Proposed Rules for the incorporation of nomina of higher-ranked zoological taxa in the *International Code of Zoological Nomenclature*. 2. The proposed Rules and their rationale

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ABSTRACT
After the critical study of a number of concepts and problems of zoological nomenclature and the proposal of terminological novelties, 24 formal Rules for nomenclature of higher-ranked taxa (i.e. for taxa above superfamily) are formulated, that are compatible with the current *Code* and could possibly be incorporated in the latter. These Rules concern: 1) the availability of nomina; 2) their allocation to taxa, through a set of generic nomina that together constitute the onomatophore of the nomen, and in some cases a set of generic nomina expressly excluded from the taxon designated by the nomen; and 3) their validity, based usually on priority, but in some cases taking into account widespread use of a nomen outside the field of systematics.

KEY WORDS
Zoological nomenclature, higher-ranked taxa, terminology, Rules, nomenclatural availability, allocation of nomen to taxon, nomenclatural validity.

RÉSUMÉ
Proposition de Règles pour l'incorporation des nomina de taxons de rangs supérieurs d'animaux dans le Code international de nomenclature zoologique. *2. Les Règles proposées et leur justification théorique.*
Après l'examen critique d'un certain nombre de concepts et problèmes de la nomenclature zoologique et la proposition de nouveaux termes, 24 Règles formelles pour la nomenclature zoologique des taxons de rangs supérieurs (c'est-à-dire au-dessus du rang de superfamille) sont formulées. Celles-ci sont compatibles avec le *Code* actuel et pourraient être incorporées dans celui-ci. Ces règles concernent : 1) la disponibilité des nomina ; 2) leur attribution aux taxons, au moyen d'un ensemble de nomina génériques qui constituent ensemble l'onomatophore du nomen, et dans certains cas d'un ensemble de nomina génériques expressément exclus du taxon désigné par le nomen ; et 3) leur validité, qui repose en règle générale sur la priorité, mais qui dans certains cas prend en compte l'usage répandu d'un nomen en dehors du domaine de la systématique.

MOTS CLÉS
Nomenclature zoologique, taxons de rangs supérieurs, terminologie, Règles, disponibilité nomenclaturale, attribution d'un nomen à un taxon, validité nomenclaturale.

Printing conventions

In the text below, species-series and genus-series nomina (see Dubois 2000) are printed, as usual, in lower case *italics*, whereas nomina of higher-ranked taxa are written in small capitals, with the following distinction: family-series nomina are in *ITALICS*, and class-series nomina in **BOLD**. Any class-series nomen validated according to the Rules presented below is presented naked, followed by its author(s) and date (e.g., **Amphibia** De Blainville, 1816), whereas a nomen that has not yet been validated under these Rules and that is used here only following "tradition" is presented between vertical bars and without author and date (e.g., |**Amphibia**|). First-users and dates of auxonyms (see below) are printed between square brackets: e.g., [Laurin, 2000]. Nomenclaturally unavailable nomina (anoplonyms) and their first-users (see Dubois 2000) are presented "between quotation marks". Vernacular nomina, i.e. nomina that are not Latin or latinized, are presented underlined. Nomina, whether valid or not, that currently apply to amphibian taxa, are presented naked, whereas those that now apply to other taxa ("reptiles", "fishes", etc.) are immediately followed by the sign *. Nomina, whether valid or not, that apply to entirely fossil taxa are preceded by the sign †. Most technical terms used in this work, especially all new ones, are defined in Appendix. "The *Code*" refers to the fourth edition, currently in force, of the *International Code of Zoological Nomenclature* (Anonymous 1999), "ICZN" to the International Commission on Zoological Nomenclature, and *BZN* to the *Bulletin of Zoological Nomenclature*, published by ICZN. The *Code* is here quoted as "Anonymous" for reasons explained in Dubois (2000: 87), as this book "does not state the name(s) of [its] author(s)", but is "attributed to a body (e.g., a committee or a commission)", thus following the definition of this term in the *Glossary* of the *Code* itself (p. 100).

INTRODUCTION

"The continuous changing of the names of higher taxa of animals and the frequent use of homonymous names for different taxa is not apt to gain friends for organismic biology. The introduction of rigid priority for the names of higher taxa would be a total calamity, but the application of '*a posteriori* priority' (= protection of widely accepted names) would greatly improve the situation".
Ernst Mayr 1968: 215

The current situation in nomenclature of higher-ranked taxa

As announced in previous publications (Dubois 2005a, b), this paper proposes formal Rules that allow incorporation of the nomina of higher-ranked or "higher" taxa (above superfamily) into the *Code*. It may be questioned whether there is a need for such a proposal. A few examples in amphibians will underline how, because of the current absence of rules, the situation can become extreme and "farcical" in some cases. Because they consider their cladograms as providing the best understanding of the cladistic relationships between groups, different authors often adopt various higher taxonomies. But then, according to their ideas, they may use the same nomina for different groups, or they may even adopt different hierarchies between the same nomina. Thus, regarding the recent amphibians, Milner (1988) and Trueb & Cloutier (1991) supported not only different taxonomies but also different uses and hierarchies for the same nomina: Milner (1988) recognized a "crownorder" **Urodela** included in an order **Caudata**, whereas Trueb & Cloutier (1991) and De Queiroz & Gauthier (1992) treated the **Caudata** as subordinate to the **Urodela**. Other examples are given in Laurin (1998: 8). In the absence of explicit statements in this respect, it is impossible to recognize a consistent logic in such treatments of the validity of nomina and of the hierarchical relationships between them, as the decisions taken are not based on any consistent use of criteria such as priority, original content of taxa, traditional uses of the nomina or first-reviser action.

Furthermore, such decisions ignore the origin and early history of the nomina, e.g., in forgetting that some nomina have been proposed as *neonyms* (Dubois 2000, for "new replacement names" or "nomina nova" in the *Code*): it is then a common (and clever) rule of all existing nomenclatural systems that, whenever a neonym has been proposed for the same taxon, *either* the original *or* the re-

placement nomen can be treated as valid, but not both together! This is however the case for example for the nomina **Caudata** and **Urodela**, that are sometimes used to designate different, hierarchically related, taxa, although the latter nomen was proposed by Duméril (1806) strictly as a neonym for the former (Dubois 2004b). Another constant and clever rule of all nomenclatural systems is to consider all *junior homonyms* as *definitively invalid*, whatever the status of the senior homonym. Nevertheless, and although such a rule exists in all existing nomenclatural systems, in higher classification some authors insistently continue to consider some nomina as valid, although these nomina have long been shown to be junior homonyms. This is, e.g., the case in amphibians for the junior homonyms **Apoda** Oppel, 1811, **Archaeobatrachia** Reig, 1958 and **Neobatrachia** Reig, 1958 (see, e.g., Kuhn 1967; Dubois 1984, 2004b). There is no need to have complete, detailed and "official" rules to consider that such nomina are invalid: this should not even be a matter of discussion, as the invalidity of junior homonyms is a general principle of all nomenclatures and terminologies, even in common language: if anyone was to propose a new term "mass" for a concept completely different from that understood under this term for centuries, there would be no need of any discussion to reject this new term as invalid.

More generally, it is a common feature of all "honest" nomenclatural systems is to rely on a "founder effect" (Dubois 2005c), i.e. to consider that the valid definition of a term, that should not be modified by subsequent authors, or only up to a certain point (see below), is the first one, that was given to this term by the author who created it: if a new concept has to be introduced later, then this should be through the creation of a new term, not through a redefinition of an existing term. The most "dishonest" attitude in this respect is to use an already existing term but with a "new definition", and to claim being the *author* of the term: this was a common practice in early zoological taxonomy, which fortunately disappeared when an international *Code* was established, but it tends to come back as a "new practice" in some recent works, especially by authors adopting the "*Phylocode*" philosophy (Dubois 2005b)! The two nomenclatural systems are not "miscible", and nomina proposed within the framework of one of them should not be considered available within the framework of the other, and vice versa.

Another recent (and philosophically connected) tendency in higher nomenclature is that, whenever an author proposes a new taxonomy, e.g., based on a new cladogram of the taxa studied, this author may simply propose a new nomen for the "new" taxon, without caring for the possible existence of earlier nomina coined for exactly the same taxon or for a very similar one. A striking recent example in amphibians is that of the nomen **Procera**, coined by Feller & Hedges (1998) for a taxon encompassing the current orders of caecilians and salamanders, although an earlier nomen already existed to designate this taxon (**Urophora** Hogg, 1839) (see Dubois 2004b). Unfortunately, this tendency to ignore earlier synonyms for "new" taxa also exists in current specific, generic and familial zoological nomenclatures, and is part of the current lax attitude of many zoologists, and of zoological journals, with respect to the *Code* (for examples in herpetology, see, e.g., Bour & Dubois 1984; Dubois 1987a, b, 1992, 1995, 1999, 2003; Dubois & Ohler 1995, 1997, 1999; Bossuyt & Dubois 2001).

Among others, Corliss (1983: 317) emphasized the problems posed by this situation. After pointing out that in many cases nomina are already available in the literature for newly redefined taxa, he added: "Our diagnoses and characterizations of major taxa will constantly be changing and improving as we acquire additional data of relevance. Should every extension or refinement, every loss or gain of certain subtaxa, set the stage for justification of a new name (followed, of course, by the name of the new author and the date of his/her new paper)? […] At times, new names will be required, but rather rarely. If for no other reason, the proposers should think of the unfavorable, even damaging, and certainly discouraging effect that dozens of new names will have on students and teachers alike who are earnestly trying to keep abreast of developments in the field".

As a result of the renewed interest in higher taxonomy, it has become increasingly necessary to

have a set of formal and compulsory rules for the nomenclature of higher taxa. Such rules should have the same properties as those of the current *Code* for the nomina of taxa of rank superfamily and below, i.e. they should be largely automatic in their application: except in rare cases, there should be no discussion on the valid nomen that should be given to a given taxon *within the frame of a given taxonomy.* Until now, in higher taxonomy, because of the absence of coverage of these nomina by the *Code*, nomina considered as "valid" have resulted mostly from a consensus among authors, without much theoretical or historical discussion about the criteria of this "validity". A few authors sometimes suggested that they simply "prefer" some nomina or some kinds of nomina (e.g., Savage 1986: 261), but others seem to have used, at least privately, more elaborate thinkings. Few authors expressly discussed criteria for the nomenclature of higher taxa, and, when they did (see below), they just mentioned some general, more or less stringent, "principles", but did not formalize the latter under "rules".

Among the many authors who proposed new higher taxa and coined new nomina, few clearly expressed detailed opinions, but it can be inferred from some of the statements that are sometimes incidentally given by some of them, when briefly discussing higher nomenclature, that they had adopted the following "guidelines" (not really stringent "rules") for the choice of the valid nomen of a higher taxon: 1) priority among nomina created for the exactly same taxon as that considered today; 2) priority among nomina created for taxa that are only partly identical to the current taxon; 3) appropriateness of nomen regarding the biological or other characteristics of the taxon as considered today; and 4) correct etymological formation of this nomen. These criteria may be used by different authors either alternatively, or hierarchically arranged, or combined. For example, Milner (1988: 82) wrote about the nomen **Paratoidea** Gardiner, 1982: "Apart from the inappropriate nature and incorrect spelling of this name, it is junior to the term Batrachia". About the same nomen, Trueb & Cloutier (1991: 295) wrote: "we agree with A. R. Milner (1988) that Paratoidea is an inappropriate (and misspelled) name". Thinking further about this, and using comparisons with other nomenclatures, suggest that both inappropriateness and incorrect etymological formation of nomen (e.g., bad latinization) are not good criteria, as they have not been retained as valid criteria for the nomina regulated by the *Code*: if they had to be suddenly introduced in the latter, the result would be a complete disturbance of all zoological nomenclature, as many currently valid nomina are either misleading (e.g., when a species called *maxima* in a genus is not the largest one of this genus!) or ill-formed (see also in this respect Dubois & Ohler 1997). Inappropriateness cannot be used as a criterion of invalidation of nomina, as pointed out by Stevens (2002: 20): "Names are for communication, and for this not any kind of name will do […]. Names do not have to somehow mirror the nature of the thing being named, however, and the demise of numerous ideal languages or naming systems that incorporated such an idea suggests that it has inherent flaws". The criteria of priority and of original content of the taxon are more relevant and appropriate for the nomenclature of higher taxa, but, as will be shown below, their application to these nomina raises several important problems.

These difficulties should be overcome, at least for those who think that the current *Code* should be improved and expanded to include class-series nomina. However, despite a few formal proposals in this respect (Rodendorf 1977a, b; Dubois 1984: 8-12, 1987c, unpublished; Starobogatov 1984, 1991), ICZN has not recently shown interest in the question, even refusing to publish such proposals in *BZN* (Dubois unpublished). This may have given the impression to some that the current *Code* was not liable to be modified in order to include stringent rules for the nomenclature of higher taxa, which, as will be shown in detail below, is not true. The latest issue of *BZN*, published long after original submission of the manuscript of the present paper, includes two papers that support this idea (Alonzo-Zarazaga 2005; Dubois 2005c).

Expanding the *Code* in order to include nomina of higher-ranked taxa

The discussion below is not concerned with the "*Phylocode*", an alternative system to the current

Code (Dubois 2005b), but with proposals of improvement of the latter, which currently has force of law for all zoologists worldwide. The suggestions presented below are meant to allow the inclusion of the nomina of higher taxa within the scope of this *Code*. In the recent decades, the lax attitude (Dubois 2005b) of some taxonomists and editors of books and periodicals, and of ICZN itself, has spread the idea that zoological nomenclature is not regulated by a *Code* but could be mastered through simple "intuition" or "common sense". In addition, the use in the *Code* of "common language" terms, such as "name", "type" or "nominal taxon", for special concepts, tools or techniques used in zoological nomenclature (called respectively here *nomen*, *onomatophore* or *taxomen*), carries a message according to which zoological nomenclature is not a special discipline but requires only "natural" thinking. However, "if zoological taxonomy is to remain a non-ambiguous universal system of reference, it cannot do without precise and stringent international rules of zoological nomenclature", and "zoological nomenclature would have much to gain, not to lose, from claiming being *a well defined technical field*, needing *a special training and competence*, rather than trying to give the misleading image of a simple domain accessible to all" (Dubois 2000: 36, 37). The process of clarification of some basic onymological concepts that I undertook (Dubois & Ohler 1997; Dubois 2000, 2005b) requires in some cases the establishment of a new terminology, that will avoid further semantic ambiguities or imprecisions.

