as it is determined by *priority** of *publication** (an objective fact). The Rules are based on facts, not on interpretations, intentions, opinions, tastes, discussions or polls. This results in the *Code* respecting a *deontology*, placing all taxonomists worldwide on a foot of equality regarding the Rules, whatever their country, language, notoriety or financial situation.

Robustness means that the nomenclatural system should display both *stability* (i.e., nomina do not change as long as ergotaxonomies do not change) and *flexibility* (i.e., in some cases nomina do not change even if ergotaxonomies change).

In zoology, the current *Code* possesses these three properties, as well as several other useful ones (see Dubois 2005*c*: 375–378). It is the result of a long evolution from the Linnaean system of 1758, improved and modified many times until the *Règles* adopted in 1889, and to the first edition of the *Code* in 1961. This *Code* was therefore not born *ex abrupto* from a theoretical reflection, but is a compromise between the need to maintain a continuity with the past, and that of introducing new concepts and Rules. It has been used as a reference in millions of publications dealing with animal taxa and nomina. For this simple reason, it should not be replaced by another nomenclatural system, because the transition from one system to another would be extremely time-, energy- and funds-consuming, and would inevitably entail considerable confusions, errors and data losses, for a final benefit (having a "theoretically better" nomenclatural system) that is highly questionable. One fundamental Principle* of the *Code* is that it should not interfere with taxonomic theory, and should be usable in the same way whatever the taxonomic system adopted. Notwithstanding a few minor problems, it generally succeeds well in reaching both aims. Being theory-free, as it uses *ostensional** allocation of nomina to taxa through onomatophores, the *Code* has shown its ability to deal with millions of nomina without major problems, and its great flexibility to work efficiently under any taxonomic paradigm (phenetic, evolutionary, phylogenetic, etc.). Finally, its major theoretical bases, although certainly not "perfect", are no doubt very sound (Hołynski 1994; Lidén & Oxelman 1996; Dominguez & Wheeler 1997; Dubois & Ohler 1997*a*; Lidén *et al.* 1997; Moore 1998, 2003; Dubois 1999*b*, 2000*b*, 2005*c*, 2008*g*; Nixon & Carpenter 2000; Blackwell 2002; Forey 2002; Nixon *et al.* 2003; Wheeler 2004; Pickett 2005*a*–*b*; Polaszek & Wilson 2005).

Among other particularities, this system makes use of nomenclatural *ranks**, such as *genus* or *family*. Some authors (e.g., Smith 1988; Sundberg & Pleijel 1994; Minelli 2000; Pleijel & Rouse 2003; Kluge 2005) claimed that ranks should be abandoned as they are subjective and arbitrary, and do not warrant comparisons between taxa of same rank in different groups. The latter is true if ranks are considered to have an *absolute* meaning, but the fact that nomenclatural ranks have been used by some authors to make invalid comparisons is not a good reason for rejecting ranks. Taxonomic hierarchies as reflected in nomenclatural ranks are "*organizational models of relationships*" that are extremely useful for keeping track of inter-level relationships among entities in a hierarchical system (Knox 1998). Whether a given higher taxon is treated as a superfamily, an order or a class is largely a matter of tradition and of general consensus among specialists of the group concerned. There would be no point in discussing whether a taxon "is" a class or an order, as there is no theoretical background for *defining* ranks: ranks only point to a place in a hierarchy, and they are highly labile according to the frequent additions to the available information and changes in taxonomic

arrangements. 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. Most importantly, as discussed below in more detail, nomenclatural ranks should be distinguished from taxonomic *categories** (Dubois 2005*c*: 412–413, 2006*a*: 219–220, 2007*a*, 2008*e–g*, 2009*c*).

Although the theoretical bases of the *Code* are sound and should not be drastically changed, the current version of this text does not address several major problems posed to taxonomy nowadays, and does not fully allow to account for the new developments of taxonomic thinking and analysis. The purpose of this paper is to review the most important of them and to make proposals of changes in several main aspects of the *Code*. All these proposed changes are fully compatible with the basic philosophy, Principles and Rules of the current *Code*, but they are meant at updating it and preparing "the *Code* of the 21st century". It is here argued that if these changes are not implemented, the *Code* will prove unable to play its role in front of several important recent theoretical and practical developments of taxonomy. The pressure exerted by concurrent nomenclatural systems is based in part on real questions and problems that should be addressed. Even if, as argued above, the alternative systems proposed so far do not provide a proper answer to these questions, the refusal of the ICZN to address them and the persistence in its current attitude of "*splendid isolation*" (Laurin 2008*a*) is liable to result in a shift of some zootaxonomists from the *Code* to an alternative nomenclatural system, thus opening a period of confusion, with several codes based on incompatible nomenclatural paradigms being in force together in parallel. Such a situation would be extremely harmful to taxonomy in the century of extinctions, so it is urgent to take these problems in consideration and to try and solve them as soon as possible.

Most of the problems of the *Code* are not theoretical but practical. They belong in three main categories: (1) general problems of interpretation of the current *Code* by zootaxonomists, due to unclarity of its text; (2) general limitations of the *Code*; (3) precise problems in some articles. These problems will be considered successively below, after a few additional general comments.

Linking the present and the past

Dayrat (2005) presented an analysis of the work of the taxonomist and several suggestions for what he called "*integrative taxonomy*". Despite the novelty and the subsequent success of the term, many of the points he raised and advices he gave are well-known of competent working taxonomists, who have already been following similar, although often untold, guidelines in their works for years. As pointed out by Valdecasas *et al.* (2008: 211), "*taxonomy has been integrative for most of his history*". Although one cannot but agree with several of Dayrat's (2005) suggestions, Valdecasas *et al.* (2008: 215–216) are doubtless right when they state that "*the taxonomic enterprise* (…) *does indeed function perfectly well*" and does not need "*unnecessary 'paradigms'*" but rather a much stronger support from society to produce "*revisions, monographs, floras, and other major descriptive activities*". In other words, it needs more professional positions and funds for field work, space and permanent professional curation in institutions like museums devoted to collections of specimens, and laboratory study of these specimens. Mostly, it needs "*brains and arms*", rather than "*magic solutions*" supposed to replace manpower at lower cost in a society in crisis (Dubois 2008*c*, 2010*d*).

As for the way taxonomy, as a discipline, works, this has been evolving over time and several distinct paradigms (from the "design of God" to the "tree of life") have been in force subsequently, with no evidence that the "universal tree" is the "final" one (Doolittle 1999; Dubois 2005*c*). Although general Principles, guidelines and recommendations can be given for an efficient scientific taxonomy of organisms (Dayrat 2005; Dubois 2005*c*: 371–375; Valdecasas *et al.* 2008; among many others), these should not be formalised under a "code of taxonomy", as this might freeze the evolution of the discipline and bind it to a particular "school of thought" (Dubois 2010*f*). Like in all other scientific disciplines, a harmonious development of the field requires to respect "*the freedom of taxonomic thought or actions*" (Anonymous 1999: 2).

Two different kinds of recommendations can be given for a good "integrative taxonomy". Some, as those discussed in the works cited above, are meant at avoiding future defaults. However taxonomy is not only about "*discovering, describing, naming*" (Valdecasas *et al.* 2008: 211), but also, and importantly, about linking our current data and hypotheses with the works of the past. Many problems in taxonomy take their roots, not only in changes of concepts and paradigms, but in loss of information (missing reference specimens, destruction of structures due to poor preservation, unexplicit methodology and data analysis in ancient works, etc.). Recommendations for integrative taxonomy should also include methodological advice for dealing with such problems. Modern taxonomy should be integrative not only in the sense that it should use various data and methodologies, but also that it should *reconcile the past and the present of taxonomy.*

Zootaxonomy is facing today most severe problems, mainly because of its misunderstanding and poor recognition among biological disciplines. Unfortunately, one of these problems is internal to the discipline, lying in the current Rules of nomenclature, particularly because of their incompleteness, as they do not cover all zoological nomina, but also for other reasons, as we will see below. In the recent decades, taxonomy has considerably evolved in order to become more "scientific", i.e., objective, testable and repeatable. This has included the use of clearly formulated hypotheses on relationships, testable and refutable in a Popperian sense, and greatly limited the use of the "argument of authority" that was much more important in the past in this discipline. This movement has concerned the way ergotaxonomies are built, although an important part of subjectivity still exists in several steps of the process of recognition of taxa: choice of studied taxa and characters (morphological, molecular or other), algorithm of analysis of taxa, decision to recognize some hypothesized nodes of the tree of life as taxa or not, etc. However, and strangely enough, in the recent period this process of "objectivisation" has been almost completely absent from the field of nomenclature. Time has come to change this situation.

Terminology

The *Code* has a widespread "bad reputation" among taxonomists, that of being a complex text, difficult to understand and use. Beside the indeniable and unavoidable fact that nomenclatural matters are in some cases genuinely complex, this situation may largely be due to two main reasons: the terminology used in the *Code*, and the plan of the book.

This point of the terminology was made previously (Dubois 2006*a*: 233–235, 2010*c*: 3–5) but is still controversial, so it is useful to address it again. The *Code* is a technical text which provides a set of Rules related to the proper way of creating nomina for zoological taxa and of identifying the valid nomen for a taxon as recognized under any taxonomic frame. As such, it is similar to a juridical text or a grammar. Like the latter, it is bound to make use of a rather high number of special concepts or technical tools for which it must provide precise definitions. A majority of these concepts are also used in the nomenclature of other organisms (plants, bacteria) and viruses, but not in other scientific fields. Given the unavoidable complexity of nomenclatural matters, the *Code* is and will remain a very specialized, highly technical set of Rules, that cannot be grasped "intuititively" by a quick look at a few lines in a book, or guessed by use of "common sense". Rather, they require proper understanding of the differences between distinct situations that may appear similar or identical at first sight (e.g., "*unjustified emendation*" *vs.* "*nomen novum*"). This specialized work should not be done by any zoologist without prior making the effort of understanding and learning the Rules in all their detail. This also requires to fully master a precise terminology designating technical nomenclatural concepts.

Most domains of human activity which rely on special concepts or technical tools use precise technical designations for them, but this is not the case of the *Code*, which makes use of very few "technical terms", and where it does so seems to do it "reluctantly". The *Code* employs mostly "common language" terms, although with special definitions and often combined in multi-word formulae. This striking fact cannot be due to chance, and one is bound to admit that it is purposeful from the part of the ICZN. The reason given in a few publications (e.g., Rentz 1973; Douglas 2008: 171), and mostly orally by members of this ICZN when

questioned about it, is that the Rules are complex enough by themselves and should not be made more complex by the use of "strange", not to say "pedant", terms for its concepts and tools. Such terms would be harmful to communication, being incomprehensible "jargon", and likely to discourage zoologists from getting acquainted with the concepts they designate. A *Code* using mostly "common language terms" would be less disheartening, if not really appealing, to laymen.

However, as well illustrated e.g. in the detailed study of Dubois (2010*c*) or again in the present paper, empirical evidence rather supports the opposite interpretation. The use of simple, "common language" terms, for precise technical concepts of the *Code*, does not appear to make the understanding of these concepts easier. To me, real "jargon" is the use of an imprecise term (like "*name**" for a *spelling**, or "*type**" for an *onomatophore**) in an imprecise sense, which results in miscommunication. In teaching nomenclature to hundreds of students for more than 15 years, I have often observed that many terms of the *Code*, sometimes arranged in multi-word expressions (e.g., "*incorrect subsequent spelling*") may be deceiving, as some zoologists, including professional taxonomists, especially when they think they are in a hurry, have sometimes the impression that the concepts they designate are "self-evident" and can be understood intuitively, without having to spend time and to make the effort of reading, studying carefully and mastering the *Code*. This results in innumerable confusions, misinterpretations and mistakes in the implementation of the Rules of the *Code* in zootaxonomic publications. Many examples of such errors have been pointed to elsewhere (Dubois 1987*b*, 2003; Dubois & Ohler 1997*a*) and many others could be.

This problem may be obviated by the use of *precise technical terms*, that no one can believe to be understandable intuitively and that *require to make this effort*.

Let us just illustrate these statements with two examples, concerning the use of the terms "*name*" and "*type*".

The *Code* makes an indifferentiated use of the term "name" to designate either: (1) a scientific name; (2) a particular use of this name (e.g., at different nomenclatural ranks: e.g., genus *Rana* and subgenus *Rana*); (3) a particular spelling of this name (e.g., *nanus* and *nana*, *RANIDAE* and *RANINAE*); (4) the name of an *author** of scientific name, *nomenclatural act** or taxonomic publication; (5) a vernacular name. This results in confusions and miscommunication, when for example an author considers different spellings or ranks given to the same scientific name as different "names". Certainly we need different terms to designate these different concepts (Dubois 2010*c*).

The continued use in zoological nomenclature, since the 19th century, of the term "type", to designate the nomenclatural tools (either specimens or "nominal taxa") which serve as objective reference for the allocation of a scientific name to a biological taxon is misleading and problematic. Because of the presence of this term "type", various (careless) outsiders of the discipline, or even some taxonomists, have construed this tool as a survival of a fixist and typological thinking in systematics. This is exemplified, among many others, by these citations from a "Focus" of the leading journal *Science*: "*The traditional system groups organisms in part according to their resemblance to a representative 'type' specimen (…). Under the traditional system, a taxonomist (…) selects the most representative species to be the 'type' for each genus, then the most representative genus to be the type of the family, and so forth. (…) as new specimens with similar characteristics are found, they are deemed part of a known species, a new species, or even a new genus based on how closely they resemble the type specimen.*" (Pennisi 2001: 2304). Such a strange statement completely misses the point of the status and role of "name-bearing types", which is not to provide *characters* but to *bear the nomen* in realizing a *connection* between the real world of organisms and the world of language (Dubois & Ohler 1997*a*). This example is not isolated: regularly, the affirmation that the *Code* is "typological" and pre-evolutionary because it uses "types" is repeated in the literature (e.g., Ruffié 1982; Joyce *et al.* 2004; Sluys *et al.* 2004), and this idea is rampantly present in the minds of many biologists not very well acquainted with the field of systematics—especially since the *Phylocode* supporters have aggressively spread it in order to "demonstrate" the modernity and theoretical superiority of their system.

To avoid the misinterpretation that the *Code* relies on an essentialist and typological thinking, the term "type" and all its derivatives should be extirpated from zoological nomenclature. This term will permanently remain a problem because it is impossible to disconnect it from the idea that a "type" bears something "typical" of the entity it represents. The formula "*name-bearing type*" currently used in the *Code* is not only

unpalatable, but also still based on this term and then does not fully clarify this question (as would have, e.g., formulae like "*name-bearing specimen*" or "*name-bearing nominal taxon*"). Several terms have been proposed to designate this tool which is a unique particularity of the codes of biological nomenclature: *test* (Dennler 1939), *onomatophore* (Simpson 1940) and *nomenifer* (Schopf 1960) emended to *nominifer* (Simpson 1960). The first one is really ill-chosen, for being a potential source of confusion with several other concepts designated by the same term in biology. The second and third terms, derived respectively from Greek and Latin roots, have exactly the same meaning, "which bears the name", and the first one should be retained, simply because it is older. A further distinction, discussed in below in more details, is between onomatophores that are specimens, or *onymophoronts**, and onomatophores that are nominal taxa, or *nucleomina**.

The resistance, quite frequent in science, to novelty in a domain where a tradition has long been in force, the attachment of taxonomists to the term "type", explains its overdue persistence in nomenclature, but this should change, in order to free nomenclature from this misleading image. For better clarity of communication, especially with non-taxonomists, it is urgent to replace "name-bearing type" by "onomatophore" in the *Code*, and also to replace all terms using the root "type" by other terms (Dubois & Ohler 1997*a*; Dubois 2000*b*, 2005*c*, 2007*a*, 2008*f–g*; see Appendix 1). Many zootaxonomists think this is not necessary, because all of them "know well" that a nomenclatural "type" is not a specimen "typical" of a taxon but just a *sample* of the latter, that provides an objective reference for the allocation of a nomen to this taxon. But this attitude completely misses the point outlined above: many *outsiders* of our discipline *do not* understand this and think that the use of the term "type" in the *Code* testifies to a persistence of typological thinking in taxonomy. This misunderstanding certainly does not help taxonomy to solve its current crisis, because most of this crisis comes from a devaluation of this discipline in the eyes of many colleagues from other biological disciplines, who constitute most of the members of the committees and boards that decide research priorities and distribute funds and positions.

A good example of term using the root "type" is *monotypy**. This term is particularly confusing, as it conveys two widely different meanings in taxonomy and nomenclature. It is sometimes used in the taxonomic literature to designate a taxon that includes a single *subordinate** taxon or no subordinate taxon at all: thus the term ''monotypic'' is sometimes applied to designate a genus with a single species or a species that does not include subspecies. With this meaning, the term "monotypy" refers to a taxonomic concept. But this term is used in the *Code* in a different sense, to designate a nomenclatural concept, i.e., a mode of designation of onomatophore for a nominal taxon, either in the genus-series (Art. 68.3 and 69.3) or in the species-series (Art. 73.1.2). This confusion is illustrated for example by stating that a ''monotypic'' species (i.e., without subspecies) can well bear a nomen that relies on a *holophoront** fixed by original designation, or on *symphoronts** among which no *lectophoront** was ever designated, i.e., two situations that do not correspond to ''monotypy'' in the sense of the *Code*. This confusion is avoided by using the terms *monohypotaxy** and *anhypotaxy** for the taxonomic concepts (Dubois & Raffaëlli 2009: 11–12), and *monophory** (Dubois, 2005*c*: 404) for the nomenclatural concept. The fact that this confusion has been entertained until now in all the literature points to the little care given by taxonomists and the ICZN to terminological problems, which certainly contributes to problems in communication.

I totally fail to see why zoological nomenclature, which is a highly specialized field, would not have its own language. All scientific and technical specialized domains do indeed have their own terminology, which is not readily transparent to outsiders, and to enter these fields and be active in them, *any outsider must first learn this language*. The deliberate use in the *Code* of special, *opaque* (*vs.* seemingly "self-speaking") terms would *force* all potential users to study this text and get acquainted with its methods and concepts. Another advantage of the use of precise, technical *single* terms is that it shortens considerably the text, as exemplified in the discussion below, where many terms designating distinct nomenclatural concepts are used in many sentences (see another example in this respect in Dubois 2006*a*: 235). In fact, technical discussions on some aspects of the *Code* (e.g., Dubois 2010*c*) are admittedly rather complex, and are made possible only thanks to the use of a special terminology, in the absence of which it would be almost impossible because it would require the use of too many explanatory periphrases in many sentences.

The use of a precise technical terminology requires to provide precise definitions for all the terms and allows a detailed formalization of the mode of functioning of the *Code* which has been little developed so far, except in a few papers, including one by Smith (1962) which was the basis for the sketches of pages 123 and 260 of the current *Code*, and several sketches in a more recent work (Dubois 2000*b*: 96–98). More detailed sketches are provided below in Figures 1 and 4–6 (Appendix 3). They should help users of the *Code* to understand the logical structure and dynamic relationships between terms, concepts, Principles and Rules used in this text.

Another advantage of using special terms, based on classical roots (from ancient Greek or Latin languages), is that they are international, and can be used almost without modification in all languages of the world. Terms based upon modern languages may look very differently in different modern languages: thus, "*spelling*" in English is "*orthographe*" in French or "*Schreibweise*" or "*Rechtschreibung*" in German. Except if one thinks that all languages other than English should now be banned from scientific publications (an opinion that has its supporters, but also opponents), it appears much better to have a single term in all languages, as even non native readers can easily guess what it is about when meeting it in a text, even if they do not completely master the language.

Additionally, for some of the concepts used in the present discussion, the *Code* proposes no designation at all, whether under an English term or a multi-word formula: for example, whereas the *Code* proposes two designations for a nomen coined especially to replace another one ("new replacement name" and "*nomen novum*"), it has none to designate the replaced one.

Finally, a very important function of such a precise, non-ambiguous terminology is that it provides an efficient tool for the computerisation of databases on nomina, and more generally of zoological nomenclature and taxonomy. Many such databases already exist on the net, but a quick look is enough to realize that many, if not most, of them, use ambiguous categories of nomina and data that do not allow to find precise and accurate information. Just one example will be enough here: most of these databases include in the same category of "*synonyms**" very different kinds of nomina and spellings (for more details, see below and Dubois 2000*b*), such as *isonyms** (nomina having the same onomatophore), *doxisonyms** (nomina having different onomatophores but designating the same taxon in a given taxonomy), *aponyms** (various spellings, ranks and *onymorphs** of the previously listed *protonyms**), *orthochresonyms** (correct *usages** of nomina) and *heterochresonyms** (incorrect usages of nomina). Using a precise terminology for all these categories would, so to speak, "force" the builders of databases on nomina, nomenclatural and taxonomic data, at least if they are serious, to enquire about the genuine status of the nomina and data before including them in the database. This would greatly enhance the efficiency of these databases for information storage and retrieval in taxonomy and to improve communication of zootaxonomists among themselves and with other members of the scientific community (Dubois 2000*b*: 35, 59).

Although the ICZN has so far not shown to be prepared to introduce such new terms in the *Code*, their progressive use in publications may be an efficient way to show in practice the advantages of employing such precise and brief terms (compared to periphrases) to designate the concepts of the *Code*. For this reason, in the present paper, I am using such technical terms, after having defined them. Except for a few of them, these terms do not correspond to proposals of "new Rules". They merely provide precise technical designations for some of the nomenclatural concepts of the *Code*. Thus, whereas I think that in many respects the Rules of the *Code* are good and should not be modified, except very carefully, I think the current terminology of the *Code* should greatly be improved: "*keep the Rules, but change the terms*" (Dubois 2010*c*).

Appendix 1 provides the correspondence between the terms of the *Code* and the terms used here, with their etymology and definition. Discussions of these terms were provided in various publications (particularly Dubois 1982, 2000*a–b*, 2005*a-b*, 2006*a*; Dubois & Malécot 2005). Some of them are again discussed below when appropriate.

One final point should be stressed here. My plea for "obscure" technical terms for nomenclatural Rules does not extend to other domains. For example, I am arguing below that nomina of taxa coined by some recent authors are too complex, long and often unpalatable, and that the *Code* should encourage taxonomists to create short, simple and euphonious nomina for taxa. The two situations are quite different. Nomina of taxa, even if created by specialists of taxonomy, are not meant to be used only by the latter, but also by the

whole community of biologists, and even, for some of them, much more widely in the whole society: this is the reason why they should be short, simple and euphonious. In contrast, the technical terms of nomenclature are a precise technical language that will, and should, be used only by the competent specialists of this peculiar discipline. Their "obscurity" is in part a guarantee that this will be evident to all, whereas the use of simple, common language terms spreads the misleading impression that anybody, without training and practice in this discipline, can intervene in it, create nomina, change them at whim, etc. In the recent decades, this has been a main reason for the multiplication of nomenclatural errors in publications, as will be amply exemplified below, and this should stop.

Structure and plan of the *Code*

The logical structure of the Rules

Although this is not mentioned in the *Code*, the status of any nomen according to the Rules is settled through a *nomenclatural process** that goes through three subsequent *stages**, steps or levels, the so-called "floors" or "storeys" of the "nomenclatural house" (Dubois 2005*a–d*): *availability**, *allocation* and *validity* (including *correctness**). Each stage is largely independent from the preceding one. These floors must be explored successively, from the first to the third, to identify the valid nomen of any taxon. This means that before being potentially the *valid** one for a taxon, any nomen must first have been made *nomenclaturally available**, and second *allocated** to one or several *identified** taxa. *Availability* is provided by publication under certain conditions (including a characterization of the taxon), *allocation* by reference to an onomatophore which requires *identification** to be usable in nomenclature, and *validity* by nomenclatural precedence (usually through priority of publication, but with exceptions; see below).

The plan of the Code

The nomenclatural Rules in zoology have been functioning according to this system since the implementation of the *Règles* (Blanchard 1889*a–b*, 1905) which preceded the *Code*, but this structure in three stages has never been recognized clearly in the subsequent versions of this text. In consequence, confusions have been regularly made regarding the proper use of the Rules, e.g., between availability and validity of nomina, or between objective ostensional allocation of nomina to taxa through onomatophores ("name-bearing types") and subjective allocation of nomina to taxa through *intensional** or *extensional** "definitions of nomina" (Dubois 2008*g*). Examples of such confusions were analyzed elsewhere (Dubois & Ohler 2000; Dubois 2006*d*, 2007*c*). The fact that such gross mistakes can appear in well-known and "highly-ranked" periodicals, or in famous and often-quoted books or online databases, highlights the existence of strong problems regarding the understanding of the basic process of the *Code*, and solutions to these problems should be sought. It is now more than time that the *Code* be modified in order to become clearer for all users, and one possible way to do so would be to change the plan of the *Code* (Dubois 2008*a*,*f*, 2010*b*).

The plan used in the *Code* is a non-hierarchical one. This book consists in three introductory texts followed by the *Code* itself, containing a "Preamble", 18 chapters, a "Glossary", a sketch giving a "*Summary of the status of works, names and nomenclatural acts*" (p. 123) and two "Appendices". The 18 chapters are presented in an order that has been kept unmodified along the successive editions and modifications of the *Code*. This order is not logical and does not help the readers and users of this book to understand clearly the way the *Code* works. The sketch on pages 123 and 260 provides a clear survey of the logical structure of the *Code*, but, although it is part of the latter, it appears at the end of this document, between the "Glossary" and the "Appendices", and is never referred to in the chapters giving the Rules themselves, so it probably remains unnoticed by most readers and users of the *Code*.

The *Code* in fact contains six different kinds of items: (1) a few general *Principles*, which are the "philosophical basis" of the whole work; (2) a rather high number of *Rules*, which correspond to the concrete implementation of these general Principles with respect to the various situations and problems encountered in zoological nomenclature; (3) a rather high number of *exceptions* to these Rules, with explanations about the dates and situations when and where they apply; (4) various *examples* that are meant at clarifying some Rules or exceptions; (5) various *Recommendations* (including a "Code of Ethics" in "Appendix A"), which do not have the binding force of Rules but that zoologists are encouraged to follow; (6) a "Glossary" giving the definitions of some (not all) of the technical and non-technical terms used in the book; and (7) an "Index" to some of the terms used in the book. Except for the "Glossary" and "Index", and for some of the Recommendations that appear in the "Appendices", all these pieces of information appear intermingled in the chapters, without any hierarchical structure.

This plan is not good, a fact that had been clearly stressed already 25 years ago by one commissioner (Dupuis 1984), but without any result. The argument consisting in saying that the plan of the *Code*, including the numbering of the chapters and articles, should be kept unchanged in subsequent editions of this book, in order not to "perturb" the zoologists "used" to the preceding version, does not hold: it would be enough to give at the beginning or end of the volume a table providing the correspondence between the items in the two successive versions. For a better understanding and use of the *Code*, especially by newcomers, drastic changes in the structure and presentation of this text should be considered. It would be necessary first to present clearly the "philosophical" Principles on which this text is based, in an introductory chapter, as is the case in the *International Code of Botanical Nomenclature* (McNeill *et al.* 2006). This should be followed by a clear presentation of the main Rules which are the implementation of these Principles in the practical situations encountered in zoological nomenclature. Only then should be given the "details" of these Rules, including the presentation of secondary Rules, examples, exceptions and Recommendations. Care should be taken to avoid the existence of discrepancies or contradictions between the articles and the "Glossary", which is not the case presently (see e.g. the discussion below regarding the notion of "*prevailing usage*"), and to present an "Index" more complete and explicit than in the current version. Additionally, it would help the users of the *Code*, if, like in the preceding editions, the headers of the pages referred to the chapters in which they are.

But the most important change should concern the structure of the *Code* in order to highlight the three successive stages of the nomenclatural process mentioned above. Most of the basic Principles of the *Code* concern only one of these stages, availability, allocation or validity of nomina. In order for this to be clear for all readers, the book should be divided, after a general introduction, in three major parts corresponding to these three floors, not in 18 chapters in an illogical order. Most of these chapters only concern one of these three stages, but a few are heterogeneous in this respect. Ignoring these minor problems and putting apart the introductory chapter C1 ("*Zoological Nomenclature*") and the two concluding chapters (C17 "*The International Commission on Zoological Nomenclature*"; C18 "*Regulations governing this Code*"), the 15 other chapters can be distributed as follows as regards the stages of the nomenclatural process to which they apply, either in full or in part of their content (as some are heterogeneous in this respect):

Stage 1. Availability of nomina. ► C2 "*The number of words in the scientific names of animals*"; C3 "*Criteria of publication*"; C4 "*Criteria of availability*"; C5 "*Date of publication*"; C7 "*Formation and treatment of names*" (partim); C8 "*Family-group nominal taxa and their names*" (partim); C9 "*Genus-group nominal taxa and their names*" (partim); C10 "*Species-group nominal taxa and their names*" (partim); C11 "*Authorship*".

Stage 2. Allocation of nomina. ► C13 "*The type concept in nomenclature*"; C14 "*Types in the family group*"; C15 "*Types in the genus group*"; C16 "*Types in the species group*".

Stage 3. Validity and correctness of nomina. ► C6 "*Validity of names and nomenclatural acts*"; C7 "*Formation and treatment of names*" (partim); C8 "*Family-group nominal taxa and their names*" (partim); C9 "*Genus-group nominal taxa and their names*" (partim); C10 "*Species-group nominal taxa and their names*" (partim); C12 "*Homonymy*".

The illogical structure of this plan is clearly apparent through the fact that the numbers of the chapters are not in a continuous sequence in the above lists of chapters corresponding to each of these three stages. To take

just an example, the place of chapter 6 is completely wrong. How can a user understand the way validity of nomina works without first knowing how nomina are allocated to taxa? This chapter should come as the first chapter of the third part, followed by others, including the chapter 12 on *homonymy**. As for the articles dealing with the *correct** spelling of nomina (distributed in chapers 7 to 10), they should be dismantled and redistributed in new chapters, some referred to the first stage (dealing with the original formation of nomina) and some to the third stage (correct treatment of nomina when used as valid in a given ergotaxonomy). Thus, for more clarity, the whole book should be reorganized, chapters should be renumbered and arranged according to the three parts outlined above, and the articles of some of them should be moved from a chapter to another.

A new situation was created by the proposed introduction in the *Code* of a new concept, that of *registration** (Anonymous 2008*a–b*). This proposed change raises numerous problems, some of which have already been discussed by several authors (Dubois 2007*d*, 2008*a*,*f*; Carlos & Voisin 2009; Michel *et al.* 2009*a–c*, 2010). It was recently suggested to consider registration as a fourth stage of the nomenclatural process, distinct and independent from the other traditional three stages (Dubois 2010*b*). The detailed consequences of this proposal, in particular regarding the Rule of reversal of precedence, were also duly considered, and this point does not need to be developed here.

Figures 1 and 4–6 below (Appendix 3) show the structure of the *Code* with respect to the traditional three levels, and show also the fourth level (registration) if it was later implemented in the *Code*. Below, we will consider successively in a rather detailed way the three current stages (or steps) of the nomenclatural process and the proposed fourth stage. Before doing so, however, some words must be said about the basic Principles of the *Code*.

Basic Principles of the *Code*: a necessary update

The *Code* recognizes six "Principles", but it does not define the term "Principle". In this context, this term can be defined as "*a fundamental and general Rule, which is the basis for all particular and specific Rules of the* Code" (Appendix 1). Five of the six Principles of the *Code* concern only one of the three stages of the nomenclatural process. Two Principles deal with the first stage (nomen availability): the *Principle of Binominal Nomenclature* and the *Principle of Coordination*. The *Principle of Typification* concerns the second stage (nomen allocation). Two Principles are relevant for the third stage (nomen validity): the *Principle of Priority* and the *Principle of Homonymy*. Finally, one Principle, the *Principle of First-Reviser*, applies to the three stages.

It is here argued that the names and definitions of some of the Principles should be updated. Some Principles bear misleading designations or should be reformulated differently. Furthermore, some "untold Principles" are in fact "surreptitiously" in force in the *Code* and should be duly recognized (some of them are briefly mentioned in pages xix–xx of the *Introduction* of the *Code*, but this chapter is not part of the *Code* as such). Finally, it is here suggested that a few additional Principles should be incorporated into the *Code*. These points are discussed below first for general Principles and then under the three stages of the nomenclatural process. Appendix 2 provides the list of the Principles as supported here.

Some of the explanations given below about the *Code* are easier to understand if illustrated by examples. Most of the examples given below are from the taxonomy and nomenclature of the amphibians, the zoological group with which I am best acquainted, but they have a general value for all zoological groups.

General Principles of the *Code*

The Principle of Nomenclatural Independence

The "Preamble" of the *Code* contains the following sentences: "*The objects of the Code are to promote stability and universality in the scientific names of animals and to ensure that the name of each taxon is unique and distinct. All its provisions and recommendations are subservient to those aims and none restricts the freedom of taxonomic thought or actions*". Although often quoted, this sentence is not always understood. Contrary to what some supporters of phylogenetic nomenclatures believe, "*the freedom of taxonomic thought or actions*" does not mean the freedom to choose a phylogeny to build a taxonomy, it means the freedom to choose either a phylogenetic or another paradigm as the basis for a taxonomy! This distinction is an important one. In fact, it is the main difference between the Linnaean-Stricklandian nomenclatural paradigm, which is theory-free, and most so-called phylogenetic nomenclatural systems, which are theory-bound. Most other differences derive from this one.

Phylogenetic nomenclatural systems are based on the assumption that "phylogenetic systematics" is the last word of the history of taxonomy and that all taxonomies from now on will be based on the "tree of life" paradigm, but this is highly questionable. This paradigm is appealing for muticellular organisms but it does not apply to prokaryotes, in which lateral gene transfer plays a major role in the transmission of genetic material, which suggests that a direct phenetic comparison of genomes might be a better approach for the taxonomy of such organisms (Doolittle 1999). Even in **METAZOA**, the importance of interspecific hybridization, especially in the origin of asexual or metasexual "strange species" (Dubois 2008*e*, 2009*c*,*e*) was long underestimated. In fact, its importance and generality questions the validity of the image of a "tree" as providing a universal representation of evolutionary phenomena, and suggests that probably another metaphor, like that of a "network", would be more appropriate.

For the time being, no general theory of taxonomy exists, and it would be very premature and arrogant to state that the phylogenetic paradigm marks the "end of science" in taxonomy. The history of taxonomy has witnessed several important changes of paradigms and it is certainly more realistic to think that this processus has not reached its end. During all this historical process, the theory-free Linnaean-Stricklandian nomenclatural Rules have allowed zoological nomenclature to "follow" the changes in taxonomic paradigms without "nomenclatural revolution", a very parsimonious process that should continue. Implementing theory-bound nomenclatural Rules would mean that the nomina recognized under such Rules could be used only for taxonomies compliant with the paradigm according to which they were created, i.e., the tree of life for phylogenetic taxonomy, and could not adapt to another paradigm. It is therefore quite easily predictable that their mere existence could act as a strong brake against the development and adoption of an alternative taxonomic paradigm, i.e., against scientific progress.

For all these reasons, the sentence of the "Preamble" of the *Code* cited above should not only be maintained, but its importance should even be highlighted more. This justifies its recognition as the first basic Principle of the *Code*, the *Principle of Nomenclatural Independence*°.

The Principle of Nomenclatural Foundation

This Principle has never been mentioned in the *Code*, but it has been "implicitly" followed since the implementation of the Rules and I propose that it be clearly formulated as one of their basic Principles. Dubois (2005*d*: 201) first defined it as follows: "*Nomina are historical entities with a given nomenclatural status (regarding their publication date and their onomatophore) which cannot be changed later. Under the Code, because of this 'founder effect', a nomen cannot be redefined after its creation. The only changes that can be brought to the nomenclatural status of nomina are through first-reviser actions, but such actions are strictly regulated and can occur only in a few situations, whenever some ambiguity remained after the original creation of the nomen (no onomatophore designation, contemporaneous publication of two synonymous or homonymous nomina, etc.).*"

The *Principle of Nomenclatural Foundation*° simply amounts to stating that the nomenclatural status of a nomen is fixed once and for all in the original publication where the nomen is created. This means that this status cannot usually be modified by subsequent actions of zoologists, including "usage". This applies both to the Rules of availability and taxonomic allocation of nomina, and consequently to their validity. A nomen is made nomenclaturally available only once, at its *creation** within the frame of scientific nomenclature, and with a given author, *date** and onomatophore—and these usually do not change subsequently. Its validity or invalidity under a given taxonomy simply and automatically derives from these founder data, no other fact being taken in consideration.

This Principle does not apply whenever an ambiguity remains concerning the status of a nomen after its creation. Given the high number of zoological nomina, this situation, although quite rare on the whole, can and does arise in many different situations. This occurs for example whenever a nomen was first published with several original spellings, one of which only can be its correct one; or whenever the original onomatophore of a nomen consisted of several specimens or nominal taxa that are now referred to different taxa (see below), which requires that the nomen be referred unambiguously to only one of them through subsequent choice; or whenever two nomina created in the same publication or in different publications but at the same date are later discovered or considered to be *synonyms* or *homonyms** or become so because of taxonomic changes, which requires that one be given *precedence** over the other. All these cases require the existence of a Principle complementary of that of Nomenclatural Foundation, and this is the *Principle of First-Reviser*°.

The Principle of First-Reviser

This Principle, recognized as such in the *Code*, has not always existed as a general Principle applying to all ambiguous nomenclatural situations. It has been permanently in force since its reinstatement in the *Copenhagen Decisions on Zoological Nomenclature* (Hemming 1953), which was an important progress to make the *Code* a fully operational system of objective, automatic and unambiguous set of Rules.

Some authors still do not seem to be aware of this Principle. For example, to decide, among competing nomina or spellings published simultaneously, and applying to the same taxon, which one has precedence and must be considered valid (nomen) or correct (spelling), a Rule of "page" or "line" precedence once existed, from 1948 (Anonymous 1950) to 1953, in the *Règles Internationales de la Nomenclature Zoologique* (Blanchard 1905) that were in force before the *Code*, but it has not been so since its suppression in 1953 (Hemming 1953: 66–67). However, some taxonomists still use it (see Nemésio 2007). Another alternative Rule was once suggested (Follett 1955: 21) for identifying the correct spelling among multiple original spellings, namely that if a competing spelling "*resulted from an inadvertent error*", it was to be rejected as incorrect, but this was never implemented in the *Code* (Dubois 2010*c*).

First stage of the *Code*: nomen availability

Criteria of availability

The scientific names or *nomina* used in zoological nomenclature to designate taxa are specific to this discipline. They are distinct (although sometimes identical in spelling) from vernacular names and from other kinds of scientific names or designations not complying with the Rules of the *Code*, e.g., for following alternative nomenclatural Rules or no rules at all. The first step of the nomenclatural process is the *creation* of the nomen within the frame of zoological nomenclature. Until this is done, the nomen "does not exist" in nomenclature, and therefore cannot be used as the valid nomen of a taxon or enter in competition with other nomina as concerns synonymy and homonymy. The *Code* provides Rules for this "official creation" of a

nomen, that results in the latter becoming *nomenclaturally available*, i.e., usable in zoological nomenclature. To be available, a nomen must fulfill a rather high number of conditions.

The first one is that it must have been *published*, and *posteriorly to 1757*. This means that it was produced in several identical copies on a *permanent* support, i.e., in fact, *printed* with ink on paper, and publicly *distributed*. This condition of publication on a permanent support is currently being challenged, the possibility of availability through electronic publication being supported by some (see below). The starting date of zoological nomenclature is the 1st January 1758, arbitrarily fixed as the date of publication of Linnaeus's (1758) tenth edition of the *Systema Naturae*.

A second condition of availability, which does not appear as such in the *Code* but which is "implicit", is that a new nomen must be allocated to one of the *nominal-series** recognized by the *Code*, a point discussed at more length below.

A third condition concerns the number of words composing the nomen. This number depends on the nominal-series at stake. It is a single term in the genus- and family-series (and also in the class-series, not recognized by the *Code*), and two or three terms in the species-series. Nomina provided for taxa at rank species are the only ones to be composed of two terms, the generic (*substantive**) and specific (*epithet**) ones. Although these are the only nomina to be composed of two words, this has given its name to one of the basic Principles of the *Code*, that of binominal nomenclature.

Various other "details" regarding availability of nomina are provided in the *Code*, which do not all need to be discussed here. An important one is the requirement that a new nomen must be associated, in the original publication, with a *characterisation* of the taxon for which it was proposed. This may be a *diagnosis**, a definition, a description or another indication (e.g., reference to a publication where the taxon was characterized), including, for nomina published before 1931, a mere illustration of a specimen. The important point in this criterion is that it demands to provide information on *characters* observed in *actual specimens* of the taxon. This is meant at impeding, or at least strongly limiting, the possibility to create a nomen for a "*hypothetical concept*", i.e., an imaginary, mythical or "probable" animal (e.g., "predicted" by a cladistic analysis), without any actual specimen having ever been caught and examined (see Dubois & Nemésio 2007). On the other hand, this condition does not in the least entail that the characterisation of the taxon should be either accurate or exhaustive (Dubois & Ohler 1997*a*). A nomen based on an inexact description is nevertheless nomenclaturally available. Its allocation to a taxon relies on its onymophoront (see below), not on the characters given in the original description.

Although all other criteria for availability are clear and must be followed by taxonomists, this is quite irrealistic for one of them, the requirement that the nomen be "Latin" or "Latin-like". This does not mean much in fact, because the "Latin" of the *Code* has little to do with classical Latin, and the *Code* allows to accept as "Latin" many nomina which would not have been possible at Roman times (see Dubois 2007*b*). In fact, given the difficulty (or impossibility) to define unambiguously which nomina may be considered "Latin" in the sense of the *Code*, in practice, any word composed of at least two letters including at least one vowel must be considered available in zoological nomenclature, even if it is "strange". It would be appropriate to simplify considerably the text of the *Code* in this respect, by simply stating that any such nomen must be *treated as* a Latin word. This matter is not explored further here, as it would deserve rather long and detailed discussions, and is not as urgent as some of the other points stressed in the present paper.

New conditions of availability were added in the 1999 edition of the *Code*, such as the requirement that the creation of a new nomen be made explicit (which excludes the creation of new nomina "by inadvertence"), and that an onymophoront be clearly indicated. These are useful progresses, but still insufficient, because if the *designation* of an onymophoront is required, its *deposition* in a permanent collection is not, which is problematic in some cases (Dubois & Nemésio 2007; Dubois 2009*d*).