Beside the basic philosophical foundation of its being an onomatophore-based system, a few other major Rules of the current *Code* should also be used in higher nomenclature, although with some special adaptations that will be discussed in detail below: in particular, the Rules or Principles of *priority*, of *homonymy*, of *first-reviser* actions and of *neonymy* (i.e. Rules concerning neonyms and archaeonyms). Rules should be as stringent as possible, because the major function of a set of Rules is to allow *automatic* allocation of nomina to taxa in a given taxonomy, that can be done independently by any zoologist worldwide, with the slightest possible place for subjective opinions, tastes and interpretations, and without having to call on an administrative body (such as a commission or a committee) for final decision. In order for this automatic allocation of nomina to be possible, the reply to the question: "Do we want a Code or a Committee?" (Fosberg 1964) should clearly be "a Code". The Rules should be universal, simple and stringent for all zoologists.

However, the particularities of higher nomenclature, and above all the fact that it has long remained unregulated by formal rules, make it necessary to consider other important factors which do not have the same weight in lower nomenclature. Especially, particular attention should be paid to the *origin* and *history* of any nomen, i.e. the *complete original content of the taxon* (all its originally included taxa and individuals) and of other taxa in the original publication where this taxon was first proposed, the *traditional use* of the nomen in the subsequent literature, and the *internal coherence of the nomenclatural system* proposed by an author (a quite new concept in zoological nomenclature).

To be useful, discussions such as that provided below regarding class-series nomenclature cannot be made on purely theoretical grounds, but must be confronted with real taxonomies: in the third part of this work (Dubois in prep.), attention will be focussed on the nomenclature of the higher groups of recent amphibians, which, as mentioned above, is currently not stabilized. Discussion of these cases will be preceded in the present paper by some new conceptual and terminological clarifications, then by a more detailed discussion of the problems posed by the nomenclature of higher taxa in zoology and finally by a set of proposed formal Rules.

Terminology is an important issue in all theoretical discussion. As pointed out already (Dubois 2000, 2005b), failure to use specific technical terms for onymological concepts is one of the causes of confusion in discussions about nomenclature. Biological nomenclature deals with (scientific) names or *nomina*. For the proper designation of the various *categories of nomina* that it recognizes, it is therefore normal and important that a nomenclatural code uses precise terms, and that these terms be recognized for precise technical tools, not imprecise "common language" words. In the current *Code*, this is far

from being clear. Three different terms are used in this text to designate categories of nomina. Some are double terms based on the Latin word *nomen* (*nomen dubium*, *nomen novum*, *nomen nudum*, etc.), some are simple words based on the Greek root *onymos* (*homonym*, *synonym*, *tautonym*, etc.) and some are double terms based on the English word *name* (*available name*, *suppressed name*, *valid name*, etc.), or its equivalent in other modern languages. This heterogeneous treatment does not make clear for the readers and users of the *Code* that all these terms designate in fact well defined categories of nomina that are precisely regulated by the Rules. In order to clarify this point, I already proposed (Dubois 2000, 2005b) to replace the vague term *name* by the Latin word *nomen* to designate zoological scientific names, and I introduced a number of other single-word terms based on the Greek root *onymos* to designate various categories of nomina. Other new terms clarifying other onymological concepts were also proposed (Dubois 2000, 2005b), in two texts that should be consulted for full understanding of what follows (see also Appendix). This clarification process will be pursued below. Hopefully, in the future, such precise and homogeneous technical terms will be introduced in the *Code* in the place of the current heterogeneous and sometimes unclear terminology of this text.

Before entering the new proposals, it will be useful to review briefly the previous proposals published for rules in higher zoological nomenclature.

PREVIOUS PROPOSALS OF RULES FOR THE NOMENCLATURE OF HIGHER-RANKED TAXA IN ZOOLOGY

In the recent years, several nomenclatural systems *alternative* to the current *Code* were proposed from several distinct perspectives, often with the purported aim of reconciling "phylogenetic taxonomy" with nomenclatural rules (e.g., De Queiroz & Gauthier 1990, 1994; Kluge 2000; Papavero *et al.* 2001). These systems will not be discussed further here, for reasons explained in Dubois (2005b): despite its imperfections, the current *Code* is an excellent system, compatible with any taxonomic philosophy or system including "phylogenetic" ones, and it has been in use in millions of publications. Rather than replacing it with another system that is also bound to be imperfect (as no taxonomy or nomenclature will ever reflect exactly the extremely complex phenomena involved in the history of life on earth), taxonomists should work on its improvement. An important need in this respect is the inclusion of the nomina of higher-ranked taxa into the Rules of the *Code*. A few attempts have already been published in this respect, most of which do not seem to have elicited much attention and comments from subsequent authors. Some of the most noteworthy are briefly reviewed below. Four points in particular have been discussed in the past: whether nomina of higher taxa should have onomatophores, whether they should have standard endings, how many nominal-series of such nomina should be recognized, and whether a Rule of Coordination should apply within this/these nominal-series. An important point that should be kept in mind in the discussion below is that, in order to be smoothly accepted by the international community of users (both taxonomists and non-taxonomists), the new Rules should not result in important changes in the nomina of "well known" taxa, such as VERTEBRATA or AMPHIBIA, but should be devised in such a way as to keep these nomina (designated below as *sozonyms*).

For a long time, the *Code* requested the use of fixed endings for two ranks of the family-series only: family (-*IDAE*) and subfamily (-*INAE*). Various authors proposed or supported systems of standard or "uniform" endings for nomina of other ranks, in particular above superfamily (Shipley 1904; Poche 1911; Berg 1932; Pearse 1936; Stenzel 1950; Rogers 1952; Anonymous 1953; Moment 1953; Chitwood 1958; Levine 1958; Bey-Biyenko 1962; Corliss 1962; Honigberg *et al.* 1964; Sprague 1966; Jeffrey 1971; Štys & Kerzhner 1975; Kevan 1977; Rodendorf 1977a, b; Levine *et al.* 1980; Starobogatov 1984, 1991; Alonzo-Zarazaga 2005), whereas others rejected this suggestion (Börner 1904; Handlirsch 1904; Hubbs 1952; Simpson 1952; Hemming 1953: 42; Mayr *et al.* 1953: 278; Teichert 1965; Griffiths 1976; Brothers 1983a, b). Stenzel's (1950) system was particularly elegant. He proposed endings for

TABLE 1. — Standard desinences proposed by Stenzel (1950) for nomina of taxa of nine ranks in the family- and class-series. Rank in Stenzel's system is a combination of "category" and "grade": each "category" contains three "grades", i.e. coordinate ranks as here defined (see text). Stenzel's system is mnemonic as it combines a simple ending for "category" (a, ae or i) and an intermediate letter (c, d or n) for "grade". In the first column, nomina here allocated to the class-series are printed in **bold**, and those of the family-series in *italics*.

Ending	Grammatical gender	"Category"	"Grade"	Rank
-ICA	Neuter	Order	Super	Superorder
-IDA	Neuter	Order	Main	Order
-INA	Neuter	Order	Sub	Suborder
-ICAE	Feminine	Family	Super	Superfamily
-IDAE	Feminine	Family	Main	Family
-INAE	Feminine	Family	Sub	Subfamily
-ICI	Masculine	Tribe	Super	Supertribe
-IDI	Masculine	Tribe	Main	Tribe
-INI	Masculine	Tribe	Sub	Subtribe

nine ranks "above the genus level and below the class level", i.e. order, family and tribe, plus one superordinate and one subordinate rank for each of them (e.g., superorder, order, suborder). His system (Table 1) had an interesting and mnemonic internal logic in the use of endings and intermediate letters, but it was not followed by ICZN when the Rules were expanded in order to include compulsory endings for superfamily (*-OIDEA*), tribe (*-INI*) and subtribe (*-INA*). Modifications to this system were later proposed (e.g., Anonymous 1953), but eventually this idea was abandoned altogether.

Another oft-debated question is how many "groups of names", i.e. *nominal-series* as here used (Dubois 2000), should be distinguished above the family-series. The most frequent opinions in this respect are in favour of two such series, "phylum-group" and "order/class-group" (Hemming 1953: 38), or three, "phylum-group", "class-group" and "order-group" (Blackwelder 1967; Rodendorf 1977a, b), but some authors even suggested to have more distinct nominal-series (Levine 1958; Brothers 1983a, b; Starobogatov 1984, 1991), whereas recently Alonso-Zarazaga (2005) suggested to include all nomina of higher taxa in the "family group", renamed "upper uninominal group". Although they did not always clearly write it, several authors who proposed the use of standard endings also proposed to expand the nomenclatural Rule of Coordination within each given nominal-series (Stenzel 1950; Levine 1958; Starobogatov 1984, 1991), a suggestion at complete variance with the traditional use in most zoological groups. Melville & Durham (1958: 498) proposed that nomina of higher taxa be treated as "co-ordinate to a limited extent; that is, a name introduced for a taxon at one level in the group is available with its original authorship and priority at all other levels in the group (with appropriate change of termination)". Melville (1958a) also suggested that nomina of superfamilies be included in the "order-group" rather than in the "family-group", but this was not later implemented in the *Code*.

The proposals mentioned above mostly concerned the formation of nomina of higher taxa, a rather trivial matter indeed as compared with the two major questions that should be solved if these nomina were to be formally incorporated into the *Code*, namely rules of allocation of nomina to taxa and of validity of nomina. Few authors seriously addressed this complex matter.

Stejneger (1907: 48-49) suggested some "principles" for the selection of valid higher nomina, and wrote: "we know no such thing as a 'type genus' or a 'type order' by the aid of which the name of the order or the class can be arbitrarily fixed, even if it were desirable to do so". Unfortunately, he did not pursue this reflection further and did not propose formal "rules" for higher nomenclature.

For a short period, i.e. between the 1953 Copenhagen Congress (Hemming 1953) and the 1958 London Congress, Rules for the naming of orders and other higher ranks were incorporated in the

international Rules of zoological nomenclature (then called the "*Règles*"), with use of type genera for such nomina (Linsley & Usinger 1959), but these Rules had been deleted when the first edition of the Rules renamed *Code* (Anonymous 1961) was published.

Beatty & Blackwelder (1974) discussed some problems associated with the change of extensions of zoological higher taxa and suggested that "well known" nomina should be retained even if the contents of the higher taxa for which they had been coined have been modified, either by removal or addition of included lower taxa.

Rodendorf (1977a, b; English translation reproduced by Rasnitsyn 1982) proposed to incorporate the nomina of higher taxa into the *Code*. These were mostly to use "nomenclatural types" (more precisely, "the name of the type genus of the oldest family [of the higher taxon]"; Rodendorf 1977b: 152) for the nomina of higher taxa, which were distributed into three groups, the "order-group", the "class-group" and the "phylum-group", and to use standard suffixes for a number of standard ranks in this hierarchy.

In contrast, Brothers (1983a, b) rejected the use of "typification" and of standard endings in higher nomenclature. He recognized four "group levels" of nomina (adding a "kingdom group" to the three groups of Rodendorf) and proposed a set of 12 "principles" for higher nomenclature. According to his system, the allocation of a nomen to a higher taxon is made "by a listing of its subordinate taxa at the next lowest categorical level in use for that taxon" (Brothers 1983a: 40). The consequence of this system is a very low nomenclatural robustness, as defined by Dubois (2005b): "If the limits of a taxon are changed by the addition or exclusion of one or more subtaxa which are considered valid within the same group level of the hierarchy, then the taxon is no longer the same in composition or properties and must be given its own name" (Brothers 1983a: 41).

Starobogatov (1984, 1991) developed further Rodendorf's proposals, keeping three distinct nominal groups and proposing new standard endings for taxa of various ranks. He formally proposed to use a Rule of Coordination within each of the three nominal groups. He adopted the distinction made by Štys & Kerzhner (1975) between two kinds of nomina for higher taxa, namely "typified names" (based on generic nomina) and "descriptive names" (not based on generic nomina). Among synonymous nomina, he suggested that the valid one be determined by priority. Alonso-Zarazaga (2005) also made this distinction and proposed to use type-genera and standard endings for the nomina of all higher taxa. He retained a single nominal-series above the genus-series, the "upper uninominal group", with four subgroups, the family-, order-, class- and phylum-groups.

Dubois (1984) proposed to recognize a single "class-group" or, better, a *class-series* (Dubois 2000) for all nomina above the family-series. He also proposed simple nomenclatural rules for these nomina (Dubois 1984: 8-12, 1987c, unpublished). According to these proposals, the principles of onomatophore and of homonymy should apply to the nomina of higher taxa, but the Rule of Priority cannot be used strictly among old nomina of this nominal-series. This means that a nomen proposed for a higher taxon should be attached to the nominal-genus or -genera originally included in this taxon, rather than to a "definition", whether "phylogenetic" or not. This also means that, among such nomina, a junior homonym is permanently invalid and should never be used. Dubois (1984: 9) also suggested that, when several spellings have been used for a nomen, the spelling to be conserved should not automatically be the oldest one, but that which has obtained a consensus among subsequent authors.

An important difference between Dubois's (1984) proposal and those of most other authors mentioned above lies in the number of nominal-series recognized above the family-series. In contrast with the situation in botany, the existence of distinct nominal-series is an important feature of the zoological *Code*. Within each nominal-series, there are important interactions between nomina, regarding onomatophores, synonymy, homonymy and priority. The Rule of Coordination is an excellent system allowing to limit the number of nomina and to have automatically fully unambiguous nomina for hierarchically related taxa in any given taxonomy (see below for more details). Nominal-series are

largely independent from each other, being only connected through the onomatophores of nomina of the higher series, that are nomina of the series just below. However, as discussed in Dubois (2005b), there is little theoretical background for *defining* higher ranks in a taxonomic system, the function of ranks being mostly to help organising the information contained in the taxonomy. There is therefore no theoretical difference between a superfamily, an order, a class or a phylum. Allocation of any given taxon to one of these ranks is largely a matter of "tradition" and "consensus". In contrast with ranks, taxa may be strictly defined, according to a philosophy of taxonomy (they may be groups, grades, clades, or whatever). New taxonomic theories or new data may result in changes in taxonomies, but these changes often concern only the *arrangement* of taxa in the taxonomy, their hierarchical relations, and not their definitions and contents: this is the case e.g., whenever any new cladogram modifies the relationships between taxa without modifying the latter, as shown by the example of figure 2A, B in Dubois (2005b). Given this framework, there would be no point in recognizing several nominal-series (or sub-series) above the superfamily: this would only largely complicate the matters, as onomatophores, authorship and dates of nomina, synonymy, homonymy and priority would have to be managed independently in these different series. However, the possibility to expand the family-series in order to include all nomina of higher taxa should not be considered, for two reasons at least: 1) whereas some older nomina above the superfamily were based on the radicals of generic nomina, this is not a general situation, as it has never been considered compulsory, contrary to the situation in the family-series; and 2) introducing the nomina of higher taxa in the same nominal-series as those of the family-series would unnecessarily raise many complex problems of synonymy, homonymy and priority. The best solution is therefore to have a single nominal-series for all taxa above the superfamily, distinct from the family-series. This means that a nomen first proposed for an order can be used for a class or any other higher taxon, and vice-versa, without any consideration of the original rank given to the taxon.

Another related question is the proposal to use standard endings for nomina of different ranks in the class-series. Such a provision would make sense if all class-series nomina, just like those of the family-series, were built by adding a suffix to the stem of a generic nomen, but this is the case of a minority of class-series nomina only. The other higher nomina are of various kinds (being either traditional terms from Latin, Greek or other languages, or nomina based on patronyms of persons, or artificial terms aiming at providing information on the characters, geographic distribution or evolutionary relationships of the included species), and adding standard endings would often produce unpalatable compound nomina. An additional reason for not supporting the use of standard endings for nomina of higher taxa is that it puts unnecessary emphasis on ranking (Hubbs 1952) and "appear[s] to give undue equivalence to taxa of widely ranging size, age or distinctiveness" (Whitehead 1972: 221). In a text dealing with taxa, in order to express the (largely artificial and often labile) rank of any taxon in the taxonomic hierarchy, rather than special endings or other diacritic marks, it seems simpler and clearer to give the nomina of such taxa preceded by the designation of their (often provisional) ranks in the taxonomy used: "class **Amphibia**", "order **Anura**", etc. (see Note 1). Furthermore, a number of higher nomina (the sozonyms) are well known and widely-used not only by taxonomists but also by other users, and there would be no point in modifying such nomina by adding them a standard ending, as pointed out already by Blackwelder (1967: 439): "If such uniform endings had been adopted early in the development of zoological nomenclature, the system would be effective and useful. After two hundred years, it appears to be too late to attain those benefits by this device". Whether considered an order, a suborder, a superorder or whatever else, the taxon **Anura** will probably remain unchanged in the future, and keeping its nomen unchanged is more important for the communication with all taxonomists and non-taxonomists than indicating its largely arbitrary and probably provisional rank in a taxonomic hierarchy. The absence of standard endings for the nomina of higher taxa is not a problem since these nomina are not inter-connected by

a Rule of Coordination (see below), and is a good manner of "de-emphasizing the importance of ranks […] and relaxing the constraints on how they are treated" (Crane & Kenrick 1997: 87, 103). Ranks are useful for retrieval of taxonomic information, but do not provide information on the "equivalence" of taxa by any standard, which might seem implied by the use of standard endings.

Although Dubois (unpublished) submitted his proposed rules to the discussion of ICZN, these proposals were simply ignored by this Commission, and never published in *BZN*. However, Starobogatov (1991: 7) aptly remarked that "sooner or later we will be forced" to devise rules for higher nomenclature, and that "it is better to discuss beforehand possible means of regulating the nomenclature of higher categories and possible ways to introduce such regulation, in order that the transition be the least painful". This is becoming more and more necessary, as the work on the "tree of life" is progressing: while hypotheses on the cladistic relationships between groups become more and more precise and robust, it is likely that the number of intermediate ranks in taxonomic hierarchies will increase dramatically – even if it is generally accepted that there is no need to name each node of the tree of life. This probable multiplication of nomina will require nomenclatural adjustments, regarding not only the endings of nomina of the numerous necessary additional ranks in the family-series (see Bour & Dubois 1985, 1986), but also the rules allowing the establishment of the valid nomen of any higher taxon and the way to treat all older nomina already proposed in the zoological literature.

In this respect, the fact that class-series nomina have never been regulated by the *Code*, probably because for a long time these nomina were relatively very few, has had important consequences, and the bases of the nomenclature of higher taxa have become quite different from those of all other nomina. As mentioned above, many current authors consider that, as soon as they recognize a "new" taxon (i.e. either with a new definition and/or with a new content), they are entitled to propose a new nomen for it, and to ignore all nomina previously published in the taxonomic literature. If carried out for a substantial period, such an attitude would no doubt result in a huge increase in the number of nomina available for higher taxa, without historical or nomenclatural connection between them: this would go in the reverse direction to all the rest of zoological nomenclature, where, through the use of the tools of onomatophore and taxomen, such a continuity does exist, and allows nomenclature to play its rôle of information-storage system, not only for taxa but also for the history of taxonomy.

The nomenclatural tool of the "nominal taxon" or *taxomen* (Dubois 2000, 2005b) establishes a link between the real world of animals (through onomatophores) and the world of language (through nomina). It has proved efficient to clarify and stabilize the nomenclature of lower taxa as recognized by the *Code*, and especially to avoid nomina to progressively diverge from their original sense, which would unavoidably occur without this stable reference. For these reasons its use for the nomenclature of higher taxa is highly to be recommanded, although specially adapted to the peculiar situation prevailing there.

The proposals of Rules made below are a development and a deepening of the rules initially proposed by Dubois (1984), with a number of clarifications that have proved useful in various special situations when the use of these proposed rules was tested in the frame of various existing taxonomies. After a rather detailed discussion of the rationale behind them, a set of numbered new formal Rules is submitted for the reflection of taxonomists. The use of the new Rules will be exemplified (Dubois in prep.) for the major higher taxa of recent amphibians. All these proposals are not final ones, but are meant to open a discussion among taxonomists. This matter is a complex one, and no definitive decision in this respect should be taken before these Rules have been duly considered, discussed and applied critically to various real taxonomies. Only after such a reflection and discussion has developed can the matter become mature for inclusion of Rules concerning class-series nomina in the *Code*, which hopefully will take place.

Let us now examine higher nomenclature through exploring successively the three storeys of the Av-Al-Va (Availability-Allocation-Validity) building described in Dubois (2005b).

AVAILABILITY OF NOMINA

Names have been proposed for groups of animals virtually since the beginning of human language and writing (see Note 2). As for nomina regulated by the *Code*, it is important to limit availability of class-series nomina in science to those proposed in recent times within the frame of scientific taxonomy, i.e. proposed with the clear purpose of being applied to higher-ranked taxa, above the family-series (and not to "informal groups" of any kind). Hence the definition of class-series nomina provided in Rule (R1) below, and the proposal to consider such nomina as nomenclaturally available only as from 1758, the year of publication of the tenth edition of Linnaeus's *Systema Naturae*, the starting point of zoological nomenclature as recognized by the *Code* (R2). Besides, like for other nomina recognized by the *Code*, to be available such nomina should have been published accompanied by a description, diagnosis or indication (intension) and/or by the available nomen/nomina of one or several included taxa (inclusive extension). The least that can be provided is one included taxon, that will then be the onomatophore by monophory, and that provides at least partial information on the content of the taxon as considered by the original author (partial inclusive extension). Finally, like genus-series and family-series nomina, any class-series nomen should be a unique word (i.e. a single word, or two words linked by a hyphen), not couples or series of words. Hence the proposed Rule (R2) below. This nomen may be either Latin or Latin-like, or in some other language (see below). Nomina proposed before 1758, nomina published without diagnosis, description, indication or included taxa, or plurinominal designations (such as "**Quadrupedes ovipari**" or "**Amphibia nuda**") are not nomenclaturally available (*anoplonyms* sensu Dubois 2000) and, as such, should be presented, when cited, between quotation marks (see Dubois 2000: 68), or under any other system allowing to clearly identify their status. Many of the nomina first used after 1757 by zoologists for higher taxa were "traditional" terms, or had been borrowed from the works of the first zoologists of the beginning of the 18th century. However, for nomenclatural purposes, their authors and dates are those of their first publication meeting the criteria above.

The proposed rules above are not very stringent, which is made necessary by the fact that class-series nomina have not been regulated by the *Code* since its beginning and cannot be so retroactively. However, for the future, it seems necessary to add a few conditions, similar to those that are required by the *Code* for the availability of recent nomina, in particular: 1) regarding the fact that the nomen is Latin or latinized; 2) concerning the existence of a definition of the taxon based on its characters (description, diagnosis or apognosis); and 3) requiring the original designation of an onomatophore. The first two conditions are now widely accepted by all taxonomists and not liable to be discussed. The second one in particular is meant to avoid the creation of *gymnonyms* (Dubois 2000, for "nomina nuda" in the *Code*), but not to give the final "definition" of the taxon: the original description or diagnosis of a taxon may be (and actually often is: see, e.g., Dubois & Ohler 1997: 305) incomplete, incorrect or even totally wrong, which has no bearing on the availability and potential validity of the nomen; this condition is simply meant to avoid the creation of nomina based on "hypothetical concepts" or applying to unidentified organisms (in this respect, see also Dubois 1999). The third condition is also necessary for all other nomina regulated by the *Code*; it had been proposed as necessary for class-series nomina already by Dubois (1984). For the sake of homogeneity and simplicity, it seems appropriate to adopt for implementation of these three conditions a starting date slightly posterior to the publication of these proposed Rules, i.e. 31 December 2006. Nomina published after that date and not meeting these three criteria should be considered as *anoplonyms*. Finally, a recent new nomen should have been published within the frame of "traditional" or so-called "Linnaean" nomenclature, i.e. of the Rules of the *Code*, not within that of a system like the "*Phylocode*" proposed expressly as alternative to "Linnaean nomenclature" and not based on the use of onomatophores. All these requirements are expressed in Rule (R3) below.

ALLOCATION OF NOMINA TO NOMINAL-SERIES AND TO TAXA

General considerations

Despite a few attempts to define them biologically (e.g., Schaefer 1976; Dubois 1988; Avise & Johns 1999), there currently exist no generally accepted concepts or definitions of the ranks of the taxonomic hierarchy above the species: the fact that a given higher taxon is treated as a superfamily, an order or a class is largely a matter of general consensus among specialists of the group concerned, and no "equivalence" exists between taxa of the same rank in widely different zoological groups. However, these ranks are important and should be maintained, as they allow a hierarchical arrangement of the information relating to taxa, without which taxonomy could not efficiently play its rôle of information storage and retrieval system.

Because of this absence of general concepts of the ranks, the limit between the family-series (nomina covered by the *Code*) and the class-series (nomina ignored by the *Code*) is largely artificial and arbitrary. It was even more so at the beginnings of zoology, two and a half centuries ago. Since those times, a common evolution of virtually all zoological taxonomies has been a progressive rise of the taxa from lower to higher ranks, even when the taxa themselves, their definitions and contents, remained largely unchanged. In many cases, what was considered a genus in the middle of the 18th century is often now considered a family, if not an order or even a higher taxon.

Although in some cases he used a few additional ranks at various levels, in zoology Linnaeus (1758) only recognized four standard ranks covering all his hierarchy below kingdom: class, order, genus and species. Subsequent authors introduced many additional ranks. The hierarchy between these ranks took a certain time to become firmly established, and some ranks used in the earlier times of zoological taxonomy (e.g., "division", "series" or "section") have stopped being universally used in zoology, although they are still used in some taxonomic groups. The family rank, now compulsory in zoological taxonomy, was not used at all by Linnaeus. Although some 18th century authors used this rank, it was often (e.g., Batsch 1788) as a very high, comprehensive rank, not as the first rank above the genus. Alternatively, other authors (e.g., De Geer 1778; Goeze & Donndorff 1797) used the family as a rank below the genus. Many earlier zoologists would not base their "family" nomina on generic nomina, which became a general practice only in the early 19th century (e.g., Goldfuss 1820; Latreille 1825), before becoming a Rule of the *Code* – whereas other authors, on the contrary, would use available generic nomina as the root for the nomina of taxa belonging to other higher ranks (such as order or class). To make matters still more complex, a few authors of these times used Latin nomina for higher taxa without stating the rank to which these were referred. This practice is still in force today in some publications, where it is however combined with a system of indentation of lines that shows the hierarchical relationships between taxa (e.g., Trueb & Cloutier 1991).

All these elements lead me to modify my proposals of 1984 regarding the allocation of earlier nomina of suprageneric taxa to either the family-series or the class-series of nomina. The status of nomina proposed by earlier authors for "higher taxa", i.e. for taxa above the genus, such as families, orders or "divisions", is currently clear only for those nomina which: 1) were proposed for taxa of the ranks family, subfamily, tribe, subtribe or superfamily, or referred to a few additional but clearly "related" ranks (e.g., infrafamily or supertribe); and 2) were built by the addition of a simple suffix denoting the plural (*-IDAE*, *-IDA*, *-AE*, etc.) to the stem of an available generic nomen. If both these conditions are met, then the nomen is clearly a family-series nomen and its nomenclature is regulated by the *Code*. But in all other cases, the situation is unclear. What is the status of a new nomen proposed for a family but not based on a generic nomen, or of a nomen based on an existing generic nomen but proposed for a taxon of unknown rank or of a rank higher than the superfamily (such as an order)? It would be irrelevant to exclude all such nomina from availability in zoological nomenclature simply because, when they were proposed, they did not follow rules that were devised only much later.

To clarify the status of such nomina, I propose a few simple principles, which are summarized in Rules (R4) and (R5) below. According to these proposals, the status of any new nomen will depend on several parameters regarding the spelling and origin 1) of the nomen, and 2) of other nomina used by the same author in the same publication. In order to make things clearer, let us consider first the case when the new nomen was the single suprageneric nomen of a given rank used in the original publication, and then the situation when several suprageneric nomina of the same rank were used.

(A) A single, new, suprageneric nomen was used in the original publication for a given taxonomic rank. Three cases must be distinguished:

(A1) The new nomen was clearly directly derived (by adjunction of a simple suffix like *-ACEA*, *-AE*, *-IDA*, *-IDAE*, *-IDEA*, *-IDI*, *-INAE*, *-INI*, *-OIDAE*, *-OIDEA*, etc.) from a genus-series nomen available in zoological nomenclature. Two different situations must then be distinguished:

(A1a) The new nomen was clearly presented in the original text as the nomen of a taxon of a rank usual within the family-series (family, subfamily, tribe, superfamily, etc.) or of an unusual rank (such as "division", "series", etc.), but the latter being clearly presented as being hierarchically subordinate to a usual rank of the latter series although above the genus: the new nomen is then deemed to apply to a taxomen of the *family-series* and should therefore follow the Rules of the *Code* for such nomina ("names of the family-group"). Example: *RANARIDIA* Rafinesque-Schmaltz, 1814, expressly proposed for a family.

(A1b) The new nomen was clearly presented in the original text as the nomen of a taxon of a rank usual above the family-series (class, order, phylum, etc.) or of an unusual rank (such as "division", "series", etc.), but the latter being clearly presented as being hierarchically at the same rank or above a usual rank of the class-series as defined here (e.g., above order), or at least above all usual ranks of the family-series (i.e. above the superfamily): the new nomen is deemed to apply to a taxomen of the *class-series* as defined here and should therefore follow the Rules proposed here for such nomina. Example: **RANACEA** Wilbrand, 1814, expressly proposed for an order.

(A2) The new nomen was derived from a genus-series nomen available in zoological nomenclature, but indirectly, by adjunction of a complex suffix like **-MORPHA**, **-FORMA**, etc., often composed of a complete term of Greek, Latin or other origin. Such a suffix is not acceptable as a suffix for a family-series term according to the *Code*, and therefore any such term is unavailable as a family-series nomen according to the *Code*: even if it was proposed originally as the nomen of a taxon of the family-series, the new nomen is deemed to apply to a taxomen of the *class-series* as defined here and should therefore follow the Rules proposed here for such nomina. Example: **RANIFORMIA** Hogg, 1839, expressly proposed for an order.