The *Code* provides a special term (*nomen nudum*) for a nomen published but nevertheless unavailable for missing a characterisation (Art. 12–13). However, it does not use terms for available nomina, or for nomina unavailable for other reasons (Art. 10–11, 14–20). Dubois (2000*b*) provided the following terms: a nomen available under the *Code* is a *hoplonym**, and an unavailable one an *anoplonym**. The category of *gymnonym** (*nomen nudum*) is only one particular case of the latter category. Because of the absence of a general term for unavailable nomina in the *Code*, many authors use the term *nomen nudum* in situations that

do not qualify as such according to the "Glossary" of the *Code* itself. Adoption in the *Code* of the three terms above, and of the new term *atelonym*** for all anoplonyms that are not gymnonyms would clarify this matter. A hoplonym has an onomatophore, a nomenclatural author (see Dubois 2008*d*) and a date. Once created, it may be modified by subsequent authors, in three distinct respects (Dubois 2010*c*): its *spelling*, its *rank* and, in the case of species-series nomina, its *onymorph*, i.e., its particular association between genus-series substantive(s) and species-series epithet(s). The *protonym* (nomen as originally created) and its *aponyms* (nomen modified in one of the three respects above) are not different nomina, but just different avatars (*paronyms**) of the same nomen, which keep the same onomatophore, author and date.

A particular case is that of the deliberate (i.e., not due to misprint or inadvertence) proposal of a new nomen to replace an existing nomen, either for good reasons (e.g., to replace an invalid *junior** homonym) or for bad ones (e.g., because the original nomen was considered "ill-formed", disharmonious or "inappropriate"). The *Code* calls such a nomen a "*new replacement name*" or "*nomen novum*". It can be known more briefly as a *neonym** (Dubois 2000*b*). The *Code* does not provide a term for the replaced nomen, so Dubois (2005*b*, 2006*a*) proposed the term *archaeonym**. The archaeonym and its neonym have the same onomatophore, but different authors and dates. Although this is not clearly stated in the *Code*, there are in fact two categories of neonyms (Dubois 2000*b*): an *autoneonym** ("*unjustified emendation*" in the *Code*) is derived directly from the archaeonym, using the same etymology, whereas an *alloneonym** is an entirely new nomen, derived from a totally or partially different etymology.

The Rules given in the *Code* regarding the formation of nomina belong in this stage of the nomenclatural process. They do not deserve much comments here—but see above regarding the need to simplify the guidelines for coining new nomina. However, the current multiplication of online databases dealing with zoological nomina requires to have stricter definitions and precise technical terms to designate the various avatars of any given nomen. This point was discussed at length by Dubois (2010*c*), who provided a "taxonomy" and a dichotomic key of these different situations, distinguishing two main categories of spellings, *original** (*protographs**) and *subsequent** (*apographs**), and dealing with the problems related to *symprotographs** and other related particular situations.

Aponyms are not nomina different from their protonyms, they have the same authors and dates. But they have distinct *first-users** (Dubois 2000*b*). Although the mention of first-users has only a historical, not nomenclatural interest, it frequently appears in "synonymies" (more exactly *logonymic lists**, see Dubois 2000*b*), so it would be useful to recognize and define this term in the *Code*.

Let us now address the question of the Principles of the *Code* that apply to this stage of the nomenclatural process. Beside the two Principles already recognized by the *Code* in this matter, that of *Binominal Nomenclature* and that of *Coordination*, I suggest to add a new Principle, the *Principle of Nominal-Series*°.

The Principle of Nominal-Series

A peculiarity of the zoological *Code*, which it does not share with the botanical one, is the existence of three distinct sets of nomina, that obey slightly different although similar Rules, and that are largely independent from one another. Each of these sets collects nomina designating taxa of several distinct but "related" ranks: e.g., family, subfamily, superfamily. Within each of these sets, the nomina interact concerning homonymy and synonymy, and the *Principle of Coordination*° applies (see below).

A problem of terminology exists for the designation of these sets of nomina. The two "official texts" of the current *Code*, the English and the French, use different and non-equivalent terms for this purpose. The English text uses the term "*group*", which may be source of confusion, for example between "*species group*" as a nomenclatural rank (between subgenus and species) and "*species group*" as a set of nomina of related ranks. Apparently for this reason, the French version of the *Code* uses the term "*niveau*" ("level") instead of "*groupe*", but this term is not better chosen, as a given "level" includes several ranks which are not at the same "level": it would be strange to write, e.g., that the rank superfamily is a "sublevel" of the level family. A solution to remove these ambiguities is the use of the term *nominal-series* for these sets of nomina (Dubois 2000*b*).

The scale of all nomenclatural ranks that have been used in zoology since 250 years, which started with 16 ranks in Linnaeus (1758) (see Dubois 2007*e*), covers several dozens ranks (see details in Dubois 2006*a*), from reign to variety and even form, but, strangely, the *Code* does not take the two extremities of this scale into account. It recognizes only three nominal-series: (1) the *species-series**, which includes the nomina of ranks species, subspecies, "aggregate of species" and "aggregate of subspecies"; (2) the *genus-series**, with only two ranks acknowledged in the *Code*, genus and subgenus; and (3) the *family-series**, with the nomina of ranks family, subfamily, superfamily, tribe, subtribe and "*any other rank below superfamily and above genus that may be desired*" (Art. 35.1).

Two additional nominal-series, not mentioned in the *Code*, can or could be recognized to cover ranks traditionally used in the zoological nomenclatural hierarchy (Dubois 2000*b*, 2006*a*): (4) the *class-series**, for all nomina of taxa above the family-series (orders, classes, phyla, etc.); (5) the *variety-series**, for the nomina of taxa below the species-series (varieties, forms, etc.). As these nominal-series are not recognized by the *Code*, for the time being the nomenclature of taxa at these ranks is not regulated by the latter and depends only on "consensus" among users. This question is discussed at more length below.

As we have seen, some authors currently challenge the use of ranks in zoological nomenclature. This has an impact on nomenclatural practices, even among zootaxonomists who did not adopt the *Phylocode* or any other "official" alternative nomenclatural system, and who claim to follow the *Code*. Some of them make a new use of ranks which is contradictory with the role ranks can play, as explained above, to express phylogenetic relationships, and which in fact is not compatible with the *Code*. In order for ranks to be able to play this role, and to follow strictly the Rules of the *Code*, four conditions must be met (Dubois 2008*g*): (C1) in the three nominal-series regulated by the *Code*, only the ranks recognized by this text should be used (this does not apply to nominal-series ignored by the *Code*, the nomenclature of which remains "free" for the time being); (C2) the nominal series should not overlap, i.e., nomina referred to a nomenclatural rank in a nominal-series should not be *subordinate* to nomina referred to a lower nominal-series (e.g., a taxon of rank order cannot be subordinate to a taxon of rank family, a taxon of rank family cannot be subordinate to a taxon of rank genus); (C3) nomina at different ranks should never be *parordinate** (Dubois 2006*b*): any two taxa considered "sister-taxa", i.e., subordinate to the same *superordinate** taxon, must be ascribed the same nomenclatural rank, in the same nominal-series; (C4) more generally, the interposition within a nomenclatural hierarchy of "informal taxa" at "informal ranks", or "unranked taxa", not being referred to any of the nominal-series and ranks recognized by the *Code*, should be considered incompatible with the latter, and such nomina should always be considered anoplonyms. The notions of "informal taxon", "informal rank" or "unranked taxon" themselves are devoid of meaning in a *Code*-compliant nomenclature: either a group of organisms is considered as a taxon, or not; and if it is so, it must be named according to the Rules of the *Code*, or this nomenclature puts itself clearly and deliberately outside the *Code*.

These untold Rules were respected by most taxonomists over most of the history of zoological nomenclature. They tend to be more and more often ignored in recent publications, as shown by a few examples. Condition (C1) above was violated by Hillis *et al.* (2001), Hillis & Wilcox (2005) and Vieites *et al.* (2007), who used additional ranks in the genus-series below subgenus or above genus. Although the names of these infrasubgeneric or suprageneric taxa were similar in aspect to genus-series nomina, they cannot be nomenclaturally valid, at least until the *Code* is modified to suppress its current limitations in the number of ranks allowed in the genus-series (Dubois 2006*b*,*d*, 2007*c*). Deuve (2004) ignored condition (C4) in recognizing taxa at an intermediate rank, not recognized by the *Code*, between genus and subgenus, and giving them names in the nominative plural (similar to family-series or class-series nomina), not in the nominative singular (as are genus-series nomina). These "informal names" are anoplonyms. The same applies to Guayasamin *et al.* (2009), who created a nomen in the nominative plural but not based on an available generic nomen for an "unranked" taxon between superfamily and family. Finally, several authors claiming to follow the *Code* did not respect the conditions (C2) and (C3) above. Thus, Benton (1997) promoted nomenclatural hierarchies with a completely chaotic use of ranks, such as a class **AVES** included in a class **REPTILIA** belonging to a superclass **TETRAPODA** subordinate to an infraclass **RHIPIDISTIA** of a class **OSTEICHTHYES**! Laurin (2005, 2008*a*–*b*) provided an analysis of this case, showing that this nomenclatural hierarchy was incompatible with phylogenetic-based taxonomy, but it is also incompatible with the use of

ranks under the *Code* as explained here. Finally, Frost *et al.* (2006), Grant *et al.* (2006), Vieites *et al.* (2007) and Van Bocxlaer *et al.* (2009) proposed nomenclatural hierarchies in which taxa clearly considered "sister-taxa" in a phylogenetic framework were given different ranks, sometimes being even referred to different nominal-series. Dubois (2008*g*) and Dubois & Bour (2010*a*) provided analyses of three of the latter publications. In all these cases, the nomenclatures used are incompatible with the *Code* and the new names created in some of these cases should be considered nomenclaturally unavailable. It is easy to realize that if such cases tend to become more and more numerous, this will result in quickly spreading confusion and doubt in zoological nomenclature.

This situation is quite similar to that of the beginnings of zoological nomenclature evoked above, where it was soon felt crucial to impose to all taxonomists the use of *binomina** for taxa of rank species in order to avoid nomenclatural chaos. For the same reason, the *Code* should now consider taking measures of "self-protection" regarding the chaotic use of nominal-series and ranks. This could be obtained by introducing a *Principle of Nominal-Series* stating what are nominal-series, that they cannot overlap, that all taxa subordinate to the same superordinate taxa should be afforded the same nomenclatural rank and that interposition of taxa at "informal ranks" within nominal-series is incompatible with the *Code*. Appendix 2 provides a formal definition of this Principle along such lines. This definition also incorporates the proposals, discussed at more length below, to recognize an additional nominal-series in the *Code*, the *class-series*, and to remove all restrictions concerning the number of ranks that can be used within each of the four nominal-series.

The Principle of Binomina

It is often stated that zoological nomenclature as regulated by the *Code* is "*the* binominal nomenclature". This qualification is misleading in two respects. First of all, it is not the only nomenclatural system having recourse to binominal formulae to designate objects. This is in fact a very general characteristic of most human languages, which use couples substantive-adjective to designate things or beings: the substantive designates a group or class, the adjective a subgroup or an individual within this class. It is more economic and it helps memorization to say "a black dog" and "a white dog" rather than having a particular name for each kind of dog. The Linnaean binominal system for species, derived from the Aristotelician couple *genus-differentia*, takes its roots in these traditional systems. This general way of functioning of human language and mind probably explains the immediate success of Linnaeus' system of binominal designation of species, when he decided to individualize the first term of the diagnosis he had used in the previous editions of his book. He was not the first using this system but to uniformly apply it for the first time to all biological taxa then recognized.

Regarding the *Code*, the term "binominal nomenclature" is however misleading for a second reason: it applies only to nomina of rank species, all nomina of higher ranks (genus, family, etc.) being *uninomina**, and the nomina of subspecies being *trinomina**.

For these two reasons, I suggest that the formula "binominal nomenclature" should not be used to designate this Principle of the *Code*. A proper qualification would be "binominal species nomenclature" or "binominal specific nomenclature", but this would be long and unpalatable. So I suggest to use simply the denomination *Principle of Binomina*°, which is short and clear enough. A revised definition of this Principle is provided in Appendix 2.

This Principle is an important one of the *Code*. It allows to "protect" the users of this nomenclatural system from the intrusion of uninominal designations for species, which would be a great source of nomenclatural confusion. Early implementation of this Principle allowed to introduce firmly in the international community of zootaxonomists the idea that, to be available, a new species nomen had to be a *binomen**. This Principle is one of the safeguards or "rails" that allow to separate *Code*-compliant zoological nomenclature from other nomenclatural systems. All authors who nowadays decide to apply uninomina to species (e.g., Graybeal 1995; Pleijel 1999; Dayrat *et al.* 2004; Béthoux 2008, 2009; Béthoux *et al.* 2009) cannot ignore that they place themselves outside the *Code* and cannot complain if others provide correct

Code-compliant nomina for the same taxa (e.g., Muona 2006). It is argued below that a few other similar safeguards should be introduced in the *Code*, to avoid the potential confusions introduced in the recent years by alternative nomenclatural systems.

The Principle of Coordination

This Principle is quite simple. It states that, within a nominal-series, any nomen created for a taxon at any rank is deemed to have been simutaneously created at all other ranks in this series. All these different uses of the nomen are not different nomina, but different *parohypses** (Dubois 2010*c*) of the same nomen, which all have the same onomatophore, author and date. Strangely, and as a result of its atomized plan, although this Principle applies equally to the three nominal-series recognized by the *Code*, the latter text, instead of presenting it once and for all, presents it repeatedly, in each of these series, as if it were three distinct Principles. Appendix 2 provides a single definition of the *Principle of Coordination*° which applies to the three series.

The consequence of this Principle is that, whenever a taxon contains several subtaxa referred to the same nominal-series, one of these subordinate taxa bears the same nomen as its superordinate one. In such cases, the nomenclature is *polysemic**, i.e., the same nomen applies to several taxa being in direct hierarchical relationship. The respective advantages (*nomenclatural parsimony*) and disadvantages (*nomenclatural ambiguity*) of this partially polysemic system were discussed by Dubois (2008*g*). One undeniable fact is that, with the growing use of online research engines, many non-taxonomists may look for nomina on the web, and, missing the basic background, may not be able to distinguish between "genus *Rana*" and "subgenus *Rana*" (Hillis 2006; Dubois 2007*c*). It would be quite easy to modify the *Code* in order to make it shift from a partially polysemic system (because of this Principle) to a fully *monosemic** one (Dubois 2008*g*), but this would have two drawbacks: (1) it would require the creation of thousands of new nomina for the whole of zootaxonomy; (2) it would result in the impossibility of naming some taxa, in the family-series. The reason for this latter problem derives from the Rules of the *Code*, which require that family-series nomina be based on the roots of genus-series nomina. Whenever a family-series subordinate taxon only includes a single subordinate genus-series taxon, this family-series nomen could not have a nomen different from that of its superordinate one. If a family *A-IDAE* includes two or more subfamilies, one will be called *A-INAE*. If this subfamily contains only one genus *A-us*, without synonym, it is impossible to coin a subfamilial nomen different from the familial one.

The *Code* calls "nominotypical" the subordinate taxa that must bear the same nomen as the superordinate one because of the Principle of Coordination. In order to avoid the use of the root "type", and to distinguish between the different positions of these terms in the hierarchy, Dubois (2006*b*) provided three terms: *epinym* for the superordinate parohypse, *hyponym* for the subordinate parohypse, and *eponym** for the general concept covering all parohypses of a nomen. In order to point that they designate different avatars of a single nomen (the *eponym*) that is used as valid at different ranks, the first two categories are here renamed *epihypse*** and *hypohypse***. It should be noted that, in two of the three nominal-series, the different parohypses can be distinguished, either by their spelling, in the family-series (e.g., *RANIDAE* and *RANINAE*), or by their onymorph, in the species-series (e.g., *Rana temporaria* and *Rana temporaria temporaria*). It is only in the genus-series that no distinction is possible by the aspect of the nomen (genus *Rana* and subgenus *Rana*). So the problem of nomenclatural ambiguity mentioned above exists only in the latter nominal-series.

The Principle of Neonymy

The *Code* offers the possibility for a taxonomist to create a *neonym* for an already existing nomen. Such a neonym is a nomen independent from its *archaeonym*, with its own author and date, although with the same onomatophore: as such, it belongs in the same "nominal taxon" or *taxomen** (see below) as the archaeonym. This particular status of neonyms distinguishes them from simple "subsequent spellings" of existing nomina.

This status is not a "normal" matter that could be grasped intuitively, as nothing similar exists in domains other than biological nomenclature. It is therefore justified to recognize and define a *Principle of Neonymy*° for this very particular procedure. The work of Dubois (2010*c*) should be consulted for a detailed analysis of this situation and a comparison with other seemingly similar situations concerning the other categories of subsequent spellings or *aponyms*. The latter include intentional changes or *meletographs** (*justified emendations* and *mandatory changes* of the *Code*) and unintentional ones or *ameletographs** (*incorrect subsequent spellings* of the *Code*).

Nomenclatural availability: synthesis

The main features of nomenclatural availability according to the *Code* are summarized in Figure 1 (Appendix 3).

Second stage of the *Code*: nomen allocation

The Principle of Onomatophores

The second floor of the *Code* is that of the *allocation* of the nomen to a taxon. Contrary to what some believe, it is not in the least obtained through a *definition* of the taxon, but through the use of a tool specific to biological nomenclature, traditionally called "type" or "name-bearing type". For reasons discussed above, the term "type" and all its derivatives should be eradicated from zoological nomenclature. The proper terms to designate this nomenclatural tool are *onomatophore*, *onymophoronts* (name-bearing specimens) and *nucleomina* (name-bearing taxomina). Under the *Code*, a nomen applies potentially, within the frame of any given ergotaxonomy, to any taxon which includes its onomatophore. In this system, also used in the Codes of botany, bacteriology and virology, allocation of nomina to taxa does not rely on intensional or extensional definitions, but on *inclusive ostension** (Keller *et al.* 2003: 99; Dubois 2005*c*, 2006*c*, 2007*a*, 2008*g*). The function of an onymophoront is not to act as *semaphoront** (Hennig 1950, 1966), i.e., of "bearer of characters", but simply to implement an objective, material and permanent link between a natural population of organisms, as represented by a specimen (or a series of specimen) drawn from it, and a nomen or several nomina, in the case of a hierarchy of nomina of different nominal-series that ultimately refer to the same specimen(s) (Dubois & Ohler 1997*a*).

A subtle distinction must be made here between two different manners in which a specimen may act as a semaphoront. For taxonomic purposes, a specimen may be used to provide information on the characters considered to be *diagnostic* or *apognostic* of a *taxon*. The term *taxont** was recently proposed for this taxonomic concept (Dubois 2010*e*). However, a specimen may also allow precise identification, through some of its characters, of the natural population from which it was drawn. This may be the case for example if it shows characters that specimens from a sympatric population of another species do not show, *even if these characters are not diagnostic of its own species if compared with a third one*. Such characters may therefore allow allocation of an onymophoront to an *ergotaxon**. In this second case, the specimen may be qualified as a *photonymophoront***, whereas if it does not allow such a discrimation it qualifies as a *nyctonymophoront***.

The idea that the *Code* still carries a residual amount of typological thinking has some foundation, unfortunately. This is shown by the fact that the *Code* still recognizes "*paratypes**" and "*paralectotypes**", and that it rather recently (Anonymous 1985) implemented a new category of onymophoronts for protists, the "*hapantotypes**", that have a function of semaphoronts rather than of onomatophores. The idea that "types" should carry taxonomic characters is still widespread among practising taxonomists, as shown by the recent proposal that the *Code* should also recognize "*allotypes**" (Santiago-Blay *et al.* 2008). This is an additional reason for eradicating the term "type" from zoological nomenclature, as it clearly is confusing even among taxonomists. The *Code* is a legislative text that governs nomenclatural practice, but it should not interfere

with taxonomic activity. In particular, it is not its role to contribute to the recognition or definition of taxa. As such, whereas it is normal that it regulates the function and use of specimens designated as onymophoronts, it does not have to do so for specimens employed for the taxonomic definition of taxa, i.e., members of the *hypodigm**. For this reason, the *Code* should not mention paratypes, paralectotypes and allotypes, which do not play any role in the allocation of nomina to taxa. It should also stop recognizing hapantotypes: from a nomenclatural point of view, protists should be treated like all other animals, and their nomina should rely on one of the four categories of onymophoronts defined below (i.e., in most cases, symphoronts present on one or several preparation).

In fact, the confusion stems from the early days of nomenclature, when the nomenclatural and taxonomic function of "types" were not clearly separated. This question was clarified, among others, by Simpson (1940, 1961) who showed that the early concept of "type" could be divided in two distinct concepts: the taxonomic concept of *hypodigm* (composed of *protaxonts**; Dubois 2010*e*), which designates the series of specimens used by a zoologist to recognize, characterize and describe a species, and the nomenclatural concept of *onomatophore*, which designates the specimen(s) used as an objective reference to tie a nomen to a taxon. It is true that, in the overwhelming majority of cases, the onymophoront is one of the specimens of the hypodigm series, but the two functions, respectively nomenclatural and taxonomic, covered by the two tools, are distinct. They are even dissociable, as shown by some old nomina, created on the basis of an illustration or of a very short description or diagnosis (sometimes consisting of a few words) securing the availability of the nomen but not the characterisation, description or precise definition of the taxon. In such cases, it is only when a series of specimens belonging unambiguously to the same taxon (e.g., from the same locality) is obtained and described, that this "subsequent hypodigm" (*apotaxonts**; Dubois 2010*e*) will allow to produce a truly operational description and diagnosis of the taxon.

The *Code* entertains a semantic ambiguity concerning the term *taxon*. This ambiguity appears in the text but is particularly evident in the "Glossary". The latter starts defining clearly *taxon* as a *taxonomic* concept, having an intension, an extension and limits. Just after, it defines *nominal taxon* as a nomenclatural concept, devoid of intension, extension and limits, but corresponding to the link between a nomen and an onomatophore. It is thus quite clear that a nominal taxon is not, as its denomination would seem to indicate, a "kind of taxon", as *it is not a taxon*. In order to try and get out of this contradiction, the "Glossary" of the *Code* attempts to distinguish the nominal taxon from "another kind" of taxon which would be the "*taxonomic taxon*". However, the definition given for the latter concept, although formulated differently, is strictly equivalent to that given for the term taxon: it designates a unit of classification, the recognition or definition of which only depends upon taxonomic concepts. The redundant and ridiculous formula "taxonomic taxon" does not bring any additional information compared to the term "taxon" alone. It is as useless as would be the formulae "tablic table", "doggic dog" or "conceptual concept". It is made necessary in the *Code* on account of the improper designation as "nominal taxon" of a concept that does not point to a taxon. In order to remove this ambiguity, it is necessary to use a distinct term for the nomenclatural concept. The term *taxomen* (plural *taxomina*), proposed by Dubois (2000*b*) fulfills this need. It can be defined as the indissoluble association between a nomen (or sometimes several nomina, in cases of neonymy) and an onomatophore (which can be real or virtual, in cases of ancient nomina).

Although it does not distinguish them by different terms, the *Code* recognizes two categories of onomatophores, according to the nominal-series at stake. In the species-series, onomatophores are (real or virtual) *specimens*, whereas in the genus- and family-series they are *taxomina*. To call the attention on their particularities and differences, it is advisable to designate these two categories of onomatophores by different terms (Dubois 2005*b*–*c*), *onymophoronts* in the first case and *nucleomina* in the second. Four subcategories of onymophoronts are recognized in the *Code*, which can be renamed *holophoronts*, *symphoronts*, *lectophoronts* and *neophoronts** in order to remove the root "type" from their designations (Dubois 2005*c*). As shown in Figure 2 (Appendix 3), the onymophoronts, being real specimens drawn from real populations of organisms, are the only onomatophores which realize an objective link between the world or organisms and the world of nomenclature. In contrast, the nucleomina do not directly rely on specimens. However, as the *nucleogenera** ("type genera") of families rely on *nucleospecies** ("type species") of genera, and the latter on

onymophoronts, through this chain where each floor bears the next on its shoulders, all nomina are connected ultimately to specimens.

Despite their being based either on specimens or on taxomina, onymophoronts and nucleomina share the same system of designation and restriction of the onomatophore. In the early days of taxonomy, nominal species were often created on the basis of a series of specimens, none of which was expressly designated as "type", not to say "holotype". Similarly, many nominal genera were created on the basis of several included nominal species, none of which was designated as "type species". In both cases, this situation was the source of an ambiguity, when the different specimens were subsequently referred to different species and the different species to different genera. Solving this ambiguity requires to restrict the function of onomatophore to a single specimen (a lectophoront) or a single nominal species (a subsequently designated nucleospecies). The *Code* provides precise Rules for this subsequent restriction, both in the species-series (Art. 74) and in the genus-series (Art. 69). Figure 3 (Appendix 3) shows how this restriction works in the species-series. Terms are wanting in the *Code* to distinguish in a general way (i.e., in all nominal-series) whether onomatophores are unambiguous, ambiguous or absent, and the different categories of nomina concerning these situations. The terms *monophory*, *symphory** and *aphory** are already available for the general categories of onomatophores, and those of *aptonym***, *monaptonym***, *holaptonym***, *lectaptonym***, *synaptonym***, *homosynaptonym***, *heterosynaptonym*** and *anaptonym*** are here provided for the nomina. These are explained below in the text, in Appendix 1 and in Figure 4 (Appendix 3).

A single Principle of the *Code* refers to this stage "allocation of nomina" of the nomenclatural process: the so-called *Principle of Typification*. In order to continue the extirpation of the root "type" from the *Code*, it should be renamed *Principle of Onomatophores*° and slightly reworded (see Appendix 2).

The need of deposition of onymophoronts in permanent collections

This point will not be further discussed here, as it was recently the matter of several publications (Dubois & Nemésio 2007; Donegan 2008; Nemésio 2009; Frick 2010) and of a forum in an issue of *Zootaxa* (Minelli 2009). For the reasons discussed at length in these papers, it is important and urgent that the ICZN clarifies its position on this problem. My personal opinion on this matter is that it would be a terrible scientific regression to allow zootaxonomists to "describe" new taxa and create new nomina without specimens carefully collected, properly fixed, studied in detail in the laboratory and kept permanently in well-curated collections (Dubois 2009*d*). We will examine below the possibility that the *Code* allows for a new nomenclatural act, that of *registration of onymophoronts*.

Nomenclatural allocation: synthesis

The main features of nomenclatural allocation according to the *Code* are summarized in Figure 4 (Appendix 3).

Third stage of the *Code*: nomen validity and correctness

Criteria of validity

In a perfect taxonomic world, there would be no need of this stage of the nomenclatural process: any taxon would bear a single nomen, and any nomen would apply to a single taxon. This is possible in a nomenclatural system applying to a very low number of objects, but not in a system covering millions of taxa and nomina: it is then unavoidable that, from time to time, different nomina be coined for the same taxon (*synonymy*), or

nomina identical in spelling for different taxa (*homonymy*). In order for nomenclature to be able to play its role of unique and universal reference system for the designation of taxa, clear Rules must exist to decide, in such cases, which nomen is *valid*, i.e., must be used in zoological nomenclature, and which one is *invalid*. The basic Principle used in the *Code* for this decision is *Priority of publication*. It applies both in cases of synonymy and of homonymy. In the (rather rare) cases of simultaneous publication of two synonyms or homonyms, priority cannot solve the problem, and this requires to appeal to another Principle mentioned above, that of First-Reviser. It states that the first author to have noticed the problem is entitled to make freely his/her choice between the two nomina at stake, and to give precedence to one of them over the other one. This choice is definitive, and cannot be challenged by a subsequent author.

According to these basic Principles, among competing available synonyms or homonyms, only one can be valid, on account either of priority or of a first-reviser action.

This situation was clear but, in the recent decades, it was confused by the introduction of a third unclear Principle, not stated as such in the *Code*, based on the concept of "*prevailing usage*". This introduction makes complex and sometimes insoluble what was until then simple and automatic.

A "nomenclatural system" is a system that commands the way designations (names) are given to certain objects. There are two main ways to make such a system work: either by universal and stringent Rules promulgated *a priori* by a legislative body, and which must be followed equally by all persons agreeing to follow these Rules, or by *a posteriori* decisions taken by an executive body on the basis of test cases, then more or less generalised by "consensus" or "majority". A third possibility advocated by some, namely *a posteriori* consensus among customers based on "usage" alone, without any Rule or any bureaucratic decision, does not qualify as a "system", and is merely an infallible recipe for chaos. The choice between the two main kinds of systems is summarised in the question "*Do we want a* Code *or a Committee?*" (Fosberg 1964). The reply mostly depends on the quantity of objects we want to name. The nomenclature of planets and stars deals with a few thousands identified objects (among many more existing in the world). This reasonable number is manageable by a committee which can decide collectively which name will be retained for any given object (Ohler 2005). In contrast, with more than 2 million of animal taxa (from species to reign) so far identified and named, and millions or dozens of millions remaining to discover, it is simply unconceivable to have a nomenclatural system in which the valid name of any object would have to be decided by a committee. The Rules must be devised in such a way as to work automatically, so that any taxonomist in the world could know which is the valid nomen of any taxon, without having to consult other people.

Rules must be binding and universal if they must be Rules. Imagine a highway code which would state that cars must stop when the traffic light is red—but with "exceptions": car accidents would be very frequent! Well, it may happen that an ambulance carrying a sick person with high urgency of intervention decides to use its siren and not to respect the light to save a life, but the same ambulance going back home will not use its siren for personal convenience. Exceptions to a Code must be really exceptional, ortherwise nobody will take it seriously. This risk currently exists for the zoological *Code*, because of the too many exceptions to its basic Rules indulged by the ICZN in the recent decades and because of the new Rule about "prevailing usage".

Before tackling this question, let us just review briefly the most important Rules regarding synonymy and homonymy that have been in force since the implementation of the *Code*.

Synonymy

The term *synonymy* is used in taxonomy in two main distinct senses: (1) to point to the fact that two distinct nomina designate the same taxon; (2) to designate a list of nomina complying with this definition, but also, very often, of aponyms of these nomina and of mere citations of the latter (*chresonyms**). In order to avoid any confusion, in what follows the term synonymy is reserved to the first sense above, whereas in the second situation the terms *synonymic list** or *logonymic list* are used (see Dubois 2000*b* for explanations).

Two main categories of synonymy are recognized in the *Code*: (1) *objective synonymy* (equivalent to *nomenclatural synonymy* in botanical nomenclature), or, more shortly, *isonymy** (Dubois 2000*b*); (2)

subjective synonymy (equivalent to *taxonomic synonymy* in botanical nomenclature), or, more shortly, *doxisonymy** (Dubois 2000*b*).

Two nomina are isonyms whenever they are based on the same onomatophore. Isonymy does not depend on the decision or interpretation of any taxonomist. It is definitive and irreversible.

In contrast, two nomina based on different onomatophores are doxisonyms whenever they are considered by one or several taxonomist(s) to designate the same taxon. Doxisonymy therefore depends on an interpretation or decision. It is reversible, liable to be modified by any subsequent taxonomist(s). A doxisonymy subsists in the long term only if a consensus exists about it within the community of taxonomists.

These two categories of synonyms are drastically different, and it is not sufficient, e.g., in a logonymic list, to state that a nomen is an "invalid synonym" of another one. It is indispensable to precise whether it is an isonym or a doxisonym, and, in the latter case, to provide at least one reference to a work where this doxisonymy was first proposed or adopted.

Homonymy

Homonymy in the *Code* has a peculiar definition. It does not point only to situations where two nomina are strictly identical (exactly same spelling), but also to a few situations where they differ by one or several letters. These latter situations concern: (1) in the species-series, specific adjectives originally spelt differently for being combined with generic nomina of different grammatical genders, if transferred to the same genus; (2) in the species-series, spellings "deemed to be identical" listed in Art. 58; and (3) in the family-series, different spellings derived from distinct generic nomina having the same stem (based on the genitive of either homonymous or non-homonymous generic nomina) but bearing different endings for being referred to different ranks. In contrast, in the genus-series, any one-letter difference is enough to avoid homonymy between two nomina.

Homonymy in the genus-series is simple, primary and absolute. It results in the definitive invalidation of the junior homonym. In the family-series, homonymy is also primary and definitive, but it may be relative, as it bears only on the stem of the nomen of the nucleogenus, not on the ending.

The situation is more complex in the species-series, where two categories of homonymy must be distinguished.

Primary homonymy or *hadromonymy*** corresponds to the situation where the two homonymous specific (or subspecific) epithets were first published combined with the same generic substantive. This homonymy is absolute and, like in the other two nominal-series, irreversible: the junior homonym is definitively invalid.

In contrast, in *secondary homonymy* or *asthenomonymy***, the homonymy is relative and may be reversible. In this case, two epithets are identical (except possibly in their ending), but they were originally published combined with distinct generic substantives, and they became homonyms only when both were referred to the same genus. As long as this is the case, the junior one is invalid, but, if they are again referred to two different genera (either the original ones, or others), they are no more homonyms and the junior one may become valid again (with an exception not discussed here, concerning junior *asthenomonyms** invalidated before 1961).

There is a problem regarding the Rules of the *Code* dealing with secondary homonymy. This is discussed below in the chapter "A cornucopia of 'details'".

Exceptions, usage, stability and robustness

The Rules briefly exposed above were those in force in zoological nomenclature before 1999, but significant changes were brought to them in the last published edition of the *Code.*

Because of the Principle of Priority, the sudden discovery of synonyms or homonyms that had remained unnoticed or unknown until then may in some cases threaten some nomina of very widespread use outside the restricted domain of taxonomy. It would occur to no responsible taxonomist to defend the possibility to

replace nomina such as *Caenorhabditis elegans*, *Archaeopteryx* or *HOMINIDAE* by obscure nomina that would suddenly be discovered to have priority on them. This situation is not new and there was here no reason to change the basic Rules of the *Code*. In such cases, according to all editions of the *Code* prior to 1999, any zoologist could appeal to the ICZN so that the latter could make use of its *Plenary-Power** to suspend exceptionally the Rules in order to protect the well-known nomen. The latter was then placed on one of the *Official Lists* of "conserved" nomina (of the species-, genus- or family-series), and the invalidated nomen on one of the *Official Indexes* of "rejected" nomina. A nomen could be so invalidated by the ICZN either fully and permanently (*archexoplonym***) or conditionally (*archypnonym***), e.g., nomina invalidated in case of doxisonymy, but which may become valid again if the doxisonymy is refuted. Such a procedure assured the universality and credibility of the *Code* and of the ICZN, and was used in hundreds of cases since the implementation of the *Code*.

In its Art. 23.9, the new 1999 text restrains the Principle of Priority in some cases by recourse to so-called "*prevailing usage*". Although introduced in the 1999 edition of the *Code* to "protect" some nomina, this change in the Rules is the final result of a tendency that has been clear in the decisions of the ICZN dealing with various particular nomenclatural cases in the recent decades, giving more and more importance to "usage" at the expense of priority as the basic structuring Principle of the *Code* regarding nomen validity. This question has been the matter of important debates.

The rationale put forward by the partisans of this change is that the "users" of taxonomy are disturbed by nomenclatural changes and that the latter should be limited as much as possible. In fact, the opposition between supporters of priority and of usage takes its roots in the opposition between different philosophical, social and juridical traditions (Dubois 2005*c*: 368), such as "Roman Law" ("*de jure*") and "Anglo-Saxon Law" ("*de facto*"). The question is not to know which system is "better" in an absolute way, but which ones serves best the purposes of a scientific nomenclature of millions of animal taxa. Given the gigantic number of "objects" that the nomenclatural system has to manage, a simple system based on a single binding and automatic Principle will doubtless be more efficient in the long run than a dual system based on two contradictory and incompatible Principles. Furthermore, the new approach raises several kinds of problems, four of which were exposed in detail by Dubois (2010*a*,*d*): (1) it weakens the binding value and strength of the *Code*; (2) it encourages useless or destructive personal debates among taxonomists; (3) it sends a wrong message to non-taxonomists; (4) it acts as a threat against natural history museums.

The binding value and strength of the Code *as a universal system*

As it challenges Priority as the basic Principle of zoological nomenclature in favour of a poorly defined "usage", the new article spreads the idea that the Rules of the *Code* are mere "indications" that one is free to follow, or not, without real consequences. These recent developments have thus been considered to have "*opened Pandora's box*", as they indirectly bring support to the development of alternative, more consistent and stringent, nomenclatural systems (Dubois 2005*c*, 2010*d*).

During its long history from the early *Règles* to the current edition of the *Code*, the concept of *nomen oblitum* ("forgotten nomen") has undergone various avatars which would be uselessly long to recall here. After having disappeared in the "third edition" of 1985, this term and this concept were back in the "fourth edition" of 1999, associated with the concept of *nomen protectum* ("protected nomen"), in the form of a new criterion of "prevailing usage" to "protect" some nomina.

According to the new Art. 23.9, any nomen that has been the matter of a "prevailing usage" should be conserved even if it does not have priority. The definition of "prevailing usage" in the *Code* is confusing, being different in the "Glossary" and in the text proper (see details in Dubois 2010*c*–*d*). Art. 23.9 states that whenever the senior nomen has not been used as *valid* since 1899, whereas the junior nomen has been used by at least 10 authors in 25 publications during at least 10 years "*for a particular taxon*" (presumably the same taxon as that designated by the senior nomen, but this is not stated in the *Code*), the first one is to be rejected as a *nomen oblitum*, and the second one is to be validated through "*reversal of precedence*" as a *nomen protectum*. The "publications" at stake concern all kinds of works confounded without restriction, no

distinction being made between the use of the nomen in specialized taxonomic literature and in the general literature. Publications eligible for this purpose may be checklists or catalogues, or written by a single research team, and may all pertain in specialized taxonomic literature, the nomen being completely unknown outside this field. Furthermore, the requirement that the senior nomen should have been considered *valid* after 1899 excludes *de facto* all nomina that have been regularly cited as nomenclaturally *available* but *invalid*, for example for being considered doxisonyms, and that therefore did not at all correspond to the concept of *nomen oblitum*—a strange Rule indeed, which appears to be based on a confusion between the concepts of availability and validity.

The conditions of Art. 23.9 are extremely lax, as a number of 25 publications of all kinds is very quickly obtained, even for completely obscure nomina, that no participant in a World Congress of Zoology except the specialists of the group would ever had heard of (see for example the case of *Testudo terrestris* Forskål, 1775 discussed by Dubois & Bour 2010*a*: 34–35). In fact, "*there is a real intellectual dishonesty in both stating that nomenclatural stability is necessary for non-systematists, users of taxonomies, but then to provide evidence for a 'need of protecting usage' based on purely taxonomic or phylogenetic publications*" (Dubois 2005*c*: 409). These very permissive conditions, allowing suspension of priority and recourse to "usage" in many cases where this usage exists only in taxonomic specialized literature, amounts in fact to stating that the *Code*'s Rules have no real structuring role even for the professionals of taxonomy, and weakens considerably the value of the *Code* in the eyes of all non-specialists. With this article, taxonomists are clearly encouraged to do hasty and careless nomenclatural work (Dubois 2005*c*, 2010*a*,*d*).

A competent taxonomist, working seriously, does not create a new nomen without having examined all the accessible onymophoronts of the concerned group, which are often dispersed in many museums all around the world. But of course such a work is costly, both in terms of time and of money, and the temptation may exist not to care for the onymophoronts kept in remote collections, for example in another continent. With the new Rule, some may feel "freed" from this constraint. When describing a new species, why should a taxonomist care for the possible existence of an available nomen for this taxon, until then treated in error as an invalid synonym? It is quicker and easier to create a nomen, then to care for having it used 25 times over 10 years, and it will be forever "protected" against it senior synonym. Those who follow such guidelines are assured that their "mistakes" or "manipulations" will be validated afterwards, under the pretext of "usage". In the long run, such pratices are likely to become a threat against the universality of zoological nomenclature and for the instauration of a chaotic situation in this field.

Since this new Rule was implemented, it was followed by some authors, but ignored by others, possibly because they considered that the junior nomen was not "well-known" outside the little closed circle of taxonomists. In contrast, other authors "defended" very aggressively "their" nomina or "their" uses of some nomina against senior synonyms that they had failed to consider when they published on the taxon. They were encouraged in this approach by the attitude of the ICZN, which over the last decades has acceded to many requests to invalidate some nomina, in some cases on the basis of ridiculously low numbers of usage of the to-be-validated nomen (see examples in Dubois 2003, 2005*c*, 2010*a*,*d*).

As we have seen, under the previous editions of the *Code*, the possibility had always existed to validate a well-known nomen against an obscure synonym or homonym suddenly "rediscovered", but this required a special action of the ICZN using its Plenary-Power. Such a procedure assured the universality and credibility of the *Code* and of the ICZN, and was used in hundreds of cases since the implementation of the *Code*. But, for the latter to remain a trustworthy reference respected by all taxonomists, this procedure must remain limited to the cases where the disturbance caused by the change of nomen would have been significant *outside the specialized taxonomic literature*, as the specialists of this discipline are, or *a priori* at least should be, armed to understand the reason for some changes and not be perturbated by them—if not, they might perhaps envision changing for another activity (Dubois 2005*c*: 410).

Useless or destructive personal debates among taxonomists

The new Rule gives undue importance to the "*argument of authority*" in nomenclatural decisions (Dubois 2010*d*). It is strange that, at a time when the science of taxonomy has progressively got rid of this kind of argument and now uses repeatable methodologies and refutable hypotheses for the definition of taxa, this principle is still of widespread use in nomenclature, under the avatar of what could be called the "Principle of Usage" (not mentioned as such in the *Code*). As this untold Principle is not clearly defined, appeal to it encourages heated personal debates among taxonomists, as can be checked easily by browsing the last decades of the *BZN*, even after the 1999 *Code*. They contain numerous discussions about some borderline nomenclature cases which do not fall under the conditions of Art. 23.9, for example because both the oldest nomen, which has priority, and the most recent one, that some wish to "protect", have been used as valid after 1899, so that none qualifies as a *nomen oblitum*. Regularly, some taxonomists apply to the ICZN to ask for the invalidation of the most recent nomen, on the pretext that it has been "less used" than the other one.

As a matter of fact, "usage" is a very ambiguous and subjective notion. It can be defined in a quantitative way (number of publications, countries, languages, periodicals, authors, independent authors; more or less recent dates of publications; number of copies of a publication distributed, or of readers, e.g., in schools or universities, etc.) or in a qualitative one ("excellence", "fame" or "importance" of an author, a country, a journal, a kind of publication), according to whether one wishes to protect certain nomina or authors. But, which one qualifies as having the widest usage, of a nomen appearing in a single book used in thousands of schools in China, or another one used by a single research team in a dozen publications read by a few hundreds or dozens of specialists?