(A3) The new nomen was not derived from a genus-series nomen available in zoological nomenclature: even if it was proposed originally as the nomen of a family or of another taxon of the family-series, in all cases the new nomen is deemed to apply to a taxomen of the *class-series* as defined here and should therefore follow the Rules proposed here for such nomina. Examples: **BATRACIENS** Brongniart, 1800, expressly proposed for an order; **LAEVOGYRINIDAE** Lataste, 1879, although expressly proposed for a family.

(B) Other nomina of higher taxa (either new or not) of the same rank were used in the original publication where the new nomen was created. Three cases must be distinguished:

(B1) All nomina of the same rank in this publication were treated in the same manner and fall into one of the four cases above (A1a, A1b, A2 or A3): all these nomina must be afforded the same rank, as explained above.

(B2) The different nomina of the same rank were treated heterogeneously in this publication, some being derived from available generic nomina whereas others were not, but all these nomina were clearly used in the original publication for taxa of the class-series: these nomina must all be considered class-series nomina.

(B3) The different nomina of the same rank were treated heterogeneously in this publication, some being derived from available generic nomina

whereas others were not, but all these nomina were clearly used in the original publication for taxa of the family-series. According to the principles above, some of these nomina (based on available genus-series nomina) would have to be considered family-series nomina, whereas others (not based on available genus-series nomina) would have to be considered class-series nomina. In this case, for reasons of *consistency* in the taxonomic hierarchy, I propose that all these nomina be referred to the family-series, but that those which are incorrectly formed (not being based on available genus-series nomina, or formed through addition of a complex suffix unacceptable as a family-series suffix according to the *Code*), be considered nomenclaturally unavailable. These are of two kinds: I propose the general term *arhizonym* (from the Greek *a-*, "without", and *rhiza*, "root") for nomina not based on generic nomina, and *caconym* (from the Greek, *kakos*, "bad", "deficient") for nomina based on generic nomina but with a complex suffix. Arhizonyms and caconyms are just particular cases of *anoplonyms*. Examples of arhizonyms include "*Batracinia*", "*Gymnodermia*" and "*Phrynacinia*", used by Rafinesque (1815) for taxa of ranks family or subfamily, along with nomina like *Hylarinia*, *Ranarinia* and *Tritonia*. Examples of caconyms include "*Raniformes*", "*Hylaeformes*", "*Bufoniformes*" and "*Pipaeformes*" used by Duméril & Bibron (1841) for taxa of rank family, along with *Cécilioïdes*, *Salamandrides*, *Amphiumides* and *Protéides*.

This latter proposal may be formally expressed under a general *Rule of Taxonomic Consistency* (R5), which does not allow the recognition of both class-series and family-series nomina among a set of nomina created in the same publication for taxa of the same rank. This applies even if following the Rules suggested above would lead one to refer some of them to the class-series and others to the family-series. For example, if an author proposes five new nomina for taxa that he considers families, these nomina are to be referred: 1) to the family-series if all five are directly derived from available genus-series nomina; 2) to the class-series if all five are not directly derived from such nomina; and 3) to the family-series if only some of them are *directly* derived from available genus-series nomina: in the latter case, the new nomina that are not so derived are arhizonyms or caconyms, i.e. nomenclaturally unavailable family-series nomina.

A basic difference between family-series and class-series nomenclatures

Under the current *Code*, the basic criterion for the allocation of a nomen to a taxon is not the "definition" of the taxon, but the taxonomic allocation of the onomatophore. A *nomen* is not unambiguously linked to a "theoretical concept" of the *taxon*, i.e. to its *intension* (list of diagnostic or apognostic characters, topological position in a cladogram), and not even to a single, unchangeable and permanent *extension* (list of included and/or excluded individuals or taxa): it is "only", but unambiguously and definitively, linked to an *onomatophore*. The definition, content and limits of the taxon may change, but not its nomen, as long as the onomatophore remains included in the taxon and as the nomen remains the oldest one available among those based on onomatophores included in the taxon (Dubois 2000). This is a very clever disposition of the current *Code*, and this mode of functioning of zoological nomenclature is very important indeed: it ensures a strong limitation of the number of available zoological nomina, and hence facilitates the storage and retrieval of information associated with nomina (Dubois 2005b). Of course, this limitation is not complete, as some fools may create lots of minimally discriminated taxa "just for fun", but it nevertheless strongly reduces the possible inflation in the number of nomina.

However, another important feature of nomenclature as covered by the *Code* is that, within each nominal-series, the *Rule of Coordination* concerns all nomina applying to a taxon and its *coordinate*, i.e. *subordinate* (endotaxic) or *superordinate* (angiotaxic), taxa including the same onomatophore ("nominotypical taxa" in the *Code*), which is not the case in the class-series. In the family-series for example, all nomina based on the nucleogenus *Rana* Linnaeus, 1758 are connected by the Rule of Coordination and their hierarchy is directly given by their suffixes: the tribe *Ranini* Rafinesque-Schmaltz, 1814 is subordinate to the subfamily *Raninae* Rafinesque-Schmaltz, 1814, the latter to

the family *RANIDAE* Rafinesque-Schmaltz, 1814 and the latter to the superfamily *RANOIDEA* Rafinesque-Schmaltz, 1814. In this system, the nomenclatural status of each nomen is automatically fixed by two factors: its onomatophore and its date. Given the *contents* adopted for taxa in a given taxonomy (i.e. not their *definitions*, whether "phylogenetic" or not), the onomatophores provide the proper allocation of each nomen to a given taxon, and, among competing nomina (applying to the same taxon), the Rule of Priority unambiguously and automatically determines which nomen is valid.

In contrast, in the class-series, several nomina may have been initially created for taxa having the same or very similar contents (i.e. included species, genera or families) but may later have been used for hierarchically related taxa having different, i.e. more or less inclusive, contents. Their hierarchical relationships are not determined by their suffixes and dates, but partly by their original definitions, ranks and contents, and mostly by their subsequent histories. It would be impossible to apply the Rule of Coordination to class-series nomina, for two distinct reasons: 1) unlike in the three other nominal series, the hierarchical "nature" (i.e. the taxonomic rank) of a nomen cannot be recognized by its simple aspect: whereas a nomen like *RANINAE* clearly applies to a subfamily, *Rana* (*Pelophylax*) clearly to a subgenus and *Rana temporaria canigonensis* clearly to a subspecies, nothing tells us if nomina like **AMPHIBIA**, **BATRACHIA** or **ANURA** apply to taxa of the ranks class, order or suborder; 2) given the *a priori* unlimited number of taxonomic ranks within the class-series, and the fact that this number is widely different from one zoological group to another, or even between different taxonomies of the same group, it would be impossible to establish *a priori* rules that would allow fixation of the ranks of taxa. The only possible way to introduce a Rule of Coordination in class-series nomina would be to introduce the concept and practice of *coordinate taxa* in this series of nomina: this would mean e.g., having a subordinate order **AMPHIBIA** in the class **AMPHIBIA**, etc.; for more clarity, it would then be better to add a suffix (as suggested, e.g., by Levine *et al.* 1980), a diacritic mark (as suggested, e.g., by Papavero *et al.* 2001) or any other system allowing recognition of the rank of a nomen from its aspect alone, like in the family-series. This would be completely different from the current use, and it would have very little chance to be adopted by the international community of zoologists *and above all by outsiders of the field* for sozonyms, i.e. "well known" nomina like **VERTEBRATA** or **AMPHIBIA**: I do not advocate this course.

In class-series taxonomy, until today the allocation of nomina to taxa has not been based on the principle of onomatophores, but mostly on the intension and extension of taxa. However, this was the case up to a certain point only, because "slight" changes in the definition or contents of taxa were usually not followed by changes in their nomina, and even "major" changes were sometimes progressively made whereas the nomina were kept for parts of the initial taxa (e.g., **AMPHIBIA**) or for more comprehensive taxa including them (e.g., **REPTILIA***). To establish general Rules for the allocation of nomina to higher taxa, especially concerning older works, we need to take into account the initial concepts of the taxa by their authors, as testified by their original extensions. I am here proposing a new formal system for the objective and unambiguous allocation of nomina to taxa in the case of a set of nomina designating taxa of several distinct hierarchical ranks but not connected between them by a Rule of Coordination. This system uses two tools consisting of two distinct pieces of information. The first one is the onomatophore of the nomen, which is defined here in a new, peculiar way. The second one is some information on the taxa originally expressly excluded from the taxon designated by the nomen. These two different points require distinct examination.

ONOMATOPHORES

What kind of onomatophores for class-series nomina?

Details were given elsewhere (Dubois 1984, 1987c) why onomatophores of class-series nomina should be *nucleogenera*, i.e. genus-series nomina, not nomina of other nominal series. Dubois (1984) furthermore proposed to extend to class-series nomina the Rule, in force for genus-series and family-series nomina, according to which the onomatophore is a single

nomen. Thus, in the case of creation of a higher taxon with several included genera, any subsequent author would be entitled to restrict the function of onomatophore to one of these nomina by a first-reviser action (nucleogenus by subsequent designation). Such a Rule has the merit of avoiding a complete drift in the use of a nomen, a possibility that would exist if the use of nomina was only fixed by "definitions" instead of "contents" of the taxa for which they were originally proposed, and which was not uncommon in biological nomenclature before introduction of the concept of onomatophore (see e.g., Underwood 1899: 251). However, this proposal does not solve the question mentioned above, regarding the allocation of nomina to various taxa hierarchically related and including the same nucleogenus (isonyms). The problem was identified long ago (Corliss 1958; Hemming 1958b; Melville & Durham 1958), but not proposed a solution then. It derives from the fact that class-series nomina have no standard endings and are not connected by a Rule of Coordination. Let us illustrate this problem with an imaginary example.

Let us consider a taxonomy of amphibians in which a taxon (A) of rank order is recognized for frogs alone (including the genus *Rana*), a taxon (B) of rank subclass for frogs and salamanders, and a taxon (C) of rank class for frogs, salamanders and caecilians. According to the rules and type-genera designations of Dubois (1984), the class-series nomina **Amphibia** Linnaeus, 1758, **Batrachia** Brongniart, 1800, **Anura** Duméril, 1806 and **Lissamphibia** Haeckel, 1866, as well as many other ones, would be isonyms, being based on the same nucleogenus *Rana* Linnaeus, 1758. If these nomina were to be treated as in the family-series, enough information would be available with the nucleogenus and the date to determine that the valid nomen of the class (C) is **Amphibia**, and the Rule of Coordination would automatically make the same nomen the valid one also for the subclass (B) and the order (A). In the class-series however, these three taxa must bear three different, unrelated nomina. To determine which ones apply to the class, the subclass or the order including the genus *Rana*, one would need to use other criteria than the nucleogenus and the date, in particular the original content of the taxon and the historical fate of the nomen in zoological taxonomy.

A first important clarification can be obtained in deciding that the onomatophore of a class-series nomen can be either *one* or *several* generic nomina, i.e. *all those that were originally included in the taxon* in the publication where the class-series nomen was created. Some class-series nomina were actually created with a single generic taxomen mentioned as included in the taxon: the latter is then the *nucleogenus* by original designation or monophory. Other class-series nomina were created with mention of several generic taxomina included in the taxon: I then propose to consider them as the *conucleogenera* of the taxomen, that are *collectively and indissolubly* onomatophore for the nomen. Such a system contributes in part to a clear, automatic and unambiguous allocation of a nomen to a given taxon of a given rank in a given taxonomy, but is not enough by itself to reach this aim, because of the absence of a Rule of Coordination. Thus, if we come back to the four nomina mentioned above: 1) the nomen **Anura**, created for a taxon including only frogs, would be available for the order (A), but also for the subclass (B) and for the class (C); 2) the nomina **Batrachia** and **Lissamphibia**, created for taxa including only frogs and salamanders, would be available for the subclass (B), but also for the class (C); and 3) and the nomen **Amphibia**, created for a taxon including frogs, salamanders and caecilians, but also many other taxa, would be available for a more extensive taxon of rank class or higher. With such Rules, the Rule of Priority can easily apply between nomina that were created for taxa of identical or similar content, such as **Batrachia** and **Lissamphibia** in this example: in this case the former clearly has priority. These Rules allow clear allocation of the nomen **Amphibia** to the class, but ambiguity remains for the subclass. To remove this ambiguity, I propose below to use a second set of information, derived from the list of taxa expressly excluded from the taxon at its creation.

In order for the proposed Rules to be efficient, clear and unambiguous, contrary to the original suggestion of Dubois (1984), restriction of the onomatophore to a single one of the originally included genera should not be allowed, and the

original *set of nomina* should remain *indissoluble*. In such a system, any *restriction* in the content of a taxon should be viewed as the *creation* of a new taxon and a new nomen. Because of the Rule of Homonymy however (see below), the most recent nomen (with restricted content) is an invalid junior homonym. Therefore, restriction in the content of a class-series taxon cannot lead to the actual creation of an available new nomen, except in the very exceptional case of some sozonyms, i.e. nomina that must be conserved in a given sense, different from the original one (see below). This new proposed Rule is a major modification as compared to all previously proposed nomenclatural systems for nomina of higher taxa, and it is the major device by which robustness in the use of higher nomina will be attained, as shown in detail below. This proposal rejects the possibility to restrict the original contents of higher taxa, accepted by most (if not all) authors until now (e.g., Beatty & Blackwelder 1974), and formalized by Ghiselin (1977: 347) in the first of his proposed principles for higher nomenclature: "The name of a taxon remains unchanged when a taxon of lower rank is removed from it". Rather, the present proposal agrees with Brothers' (1983a: 41) third principle: "If the limits of a taxon are changed by the addition or exclusion of one or more subtaxa which are considered valid within the same group level of the hierarchy, then the taxon is no longer the same in composition or properties and must be given its own name". In the system here proposed however, additions to the original content of a taxon do not result in the automatic creation of a new taxon: in many cases this is simply similar to the addition of specimens into an already described species, or of species into an already described genus. As long as no new hierarchical ranks are added in the taxonomy and as the whole original onomatophore remains included in the taxon, the nomen should be conserved for the latter.