In such cases, rather than refusing to consider these borderline demands, the ICZN, which on the other hand regularly exerts censorship on some texts submitted for publication to the *BZN* (Dubois 2005*c*: 423–424, Laurin 2008*a*), is prone to publish large debates between two groups of authors, those in favour of suspension of the Rules and those opposed to it. In some cases (e.g., Jennings *et al.* 1994; Webb *et al.* 1994; Zug *et al.* 2009; Bour *et al.* 2009; Takahashi *et al.* 2009; Matyot *et al.* 2009; Chambers *et al.* 2010; Lawrence *et al.* 2010), the high number of interveners in the debate (mostly in favour in "usage"), some of whom had never published anything on the taxa at stake previously, clearly points to the fact that they were informed and *asked* to write in support of the application, sometimes even before its publication in the *BZN* (e.g., Zug *et al.* 2009). The organisation of such "lobbying" actions to try and convince the ICZN to follow the opinion of one group of colleagues has little to do with science, and gives a poor image of zoological nomenclature to outside observers. When it comes to deciding whether a scientific point of view, hypothesis or theory is valid, lobbying, pressure groups, polls, "majority" (among a restricted group of voters) and "argument of authority" are not appropriate approaches.

The recourse by some authors to what has been called "Google taxonomy" (Dubois 2007*c*: 399) or "scientific webology" (Lawrence *et al.* 2010: 252) is very enlightening regarding the appalling intellectual derive of some discussions about "usage" in nomenclature. In which other scientific domain would specialists believe that any kind of "truth" could emerge from the number of "usages" of a term, concept or opinion on the web or from the number of "hits" it obtained in a "Google search"? This is philosophically and scientifically untenable: "*In all cultural domains including science, as soon as two different opinions exist, both have their philosophical justification and are entitled to consideration, irrespective of their numbers of supporters, of the institutional 'importance' of the latter, of their financial situation or other similar criteria: no quantitative criterion is useful to decide which opinion is 'more important' or 'more significant' and therefore should be followed (actually, the history of science is full of examples where the majority was later shown to have been completely wrong).*" (Dubois 2005*c*: 410).

Furthermore, the tone of some interventions in these debates sometimes reaches high levels of aggressiveness between colleagues, and it is surprising to see them accepted for publication in the *BZN*. Some formulations are clearly insulting to colleagues, e.g. when they accuse them to have manipulated data to support their nomenclatural opinion (see examples in Zug *et al.* 2009 and Takahashi *et al.* 2009), not to mention additional very offensive statements which can be found quite easily through a quick survey on the web, in "unofficial documents" dealing with these nomenclatural cases that are not a credit to their authors.

Such cases, even if they are a minority, clearly go beyond what is acceptable in scientific discussions among colleagues—which after all deal only with "opinions", not with scientific data or theories (Dubois *et al.* 2010).

Even if no lobbying is implied, the criterion of "usage", under the lax definition of this term in the *Code*, allows all kinds of manipulation, as this text puts no limit date for the citations produced in support of the conservation of the junior nomen, so that, not rarely, some of the citations produced are posterior to the demonstration that the junior nomen was invalid under the *Code* (see a list of references to several concrete examples of this kind in Dubois 2005*c*: 426).

Taken altogether, all these facts give a poor image of taxonomic research among biological sciences, giving support to the idea that this discipline has not yet reached "maturity" and is still deeply impregnated with ideology and struggles for personal power. In the current situation of taxonomy among biological sciences, giving this "spectacle" to the international community certainly cannot help for the recognition of this discipline as a major scientific field. Time has certainly come for zoological nomenclature to follow other disciplines in an effort of objectivation of its procedures. Its Rules should be as automatic as possible and leave no place to opinions, tastes, preferences, feelings, lobbies and pressure groups. Zootaxonomy will have reached adulthood when all taxonomists realize that nomenclature is nothing but an *information storage and retrieval system* (Mayr 1969, 1981) and that scientific nomina of taxa are just *neutral and arbitrary labels automatically attached to taxa*, the function of which is merely one of *indexation of the taxonomic information* and carry no meaning or content by themselves. They are not living beings that would "resurrect" when a once invalid synonym is revalidated, or that would require "protection" or "conservation", a semantic practice that is not naive as it recalls the use of these terms in conservation biology, and therefore has a strong impact on the minds nowadays (Dubois 2010*d*).

Of course, the taxa that were recognized by the authors of the past were most often very different from the taxa we now recognize. This is not only because these authors were aware of the existence of just a handful of species compared to what we now know. This is also because the taxonomic paradigms, concepts, criteria and characters they used had little to do with ours. In the first century of zootaxonomy, starting with Linnaeus, they did not believe in organic evolution, their taxa were not meant at reflecting the phylogenetic relationships, they did not distinguish homology from homoplasy, etc. But, as far as nomenclature is concerned, this is of little importance. The role of nomenclature is not to provide information about the taxa themselves, their characters, relationships or the criteria used by taxonomists for their recognition. It is to provide *labels* to designate unambiguously the taxa *within the frame of a given taxonomy*, and, through logonymic lists, to provide a connection between the different historical stages of the taxonomy of the group at stake. The relationships between content (extension) of taxon, definition (intension) of taxon and nomen may be varied and complex (see details in Dubois 2005*c*), e.g., the same taxon may be recognized under the same nomen by different authors for different reasons, or the same nomen may be used by different authors for widely different taxa, provided they include the onomatophore of the nomen, but this is of no relevance for nomenclature. Both Linnaeus (1758) and Frost *et al.* (2006) recognized a frog genus called *Rana* Linnaeus, 1758, but the concept of this taxon had drastically changed in the meanwhile: the former covered all frogs of the world, the latter only one among hundreds of genera now recognized in the order **ANURA**. The persistence of this nomen, like many others, for 250 years, may give a wrong impression of "nomenclatural stability", but if the latter is not accompanied by taxonomic stability, it is only misleading. On the other hand, if every change in the taxonomy of the amphibians had been accompanied by the abandonment of the existing nomina and the creation of new nomina for the newly defined taxa, the history of taxonomy would be undecipherable for non-specialists of the group. Thanks to the perenniality of nomina, and the irreplaceable role of logonymic lists, any competent taxonomist is able to reconstruct rapidly the taxonomic history of a zoological group even if he/she has never previously had the opportunity to look at it and at the relevant bibliography.

A wrong message to non-taxonomists

Contrary to a belief still widespread among non-taxonomists (including most biologists), taxonomy is very far from having inventoried a significant proportion of the living species of the planet. It has described and named less than 2 millions species over possibly 10 to 100 millions on earth. For the time being, almost every field work expedition or laboratory taxonomic revision of a group leads to the recognition of new species, and to redefinition of the species "already known". The rate of mistakes or missing data usually considered acceptable in science is below 5 %, and in no other research field our society would be satisfied with a percentage of missing data of 50–90 %. Even if missing data are not errors and if the accuracy of a geographical charting, for example, is not homogeneous with the degree of charting a territory, no one could argue that the taxonomic composition of the planet's organisms is satisfying to a reasonable degree, all the more that the missing data are not randomly distributed, some groups having rather well surveyed whereas others are very poorly known.

In front of this *taxonomic gap* (Dubois 2010*a*,*d*), it has been rightly stressed that "*taxonomic stability is ignorance*" (Gaffney 1979; Dominguez & Wheeler 1997; Benton 2000; Dubois 2005*c*). Highlighting "stability" as a basic criterion of quality of taxonomic research misses this point and sends a fully misleading message to the international community of non-taxonomist biologists and to laymen as regards completion of the taxonomic work. It carries the wrong idea that the work of taxonomy is finished or almost so, and therefore does not need further institutional and societal support. If "final and stable lists" of living taxa, with stabilized patterns of relationships, indeed existed, and should remain unchanged, the proper consequence to draw would be that taxonomic research should stop, and should receive no more funding and professional positions (Dubois 1998). Such a distressing message does not help for the sudden awareness by laymen and policymakers of the existence and importance of the taxonomic gap and impediment. The misleading idea that "final lists of species" or "final taxonomies" are or should be available, and that, in order not to disturb the peace of mind of non-taxonomist users of data on biodiversity (including "conservation biologists"), no significant changes are necessary to the classifications and nomina, is not doing a service to the discipline of taxonomy and to our knowledge of our planet's biodiversity.

Sure, it is "sad" and regrettable to realize that we are far from having a complete inventory of the species of our planet. But then, rather than trying to deny and hide this unpleasant reality, taxonomists should use it as a tool for calling attention to their discipline and its current critical situation. If administrators, custom officers, conservation biologists, ecologists, physiologists, biochemists, are worried by the current incompleteness and inaccuracy of taxonomic data, they should help taxonomists to obtain the means to change this situation. The "worship" for taxonomic and nomenclatural stability goes in the reverse direction, encourages ignorance and should not be supported: "*Rather than trying to comply with the requests for 'final lists' that are often presented to them, taxonomists should explain the reasons for this instability, and should try and convince our 'social partners' that, rather than asking for a 'freezing' of the scientific activity of exploration and analysis of biodiversity, they should support and encourage it. In the long run, it may prove more interesting and useful to better understand the biodiversity on our planet than to have 'final' and 'stable', i.e. wrong and incomplete, lists of this biodiversity for the peace of minds of administrators and technocrats*." (Dubois 1998: 22).

Rather than "stability", which is not a scientific aim, nomenclatural Rules should tend to support nomenclatural *robustness*, as defined above, i.e., a combination of stability (nomina do not change as long as ergotaxonomies do not change and if nomenclatural Rules are correctly followed) and flexibility (in some cases nomina do not change even if ergotaxonomies change). Robustness is favoured by the current Rules of the *Code* based on Priority, and the latter should remain the basic Principle.

A threat against natural history museums

The logic behind the new Rule is that "usage" must be protected in all cases, even when it concerns only a few obscure publications and is due to manifest errors from the part of their authors, in fact to bad quality

taxonomic work. Whenever a subsequent, more serious, author finally examines the onymophoronts, two possibilities exist: either they correspond to usage and "everything is alright"; or they don't, and then the oldest nomen must be invalidated to "protect the mistake". Few other scientific disciplines support such a clear encouragement to validate and stabilize errors and to produce quick and superficial work in order to "save time and energy". In the long run, the consequence of this logic would be simple: it would be useless for museums to keep at great cost their onymophoronts, if they are not indispensable or even useful to identify the valid nomina of taxa. This could become a major threat to natural history museums (Dubois 2010*a*).

Natural history museums store millions of specimens from the whole world that are of inestimable importance to understand the evolution, structure and problems of biodiversity. One of their main and best advertised and "visible" functions is to act as repositories of onomatophores. These allow long-term universality and stability of biological nomenclature through providing an objective and permanent link between the world of language and the world of organisms. The new Rule puts the emphasis on "usage" of nomina and challenges priority as the basic Principle of nomenclatural validity. If the discovery that an onomatophore has been wrongly identified until now has no nomenclatural consequences, why should taxonomists care for examining old specimens? If nomina based on ill-identified or ignored specimens are invalidated whenever this mistake is disclosed, why should museums care for keeping these old specimens, for devoting space and facilities to collections, for having reliable catalogues, for making this material available for study by researchers from the whole world, for paying staff for this very specialized task?

This move entails a shift from *specimens* to *concepts* or *tradition* for the identification of the valid nomina of taxa. This attitude weakens the significance and importance of these specimens in taxonomy, undermining their important flag function for the image, funding and even the mere existence of natural history museums. For the same reason, nomenclatural systems that rely on intensional definitions of nomina rather than on onymophoronts for the allocation of nomina to taxa should not be supported. It is crucial that the unique value and irreplaceable role of onymophoronts be again highlighted by reducing drastically the number of nomina "invalidated" in favour of junior synonyms unknown to the laymen, and that the institutions which care for their long-term conservation and scientific managing be recognized as major institutions for the study of biodiversity and permanently provided with appropriate funding and staff. Many other disciplines of biology do or will benefit from such a support to museums (Alberch 1993; Winker 2004).

This recent tendency to ignore or devaluate onymophoronts can also be reinforced by the illusion, which is currently spreading among some taxonomists, that the study of onymophoronts and hypodigms can be replaced by the study of their digitalized photographs online, although many characters cannot be properly examined on photographs and relying only on photos can lead to important errors (Dubois & Nemésio 2007).

Categories of usage

The change introduced in the *Code* by the new Art. 23.9 is not only a technical one, which would be aiming for example at reducing the burden of contentious or borderline cases to be examined by the ICZN, through transferring to "individual taxonomists" the ability to solve them. More than this, it is a partial change of paradigm regarding the basic Principles of the *Code*. As long as any "suspension of the Rules" required the case to be referred to the ICZN, the Rules remained clear, Priority remaining the fundamental Principle of the *Code* and every exception, before being accepted, had to be examined by a group of "specialists of zoological nomenclature". In the new system, any zoologist can lay down the law almost to his/her taste, since the quantitative criteria required are ridiculously lax and liable to be applied to most nomina, even the most obscure and unknown ones. It is enough for the to-be-validated nomen to have appeared in lists or catalogues, even if no zoologist has used this nomen in genuine research publications since 1899. This is all the more true that this article merely mentions "works" in general, without precising their nature, although it is clear that specialized works of systematics should be excluded from this corpus, and that the mention of nomina used as *valid* after 1899 amounts to stating that a doxisonym can be deliberately ignored by an author who wishes to replace it by a more recent nomen, for example for being the author of the latter.

The numerous basic differences between priority and usage were presented in detail elsewhere (Dubois 2005*b*: table 1, 2010*d*: table 1). Briefly, priority is a fact that depends on a single linear unidimensional factor, time (see Ohler 2005: fig. 1) and that cannot be modified or falsified. The criterion of priority is unambiguous, democratic and difficult to manipulate *a posteriori*. Once carefully applied within a given zoological group, it results in a nomenclatural stability which is important if not absolute (of course, mistakes or omissions can always remain, especially concerning rare and old publications, or on the contrary very recent ones). In contrast, decisions based on usage can be labile, as the factors which define usage are multiple and liable to change with time.

What precedes suggests that "protection" of some nomina "threatened" by the Rules of the *Code* should be strictly limited to nomina well-known outside the small world of systematics. This would require implementing new Rules in the *Code* to clearly define categories of usage based on objective criteria. Any validation of junior synonyms or homonyms to protect usage should be strictly limited to nomina well-documented to be in very widespread use, not only in specialized systematic publications but in the general scientific and non-scientific literature and in society as a whole.

To solve this problem, Dubois (2005*a*,*c*–*d*, 2010*d*) proposed strictly defined *categories of usage* for the nomina of taxa. These definitions rely above all on a clear difference being made between the usage of nomina in publications of systematics and outside this discipline. Only nomina that have a *really important* use outside systematics should be liable to be "protected" whenever this widespread use proves to be invalid.

Four categories of nomina regarding usage can be defined—all after a given "starting" date, chosen as 1899 for reasons of consistency with other Rules of the *Code*: (1) *symphonyms** ("harmonious nomina") are of real universal use for a given taxon; (2) *aphonyms** ("silent nomina") have appeared as *available* but *invalid* (for being junior synonyms or homonyms) in lists, catalogues, logonymies, etc.; (3) in contrast, *eneonyms** ("mute nomina") have been completely forgotten, i.e., never listed as available (these are the only true *nomina oblita*); (4) finally, *diaphonyms** ("discordant nomina") have been used by part of the authors, but alternatively to other diaphonyms, to designate the same taxon. This last category contains two subcategories, the distinction of which is important: *stenodiaphonyms** have been used only in the specialized literature of systematics, whereas *eurydiaphonyms** have been used also in the non-specialized literature. The latter subcategory can be further subdivided into *paneurydiaphonyms**, i.e., diaphonyms that are the only ones to have been used for their taxa in the non-systematic literature, and *schizeurydiaphonyms**, that have been used alternatively among them in this literature. These categories are defined in an objective way and allow to distinguish on one hand *sozonyms** ("nomina to be conserved, protected"), which cover symphonyms and paneurydiaphonyms, and on the other hand *distagmonyms* ("doubtful nomina"), which include the nomina of all other categories of usage. The latter are invalidated through the *sozonym validation*, either *permanently* in the case of *eudistagmonyms***, or *conditionally* in the case of *astatodistagmonyms*** (e.g., nomina invalidated in case of doxisonymy, but which may become valid again if the doxisonymy is refuted).

The unclear formula "nomenclatural stability" makes sense only for sozonyms, i.e., genuinely well-known nomina, having had a documented widespread use in non-specialized publications, in various languages, from various authors in various countries, to designate taxa traditionally recognized in the general scientific and non-scientific literature and in society as a whole, i.e., outside the narrow community of taxonomists, phylogeneticists and systematists. Just open any dictionary in any language and you will find the nomen *Archaeopteryx*: it would be plainly irrelevant to replace this nomen by a senior synonym, should one be suddenly "discovered". It is legitimate to consider that the Rules should be suspended in order to validate a sozonym against a completely unknown distagmonym. The *Code* must allow an automatic and straightforward distinction between sozonyms and distagmonyms, and then it must provide Rules for an automatic, easy and permanent validation of the former, but not of the latter. But these Rules must be strict, reserving these exceptions to real sozonyms, and forbidding the "protection" of some nomina by laziness, personal comfort and taste, or "lobby" pressure.

Such a process would solve the contradiction between the need to protect some nomina of real important usage and to have stringent Rules, relying on onymophoronts kept in permanent collections, for the

identification of the valid nomina of most taxa. It would allow a much needed return to respect for the basic Rules of the *Code* in taxonomic publications.

The "Principle of Usage", as it currently appears in the *Code*, is a threat against the universality of the latter. In the long run, what is at stake is to replace a universal nomenclature by one controlled by a few groups of taxonomists through "lobbies" and "polls". But this "revolution" has not yet ben carried to its term, this is why above I mentioned a *partial* change of paradigm. The current situation will not last for ever, however. No juridical system can function for a long time on the basis of two "fundamental Principles" contradictory and incompatible, between which no clear hierarchy exists (Melville 1958: 1249; Hołynski 1994: 12; Dubois 2010*d*). Clear pre-eminence will have to be given to one of them in the *Code*. For all the reasons given above this should clearly be Priority.

The Principles of validity

The *Code* dedicates two Principles to nomenclatural validity: the *Principle of Priority* and the *Principle of Homonymy*. In fact, the first of them is a general one whereas the second one is just subordinate to the first one, as Priority applies both to synonyms and homonyms, as well as to all other nomenclatural acts implying a First-Reviser action, whether dealing with spellings or with subsequent onomatophore fixation. Although homonymy is defined in a Principle of the *Code*, synonymy is not so defined, although it also deserves to be. Finally, no Principle expressly deals with "prevailing usage", although such a Principle is implicitly in force in the last edition of this book.

To clarify this situation and to take into account the discussions presented above, I propose to recognize four Principles regarding the validity of nomina: the *Principle of Synonymy*° and the *Principle of Homonymy*°, which provide parallel statements regarding the unacceptability of these two sources of ambiguity and confusion in zoological nomenclature; and the *Principle of Priority*° and the *Principle of Sozonymy*°, which provide solutions to these problems. Precise formulations of these four Principles are presented in Appendix 2. Parts of the questions mentioned in Art. 23 on the Principle of Priority of the *Code*, relating to nomenclatural acts, are here removed from this Principle, as they appear already under the Principle of First-Reviser. As proposed in Appendix 2, a distinction is made between the use of the concept of priority of publication for stabilizing the solution of an *ambiguity* that stems from the creation of a nomen or nomina published at the same date (Principle of First-Reviser), and its use for solving an *a posteriori* problem resulting from the competition between two or more nomina published at different dates (Principle of Priority).

Correctness

A particular aspect of the validity of a nomen in the frame of a given ergotaxonomy is its being correctly spelt, used at the proper rank and in the proper onymorph. The concept of nomen *correctness* applies to these aspects of the use of a nomen, designated as its *paronyms*. Correctness is distinct from validity as a nomen can be valid but used in an *incorrect** paronym. One could formally consider correctness as a stage of the nomenclatural process distinct from validity, but this would just complicate the understanding of the main lines of this process. However, any nomen used at a given rank in a given ergotaxonomy can have only one correct paronym (its *eunym**). If it is recognized as valid in this ergotaxonomy (*kyronym**) and used, it is an *ergonym**. Any ergotaxonomy used by any author should include only ergonyms.

Nomenclatural validity and correctness: synthesis

The relationships between all kinds of nomina regarding validity and correctness are shown in Figure 5 (Appendix 3), and Appendix 1 explicits the use of these terms.

Fourth possible stage of the *Code*: nomen registration

This question was discussed recently elsewhere (Dubois 2010*b*) and does not need further development here. The proposal to recognize nomen *registration* as a fourth stage of the nomenclatural process was made as an alternative to that of the ICZN to allow online registration of new nomina as a possible pathway for making a new nomen *available*, a very questionable idea indeed (Dubois 2007*d*, 2008*a*,*f*, 2010*b*; Carlos & Voisin, 2009; Welter-Schultes *et al.* 2009; Löbl 2009; Michel *et al.* 2010). Under the proposal supported here, nomenclatural availability of nomina and nomenclatural acts remain attached to paper publication, but their registration constitutes a fourth step in the nomenclatural process, independent from availability, taxonomic allocation and validity of nomina. Registered nomina (*delonyms***) and acts are protected from oblivion and cannot become distagmonyms and be rejected in order to protect a sozonym. It is still too early to know whether or not the ICZN will consider and possibly adopt this proposal, but one of the main advantages of the latter is that it does not require any change in the Rules dealing with the other three stages of the nomenclatural process, except for the possible rejection of unregistered nomina to protect sozonyms. Appendix 2 proposes a *Principle of Registration*° that could be implemented into the *Code* in case this proposal would be accepted.

Registration would not be limited to new nomina. *Once the latter are registered*, it could also cover their onomatophores (*delophoronts*** and *delonucleonomina***), spellings (*delographs***), ranks (*delohypses***) and onymorphs (*delonymorphs***). These pieces of information should be provided with their references, first-users and dates, which may be different from those of the nomen itself (in the cases of subsequent onymophoront designations or of a subsequent spellings, ranks or onymorphs). The first point is of particular importance, especially for species-series nomina. Not rarely, authors announce in publications that *they will* deposit onymophoronts in permanent collection but *fail to do it* later on. In order to avoid this problem, Erna Aescht (personal communication) suggested that registration of onymophoronts (delophoronts) should not be allowed by the authors of publications themselves, but only by the curators of the relevant permanent collections, once they have received the specimen(s) and duly entered it/them in the collection.

Figure 6 (Appendix 3) shows in a synthetic way the whole nomenclatural process described above, including the stage of registration if it was implemented as a distinct nomenclatural act in the *Code*.

Higher-ranked and lower-ranked taxa nomenclatures

The recent decades have been marked by unprecedented developments of taxonomic thinking and methods. Such novelties include the multiplication of cladistic analyses, particularly following the improvement and generalisation of the techniques of nucleic acid sequencing. Hypotheses about cladistic relationships are now available for many zoological groups and at all levels. They result in an important increase in the number of identified or hypothesized “clades” and phylogenetic nodes at all levels, that can be the basis for the recognition of formal taxa. However, when it comes to naming these taxa, the current *Code* has limitations which do not allow it to play properly its role at all levels of the nomenclatural hierarchy. This may be a motivation for some zootaxonomists to shift from the *Code* to another system devoid of these limitations. Beside other minor ones, I identify two main related problems in the current *Code* that should in my opinion be solved by modifications of its Rules.

These problems stem from the simple fact that the *Code* currently only regulates the nomina of zoological taxa from the rank superfamily to the rank subspecies. This is different from the botanical Code, which regulates nomina at all ranks (McNeill *et al.* 2006). In zoology, the nomina of higher taxa (orders, classes, reigns, etc.) are not covered by the *Code*, being left to the "freedom" of individual zoologists. At the other end of the taxonomic hierarchy, this *Code* further "forbids" to formally recognize taxa below the rank subspecies. Besides, the *Code* only allows the use of a limited number of nomenclatural ranks within the nominal-series that it recognizes. In other words, the *Code* imposes normative constraints regarding the number and respective hierarchical relations between taxa. These two latter limitations have no theoretical or practical justification. They are contradictory with the basic statement of the *Preamble* of the *Code* (Anonymous 1999: 2) that no provisions and recommendations of this text restricts the freedom of taxonomic thought or actions, reformulated here as the Principle of Nomenclatural Independence. These limitations are not acceptable. The *Code*'s coverage should without any doubt be expanded above and below the ranks currently covered, to address the whole nomenclatural hierarchy in zootaxonomy, allowing recognition of as many ranks as necessary to express in all their details the hypothesized relationships between organisms and taxa. Deciding to recognize a rank or not in a classification is a scientific decision that depends on taxonomy, and the *Code* does not have to infringe upon it.

Nomenclatural ranks and taxonomic categories

As we have seen, some recent authors claimed that ranks should be abandoned as they are subjective and arbitrary. This criticism applies in fact to a particular usage of ranks, as *absolute ranks* or *categorical ranks*. Under this usage, ranks are believed to have a taxonomic meaning by themselves, so that it could be possible to state that a given taxon "is" a genus, a family, an order or a class. However, it has been known for long (e.g., Schaefer 1976; Dubois 1988) that no universal *criteria of equivalence* exists that would allow "defining" taxa at all ranks. A few criteria could be considered, but they are either limited in use, like the criterion of hybridizability at genus level (see Dubois 1988, 2004*b*), or likely to raise considerable problems if they had to be implemented over the whole animal kingdom, like the criterion of genealogical age of the taxa (see Dubois 2008*g*: 57).

But this is not a real problem, as very few taxonomists nowadays (except the apologists of "*unranked nomenclature*") still believe in absolute or categorical ranks, and most of them only use *relative ranks*. Ranks in this usage just provide information on the hierarchical structure of the taxonomy adopted, i.e., nowadays, usually on the phylogenetic tree used to build this taxonomy, and in particular on sister-taxa and subordination relationships—a very useful function of ranks indeed. This idea is by no means new, as shown by the following quote, among many other possible ones: "*In any Linnaean classification, the taxa are arranged in a nested hierarchy of progressively more inclusive ranks or categories. In cladistic classification, the pattern of cladistic relationships, usually taken to hypothesize genealogy, is the basis for ranking. The clades are recognized as taxa and their rank is determined by their position. More inclusive groups are ranked at higher category levels than less inclusive groups. In its simplest form, a cladistic classification places all sister taxa at the same rank. This is totally unambiguous; the classification exactly expresses the genealogy*." (Raikow 1985: 195).

This long-lasting confusion may be removed by distinguishing *taxonomic categories* from *nomenclatural ranks* (Dubois 2007*a*, 2008*g*). Whereas the former designate taxonomic concepts such as "biological species concept", "phylogenetic species concept", "superspecies", "syngameon" or "klepton", the latter express only the relative positions of taxa in a phylogenetic tree or any hierarchical taxonomy (for more details, see Dubois 2007*a*, 2008*e*,*g*, 2009*c*). This important distinction should be mentioned in the *Code* and in its "Glossary".

Higher-ranked taxa nomenclature

The need of Rules for higher-ranked taxa nomenclature

In zoology, the current *Code* does not provide nomenclatural Rules for the allocation and validation of *nomina* to taxa above the rank superfamily, i.e. belonging to the *class-series* of nomina (Dubois 2000*b*). This is a source of potential confusion, and possibly of progressive nomenclatural chaos and difficulties in communication between scientists, at the time when many new higher taxa are regularly recognized to account for some of the "clades" which are disclosed by the recent, mostly molecular, cladistic studies. As there are no Rules for the naming of these taxa, each author is left free to follow his/her personal views in this respect. Many authors therefore feel entitled to just coin new nomina as soon as they recognize new hypothesized clades as taxa, without caring for the older nomina that are often already available for the same or only slightly different taxa, or on the contrary to "redefine" older nomina to apply them to taxa slightly or widely different from the original ones. As such practices are not based on any set of formal *Rules* but only on personal *interpretations*, *opinions* or *tastes* of individual zoologists, sometimes supported by a "principle of authority", they are bound to result in very labile nomenclatures and in rather futile, and sometimes "surrealist", debates among supporters of different nomina (e.g., Laurin & Anderson 2004; Martin & Benton 2008; Brochu *et al.* 2009). It is more than time to see this situation end. Just like the useless or sometimes deleterious discussions about which "usage" should be considered "more abundant" or "better", discussions about the "best" nomina for higher-ranked taxa are a waste of time and energy for taxonomists and evolutionary biologists. This is all the more justified and possible as many higher taxa nomina are already available in zoological nomenclature that can be used to name the taxa suggested by recent phylogenetic analyses. For this reason, "*new names should be coined with great reluctance, relying whenever possible on existing terms*" (Asher & Helgen 2010: 7). But for this to be possible in an objective and automatic manner, without opening possible endless discussions, Rules are necessary.

The absence of nomenclatural Rules for these taxa results in a strong ambiguity in the use of existing nomina, in an unnecessary multiplication of new nomina, and in the frequent impossibility to follow the fate of a given nomen in different taxonomies. This chaotic situation strongly reminds that which was prevailing two centuries ago, at the beginnings of taxonomy, for lower-ranked taxa, when no Rules for allocation of nomina to taxa and for validation of nomina were in force. Each author then felt free to create his/her own nomina (often claiming that they were "more appropriate") for already named taxa, or to modify the use of existing nomina. This chaos was greatly reduced, if not completely suppressed, by the introduction of three key concepts in zoological nomenclature: (1) the concept of onomatophore, which allows unambiguous allocation by ostension of a nomen to a taxon or several taxa in any given ergotaxonomy, and avoids the problems posed by intensional definitions of nomina; (2) the concept of coordinated nominal-series, which allows the same nomen to apply to several taxa directly connected by a hierarchical relation; (3) and the concept of priority of publication, which allows automatic identification of the valid nomen of a taxon whenever several synonyms or homonyms exist.

Expanding the zoological *Code* in order for the latter to cover the nomina of higher taxa (orders, classes, etc.) is a very urgent need. New Rules must be devised relying on the same theoretical framework as the current *Code*, in order to be compatible with its Principles and to be incorporated into it. These Rules should be theory-free regarding taxonomy, and should work automatically, without having to rely on a board or committee for allocation and validation of nomina. However, after 250 years of unregulated nomenclature for higher-ranked taxa, it would be fully inappropriate to devise Rules that would result in changing many universally or very widely accepted nomina for such taxa, and conserving these latter nomina should be the first preoccupation. The new Rules should provide provisions for respecting the tradition of usage for nomina widely used outside the small community of taxonomists, phylogeneticists and evolutionary biologists. This should not impede from implementing clear and stringent Rules for all other "less consensual" nomina that are ignored by most non-specialists.

The ambiostensional nomenclatural system

All these conditions are met by a recently proposed system (Dubois 2004*a*, 2005*b–d*, 2006*a*,*c*, 2007*a*, 2008*g*, 2009*b*) in which: (1) the status of any nomen relies on a Principle of Nomenclatural Foundation (i.e., this status is determined by information provided in the original publication where the nomen is first proposed, not in subsequent publications, except in very rare cases which require a first-reviser action); (2) allocation of nomina to taxa relies on onomatophores, not on intensional definitions; (3) a Principle of Synonymy (i.e., one should not create a new nomen for a taxon that has already received one) and a Principle of Homonymy (i.e., a higher taxon should not be given the same nomen as an earlier named one) are respected, and validity of nomina is primarily based on priority; (4) but special protection must be given to sozonyms, i.e., nomina that have been widely used, especially outside the specialized systematic literature, for one or two centuries or more, such as **MAMMALIA**, **MOLLUSCA** or **COLEOPTERA**.

These Rules were presented in detail elweshere (Dubois 2006*a*) and it will be enough here to recall briefly the way they work, i.e., how in this system class-series nomina are (1) made available, (2) allocated to taxa and (3) validated.

As for the point (1) *availability* of class-series nomina, the detailed Rules provided by Dubois (2006*a*) allow to cope with several problems of some ancient texts that cannot be solved intuitively, in particular for nomina published in a non-latinized form (Dubois 2009*b*) and regarding the need of objective criteria to distinguish family-series and class-series nomina, a problem for which the *Code* does not provide Rules or even guidelines (Dubois & Bour 2010*b*).

Concerning (2) *allocation* of nomina to taxa, just like that used in the *Code*, this system does no take into account the intensional or extensional *definitions* of taxa, but inclusive ostensional allocation of nomina through *onomatophores* (included nominal genera), sometimes combined with *exclusive ostension** by *onomatostases** (excluded nominal genera, pointing to the external limits of the taxon). It requires to distinguish the *protaxon**, i.e., the taxon as defined in the publication where the nomen was created, from the *ergotaxon*, i.e., a taxon as recognized in a recent ergotaxonomy and to which this nomen may apply. Allocation of a class-series nomen to an ergotaxon simply relies on the current taxonomic allocation of *all* the genera originally included in (*conucleogenera**) and sometimes also excluded from (*alienogenera**) the protaxon for which the nomen was proposed. The *metrotaxon** is the *least inclusive* ergotaxon including all the conucleogenera of the protaxon. Two alternative situations must be distinguished: (S1) the nomen is a *metronym***[1] whenever at least one of the alienogenera of the protaxon is now included in the metrotaxon (*intragenus**): the nomen then applies to the *metrotaxon* itself, without taking the current allocation of the alienogenera into account; (S2) the nomen qualifies as an *oronym***[2] whenever all alienogenera of its protaxon are still currently excluded from the metrotaxon (*extragenera**): the nomen then applies to the *most inclusive* ergotaxon including all its conucleogenera and excluding all its alienogenera (*orotaxon**), which is often more inclusive than the metrotaxon. In such a system, the ergotaxa may well be defined phylogenetically, even if the nomina are not so: Dubois (2007*a*: Appendix) gave examples of "phylogenetic definitions" or *cladognoses** that allow unambiguous allocation by such an ostensional system of nomina to phylogenetically defined taxa.

This new system has not yet been named, and it is here proposed to call it *ambiostensional*** *nomenclatural system* (see Appendix 1). This accounts for its double or alternative way of allocating nomina to taxa. In situation (S1) above, the nomen is allocated to the taxon by a simple system of *inclusive ostension**, similar to that of the *Code* for the nomina it covers. In contrast, in situation (S2) above, the nomen is allocated to the taxon by a double system of *bidirectional ostension** (Dubois 2007*a*: 46), i.e., a combination of *inclusive* and *exclusive ostension* (Dubois 2006*c*: 25).

Oronyms and metronyms do not have the same "taxonomic quality". Oronyms are nomina which were created for taxa which still "make sense" nowadays according to our current taxonomic ideas. Their original

1. The term *metronym* is here substituted to the term *nesonym* (Dubois, 2005*b*: 80, 2006*a*: 188) to facilitate memorization, as it resembles the term *metrotaxon*, the term designating the ergotaxon to which it applies in a given ergotaxonomy.
2. The term *oronym* is here substituted to the term *choronym* (Dubois, 2005*b*: 80, 2006*a*: 188) to facilitate memorization, as it resembles the term *orotaxon*, the term designating the ergotaxon to which it applies in a given ergotaxonomy.

inclusion and exclusion are still "homogeneous" by our current standards. In contrast, metronyms are "heterogeneous" nowadays, as their original inclusion contained "intruders" in view of our current ideas. It could be considered to exclude metronyms from zoological nomenclature, and to accept only oronyms as "*potentially valid**" nomina, as is done in the Kluge's circumscriptional nomenclatural system mentioned below[3]. But this would be based upon a confusion between taxonomy and nomenclature. Rules of nomenclatural availability should be disconnected from all possible judgements on the quality of the taxonomic work in which the new nomina were produced. This is the case in the nominal-series covered by the *Code*: many ancient nomina were created for taxa that do not make sense nowadays, in the light of the progress of taxonomic thinking and research results, but the system of onomatophores allows unambiguous allocation of these nomina and they can be used now for taxa that are sometimes very different from those for which they were created. The ambiostensional system allows an automatic and unambiguous allocation of all class-series nomina to taxa as recognized in a current ergotaxonomy. Just like for nomina currently covered by the *Code*, this allocation may change with time. A nomen that was once an oronym may become a metronym, and *vice versa*. The Rules proposed above allow a straightforward allocation of all available class-series nomina to their proper synonymic list in any ergotaxonomy, whereas if only oronyms were considered, for each new ergotaxonomy some nomina, the metronyms, would be excluded from nomenclature and could not be allocated to synonymies.

Furthermore, this double system has another advantage: it allows to obtain rapidly a wider coverage of the nomenclatural hierarchy, without having to create new nomina, especially for the higher ranked taxa. Because many class-series were created in the early period of zootaxonomy, when rather few zoological genera had been named, including very few fossil ones, metronyms often correspond nowadays to little inclusive taxa, at a low hierarchical level in the class-series hierarchy (crown-taxa or slightly more inclusive taxa). In contrast, oronyms, which were generally created later, often correspond to much more inclusive taxa, at a higher hierarchical level in the class-series hierarchy (pan-taxa or slightly less inclusive taxa). Both kinds of nomina are therefore often complementary in terms of coverage of the nomenclatural hierarchy. Examples of both situations were given elsewhere concerning the **AMPHIBIA** (Dubois 2004*a*, 2006*a*, 2009*b*; Dubois & Ohler 2009; Dubois & Bour 2010*a*).

Finally, as concerns (3) *validity* of class-series nomina, this system simply follows the four Principles of validity discussed above, those of Synonymy, Homonymy, Priority and Sozonymy. An important feature of this system is that the Principle of Sozonymy allows, when necessary, to validate a sozonym being a junior homonym of a nomen which applies to a different (usually more inclusive) taxon now obsolete, thus stabilizing the use of this nomen in its traditional sense, not in its earliest one. This allows a parsimonious solution to a frequent problem when dealing with the nomina of the early days of zoology. The way this system works was also shown in detail for several nomina of **AMPHIBIA** (Dubois 2004*a*, 2006*a*, 2009*b*; Dubois & Ohler 2009; Dubois & Bour 2010*a*).

These Rules are simple, automatic and do not allow any room for "opinion", personal preferences, discussion and debate. They are therefore appropriate for an automatic, unambiguous and universal naming of higher taxa. This is the kind of Rules taxonomists need at our time of intense taxonomic and phylogenetic research, with frequent taxonomic changes and recognition of new, or newly defined, taxa.

Although these Rules may appear complex at first reading, they are in fact of very simple use, as they only require to list the nominal genera included in and excluded from the protaxon at the creation of the nomen, and to ascertain the allocation of these genera in the ergotaxonomy chosen. A detailed illustration of the way these Rules work was given (Dubois & Ohler 2009) in a rather complex case, that of the nomina of higher taxa of **AMPHIBIA** (as now understood) created in the works of Merrem (1820) and Ritgen (1828).

Although it is not intellectually complex, the process allowing to acertain the proper allocation of a class-series nomen to a taxon is time-consuming and requires continuous care and attention. It may well be considered "heavy" by some zootaxonomists, especially in our times when everything must be made "quickly". As explained by Dubois (2006*a*), implementation of an online database including all class-series

3. Another possibility would be to allocate metronyms to "crown-taxa" as defined by Meier & Richter (1992) and oronyms to their "pan-taxa", but this would require to link nomenclature with a taxonomic paradigm, a practice which is not supported here as it is theory-bound regarding nomenclature.

nomina available in zoology with the complete list of their included and excluded nominal genera, coupled with a software allowing an automatic research of the relevant nomen for a given taxon through the methodology described above, would make the use of these automatic Rules simple and easy for all zootaxonomists worldwide. Zootaxonomists indeed have other priorities nowadays (Dubois 2008*a*) than discussing at length the valid nomina of taxa, and the role of nomenclatural Rules is to facilitate the identification of such nomina by making it automatic. Until now, only preliminary work has been published in this respect (Gérard *et al.* 2006), but other works are in progress (Berkani & Dubois in preparation) and hopefully the community of zootaxonomists will find it useful to devote work and funds to the implementation of this tool for the whole of zoology.

Other systems

Few other proposals of Rules for higher taxa nomenclature have been published beside the ambiostensional one just described (see Dubois 2006*a*: 170–174), and none contains a complete set of Rules aiming at coping with all the particular situations and problems that unavoidably raise when proposing formal Rules in a domain which has functioned without Rules for 250 years. Two recently proposed systems, stated by their authors to be compatible with the *Code*, will be briefly discussed here.

A so-called *circumscriptional** nomenclatural system for higher taxa was proposed by Kluge (1999*a–c*, 2000, 2004, 2009). A detailed critical study of this nomenclatural system would be beyond the scope of this paper, so a few problems only will be outlined here. This system does not make a clear distinction between taxonomy and nomenclature, as it uses both ostensional and intensional criteria for taxonomic allocation of nomina. Its "main" mode of allocation of nomina to taxa corresponds more or less to bidirectional ostension in the system of Dubois (2006*a*), so this system only recognizes oronyms, but does not deal properly with the situation of metronyms. Although not using these terms, it relies on a combination of onomatophores and onomatostases, but whereas in the ambiostensional system the latter are nominal genera, in Kluge's system they are nominal species. This highly complicates matters regarding the allocation of many old class-series nomina to current taxa, because many early nominal genera were taxonomically heterogeneous (Dubois 2006*a*: 181–182). This problem is solved in the ambiostensional system by using nominal genera, as defined (or restricted) through their (often subsequent) nucleospecies designation. But if nominal species are used as collective onomatophore, they will often point to a very high-ranked taxon, quite different from that which the original author had in mind, simply because of the frequent presence of "intruders" among the species originally included in a genus, i.e., nominal species which do not fit with the diagnosis provided for the higher-ranked taxon in the original publication. Kluge's solution to this problem is through the "elimination" of these nominal species from the onomatophore of the class-series nomen, which amounts to using intensional criteria for the taxonomic allocation of nomina. Kluge's system does not provide Rules or guidelines for the distinction between family-series and class-series nomina, and therefore allows for example for a nomen of the class-series to be considered synonym of, or subordinate to, a nomen of the family-series, which is not compatible with the *Code*. It does not clearly distinguish nomina from spellings (e.g., it considers symprotographs as different nomina), and aponyms from junior homonyms. It allows to consider several synonymous nomina as valid to designate the same taxon, thus introducing in zoological nomenclature the possibility of accepting *allelonyms***—at the time when botanical nomenclature tends to get rid of the allelonyms it has traditionally recognized for a few plant families! Most of the problems of this system derive from its absence of strict and clear Rules for dealing with synonymy, homonymy, priority and sozonymy, and for "choosing" the valid nomen of a taxon (priority being considered "*desirable*", but often ignored). Until these problems (and a few others) are addressed, this system is not fully automatic and operational, as many subjective decisions still have to be taken at various stages of the nomenclatural process to identify the valid nomen of a taxon in an ergotaxonomy.