A last comment is useful here regarding the status of generic nomina that are the onomatophores of class-series nomina: in zoological nomenclature, the status of a generomen is determined by the status of its onomatophore, i.e. of its nucleospecies; the status of the latter, in its turn, is determined by the status of its onomatophore, i.e. of its onymophoront (Dubois 2005b). Allocation of a generic nomen to a generic taxon relies only on this criterion, i.e. neither on any "definition" of the taxon, nor on the original extension of the generic protaxon for which this nomen had been coined. The decision to use generomina as onomatophores of classomina (taxomina of the class-series) implies that these generomina are defined by their onomatophores, even if the latter were designated subsequently to their creation or to the creation of the classomen. Especially in the older literature, many class-series taxa were created with conucleogenera that were not understood exactly as today: most generally, the genus as now understood is much less inclusive, so that some of the species that were then included in the genus are now excluded from it. However, this difference should not be considered when establishing the status of the classomen, as doing so would result in using specific nomina instead of generic nomina as onomatophores of classomina. This would considerably complicate matters, especially when coming to the problem of allocating the latter to class-series taxa (see below), so that in many cases it would be virtually impossible to circumscribe exactly the onomatophore of a class-series nomen. Actually, the same is true for all other nominal-series: thus, the status of any family-series nomen is determined by the status of its nucleogenus, as established by its nucleospecies *and not* by its originally included species.

Modes of designation of nucleomina in the class-series

It was proposed above that the onomatophore of a class-series taxomen be either a single nucleogenus or a set of conucleogenera. The question that must then be addressed is the mode of establishment of the nucleogenus or conucleogenera of a class, order or other higher taxon. It must rely on simple Rules that follow a hierarchy, like for all three other nominal-series of the *Code*: this means that a first criterion is tested first, then, if it does not apply, a second criterion is called upon, and so on. Here also, the nucleogenus or conucleogenera designation can be either original or subsequent. The following hierarchy can be recognized among all possible modes of designation:

(A) Original designation.

(A1) Clear designation in full words of a nucleogenus or of conucleogenera.

(A2) Implicit designation by generic monophory or symphory, through the explicit allocation to the new higher taxomen, at its creation, of one or several available genus-series nomen or nomina considered as *valid* (i.e. excluding all the synonyms of these nomina, even if mentioned).

(A3) Implicit designation by familial monophory or symphory, when no genus-series nomen was mentioned in the original work, but when a single or several available family-series nomen or nomina considered valid (i.e. excluding synonyms) was/were explicitly referred to the new higher taxon at its creation: then the nucleogenus (or nucleogenera) of this family (or of these families) is/are also the nucleogenus/conucleogenera of the higher taxomen by implication.

(A4) Implicit designation by class-series monophory or symphory, when no genus-series nomen was mentioned in the original work, but when a single or several available class-series nomen or nomina considered valid (i.e. excluding synonyms) was/were explicitly referred to the new higher taxon at its creation: then the nucleogenus or the conucleogenera of this class-series taxon (or of these class-series taxa) is/are also the nucleogenus/conucleogenera of the higher taxomen by implication.

(A5) Implicit designation by specific monophory or symphory, when no genus-series, family-series or class-series uninomen was mentioned in the original work, but when one or several available species-series binomen or binomina considered valid (i.e. excluding synonyms), was/were referred to the higher taxon at its creation: then the generic substantive(s) with which the epithet(s) of this/these binomen/binomina were combined in the original text where the new class-series nomen was created, designate(s) the nucleogenus or the conucleogenera of the latter taxomen by implication.

(A6) Implicit etymological designation, in the case of a class-series nomen based on an available genus-series nomen, in the case where no included taxomen was explicitly mentioned in the original publication. This is similar to the situation recognized by the *Code* for family-series nomina, although the *Code* does not use the formula "implicit etymological designation" (first proposed by Dubois 1984: 24).

(B) Subsequent designation.

When the original publication gave only a diagnosis or definition of the higher taxon, without mentioning any included taxon (generic, familial, class-series and specific aphory), the first subsequent author who clearly allocated *nomenclaturally available* nomina to this higher taxon established the list of included taxomina, and therefore acted as first-reviser and designated the nucleogenus or conucleogenera of the higher taxon. The same Rules as above then apply hierarchically (clear nucleogenus or conucleogenera designation in full words, then implicit designation by subsequent generic monophory or symphory, then by familial monophory or symphory, then by class-series monophory or symphory, then by specific monophory or symphory). Any such first subsequent nucleomen designation is valid and definitive.

The Rules (R6) and (R7) below summarize this hierarchy of successive (and not alternative) criteria.

Nucleomina of archaeonyms, neonyms and allelonyms

A particular situation is that of a nomen *expressly* proposed by an author to *replace* an existing nomen, i.e. a *neonym* (Dubois 2000), or, according to the *Code*'s terminology, a "new replacement name" or "nomen novum". For more clarity in the discussions below, I propose the new term *archaeonym* (from the Greek *arkhaios*, "ancient") to designate the original nomen replaced by a neonym. When an author decides to replace a nomen by a neonym, this is in most cases not only in order to change the nomen, but also to redefine the taxon designated by the archaeonym. However, in order to qualify as a neonym, the new nomen should apply to a taxon including all the onomatophore of the archaeonym. In the three nominal series covered by the *Code*, both the archaeonym and the neonym belong in the same taxomen, and have by definition the same onomatophore, a situation called *isonymy* (Dubois 2000). In the class-series however, the situation is more complicated, as there are two

distinct situations regarding the nucleomina, with a single nucleogenus or with a set of conucleogenera. This has consequences on the onomatophore of the neonym:
1) When the archaeonym was based on a single generic nomen (its nucleogenus), the situation is the same as in the three other nominal-series: the neonym has exactly the same onomatophore (nucleogenus) as the latter (they are isonyms *sensu* Dubois 2000). If, in the original publication where the neonym is created, additional genera are mentioned as included in the taxon, the latter cannot be added to the onomatophore. On the other hand, if the original nucleogenus is not included in the taxon designated by the new nomen, then the latter is a xenonym and it must be treated as the nomen of a new taxomen, not as a neonym (despite possible statements in this respect from the author of the new nomen).
2) In the second situation, the archaeonym was based on several generomina, its conucleogenera, which together play the rôle of its onomatophore. Here also, to qualify as a neonym, the new nomen should be applied to a taxon including *all conucleogenera* of the protaxon of the archaeonym, and, if additional genera are mentioned as included in the taxon for which the neonym is created (i.e. if the latter is angioprotaxic to the original protaxon), these genera are not to be considered as added to the onomatophore. In all other cases, any so-called neonym, created for a taxon xenoprotaxic, gephyroprotaxic or endoprotaxic to the original protaxon, must be considered a xenonym, not a neonym. Therefore, whenever an author creates a new nomen and presents it as a neonym for an existing nomen, but for a taxon that excludes at least one conucleogenus of the original taxon, he/she must be understood as having in fact realized three distinct nomenclatural acts: A) creation of a new taxomen, with a distinct onomatophore; B) creation for this taxomen of a nomen that is a junior homonym of an existing nomen, and therefore invalid; and C) creation of a neonym for this invalid nomen. In fact, in most cases, it will be enough to consider that the new author has simply created a new nomen for a new taxon, as the invalid junior homonym was not mentioned in the new work (see Note 3), but there are exceptions in which it is necessary to mention the complete course described above (see e.g., in Dubois 2004b and in prep., the case of the nomina **CAUDATA/URODELA** and **ECAUDATA/ANURA** in Duméril 1806). More details on this situation will be discussed below.

Another particular situation, quite rare in lower nomenclature but more frequent in higher nomenclature, is that where an author proposes two or more alternative nomina for the same taxon (same content, same taxonomic rank), without choosing between them. I propose to call such nomina *allelonyms* (from the Greek *allelos*, "the one… the other…"). By definition, allelonyms created together have the same content and the same onomatophore (nucleogenus or conucleogenera). Priority between them must be fixed, when necessary, by a first-reviser action.

Nucleomina of anoplonyms

The question may be asked, whether anoplonyms (unavailable nomina) may have onomatophores or not. In previous publications (e.g., Dubois & Ohler 1995; Bossuyt & Dubois 2001), it was assumed that they had none, but this may raise problems if one wants to stabilize the place of such nomina in synonymies or other logonymies. Not rarely, such nomina are mentioned in taxonomic literature, and users of taxonomic and nomenclatural databases are likely to look for them: ignoring them would raise more problems than listing them as unavailable but in their proper place. Actually, for most nomina of lower ranks, allocation of an anoplonym to a logonymy is automatic. But this may be different for nomina of the higher ranks. In the family-series, the existence, according to the Rules here proposed, of unavailable nomina without clear root (arhizonyms) raises a special problem. For example, without designated onomatophore, it is impossible to allocate clearly the unavailable family-series nomen "*BATRACHI*" Batsch, 1788, created for a taxon that included the genera *Bufo*, *Hyla*, *Pipa* and *Rana*, to the synonymy of either family-series nomina *BUFONIDAE*, *HYLIDAE*, *PIPIDAE* or *RANIDAE*. Any decision taken by any author in this respect would be liable to be modified by a subsequent author and no stability would ever be

obtained. For this reason, it seems appropriate to consider that anoplonyms, just like hoplonyms, do have (real or potential) onomatophores, and that onomatophores can be designated to stabilize their status when necessary. This has no bearing on the fact that they remain nomenclaturally unavailable, as this unavailability derives from their lacking some of the conditions for availability of nomina provided by the *Code* (e.g., absence of diagnosis or definition, publication as synonym, incorrect formation of nomen, etc.). Thus, for any unavailable nomen of the family-series that is an arhizonym, the ambiguity can be solved through the original or subsequent designation of a nucleogenus among the prenucleogenera (originally included genera) (see Dubois 2005b), whereas unavailable nomina of the class-series will have, according to the situation, either a nucleogenus or a set of conucleogenera.

PROTAXON, APOTAXON, ALLOTAXON

Protaxon and apotaxon: Rule of Preoccupation

Earlier authors usually tended both to copy each other and to modify the proposals of their predecessors: thus, they would often use a nomen created by another author, but modify its "sense", i.e. its intension and extension (thus replacing the original *protaxon* by an *apotaxon* redefined by them) and also sometimes its spelling and rank (replacing the *protonym* by an *aponym*). Such changes (both in definition/content of the taxon and in spelling/rank of the nomen) were sometimes indicated clearly (by words like "*mihi*" or "*nobis*"), but sometimes were not. Furthermore, in those times, most biologists were usually aware of all or most of the other published works dealing with the zoological group considered, and they often did not find it useful to mention the authors and dates of the nomina they used. It would be possible to adopt a very rigid attitude in such cases, and to consider that, whenever a nomen was used for a newly defined taxon (indicated e.g., by "*mihi*" or "*nobis*"), or that no author had been mentioned for the nomen, we are dealing with a new nomen with its own author and date, and therefore a new taxomen. Such an interpretation would indefinitely and unnecessarily multiply the number of homonymous available nomina in higher nomenclature, and would be liable to create numerous confusions and difficulties (see Dubois & Ohler 1997: 306-308). In order to escape these problems, and to avoid the endless multiplication of unnecessary "new nomina" for what are in fact only modified nomina or modified taxa, I propose a *Rule of Preoccupation* (R8) according to which, once created, any class-series nomen is deemed to preoccupy all possible spellings derived from the same root and applied to taxa of any rank within the class-series *including the onomatophore of the original taxomen*. In other words, all subsequent uses of "similar" nomina derived from that nomen and for taxa including its onomatophore will be deemed to be only aponyms of the latter, and will have the same nomenclatural author and date, albeit different first-users (for the difference between *author* and *first-user*, see Appendix and Dubois 2000).

Apotaxon and allotaxon: Rule of Homonymy

However, in some other cases, it indeed happened that different authors, rather than "borrowing" nomina from colleagues, did independently create identical or similar nomina, ignoring each other's works. This is particularly possible in the case of simple terms based on common anatomical features (e.g., the case of the nomina APODA or NUDA, discussed in Dubois 2004b, in prep.), or of compound terms based on already existing nomina (e.g., the case of the nomina ARCHAEOBATRACHI and NEOBATRACHI, discussed in Dubois 2004b, in prep.). Another related case is that of an author who uses an existing nomen but for a new taxon, e.g., xenotaxic, gephyrotaxic or endotaxic to the protaxon for which this nomen had been coined: this results in fact, in nomenclatural terms, in the creation of a new taxomen, onomatophore and nomen. The question may be asked, how and "up to which point" can a protaxon be modified whereas nevertheless remaining an *apotaxon* of the same taxon, and when should we consider that, rather than an apotaxon, we are faced with a "new taxon"? The term *allotaxon* (from the Greek *allos*, "other, different") is here suggested to designate a new taxon, with a new taxomen, onomatophore and nomen, proposed by an author but bearing the same nomen as, or a nomen very similar to, that of an already existing taxomen: the nomen of this

allotaxon is an *allonym*, i.e. a *junior homonym* of the nomen of the latter.

The distinction between apotaxon and allotaxon can be based on two kinds of evidence: 1) statement in full words from the author of the allotaxon that the latter is a new taxon, distinct in its contents and definition from the taxon previously known under the same nomen: examples of this situation in the species-series are provided by the nomina *Rana pipiens* Schreber, 1782 and *Rana pipiens* Daudin *in* Sonnini & Latreille 1801 (see Dubois & Ohler 1997: 307-308), or *Bufo scaber* Schneider, 1799 and *Bufo scaber* Daudin, 1802 (see Dubois & Ohler 1999: 143-145); and 2) indirect evidence through the extension of the new taxon, or more precisely through its onomatophore. Of course, if the newly recognized taxon is fully xenotaxic to the protaxon of the existing nomen, it is an allotaxon. But in some other cases, the situation is more subtle, as both taxa can be largely gephyrotaxic or peritaxic but distinct, if one of them or each of them excludes the onomatophore of the other or part of this onomatophore. In the species-, genus- and family-series, the simple clear exclusion of a single specimen (the onymophoront) or of a single taxomen (the nucleomen) of the original taxon results in the creation of a new taxon. The same applies to the class-series, with the particularity here that the onomatophore can be composed of several taxomina (conucleogenera). To be considered an apotaxon of an existing taxon, any newly defined taxon *must include all the onomatophore* of the taxomen of the latter, i.e. all the conucleogenera: explicit exclusion of but one conucleogenus from the taxon results in the creation of an allotaxon.

According to these criteria, allotaxa are not rare in the older taxonomic literature, although much less frequent than apotaxa. By definition, such allotaxa bear the same nomen (junior homonym) as another senior taxon. In such cases, as already suggested (Dubois 1984), in order to avoid confusion and instability, the *Code*'s *Principle of Homonymy* should apply to class-series nomina: hence the Rule (R9) below, similar to the Rules in force for all other three nominal-series. This Rule provides criteria allowing distinction of an allonym from an aponym of an existing nomen: it should either have been clearly proposed as a new nomen, or/and it should have been used for a taxon excluding all or part of the onomatophore of the taxomen for which the original nomen had been coined.

Combination of the Rules of Preoccupation and of Homonymy allows rejection as invalid of any subsequent proposal of a junior homonymous class-series nomen, even when it is not quite clear if the new nomen was an aponym of an existing nomen or a brand new protonym, which sometimes is the case in old texts: in such a case the new use can be considered a new nomen, with a distinct onomatophore, but invalid, being a junior homonym.