Another recent system (Alonso-Zarazaga 2005) proposes to expand the Rules for family-series taxa to all higher taxa. In this system, all nomina of taxa above genus would have to be based on generic nomina and to bear standard endings, and nomenclatural coordination would apply to all of them. Therefore, in this system

no care is taken for conserving sozonyms for higher taxa. This new system is completely at variance with the traditional higher zoological nomenclature. Thus, to take just three examples, following these proposals would require to replace the class nomen **AMPHIBIA**, almost universally used in the last century, by the nomen **RANIMORPHES**, the superorder nomen **BATRACHIA** by **RANIFORMAE**, and the order nomen **ANURA** by **RANIFORMES**. This is clearly not the kind of Rules we need if one of the objects of the *Code* is to promote robustness of nomina. Such a Rule has very little chance to be adopted by non-taxonomists, and it would have a disastrous effect on the perception of the *Code* outside the community of specialists. This would be particularly inappropriate, as in the meantime practitioners of the *Phylocode* intend to use the traditional Linnaean-Stricklandian nomina of higher taxa, after "conversion" to their system (Pleijel & Rouse 2003; Joyce *et al.* 2004): thus these nomina would appear "the same" although being in fact different nomina, following a widely distinct nomenclatural system. To avoid disruption and misunderstandings, it is crucial that nomina which have been in use in zoological nomenclature for one or two centuries or more, such as **AVES**, **INSECTA** or **HEMIPTERA**, be validated in the new Linnaean-Stricklandian nomenclatural system for higher taxa nomina when the latter are incorporated into the *Code*. Not doing so and "abandoning" these widely-used nomina would result in "offering" them to *Phylocode* practitioners, who would certainly appreciate this windfall. As these nomina are well-known to many non-specialists, whereas the new nomina with standard endings would be unknown to them, the *Phylocode* nomenclature would be "naturally" and "surreptitiously" adopted by the vast majority of users of nomina, who may not realize that these nomina are not "the same" as those that have been in use for centuries. The idea of replacing the traditional nomina of higher taxa by nomina with standard endings would probably be a kind of "hara-kiri" for Linnaean-Stricklandian nomenclature of higher taxa (Dubois, 2006*c*). The ICZN should address seriously this question and give full attention to the detailed proposals mentioned above, which respect the traditional use of well-known nomina.

Whereas the *Code* fails to provide Rules for the nomenclature of taxa above the rank superfamily, "phylogenetic nomenclatural systems", including the *Phylocode*, do not have such limitations, as they cover the whole nomenclatural hierarchy. It is comprehensible in such conditions that some authors (e.g., Kuntner & Agnarsson 2006) propose a compromise solution, "maintaining" the nomina of lower taxa in the *Code* and "offering" the nomina of higher taxa to the *Phylocode*. This solution is not only "bandy-legged", it is not viable in the long run. The modes of functioning of the two nomenclatural systems, and particularly of allocation of nomina to taxa, are fundamentally different and *incompatible*, as the *Code* relies on an intensional system with onomatophores and the *Phylocode* on an intensional system with "phylogenetic definitions". Their association in a unique nomenclatural system could not function harmoniously for long, and the time would come, probably quite soon, when one of the two systems would prevail. Nomenclatural ranks as used in the *Code* carry most useful information on the structure of a taxonomic hierarchy (and thus also, through the latter and following some conventions, about a phylogenetic tree), but are fully arbitrary, having by themselves no biological meaning concerning the "kind of taxon" at stake (Dubois 2007*a*, 2008*g*), so that not rarely a taxon has to shift from a rank to another, in order to allow a better expression of phylogenetic relationships in a group. But this can often be done without any change in its intensional and extensional definition. In a system based on a chimera between the *Code* and the *Phylocode*, what would occur if a nomen has to shift, e.g., from the rank superfamily to suborder, or *vice versa*? It would also have to shift from an ostensional definition based on an onomatophore to an intensional "phylogenetic" definition, or *vice versa*. This would be fully unmanageable. The proper solution to the problem of higher taxa nomenclature is not in an unholy marriage but in a widening of the domain of competence of the *Code* in order to include all taxa at all ranks.

Lower-ranked taxa nomenclature

A similar problem exists at the other end of the nomenclatural hierarchy. The *Code* should also be expanded to accept more ranks at the lowest levels, i.e., just above and below the ranks genus and species. The current *Code* allows the use of as many ranks as necessary below the rank subfamily in the family-series, but forbids

the use of more than two ranks (subgenus in the genus-series and "aggregate of species" in the species-series) below genus and above species, and two ranks (subspecies and "aggregate of subspecies") below species. This limitation has no theoretical background, does not respect the freedom of taxonomic thoughts or actions, and is harmful to zoological taxonomy in two respects at least (Dubois 2006*b*,*d*, 2007*c*): (1) it does not allow to express in detail hypothesized cladistic relationships among taxa at lower taxonomic levels; (2) it does not allow to point to low-level differentiation between populations of the same species, although this would be useful in some cases, in particular for phylogeographic studies of historical relationships between populations and for conservation biology purposes. This last situation is particularly inappropriate, as it forbids to name infrasubspecific entities which may deserve peculiar measures of protection. In order to include such entities into laws and regulations dealing with the destruction, management, exploitation and commerce of animals or animal populations, these entities must be designated by "official" Latin nomina, and the non-recognition by the *Code* of such nomina forbids doing so. The situation is quite different in botany, where it is possible to name varieties, forms and additional lower taxa while following the Code, and consequently to include these taxa in lists of protected taxa, in decrees concerning the habitats, etc.

The *Code* should allow use by taxonomists of an undeterminate number of ranks in all nominal-series, which could be done simply by modifying the wordings of Articles 35.1, 42.1 and 45.1 which put unwarranted restrictions in this respect. Here also, if the *Code* does not evolve to allow for such possibilities, it will appear to some as inferior in practice to alternative nomenclatural systems which allow a multiplication of hierarchically related taxa, as was already exemplified in a few recent works (e.g., Hillis *et al.* 2001; Hillis & Wilcox 2005; Vieites *et al.* 2007) which are not *Code*-compliant (Dubois 2006*b*,*d*, 2007*c*, 2008*g*).

Removing all restrictions in the number of ranks that can be recognized in zoological nomenclature is not enough in lower nomenclature. More details are needed to regulate the nomenclature at ranks like variety and form. Today, the situation is not yet ripe to propose more detailed Rules concerning *circumspecific*** nomenclature (just above and below the ranks species and subspecies).

Possibly in part to cope with the deficiency of the *Code* in the nomenclature of lower-ranked taxa, in the recent decades conservation biologists developed the use or special-purpose categories such as "*evolutionary significant units*" or "*management units*" (Ryder 1986; Moritz 1994; Fraser & Bernetchez 2001). Although some of these categories correspond in some cases to taxonomic species or subspecies, this is not always the case. Such categories can have a practical utility in conservation biology and should not be discouraged simply because of a rigid taxonomic attitude. Whether or not taxonomists and conservation biologists will find it useful, especially for biodiversity conservation purposes, to use more ranks than one below the rank species in zoological nomenclature is not a nomenclatural problem *per se*. This question is not yet satisfactorily solved and should be so through careful discussions among taxonomists and with other biologists. But the *Code* should not put a *technical* limitation on these discussions, by *a priori* prohibiting the use of additional ranks. Both taxonomy and conservation biology of animals would probably benefit from the nomenclatural recognition of many more infrasubgeneric ranks than is currently possible under the *Code*.

Although such a move would probably have been premature a few decades ago, when infrasubspecific taxa were proposed by some authors mostly on the basis of rare mutations, local micro-variation or populational short-term selection, recent progresses in low-level molecular analysis and phylogeography are modifying the situation, and this should be acknowledged by an evolution of the Rules of the *Code*. This will require a detailed exploration and comparison of two different solutions to this question.

The first one would be to expand significantly the number of ranks in the species-series, incorporating ranks like variety and form, recognized by the botanical Code. In this case, the Principle of Coordination would apply to all these nomina. One question should then be addressed carefully: what would be the status of nomina published for taxa at such infrasubspecific ranks in the early decades of zootaxonomy, before implementation of the *Règles*? Such nomina, created as *quadrinomina** or even *quinquenomina**, are currently unavailable under the *Code*, being sometimes designated, e.g. in logonymic lists, as *nomina illegitima*. If they were given retroactive availability, this would no doubt cause problems regarding some more recent nomina created at higher ranks and that have been considered valid for decades or centuries. Because of such problems, introduction of retroactive changes in the *Code* should always be done with great

care (Dubois 2010*c*), and in this case it would probably be better to deny retroactivity to the new Rule and to allow availability of such nomina only after its publication.

The second, more drastic, possibility, advocated by Dubois (2006*a–b*), would be to introduce in the *Code* a fifth nominal-series, the variety-series. In such a case, nomina in this nominal-series would not be connected to those of the species-series by nomenclatural coordination, and thus would not compete with them for synonymy and homonymy. Therefore, there would be no problem in granting retroactive availability to such nomina published in the past (some of which had even been regularly used for a while). But then, precise and formal new Rules would have to be devised and published for the management of these nomina, as was done for the nomina of the class-series (Dubois 2006*a*).

Pending a careful comparison of the two possibilities, choice between them and the writing of Rules for this lower nomenclature, no change is proposed here in the *Code* except for the suppression of all restrictions currently in force in Articles 35.1, 42.1 and 45.1 concerning the number of ranks acceptable in the three nominal-series of the *Code*.

A cornucopia of "details"

Beside the main questions that we examined above, many other points of the *Code* require modifications or improvement, sometimes concerning only minor points of writing, sometimes more important aspects. This is stressed by the many mistakes that are regularly made by many taxonomists as a result of bad interpretations of the *Code*, which require time-consuming and sometimes complex discussions to correct them (see a list of examples in Dubois 2003). Some only of these points will be discussed below, and some only briefly mentioned as they were developed elsewhere. These examples will show that, despite the lot of work that has been devoted to this text over more than one century, some unclarities, ambiguities and confusions remain, and that the *Code* still requires a very careful critical survey. We will consider the cases below successively according to the three stages of the nomenclatural process.

Availability

Diagnoses and cladognoses

As we have seen, nomenclatural availability of a nomen requires that a description, "definition" or diagnosis of the taxon for which this nomen is proposed be provided. This characterisation must be borne directly by *characters* observed on the specimens referred to this taxon, not indirectly by inferences (e.g., phylogenetic) based on these characters. The *Code* expressly excludes the possibility to provide nomenclatural availability to a nomen by giving a "phylogenetic definition" of the taxon to which it applies that would not be based on characters but on (hypothesized) relationships. A nomen published with only such a "definition" is nomenclaturally unavailable (Dubois 1999*b*, 2006*d*, 2007*c*).

The same ideas can be expressed using more precise technical terms. Taxonomy can use different categories of "diagnoses" or "definitions" of taxa, or *taxognoses** (Dubois & Raffaëlli 2009: 15–17). Among them, only those based on characters can be used on purpose of making a nomen nomenclaturally available under the *Code*. They may be *diagnoses* s. str., based on character states considered differential for the taxon, *idiognoses**, based both on character states shared with other taxa and character states differential for the taxon, or *apognoses** (or "apomorphy-based definitions", de Queiroz & Gauthier 1990), based on character states considered to be autapomorphic for the taxon. On the other hand, *cladognoses* that do not mention characters, i.e., taxognoses associated with a cladistic hypothesis but that only mention taxa and hypothesized cladistic hypotheses, are not sufficient alone for making a nomen nomenclaturally available under the *Code*, and nomina so published are "non-existent" in zoological nomenclature. As some recent authors have shown

difficulties understanding this (e.g., Emerson & Ward 1998, Hillis & Wilcox 2005, Hillis 2006), this should be stated in full words in the *Code*.

Nomina and spellings

A taxonomy of nomina and spellings

The complex problems posed by the distinction between the different kinds of spellings, either original or subsequent, that a nomen can take in the taxonomic literature (its *parographs**) were discussed in details elsewhere (Dubois 1987*b*, 2010*c*). A "taxonomy" of the different kinds of nomina and spellings that exist in zootaxonomy, and a "dichotomic key" to all these situations were provided. The *Code* would gain much in clarity and usefulness, especially for debutant taxonomists, in incorporating part at least of these clarifications and distinctions. Besides, Dubois (2010*c*) explained in detail why some of the Rules dealing with these matters, especially several of them introduced in the *Code* with a retroactive effect, are source of confusions and even in some cases of real nomenclatural problems, and should be deleted or modified. Care should be taken to consider these points when a revision of the *Code* is made.

Structure and length of nomina

According to the Principle of Nomenclatural Foundation, the status of a nomen, including its spelling, is fixed once and for all in the original publication where this nomen is first published. This is a very sound provision of the *Code*, as otherwise there might be no limits to the changes that could be brought to nomina for various reasons of etymology, harmony, euphony, tradition, etc. Such a multiplication of variant spellings for the same nomen was indeed very frequent at the beginnings of zoological taxonomy, before the *Règles* were implemented. The exceptions to this Principle regarding spelling are very few, including first-reviser actions as discussed above, as well as a few mandatory changes in spelling (for agreement in grammatical gender of an epithet with the generic nomen with which it is combined, or for mandatory endings of some family-series nomina). Even in such cases, the possibilities of change are very limited: for example, contrary to what some zoologists believe, it is not possible to change an original spelling because of "*incorrect latinisation*" (for details, see Dubois 2007*b*). The requirements imposed by the *Code* on a new nomen are essentially limited to the need to count more than one letter and to be a single word. In almost all cases, a new nomen must be accepted as it stands in the original publication. If its etymology is unknown, unclear or incorrect, the nomen can nevertheless be considered an "*arbitrary combination of letters*" (Art. 11.3) which cannot be modified. This situation has some consequences which have not always been drawn by taxonomists.

Ng (1994), Dubois & Raffaëlli (2009) and Dubois (2010*g*) provided comments on the structure and length of nomina and suggested that, rather than using complex etymologies, taxonomists should pay more care to the need for short and euphonious nomina. Nomina are communication tools between zoologists and between them and others, and there is no advantage in coining long, unpalatable and repulsive nomina. A few years ago, I heard that a number of "amateur batrachologists" and pet-keepers refused to use a new generic nomen proposed for a genus of salamanders for its being much too long, so they decided to maintain the animals at stake in their previous genus, although it had been shown to be paraphyletic! I am not sure this example is an isolated one in zoology.

Once created, and apart for the rare exceptions mentioned above, a new nomen will have to remain unchanged in all the subsequent literature. If it concerns a well-known species, for example a species frequently used as material in experimental research, or a species of medical, veterinary, agronomical or other commercial importance, its nomen may later be quoted in hundreds, thousands or millions of scientific publications. If the nomen is not well chosen, its use may be viewed as a nuisance by readers and users of these texts. Appendix B of the *Code* recommands to create "*euphonious and easily memorable*" nomina, but

this is only a Recommendation, that has no binding strength on taxonomists. Furthermore, many zoologists think that they are the "owners" of the nomina they create, and they will speak of them as of "their" nomina. They would be very shocked if some colleagues dared to criticize the nomina they created, considering that this is not "their affair". As a matter of fact, although privately many zoologists may criticize the nomina created by some colleagues, they will seldom dare to write it in publications, and when they happen to do so, the original authors will usually complain bitterly (e.g., Hillis & Wilcox 2005; Dubois 2006*d*, 2007*c*; Hillis 2006).

This respect for the "right of a taxonomist to do anything when creating a nomen" is excessive, and Ng's (1994: 511) wise comments on the need to be more careful when creating nomina should be backed: "*Zoologists and the* Code *have almost no defence against species (or genus) names which are tediously long, unpronounceable, atrocious, stupid or grammatically incorrect;* (…). *Taxonomists must feel that their responsibility is to provide tools or devices (which is what names are) which are as easy to use as possible*". Ng (1994) further pointed to a case where the ICZN was led to invalidate some nomina, counting up to 14 syllables and 29 letters (e.g., *Siemienkiewicziechinogammarus* Dybowski, 1926), for being a potential cause of "*greater confusion than uniformity*" (Anonymous 1929: 1)—an unclear formulation itself. (What does "*uniformity*" mean in this context? Why not state clearly that this nomen was "*atrocious*"?). But, of course, such a procedure can only be exceptional, as it is not possible to apply to the ICZN for the invalidation of every ill-formed, unpalatable or excessively long nomen.

Long nomina occupy a uselessly large place in a line or in a table's column in any printed document and should preferably be avoided. Two quantitative criteria can be used to estimate the length and "pronounceability", i.e. the "palatability", of nomina: the number of syllables (that have to be pronounced separately in Latin) and the number of letters. Dubois (2010*g*) carried out a survey of 924 specific and 230 generic amphibian nomina published in various years from 1758 to 2008. In this sample, the number of letters of specific epithets varied from 3 to 18, with a mean of 8.94 ± 2.61, a mode of 8 and a median of 9. The 230 generic substantives surveyed covered the same range of variation in number of letters (3–18), but they tended to be longer than specific epithets, with a mean of 10.62 ± 2.80, a mode and a median of 10.

We certainly do not need in zoological nomenclature specific nomina like *thoracotuberculatus* (19 letters, 8 syllables), *acanthidiocephalum* (18 letters, 8 syllables), *christianbergmanni* (18 letters, 6 syllables), *caeruleomaculatus* (17 letters, 9 syllables) or *tchabalmbaboensis* (17 letters, 6 syllables), generic nomina like *Amphignathodontoides* (20 letters, 8 syllables), *Saevesoederberghia* (18 letters, 9 syllables), *Palaeosalamandrina* (18 letters, 9 syllables), *Pseudotyphlonectes* (18 letters, 7 syllables) or *Cryptobranchichnus* (18 letters, 5 syllables), familial nomina like *PSEUDOPHLEGETHONTIIDAE* (22 letters, 10 syllables) or *CALYPTOCEPHALELLIDAE* (20 letters, 9 syllables), or higher taxa nomina like **HYDATINOSALAMANDROIDEI** (22 letters, 11 syllables) or **PALAEOBATRACHOMORPHA** (20 letters, 9 syllables). Although such nomina are indeed a very small minority among the many available nomina of zoology, they tend to become more and more common, at least in some taxonomic groups (see Dubois & Raffaëlli 2009). This trend more resembles a "fashion" than a need, as the possibilities to coin much shorter nomina remain very numerous without risk of creating junior homonyms, as shown by the thousands of new generic nomina with two, three or four syllables and less than ten letters that were created in zoology in the recent decades. This "fashion" is not justified and does not render service to the discipline of taxonomy.

For a species widely used in experimental research and whose nomen will appear in thousands of publications, it is much better to have a short and euphonious nomen like *Mus musculus* than *Caenorhabditis elegans*, the substantive of which no one knows how to spell. Particular care should be taken not to coin long and unpalatable nomina in two situations: (1) when a taxon is "exceptional" or "extraordinary" in some respect, and thus likely to become famous and to be quoted hundreds of times in textbooks, in non-specialized literature, on the web and in various other media; in this respect, a nomen like *Karsenia* (8 letters, 4 syllables) is certainly preferable to *Nasikabatrachus* (15 letters, 6 syllables); (2) in the case of genera, whenever their nomen is from the start, or is likely to become later, the root of a family-series nomen, which will require to add three to five letters to it (*–INI*, *–IDAE*, *–OIDEA*, etc.); in this regard, a nomen like *Paa* (3 letters, 2 syllables; basis of *PAINI*, 5 letters, 3 syllables) is certainly preferable again to *Nasikabatrachus* (basis of *NASIKABATRACHIDAE*, 17 letters, 8 syllables).

As suggested by the examples above, the domain in which the tendency to coin long unpalatable nomina is the strongest is probably the class-series nomenclature. This supports the interpretation that the risk of homonymy is not responsible for this trend, as this nominal-series is the one which includes the lowest number of nomina and where homonymy is the easiest to avoid (this is even more true in species-series nomenclature, as homonymy here is restricted to the usually low number of specific nomina that are or were referred to the same nominal genus). One might wonder if, for a number of taxonomists, long nomina, and especially nomina with complex Latin or Greek etymologies, might not look more "serious", "scholar" and "scientific" than simple nomina.

Dubois & Raffaëlli (2009) and Dubois (2010*g*) proposed a rule of thumb regarding specific and generic nomina: these should include a maximum of 8–12 letters (preferably less) arranged in 4–5 syllables, the latter being mostly composed of one or two consonant(s) and one vowel, as this is more likely to be euphonious in all or most languages. I suggest that these ideas should be incorporated into Dayrat's (2005) recommendations for integrative taxonomy mentioned above:

"*Nomina being just arbitrary labels for taxa, it is more important for them to be short, euphonious, easily pronounced in all languages and easily remembered, than etymologically complex, scholar and 'full of sense'. As far as possible, species-series epithets, genus-series and class-series substantives should count few syllables and letters, and be preferably composed of simple syllables of one consonant (sometimes two) and one vowel. For nomina of well-known taxa, likely to be mentioned in many scientific publications, generic substantives and specific epithets should be very short, preferably with two or three syllables and three to eight letters, and a maximum of five syllables and twelve letters. All other nomina should preferably not exceed four or five syllables and eight to twelve letters*."

This should probably not become a Rule of the *Code*, but it would be a useful addition to its Recommendations.

The length of nomina is in part due to the way they are coined, i.e., their etymology. The data of Dubois (2010*g*) show that the length is shorter for nomina based on patronyms and on modern terms, higher for nomina based on classic (Greek and Latin roots) and on geographical terms (name of a locality, region or country), and dramatically higher for nomina based on geographical terms combined with the ending *–ensis* (in the masculine or feminine) or *–ense* (in the neuter). This is simply because the length of the latter nomina is always increased by 4 or 5 letters, making them 8–17 letters long, with a mean of 11.60 ± 1.75 letters, in the surveyed sample. Nomina in *–ensis* are clearly unnecessary long, and they have another drawback: as they share this long ending, they often tend to resemble each other, thus being liable to cause confusions among them. This is well shown by the following 15 epithets of Chinese species of the frog genus *Xenophrys* (Megophryidae) (see Fei *et al*., 2008): *baolongensis*, *binchuanensis*, *binlingensis*, *huangshanensis*, *jingdongensis*, *kuatunensis*, *mangshanensis*, *medogensis*, *nankiangensis*, *sangzhiensis*, *shapingensis*, *shuichengensis*, *wawuensis*, *wuliangshanensis* and *wushanensis*. The same problem concerns the endings in *–cola*, *–icus*, *–ica*, *–icum*, *–ianus*, *–iana*, *–ianum*, etc.

An efficient way to reduce the length of such nomina is to avoid adding long, useless endings to their root. A specific epithet can well be coined by simply using a geographical term as it is, placed in apposition to the generic nomen, hence invariable (which furthermore avoids problems of grammatical agreement with the latter in case of transfer to another genus). Dubois & Raffaëlli (2009) suggested that this should become a Recommendation of the *Code*, and that its current Recommendation that "*An unmodified vernacular word should not be used as a scientific name*" should be deleted. This Recommendation in fact amounts to encouraging the creation of long unpalatable nomina. The recent increase in the number of specific epithets ending in *–ensis*, especially in some countries, provokes a real indigestion to people who are sensible to the aspect and length of nomina, and this should certainly change. Until now, specific nomina based on local geographical terms are rarely very short (see Dubois 2010*g*), but they can: short nomina like *Rana rara* (4 letters), *Rana diuata* (6 letters), *Aubria masako* (6 letters), *Hyperolius viridiflavus nimbae* (6 letters), *Avitabatrachus uliana* (6 letters), *Polypedates afghana* (7 letters), *Phrynopus carpish* (7 letters), *Rhacophorus laoshan* (7 letters), *Colostethus roraima* (7 letters) or *Bufo siculus* (7 letters) are based on geographic terms, and such nomina should be preferred to unpalatable ones in *–ensis* or *–ianus*. All biologists and other users of zoological nomina would certainly appreciate such a move from zootaxonomists.

The *Code* regulates the use of nomina many of which are just "Latin-like" but not genuine Latin terms. At the beginnings of zoological nomenclature, most zoologists had a good knowledge of Latin language, but this has not been the case for a long time already. The "Latin" used in the *Code* is a very special, mostly technical, language, that has very little to do with classical Latin. Latinists consider it as "dog Latin", but it may be simply qualified as "*Code* Latin" (Dubois, 2007*b*). Only a small minority of all available nomina of animal taxa are real classical Latin terms. The *Code* only requires the use of the "Latin alphabet" (in fact expanded to include the letters *j*, *k*, *w* and *y*, absent in classical Latin), and a nomen may be derived from any language (even not using an alphabet), or even "*be an arbitrary combination of letters providing this is formed to be used as a word*". The use of other languages offers an unlimited source of roots for scientific nomina that has been underexploited so far, although more and more taxonomists tend to use them. They allow in many cases to coin very short, euphonious nomina that bring new blood in the old discipline of zoological nomenclature, such as *Rhacophorus kio* (3 letters), *Leptodactylus coca* (4 letters), *Batrachoseps kawia* (5 letters), *Leptolalax kecil* (5 letters), *Colostethus wayuu* (5 letters), *Plethodon cheoah* (6 letters), *Proceratophrys cururu* (6 letters), *Telmatobius huayra* (6 letters), *Platymantis isarog* (6 letters) or *Oreophryne wapoga* (6 letters). The recourse to such odd or unusual etymologies should be strongly encouraged.

Although important, the length of nomina is not the only element of their aspect that should be taken into account. An important aspect is euphony or "pronounceability", which should discourage the publication of nomina, even very short, but that cannot be articulated in most languages, such as *Philautus crnri* (see Dubois 1999*a*).

Another strong quality for a nomen is its originality. It often allows memorization of the nomen, avoids potential confusion with other nomina, or potential homonymy in case of generic reallocation. Many taxonomists seem to lack imagination and to be prisoners of academic traditions, as testified by the plethora of species bearing nomina like *viridis*, *maculatus*, *vulgaris*, *monticola* or *sinensis*. Using either classic or modern etymologies, it is possible to coin original, poetic, suggestive nomina like *campanisona*, *cavernibardus*, *cuneirostris*, *orchymelas* or *pipilodryas*, which, although not very short, are to be encouraged as they are likely to remain associated with a unique, well identified species. Taxonomists should feel free to use their imagination and good taste to coin unprecedented nomina rather than always using the same old terms.

Scientific nomina should be an aid to communication, not a brake to it. The Recommendations of the *Code* should strongly urge taxonomists to stop coining long, unpalatable and pedant nomina, and to use short, euphonious and original nomina, as these will appear in several, many or, who knows, thousands of publications after their creation.

Nominal-complex

The *Code* should be modified in its Rules and Recommendations dealing with the way of citing the *nominal-complex** of a nomen (Dubois 2000*b*), i.e., the complex [*nomen + author + date*]: e.g., "*Drosophila melanogaster* Meigen, 1830". In its current version, the *Code* allows for citing the nomen followed by the name of its author only, without the date. As aptly explained by Ng (1994), this is based on a severe misunderstanding on the function of citing the author's name and the date in the nominal-complex.

According to the *Code*, in any scientific publication dealing with a biological taxon, the Latin nomen of the latter should be mentioned at least once, preferably under the complete form of its nominal-complex. This is to avoid all possibility of confusion or ambiguity as to the biological taxon at stake, a possibility that is not null because of the existence of homonyms, i.e., nomina having the same spelling but created for different taxa. Although the *Code* requires that one of any two homonyms (usually the most recent one) be renamed, some biologists may happen not to be aware that a taxon has been renamed, and use an invalid homonym to designate it. This is usually not problematic as long as they provide the author and date of the nomen, which allow to identify it.

Therefore, the purpose of mentioning the author's name and the date after a nomen is to help for the search of literature and information. In zoology, when using the three pieces of information of the shortened

bibliographic references given by nominal-complexes, a database, the *Zoological Record*, allows the immediate finding of the complete reference of the work where this taxon was named. This database has been published yearly since 1864, and now many online databases exist (although most of them are incomplete or partly inaccurate). For example, if an author mentions the frog's nomen *Rana microtympanum*, this information is ambiguous, because of the existence of two different homonyms (Dubois 1999*b*): *Rana microtympanum* Van Kampen, 1907 (now a member of the genus *Limnonectes* Fitzinger, 1843) and *Rana microtympanum* Boulenger, 1919 (now a member of the genus *Hildebrandtia* Nieden, 1907). With the author's name and year, it is only a matter of seconds to find the original reference of the nomen at stake in the *Zoological Record*.

A very usual practice in scientific publications, and particularly in their titles, is to designate animal taxa simply with their Latin nomina followed by the author's name, but without the date. In case of existence of homonyms, this is not very useful, barely more than just citing the Latin nomen without its author: writing "*Rana microtympanum* Boulenger" is poorly informative, as George Albert Boulenger actively published on frogs from 1879 to 1921, so that surveying all his publications would require to browse 43 volumes of the *Zoological Record*. This practice is based on a misunderstanding of the function of the presence of the author's name in the nominal-complex: "*It is not, as many detractors would have it, merely to promote the reputation of a scientist or simply an egotistical exercise. The value of knowing the author's name so as to be able to track down the original reference which describes the species is much more important than merely knowing who the person responsible for the name is*." (Ng 1994).

As a matter of fact, many taxonomists act as if the function of adding the author's name after the nomen was a way to glorify the author and to "*retain a place in posterity*" (Pillon & Chase 2006). This has had a well-known impact on the discipline of taxonomy: "*The discovery and naming of new species can* (…) *be highly competitive in some taxa, and that has led to another unfortunate situation in the taxonomic sciences. The citation of author's names after new species often becomes a 'symbol' for personal recognition and publicity. In such cases, the charges that taxonomy is no more than en egotistical exercise in self-glorification appear justified.*" (Ng 1994). Unwarranted descriptions of new taxa, purported to differ only very slightly from existing taxa, on the clear purpose to try and "immortalize" their authors, is indeed an old plague of the discipline of taxonomy, nicely and ironically termed *mihilism* by Bruun (1950) or *mihi-itch* by others (Evenhuis 2008). This is certainly an important cause for the existence of many synonyms in zootaxonomy. For this reason, Dubois (2008*c*) suggested that deletion of the author's name, but not the date, from the nominal-complex, might help in reducing the *synonymy load** of zootaxonomy, without causing any problem for the research of the original publication of any nomen, which remains easy with the date alone.

Recommendation 51A of the *Code* explains why the author and date of each nomen should be cited at least once in any publication mentioning it: "*This is especially important in distinguishing between homonyms and in identifying species-group names which are not in their original combinations*". However, as regards distinction between homonyms, citation of the date alone would play the same function as citing both the author's name and the date. As for the change of *combination**, which is currently shown by inclusion of the author's name and date in parentheses, it could be so exactly in the same manner, but just including the date in parentheses. Thus, "*Rana microtympanum* 1907" would point to the original combination, and "*Limnonectes microtympanum* (1907)" would mean that this nominal species was transferred to another genus.

Implementing such a change in the *Code* would not affect the status of nomina, but the way they are presented. Rather than modifying drastically the current Rules immediately, a first step could consist in leaving the choice to biologists to cite a nomen either naked, or followed by its authors and date, or (preferably) by its date alone. Besides, the *Code* should strongly discourage the citation of a taxon's nomen followed by its author alone, without its date. The current *Code*, not only does not forbid this, but rather would tend to encourage it, as Articles 51.1 and 51.2 deal with the citation of authors' names but not dates (which are mentioned only in their Recommendations), and 51.3 expressly states that the authors' name *can* be cited without the date ("*the date, if cited*"; see below). If the *Code* was changed in this respect, editors of periodicals and books dealing with animal taxonomy could (and should) refuse to publish papers and titles mentioning a nomen and its author without its date, a bad but common practice nowadays.

In a second step, after some years and in case of success of such a reform, the *Code* could be further modified in suppressing completely any mention of the author's name in the nominal-complex.

Dubois (2008*c*) proposed precise alternative writings for the Art. 51 of the *Code* and its Recommendations which take these suggestions into account.

Allocation

Onomatophores

Categories of onomatophores

As mentioned above, the *Code* should mention the difference between the two main categories of onomatophores, *onymophoronts* and *nucleomina*. Because the latter depend on the former for their allocation to taxa, the order of presentation of the chapters 14 to 16 in the *Code*, which is illogical, should be exactly reversed, and the same should be done for the chapters 8–10 and for the articles 29–31 of chapter 7.

Categories of symphoronts

Dubois & Ohler (1997*a–b*) distinguished three categories of symphoronts and illustrated them with examples: (1) the *primary symphoronts** of a new species-series nomen N created for a new taxon T are the specimens which had been examined, described and/or illustrated by the author A of the original description D him/herself; (2) the *secondary symphoronts** of this nomen are the specimens which had not been examined, described and/or illustrated by the author A, but by a previous author B in a earlier work W quoted in the original description D as a basis for the taxon T; (3) the *tertiary symphoronts** of this nomen are the specimens which had been examined neither by authors A and B, but by a still earlier author C, quoted by author B in the work W quoted by A in the original description D of the taxon T. The original onomatophore of this nomen is composed of all the specimens of these three categories, which are all available for lectophoront designation.

These categories of symphoronts are particularly useful when ascertaining the status of old nomina dating from the beginnings of zoology. Some taxonomists believe in error that, when a nominal species had been created with several symphoronts, and that all of them but one have subsequently been lost, the remaining specimen is *ipso facto* the lectophoront of the nominal species (or, if a few specimens are still available, that the lectophoront must be chosen among them). In some cases, this may cause nomenclatural problems, if this or these specimen(s) happen(s) to belong in a species different from that to which the nomen had traditionally been allocated, for example on the basis of the original illustration. In fact, in such cases, the *Code* does not prescribe in the least to designate the remaining specimen as lectophoront. Following such an "implicit rule" would be similar to accept designation of a nucleospecies for a nominal genus "by elimination", a mode of designation clearly declared invalid in Art. 69.4 of the *Code*.

In such cases, the choice of a lectophoront should be guided by concern about nomenclatural clarity and robustness, and it may be much better to designate a specimen now lost, but described or figured in one of the three categories of symphoronts defined above (with a preference for primary over secondary, and secondary over tertiary symphoronts, but no obligation to follow this preference). Designation of a now lost specimen as lectophoront in such cases has two major advantages: (1) it avoids the designation as lectophoront of the still extant specimen(s) that might cause a nomenclatural problem; (2) it allows to fix the *onymotope** ("type-locality") of the species to the locality of collection of the lectophoront, which in some cases may allow clarifying the status of the nomen in current ergotaxonomies. Once a lectophoront has been designated for the taxon, all the other original symphoronts have lost their "name-bearing" status and cannot be a cause of nomenclatural problems any more. The fact that the lectophoront has been lost may, in its turn, be a cause of

problems, but then, the fact that it is lost has "opened the way" to the designation of a neophoront, which was not possible as long as one or several symphoront(s) was or were still in existence. The four-step process in such cases was described in detail by Dubois & Ohler (1997*a–b*): (1) first, to designate as lectophoront one of the primary, secondary or tertiary symphoronts; (2) this results in an onymotope restriction for the nomen; (3) then, state that this specimen is now lost and why this raises nomenclatural problems; (4) then designate a neophoront, originating from the restricted onymotope. This procedure was exemplified in frogs by Dubois & Ohler (1995*a*, 1997*b*) and in fishes by Kottelat & Lim (1993) and Kottelat & Persat (2005).

Another interpretation of such cases was given by Gentry (2007). She wrote: "(...) *the references cited by Linnaeus form an integral part of his description and that material on which the descriptions and/or illustrations of the other authors was based is syntypic, whether or not it was examined by Linnaeus and whether or not it still exists. Thus, Linnaeus's own specimens, those of the earlier authors, his description and those of previous authors cited by him are all of equal status and together they form what botanists call the 'protologue'*." This statement is partly wrong. The zoological *Code* does not make use of the concept of *protologue**, according to which the status of a botanical nomen can be based upon (1) specimens, (2) illustrations as such (so-called "*iconotypes**"), (3) geographical data and (4) descriptions, diagnoses, references and comments. In the zoological *Code*, the status of a nomen depends only on specimen(s), the onymophoront(s). There are no iconotypes in zoological nomenclature, and whenever a nomen is made available through an illustration, the onomatophore is not the illustration, but the *specimen* shown in the illustration, whether still extant or not. If this specimen is now lost, the onomatophore is lost, but the illustration *per se* cannot replace it and be the onomatophore (unlike in botany). This is a very important distinction, because there can exist a "mistake" in the illustration, sometimes leading to a wrong interpretation of the nomen, but there cannot be a "mistake" in a specimen. Similarly, in zoological nomenclature, references may be part of the "indications" used to ascertain the status of the onomatophore, but they are not part of the onomatophore. The nomen does not either rest on the description, as suggested by the last part of the cited text of Gentry above: even if the description is inaccurate, the status of the nomen can be ascertained if the original publication allows to identify with certainty the onymophoront(s), and even if it/they is/are now lost or destroyed. One of the most important features of the original description is in fact the identification of the onymotope, i.e., the locality whence the original onomatophore came, and this also deserves some comments.

Onymotopes

Art. 76.1 of the *Code* defines the onymotope ("type locality") of a nominal species or subspecies as "*the geographical (and, where relevant, stratigraphical) place of capture, collection or observation of the name-bearing type; if there are syntypes and no lectotype has been designated, the type locality encompasses the localities of all of them*". Recommendation 74E further states: "*When selecting a lectotype, the author should, if possible, verify the accuracy of the locality ascribed to it. A syntype of known locality should be preferred to one of unknown origin*."

It is therefore quite clear that the onymotope of a taxon is the place of origin of its onymophoront(s), nothing else, like for example a place of common occurrence or of frequent study of the taxon. Many taxonomists, for example in checklists, catalogues or faunae, are fond of restricting the onymotopes of species and subspecies, without caring for the genuine origin of onymohoront(s). Therefore, many so-called "restrictions of type-locality", often through use of the simple formula ''*terra typica restricta*'', but without providing any evidence to support this claim, are nomenclaturally invalid for not being associated with a lectophoront or neophoront designation (Dubois & Ohler, 1995*a*: 146, 1997*a*: 312; Dubois & Raffaëlli 2009: 27).

In fact, the unclear term "*restriction of type locality*" may have two different meanings. It may mean that a species was described first on the basis of several specimens from different localities but that later a lectophoront was selected among them, thus restricting the onymotope to its collection locality. Such an "onymotope restriction" is a valid nomenclatural act. But the same formula may also mean that the original

description was based on one (or several) specimen(s) of imprecise origin (e.g., "Mexico", "Asia"). Then, two cases can be distinguished. Some external evidence may exist, such as notes on the itinerary of an expedition, museum catalogues, labels in a museum collection, etc., that allows to ascertain the collection locality more precisely than in the original publication. Such an action is also valid, but is not properly an "onymotope restriction". It should rather be called "onymotope clarification". But many of the "restrictions" made in the literature are invalid because based on arbitrary decisions and choices of localities that seemed to these authors appropriate for some more or less obscure reason. They did not rely on actual data about the place of collection of the onomyphoront(s) and are therefore nomenclaturally void.

An interesting case is when the original onymophoront(s) had no precise locality (e.g., only a country or "region") and is (are) lost or destroyed. It is then justified, not to say strongly recommended, to designate and describe a neophoront from a precise locality, that will then become the "restricted onymotope". This specimen just has to fit the original description and to come from the general area whence the taxon was described.

But in all other cases where an onymophoront still exists and where the original onymotope is imprecise and cannot be known with precision from the original publication or specimen(s), there is no way to restrict validly the onymotope and one has to accept this imprecision. There is some hope however that this situation will change in the future, with the progresses of sequencing techniques. It will probably once be possible to extract routinely DNA from old or very old specimens, even if they had been fixed with formalin. Then, it might be possible to ascertain, through analyses and comparisons based on sequencing of recent populations, the origin of these specimens. In the meanwhile, it is much better not to create possible problems for the future by publishing unwarranted onymotope restrictions based on no hard evidence. Let us stress in passing that this is an additional good reason for caring for all onymophoronts to be kept in good conditions in permanent collections and used as the only reference for the allocation of nomina to taxa. They will then play a role of *photonymophoront* as defined above.

In conclusion, the *Code* should be expanded in several articles in order to incorporate some of the comments and recommendations above.

Modes of designation of onomatophores

The *Code* is quite clear about the modes of designation of onomatophores for nominal taxa of the species-series (Art. 73–75) and of the genus-series (Art. 68–69). In both cases, it is clear that: (1) only the modes of designation listed in the *Code* are acceptable, excluding other modes sometimes referred to in error by some authors, such as designation "*by elimination*" (see above) or "*by implication*" (Dubois & Raffaëlli 2009: 22–23); (2) there is a hierarchical order of precedence for implementation of these modes of designation, so that, once one mode of designation has been used, it is irrelevant to look for others made according to a hierarchically lower mode. It is thus incorrect to mention nucleospecies designations by "*original designation and monotypy*" or "*monotypy and subsequent designation*" (see Dubois 1987*a*: 136).

Problems exist regarding the modes of designation of onomatophores in two of the nominal-series recognized by the *Code*.

(1) In the family-series, the *Code* does not mention any mode of designation of the nucleogenus, but three distinct ones exist in fact. The first one, which is the only one valid after 1999 (Art. 16.2) is *explicit nucleogenus designation***. Under the *Code* now in force, if this designation is missing, the nomen is not available. But this Rule is recent and, until 2000, many family-series nomina were created without explicit designation of their nucleogenus. In most of these cases however, the resemblance between the family-series nomen and the nomen of one of the genera included in the taxon for which it was coined allowed to identify it without ambiguity. In such cases, it is appropriate to designate this mode of designation by the phrase *implicit etymological nucleogenus designation** (Dubois 1984), a clear formula that should be mentioned in the *Code*. Cases of ambiguity are very rare, but occur when a family-series nomen is proposed for a taxon that includes two or more genera, the nomina of which have the same stem, and none of which is explicitly designated as nucleogenus. In such cases, it is necessary to clarify the situation by *subsequent designation* among the

*prenucleogenera**, i.e., all the nominal genera originally referred to the new family-series taxon. This is similar to subsequent designation of a lectophoront among symphoronts in the species-series, or of a nucleospecies among *prenucleospecies**, i.e., it is just one case of subsequent designation of a lectaptonym among synaptonyms as shown in Figure 4 (Appendix 3). Subsequent designation is also appropriate for *arhizonyms**, i.e., family-series nomina incorrectly formed, as not being based on the stem of an available genus-series nomen. Although such nomina are nomenclaturally unavailable (anoplonyms), it is useful to fix their taxonomic allocation through nucleogenus designation, in order to allow each of them to be allocated to the synonymy of a single nomen (see Dubois & Raffaëlli 2009: 28–29).

(2) In Art. 16 of the 1999 edition of the *Code*, several changes were implemented which clearly result from a decision of the ICZN to require all onomatophore designations to be explicit for availability of nomina after 1999. This is an excellent improvement of the *Code*, that will allow more clarity and unambiguity. It results in lumping the first two stages of the nomenclatural process (availability and allocation) for nomina created after 1999 (but not before, except for genus-series nomina after 1930; see Art. 13.3). However, one case was forgotten in this process. It concerns the situation where a nominal genus or subgenus was created before 1931 without prenucleospecies, i.e., as an anaptonym. In such a case, Art. 67.2.2 states that "*the nominal species that were first subsequently and expressly included in it are deemed to be the only originally included nominal species*". These nominal species, which are prenucleospecies by subsequent symphory, are the only ones among which a nucleospecies may be later designated, and such a designation must be explicit to be valid. However, in one case this designation may be "involuntary", thus making exception to the new way of fixing onomatophores in force in the *Code* since 1931 for genera and since 1999 for other taxa. This is the case of a nominal genus created without any prenucleospecies before 1931, and to which an author after 1930 refers a single nominal species. According to Art. 69.3, such a case results in a designation of nucleospecies by *subsequent monophory* and not by explicit designation as required by Art. 13.3. This was still acceptable between 1930 and 1999, but after 1999 this is really at variance with the Rules of Art. 16. It is here suggested that, if such a generic nomen is rediscovered after 1999, its nucleospecies could be fixed only by *subsequent explicit designation*, not by subsequent monophory. Such cases are rare nowadays, but still may occur, are well illustrated with the recent rediscovery by Welter-Schultes *et al.* (2008) of Garsault's (1764) work. In their treatment of the amphibian and reptile nomina in this work, Dubois & Bour (2010*a*) explicitly designated nucleospecies for the genera, without taking into account the fact that, in a few cases, Welter-Schultes & Klug (2009) had mentioned a single nominal species as belonging to this genus—while clearly stating that they *did not designate nucleospecies* in their paper. In this case, a rigid application of Art. 69.3 would result in crediting them with a designation that they had expressly stated not to do, and this would be in contradiction with the new Rules of Art. 16 of the *Code*. This problem could be solved by stating in Art. 16 that Art. 69.3 only applies until 2000, but that after 1999, to be valid, a subsequent designation of nucleospecies, for a genus created before 1931 without prenucleospecies, must be explicit.

Aporionyms

A particularly irritating problem of zoological nomenclature is that of *nomina dubia* or *aporionyms**. These are nomina which, although qualifying nomenclaturally as hoplonyms, cannot be allocated unambiguously to taxa currently recognized. Several reasons may be responsible for this uncertainty, some nomenclatural and some taxonomic. For a species-series nomen, the onamotophore may be composed of several specimens belonging to distinct taxa, among which none has yet been designated as lectophoront; the onymophoront(s) may also have been destroyed or lost, whereas the original description and/or illustration(s) does not allow identifying the species it/they belonged to; its/their onymotope (type-locality) may be unknown or imprecise; it/they may not bear characters allowing distinction between two closely related taxa or sympatric populations; etc. For a genus-series nomen, the nucleospecies may not have been designated among several species that are now referred to several distinct genera, or be itself an aporionym. For a family-series nomen, an ambiguity may similarly exist at the level of the nucleogenus. For a class-series nomen, doubt may exist regarding the status of the conucleogenera and/or alienogenera, or some of them.

Some taxonomists tend to get rid of such nomina by "sweeping them under the carpet", i.e., by simply ignoring them, even in catalogues or taxonomic revisions. This is an error. In all these cases, although the nomen cannot be properly allocated to a taxon, it exists nomenclaturally, having being validly published in conditions respecting the criteria of availability of nomina. As long as its status is dubious and as this nomen is so to speak "kept apart" from zoological nomenclature, it does not interfere with other nomina except for homonymy. But this does not mean that it disappeared from nomenclature, and whenever its status is clarified it reappears and interferes again with the other nomina regarding priority and potential validity. This can happen for example if a lost onymophoront is rediscovered or if a more careful and meticulous analysis of the original publication allows clarifying the nomenclatural allocation of the nomen even without rediscovery of the onymophoront(s) (which is not very rare).

The longest time has a nomen remained under the status of aporionym before clarification, the more this clarification risks to have disturbing effects on the stability of nomenclature. For example, if the nomen is finally discovered to be a senior synonym of another nomen in current use, either the use will have to be changed or a special action taken to invalidate the senior nomen. Such actions are time- and energy-consuming and, as we have seen, they too often open lamentable debates or polemics among taxonomists. As taxonomists surely have more important things to do, especially at the beginning of the century of extinctions, such problems should be avoided whenever possible, and the early clarification of the status of aporionyms is an efficient way to do so.

In his proposals about "integrative taxonomy", Dayrat (2005) complained much about the mere *existence* of aporionyms, and suggested guidelines to avoid *creating* aporionyms, which is good, but he failed to provide operational guidelines to deal with them once they have been created. In fact, although it is fully appropriate to avoid creating more of them, few aporionyms are created nowadays. Most of them were created in the first 150 years of zootaxonomy. Although they may be so, ancient aporionyms are not always a consequence of bad taxonomy. They may result from loss of information over time and changes in taxonomic concepts and methods. For example, for a long time variation was not considered to exist within species or to have taxonomic relevance, so it was not considered useful to rely on series of specimens to describe new species. Similarly, the recommendations meant at avoiding creating aporionyms may only be valid in the present or near future, as no one can predict what kind of data will be necessary in the further future to do good taxonomy. We may like it or not, but aporionyms do indeed exist in zoological taxonomy, and may appear again in the future. Any set of guidelines for taxonomists should propose recommendations about how to deal with them (Dubois & Ohler 1997*a*: 298–299). These should be devised in such a way as to remove the uncertainty carried by such nomina, in order to transform them into "*nomina non-dubia*" or "*nomina clara*" (Smith 1962), or more shortly *photonyms***, by attaching them to well-identified onymophoronts.

The category of aporionym (*nomen dubium*) is a heterogeneous one. All the particular cases evoked above fall in three principal categories (see Figure 4, Appendix 3): *anaptonyms*, *heterosynaptonyms* and *nyctonyms**.

In the first situation, that of *anaptonyms*, no onomatophore was originally designated for the nomen (situation of *original aphory*), the availability of the latter resting only on intensional information (description, diagnosis, etc.). This is not possible nowadays but it is acceptable in some cases in old works. In such cases, the allocation of the nomen in a current ergotaxonomy will require a subsequent designation of onomatophore. Until this is done, the nomen is an aporionym.

In the second situation, that of *synaptonyms*, several specimens (*symphoronts*) or taxomina (*prenucleospecies* or *prenucleogenera*) were referred to the taxon for which the nomen was created (situation of *original* or *subsequent symphory*). *If* they are subsequently referred to different taxa (which is not always, but rather often, the case, especially for ancient nomina), they are *heterosynaptonyms*. This results in an ambiguity for the taxonomic allocation of the nomen. This ambiguity will be solved only by the subsequent designation of a single specimen or taxomen as onomatophore of the nomen. Until this is done, the nomen is an aporionym. Such a designation is not necessary (although often practised in revisionary works, in order to avoid any possible subsequent ambiguity problem due to previously undetected taxonomic heterogeneity) in the case of homosynaptonyms. It is forbidden, under the Rules of the *Code*, among *hapantotypes*, as well as

among *conucleogenera* under the ambiostensional Rules suggested by Dubois (2005*d*, 2006*a*) for class-series nomenclature.

Finally, *monaptonyms*, i.e., nomina that rely on an unambiguous onomatophore (situation of *original* or *subsequent monophory*: a single specimen or a single taxomen), but also *homosynaptonyms* as long as they are considered taxonomically homogeneous, normally do not pose problems of allocation to zoological taxa as recognized in a given ergotaxonomy. Exceptions exist however, whenever the original specimen(s) on which the nomen or nomina rely is/are damaged, incomplete, or does/do not show relevant characters for its/their allocation to a living population (see above). A nomen in this case (*nyctonym*) cannot be applied to a taxon and is thus also an aporionym, not for being *unallocated nomenclaturally*, but for being *unidentified taxonomically*. In such cases, a technical solution may exist (e.g., the recourse to nucleic acid sequencing for taxonomic identification), but in some other cases (in particular in paleontology) it will probably remain forever impossible to identify the onymophoront. In such cases, in order for this nomen to be identified taxonomically and to become a *photonym*, an intervention of the ICZN using its *Plenary-Power* is needed to invalidate the original onymophoront and designate another one. In botanical nomenclature, the use of an *epitype* may allow to solve such problems, but this is fortunately not possible in zoological nomenclature. In view of the recent support of zome zootaxonomists to the vague concept of "usage", and of the questionable behaviours of some of them in the recent decades (see above), this is certainly better as it avoids the possibility for some authors to create nomenclatural problems by the unwarranted designation of epitypes according to their personal preferences although other solutions to the nomenclatural problem exist. Such cases are rare enough to deserve a special action of the ICZN, and this is in fact largely because of the existence of such problems that we indeed need such a Commission.

As we have seen above, a basic condition for nomenclature to function harmoniously and automatically is that the status of nomina be objectively and strictly determined by their onomatophores. But this is true only as far as the latter are a source of reliable information. Taxonomists should get rid of an attitude too respectul, not to say "fetishist", towards ancient aporionyms whenever the status of the latter cannot be objectively determined because their onomatophore is lost or incomplete, and the original description insufficient for an unambiguous allocation of the nomen to a taxon. This is all the more a problem with the most ancient aporionyms, precisely because they are particularly liable to create problems of nomenclatural priority.

The core of taxonomic research is not the works presenting isolated descriptions of new species, synonymisations or other taxonomic and nomenclatural changes. It is constituted by wide- or relatively wide-scale taxonomic and nomenclatural revisions taking into account and redefining all the available taxa of a group, preferably relying on a phylogenetic analysis and on as many specimens and characters as possible (including both morphological and non-morphological ones), and ascertaining the status of all nomina, based on re-examination of all accessible onymophoronts, of all available publications dealing with the group, etc. Such revisions, either and preferably dealing with taxonomic units (e.g., a family or a genus), or with a geographical subunit of a taxonomic unit (e.g., the taxa of a family occurring in a country or region), are usually long-term works that require important field, laboratory and bibliographic research, and the author(s) of such work(s) are often the persons in the world who are the best acquainted with the organisms at stake and with all the past research dealing with them, the relevant literature and the taxonomic and nomenclatural problems. A taxonomist who finishes an important work of taxonomic revision, of compiling a list or a catalogue or of writing a fauna, should have the elements to solve at best the problems posed by aporionyms. If he/she does not, probably nobody else will do it.

This process should be done with the greatest care for the original works where these nomina were published, but without any "religious respect" for these works. In many cases, with the published information and specimens at hand, it is impossible, and will remain impossible in the future, to ascertain which taxon was indeed in the hands of the author of the nomen. Although this is no doubt preferable, it is certainly not indispensable to solve this question. Nomenclature is not psychology or history of science. From a nomenclatural point of view, it is of minor importance to know what were the intentions of a taxonomist who wrote and died one or two centuries ago. Rather than trying, often in vain, to ascertain this fact, our aim should be to clarify the nomenclatural uncertainty and ambiguity if it exists. Whenever there are doubts regarding the status of a nomen because of uncertainties regarding its onomatophore, the best should be done

to remove them. This can be done in various ways, e.g., in the case of a species-series nomen through the designation of a lectophoront or neophoront (see examples in Dubois 1995 and Dubois & Ohler 1995*a–b*, 1997*a–b*, 1999, 2000), in the case of genus-series nomen through the designation of a nucleospecies (see examples in Dubois & Raffaëlli 2009 and Dubois & Bour 2010*a*), or through another first-reviser action if appropriate. Once such an action has been taken, the nomenclatural status of the nomen is again permanently fixed, and the nomen can take its proper place in taxonomies and synonymies. Whether or not this corresponds to the original "intention" of the author of the nomen is of secondary importance.

Much more important than respecting the thought of the original author is the need to consider the possible nomenclatural disruptions that could be caused by inappropriate choices in the process of clarification of the status of a nomen. Care should be taken to designate as lectophoront of a specific nomen, or as nucleospecies of a generic nomen, a specimen or a nominal species which will make the former aporionym disappear as a junior synonym of a nomen in current use, or be allocated to a poorly known taxon, the nomen of which is not well-known by "normal" taxonomists who are not specialized in the group at stake. In most cases, this is possible through the simple use of the normal Rules of the *Code*, as exemplified by Dubois & Ohler (2009) with all the generic nomina of Ritgen (1828).

When the problem cannot be solved by the action of an individual taxonomist, the author of a revision should be strongly encouraged by the *Code* to apply to the ICZN for solving the case, if necessary through use of its Plenary-Power. This may be necessary to protect a sozonym that would be threatened by the clarification of the status of an aporionym using the normal provisions of the *Code*.

It should be considered to be the duty of any taxonomist finishing a revision or monograph to solve such problems. If he/she does not make this work, there is a risk that another colleague, who may be much less acquainted with the group, the bibliography and the problems at stake, proposes a less good, or really bad, solution to the same nomenclatural problem. *At the close of an important taxonomic revision work, there should not remain any aporionym*. Too many taxonomists are pusillanimous when it comes to designate neophoronts or to take other first-reviser actions, and the *Code* should clearly encourage them, through a vigorous Recommendation, to do this when it is indispensable to clarify and stabilize the status of a nomen. *This should actually be viewed as a major criterion of a good quality taxonomic work.*

One possible reason for the doubtful status of a nomen may be unavailability of its onymophoront(s) for study by taxonomists. Given the crucial role they play in the objectivity and stability of nomenclature, onymophoronts must be accessible for study to all taxonomists worldwide who ask for examining them. Even if they are deposited in a given institution, these specimens do not "belong" to it, they belong to the international scientific community. This is why museums or other institutions where they were deposited must insure that they are properly kept and curated in the long term, indexed, and put without restriction at the disposal of taxonomists of all countries who ask for their examination and, if necessary, care for visiting the establishment in order to avoid costs and risks linked to postal expedition. If they keep them in "secret cabinets" and refuse to show them to visitor taxonomists, the latter are entitled to consider these onymophoronts as destroyed or lost, and then to designate neophoronts in other institutions in order to clarify and stabilize the nomenclature of the taxa at stake. In order to encourage them to do so and to stop the "retention" of onymophoronts practiced by some institutions, a Rule of the *Code* should make this clear and encourage taxonomists to create neophoronts in such cases. If later the original onymophoront(s) "surface(s)" again, the normal provisions of Art. 75.8 of the current *Code* will apply.

In conclusion, it would be useful to add the following recommendation to the proposed standards regarding integrative taxonomy (Dayrat 2005; Dubois 2005*b*; Valdecasas *et al.* 2008):

"*It should be within the aims of any revisionary taxonomic and/or nomenclatural work to reduce as much as possible the number of aporionyms (*nomina dubia*) in the revised taxon, and hopefully to suppress them all. Appropriate nomenclatural actions should be taken to clarify permanently the status of the onomatophores and consequently of nomina that constitute the* aporionymy load* *of the taxon*."

Such a recommendation should be brought to the knowledge not only of authors but also of editors of taxonomic publications. It should concern genuine taxonomic and nomenclatural revisions, but also all publications that deal with the status of nomina. To take just three real examples, it is thus not advisable to publish a revision of a fossil fauna leaving many nomina unallocated to taxa, although most taxa of this fauna

are well known (Fischer 2000), or a paper aiming at clarifying the nomenclatural status of a specific nomen, the original onomatophore of which has been lost, without designating a neophoront for it (Amiet 2004), or a catalogue of the onymophoronts in a collection leaving many specimens with a doubtful status (Thireau 1987). In such cases, it should be the duty of the author, who should be a genuine specialist of the group (not a curator inadequately acquainted with it) and normally must have devoted a considerable time to the study of the literature and specimens at stake, to carry the work to its end, and to ascertain that subsequent taxonomists won't have to face the same problem again, often with much less information at hand than they had. Editors should encourage authors of papers containing nomenclatural information to "hunt" aporionyms, as this is a service to render to all taxonomists. The *Code* should provide a clear Recommendation in this respect.

Validity and correctness

Nomenclature of "strange species"

This point is not discussed in detail here as it was so already on several occasions (Dubois & Günther 1982; Dubois 1991, 2008*e*, 2009*c*). In the recent decades, many cases of "strange species" were discovered in the animal kingdom, most of which result from peculiar kinds of speciation (mostly through interspecific hybridization) and show peculiar reproductive modes, either regarding their gametogenesis (ameiosis or metameiosis) or the initiation of their development (parthenogenesis, gynogenesis, androgenesis, etc.). The recognition of such entities as species-rank taxa referred to peculiar species-rank taxonomic categories, advocated by some, requires to point to their biological peculiarities by using a special mode of notation of their specific binomina. This can be done through interpolation of a symbol between the generic substantive and the specific epithet, such as "kl." for kleptons (e.g., *Pelophylax* kl. *esculentus*), "kn." for klonons (e.g., *Warramaba* kn. *virgo*) or "k." for kyons (e.g., *Saga* k. *pedo*). It would be useful for all biologists who deal with such "strange entities" to have the use such a notation acknowledged in the *Code*. This would be similar to the possibility to "*place a term to indicate the taxonomic meaning of the aggregate in the same parentheses as its interpolated species-group name*" acknowledged by Recommendation 6B of the *Code* for aggregates of species and subspecies.

Secondary homonymy

The Rules of the *Code* dealing with homonymy in the species-series are not well formulated and this results in completely illogical and confusing situations.

Except in the special conditions of Art. 23.9.5 (which requires intervention of the ICZN using its Plenary-Power), in any case of two primary homonyms, the junior one remains forever invalid. This means that the senior one permanently preoccupies the use of the epithet against the junior one, whatever the subsequent fate of the two nomina. Two identical epithets *a* and *b* created in the same nominal genus A remain homonyms even if the first one *a* is later transferred to the genus B and the second one *b* to the genus C: the epithet *b* will remain invalid forever. Therefore, in this case, the original combination plays a major and definitive role.

In contrast, in the case of secondary homonymy, the important criterion taken into account is not the original combination, but the subsequent fact that at a given date the two specific nomina are, or not, combined with the same generic nomen. In this case, homonymy applies only whenever the two nomina are considered congeneric. If a first epithet *a* was created in a nominal genus A, and a second identical epithet *b* in a nominal genus B, they will be considered homonyms if both are referred to the same genus (A, B or even C), but not if they are referred to different genera, including their respective original genera, but interverted: if the epithet *a* is referred to the genus B and *b* to the genus A, they will not be considered homonyms. This means

that in this case the original combination does not preoccupy the epithet in its own original genus. This is fully illogical, inconsistent with the Rule for primary homonyms and doubtless confusing for taxonomists.

Two cases in herpetology will illustrate this strange difference between the two Rules.

Let us start with a classical case of primary homonymy. Steffen (1815) described under the nomen *Rana latrans* a frog species from Brazil, which is now referred to the genus *Leptodactylus* Fitzinger, 1826 (*LEPTODACTYLIDAE*) and known as *Leptodactylus latrans* (see Lavilla *et al.* 2010). David (1872) described under the nomen *Rana latrans* a frog from China which is now referred to the genus *Quasipaa* Dubois, 1992 (*RANIDAE*). Although the nomen *Rana latrans* was the first one given to the Chinese species, it cannot be used for this species and had to be replaced by its junior synonym *Rana spinosa* David, 1875, now known as *Quasipaa spinosa* (see Ohler & Dubois 2006)—and this although the two nominal species are now placed in two distinct genera in two distinct and unrelated families.

In contrast, let us consider a, admittedly rather unusual, case of secondary homonymy. Audouin (1827) described a lizard species from Egypt as *Trapelus savignyi*. As a result of a lectophoront designation (Wagner & Crochet 2009), this nomen is now an invalid junior doxisonym of *Stenodactylus sthenodactylus* (Lichtenstein, 1823) (*GEKKONIDAE*). Duméril & Bibron (1837) described as *Agama savignii* another lizard species from Egypt, now referred to the genus *Trapelus* Cuvier, 1817 (*AGAMIDAE*). Despite the one-letter difference, according to Art. 58.2 of the *Code*, the epithets *savignyi* and *savignii*, if referred to the same genus, must be considered homonyms. However, they are currently not referred to the same genus or even family, so they do not correspond to the definition of "secondary homonyms" given by the *Code*. As a consequence, the junior nomen remains valid and the agamid species must bear the nomen *Trapelus savignii* (Duméril & Bibron, 1837), although this nomen is the same as the original combination of another, senior, nominal species, which therefore does not preoccupy any more the epithet in the genus *Trapelus*.

These two Rules do not correspond to the same logic. In the Rule dealing with primary homonyms, the criterion of homonymy relies on the original combination of the older nomen, without consideration for its subsequent fate, thus obeying the Principle of Nomenclatural Foundation as defined above and in Appendix 2. In contrast, in the Rule dealing with secondary homonyms, the original combination of the older nomen has no importance, it can be forgotten and homonymy relies only on the subsequent fate of nomina, i.e., whether or not, at a given moment, both nomina are considered valid for different species of the same genus. This latter Rule is not consistent with the Principle of Nomenclatural Foundation.

Dubois (1995) discussed this problem in detail and proposed to change the *Code* in order to give it more internal consistency. He showed that part of the problem derived from the fact that two slightly different criteria are used in the *Code* for recognition of secondary homonyms: in Art. 53.3 and 57.3.1, the important criterion is publication of the two epithets *in combination* with the same generic substantive, whereas in Art. 59.1 and 59.2 it is the fact that the two taxa to which these nomina apply are *considered congeneric*, irrespective of the combinations actually used for them. He proposed to clarify this issue by introducing the terms *primary combination** and *secondary combination**. He proposed the following definitions: (D1) a *primary combination* is the original association between a new *final epithet** and a generic substantive as it was first published; (D2) a *secondary combination* is any subsequent association of this *final epithet* with a different generic substantive.

Using these terms and definitions, Dubois (1995) suggested that the wording of the *Code* would be appropriately modified by introducing the following Rules: (R1) any primary combination permanently preoccupies the use of its final epithet in its nominal genus, even if this epithet is later transferred to another genus; (R2) a final epithet in a secondary generic combination competes for homonymy with all other primary and secondary generic combinations using the same final epithet within this genus only as long as it is maintained in this genus, but stops doing so if it is transferred to another genus (either its original genus or a third one); (R3) transfer of a final epithet from a nominal genus to another one should automatically be interpreted as the establishment of a new secondary combination; this establishment is usually actual, but it may also be "virtual", when the final epithet is only transferred to the new genus as a junior synonym, even without the actual use and publication of the combination.

Rule (R1) is meant at replacing the end of Art. 59.2. In this article, the phrase "*even if one species-group name was originally proposed in the current genus of the other*" works both ways, i.e., whatever generic

combination is the oldest one, the primary or the secondary. Dubois (1995) argued that a final epithet first published in combination with a generic substantive should definitely preoccupy this epithet in this genus, even after transfer of the nominal species or subspecies to which it applies to another genus. This new Rule would be consistent with Art. 57.2 which states that a junior primary homonym is permanently invalid. On the other hand, an epithet first published in a genus A and later transferred to a genus B would preoccupy this epithet in the genus B only as long as it would remain allocated to this genus, as stated in Rule (R2).

Finally, the Rule (R3) is meant at suppressing the ambiguities caused by the mention of *publication* of the two epithets in combination with the same generic substantive (Art. 53 and 57) and at replacing it by the criterion of these epithets being *considered congeneric*: thus an epithet would become preoccupied in a genus whenever a species-series nomen using this epithet is transferred to this genus, even as a synonym and even without actually creating the combination of this epithet with this generic substantive.

These proposed changes also entail changes in the definitions of *hadromonym** ("primary homonym") and *asthenomonym* ("secondary homonym").

The ICZN has apparently never discussed these proposals, so that this question remains open. Adopting them would allow to clarify this illogical situation. If these Rules were adopted, then the nomen *Agama savignii* would be an invalid secondary homonym in the genus *Trapelus* Cuvier, 1817, just like the nomen *Hylaria variegata* Rafinesque-Schmaltz, 1814 in the genus *Hyla* Laurenti, 1768, as discussed in detail by Dubois (1995).

Family-series nomenclature

Although regulated by the *Code*, the nomenclature of families and other taxa of the family-series is more problematic and instable than that of lower taxa. This is in part due to the fact that many zootaxonomists never open their copy of the *Code*—if they indeed have one. Not rarely, colleagues will state, even in scientific meetings, that the nomenclature of families is "free", not being regulated by the *Code*. This appears more rarely in publications, because most editors do their work carefully.

Myers & Leviton (1962) provided a very perceptive and useful analysis of the problems posed by this nomenclature. Dubois (1984, 1987*b*, 2005*a*) further commented on this question.

The nomenclatural problems in this nominal-series are in part due to the fact that different conceptions have existed during the history of zoological nomenclature regarding the validity of family-series nomina. Five distinct Rules can be considered for applying priority to these nomina. According to the Rule retained, the valid familial nomen would be: (R1) that based on the oldest *available* generic nomen; (R2) that based on the oldest *valid* generic nomen; (R3) the oldest familial nomen based on a *valid* generic nomen; (R4) the oldest familial nomen based on an *available* generic nomen and having been originally published with a *correct* spelling according to our current Rules; (R5) the oldest familial nomen based on an *available* generic nomen, whatever its original spelling was, provided it was a noun in the nominative plural. These five Rules are strict and based on priority, and could *a priori* be structuring, but they are not equivalent from the points of view of the internal consistency of the *Code* and of nomenclatural stability. A detailed comparison (Dubois 1987*b*: 48–49), not repeated here, shows that Rule (R5) is consistent with the Principles of the *Code*, is the one that ensures the highest stability possible for family-series nomina, and credits these nomina with their proper authors. As had been stressed by Dubois (1984), the Rules in force in the second edition of the *Code* then in force (Anonymous 1964, 1974) were excellent, as they allowed a stability of family-series nomenclature even when minor changes were introduced in the generic content of a family-series taxon or in the status of some generic nomina. Unfortunately, the changes brought to Art. 32, 35 and 39 in the 1985 edition of the *Code*, and maintained in the 1999 edition, are a new source of confusion and instability. This problem was analysed in detail elsewhere (Dubois 1987*b*, 2010*c*) and is not detailed here. The conclusion of this careful study is that these articles should be reconsidered and changed again, but this will require particular attention, because a simple return to the Rules of the second edition would also be a source of instability, in the case of the (apparently minority) zoological groups in which the changes of the third edition were implemented.

Implementation of changes into the *Code*

This paper presents a rather detailed, although not complete, review of the problems posed by the current text of the *Code*. These problems are of various kinds. Some concern its incompleteness regarding the coverage of the nomenclatural hierarchy, some its internal logic and consistency, some its objectivity and automaticity of use as opposed to its relying on an "argument of authority", some various "minor" problems of writing, etc. Taken altogether, they suggest that the *Code* needs a thorough update and improvement. It is here suggested that, if this work is not done, the *Code* may rightfully appear to many zoologists as an incomplete set of Rules that do not deal with all situations and needs of zoological nomenclature, and they might turn to alternative nomenclatural systems like the *Phylocode*.

Probably not all colleagues will be convinced by all the arguments presented above, and some will "defend" the *Code* as it now stands, partly for simple "fear of change", partly because they "like" the *Code* as it is. However, it would seem difficult to ignore all these points altogether and to refuse discussing them. The problem that then appears is: how could it be possible to obtain that these points be *really discussed* in an open manner by all interested zootaxonomists and that the final decisions reflect the opinions and wills of the international community? As stressed by Laurin (2008*a*), the ICZN has shown in the recent decades a strong tendency to "*splendid isolation*" that cannot be beneficial to zootaxonomy. This is stressed by the repeated refusal to publish in the *BZN* comments that were in disagreement with the "philosophy" of ICZN regarding sensible questions like "usage" (see e.g. Hołynski 1994, Dubois 2005*c*: 423–424), and according to Laurin (2008*a*) one of the reasons which led the *Phylocode* supporters to develop their own Code and society was the refusal of the ICZN to discuss their ideas and proposals.

In the recent years, the ICZN has offered the possibility to colleagues who wish so to send to the ICZN website online comments and proposals concerning the *Code*, as well as *Zoobank*, but some zoologists, including myself, do not wish to use this tool, for two basic reasons.

The first one is that discussions of the *Code* are of potential interest and importance to all zoologists worldwide and should be made public on a permanent support, i.e., in a printed periodical that will remain available in decades (if we still have a zoological nomenclature then). In 1957 and 1958, Francis Hemming, then Secretary of the ICZN, published a huge volume **15** of the *BZN* that contained all the contributions submitted by zoologists on all aspects of the *Code* before some changes were introduced in its "first" edition (Anonymous 1961). These issues of the *BZN* are still available to readers. I regularly re-read some of these papers, some of which are remarkable. To tell the truth, I think that many discussions that come out nowadays in zoological nomenclature, for example the question "priority *vs.* usage", had already been very aptly discussed in some of these papers, and that our colleagues today could in some cases save time and energy if they went back to these papers, rather than "reinventing the wheel" every 20 or 50 years. I regret that in the recent years only very short extracts of the discussions, either in meetings of the ICZN, or now on registration of names, were published in the *BZN*. I think these questions should not remain the private affair of members of the ICZN or of internet forums, which are not permanent publications and will not leave long-lasting traces, being more similar to private discussions between colleagues than to publications.

Of course, publishing on paper is costly, and the ICZN, unlike at the time of Hemming, apparently does not have enough funds to publish detailed discussions on these issues. But other journals do exist which will accept even long papers on these matters. This is justified, as these questions, that may appear trivial at quick glance, may or will have important practical consequences in all the scientific literature that deals more or less with animal taxa, i.e., millions of publications. One possibility, if the *BZN* does not have the material possibility to publish all the details of the contributions[4], would be to publish a one-page summary of each of them, and to refer clearly to another publication in another journal where the detailed discussion appears.

4. This is in part a matter of choice from the part of the editorial team of this journal, as the *BZN* sometimes finds place to publish dozens of pages dealing with particular cases (e.g., 95 pages so far on the "*Testudo gigantea* case", which is not yet closed: Frazier 2009; Zug *et al.* 2009; Bour *et al.* 2009; Takahashi *et al.* 2009; Matyot *et al.* 2009; Chambers *et al.* 2010; Lawrence *et al.* 2010), including redundant comments bringing no new information and "strange comments" the usefulness of which is highly open to question.

The second reason why I won't contribute to the ICZN online forums is that I am a professional biologist, not a retired one, an amateur or an idle assistant. Nowadays, professional researchers are permanently "evaluated" for their activity, and their budgets, means of work, opportunity to train students, career and responsibilities depend on these evaluations. So they have to produce regularly the results of their work to their administration and colleagues. Nomenclatural matters are often complex questions, and a paper like this one or like many others dealing with these matters often keep their authors, if they are serious, busy for weeks and weeks, during which they cannot do anything else. Such a work has to be included in the "visible" results of their activity, and the only way for this is to have it published in a journal, preferably having an impact factor (which is not the case of the *BZN*). Such a work sent to an "internet forum" does not qualify as the result of a scientific activity and is null and void (if not a nuisance) for "evaluation" by peers and administrations.

In fact, I think that we are here touching a basic problem with such forums. Those of the ICZN receive two main kinds of contributions: by members of the ICZN, and by outsiders. As for the first ones, their participation to such forums appears normal and part of their duty. It can be fully incorporated in their evaluable work, not for their contributions themselves, but because they are members of this international Commission, a fact that they can mention in their CV, and being part of such a body of course requires to devote time to it. But the situation is different for all other contributors to these forums. They do it because they have a personal interest in nomenclatural matters and think they can provide useful comments or suggestions. This is a purely "gratuitous" contribution from their part, and particularly because these forums are just "discussion" forums, not a place where decisions are taken. The decisions are a prerogative of the ICZN, outsiders are not invited to contribute to the final debates and votes. Once their comments have been published, contributors have no way to follow their fate: ICZN members can use their ideas or suggestions or not[5]. Professional biologists cannot afford to spend their time for this kind of free and sometimes useless contributions. By suggesting individual colleagues to contribute to these forums with no reward, the ICZN may deprive itself from receiving interesting reflections, detailed analyses and constructive proposals like those proposed in the present paper, because this takes a lot of time, and this would be a pity. I think the forum should be restricted mostly to ICZN members and possibly to a few tiny suggestions by other colleagues, but that real analyses and texts received should be duly published in permanent printed form. Several journals (such as *Zootaxa* and *Bionomina*) could be proper outlets for this.

This question raises another one, regarding the way changes are implemented in the *Code*. Experience has shown that, in the past, the ICZN has done a number of errors, both in changes brought to the *Code*, and in decisions taken regarding some problematic cases of zoological nomenclature. There is nothing surprising or shocking in this. No human individual or group is perfect, everybody can make mistakes, and even a collective body is liable to take wrong decisions (the only way not to make errors is not to do anything). The ICZN has sometimes been able to correct these mistakes, but not always. The problem is not here. It is rather in the fact that nomenclatural Rules have (unavoidably) become so complex that, as well shown e.g. in the detailed study of Dubois (2010*c*), any change in one part of the *Code* may have consequences in another one. In many cases, only a practical experience of the proposed new Rules will allow to test them and to disclose their possibly unexpected consequences. In this respect, the more zootaxonomists from different backgrounds

5. The same was true, in the past at least, for some contributions sent by zoologists to the *BZN*, which were sometimes used by the ICZN Secretary to prepare a paper signed by his name alone (e.g., Tubbs 1992), thus so to speak "stealing" information from colleagues. This point is just one aspect of a more general one, which concerns censorship or at least "control of content" of papers published in this bulletin by its secretariat. This is well known of all zoologists who ever submitted manuscripts to this journal: these are generally considerably "re-written" by this secretariat before publication. Two reasons are invoked for this "re-writing": shortening (for financial reasons, i.e., to save printed paper) and compliance with the *Code*. Shortening is acceptable only when it respects the author's ideas and proposals and does not result in deleting some of them. And "compliance with the *Code*" should not result in forbidding the expression of proposals of changes to the latter! Thus, for example, from 2000 to 2010 I published about 50 papers using the term *nomen* instead of *name* to designate scientific zoological names, including one in the *BZN* (Dubois 2005*d*), but in the last two that were published (Dubois 2010*b*; Dubois *et al.* 2010) I was imposed the use of *name*. In the latter paper, we were also imposed the use of the nomen "**TESTUDINES**" instead of **CHELONII** Brongniart, 1800 for the order of tortoises, although (1) the *Code* so far does not regulate the use of class-series nomina, and (2) the nomen "*Testudines* Linnaeus, 1758" is not a higher taxon nomen, but the generic nomen *Testudo* in the plural, and *TESTUDINES* Batsch, 1788 is a family-series nomen and is therefore not available for an order (Dubois & Bour 2010*b*). These are just two recent examples among many possible.

and countries, and working on different groups of animals, are involved in the reflections and decisions regarding the *Code*, the better.

In order to limit the number and importance of these problems, the solution might be to associate more closely the community of zootaxonomists to the elaboration of changes in the *Code* and to the final decisions regarding these changes. There would be several possibilities allowing to do that, as shown by several examples of other biological nomenclatures which are not directed by a closed self-recruited Commission but democratically by the whole community of taxonomists (this is the case in botany) or by all members of a society (this is the case for the project of *Phylocode*).

In botany, since the Stockholm Congress of 1950, the Code is revised and modified regularly every six years during International Congresses of Botany. On this occasion, all interested botanists worldwide may submit proposals of amendments, which, after publication in the journal *Taxon*, are put to the vote of the congress, and then, if adopted, incorporated in the Code by its editorial committee. As for the *Phylocode*, all decisions regarding its text (still unpublished so far) are prepared by the International Society for Phylogenetic Nomenclature (ISPN), through its Committee on Phylogenetic Nomenclature (CPN), a committee elected by the international meetings of the Society, three of which have taken place already (Laurin & Cantino 2004, 2006; Laurin & Bryant 2009).

In zoology, the whole process of modification of the Rules is under the responsibility of an international body, the International Commission on Zoological Nomenclature (ICZN), which decides the changes brought to the *Code* and the (irregular) publication of new editions. This committee is under no circumstances elected by the international community of zoologists, by an international congress or by the members of a society, but new members are co-opted by the members in activity, the new composition of the Commission being approved as a matter of form by the International Union of Biological Sciences (IUBS). As we have seen, applications submitted to the ICZN for publication in the *BZN* are published, or not, according to obscure criteria, as many texts submitted have never been published without any explanation from the ICZN secretariat (see e.g. Dubois, 2005*c*: 423–424). This mode of composition and functioning of a committee that takes all decisions regarding the Rules of nomenclature applying to millions of taxa mentioned in millions of publications is overdue. The composition of this Commission is strikingly unbalanced, with a strong majority of members from Europe and North America, which does not reflect the quantitative contribution of these countries to taxonomic works nowadays (see Dubois 2010*b*: 13). It is difficult in such conditions to admit that this Commission is representative of the current international community of zootaxonomists.

This would not be very problematic if unanimity existed among zootaxonomists regarding the major questions raised in zoological nomenclature in the recent decades, such as "usage *vs.* priority", electronic publication, registration of nomina, higher taxa nomenclature, compulsory deposition of onymophoronts in permanent collections, etc. But this is not the case. The absence so far of an independent society dealing with nomenclatural questions (apart from the ISPN) is a striking peculiarity of biological nomenclature, considering that in most other scientific domains, not to say in most domains of human activity, independent societies based on shared interest and voluntary membership have developed. Does this reflect the lack of interest of zootaxonomists for these boring and time-consuming questions? Or their belief that the Rules of the *Code* are perfect and should never change?

In order to address the challenges that zoological nomenclature will be facing in the coming decades, it appears justified to consider changing its mode of governing. Several possibilities could be examined. One would be to have the members of the ICZN elected by the whole international community of zootaxonomists, which could be possible nowadays by way of internet, provided safeguards are implemented to ensure that only *practising taxonomists* contribute to these elections. Another one would be to open the ICZN to all zootaxonomists who express willingness to serve in this body, provided they give information showing their genuine involvement in taxonomic research. Another one would be to have the decisions regarding the *Code* taken in plenary nomenclatural sessions of important international or world congresses of zoology or taxonomy, or through internet with safeguards as mentioned above. Another one, following the example of the ISPN, would be to create a society in support to the Linnaean-Stricklandian zoological *Code*, which would take the relevant decisions during its meetings, after preparation of the latter by an elected committee. Still other possibilities could be considered, but the point of view supported here is that the system relying on a

closed committee recruiting by co-optation should come to its end and give way to a new, open and democratic system that still has to be conceived.

At any rate, it seems inescapable to admit that important changes in the *Code*, which may have far-reaching consequences (see e.g. Dubois 2010*c*), should not be implemented without thorough examination by a high number of practising taxonomists. Be it for availability of nomina through electronic publication, compulsory online registration of new nomina, or several other questions discussed above, new proposals should be thought about collectively and for a sufficient period by the whole community of zoologists, and any final decision should be taken collectively during an international congress or through another democratic and open system.

Code-compliance in publications

As we have seen, in the present decades confusion has spread in zootaxonomic publications, regarding the nomenclatural rules they are following, particularly in three respects: (R1) their compliance with the written Rules and Recommendations of the *Code*, as well as (R2) with unwritten rules (R2a) that have long ago been in traditional use in zoological nomenclature, or (R2b) that can be derived from an expansion of the Rules to nominal-series currently not covered by the *Code* or (R2c) to matters or problems not explicitly mentioned in the *Code* but implicitly covered by it, and finally (R3) the use of alternative nomenclatural Rules, either explicit or implicit.

Examples of such situations include: (R1a) the description of new species without designated onymophoronts, or with "types" not recognized by the *Code* such as "allotypes"; (R1b) the use of uninoma for species; (R1c) the use of suprageneric or infrasubgeneric nomina in the genus-series; (R1d) the use of "unranked" nomina for taxa hierarchically nested within one of the three nominal-series recognized by the *Code*; (R2a) the allocation of nomina at different ranks (or one ranked *vs.* one unranked) for taxa that are considered sister-taxa in the phylogeny explicitly adopted as the basis for an ergotaxonomy; (R2b) the use of nomina not being in the nominative plural for taxa of the class-series (above the family-series); (R2c) the description of a new species with an onymophoront left alive in the wild and not deposited in a permanent collection; (R3) the use of seemingly "traditional nomina" but redefined under an alternative nomenclatural system such as the *Phylocode*.

It is the full right of any taxonomist to decide to follow a set of nomenclatural Rules of his/her choice, but this choice should be made fully clear to any reader. For a non-taxonomist, candid user of taxonomic data, it may be difficult from simple reading to know whether any publication indeed follows the Rules and Recommendations of the *Code*, or not. It would therefore be most useful to clarify this point by providing published information regarding the nomenclatural Rules or guidelines followed in any given paper, periodical or book. This could be done in two ways: (1) in providing an explicit statement in this respect at the beginning of each publication, e.g., in the "Material and methods" section; (2) or in including such a statement in the "Instructions for authors" of the journal or book at stake. This would allow any reader to know under which reference system the nomina used in a given paper or book are considered available, allocated to taxa and considered as valid and correct.

However, it must be stressed here that the fact that a given journal states in its "Instructions for authors" that it follows the *Code* is not a guarantee against the presence in some of the papers published in this journal of mistakes regarding some of the Rules or Recommendations of this text, or of "implicit recommendations" such as those listed above under (R2). Many examples could be given in support of this statement (e.g., in herpetology: Dubois 2003: S15, 2009*a*; Dubois & Raffaëlli 2009). One of the reasons of this situation is that few editorial boards of journals include taxonomists competent for nomenclatural matters, and even less have specialized "nomenclature editors". Another reason is the lax attitude of the ICZN which, in "validating the mistakes" published in many recent works, fails to play the "pedagogical role" it could be expected to play as "*Keeper of the Law*" (Dubois 2005*c*: 387).

A possible way to limit this problem might be to encourage a practice which is currently rare, consisting in associating nomenclature specialists as co-authors of taxonomic papers. Most taxonomic publications nowadays have several co-authors. This is because many works are now the result of collaborations between specialists of various disciplines, including field naturalists, morphologists, molecular phylogeneticists, etc. In this process, it is very enlightening to realize that few researcher teams care for including in their group experienced taxonomists having a good mastering of the *Code*. Although the advice of taxonomists is often requested by such multidisciplinary teams, their work is considered as a "normal service" that does not need to be funded and even recognized by acknowledgements at the end of the paper, not to say by co-authorship of the paper—in contrast with other practices like recognition of co-authorship of a paper dealing with molecular phylogeny of a group for the mere supplying of a sample of tissue of a "rare" species included in the survey, without additional contribution. As rightly stressed by Boero (2010: 124), this contributes to the poor rating of taxonomy among biological sciences: "*No research institution would hire scientists that do not bring research money and that work for free to the projects of other scientists*". Taxonomists should try and change this practice and require proper recognition of their competence and work, in particular through their inclusion among co-authors of papers whenever they provide information and advice for a correct taxonomic and nomenclatural treatment of the results of a study.