Preoccupation and homonymy as defined here are based on the different morphonyms at stake having *the same root*. As discussed in detail by Dubois (1985: 62-71, 1987c: 38, 39), establishing whether this is the case, or not, is not always as simple and clear as one might think. The situation is clear only in one case, i.e. for class-series nomina that are derived, like family-series nomina, from available genus-series nomina: all different morphonyms based on that stem are to be treated either as aponyms of the first published such nomen (protonym), or as junior homonyms of that nomen. The situation is more complex for nomina derived from anatomical, biological, geographical or other terms: however, in most cases, intelligent study of the situation by people having a basic knowledge of Latin and/or Greek grammar will often allow appropriate decisions to be taken. If such people are wanting in biological laboratories, why not "try the language departments of your universities" (Filgueiras 1997: 748)?

Allocation of class-series nomina to ergotaxa

Protaxon and ergotaxon

In the absence until now of a principle of onomatophores in higher nomenclature, no general rule has been followed by previous authors concerning the relationships between the current allocation of higher nomina to taxa and the original definitions and contents of the taxa for which these nomina were first proposed. Therefore, several relationships can exist between a current ergotaxon and the protaxon that served as the basis for a nomen. All

five following situations may be encountered: (S1) the ergotaxon is isotaxic to the original protaxon, i.e. no substantial change has been brought to the definition and content of the taxon since its creation (except of course addition of newly discovered taxa, closely related to the originally included ones); (S2) the ergotaxon is angiotaxic to the protaxon, i.e. it includes all the latter but also other taxa that were not initially part of it; (S3) the ergotaxon is endotaxic to the protaxon, i.e. it corresponds only to a part of the taxon originally designated by the same nomen; (S4) the ergotaxon is gephyrotaxic to the protaxon, i.e. it includes only parts of the latter but also parts of other taxa that were initially included in other taxa; (S5) the ergotaxon is xenotaxic to the protaxon, i.e. both taxa do not have a single common included taxon.

This last case (S5) exemplifies the progressive derive or divergence of nomina from their original sense which has sometimes occurred because of the absence of a Principle of Onomatophore. An example of this situation is given by the nomen |ANTHRACOSAURIA|*, which had initially been based on the generic nomen *Anthracosaurus*, but which was later used by some authors for a higher taxon excluding this genus (see discussion of this case in Laurin 2001: 206-208). For a nomenclature based on the Principle of Onomatophore, this latter situation is clearly unacceptable, and a nomen used in this incorrect sense, even for a long time, should be rejected and replaced by an appropriate nomen, coined for a taxon synotaxic to the current taxon. However, if one accepts that onomatophores in the class-series can be composed of several generomina, the situations (S3) and (S4) also are unacceptable, as they would amount to accepting that a part of the onomatophore of a nomen be excluded from the taxon designated by this nomen. Situations (S1) and (S2) are the only ones that are compatible with validation of the use of a nomen for a taxon following the Principle of Onomatophores as defined above.

Kyrotaxon; alienogenus, extragenus and intragenus; choronym and nesonym

In most animal groups, the higher taxonomy (above the superfamily) consists of several, if not numerous, hierarchically coordinate taxa. These taxa therefore have partially common contents. The highest taxon is angiotaxic to all its subordinate taxa, and the latter have two kinds of relationships between them: peritaxy between subordinate and superordinate taxa, and xenotaxy between different taxa of the same rank subordinate to the same taxon of higher rank. In most cases, because of the long absence of rules in higher nomenclature, the number of available class-series nomina that may potentially apply to these taxa is greater or much greater than the number of taxa. Before determining which nomen is the valid one for each taxon, we first need some Rules to allocate nomina to taxa. These Rules will have to fix in an automatic manner the allocation of a given nomen to a given taxon in a given ergotaxonomy. I propose to call *kyrotaxon* (from the Greek *kyrios*, "proper, correct") the ergotaxon to which a nomen must be allocated under the Rules presented here and within the frame of a given ergotaxonomy. In order for the Rules to play the rôle we expect from them, they should allow to establish that a given nomen can be allocated to *a single taxon* within the frame of a given ergotaxonomy. The precise and simple formulation of these Rules will require the introduction of several new terms.

As we have seen above, because of the absence in the class-series of a Rule of Coordination, onomatophores alone do not allow a non-ambiguous allocation of nomina to higher taxa, as several (or even many) hierarchically coordinate taxa may include the same onomatophore. The proposal made here is to combine the use of onomatophores with other pieces of information, derived from the contents of the other taxa recognized by an author while creating the new taxon and its nomen. Therefore, the allocation of the nomen does not rely only on the *inclusion* of the onomatophore in the original taxomen, but also on the *exclusion* of other taxomina from the latter. Several situations can be recognized here.

Whenever a new protaxon and its nomen (N) are proposed, the same publication also usually contains information on the other taxa of the same group or even of many other groups (up to the whole animal kingdom). In the new protaxonomy proposed, all taxa that are considered external to the new protaxon,

i.e. that do not include it or any of its members, are its *xenoprotaxa* (Dubois 2005b). These will allow to qualify further the new nomen.

There is one apparent exception to this situation: that of an *eremoprotaxon*, i.e. a protaxon created by an author as isolated, without other taxa of the same rank subordinate to the same immediately higher taxon (Dubois 2005b). Such a taxon does not have "twin" taxa at its creation, but some information is often provided regarding its supposed relationships in the animal kingdom, even sometimes very imprecise or tentative. To qualify this taxon by its exclusion, it is therefore often possible to go up the taxonomical hierarchy until one reaches a rank shared by the higher taxon including this single eremoprotaxon with other taxa: then this higher taxon can be qualified by exclusion, as discussed below. Consequently, the different coordinate taxa from the eremoprotaxon up to the higher taxon in question are identical in content. There is no justification then for keeping these several coordinate nomina, except for reasons of homogeneity in the taxonomic hierarchy: this question will be addressed further below. Finally, in the case of eremoprotaxa created without any information on their place in the taxonomy, their nomina have to be qualified by inclusion only, as explained below for nesonyms.

Although xenoprotaxa can be of various ranks, they all include genera: these can be designated as the *alienogenera* (singular *alienogenus*; from the Latin *alienus*, "alien, foreign") of the protaxon for which the nomen (N) was proposed. To be considered an alienogenus of a protaxon, a generomen must have been expressly mentioned in the original publication as not being part of the protaxon, or this information can be directly derived from the information available: the alienogenera of any class-series nomen can be established following exactly the same hierarchy of criteria as explained above for conucleogenera. This is summarized in Rules (R6) and (R10).

The allocation of a class-series nomen to an ergotaxon, in any ergotaxonomy, will be made according to the current ergotaxonomic allocation of the taxa originally included not only in the protaxon itself (its onomatophore) but also all other taxa originally recognized in the protaxonomy. With respect to a given ergotaxonomy, the alienogenera of a class-series nomen can belong in two different categories: the *extragenera* (singular *extragenus*; from the Latin *extra-*, "out of, outside") are generomina that are excluded from the current class-series ergotaxon, whereas the *intragenera* (singular *intragenus*; from the Latin *intra-*, "within, inside") are currently included in this taxon.

In other words, the important information here is the kind of *topotaxy* that existed between the protaxon being studied and its xenoprotaxa, relative to the topotaxy between taxa in the current ergotaxonomy. Two major cases must then be distinguished: in the case (C1), in the light of the ergotaxonomy chosen, this protaxon is *xenotaxic* to all its xenoergotaxa; in the case (C2), in the light of the ergotaxonomy chosen, the protaxon under study is *synotaxic* (i.e. either endotaxic, angiotaxic or gephyrotaxic) to at least one of its other xenoergotaxa. My proposal is to treat these two cases differently, as follows.

(C1) Whenever a protaxon (A) is now xenotaxic to all its xenoergotaxa (B, C, D… to N), i.e. when all its alienogenera are now its extragenera relative to (A), this protaxon (A) can be distinguished from (B-N) both by its inclusion (conucleogenera) and by its exclusion (extragenera). In the ergotaxonomy adopted, the ergotaxa (A) and (B-N) have non-overlapping contents and are usually (although not always) ametoxenoergotaxa (taxa of the same rank subordinate to the same immediately higher taxon; Dubois 2005b). They then constitute together the higher taxon in which they are all included, like the provinces together constitute a state, without overlapping: hence the proposed terms *choroprotaxon* (from the Greek *chora*, "space of land between two limits, country") to designate such a protaxon, and *choronym* to designate its nomen. To put the same thing differently, all genera referred to (A) in the work where this protaxon was created are still now placed in the ergotaxon (A), whereas none of the genera expressly referred to the protaxa (B-N) is now placed in the ergotaxon (A). In such a case, the extragenera provide an objective limit for the possible extension of the taxon (A), thus playing a rôle complementary to that of the onomatophore to establish the taxonomic allocation of the

nomen. It is here proposed that, in the frame of this ergotaxonomy, the nomen of this protaxon (A) or choronym applies *to the most inclusive (highest ranked) ergotaxon including all its conucleogenera and excluding all its extragenera*. This particular ergotaxon can be designated as *orotaxon* (from the Greek *oros*, "landmark"). According to this proposed Rule, the kyrotaxon of a choroprotaxon is its orotaxon, which is defined both by its conucleogenera and by its extragenera.

(C2) In a second situation, a protaxon (A) may have been created with reference to one or several other protaxon/a (B-N), one of which at least is now synotaxic to this taxon in the frame of a given ergotaxonomy. In other words, its alienogenera include both extragenera and intragenera (or even only intragenera): all genera referred to this protaxon (A) in the work where this protaxon was created are still now placed in the ergotaxon (A), but one at least of the extragenera referred to the protaxa (B-N) is now placed in the ergotaxon (A), or vice-versa. This protaxon (A) cannot then be distinguished from the other protaxa (B-N) by mutual exclusion of extragenera and can only be qualified by its proper characteristics, ignoring its relations with other taxa. I propose to call such a protaxon a *nesoprotaxon* (from the Greek *nesos*, "island") and its nomen a *nesonym*. It is here proposed that, *in the frame of this ergotaxonomy*, this nesonym (A) applies *to the least inclusive (lowest ranked) ergotaxon including all the conucleogenera of the nesoprotaxon*, without taking into account the alienogenera, whether extragenera or intragenera. This particular ergotaxon, which is member of all its superordinate ergotaxa, can be designated as *metrotaxon* (from the Greek *metros*, "mother"). According to this proposed Rule, the kyrotaxon of a nesoprotaxon is its metrotaxon, which is defined by its conucleogenera alone, without taking any extragenus into account.

This matter may be made clearer by looking at an hypothetical given ergotaxonomy, illustrated in Figure 1. In this figure, taxonomic relationships are shown under the form of cladograms. Let us consider that, in the current ergotaxonomy of a zoological group, a class C1 contains two orders, the first one, O1, with two families F1 (with genera G1, G2 and G3) and F2 (with genus G4), and the second one, O2, with three families F3 (with genera G5 and G6), F4 (with genus G7) and F5 (with genus G8) (Fig. 1A). Let us also consider that, in the past, some higher nomina had been provided for protaxa that contained some of these taxa. To which of the currently recognized taxa should these nomina be allocated? A protaxon containing all eight genera G1 to G8 would be isoprotaxic to the current ergotaxon of rank class and its nomen would therefore be available for class C1. Similarly, a nomen provided for a higher protaxon containing all the genera of a given order of the current ergotaxonomy would be available for this ergotaxon. But let us now consider the case of nomina provided for protaxa that contained only some of the genera considered as valid in the current ergotaxonomy. Figure 1B-D shows situations of the case (C1) above, whereas Figure 1E-G shows situations of the case (C2). Whenever a nomen N1 was provided for a higher protaxon containing all the genera of one of the current orders O1, whereas a second nomen N2 was coined for another higher protaxon including all the genera now placed in the second order O2, these two nomina N1 and N2 are choronyms that apply respectively to the taxa O1 and O2 (Fig. 1B). The same is true irrespective of the fact that the genera now included in these taxa were all listed (Fig. 1B) or only partly listed (Fig. 1C, D) in the original protaxa: in the two latter cases, the nomina N3 and N4, or N5 and N6, respectively apply to the two orders O1 and O2. However, whenever the original protaxa were heterogeneous in the light of the current taxonomy (Fig. 1E-G), their nomina would now apply to ergotaxa that would be either peritaxic (Fig. 1E: N7 would apply to O1, and N8 to C1) or isotaxic (Fig. 1F, G: in both cases, both nomina apply to C1): such nomina are therefore nesonyms and their allocation to taxa must be based only on their original content, irrespective of the genera initially excluded from them. More details will be given below for the allocation of nesonyms to ergotaxa.

Getotaxon and teletaxon; getextragenus and telextragenus; onomatostasis

Although the conucleogenera of any given protaxon are often easy to identify and rather limited in

number, its alienogenera may be much more numerous and difficult to list exhaustively (especially if created in publications that refer to various other previously published works for the ergotaxonomy chosen). In practice however, in order to qualify a choronym by exclusion, it is not necessary to list all its extragenera: it is enough to be sure to identify its "closest" extragenus (or extragenera) in the ergotaxonomy used. This concept of "closest" extragenus is easy to understand in a cladistic context, i.e. in any taxonomy based on the topology of a cladogram: the "closest" xenotaxon of any ergotaxon is then its "twin-taxon". The term *ametoxenotaxa* (Dubois 2005b) designates such pairs (or series, in all cases of polytomies) of "most closely related" taxa. In more general terms, relative to a given ergotaxonomy, two (or more) ametoxenotaxa are taxa of the same rank that are members of the same immediately superordinate taxon, or, to put the same thing differently, that together constitute the latter. In contrast, *teletaxa* (Dubois 2005b) are taxa that are more remotely related, i.e. taxa, whether of the same rank or not, that are not members of the same immediately superordinate higher taxon. Often, ametoxenotaxa in a given ergotaxonomy prove to have been originally proposed as didymoprotaxa or adelphoprotaxa, but this is not a general rule. The concepts of adelphoprotaxa and didymoprotaxa, just like those of eremoprotaxa and ametoxenoprotaxa, refer to the original creation or use of taxa in the context of a given protaxonomy, whereas those of ametoxenoergotaxa and telergotaxa refer to the relation between taxa in a given ergotaxonomy adopted as valid by a given author. Relative to a given class-series ergotaxonomy, the *getextragenera* (singular *getextragenus*; from the Greek *geiton*, "neighbour") of a given ergotaxon are its extragenera that belong in its ametoxenotaxon/a. In contrast, its *telextragenera* (singular *telextragenus*; from the Greek *tele*, "far from") are all its extragenera that belong in all its teletaxa.

In order to qualify a choronym by its exclusion, it is enough to know its getextragenera, as any taxon that excludes them is bound to exclude also its telextragenera. The getextragenera of a choronym can be designated as its *onomatostasis* (from the Greek *stasis*, in the sense of "stop"). Combined with the onomatophore, the onomatostasis of a choronym allows to know the ergotaxon to which this choronym unambiguously applies. In the practical work of establishing the choroprotaxon of a choronym, it is enough to be sure to identify and list all its getextragenera, and its telextragenera can be ignored. It is here important to note that, unlike the onomatophore, the onomatostasis is not permanently attached to a nomen, as it depends on the ergotaxonomy adopted.

Examples

Let us take some examples to illustrate the way these proposed new Rules work, which is much simpler indeed than it might appear from the description above and from the seemingly complex terms necessary to formulate such Rules unequivocally. The ergotaxonomy used for the taxonomic allocation of nomina to taxa in these examples is presented in Table 2. More details on these nomina were provided or will be provided elsewhere (Dubois 2004b, in prep.).

The taxon **Amphibia** as used in Linnaeus (1758) was a class including a number of genera that are currently referred to the following ergotaxa (Table 2): |**Petromyzontiformes**|*, |**Chondrichthyes**|*, |**Actinopterygii**|*, |**Reptilia**|* and **Amphibia**. In the same work, Linnaeus (1758) recognized five didymoprotaxa beside **Amphibia**: the classes **Aves***, **Insecta***, **Mammalia***, **Pisces*** and **Vermes***. His class **Pisces*** included 51 genera which are now included in the |**Actinopterygii**|*. Therefore his classes **Amphibia** and **Pisces*** have overlapping contents in the light of the current ergotaxonomy, they are synotaxic. The nomen **Amphibia** Linnaeus, 1758 is therefore a *nesonym* which applies to the *least inclusive* ergotaxon including all the conucleogenera of its nesoprotaxon, irrespective of the contents of its ametoxenoprotaxa. This nomen therefore applies to the taxon **Vertebrata** Cuvier, 1800 (see Dubois in prep. for more details on this taxon and its valid nomen).

Batsch (1788) proposed a new definition of the taxon **Amphibia**, excluding some of the genera placed by Linnaeus (1758) in the taxon, and hence proposed a new, junior homonym, nomen **Amphibia** Batsch, 1788. His allotaxon **Amphibia** was one of

the four classes he recognized in the **Ossea** (a senior synonym of **Vertebrata**, see Dubois in prep.). His class **Amphibia** included four families, *Batrachi*, *Lacertae**, *Serpentes** and *Testudines**, and all the genera he included in this class are currently referred either to the **Amphibia** or to the |**Reptilia**|*. However, since he excluded the classes **Mammalia*** and **Aves*** from this class, his taxon **Amphibia** is synotaxic with the |**Reptilia**|* according to the taxonomy of Table 2. This nomen is therefore a *nesonym* which applies to the *least inclusive* ergotaxon including all the conucleogenera of its nesoprotaxon, i.e. the superclassis |**Neotetrapoda**|.

In contrast, the taxon **Amphibia** as redefined by De Blainville (1816) was opposed to the redefined taxon **Reptilia**: each of these redefined taxa only included recent genera that are still currently referred to these taxa (for more details, see Dubois in prep.). All genera currently considered to be amphibians (according to the ergotaxonomy of Table 2) listed in De Blainville (1816) were included in his **Amphibia**, and no amphibian genus was referred to another taxon. The nomen **Amphibia** De Blainville, 1816 is therefore a *choronym*, that applies to the *most inclusive* ergotaxon including all its conucleogenera *and* excluding all its extragenera, i.e. the current class recognized by most authors nowadays under this nomen. It is noteworthy that this nomen applies to this class as including the groups currently known as the † |**Labyrinthodontia**| and the † |**Lepospondyli**|, although both these latter taxa were unknown at the time of De Blainville (1816). However, the situation is different for the nomen **Reptilia*** De Blainville, 1816, as the taxon understood by De Blainville (1816) under this nomen still excluded the **Mammalia*** and **Aves***: it is therefore a *nesonym*, which applies to the *least inclusive* ergotaxon including all its conucleogenera, irrespective of its extragenera, i.e. the |**Sauropsida**|*.

Let us now consider the nomen **Ranacea** Wilbrand, 1814. Wilbrand's (1814) class **Amphibia** was similar in contents to that of Batsch (1788), with four orders **Lacertae***, **Ranacea**, **Serpentes*** and **Testudines***. Wilbrand only mentioned four genera (*Rana*, *Proteus*, *Salamandra* and *Siren*) as included in his **Ranacea**. These genera belong in two of the three current orders of recent **Amphibia**, namely the **Anura** and the **Urodela**, but the order **Gymnophiona** (or its then only described genus *Caecilia*) was not mentioned in Wilbrand's (1814) classification. Thus, if the nomen **Ranacea** was a nesonym, it would apply to the taxon **Batrachia**, including only the **Anura** and the **Urodela**. But as, according to the ergotaxonomy of Table 2, the protaxon **Ranacea** is xenotaxic to all other taxa mentioned by Wilbrand (1814), or, to put it differently, as it included all the genera mentioned in Wilbrand (1814) that are currently placed in the **Amphibia**, and as it did not include any genus currently placed in other taxa, this nomen is a *choronym*. It therefore applies to the *most inclusive* ergotaxon including all its conucleogenera *and* excluding all its extragenera, i.e. to the class **Amphibia**.

This latter case clearly exemplifies the difference of taxonomic allocation of a nomen according to whether it is a nesonym or a choronym: choronyms often apply to more inclusive taxa, with higher hierarchical rank, and sometimes including fossil taxa that were unknown at the time of creation of the nomen. This is because the taxonomy used when a choronym was created was already largely similar, and at least not contradictory, to the current ergotaxonomy, whereas that used at the creation of a nesonym was much more different from the latter.

A last, interesting example is that of the nomen **Lissamphibia** Haeckel, 1866. Although it was used by some recent authors for a subclass of the **Amphibia** containing all the recent representatives of this class (i.e. frogs, salamanders and caecilians), this nomen does not apply to this subclass. Haeckel (1866: cxxx-cxxxii) recognized a class **Amphibia**, with two subclasses, for which he proposed the didymonyms **Phractamphibia** and **Lissamphibia**. The **Phractamphibia** were composed of three orders, two containing only fossil taxa († **Ganocephala** and † **Labyrinthodonta**) and one (**Peromela**) composed of the caecilians. The **Lissamphibia** contained three orders of living taxa, two of which (**Sozobranchia** and **Sozura**) embraced the current tailed amphibians (salamanders), whereas the third one, **Anura**, contained the tailless amphibians (frogs). Therefore, Haeckel's (1866) **Lissamphibia** were exactly equivalent to Brongniart's (1800)

Batrachia, and not to the latter plus the **Gymnophiona**, as stated by several recent authors. The nomen **Lissamphibia** is therefore a nesonym and a strict junior synonym of **Batrachia** Brongniart, 1800, whereas the valid nomen for the subclass encompassing all recent amphibians is **Neobatrachi** Sarasin & Sarasin, 1890 (see Table 2 and Dubois 2004b, in prep.).

Allocation of nesonyms to ergotaxa and hierarchy between class-series nomina

Under the principles described above, the allocation of choronyms to ergotaxa is a fully automatic and non-ambiguous process: in any taxonomy, there is only one "most inclusive" taxon including any given set of genera and excluding any other given set of genera (see Fig. 1B-D). The situation (C2), concerning nesonyms (Fig. 1E-G), is a bit more complex, and deserves a special discussion. For the allocation of nesonyms to ergotaxa, the following hierarchy of Rules is here proposed:

1) To be potentially applicable to an ergotaxon, a nesonym must have been created for a protaxon isotaxic or endotaxic to this ergotaxon. A nesonym created for a taxon xeno-, gephyro- or angioprotaxic to the ergotaxon, i.e. proposed for a taxon including genera not included in the latter, is definitively unapplicable to this taxon, and should be allocated to an ergotaxon that is isotaxic or angiotaxic to it.

2) In a hierarchy of current subordinate ergotaxa, when available a nesonym endotaxic to several ergotaxa must be allocated to the ergotaxon of lowest hierarchical rank among them (the least inclusive one).

This matter may be made clearer by looking at an hypothetical given ergotaxonomy, illustrated in Figure 2. Let us start from the same hypothetical ergotaxonomy as in Figure 1. We will now consider only the fate of nesonyms, i.e. nomina which, like in Figure 1E-G, would now apply to synotaxic ergotaxa: for the allocation of such nomina to ergotaxa, we will now only consider the taxa originally included in their protaxa, not the taxa excluded from the latter. A nomen N1 provided for a higher protaxon containing five genera (G1, G4, G5, G7 and G8) belonging to all five of the current families (F1 to F5) (Fig. 2B) would be available for the higher taxon containing all these families, i.e. for class C1. Nomina provided for taxa containing genera included in some families only would be available for the taxa of lowest rank including all these genera: thus, a nomen N2 provided for a protaxon including genera G1, G4, G5 and G7 would still be available for C1, and the same would be true for N3 provided for a protaxon including only G1 and G5, as these two genera belong in the two distinct orders of C1 (Fig. 2C, D). However, a nomen N4 provided for a taxon containing only G5, G7 and G8 would not be available for C1 but for O2, as this is the class-series taxon of lowest hierarchical rank including these three genera (Fig. 2E). The same would apply to a nomen N5 coined for a taxon including two genera G5 and G7 that belong in the families F3 and F4 (Fig. 2F), and to a nomen N6 proposed for a taxon including only genera G5 and G6 that are both members of F3 (Fig. 2G).

In Figures 1 and 2, taxonomic relationships were expressed under the form of cladograms, which is a pertinent way of showing them for anyone who admits that the only criterion of inclusion used to build up a taxonomy (or cladonomy) is the holophyly of taxa (see e.g., Ashlock 1971, 1984; Dubois 1986). However, a more general statement, although strictly equivalent in terms of logics, of this taxonomy would be to express it as a hierarchical system of inclusion of members into sets of higher rank, as shown in Figure 3, which displays differently (and more generally) the same taxonomic relationships as illustrated in Figure 2.

It should be noted that the system explained above allows clear and unambiguous allocation of a single nesonym to a single taxon, notwithstanding the philosophy of classification or cladification used, and in any taxonomy or cladonomy. Whatever the hypotheses of cladistic relationships between taxa used, in the end any cladonomy places all species, "terminal taxa" or LITUs (Pleijel & Rouse 2000) into a classificatory or cladificatory unit: what Rules tell us is simply which nomina should be given to these units, independently from the theoretical framework used to recognize these units.

The principles proposed above for the allocation of nomina to taxa are presented in a formal and shortened way in Rule (R11) below. Once the

TABLE 2. — Partial higher ergotaxonomy of the **VERTEBRATA** used in the present work. As the cladistic relationships between many of these taxa is still highly debated, this ergotaxonomy must be considered highly provisional, especially as concerns the ranks of these taxa. As for the taxa of recent amphibians, the nomina given to them in the ergotaxonomy below are the valid ones according to the nomenclatural Rules here proposed (for more details on these nomina, see Dubois 2004b, in prep.), and are presented naked, followed by their author(s) and date (e.g., **AMPHIBIA** De Blainville, 1816). Nomina, whether valid or not, that apply to entirely fossil taxa are preceded by the sign †. All nomina followed by an asterisk (*) designate taxa that do not include **AMPHIBIA** as understood here. All nomina that have not been critically studied for the purpose of the present work and that are used here only following "tradition", are presented between vertical bars and naked, i.e. without author and date (e.g., |**REPTILIA**|*): their validity under the proposed class-series nomenclatural Rules here proposed is questionable. Most of these nomina were borrowed from Trueb & Cloutier (1991) **[TC]**, Carroll *et al.* (1998) **[C]**, Tudge (2000) **[T]** or Lecointre & Le Guyader (2001) **[LLG]**; they are used here for ergotaxa as recognized in these works. **1**, as *DROMAEOSAURIDAE*. Codes designating ranks (e.g., CP02C) are built as explained in text and listed in Table 6.

CP02C. Hyperregnum |**BIOTA**|
CP02B. Epiregnum |**EUCARYA**| [T]
CP02A. Superregnum |**OPISTHOCHONTA**| [LLG]
CP02. Regnum **ANIMALIA** Linnaeus, 1758 [T]
CP02a. Subregnum |**METAZOA**| [T]
CP02b. Infraregnum |**EUMETAZOA**| [T]
CP02c. Hyporegnum |**BILATERIA**| [T]
CP02d. Catoregnum |**DEUTEROSTOMIA**| [T]
CS01A. Superprovincia |**CYRTOTRETA**| [T]
CS01. Provincia |**CHORDATA**|
CP04A. Superphylum |**MYOMEROZOA**| [LLG]
CP04. Phylum |**CRANIATA**| [LLG]
CP04a. Subphylum |**MYXINOIDEA**|* [LLG]
CP04a. Subphylum **VERTEBRATA** Cuvier, 1800 [LLG]
CP04b. Infraphylum † |**ANASPIDA**|* [T]
CP04b. Infraphylum † |**CONODONTIA**|* [T]
CP04b. Infraphylum † |**GALASPIDA**|* [T]
CP04b. Infraphylum † |**HETEROSTRACI**|* [T]
CP04b. Infraphylum † |**THELODONTI**|* [T]
CP04b. Infraphylum † |**OSTEOSTRACI**|* [T]
CP04b. Infraphylum |**PETROMYZONTIFORMES**|* [T]
CP04b. Infraphylum |**GNATHOSTOMATA**|
CP04c. Hypophylum † |**ACANTHODII**|* [T]
CP04c. Hypophylum |**CHONDRICHTHYES**|* [T]
CP06. Classis |**ELASMOBRANCHII**|* [T]
CP06. Classis |**HOLOCEPHALI**|* [T]
CP04c. Hypophylum † "**PLACODERMI**"* [T]
CP04c. Hypophylum |**OSTEICHTHYES**|
CP06C. Hyperclassis |**ACTINOPTERYGII**|* [T]
CP06B. Epiclassis † |**CHEIROLEPIFORMES**|* [T]
CP06B. Epiclassis † |**PALAEONISCIFORMES**|* [T]
CP06B. Epiclassis |**ACIPENSERIFORMES**|* [T]
CP06B. Epiclassis |**POLYPTERIFORMES**|* [T]
CP06B. Epiclassis |**NEOPTERYGII**|* [T]
CP06A. Superclassis |**AMIIFORMES**|* [T]
CP06A. Superclassis |**SEMIONOTIFORMES**|* [T]
CP06A. Superclassis |**TELEOSTEI**|* [T]
CP06C. Hyperclassis |**SARCOPTERYGII**|
CP06B. Epiclassis † |**OSTEOLEPIFORMES**|* [T]
CP06B. Epiclassis † |**PANDERICHTHYIDA**|* [T]
CP06B. Epiclassis † |**POROLEPIFORMES**|* [T]
CP06B. Epiclassis |**ACTINISTIA**|* [T]
CP06B. Epiclassis |**DIPNOI**|* [T]
CP06B. Epiclassis |**TETRAPODA**|
CP06A. Superclassis † |**ICHTHYOSTEGALIA**|* [TC]
CP06A. Superclassis |**NEOTETRAPODA**|
CP06. Classis **AMPHIBIA** De Blainville, 1816
CP06a. Subclassis † |**LABYRINTHODONTIA**| [C]
CP06a. Subclassis † |**LEPOSPONDYLI**| [C]
CP06a. Subclassis **NEOBATRACHI** Sarasin & Sarasin, 1890
CP08A. Superordo **BATRACHIA** Brongniart, 1800
CP08. Ordo **ANURA** Duméril, 1806