Concerning the use of alternative nomenclatural systems, such as the *Phylocode*, it is more than time that periodicals and books impose the use of a particular mode of notation of the nomina used under these systems, in order to distinguish them from nomina defined under the Linnaean-Stricklandian Codes (Blackwell 2002; Stevens 2002; Greuter 2004; Dubois 2005*b*-*c*, 2006*d*; Frost *et al.* 2009). Dubois (2005*c*) proposed to write the nomina following the *Phylocode* in small capitals and between < and > marks, e.g., <RANA>, <AGAMIDAE> or <OSTEICHTHYES>, and Frost *et al.* (2009) recommended adoption of such conventions. It should be the duty of editors and publishers of periodicals and books to implement this or another system making clear for the reader that the nomina that appear in a given text follow such alternative rules, and, although they may "look the same" as the traditional nomina, are not equivalent to the latter, both in their systems of allocation to taxa and of nomenclatural validity.

Editors and publishers indeed have a responsibility concerning the future of biogical nomenclature and they should assume it. They cannot continue to have a lax attitude regarding nomenclatural matters and to leave authors free to follow their own ideas, opinions and tastes in this respect without making this clear to their readers. They will not accept to publish a paper with a gross and obvious error regarding mathematical, statistical, molecular matters or any other methodological mistake or unclarity, so why should they do it in the case of nomenclature?

It is clear that nobody has the power to impose such a policy to editors and publishers, but then the latter have the possibility to adopt such a policy by themselves and to make it clear to their readers. It would be possible to create a so-to-speak "club" of journals, editors and publishers who decide to follow strictly the Rules of the Codes in the papers they publish, or to require from authors who publish in their columns and who wish to follow alternative nomenclatural Rules (or no rules at all, but simply subjective opinions and tastes, or simply "alternative codes of ignorance", which is not rare nowadays) to make it clear, by using special ways of writing the nomina, that these do not follow the *Code*. The members of this "club" could announce this decision in their "Instructions for authors". Joining this "club" would be entirely voluntary, but authors submitting manuscripts to such publications would be aware that they are requested either to follow the Codes in vigour or to make it clear in their papers that they are following other rules, by writing nomina in a special way. Refusing to follow these requirements would be by itself a reason for refusing publication of the paper, without consideration for its other strengthes and weaknesses.

This "club", once created, could have other activities regarding biological nomenclature, such as organizing meetings or publishing debates about controversial questions of nomenclature, the evolution of the Codes, guidelines for publication of nomenclatural matters, etc. This could start as an informal "club" but, if successful, evolve into a formal Society.

In the meanwhile, as announced in its first Editorial (Dubois 2010*f*), the journal *Bionomina* will be acting as a "forum", being opened to the publication of contributions discussing all issues of biological nomenclature and terminology.

Conclusions

The recent decades have witnessed an unusual flourishment of reflections and publications dealing with the theory and practice of biological nomenclature. Credit in this respect must be given to the supporters of "phylogenetic nomenclature". They produced a rich body of interesting papers in which they raised several important questions and pointed to problems in the current Codes of nomenclature following Linnaean-Stricklandian principles, especially the zoological *Code*. Their papers were followed by a number of replies from supporters of the traditional nomenclatural system (for a rather complete list of references from both sides until 2005 and a discussion of the major problems at stake, see Dubois 2005*c*: 387–398). Interestingly, although they insisted on the excellency of the current Codes and showed convincingly some major weaknesses of the systems of "phylogenetic nomenclature", most of these replies did not address several of the important criticisms of the "phylogeneticists" against the current Codes, just as if the latter were "perfect" and did not deserve any improvement.

Interestingly also, few of these replies came from members of the ICZN, just as if these theoretical discussions were of no interest and importance. Browsing the volumes of the *BZN* during this period suggest that most of the work, engagement and efforts of the ICZN in the last decades were devoted to three major questions: (1) validating invalid junior synonyms and homonyms in the name of "usage"; (2) developing the presence of the ICZN on the web, in particular through the creation of *Zoobank*; (3) preparing new Rules aiming at the implementation of electronic publication and online registration as a valid support for the publication of new nomina and nomenclatural acts. This strong focus on a few questions gives support to the idea that the ICZN "*seems to be eager to stick to 'modern techniques' and to follow the emergence of new processes of publication and archiving of data and documents*" (Dubois 2010*b*: 22) but that it has little interest in the other theoretical and practical problems of zoological nomenclature nowadays. At any rate, few of the problems discussed above appear in the last 20 volumes of the *BZN*. In front of a group of colleagues interested in the epistemology and theory of nomenclature and its relationships with the evolutionary biology of our time, the Commission in charge of the *Code* showed a striking disinterest for theory and refusal to discuss annoying questions, which was perceived by some as a rigid stand (Laurin 2008*a*).

The current *Code* is the result of a progressive evolution of 250 years. It rests on solid and healthy theoretical bases: it (mostly) respects the independence between taxonomy and nomenclature, being theory-free regarding all taxonomic paradigms; it is therefore able to adapt to any new change in this respect; the allocation of nomina to taxa in this system relies on ostension, using a tool, the onomatophore, which maintains a permanent link between the real world of organisms and the world of language; it allows to translate into nomenclatural terms any taxonomy, including "phylogenetic" ones, provided some simple Principles are respected, and particularly that nomenclatural ranks be understood exclusively as a tool allowing to express unambiguously our hypotheses of hierarchy. It is highly superior to theory-bound nomenclatural systems like the *Phylocode*, and perhaps above all for practical reasons: in front of the current and coming mass extinctions, the urgent task of taxonomists is to collect, study and describe as many unknown species as possible before they disappear, not to "redefine" the millions of nomina already created and used in millions of publications since 250 years.

However, the *Code* is not perfect, and must be improved in the coming decade. It is vulnerable in front of proposals of alternative nomenclatures, inasmuch as it does dot cover the whole nomenclatural hierarchy, excluding higher-ranked and lower-ranked taxa as well as some taxa at genus and species levels. Besides, some of its Rules are ambiguous, unclear or inconsistent, its terminology and plan are confuse and puzzling for beginners and even for some professional zoologists. Important changes must be brought to this text which is basic for all systematics and for all comparative (i.e., non-reductionist) biology. The *Code* should be able to express in details, under really rigorous and fully automatic Rules, the complexity of taxonomic hierarchies suggested by recent phylogenetic studies. It would be most unfortunate if, because of its current weaknesses and the inability of the international community of zootaxonomists to care for its updating, this text was finally rejected by a significant part of phylogeneticists and taxonomists to adhere to an alternative nomenclatural system. A division of this community in two (or more?) groups following different nomenclatural Rules would be an unlucky blow given to the inventory of life on earth at the beginning of the

century of extinctions. It could have incalculable detrimental consequences on the science of taxonomy, and by way of consequence on the unity of biology as a whole.

In summary, the *Code* should be modified at least in nine directions: (1) it should adopt a technical terminology avoiding possible misinterpretations from outsiders of the field and even from specialists, and allowing a precise formalisation of its mode of functioning; (2) its plan should be drastically modified; (3) its Principles should be redefined, and some added; (4) material evidence for the allocation of nomina to taxa through specimens deposited in permanent collections should be given more weight; (5) it should incorporate all nomina of higher taxa, providing clear and stringent universal Rules for their naming, whereas conserving the traditional nomina largely used in non-specialized systematic literature; (6) it should allow for the recognition of many more ranks at lower nomenclatural levels, i.e., just above genus, between genus and species, and below species; (7) it should provide much more stringent Rules for the protection against priority of "well-known" nomina or sozonyms; (8) various "details" should be addressed, various Rules and Recommendations changed before a new edition of the *Code* is published; (9) the procedure of implementations of changes in the *Code* should be modified in order to involve active zootaxonomists of the whole world in the decisions.

Discussing the questions tackled here from a more general viewpoint, this detailed analysis provides an opportunity to make a few recommendations concerning the standards and guidelines listed by recent authors for a good, modern, integrative taxonomy. The main points raised here in this respect deal with the status of aporionyms (*nomina dubia*), with the automaticity of nomenclatural Rules and the function of nomina as arbitrary labels, and with the need for short and euphonious nomina for zoological taxa.

Naming of biodiversity is indeed at a crossroads (Sluys *et al.* 2004). The recent proposal of several nomenclatural systems alternative to the traditional Codes imperils the urgent need of an inventory of our planet's biodiversity by requiring zoologists to spend considerable time, energy and money about nomenclatural matters. In order to avoid this, nomenclatural Rules should be as automatic and "emotion-free" as possible. In this respect, the recent support brought by some zoologists to the concept of "usage", sometimes through "lobbying" actions that have very little to do with science, is a real nuisance and should be countered by more reasonable colleagues having a less "passionate" relationship with "nomenclatural stability".

The ICZN has recently devoted a lot of work to the creation of the database *Zoobank*, for the registration and indexation of all zoological nomina (Polaszek *et al.* 2005*a–b*; Polaszek 2006). This database will certainly prove very useful, especially if zoologists continue to use the *Code* as the reference system for the definition and use of zoological nomina. But it would prove useless if a large part of the community of zoologists decided not to do so. Working on *Zoobank*, on electronic publication and the registration of nomina cannot be the only project of the ICZN for the years to come. The international community of zoologists should take the necessary steps to update the *Code* before it is wiped out by another system.

A text drastically improved along the suggestions presented above would give the *Code* a strength and clarity which would place it for the coming years in a favourable position for the competition that will unavoidably confront this text to projects of alternative nomenclatures.

Acknowledgements

I am most grateful to Erna Aescht (Linz) and Alessandro Minelli (Padova) for their very careful reading of an earlier draft of this manuscript and for their very constructive suggestions, to Roger Bour (Paris) and Annemarie Ohler (Paris) for the realization of the figures of this paper and discussions about the *Code*, and to Myrianne Brival (Paris), Andrea Kourgli (Wien) and Victoire Koyamba (Paris) for help in bibliographic research.

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Submitted: 9 June 2010. Accepted: 14 December 2010. Published: 18 February 2011.
Corresponding Editor: Alessandro Minelli.

APPENDIX 1. GLOSSARY. Technical nomenclatural terms used here and their correspondence with terms used in the *Code*, if available. For each term used in this paper, this list provides: (1) the stage of the nomenclatural process to which this nomen applies (AL, allocation; AV, availability; CO, correctness; NO, all nomenclatural stages; RE, registration; VA, validity) or its domain of use (TA, taxonomy); (2) the etymology (only for technical terms coined especially for nomenclature and taxonomy): G, Greek; L, Latin; (3) a definition, with comments and/or mention of related terms and antonyms (terms of contrary meaning) if relevant; (4) the reference to creation of the term; (5) the equivalent term or expression used in the *Code* for the same concept, if available. New terms proposed in this paper are marked by an asterisk: *. Terms in bold are defined elsewhere in this "Glossary".

Adelograph*. • RE. • G: ἀ- (*a-*), "without"; δηλος (*delos*), "visible, evident, plain, clear"; γράφω (*grapho*), "I write". • Unregistered **spelling** of an **adelonym** or of a **delonym**. Antonym: **delograph**. • New term. • *Code*: no term.

Adelohypse*. • RE. • G: ἀ- (*a-*), "without"; δηλος (*delos*), "visible, evident, plain, clear"; υψος (*hupsos*), "height". • Unregistered **rank** of an **adelonym** or of a **delonym**. Antonym: **delohypse**. • New term. • *Code*: no term.

Adelonucleomen*. • RE. • G: ἀ- (*a-*), "without"; δηλος (*delos*), "visible, evident, plain, clear"; *nucleus* (from *nux*, "nut"), "nucleus, core, stone"; *nomen*, "name". • Unregistered **nucleomen** of an **adelonym** or of a **delonym**. Antonym: **delonucleonomen**. • New term. • *Code*: no term.

Adelonym*. • RE. • G: ἀ- (*a-*), "without"; δηλος (*delos*), "visible, evident, plain, clear"; ὄνομα (*onoma*), "name". • Unregistered nomen, thus unprotected against potential invalidation through **sozonym** validation. Antonym: **delonym**. • New term. • *Code*: no term.

Adelonymorph*. • RE. • G: ἀ- (*a-*), "without"; δηλος (*delos*), "visible, evident, plain, clear"; ὄνομα (*onoma*), "name"; μορφή (*morphe*), "form, shape". • Unregistered **onymorph** of an **adelonym** or of a **delonym**. Antonym: **delonymorph**. • New term. • *Code*: no term.

Adelophoront*. • RE. • G: ἀ- (*a-*), "without"; δηλος (*delos*), "visible, evident, plain, clear"; φέρω (*phero*), "I bear"; ὄν, ὄντος (*on*, *ontos*), "being, individual". • Unregistered **onymophoront** of an **adelonym** or of a **delonym**. Antonym: **delophoront**. • New term. • *Code*: no term.

Akyronym. • VA. • G: ἄκῡρος (*akyros*), "invalid, incorrect"; ὄνομα (*onoma*), "name". • Invalid nomen for a given taxon in a given **ergotaxonomy**. Antonym: **kyronym**. • Dubois 2000*b*: 51. • *Code*: no term.

Alienogenera. • Plural of **alienogenus**.

Alienogenus (pl. **alienogenera**). • AL. • L: *alienus*, "foreign, unrelated"; *genus*, "birth, origin, class, kind". • Any member of the indissoluble set of all the genus-series nomina originally excluded from the **protaxon** for which a new class-series nomen was proposed. • Dubois 2005*d*: 203. • *Code*: no term.

Allelonym. • G: ἀλλήλων (*allelon*), "the one… the other…"; ονομα (*onoma*), "name". • One of two (or several) synonymous nomina used both (or all) as valid for the same taxon (same content) in the same publication. Two categories: **protoallelonym** and **apoallelonym**. • Dubois 2006*a*: 183 (in the sense of **protoallalonym**); new, extended, meaning of the term proposed here. • *Code*: no term.

Allocated. • AL. • Qualification of a nomen (**aptonym**) that conforms to the conditions of nomenclatural allocation as regulated by the *Code*. Antonym: **unallocated**. • Dubois 2005*c*: 383. • *Code*: no term.

Allocation. • AL. • Nomenclatural act regulated by the *Code* by which a nomen becomes attached to a taxon or several taxa in zoological nomenclature (**aptonym**). This act gives its name to the second floor or stage of the nomenclatural process (Dubois 2005*a–d*). • Dubois 2005*c*: 369. • *Code*: no term.

Alloneonym. • AV. • G: ἄλλος (*allos*), "other"; νέος (*neos*), "new"; ὄνομα (*onoma*), "name". • **Neonym** having a partially or totally different etymology from its **archaeonym**, i.e., not directly derived from it through unjustified emendation. Antonym: **autoneonym**. • Dubois 2000*b*: 52. • *Code*: new replacement name, *nomen novum*.

Allotype. • AL. • G: ἄλλος (*allos*), "other"; τύπος (*typos*), "image, figure". • **Paratype** of sex opposite to the **holotype** of a species-series taxon. This specimen does not play a nomenclatural function of **onomatophore** but only a taxonomic function of **protaxont**, being one of the specimens of the

hypodigm. The use in nomenclature of this term not recognized by the *Code* is here discouraged (see Dubois 2005*c*: 401–405). • Traditional term in biological nomenclature. • *Code*: allotype.

Ambiostensional*. • AL. • L: *ambo*, "both, two together"; *ostensio*, "action of showing". • Qualification of a nomenclatural system which makes use of a double or alternative way of allocating nomina to taxa according to the situation, i.e., either **inclusive ostension** or **bidirectional ostension** (see Dubois 2006*a*, 2007*a*, 2008*g*; Dubois & Ohler 2009). • New term. • *Code*: no term.

Ameletograph. • AV. • G.: ἀμελής (*ameles*), "inattentive, careless"; γράφω (*grapho*), "to write". • Spelling of a nomen used inadvertently in a publication by an author, editor or publisher. • Dubois 2000*b*: 54 (as *ameletonym*), 2010*c*: 7. • *Code*: no term.

Anaptonym*. • AL. • G: ἀν- (*an*-), "without"; ἅπτω (*apto*), "fasten, attach, fix"; ὄνομα (*onoma*), "name". • Nomenclaturally unallocated nomen according to the Rules of the *Code*, i.e., not being clearly attached to an onomatophore. Antonym: **aptonym**. • New term. • *Code*: no term.

Anhypotaxy. • TA. • G: ἀν- (*an*-), "without"; ὑπό (hypo), "below"; τάξις (*taxis*), "order, arrangement". • Mode of **hypotaxy** of a taxon that includes *no* subordinate taxon, being the ''terminal'' lower taxon in a nomenclatural hierarchy. Given the current Rules of the *Code*, this can occur only in two cases, when the "final" taxon is either a species or a subspecies. All nomina at ranks above the rank species designate taxa that include at least one species, even possibly still unnamed and undescribed, so they cannot fall in this category of hypotaxy. • Dubois & Raffaëlli 2009: 12. • *Code*: no term.

Anoplonym. • AV. • G: ἄνοπλος (*anoplos*), "unarmed"; ὄνομα (*onoma*), "name". • Published but nomenclaturally unavailable nomen according to the Rules of the *Code*. Two categories: **atelonym** and **gymnonym**. Antonym: **hoplonym**. • Dubois 2000*b*: 50. • *Code*: unavailable name.

Aphonym. • VA. • G: ἄφωνο (*aphonos*), "speechless, silent"; ὄνομα (*onoma*), "name". • Nomen clearly mentioned as nomenclaturally **available** (in some cases as an available senior homonym making a junior homonym invalid) but never used as **valid** by *any* author and in *any* publication after 31 December 1899. • Dubois 2005*b*: 85, 2005*c*: 411. • *Code*: no term.

Aphory. • AL. • G: ἀ- (*a*-), "without"; φέρω (*phero*), "I bear". • Qualification of a nomen created without any onomatophore. • Dubois 2005*c*: 404. • *Code*: no term.

Apoallelonym*. • G: ἀπό (*apo*), ''from, away from''; ἀλλήλων (*allelon*), "the one… the other…"; ονομα (*onoma*), "name". • One of two (or several) **allelonyms**, created in different publications, subsequently used both (or all) for the same taxon (same content) in the same publication. Antonym: **protoallelonym**. • New term. • *Code*: no term.

Apognoses. • Plural of **apognosis**.

Apognosis (pl. **apognoses**). • TA. • G: ἀπό (*apo*), ''from, away from''; γιγνώσκω (*gignosko*), ''to know''. • A **cladognosis** of a taxon based on "character states" or *signifiers* (Ashlock 1985) that are considered to be shared by all members of the taxon and absent in all non-members, and that are considered, on the basis of a cladistic analysis and hypothesis, to be autapomorphic for the taxon. Term synonym of ''*apomorphy-based definition*'' according to de Queiroz & Gauthier (1990). • Dubois 1997: 135. • *Code*: no term.

Apograph. • AV. • G: ἀπό (*apo*), "away from, far from"; γράφω (*grapho*), "I write". • Any subsequent spelling of a nomen. Antonym: **protograph**. • Dubois 2010*c*: 6. • *Code*: subsequent spelling.

Apohypse. • AV. • G: ἀπό (*apo*), "away from, far from"; υψος (*hupsos*), "height". • Any subsequent rank of a nomen. Antonym: **protohypse**. • Dubois 2010*c*: 6. • *Code*: no term.

Aponym. • AV. • G: ἀπό (*apo*), "away from, far from"; ὄνομα (*onoma*), "name". • Any subsequent paronym of a protonym, modified in spelling (**apograph**), rank (**apohypse**) and/or, if relevant, onymorph (**aponymorph**). An aponym is **established** by its **first-user**. Antonym: **protonym**. • Dubois 2000*b*: 51. • *Code*: no term.

Aponymorph. • AV. • G: ἀπό (*apo*), "away from, far from"; ὄνομα (*onoma*), "name"; μορφή (*morphe*), "form, shape". • Any subsequent onymorph of a nomen. Antonym: **protonymorph**. • Dubois 2010*c*: 6. • *Code*: no term.

Aporionym. • AL. • G: ἀπορίᾱ (*aporia*), "doubt, difficulty"; ὄνομα (*onoma*), "name". • Nomen that cannot be clearly referred to a taxon in an ergotaxonomy, either for nomenclatural or for taxonomic reasons.

Three categories: **anaptonym**, **synaptonym** and **nyctonym**. ● Dubois 2008*f*: 378. ● *Code*: *nomen dubium.*

Aporionymy*. ● AL. ● The fact that a nomen is an **aporionym**, either for nomenclatural or for taxonomic reasons. ● New term. ● *Code*: no term.

Aporionymy load*. ● AL. ● The quantitative importance of **aporionyms** in a given ergotaxonomy. ● New term. ● *Code*: no term.

Apotaxont. ● TA. ● G: ἀπό (*apo*), "away from, far from"; τάξις *(taxis)*, "order, arrangement"; ὄν, ὄντος (*on, ontos*), "being, individual". ● A specimen used in a taxonomic work subsequent to the original description of a species-series taxon to provide information on the characters considered to be **diagnostic** or **apognostic** of a taxon. Antonym: **protaxont**. ● Dubois 2010*e*: 23. ● *Code*: no term.

Aptonym*. ● AL. ● G: ἅπτω (*apto*), "fasten, attach, fix"; ὄνομα (*onoma*), "name". ● Nomenclaturally allocated nomen according to the Rules of the *Code*, i.e., being clearly attached to an onomatophore. Two main categories: **monaptonym** and **synaptonym**. Antonym: **anaptonym**. ● New term. ● *Code*: no term.

Archaeonym. ● AV. ● G: ἀρχαῖος (*arkhaios*), "ancient"; ὄνομα (*onoma*), "name". ● Original nomen that has been replaced by a **neonym**. ● Dubois 2005*a*: 88, 2006*a*: 166. ● *Code*: no term.

Archexoplonym*. ● VA. ● G: ἄρχω (*archo*), "to rule, to govern"; ἔξοπλος (*exoplos*), "disarmed"; ὄνομα (*onoma*), "name". ● **Exoplonym** permanently invalidated as a result of a specific action of the ICZN under its Plenary-Power. ● New term. ● *Code*: no term.

Archypnonym*. ● VA. ● G: ἄρχω (*archo*), "to rule, to govern"; ὕπνος (*hypnos*), "sleep, sleepiness"; ὄνομα (*onoma*), "name". ● **Hypnonym** conditionally invalidated as a result of a specific action of the ICZN under its Plenary-Power. ● New term. ● *Code*: no term.

Argionym. ● CO. ● G: ἀργίᾱ (*argia*), "idleness, inaction"; ὄνομα (*onoma*), "name". ● **Eunym** currently unused in any ergotaxonomy. Antonym: **ergonym**. ● Dubois 2000*b*: 55. ● *Code*: no term.

Arhizonym. ● AV. ● G: ἀ- (*a*-), "without"; ρίζα (*rhiza*), "root, stem"; ὄνομα (*onoma*), "name". ● Family-series nomen incorrectly formed according to the *Code*, as not being based on the stem of an available genus-series nomen recognized as valid in the family-series taxon at stake, and therefore nomenclaturally unavailable (**anoplonym**). ● Dubois 2006*a*: 178. ● *Code*: no term.

Astatodistagmonym*. ● VA. ● G: ἄστατος (*astatos*), "unstable, uncertain"; δισταγμός (*distagmos*), "doubt, uncertainty"; ὄνομα (*onoma*), "name". ● Category of **distagmonym**: nomen *conditionally* rejected through **sozonym validation**. Antonym: **eudistagmonym**. ● New term. ● *Code*: no term.

Asthenomonym. ● VA. ● G: ἀσθενής (*asthenes*), "weak"; ὁμός (*homos*), "the same"; ὄνομα (*onoma*), "name". ● Any of two or more identical (or "*deemed to be identical*" under Article 58 of the *Code*) species-series epithets created for distinct nominal taxa and originally combined with different generic substantives but subsequently combined with the same generic substantive, the latter being different from that of the first published among them. ● Dubois 2000*b*: 57. ● *Code*: secondary homonym and primary homonym (in part).

Asthenomonymy*. ● VA. ● The fact that two distinct nomina are **asthenomonyms**. ● New term. ● *Code*: secondary homonymy.

Atelonym*. ● AV. ● G: ἀτελής (*ateles*), "unfinished, invalid"; ὄνομα (*onoma*), "name". ● A particular case of **anoplonym**: published but nomenclaturally unavailable nomen according to the *Code*, for not being conform to the provisions of Articles 10, 11 and 14 to 20. ● New term. ● *Code*: unavailable name.

Author. ● NO, TA. ● In the context of zoological nomenclature, name(s) of the person(s) to whom a published work, protonym, protaxon or nomenclatural act is credited, i.e., whose name(s) appear(s) as "author" in the work itself—not through subsequent investigation (see Dubois 2008*d*). ● Traditional term in zootaxonomy. ● *Code*: author.

Autoneonym. ● AV. ● G: αὐτός (*autos*), "same"; νέος (*neos*), "new"; ὄνομα (*onoma*), "name". ● **Neonym** having the same etymology as its archaeonym, i.e., directly derived from it through unjustified emendation. Antonym: **alloneonym**. ● Dubois 2000*b*: 52. ● *Code*: unjustified emendation.

Availability. • AV. • Nomenclatural act regulated by the *Code* by which a nomen is **created** and becomes **available** in zoological nomenclature (**hoplonym**). This act gives its name to the first floor or stage of the nomenclatural process (Dubois 2005*a–d*). • Traditional term in nomenclature. • *Code*: availability.

Available. • AV. • Qualification of a nomen (**hoplonym**) that conforms to the conditions of nomenclatural **availability** as regulated by the *Code*. Antonym: **unavailable**. • Traditional term in nomenclature. • *Code*: available, potentially valid.

Bidirectional ostension. • AL. • Composite system of ostension by **inclusion** and **exclusion**, pointing both to one or several member(s) and non-member(s) of a class (such as a taxon) (see Dubois 2006*c*: 25). • Dubois 2007*a*: 46. • *Code*: no term.

Binomen. • AV, CO. • L: *bis*, "twice"; *nomen*, "name". • Nomen of rank species, composed of two terms, the generic substantive and the specific epithet. • Traditional term in zoological nomenclature. • *Code*: binomen.

Binomina. • Plural of *binomen.*

Category. • TA. • A group of taxa that share certain biological (e.g., hybridizability) or historical (e.g., geological age) characteristics (see Dubois 2005*c*: 412–413, 2006*a*: 219–220, 2007*a*, 2008*e–g*, 2009*c*). • Traditional term in nomenclature and taxonomy. • *Code*: no term.

Character. • NO, TA. • Any particular intrinsic feature of an organism. • Term in traditional use in biology. • *Code*: character.

Choronym. • AL. • G: χῶρος (choros), "space, place"; ὄνομα (*onoma*), "name". • See **oronym**.

Chresonym. • TA. • G: χρησις (*chresis*), "use"; ὄνομα (*onoma*), "name". • Subsequent use or citation of a nomen under any of its avatars or **paronyms** (**parographs**, **parohypses** or **paronymorphes**). Two categories: **orthochresonym** and **heterochresonym**. • Dubois 1982: 267. • *Code*: no term.

Chresonymic list. • TA. • List of chresonyms. • Smith & Smith 1973: 445 (as *chresonymy*). • *Code*: no term.

Circumscription. • AL. • A synonym of **extension**. • Traditional term in philosophy, logics and didactics. • *Code*: no term.

Circumscriptional. • AL. • In zoological nomenclature, a system which uses **bidirectional ostension** for the allocation of nomina to taxa (see Kluge 1999*a–c*, 2000, 2004, 2009). • Kluge 1999*a–c*, 2000, 2004, 2009. • *Code*: no term.

Circumspecific*. • NO. • L: *circum*, "around, near"; *species*, "view, sight, shape, form, kind, species". • That deals with taxa at ranks just above and below the ranks species and subspecies. • New term. • *Code*: no term.

Cladognoses. • Plural of **cladognosis**.

Cladognosis (pl. **cladognoses**). • TA. • G: κλάδος (*klados*), ''branch''; γιγνώσκω (*gignosko*), ''to know''. • An intensional definition of a taxon based on a cladistic hypothesis concerning its relationships with other taxa. • Dubois 1997: 135, 2007*a*: 43. • *Code*: no term.

Classification. • NO, TA. • L: *classis*, "group, division, class". • Any process or system of ordering objects according to *a priori* criteria. • Term in traditional use in biology. • *Code*: classification.

Class-series. • NO. • In the nomenclatural hierarchy, the **nominal-series** ranked above the **family-series**, which is not fully regulated by the *Code*. It includes nomina of taxa at the ranks of phylum, class, order, and any additional ranks that may be required. • Dubois 2000*b*: 40. • *Code*: no term.

Combination. • AV, VA. • Any **onymorph** of a nomen implying association between a generic **substantive** and a specific or subspecific **final epithet**, irrespective of potential other words in the binomen or trinomen. • Traditional term in zoological nomenclature. • *Code*: combination.

Conucleogenera. • Plural of conucleogenus.

Conucleogenus (plural **conucleogenera**). • AL. • L: *cum*, "with"; *nucleus*, "kernel, nut"; *genus*, "birth, origin, class, kind". • Any member of the indissoluble set of all the genus-series nomina originally included in the **protaxon** for which a new class-series nomen was created. • Dubois 2005*b*: 79, 2005*c*: 404. • *Code*: no term.

Coordination. • AV. • In the context of zoological nomenclature, the fact that any nomen created for a taxon at any rank within a nominal-series is deemed to have been simultaneously created for all taxa of other ranks within that nominal-series including its onomatophore that might have to be recognized. • Traditional term in zoological nomenclature. • *Code*: coordination.

Correct. • CO. • In the context of zoological nomenclature, qualification of a nomen (**eunym**) that conforms to the Rules of the *Code* regarding spelling, rank and, if relevant, onymorph. Antonym: **incorrect**. • Traditional term in nomenclature. • *Code*: correct.

Correctness. • VA. • Qualification of a **kyronym** that bears a paronym—i.e., a spelling (**parograph**), rank (**parohypse**) and, if relevant, onymorph (**paronymorph**)—in agreement with the Rules of the *Code*. • Traditional term in nomenclature. • *Code*: correctness.

Creation*. • AV. • The process by which an **author** creates a new **hoplonym** under its **protonym** (**protograph**, **protohypse** and **protonymorph**). • Term in common use with various meanings in common language, here used in a specialized technical sense proper to nomenclature. • *Code*: no term.

Date. • NO. • In the context of zoological nomenclature, the *actual* date of *public distribution* of a publication—not its date of writing, submission, acceptance, printing or any other date that may appear in the document itself. • Traditional term in nomenclature. • *Code*: date.

Delograph*. • RE. • G: δηλος (*delos*), "visible, evident, plain, clear"; γράφω (*grapho*), "I write". • Registered **spelling** of a **delonym**. Antonym: **adelograph**. • New term. • *Code*: no term.

Delohypse*. • RE. • G: δηλος (*delos*), "visible, evident, plain, clear"; υψος (*hupsos*), "height". • Registered **rank** of a **delonym**. Antonym: **adelohypse**. • New term. • *Code*: no term.

Delonucleomen*. • RE. • G: δηλος (*delos*), "visible, evident, plain, clear"; *nucleus* (from *nux*, "nut"), "nucleus, core, stone"; *nomen*, "name". • Registered **nucleomen** of a **delonym**. Antonym: **adelonucleonomen**. • New term. • *Code*: no term.

Delonym*. • RE. • G: δηλος (*delos*), "visible, evident, plain, clear"; ὄνομα (*onoma*), "name". • Registered nomen, thus protected against potential invalidation through sozonym validation. Antonym: **adelonym**. • New term. • *Code*: no term.

Delonymorph*. • RE. • G: δηλος (*delos*), "visible, evident, plain, clear"; ὄνομα (*onoma*), "name"; μορφή (*morphe*), "form, shape". • Registered **onymorph** of a **delonym**. Antonym: **adelonymorph**. • New term. • *Code*: no term.

Delophoront*. • RE. • G: δηλος (*delos*), "visible, evident, plain, clear"; φέρω (*phero*), "I bear"; ὄν, ὄντος (*on*, *ontos*), "being, individual". • Registered **onymophoront** of a **delonym**. Antonym: **adelophoront**. • New term. • *Code*: no term.

Diagnoses. • Plural of **diagnosis**.

Diagnosis (pl. **diagnoses**). • TA. • G: διάγνωσις (*diagnosis*), "distinction, discrimination". • An **intensional** definition of a taxon based on "character states" or *signifiers* (Ashlock 1985) that are considered to be differential for the taxon, i.e., shared by all members of the taxon and absent in all non-members. • Traditional term in taxonomy. • *Code*: diagnosis.

Diaphonym. • VA. • G: διάφωνος (*diaphonos*), "discordant"; ὄνομα (*onoma*), "name". • Nomen used as valid by *at least one* author and in *at least one* publication after 31 December 1899. • Dubois 2005*b*: 85, 2005*c*: 411. • *Code*: no term.

Diplohypotaxy. • TA. • G: διπλόος (*diploos*), "double"; ὑπό (hypo), "below"; τάξις (*taxis*), "order, arrangement". • Mode of **hypotaxy** of a taxon that includes two **parordinate** taxa of just lower rank. In a phylogenetic taxonomic frame, the meaning of this situation is that a simple hypothesis of relationships between these two taxa is adopted, these two parordinate taxa being considered as sister-taxa. Although this interpretation can be challenged by subsequent works, as long as it is not such a taxonomy appears like a ''final'' one. • Dubois & Raffaëlli 2009: 12. • *Code*: no term.

Distagmonym. • VA. • G: δισταγμός (*distagmos*), "doubt, uncertainty"; ὄνομα (*onoma*), "name". • Nomen that has *not* had a universal or significant use in non-systematic literature after 31 December 1899, being an **aphonym**, **eneonym**, **schizoeurydiaphonym** or **stenodiaphonym**. Two categories

regarding validity: **astatodistagmonym** and **eudistagmonym**. Antonym: **sozonym**. • Dubois 2005*b*: 86, 2005*c*: 412. • *Code*: *nomen oblitum*.

Doxisonym. • VA, TA. •G: δόξα (*doxa*), "opinion"; ἴσος (*isos*), "equal"; ὄνομα (*onoma*), "name". • A category of **synonym**: any of two or more nomina *of the same nominal-series* based on different onomatophores but considered, for subjective (taxonomic) reasons, to denote the same taxon, whose **inclusive extension** includes both their onomatophores. • Dubois 2000*b*: 57. • *Code*: subjective synonym.

Doxisonymization*. • VA, TA. • Statement that two or more nomina are **doxisonyms** and of the valid one (**kyronym**) for the taxon they denote. • New term. • *Code*: no term.

Doxisonymy. • VA, TA. • A category of **synonymy**: the fact that two distinct nomina of the same nominal-series having different onomatophores (and onomatostases if relevant) are considered to denote the same taxon in a given ergotaxonomy for subjective reasons, i.e., on the basis of a taxonomic interpretation. • Dubois 2008*g*: 53. • *Code*: subjective synonymy.

Eneonym. • VA. • G: ἐνεός (*eneos*), "dumb"; ὄνομα (*onoma*), "name". • Nomen never mentioned as nomenclaturally available by *any* author and in *any* publication after 31 December 1899. • Dubois 2005*b*: 85, 2005*c*: 411. • *Code*: no term.

Epihypse*. • AV. • G: ἐπί (*epi*), "above"; υψος (*hupsos*), "height". • A category of **eponym**: in a given nominal-series, nomen of a **superordinate** taxon bearing the same nomen (with the same author, date and onomatophore) as one of its **subordinate** taxon. • Dubois 2006*b*: 828 (as *epinym*). • *Code*: no term.

Epithet. • NO. • Specific or subspecific **nomen**, never bearing a capital, being part of a binomen or trinomen. • Traditional term in zoological nomenclature. • *Code*: species-group name [English text]; nom du niveau espèce [French text].

Epitype. • AL. • A specimen or illustration selected to serve as an interpretative type when the holotype, lectotype, or previously designated neotype, or all original material associated with a nomen, is demonstrably ambiguous and cannot be critically identified for purposes of the precise application of the nomen to a taxon. • Term and concept in use in botanical nomenclature (McNeill *et al.* 2006) but not in zoological nomenclature. • *Code*: no term.

Eponym. • AV. • G: ἐπί (*epi*), "above"; ὄνομα (*onoma*), "name". • In a given nominal-series, nomen used as valid in a publication for several coordinated taxa at different ranks. Two categories: **epihypse** and **hypohypse**. • Dubois 2006*b*: 828. • *Code*: no term.

Ergonym. • CO. • G: ἔργον (*ergon*), "work, action"; ὄνομα (*onoma*), "name". • **Eunym** currently used in all or some ergotaxonomies. Antonym: **argionym**. • Dubois 2000*b*: 54. • *Code*: no term.

Ergotaxon. • NO, TA. • G: ἔργον (*ergon*), "work, action"; τάξις (*taxis*), "order, arrangement". • Any taxon with a given **extension** (i.e., members, **circumscription**) recognized as valid by a given author in a given **ergotaxonomy**. • Dubois 2005*a*: 405. • *Code*: no term.

Ergotaxonomy. • NO, TA. • G: ἔργον (*ergon*), "work, action"; τάξις (*taxis*), "order, arrangement"; νόμος (*nomos*), "law, rule". • Any classification considered valid in a certain work by a given author. • Dubois 2005*c*: 406. • *Code*: no term.

Establishment*. • AV. • The process by which a **first-user** establishes (i.e., uses for the first time in the taxonomic literature) a new **aponym** (**apograph**, **apohypse** or **aponymorph**) for a **hoplonym**. • Term in common use with various meanings in common language, here used in a specialized technical sense proper to nomenclature. • *Code*: no term.

Eudistagmonym*. • VA. • G: ευ (*eu*), "well, easily"; δισταγμός (*distagmos*), "doubt, uncertainty"; ὄνομα (*onoma*), "name". • Category of **distagmonym**: nomen *permanently* rejected through **sozonym validation**. Antonym: **astatodistagmnym**. • New term. • *Code*: no term.

Eugraph*. • CO. • G: ευ (*eu*), "well, easily"; γράφω (*grapho*), "I write". • Correct spelling of a nomen for a given taxon in a given taxonomy. • New term. • *Code*: correct original spelling, justified emendation, mandatory change.

Euhypse*. • CO. • G: ευ (*eu*), "well, easily"; υψος (*hupsos*), "height". • Correct rank of a nomen for a given taxon in a given taxonomy. • New term. • *Code*: no term.

Eunym. • CO. • G: εὖ (*eu*), "well, easily"; ὄνομα (*onoma*), "name". • Correct **paronym** (**eugraph**, **euhypse** and **eunymorph**) of a nomen for a given taxon in a given ergotaxonomy. Antonym: **nothonym**. • Dubois 2000*b*: 54. • *Code*: no term.

Eunymorph*. • CO. • G: ευ (*eu*), "well, easily"; ονομα (*onoma*), "name"; μορφή (*morphe*), "form, shape". • Correct onymorph of a nomen for a given taxon in a given taxonomy. • New term. • *Code*: no term.

Eurydiaphonym. • VA. • G: εὐρύς (*eurus*), "broad, wide"; διάφωνος (*diaphonos*), "discordant"; ὄνομα (*onoma*), "name". • Nomen that has been *significantly* used as valid for a given taxon or for synotaxic taxa in *non-systematic* literature after 31 December 1899. • Dubois 2005*b*: 85, 2005*c*: 412. • *Code*: no term.

Exclusive extension. • AL. • System of **extension** by exclusion, listing all non-members of a class (such as a taxon). • Dubois 2005*a*: 379. • *Code*: no term.

Exclusive ostension. • AL. • System of **ostension** by exclusion, pointing to one or several non-member(s) of a class (such as a taxon). • Dubois 2006*c*: 25. • *Code*: no term.

Exonymophoront. • AL. • G: ἐκ, ἐξ (*ek*, *ex*), "out of, from"; ὄνομα (*onoma*), "name"; φέρω (*phero*), "I bear"; ὄν, ὄντος (*on*, *ontos*), "being, individual". • A specimen that was originally one of the symphoronts of a species-series nomen, but that lost its status of **onymophoront** following the designation of another **symphoront** as **lectophoront**. • Dubois 2005*c*: 403. • *Code*: paralectotype.

Exoplonym. • VA. • G: ἔξοπλος (*exoplos*), "disarmed"; ὄνομα (*onoma*), "name". • **Hoplonym** permanently invalidated, either as a result of the Rules of the *Code* or of a specific action of the ICZN under its Plenary-Power. Four categories: **archexoplonym**, **eudistagmonym**, **junior hadromonym** and **junior isonym**. • Dubois 2000*b*: 51. • *Code*: no term.

Explicit nucleogenus designation*. • AL. • In the family-series, explicit mention of the nucleogenus of a new family-series nomen, indispensable after 1999 for its nomenclatural availability (Art. 16.2). • New term. • *Code*: no term.

Extension. • AL. • System of allocation of a nomen to a concept or class (such as a taxon) through providing a list of all objects that satisfy the intensional definition of a concept (**inclusive extension**), or that do not satisfy it (**exclusive extension**). • Traditional term in philosophy, logics and didactics (see Dubois 2005*a*: 379). • *Code*: no term.

Extragenera. • Plural of **extragenus**.

Extragenus (pl. **extragenera**). • AL. • L: *extra*-, "out of, outside"; *genus*, "birth, origin, class, kind". • **Alienogenus** of a class-series nomen that in a given **ergotaxonomy** is excluded from the class-series taxon including all the **conucleogenera** of this class-series taxon. • Dubois 2006*a*: 187. • *Code*: no term.

Family-series. • NO. • In the nomenclatural hierarchy, the highest-ranking **nominal-series** fully regulated by the *Code*. It includes nomina of taxa at the ranks of family, subfamily, tribe, superfamily, and any additional ranks that may be required. • Dubois 2000*b*: 40. • *Code*: family group [English text]; niveau famille [French text].

Final epithet. • NO. • The last epithet in sequence of any particular combination, whether in the rank of species or of subspecies. • Term in use in botanical nomenclature (McNeill *et al.* 2006). • *Code*: no term.

First-reviser. • NO. • Author of a nomenclatural act modifying the nomenclatural status of a nomen. • Traditional term in zoological nomenclature. • *Code*: First Reviser.

First-user. • AV. • Name(s) of the person(s) to whom the **establishment** of an **aponym** is credited, i.e., whose name(s) appear(s) as "author" of the work where this aponym first appeared itself—not through subsequent investigation (see Dubois2008*d*). • Dubois 2000*b*: 42. • *Code*: no term.

Genus-series. • NO. • In the nomenclatural hierarchy, the **nominal-series** ranked between the **species-series** and the **family-series**. It includes taxa at the ranks of genus and subgenus. • Dubois 2000*b*: 40. • *Code*: genus group [English text]; niveau genre [French text].

Gymnonym. • AV. • G: γυμνός (*gymnos*), "naked"; ὄνομα (*onoma*), "name". • A particular case of **anoplonym**: published but nomenclaturally unavailable nomen according to the *Code*, for not being

conform to the provisions of Articles 12 or 13 (i.e., missing a diagnosis or description). ● Dubois 2000*b*: 49–50. ● *Code*: *nomen nudum*.

Hadromonym. ● VA. ● G: ἁδρός (*hadros*), "robust"; ὁμός (*homos*), "the same"; ὄνομα (*onoma*), "name". ● Any of two or more **homonyms** created for distinct nominal taxa and having either: (1) in the family-series and class-series, exactly the same stem; or (2) in the genus-series, exactly the same spelling; or (3) in the species-series, spellings exactly identical or "*deemed to be identical*" under Article 58 of the *Code*, and originally or subsequently combined with the same generic substantive as the first published among them. ● Dubois 2000*b*: 57. ● *Code*: (1) and (2) homonym; (3) primary homonym (in part).

Hadromonymy*. ● VA. ● The fact that two distinct nomina are **hadromonyms**. ● New term. ● *Code*: primary homonymy.

Hapantotype. ● AL. ● G: ἁπάντη (*hapante*), "everywhere"; τύπος (*typos*), "image, figure". ● A series of "*directly related*" individuals, on one or more preparations, representing distinct stages in the life cycle, which together constitute the onomatophore of an extant species of protist according to the current *Code*. Despite this definition, this tool is confusing as it covers both a nomenclatural function of **onomatophore** and a taxonomic function of **protaxont**. The use of this term and concept in nomenclature should be abandoned (see Dubois 2005*c*: 401–405). ● Term used in the zoological *Code*. ● *Code*: hapantotype.

Heterochresonym. ● TA. ● G: ἕτερος (*eteros*), "other, different"; χρησις (*chresis*), "use"; ὄνομα (*onoma*), "name". ● Chresonym inappropriately used to designate a taxon (misidentification). Antonym: **orthochresonym**. ● Dubois 2000*b*: 59. ● *Code*: no term.

Heterosynaptonym*. ● AL. ● G: ἕτερος (*eteros*), "other, different"; σύν (*syn*), "together"; ἅπτω (*apto*), "fasten, attach, fix"; ὄνομα (*onoma*), "name". ● **Synaptonym** considered taxonomically heterogeneous (composed of specimens or taxomina which are referred to different taxa). Antonym: **homosynaptonym**. ● New term. ● *Code*: no term.

Holaptonym*. ● AL. ● G: ὅλος (*holos*), "complete, entire"; ἅπτω (*apto*), "fasten, attach, fix"; ὄνομα (*onoma*), "name". ● **Monaptonym** whose **monophoric** onomatophore (**holophoront**, **nucleospecies** or **nucleogenus**) was designated in the original publication where the nomen was created. ● New term. ● *Code*: no term.

Holophoront. ● AL. ● G: ὅλος (*holos*), "complete, entire"; φέρω (*phero*), "I bear"; ὄν, ὄντος (*on*, *ontos*), "being, individual". ● Single specimen originally designated as **onymophoront** of a species-series nomen. ● Dubois 2005*c*: 403. ● *Code*: holotype.

Homonym. ● VA. ● G: ὁμός (*homos*), "the same"; ονομα (*onoma*), "name". ● Any of two or more distinct **protonyms** (having different authors, dates and onomatophores) *of the same nominal-series* having the exactly same spelling or spellings "*deemed to be identical*" under the *Code*. Two categories: **asthenomonym** and **hadromonym**. ● Traditional term in zootaxonomy. ● *Code*: homonym.

Homonymy. ● AV, VA. ● The fact that two distinct nomina of the same nominal-series have exactly the same spelling or spellings "*deemed to be identical*" under the *Code*. ● Traditional term in zootaxonomy. ● *Code*: homonymy.

Homosynaptonym*. ● AL. ● G: ὁμός (*homos*), "the same"; σύν (*syn*), "together"; ἅπτω (*apto*), "fasten, attach, fix"; ὄνομα (*onoma*), "name". ● **Synaptonym** which is either indissoluble (members of a **hapantotype** as defined in the *Code*; **conucleogenera** of a class-series nomen under the Rules proposed by Dubois 2005*d*, 2006*a*) or considered taxonomically homogeneous (composed of specimens or taxomina which are referred to the same taxon). Antonym: **heterosynaptonym**. ● New term. ● *Code*: no term.

Hoplonym. ● AV. ● G: ὅπλον (*hoplon*), "tool, arm, weapon"; ὄνομα (*onoma*), "name". ● Nomenclaturally available nomen according to the Rules of the *Code*. Antonym: **anoplonym**. ● Dubois 2000*b*: 50. ● *Code*: available name.

Hypnonym. ● VA. ● G: ὕπνος (*hypnos*), "sleep, sleepiness"; ὄνομα (*onoma*), "name". ● Conditional **akyronym**, i.e., liable to be reinstored as valid as a result of taxonomic changes. Four categories:

archypnonym, **astatodistagmonym**, **junior asthenomonym** and **junior doxisonym**. ● Dubois 2000*b*: 51. ● *Code*: no term.

Hypodigm. ● TA. ● G: ὑπό (*hypo*), "below"; δεῖγμα (*deigma*), "proof, sample, specimen". ● Set of specimens (**phoronts**) used by a taxonomist to recognize and describe a new species-series taxon. ● Simpson 1940: 418. ● *Code*: no term.

Hypohypse. ● AV. ● G: ὑπό (*hypo*), "below"; ὄνομα (*onoma*), "name". ● A category of **eponym**: in a given nominal-series, nomen of a **subordinate** taxon bearing the same nomen (with the same author, date and onomatophore) as its **superordinate** taxon. ● Dubois 2006*b*: 828 (as *hyponym*). ● *Code*: nominotypical.

Hypotaxy. ● TA. ● G: ὑπό (*hypo*), "below"; τάξις (*taxis*), "order, arrangement". ● Taxonomic or nomenclatural subordination. Four categories: **anhypotaxy**, **diplohypotaxy**, **monohypotaxy** and **polyhypotaxy**. If used in a phylogenetic taxonomic frame, they correspond to different topologies of trees, with or without polytomies, thus partly reflecting the resolution of the tree. ● Dubois & Raffaëlli 2009: 11. ● *Code*: no term.

Iconotype. ● AL. ● G: εἰκών (eikon), "image, picture"; τύπος (*typos*), "mark, image, figure, model". ● A term used by some authors in botanical nomenclature, although not in the botanical Code, which designates an illustration used as onomatophore of a nomen. ● Term in traditional but unofficial use in botanical nomenclature. ● *Code*: no term.

Identification. ● AL. ● Taxonomic act that refers a nomen to a known **ergotaxon** in a given **ergotaxonomy**. ● Traditional term in taxonomy. ● *Code*: no term.

Identified. ● AL. ● Qualification of a nomen (**photonym**) that has been identified to refer to a known **ergotaxon**. Antonym: **unidentified**. ● Traditional term in taxonomy. ● *Code*: no term.

Idiognoses. ● Plural of **idiognosis**.

Idiognosis (pl. **idiognoses**). ● TA. ● G: ἴδιος (*idios*), ''one's own, particular, proper''; γιγνώσκω (*gignosko*), ''to know''. ● An intensional definition of a taxon based on "character states" or *signifiers* (Ashlock 1985) that are considered to provide a brief description or characterisation of a taxon, including both diagnostic (differential) signifiers and signifiers shared with other taxa. ● Dubois & Raffaëlli 2009: 15. ● *Code*: no term.

Implicit etymological nucleogenus designation. ● AL. ● In the family-series, implicit designation of the nucleogenus of a new family-series nomen, derived from the fact that a single nominal genus included in the new family-series taxon bears a nomen the stem of which is unambiguously the stem of the new family-series nomen. Such a mode of designation is invalid after 1999 (Art. 16.2). ● Dubois 1984: 24. ● *Code*: no term.

Inclusive extension. ● AL. ● System of **extension** by inclusion, listing all members of a class (such as a taxon). ● Dubois 2005*a*: 379. ● *Code*: no term.

Inclusive ostension. ● AL. ● System of **ostension** by inclusion, pointing to one or several member(s) of a class (such as a taxon). ● Dubois 2006*c*: 25. ● *Code*: no term.

Incorrect. ● CO. ● Qualification of a nomen (**nothonym**) that fails to conform to the Rules of the *Code* regarding spelling, rank and, if relevant, onymorph. Antonym: **correct**. ● Traditional term in nomenclature. ● *Code*: incorrect.

Intension. ● AL. ● Set of properties or attributes that characterize a concept or a class. ● Traditional term in philosophy, logics and didactics (see Dubois 2005*a*: 379). ● *Code*: no term.

Intragenera. ● Plural of **intragenus**.

Intragenus (pl. **intragenera**). ● AL. ● L: *intra-*, "within, inside"; *genus*, "birth, origin, class, kind". ● **Alienogenus** of a class-series nomen that in a given **ergotaxonomy** is included in the class-series taxon including all the **conucleogenera** of this class-series taxon. ● Dubois 2006*a*: 187. ● No term.

Isonym. ● VA. ● G: ἴσος (*isos*), "equal"; ὄνομα (*onoma*), "name". ● A category of **synonym**: any of two or more nomina *of the same nominal-series* based on the same onomatophore. ● Dubois 2000*b*: 57. ● *Code*: objective synonym.

Isonymy. ● VA, TA. ● A category of **synonymy**: the fact that two distinct nomina of the same nominal-series denote the same taxon in a given ergotaxonomy for objective reasons, i.e., for having the exactly

same onomatophore (and onomatostasis if relevant). • Dubois 2006*a*: 182. • *Code*: objective synonymy.

Junior. • VA. • In the context of zoological nomenclature, and concerning a nomen or a nomenclatural act: published at a date subsequent to that of publication of another nomen or nomenclatural act, qualified as **senior**. • Traditional term in nomenclature. • *Code*: junior.

Kyronym. • VA. • G: κύριος (*kyrios*), "proper, correct"; ὄνομα (*onoma*), "name". • Valid nomen for a given taxon in a given ergotaxonomy. Antonym: **akyronym**. • Dubois 2000*b*: 51. • *Code*: no term.

Lectaptonym*. • AL. • G: λεκτός (*lektos*), "chosen, picked out"; ἅπτω (*apto*), "fasten, attach, fix"; ὄνομα (*onoma*), "name". • **Monaptonym** whose **monophoric** onomatophore (**lectophoront**, **neophoront**, **nucleospecies** or **nucleogenus**) was designated in a publication subsequent to that where the nomen was created. • New term. • *Code*: no term.

Lectophoront. • AL. • G: λεκτός (*lektos*), "chosen, picked out"; φέρω (*phero*), "I bear"; ὄν, ὄντος (*on, ontos*), "being, individual". • Single specimen subsequently chosen in a series of **symphoronts** for designation as **onymophoront** of a species-series nomen. • Dubois 2005*c*: 403. • *Code*: lectotype.

Logonymic list. • NO, TA. • G: λόγος (*logos*), "speech, discourse"; ὄνομα (*onoma*), "name". • Any list of nomina, including **synonyms**, **aponyms** and/or nomen uses or citations (**chresonyms**). • Dubois 2000*b*: 59 (as *logonymy*). • *Code*: no term.

Meletograph. • AV. • G: μελέτη (*melete*), "attention, care"; γράφω (*grapho*), "I write". • Spelling of a nomen used intentionally in a publication by its author. Antonym: **ameletograph**. • Dubois 2000*b*: 54 (as *meletonym*) , 2010*c*: 7. • *Code*: no term.

Metronym. • AL. • G: μήτηρ, μητρός (*meter, metros*), "mother"; ὄνομα (*onoma*), "name". • Nomen created for a class-series protaxon at least one of the **alienogenera** of which is now included in the metrotaxon including all its **conucleogenera** in a given class-series ergotaxonomy. In this ergotaxonomy, this nomen, once called **nesonym** (Dubois 2005*b*: 80, 2006*a*: 188), applies to this metrotaxon. • New term. • *Code*: no term.

Metrotaxa. • Plural of **metrotaxon**.

Metrotaxon (pl. **metrotaxa**) • AL. • G: μήτηρ, μητρός (*meter, metros*), "mother"; τάξις (*taxis*), "order, arrangement". • In a given **ergotaxonomy**, the least inclusive (lowest ranked) class-series **ergotaxon** including all the **conucleogenera** of a class-series protaxon. • Dubois 2006*a*: 188. • *Code*: no term.

Monaptonym*. • AL. • G: μόνος (*monos*), "single, unique"; ἅπτω (*apto*), "fasten, attach, fix"; ὄνομα (*onoma*), "name". • **Aptonym** whose onomatophore is **monophoric**, being composed of a single specimen (in the species-series: **holophoront**, **lectophoront** or **neophoront**) or **taxomen** (in the three other nominal-series: **nucleospecies** in the genus-series, **nucleogenus** in the family-series and class-series). Two categories: **holaptonym** and **lectaptonym**. Antonym: **synaptonym**. • New term. • *Code*: no term.

Monohypotaxy. • TA. • G: μόνος (*monos*), "single, unique"; ὑπό (hypo), "below"; τάξις (*taxis*), "order, arrangement". • Mode of **hypotaxy** of a taxon that includes only one immediately subordinate taxon. In a phylogenetic taxonomic frame, the two successive ranks are clearly redundant, as they do not provide distinct taxonomic information, but they may be useful for mere nomenclatural reasons (see Dubois, 2007*a*, 2008*g*). • Dubois & Raffaëlli 2009: 12. • *Code*: no term.

Monophory. • AL. • G: μόνος (*monos*), "single, unique"; φέρω (*phero*), "I bear". • Qualification of a nomen created with and supported by an onomatophore composed of a single specimen (in the species-series) or taxomen (in the three other nominal-series). • Dubois 2005*a*: 404. • *Code*: monotypy.

Monosemic. • AV. • G: μόνος (*monos*), "single, unique"; σῆμα (sema), "sign, mark". • In the context of zoological nomenclature, the qualification of either (1) a system that does not allow the same nomen to designate distinct taxa, or (2) any nomen being in this situation (see Dubois 2007*a*: 41). Antonym: **polysemic**. • Traditional term in linguistics and grammar. • *Code*: no term.

Monotypy. • AL, TA. • G: μόνος (*monos*), "single, unique"; τύπος (*typos*), "mark, image, figure, model". • A confusing term, used in systematics in two distinct senses, a taxonomic one (see **monohypotaxy** and **anhypotaxy**) and a nomenclatural one (see **monophory**). The use of this term in nomenclature is

here discouraged (see Dubois & Raffaëlli 2009: 401–405). • Traditional term in nomenclature. • *Code*: monotypy.

Name. • NO, TA. • A confusing term, used with many distinct senses in common language as well as in biology, and in biological nomenclature with several distinct meanings (see **nomen**, **onymorph**, **spelling**, **rank**, **author**). The use of this term in nomenclature to designate a scientific name is here discouraged (see Dubois 2000*b*: 39–40). • Traditional term in various domains of biology, including nomenclature. • *Code*: name.

Neonym. • AV. • G: νέος (*neos*), "new"; ὄνομα (*onoma*), "name". • Nomen created expressly to replace an available nomen (its **archaeonym**), and having the same onomatophore. Two categories: **alloneonym** and **autoneonym**. • Dubois 2000*b*: 52. • *Code*: new replacement name, *nomen novum*.

Neonymy. • AV. • The relationship between an archaeonym and its neonym. • Dubois 2006*a*: 169. • *Code*: no term.

Neophoront. • AL. • G: νέος (*neos*), "new"; φέρω (*phero*), "I bear"; ὄν, ὄντος (*on*, *ontos*), "being, individual". • Single specimen designated as **onymophoront** of a species-series nomen when the original or subsequent **onymophoront(s)** is/are considered to have been lost or destroyed. • Dubois 2005*a*: 403. • *Code*: neotype.

Nesonym. • AL. • G: νῆσος (*nesos*), "island"; ὄνομα (*onoma*), "name". • See **metronym**.

Nomen (pl. **nomina**). • NO, TA. • L: *nomen*, "name". • Scientific name as defined and regulated by the *Code*. • Dubois 2000*b*: 39. • *Code*: scientific name.

Nomenclatural act. • NO. • Any published action creating a new nomen or modifying the nomenclatural status of a nomen (e.g., a subsequent onomatophore designation, or a first-reviser action). • Term in traditional use in zoological nomenclature. • *Code*: nomenclatural act.

Nomenclatural process. • NO. • The process through which the valid nomen of a taxon is identified. It consists of three or four stages or steps (Dubois 2005*a–d*): **availability**, **allocation**, **validity and correctness**, and possibly **registration**. • Dubois 2005*c*: 381, 2010*b*: 11. • *Code*: no term.

Nomenclature. • NO, TA. • L: *nomenclatura*, "nomenclature". • In taxonomy, the system of nomina for taxonomy and taxa, including information attached to these nomina. • Term in traditional use in biology. • *Code*: nomenclature.

Nomina. • Plural of **nomen**.

Nominal-complex. • NO. • The complex [**nomen** + its **author** + its **date**] when these three pieces of information are given together as a single expression, which in this context can be viewed as an indissociable unit. • Dubois 2000*b*: 40. • *Code*: no term.

Nominal-series. • NO. • Any of the sets of coordinated nomina interacting for priority regarding synonymy and homonymy (**species-series**, **genus-series**, **family-series** or **class-series**). • Dubois 2000*b*: 40. • *Code*: group of names [English text]; niveau nomenclatural [French text].

Nothograph*. • CO. • G: νόθος (*nothos*), "wrong, illegitimate"; γράφω (*grapho*), "I write". • A category of **nothonym**: incorrect spelling of a nomen for a given taxon in a given taxonomy. Antonym: **eugraph**. • New term. • *Code*: incorrect spelling.

Nothohypse*. • CO. • G: νόθος (*nothos*), "wrong, illegitimate"; υψος (*hupsos*), "height". • A category of **nothonym**: incorrect rank of a nomen for a given taxon in a given taxonomy. Antonym: **euhypse**. • New term. • *Code*: no term.

Nothonym. • CO. • G: νόθος (*nothos*), "wrong, illegitimate"; ονομα (*onoma*), "name". • Incorrect **paronym** (**nothograph**, **nothohypse** and/or **nothonymorph**) of a nomen for a given taxon in a given taxonomy. Antonym: **eunym**. • Dubois 2000*b*: 54. • *Code*: no term.

Nothonymorph*. • CO. • G: νόθος (*nothos*), "wrong, illegitimate"; ονομα (*onoma*), "name"; μορφή (*morphe*), "form, shape". • A category of **nothonym**: incorrect onymorph of a nomen for a given taxon in a given taxonomy. Antonym: **eunymorph**. • New term. • *Code*: no term.

Nucleogenera. • Plural of *nucleogenus*.

Nucleogenus (pl. **nucleogenera**). • AL. • L: *nucleus* (from *nux*, "nut"), "nucleus, core, stone"; *genus*, "kind, family, race". • Generic taxomen used as onomatophore of a family-series or class-series nomen. • Dubois 2005*c*: 404. • *Code*: type genus.

Nucleomen (pl. **nucleomina**). ● AL. ● L: *nucleus* (from *nux*, "nut"), "nucleus, core, stone"; *nomen*, "name". ● Taxomen serving as onomatophore of a nomen of a nominal-series above the species-series. Two categories: **nucleogenus** and **nucleospecies**. ● Dubois 2005*c*: 403. ● *Code*: no term.

Nucleomina. ● Plural of *nucleomen*.

Nucleospecies. ● AL. ● L: *nucleus* (from *nux*, "nut"), "nucleus, core, stone"; *species*, "idea, kind, species". ● Specific taxomen serving as onomatophore of a genus-series nomen. ● Dubois 2005*c*: 404. ● *Code*: type species.

Nyctonym*. ● AL. ● G: νύξ, νυκτός (*nyx*, *nyctos*), "night, darkness"; ὄνομα (*onoma*), "name". ● **Monaptonym** whose **monophoric** onomatophore (**lectophoront**, **neophoront**, **nucleospecies** or **nucleogenus**) is a **nyctonymophoront**, i.e., cannot be identified as belonging to a known **ergotaxon**. Antonym: **photonym**. ● New term. ● *Code*: no term.

Nyctonymophoront*. ● AL. ● G: νύξ, νυκτός (*nyx*, *nyctos*), "night, darkness"; ὄνομα (*onoma*), φέρω (*phero*), "I bear"; ὄν, ὄντος (*on*, *ontos*), "being, individual". ● **Onymophoront** which does not show characters allowing identification of the natural population from which it was drawn. Antonym: **photonymophoront**. ● New term. ● *Code*: no term.

Onomatophore. ● AL. ● G: ὄνομα (*onoma*), "name"; φέρω (*phero*), "I bear, I carry". ● Objective standard of reference of **inclusive ostension** determining the taxonomic allocation of a nomen: the nomen can be potentially applied to any taxon that includes the onomatophore. In the species-series, onomatophores are specimens (see **onymophoront**), whereas in the genus-, family- and class-series they are **taxomina** (see **nucleomen**). ● Simpson 1940: 421. ● *Code*: type, name-bearing type.

Onomatostases. ● Plural of **onomatostasis**.

Onomatostasis (pl. **onomatostases**). ● AL. ● G: ὄνομα (*onoma*), "name"; στάσις (*stasis*), "standing, position, station". ● Objective standard of reference of **exclusive ostension** determining the taxonomic allocation of a nomen. ● Dubois 2005*b*: 79, 2005*d*: 203, 2006*a*: 189. ● *Code*: no term.

Onymology. ● NO. ● G: ὄνομα (*onoma*), "name"; λόγος (*logos*), "speech, discourse". ● The study of the concepts and theory of biological nomenclature. ● Dubois 2000*b*: 36. ● *Code*: no term.

Onymophoront. ● AL. ● G: ὄνομα (*onoma*), "name"; φέρω (*phero*), "I bear"; ὄν, ὄντος (*on*, *ontos*), "being, individual". ● Specimen(s) serving as onomatophore of a nomen of the species-series, which may be either single (**holophoront**, **lectophoront** or **neophoront**) or multiple (**symphoronts**). ● Dubois 2005*c*: 403. ● *Code*: type specimen.

Onymorph. ● AV, CO. ● G: ὄνομα (*onoma*), "name"; μορφή (*morphe*), "form, shape". ● Any particular association between genus-series **substantive**(s) and species-series **epithet**(s), used to designate a species-series taxon. A **combination** is a particular case of onymorph. ● Smith & Pérez-Higareda 1986: 422. ● *Code*: no term.

Onymotope. ● AL. ● G: ὄνομα (*onoma*), "name"; τόπος (*topos*), "place". ● Place of collection of the **onymophoront**(s) of a species-series nominal taxon. ● Dubois 2005*a*: 404. ● *Code*: type locality.

Original. ● NO. ● Concerning a **hoplonym**, any information provided in the very publication where it was created. ● Traditional term in zoological taxonomy and nomenclature. ● *Code*: original.

Oronym. ● AL. ● G: ὄρος (oros), "mountain"; ὄνομα (*onoma*), "name". ● Nomen created for a class-series protaxon all the **alienogenera** of which are still currently excluded from the metrotaxon including all its **conucleogenera** in a given class-series ergotaxonomy. This nomen, once called **choronym** (Dubois 2005*b*: 80, 2006*a*: 187), applies to the **orotaxon** that corresponds to it in this ergotaxonomy. ● New term. ● *Code*: no term.

Orotaxon. ● AL. ● G: ὄρος (oros), "mountain"; τάξις (*taxis*), "order, arrangement". ● In a given **ergotaxonomy**, the most inclusive (highest ranked) class-series **ergotaxon** including all the **conucleogenera** of a class-series **protaxon** and excluding all its alienogenera. ● Dubois 2006*a*: 188. ● *Code*: no term.

Orthochresonym. ● TA. ● G: ὀρθός (*orthos*), "right, correct"; χρησις (*chresis*), "use"; ονομα (*onoma*), "name". ● **Chresonym** appropriately used to designate a taxon. Antonym: **heterochresonym**. ● Dubois 2000*b*: 59. ● *Code*: no term.

Ostension. • NO. • System of allocation of a nomen to a concept or class (such as a taxon) through pointing to an object being an example or member of the class (**inclusive ostension**), or a non-example or non-member of the class (**exclusive ostension**), without providing an **intensional** or **extensional** definition, or information on the limits of the class. Three categories: **bidirectional**, **exclusive** and **inclusive** ostensions. • Traditional term in philosophy, logics and didactics (see Keller *et al.* 2003: 99; Dubois 2005*a*: 380). • *Code*: no term.

Paneurydiaphonym. • VA. • G: πᾶς (*pas*), "all, every, each"; εὐρύς (*eurus*), "broad, wide"; διάφωνος (*diaphonos*), "discordant"; ὄνομα (*onoma*), "name". • **Eurydiaphonym** that is the only one to have been used as valid for a given taxon, or for taxa having totally or partially identical extensions, in non-systematic literature after 31 December 1899. • Dubois 2005*b*: 85, 2005*c*: 412. • *Code*: no term.

Paralectotype. • NO, TA. • G: παρά (*para*), "near, beside, along"; λεκτός (*lektos*), "chosen, picked out", from the verb λέγω (*lego*), "to choose, to pick"; τύπος (*typos*), "image, figure". • A confusing term, used in the *Code* to designate "*each specimen of a former syntype series remaining after the designation of a lectotype*". Contrary to the latter, it does not play any more, after this designation, a nomenclatural function of **onomatophore** but only a taxonomic function of **protaxont**, being one of the specimens of the **hypodigm**. The use of this term in nomenclature is here discouraged (see Dubois 2005*c*: 401–405). • Traditional term in biological nomenclature. • *Code*: paralectotype.

Paratype. • NO, TA. • G: παρά (*para*), "near, beside, along"; τύπος (*typos*), "image, figure". • A confusing term, used in the *Code* to designate "*each specimen of a type series other than the holotype*". Contrary to the latter, it does not play a nomenclatural function of **onomatophore** but only a taxonomic function of **protaxont**, being one of the specimens of the **hypodigm**. The use of this term in nomenclature is here discouraged (see Dubois 2005*c*: 401–405). • Traditional term in biological nomenclature. • *Code*: paratype.

Parograph. • AV, CO. • G: παρά (*para*), "near, beside, along"; γράφω (*grapho*), "value, dignity". • A category of **paronym**: any of the avatars, either original (**protograph**) or subsequent (**apograph**), of the spelling of a nomen. • Dubois 2010*c*: 6. • *Code*: no term.

Parohypse. • AV, CO. • G: παρά (*para*), "near, beside, along"; υψος (*hupsos*), "height". • A category of **paronym**: any of the avatars, either original (**protohypse**) or subsequent (**apohypse**), of the rank of a nomen. • Dubois 2010*c*: 6. • *Code*: no term.

Paronym. • AV, CO. • G: παρά (*para*), "near, beside, along"; ὄνομα (*onoma*), "name". • Any of the avatars of a nomen, either original (**protonym**) or subsequent (**aponym**), and concerning its spelling (**parograph**), rank (**parohypse**) and/or, if relevant, onymorph (**paronymorph**) (spellings, ranks or onymorphs). • Dubois 2000*b*: 53. • *Code*: no term.

Paronymorph. • AV, CO. • Gr: παρά (*para*), "near, beside, along"; ονομα (*onoma*), "name"; μορφή (*morphe*), "form, shape". • A category of **paronym**: any of the avatars, either original (**protonymorph**) or subsequent (**aponymorph**), of the onymorph of a nomen. • Dubois 2000*b*: 53. • *Code*: no term.

Paronymy*. • AV, CO. • The relationships between the **paronyms** of a nomen. • Dubois 2000*b*: 58 (in the sense of *paronymic list*). • *Code*: no term.

Parordinate. • NO, TA. • L: *par*, "equal, same"; *ordo*, "series, line, row, order". • Qualification of any of two or more taxa that have the same hierarchical rank and are *immediately* **subordinate** to the same **superordinate** taxon. • Dubois 2006*b*: 827, 2007*a*: 33, 2008*a*: 60. • *Code*: no term.

Photonym*. • AL. • G: φως, φωτός (*phos, photos*), "light, day"; ὄνομα (*onoma*), "name". • **Monaptonym** whose **monophoric** onomatophore (**lectophoront**, **neophoront**, **nucleospecies** or **nucleogenus**) is a **photonymophoront**, i.e., is identified as belonging to a known **ergotaxon**. Antonym: **nyctonym**. • New term. • *Code*: no term.

Photonymophoront*. • AL. • G: φως, φωτός (*phos, photos*), "light, day"; ὄνομα (*onoma*), φέρω (*phero*), "I bear"; ὄν, ὄντος (*on, ontos*), "being, individual". • **Onymophoront** showing characters allowing identification of the natural population from which it was drawn. Antonym: **nyctonymophoront**. • New term. • *Code*: no term.

Plenary-Power. ● NO. ● The power of the ICZN to suspend or modify the application of Art. 1 to 76 of the *Code* in certains cases in the way that it considers necessary to serve the interests of stability and universality of nomenclature. ● *Code*: plenary power.

Polyhypotaxy. ● TA. ● G: πολύς (*polys*), "numerous"; ὑπό (hypo), "below"; τάξις (*taxis*), "order, arrangement". ● Mode of **hypotaxy** of a taxon that includes more than two **parordinate** taxa of just lower rank. In a phylogenetic taxonomic frame, the meaning of this pattern is unclear, as two different situations may account for it: (1) these parordinate taxa are the members of a still unresolved polytomy, which subsequent work can possibly resolve; (2) an hypothesis already exists regarding the relationships between the members of the polytomy, but it was not implemented into the ergotaxonomy in order to limit the number of ranks of this taxonomy. ● Dubois & Raffaëlli 2009: 12. ● *Code*: no term.

Polysemic. ● AV. ● G: πολύς (*polys*), "numerous"; σῆμα (sema), "sign, mark". ● In the context of zoological nomenclature, the qualification of either (1) a system that allows the same nomen to designate distinct taxa at different nomenclatural ranks within the same nominal-series, and standing in a situation of nomenclatural **coordination**, or (2) any nomen being in this situation (see Dubois 2007*a*: 41). Antonym: **monosemic**. ● Traditional term in linguistics and grammar. ● *Code*: no term.

Potentially valid. ● AV. ● A useless term, used briefly in page 123 and 260 of the *Code* but being strictly synonym of the term **available**. The use of this term in zoological nomenclature is here discouraged. ● Traditional term in zoological and botanical nomenclature. ● *Code*: potentially valid.

Precedence. ● VA. ● In zoological nomenclature, the fact that a nomen must be used as valid against its potential synonyms and homonyms, as a result either of the Principle of First-Reviser, of the Principle of Priority or of the Principle of Sozonymy (see Appendix 2). ● Traditional term in zoological nomenclature. ● *Code*: precedence.

Prenucleogenera. ● Plural of **prenucleogenus**.

Prenucleogenus (pl. **prenucleogenera**). ● AL. ● L: *prae*, in the sense of "before"; *nucleus*, "nucleus, core, stone" (from *nux*, "nut"); *genus*, "birth, origin, class, kind". ● One of several nominal genera originally included in a new nominal family-series at its first publication (generic **symphory**), before subsequent designation among them of a single nucleospecies. ● Dubois 2005*c*: 404. ● *Code*: originally included nominal genera.

Prenucleospecies. ● AL. ● L: *prae*, in the sense of "before"; *nucleus*,"nucleus, core, stone" (from *nux*, "nut"); *species*, "species". ● One of several nominal species originally included in a new nominal genus or subgenus at its first publication (specific **symphory**), before subsequent designation among them of a single nucleospecies. ● Dubois 2005*c*: 404. ● *Code*: originally included nominal species.

Primary combination. ● VA. ● The original association between a new final epithet and a generic substantive as it was first published. ● Dubois 1995: 64. ● *Code*: no term.

Primary symphoront. ● AL. ● The specimens which had been examined, described and/or illustrated by the author of the original description in which a new nomen was created. ● Dubois & Ohler 1997*a*: 310 (as *primary syntype*). ● *Code*: no term.

Principle. ● NO. ● A fundamental and general Rule, which is the basis for all particular and specific Rules of the *Code*. Appendix 2 presents the 13 Principles recognized and defined in the present work. ● Traditional term in zoological nomenclature. ● *Code*: Principle.

Priority. ● VA. ● In the context of zoological nomenclature, the fact that a nomen or a nomenclatural act published previously to another one has nomenclatural precedence on the latter. ● Traditional term in zoological nomenclature. ● *Code*: priority.

Protaxon. ● AL. ● G: προ- (*pro*-), in the sense of "first, primitive, original"; τάξις (*taxis*), "order, arrangement". ● Taxon with its complete original **extension** (i.e., members, **circumscription**) in the publication where it was first proposed. ● Dubois 2005*a*: 405. ● *Code*: no term.

Protaxont. ● TA. ● G: πρωτος (*protos*), "first, earliest"; τάξις *(taxis)*, "order, arrangement"; ὄν, ὄντος (*on*, *ontos*), "being, individual". ● A specimen member of the **hypodigm**, i.e., used in taxonomy in the original description of a species-series taxon to provide information on the characters considered to be **diagnostic** or **apognostic** of a taxon. Antonym: **apotaxont**. ● Dubois 2010*e*: 23. ● *Code*: no term.

Protoallelonym*. ● G: πρωτος (*protos*), “first, earliest”; άλλήλων (*allelon*), “the one… the other…”; ονομα (*onoma*), “name”. ● One of two (or several) **allelonyms** having the same onomatophore proposed for the same taxon (same content) in the same publication. Antonym: **apoallelonym**. ● New term. ● *Code*: no term.

Protaxonomy. ● NO, TA. ● G: προ- (*pro*-), in the sense of “first, primitive, original”; τάξις (*taxis*), “order, arrangement”; νόμος (*nomos*), “law, rule”. ● Original classification used by an author in a publication where he/she created at least one new nomen. ● Dubois 2005*c*: 406. ● *Code*: no term.

Protograph. ● AV. ● G: πρωτος (*protos*), “first, earliest”; γράφω (*grapho*), “I write”. ● A category of **protonym**: original **parograph** (spelling) of a nomen. Antonym: **apograph**. ● Dubois 2010*c*: 6. ● *Code*: original spelling.

Protohypse. ● AV. ● Gr: πρωτος (*protos*), “first, earliest”; υψος (*hypsos*), “height”. ● A category of **protonym**: original rank of a nomen. Antonym: **apohypse**. ● Dubois 2010*c*: 6. ● *Code*: no term.

Protologue. ● AL. ● G: πρῶτος (*protos*), “first, earliest”; λόγος (*logos*), “speech, discourse”. ● A term of botanical nomenclature, which designates everything associated with a nomen in the original publication where it was created, i.e., diagnosis, description, specimens, illustrations, references, synonymy, geographical data, discussion and comments. ● Term in traditional use in botanical nomenclature. ● *Code*: no term.

Protonym. ● AV. ● G: πρῶτος (*protos*), “first, earliest”; ὄνομα (*onoma*), “name”. ● Original spelling (**protograph**), rank (**protohypse**) and/or, if relevant, onymorph (**protonymorph**) of a nomen. Antonym: **aponym**. ● Dubois 2000*b*: 51. ● *Code*: no term.

Protonymorph. ● AV. ● G: πρωτος (*protos*), “first, earliest”; ὄνομα (*onoma*), “name”; μορφή (*morphe*), “form, shape”. ● A category of **protonym**: original onymorph of a nomen. Antonym: **aponymorph**. ● Dubois 2010*c*: 6. ● *Code*: no term.

Publication. ● AV. ● In the context of zoological nomenclature, issuing of a work conforming to the provisions of Art. 8–9 of the *Code* (i.e., mostly, printed with ink on paper and distributed as several identical copies). ● Traditional term in zoological nomenclature. ● *Code*: publication.

Quadrinomen (pl. **quadrinomina**). ● AV, CO. ● L: *quattuor*, “four”; *nomen*, “name”. ● Nomen of rank variety, composed of four terms, the genus substantive and the species, subspecies and variety epithets. ● Traditional term in zoological nomenclature. ● *Code*: no term.

Quadrinomina. ● Plural of *quadrinomen.*

Quinquenomen* (pl. **quinquenomina***). ● AV, CO. ● L: *quinque*, “five”; *nomen*, “name”. ● Nomen of rank form, composed of five terms, the genus substantive and the species, subspecies, variety and form epithets. ● New term. ● *Code*: no term.

Quinquenomina*. ● Plural of *quinquenomen.*

Rank. ● NO, TA. ● The place of a nomen in a nomenclatural hierarchy or of a taxon in a taxonomic hierarchy. In the zoological *Code*, each rank is referred to a given **nominal-series**. ● Traditional term in nomenclature and taxonomy. ● *Code*: rank.

Registered. ● RE. ● Qualification of a **nomen** (**delonym**), of an **onomatophore** or of a **paronym** that will conform to the conditions of nomenclatural registration if they are once incorporated into the *Code* (see Dubois 2010*b*). Antonym: **unregistered**. ● Traditional term in many domains. ● *Code*: no term.

Registration. ● RE. ● Nomenclatural act not yet regulated by the *Code* by which a nomen (**delonym**), an onomatophore or a paronym registered into an international nomenclatural database is permanently available in zoological nomenclature. If recognized by the *Code*, this act would give its name to the fourth floor or stage of the nomenclatural process (Dubois 2005*a–d*, 2010*b*). ● Traditional term in many domains. ● *Code*: registration.

Schizeurydiaphonym. ● VA. ● G: σχίζω (*skhizo*), “to split, to cleave, to separate”; εὐρύς (*eurus*), “broad, wide”; διάφωνος (*diaphonos*), “discordant”; ὄνομα (*onoma*), “name”. ● **Eurydiaphonym** that has been *significantly* used as valid for a given taxon, or for taxa having totally or partially identical extensions, in non-systematic literature after 31 December 1899, but *alternatively* to another eurydiaphonym that has also been used significantly for the same taxon or for taxa having totally or partially identical extensions. ● Dubois 2005*b*: 85, 2005*c*: 412. ● *Code*: no term.

Secondary combination. • CO. • Any subsequent association of a final epithet with a generic substantive different from that with which it was combined in the original publication where it was made available. • Dubois 1995: 64. • *Code*: no term.

Secondary symphoront. • AL. • The specimens which had not been examined, described and/or illustrated by the author of the original description in which a new nomen was created, but by a previous author in a earlier work quoted in this original description as a basis for the recognition of a new taxon. • Dubois & Ohler 1997*a*: 310 (as *secondary syntype*). • *Code*: no term.

Semaphoront. • TA. • G: σῆμα (*sema*), "sign, mark"; φέρω (*phero*), "I bear"; ὄν, ὄντος (*on*, *ontos*), "being, individual". • Any specimen from a given population and of a given sex, stage and age, that bears an indefinite number of characters potentially usable in taxonomy (as **taxont**) or sometimes in nomenclature (as **photonymophoront**). • Hennig 1950, 1966. • *Code*: no term.

Senior. • VA. • In the context of zoological nomenclature, and concerning a nomen or a nomenclatural act: published at a date prior to that of publication of another nomen or nomenclatural act, qualified as **junior**. • Traditional term in nomenclature. • *Code*: senior.

Sozonym. • VA. • G: σῴζω (*sozo*), "to keep, to protect"; ὄνομα (*onoma*), "name". • Nomen that has had a universal or significant use in non-systematic literature after 31 December 1899, being either a **symphonym** or a **paneurydiaphonym**, whereas none of its synonyms has been used so for the same taxon or closely related taxa. Such a nomen, if not invalid for another reason, must be validated even if this requires to make an exception to the Rules, e.g., against a senior synonym or homonym. Antonym: **distagmonym**. • Dubois 2005*b*: 86, 2005*c*: 412. • *Code*: *nomen protectum*.

Sozonymy. • VA. • Principle which applies in zoological nomenclature whenever, among two or more synonyms or homonyms, one qualifies as a **sozonym**. In such cases, the sozonym must be given precedence for validity (if not invalid for another reason) over its senior synonym(s) or homonym(s). • New term. • *Code*: prevailing usage.

Species-series. • NO. • In the nomenclatural hierarchy, the lowest-ranking **nominal-series** which is fully regulated by the *Code*, ranked below the genus-series. It includes nomina of taxa at the ranks of species, subspecies, species aggregate and subspecies aggregate. • Dubois 2000*b*: 40. • *Code*: species group [English text]; niveau espèce [French text].

Spelling. • AV, CO. • The arrangement of letters that form a word. In nomenclature, the same nomen can take different spellings, its **parographs**. • Traditional term in nomenclature. • *Code*: spelling.

Stage. • NO. • One of the three or four stages, steps or levels of the **nomenclatural process** leading to the valid nomen of any given taxon (Dubois 2005*a–d*): **availability**, **allocation**, **validity** and possibly **registration**. • Dubois 2005*c*: 381, 2010*b*: 11. • *Code*: no term.

Stenodiaphonym. • VA. • G: στενός (*stenos*), "narrow"; διάφωνος (*diaphonos*), "discordant"; ὄνομα (*onoma*), "name". • Nomen that has *not* been *significantly* used as valid in non-systematic literature after 31 December 1899. • Dubois 2005*b*: 85, 2005*c*: 411. • *Code*: no term.

Subordinate. • NO, TA. • L: *sub*, "below"; *ordo*, "series, line, row, order". • Qualification of a taxon that is at a lower hierarchical rank than another taxon, which is **superordinate** to it. • Traditional term in zoological taxonomy and nomenclature. • *Code*: subordinate.

Subsequent. • NO. • Concerning a **hoplonym**, any nomenclatural act, creation of an aponym or publication of information relevant for nomenclature in a work published subsequently to the original publication where the hoplonym was created. • Traditional term in zoological taxonomy and nomenclature. • *Code*: subsequent.

Substantive. • NO. • Generic or subgeneric **nomen**, always bearing a capital, being part of a binomen, trinomen, quadrinomen or quinquenomen. • Dubois 2000*b*: 40. • *Code*: genus-group name [English text]; nom du niveau genre [French text].

Superordinate. • NO, TA. • L: *super*, "above"; *ordo*, "series, line, row, order". • Qualification of a taxon that is at a higher hierarchical rank than another taxon, which is **subordinate** to it. • Traditional term in zoological taxonomy and nomenclature. • *Code*: no term.

Symphonym. • VA. • G: σύμφωνος (*symphonos*), "harmonious"; ὄνομα (*onoma*), "name". • Nomen used as valid for the taxon it denotes, or for taxa having totally or partially identical extensions, by *all* authors and in *all* publications after 31 December 1899. • Dubois 2005*b*: 85, 2005*c*: 411. • *Code*: no term.

Symphoront. • AL. • G: σύν (*syn*), "together"; φέρω (*phero*),"I bear"; ὄν, ὄντος (*on*, *ontos*), "being, individual". • One of several specimens originally used collectively as **onomatophore** of a species-series nomen. • Dubois 2005*c*: 403. • *Code*: syntype.

Symphory. • AL. • G: σύν (*syn*), "together"; φέρω (*phero*), "I bear". • Qualification of a nomen created with and supported by an onomatophore composed of a series of specimens (in the species-series) or of taxomina (in the three other nominal-series). • Dubois 2005*c*: 404. • *Code*: no term.

Symprotograph. • AV. • G: σύν (*syn*), "together"; πρωτος (*protos*), "first, earliest"; γράφω (*grapho*), "I write". • A category of **symprotonym**: one of two or more alternative original spellings of a nomen. • Dubois 2010*c*: 8. • *Code*: one of multiple original spellings.

Symprotohypse*. • AV. • G: σύν (*syn*), "together"; πρωτος (*protos*), "first, earliest"; υψος (*hupsos*), "height". • A category of **symprotonym**: one of two or more alternative original ranks of a nomen. • New term. • *Code*: no term.

Symprotonym. • AV. • G: σύν (*syn*), "together"; πρῶτος (*protos*), "first, earliest"; ὄνομα (*onoma*), "name". • One of two or more alternative original protonyms (**symprotograph**, **symprotohypse** and, if relevant, **symprotonymorph**) of a nomen (see details in Dubois 2010*c*). • Dubois & Ohler 2009: 4. • *Code*: one of the multiple original spellings.

Symprotonymorph*. • AV. • G: σύν (*syn*), "together"; πρωτος (*protos*), "first, earliest"; ονομα (*onoma*), "name"; μορφή (*morphe*), "form, shape". • A category of **symprotonym**: one of two or more alternative original onymorphs of a nomen. • New term. • *Code*: no term.

Synaptonym*. • AL. • G: σύν (*syn*), "together"; ἅπτω (*apto*), "fasten, attach, fix"; ὄνομα (*onoma*), "name". • **Aptonym** whose onomatophore is **symphoric**, being composed of more than one specimen (in the species-series: *symphoronts*) or **taxomen** (in the genus-series: **prenucleospecies**; in the class-series: **conucleogenera**). Synaptonyms may be **original** (**symphory** fixed in the original publication) or **subsequent** (**symphory** being subsequent to **aphory** in the original publication). They may also be indissoluble or considered taxonomically homogeneous (**homosynaptonyms**) or considered taxonomically heterogeneous (**heterosynaptonyms**). Antonym: **monaptonym**. • New term. • *Code*: no term.

Synonym. • VA, TA. • G: σύν (*syn*), "together"; ονομα (*onoma*), "name". • Any of two or more distinct **protonyms** *of the same nominal-series* considered, either for objective (**isonyms**) or for subjective (**doxisonyms**) reasons, to denote the same taxon in a given **ergotaxonomy**. • Traditional term in zootaxonomy. • *Code*: synonym.

Synonymic list. • VA, TA. • List of synonyms. • Traditional term in zootaxonomy. • *Code*: no term.

Synonymy. • VA, TA. • The fact that two distinct nomina of the same nominal-series are considered to denote the same taxon in a given ergotaxonomy, either for objective (**isonymy**) or for subjective (**doxisonymy**) reasons. • Traditional term in zootaxonomy. • *Code*: synonymy.

Synonymy load. • NO. • The quantitative importance of synonyms (mainly doxisonyms) in a given ergotaxonomy. • Dubois 2008*c*: 857. • *Code*: no term.

Systematics. • NO, TA. • G: σύστημα (*systema*), "group, troup, system of doctrines, institutions, political constitution, philosophical system". • The domain of biology devoted to the study of the diversity of living organisms and of the relationships among them. • Term in traditional use in biology. • *Code*: systematics.

Taxa. • Plural of **taxon**.

Taxognoses. • Plural of **taxognosis**.

Taxognosis. • TA. • G: τάξις (*taxis*), "order, arrangement"; γιγνώσκω (*gignosko*), ''to know''. • Any definition of a taxon, whether based on characters or on hypothesized cladistic relationships between taxa. • Dubois & Raffaëlli 2009: 15. • *Code*: no term.

Taxomen (pl. **taxomina**). • AL. • G: τάξις (*taxis*), "order, arrangement"; L: *nomen*, "name". • The permanent association between a nomen (**hoplonym**) and an **onomatophore**, allowing objective, non-ambiguous and stable allocation of nomina to taxa. • Dubois 2000*b*: 40. • *Code*: nominal taxon.

Taxomina. • Plural of **taxomen**.

Taxon (pl. **taxa**). • NO, TA. • Gr.: τάξις (*taxis*), "order, arrangement". • Any taxonomic unit recognized by a zoologist, whether named or not. • Meyer 1926: 127. • *Code*: taxon, taxonomic taxon.

Taxonomy. • NO, TA. • G: τάξις (*taxis*), "order, arrangement"; νόμος (*nomos*), "law, rule". • The discipline of systematics that deals with the theory and practice of the classification of living organisms. • De Candolle 1813: 19. • *Code*: taxonomy.

Taxont. • TA. • G: τάξις *(taxis)*, "order, arrangement"; ὄν, ὄντος (*on*, *ontos*), "being, individual". • A specimen used in taxonomy to provide information on the characters considered to be **diagnostic** or **apognostic** of a species-series taxon. Two categories: **protaxont** and **apotaxont**. • Dubois 2010*e*: 23. • *Code*: no term.

Tertiary symphoront. • AL. • The specimens which had been examined, described and/or illustrated neither by the author A of the original description in which a new nomen was created, nor by a previous author B in a earlier work quoted in this original description, but by a still earlier author C, quoted by the author B in the work quoted by A in the original description, as a basis for the recognition of a new taxon. • Dubois & Ohler 1997*a*: 310 (as *tertiary syntype*). • *Code*: no term.

Theory-bound. • AL. • Concerning a nomenclatural system, the fact that it is linked to a taxonomic paradigm. In such a system, the allocation of nomina to taxa relies on **intension**, not on **ostension** or **extension** (see Dubois 2006*b–c*, 2007*a*, 2008*g*). • Dubois 2010*f*: 5. • *Code*: no term.

Theory-free. • AL. • Concerning a nomenclatural system, the fact that it is independent from all taxonomic paradigms. In such a system, the allocation of nomina to taxa relies exclusively on ostension or extension, never on intension (see Dubois 2006*b–c*, 2007*a*, 2008*g*). • Dubois 2007*a*: 43, 2007*c*: 396. • *Code*: no term.

Trinomen (pl. **trinomina**). • AV, CO. • L: *tres*, "three"; *nomen*, "name". • Nomen of rank subspecies, composed of three terms, the generic substantive and the specific and subspecific epithets. • Traditional term in zoological nomenclature. • *Code*: trinomen.

Trinomina. • Plural of *trinomen.*

Type. • NO, TA. • G: τύπος (*typos*), "image, figure". • A confusing term, used with many distinct senses in common language as well as in biology, and in systematics with two distinct meanings, a taxonomic one (see **hypodigm**) and a nomenclatural one (see **onomatophore**). The use of this term in nomenclature is here discouraged (see Dubois 2005*c*: 401–405). • Traditional term in various domains of biology, including nomenclature. • *Code*: type.

Unallocated. • AL. • Qualification of a nomen (**anaptonym**) that does not conform to the conditions of nomenclatural allocation as regulated by the *Code*. Antonym: **allocated**. • Dubois 2005*c*: 396. • *Code*: no term.

Unavailable. • AV. • Qualification of a nomen (**anoplonym**) that does not conform to the conditions of nomenclatural availability as regulated by the *Code*. Antonym: **available**. • Traditional term in nomenclature. • *Code*: unavailable.

Unidentified. • AL. • Qualification of a nomen (**nyctonym**) that cannot be identified to refer to a known **ergotaxon**. Antonym: **identified**. • Traditional term in taxonomy. • *Code*: no term.

Uninomen (pl. **uninomina**). • AL. • L: *unus*, "one"; *nomen*, "name". • Nomen of any rank composed of a single term. • Traditional term in zoological nomenclature. • *Code*: no term.

Uninomina. • Plural of *uninomen.*

Unregistered. • RE. • Qualification of a nomen (**adelonym**) that will not conform to the conditions of nomenclatural registration if they are once incorporated into the *Code* (see Dubois 2010*b*). Antonym: **registered**. • Traditional term in many domains. • *Code*: no term.

Usage. • VA. • In the context of zoological nomenclature, the fact that a nomen has been mentioned in some publications and during a given period. • Traditional term in nomenclature. • *Code*: usage.

Valid. ● VA. ● In the context of zoological nomenclature, qualification of a nomen (**kyronym**) that conforms to the conditions of nomenclatural validity as regulated by the *Code*. Antonym: **invalid**. ● Traditional term in nomenclature. ● *Code*: valid.

Validity. ● VA. ● Nomenclatural act regulated by the *Code* by which a nomen is determined to be the one that must be used for to a taxon or several taxa in zoological nomenclature (**kyronym**). This act gives its name to the third floor or stage of the nomenclatural process (Dubois 2005*a–d*). ● Traditional term in nomenclature. ● *Code*: validity.

Variety-series. ● NO. ● In the nomenclatural hierarchy, the set of nomina ranked below the species-series, which are not regulated by the *Code*. If it was to be recognized as a distinct nominal-series (see text), it would include nomina of taxa at the ranks of variety, form, morph, phase, and additional ranks that may be required. ● Dubois 2005*c*: 408. ● *Code*: no term.

Zootaxonomy. ● NO, TA. ● G: ζωον (*zoon*), "animal", τάξις (*taxis*), "order, arrangement"; νόμος (*nomos*), "law, rule". ● Zoological taxonomy. ● Term in use in recent publications dealing with zoological taxonomy. ● *Code*: no term.

APPENDIX 2. NOMENCLATURAL PRINCIPLES. New proposals concerning the Principles of the *Code*. See text for explanations and details. For each Principle this list provides: (1) the name of the Principle; (2) a definition; (3) correspondence in the *Code*.

P1. **Principle of Nomenclatural Independence**. • The *Code* only regulates the availability, taxonomic allocation, validity and registration of nomina of zoological taxa. It is independent from taxonomy, i.e., it does not interfere with taxonomic thought and actions, and therefore does not prescribe the choice of a taxonomic paradigm or of criteria for the recognition, discrimination or definition of taxa. • *Code*: not stated as a Principle, but appears in one sentence in *Preamble* (p. 2).

P2. **Principle of Nomenclatural Foundation**. • The nomenclatural status of a nomen is fixed once and for all in the original publication where the nomen is created. Except in the cases that fall under the provisions of the Principle of First-Reviser, this status cannot be modified by subsequent actions of individual zoologists, but only by the ICZN using its Plenary-Powers. • *Code*: not stated as a Principle, but implicitly followed throughout the *Code*.

P3. **Principle of First-Reviser**. • Whenever an ambiguity exists regarding the nomenclatural status of a nomen after its creation (e.g., if the precedence between nomina or spellings cannot be objectively determined by priority, or if the original onomatophore of a nomen consists of several specimens or taxomina that are subsequently referred to different taxa), the action of the first author publishing an explicit nomenclatural act (e.g., choice between these nomina or spellings, or among several onomatophores) removes this ambiguity forever. This First-Reviser action is definitive and irreversible by subsequent actions of individual zoologists. • *Code*: Principle of the First Reviser (Art. 24.2.1, p. 30).

P4. **Principle of Nominal-Series**. • The *Code*'s nomenclatural hierarchy covers all taxa recognized by taxonomists in the animal kingdom. This hierarchy is divided in four nominal-series: the species-series (species, subspecies, etc.), the genus-series (genus, subgenus, etc.), the family-series (family, superfamily, subfamily, tribe, subtribe, etc.) and the class-series (class, order, etc.). Within each series, zootaxonomists can recognize as many ranks as needed, using special terms (e.g., phalanx or exerge) or prefixes (e.g., sub- or super-) to distinguish them. To become available, in the original publication where a new nomen is created, it must be unambiguously referred, either implicitly (before 2011) or explicitly (after 2010) to one of these four nominal-series, it must follow the Principle of Binomina regarding the number of its words and the Rules of formation of nomina applying to the nominal-series at stake, and the nominal-series must not overlap hierarchically, i.e., the following conditions must be respected: (1) a nomen referred to a nominal-series should not be created subordinate to a nomen referred to a lower nominal-series (e.g., a taxon of rank order cannot be subordinate to a taxon of rank family, a taxon of rank family cannot be subordinate to a taxon of rank genus); (2) nomina at different ranks should never be parordinate, i.e., any two taxa subordinate to the same superordinate taxon must be ascribed the same nomenclatural rank, in the same nominal-series. The interposition within a nomenclatural hierarchy of "informal taxa" at "informal ranks", or "unranked taxa", not being referred to any of the nominal-series and ranks recognized by the *Code*, are incompatible with the latter, and such nomina are unavailable. • *Code*: not stated as a Principle, but some of the conditions listed here are briefly mentioned in Art. 1.2.2 (p. 3) and followed throughout the *Code*.

P5. **Principle of Binomina**. • The nomen of a taxon of rank species is a binomen, i.e., a combination of a generic substantive and a specific epithet. The nomen of a taxon of rank subspecies is a trinomen, including a subspecific epithet after the specific epithet. The nomina of all taxa above the species-series are uninomina, i.e., they consist of a single word. Nomina of subgenera, aggregates of species and aggregates of subspecies are uninomina that must be interpolated in parentheses between those of their superordinate and subordinate taxa; such nomina are not counted in the number of words of a binomen or trinomen. Epithets must begin with a lower-case letter, and all other nomina with an upper-case letter. An epithet must be either a noun in the genitive or in apposition, or an adjective or a participle agreeing in grammatical gender with the generic substantive. A generic or subgeneric

substantive must be a noun in the nominative singular. A family-series nomen must be a noun in the nominative plural based on the stem of a generic substantive, and followed by an ending which indicates the rank in which it is used. A class-series nomen must be a noun in the nominative plural. • *Code*: Principle of Binominal Nomenclature (Art. 5–6, p. 4–6).

P6. **Principle of Coordination**. • (1) In the family-, genus- and species-series, a nomen created for a taxon at any rank of the nominal-series is deemed to be simultaneously created for any other taxon at any other rank of the same nominal-series. Whenever indeed used for such other taxa, these are not different nomina but they are all avatars of the same nomen, having the same onomatophore, author and date. They are modified whenever appropriate, either in their spelling (in the family-series) or in their onymorph (in the species-series), but not in the genus-series. (2) The Principle of Coordination does not apply in the class-series, except in the case of a taxon that includes only one taxon of the just subordinate rank (e.g., a class with a single order), in which cases both taxa bear the same nomen, with the same onomatophore, author and date. • *Code*: Principle of Coordination (Art. 36, p. 45; Art. 43, p. 48; Art 46, p. 50).

P7. **Principle of Neonymy**. • Explicit replacement of an available nomen by a different nomen results in the creation of a *neonym*, which has the same onomatophore as the replaced nomen (*archaeonym*) but a different author and date. A neonym having the exactly same etymology (stem) as its archaeonym is an *autoneonym*, whereas a neonym having a partially or completely different etymology (different or multiple stem) is an *alloneonym*. • *Code*: not stated as a Principle, but some of the conditions listed here are mentioned in Art. 67.8 (p. 68) and 72.7 (p. 78).

P8. **Principle of Onomatophores**. • (1) Each nomen in the family-, genus- or species-series has, actually or potentially, an *onomatophore*, i.e., an objective standard of reference of inclusive ostension whereby the taxonomic allocation of the nomen can be determined. In any given ergotaxonomy, the nomen can be potentially applied to any taxon that includes its onomatophore. In the species-series, onomatophores are specimens (*onymophoronts*), whereas in the genus- and family-series they are nomina (*nucleomina*): *nucleospecies* in the genus-series and *nucleogenera* in the family-series. (2) In the class-series, the taxonomic allocation of each nomen is made, according to the situation, either by inclusive ostension using a set of *conucleogenera* as onomatophore, or by bidirectional ostension using both a set of *conucleogenera* as onomatophore and a set of *alienogenera* as *onomatostases*, i.e., objective standard of reference of exclusive ostension. • *Code*: Principle of Typification (Art. 61, p. 63–64).

P9. **Principle of Synonymy**. • Whenever two nomina of the same nominal-series are based on the same onomatophore (*isonyms*) or considered as synonyms in a given ergotaxonomy (*doxisonyms*), only one can be potentially valid (if not invalid for another reason). This potentially valid nomen is determined, according to the situation, by either the Principle of Priority or the Principle of Sozonymy. • *Code*: part of the Principle of Priority (Art. 23, p. 24).

P10. **Principle of Homonymy**. • Whenever two nomina of the same nominal-series are strictly identical or deemed to be identical under the Rules of the *Code*, only one can be potentially valid (if not invalid for another reason). This potentially valid nomen is determined, according to the situation, by either the Principle of Priority or the Principle of Sozonymy. • *Code*: Principle of Homonymy (Art. 52, p. 56).

P11. **Principle of Priority**. • Among two or more synonyms or homonyms, the valid one (if not invalid for another reason) is the first published one. In case of simultaneous publication of the nomina at stake, the Principle of First-Reviser applies. In case one of the nomina at stake is a sozonym, the Principle of Sozonymy applies. • *Code*: part of the Principle of Priority (Art. 23, p. 24).

P12. **Principle of Sozonymy**. • Among two or more synonyms, whenever one qualifies as *sozonym*, i.e., has been used since its creation either *universally* (*symphonym*) or *significantly in the non-systematic literature* whereas none of its synonyms has been used so for the same taxon or closely related taxa (*paneurydiaphonym*), it must be given precedence for validity (if not invalid for another reason) over its senior synonym(s). The same applies to two or more homonyms, if one qualifies as a sozonym and if its senior homonym(s) have not been used significantly in the non-systematic literature. • *Code*: not

stated as a Principle, but some of the conditions listed here appear in Art. 23.9 on Reversal of precedence (p. 27–29).

P13. **Principle of Registration**. • Nomina registered online in an international open database under the control of the ICZN are protected from oblivion and rejection through sozonym validation. They cannot become *nomina oblita* and their validity against potential synonyms or homonyms rests on the Principle of Priority alone. Registration can also apply to onomatophores (onymophoronts and nucleomina) and paronyms (parographs, parohypses and paronymorphs). • *Code*: absent.

APPENDIX 3. FIGURES.

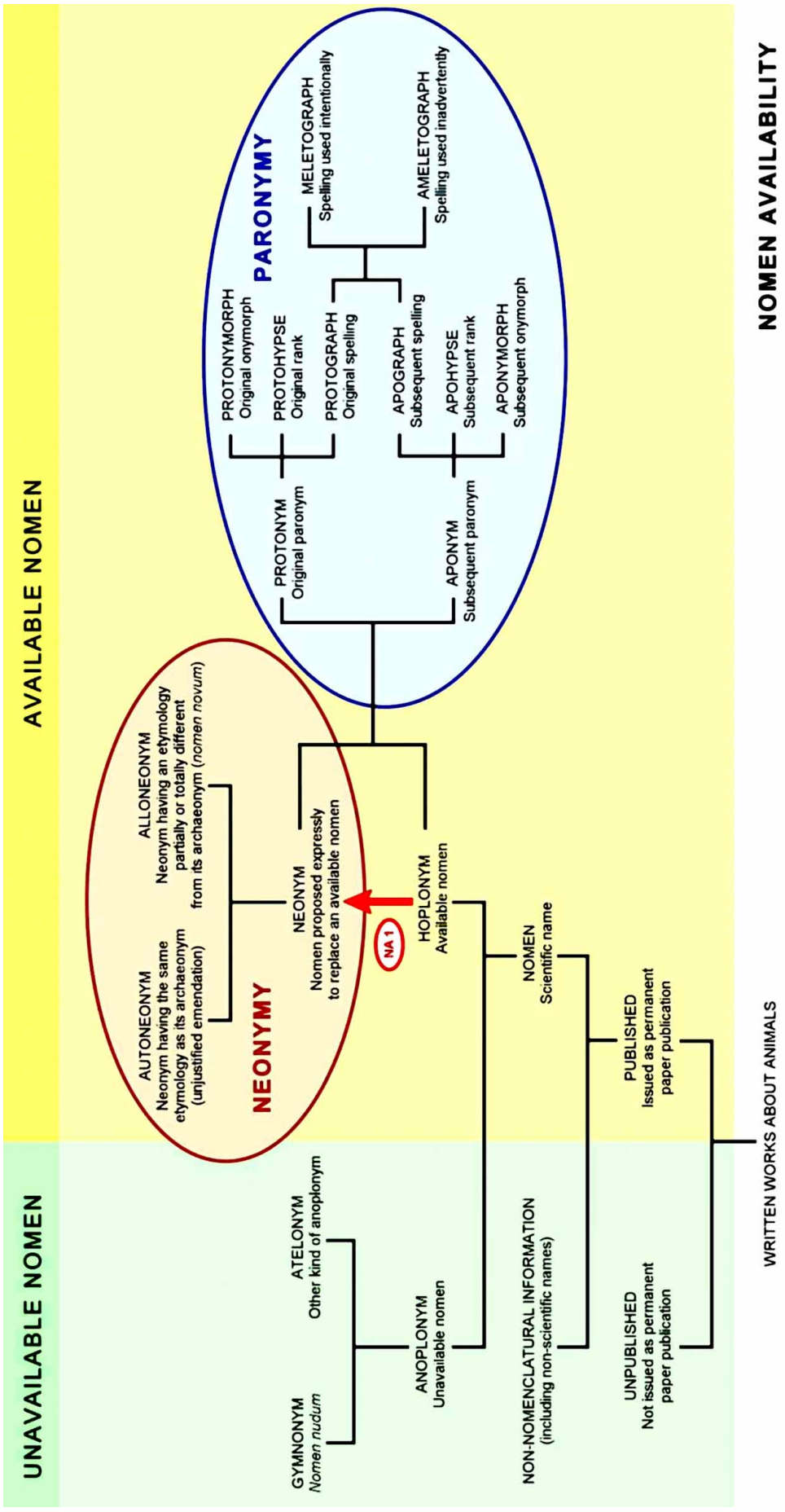

FIGURE 1. NOMEN AVAILABILITY. The main categories of nomina involved in the first stage of the nomenclatural process (*availability*). Black lines connect categories with subcategories, whereas the red arrow indicates a nomenclatural act (NA 1, replacement of a hoplonym by a neonym). See text for explanations, and Appendix 1 for definitions of the terms.

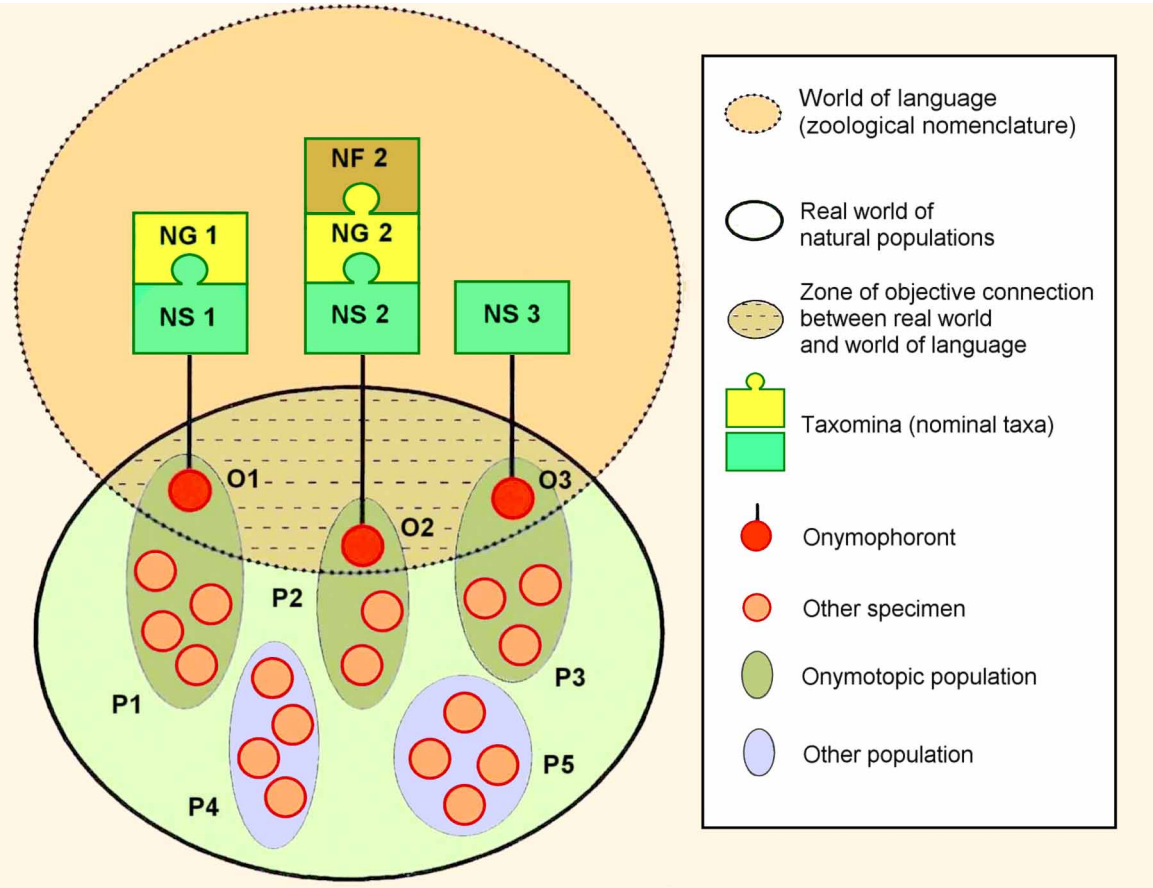

FIGURE 2. ONOMATOPHORES. The role of onomatophores as an objective connection between the real world of populations of organisms and the world of language (zoological nomenclature). NF 2, nominal family; NG 1 and NG 2, nominal genera, one of which (NG 2) is also a nucleogenus; NS 1 to NS 3, nominal species, two of which (NS 1 and NS 2) are also nucleospecies; O1 to O3, onymophoronts; P1 to P5, natural populations. See text for explanations, and Appendix 1 for definitions of the terms. (Modified after Dubois & Ohler, 1997*a*: 304).

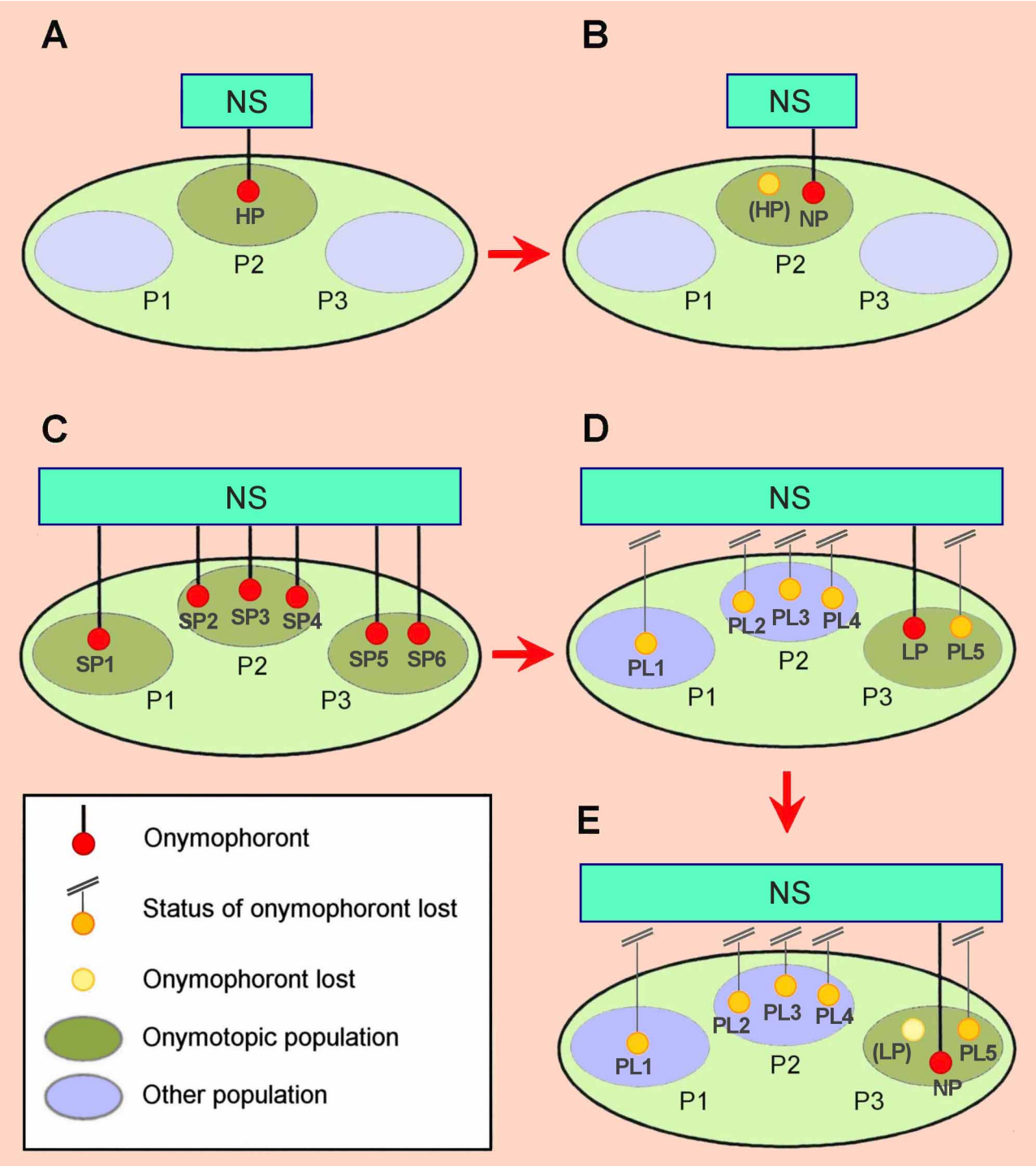

FIGURE 3. ONYMOPHORONTS. The different categories of onymophoronts in zoological nomenclature). HP, holophoront; LP, lectophoront; NP, neophoront; NS, nominal species; P1 to P3, natural populations; PL1 to PL5, exonymophoronts; SP1 to SP6, symphoronts. See text for explanations, and Appendix 1 for definitions of the terms. The figure only shows examples among various other possible situations: for example, exonymophoronts are eligible for neophoront designation in case of loss of first neophoront. (Modified after Dubois & Ohler, 1997*a*: 309).

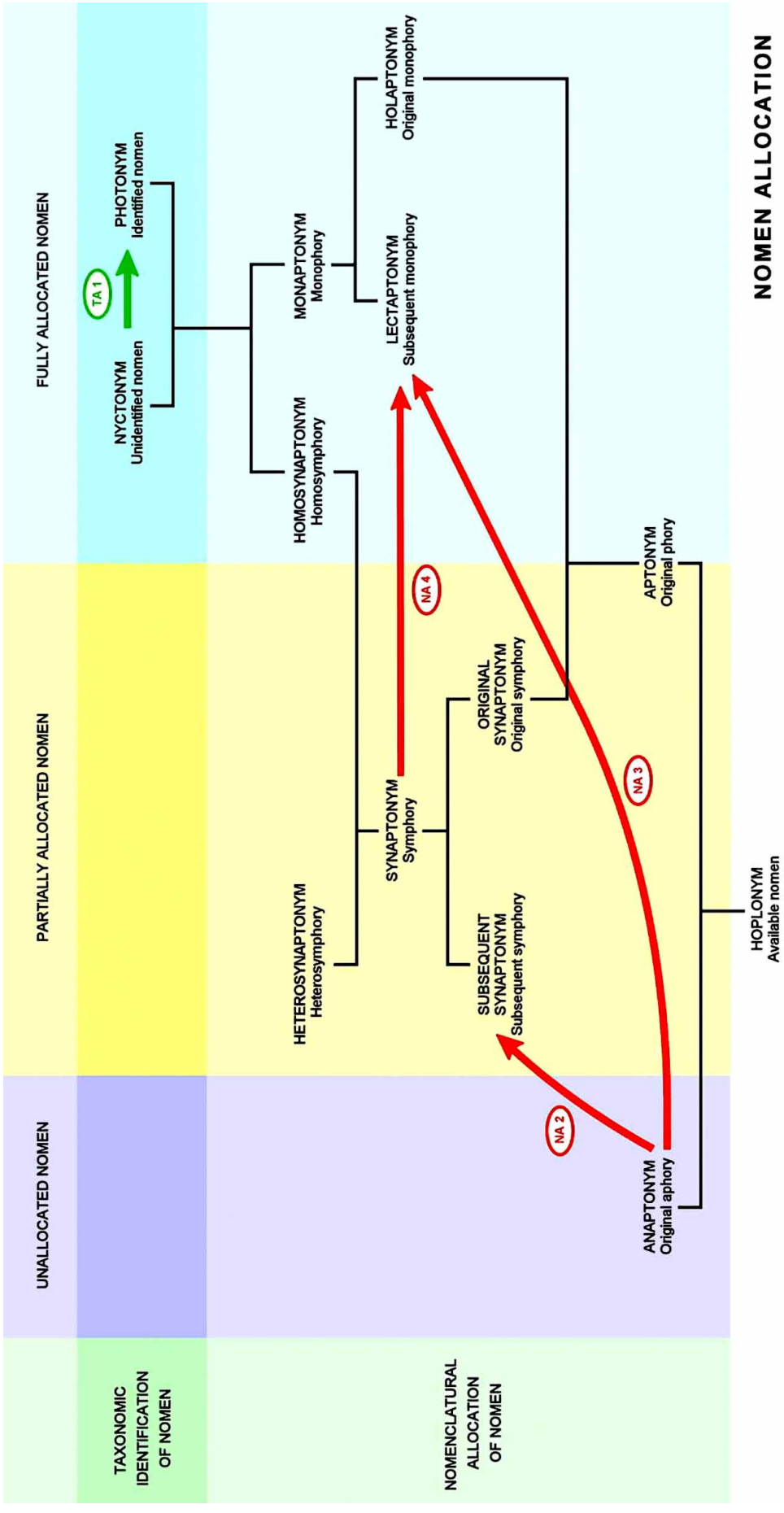

FIGURE 4. NOMEN ALLOCATION. The main categories of nomina involved in the second stage of the nomenclatural process (*allocation*). Black lines connect categories with subcategories, whereas the red arrows indicate nomenclatural acts (NA 2, designation of synaptonyms for an anaptonym; NA 3, designation of a lectaptonym for an anaptonym; NA 4, choice of a lectaptonym among synaptonyms) and the green arrow a taxonomic act (TA 1, identification of a monaptonym). See text for explanations, and Appendix 1 for definitions of the terms.

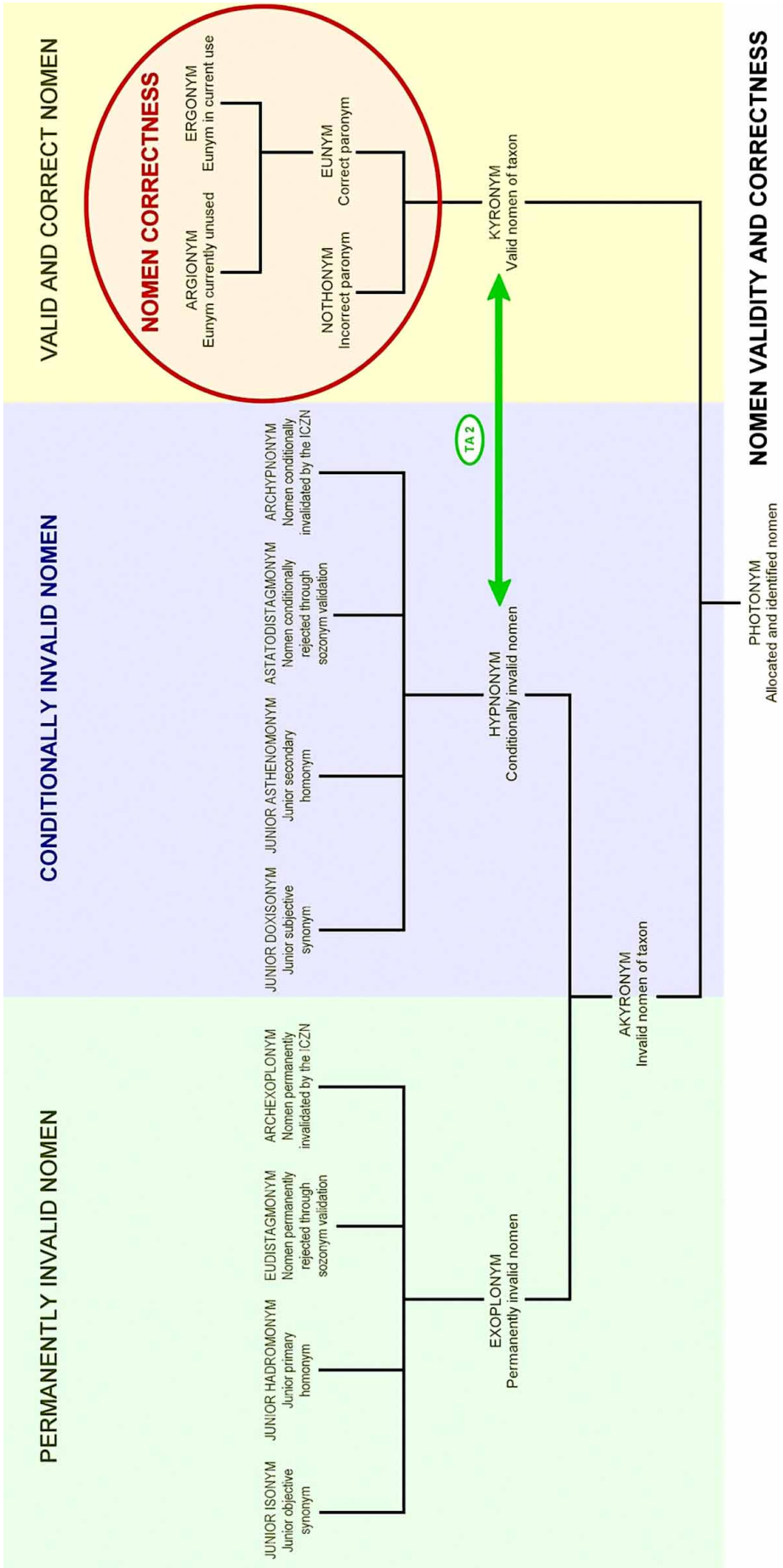

FIGURE 5. NOMEN VALIDITY AND CORRECTNESS. The main categories of nomina involved in the third stage of the nomenclatural process (*validity and correctness*). Black lines connect categories with subcategories, whereas the green arrow indicates a reversible taxonomic act (TA 2, doxisonymization of two nomina). See text for explanations, and Appendix 1 for definitions of the terms.

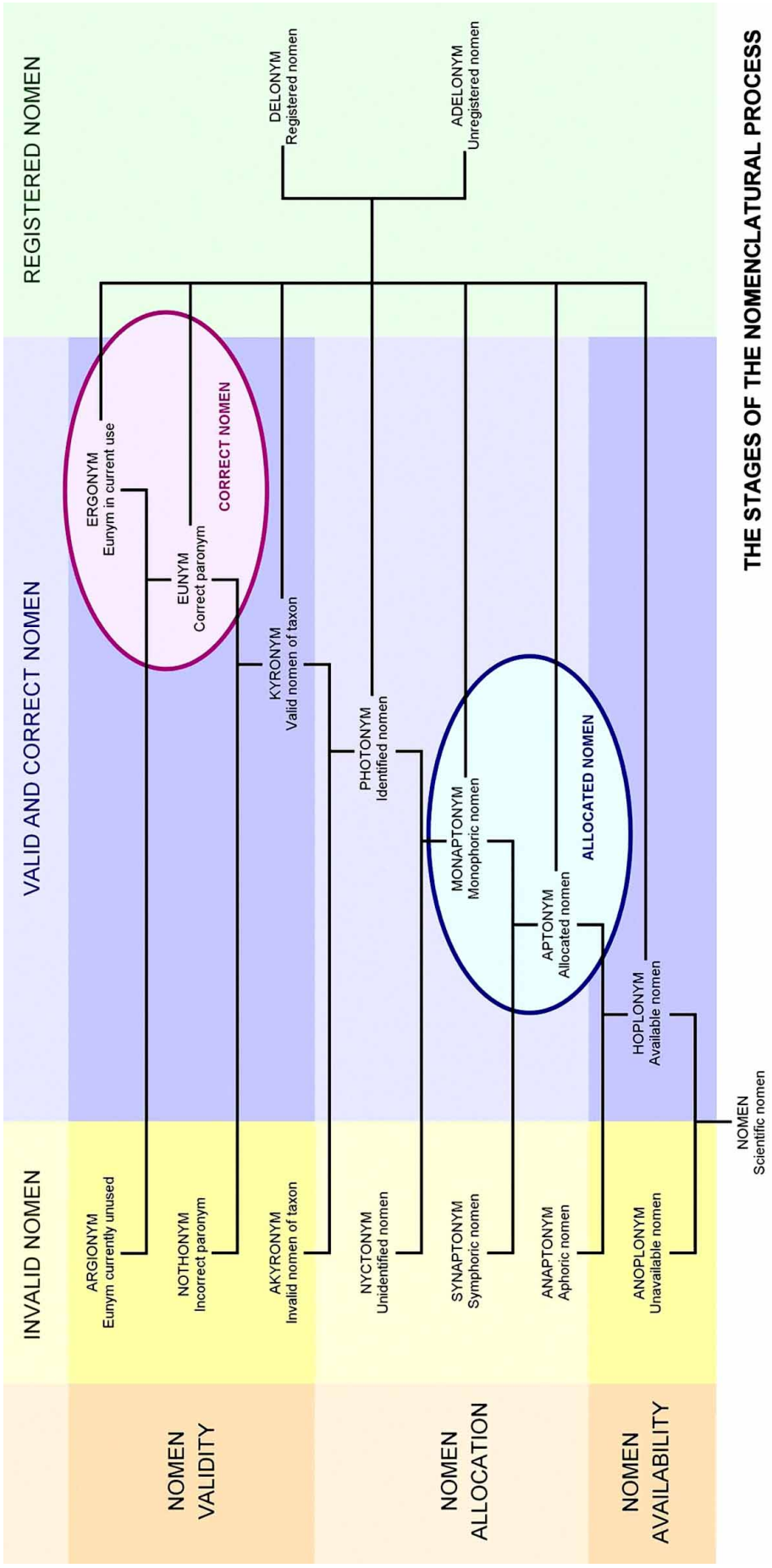

FIGURE 6. THE MAIN STAGES OF THE NOMENCLATURAL PROCESS. The four stages of the nomenclatural process (*availability, allocation, validity and correctness, registration*). Black lines connect categories with subcategories. See text for explanations, and Appendix 1 for definitions of the terms.