CP08. Ordo **URODELA** Duméril, 1806
CP08A. Superordo **GYMNOPHIONA** Rafinesque-Schmaltz, 1814
CP08. Ordo **GYMNOPHIONA** Rafinesque-Schmaltz, 1814
CP06. Classis |**REPTILIA**|* [T]
CP06a. Subclassis † |**ANTHRACOSAURIA**|* [T]
CP06a. Subclassis † |**DIADECTOMORPHA**|* [T]
CP06a. Subclassis † |**SEYMOURIAMORPHA**|* [T]
CP06a. Subclassis |**AMNIOTA**|* [T]
CP06b. Infraclassis |**SAUROPSIDA**|* [T]
CP06c. Hypoclassis |**ANAPSIDA**|* [T]
CP08. Ordo † |**PARAREPTILIA**|* [T]
CP08. Ordo |**CHELONIA**|* [T]
CP06c. Hypoclassis |**DIAPSIDA**|* [T]
CP06d. Catoclassis † |**YOUNGINIFORMES**|* [T]
CP06d. Catoclassis |**NEODIAPSIDA**|* [T]
CP08B. Epiordo |**ARCHOSAUROMORPHA**|* [T]
CP08A. Superordo |**ARCHOSAURIA**|* [T]
CP08. Ordo |**CROCODYLOTARSI**|* [T]
CP08. Ordo |**ORNITHODIRA**|* [T]
CP08a. Subordo |**DINOSAURIA**|* [T]
CP08b. Infraordo † |**ORNITHISCHIA**|* [T]
CP08b. Infraordo |**SAURISCHIA**|* [T]
CP08c. Hypordo † |**SAUROPODOMORPHA**|* [T]
CP08c. Hypordo |**THEROPODA**|* [T]
CP08d. Cacordo † |**CARNOSAURIA**|* [T]
CP08d. Cacordo † |**CERATOSAURIA**|* [T]
CP08d. Cacordo |**MANIRAPTORA**|* [T]
CS09. Phalanx |**AVES**|* [T]
CS09. Phalanx † |**DROMAEOSAURIA**|* [T][1]
CP08a. Subordo † |**PTEROSAURIA**|* [T]
CP08. Ordo |**THECODONTIA**|* [T]
CP08A. Superordo |**PROLACERTIFORMES**|* [T]
CP08A. Superordo |**RHYNCHOSAURIA**|* [T]
CP08B. Epiordo |**LEPIDOSAUROMORPHA**|* [T]
CP08A. Superordo † |**ICHTHYOSAURIA**|* [T]
CP08A. Superordo |**LEPIDOSAURIA**|* [T]
CP08. Ordo |**SPHENODONTIDA**|* [T]
CP08. Ordo |**SQUAMATA**|* [T]
CP08A. Superordo † |**SAUROPTERYGIA**|* [T]
CP08. Ordo † |**NOTHOSAURIA**|* [T]
CP08. Ordo † |**PLACODONTIA**|* [T]
CP08. Ordo † | **PLESIOSAURIA**|* [T]
CP06b. Infraclassis |**SYNAPSIDA**|* [T]
CP08A. Superordo † |**PELYCOSAURIA**|* [T]
CP08A. Superordo |**THERAPSIDA**|* [T]
CP08. Ordo † |**CYNODONTIA**|* [T]
CP08. Ordo † |**DICYNODONTIA**|* [T]
CP08. Ordo |**MAMMALIA**|* [T]
CP08a. Subordo † |**MORGACUNOCONTA**|* [T]
CP08a. Subordo † |**MULTITUBERCULATA**|* [T]
CP08a. Subordo |**MONOTREMATA**|* [T]
CP08a. Subordo |**THERIA**|* [T]
CP08b. Infraordo |**METATHERIA**|* [T]
CP08b. Infraordo |**EUTHERIA**|* [T]
CP08c. Hypordo |**EDENTATA**|* [T]
CP08c. Hypordo |**PHOLIDOTA**|* [T]
CP08c. Hypordo |**PREPTOTHERIA**|* [T]
CP08d. Cacordo † |**CONDYLARTHRA**|* [T]
CP08d. Cacordo † |**CREODONTA**|* [T]
CP08d. Cacordo |**ANAGALIDEA**|* [LLG]
CP08d. Cacordo |**ARCHONTA**|* [T]
CP08d. Cacordo |**CARNIVORA**|* [T]
CP08d. Cacordo |**INSECTIVORA**|* [T]
CP08d. Cacordo |**UNGULATA**|* [T]

nomina have been allocated to taxa according to these criteria, quite often we are faced by a situation where several nomina apply to the same taxon. We then need further Rules to establish which among these nomina is the valid one for each taxon (third floor of the Av-Al-Va building).

VALIDITY OF NOMINA

Priority and usage: Rule of Sozonym Validation

The Rules here proposed are meant to provide criteria for allocating a nomen to a higher taxon, especially within the frame of new taxonomies or cladonomies based on new cladistic hypotheses. Particular attention should be paid not to invalidate universally or very widely adopted nomina for some higher taxa. Because the *Code* never recognized class-series nomina, the Rule of Priority has never been consistently applied to these nomina, and rigidly introducing such a rule now would have disruptive effects on their stability and universality. Nomina used by most authors have resulted primarily from a consensus among them, but, as exemplified above in higher amphibian taxonomy, this consensus is far from being general and several competing nomenclatures are often used by different authors, even contemporaneous ones (see also Yochelson 1971). Matters would be clear and satisfactory in this respect only 1) if the consensus among all authors on the use of nomina was always universal, and 2) if the higher classification of animals was fixed and definitive, and if no, or only a few, new taxa would still have to be recognized and named. However, neither of these two conditions is met: 1) the consensus among authors exists for some class-series nomina (e.g., **Vertebrata**), but not for others (e.g., **Urodela** or **Caudata**), and in such cases we need some Rules to decide what to do; and 2) mostly as a result of the multiplication of cladistic analyses, many new taxa are regularly being recognized or will be so in the near future, and we will need Rules to decide if existing, but currently unused, nomina should be restored to name them, or if new nomina must be coined for these new taxa. The proposals made here are meant at reconciling the past and the future, and at offering guidelines for the establishment of valid nomina for higher taxa.

The categories of nomina with respect to usage introduced by Dubois (2005b) (symphonyms, aphonyms, eneonyms and diaphonyms, the latter subdivided into stenodiaphonyms, schizeurydiaphonyms and paneurydiaphonyms), and defined in Rule (R12), are of first help to fix the validity of class-series nomina, i.e. to decide which nomen should be retained as the *kyronym* (Dubois 2000) of a given ergotaxon. The basic idea here is that we should try and tend, in the long run, towards a situation in which priority will be the fundamental principle for fixing the valid nomen of any higher taxon. However, this basic principle should not result in threatening nomina that are currently universally or very widely established and accepted, although in many cases they were not the first nomina to have been proposed for these taxa. In order to *protect* such nomina, whenever they would turn out to be invalid under the new Rules, we need a provision for *exceptions* to the latter in some cases. In order to avoid the proposal by some of subjective criteria to protect some nomina, these Rules must be very precise and rigorous. First comments and suggestions regarding this question were provided elsewhere (Dubois 1997a, 2005b). For reasons explained in Dubois (2005b), protection of a nomen on the ground of its universal or almost universal use is justified only when one deals with usage *outside the field of systematics*, i.e. in general biology, environmental or medical sciences, administrative and legislative texts, and in general, non-scientific literature. Any sozonym, i.e. any nomen that is either *universally* (symphonym) or *almost so* (eurydiaphonym) used *for a given taxon or closely related taxa* in such works should be protected through special Rules. However, in all other cases, the normal Rules should apply, which means that a nomen does not have to be protected even when it has been largely used by systematists, taxonomists and phylogeneticists (stenodiaphonym).

Protection of well known nomina can be obtained by a *Rule of Sozonym Validation* (R13), according to which, whenever a given nomen has

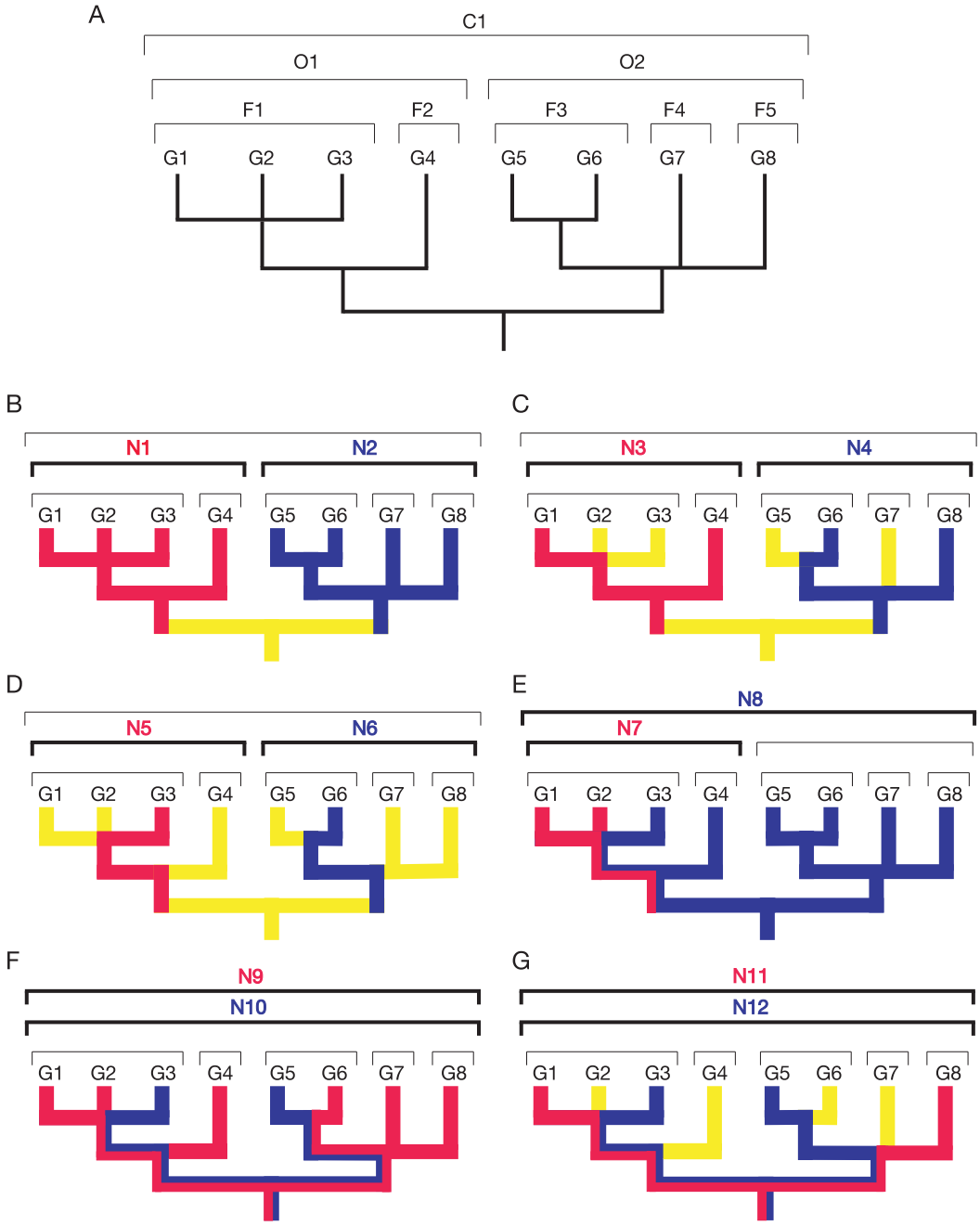


FIG. 1. — Diagrammatic illustration (as cladograms) of the different kinds of relationships between taxa in a given ergotaxonomy (**G1** to **G8** are genera; **F1** to **F4** are families; **O1** and **O2** are orders; **C1** is a class) and nomina (**N1** to **N12**) proposed for various protaxa composed of some of the genera **G1** to **G8**. See text for explanation.

been used *universally or almost so* since 1st January 1900 *for the same taxon or synotaxic taxa* by all or most systematists *and non-systematists*, whereas *no alternative nomen* was used similarly for the same taxa, this nomen should be conserved with its current acception, even if this is quite far from its original meaning, even if it was not the first one to have been proposed for this taxon, and even if it is a junior homonym; however, to be consistent with the new Rules, it should in some cases be *credited* to an author different from its real author (see below).

Whereas a symphonym is clearly defined (usage must be really universal since 1900, without a single exception, which is quite rare), the definition of paneurydiaphonym is more vague: a paneurydiaphonym is a nomen that has been used *significantly* in non-systematic literature, and when *no other nomen* has been used *significantly* in the same literature *for the same taxon or synotaxic taxa*. A working definition of the term "significantly" requires a basic quantitative criterion: we need a minimum number of usages to accept a nomen as an eurydiaphonym (Rule R11). One would expect that any "widely known" nomen would be regularly mentioned in the *titles* of books or papers, where these nomina will appear meaningful to a potential reader or buyer. More "obscure" or "confidential" nomina would be a matter of confusion or misunderstanding for non-specialists, and are likely to be ignored in titles of publications, even if they appear in their texts. Furthermore, titles of books and papers can be easily searched for in databases like the *Zoological Record*, so any research on the reality of a so-called "common usage" of a taxonomic nomen can be rather quickly and easily done by looking into such databases, as exemplified in table 1 of Dubois (1984: 10). I therefore suggest that, to be considered an eurydiaphonym, a nomen should have been used, either in its Latin form or as a vernacular name in any recent language: either 1) in the *titles* of at least *twenty-five* non-purely systematic *books*, written by at least *twenty-five independent-authors* (as defined by Dubois 1997a) and published in at least *ten different countries* after 31 December 1899; or 2) in the *titles* of at least *one hundred* non-purely systematic *publications* (books, book chapters or periodical articles) written by *one hundred independent-authors* and published in at least *ten different countries* after 31 December 1899.

The concept of *independent-authors* was defined by Dubois (1997a: 318, 319) as *authors who never published together* (as co-authors) on the zoological group concerned before the case is considered. The reason for using such a criterion is the following: "authors who are working together, in a single research team or laboratory, or as collaborators from different units, are likely to adopt a single nomenclature for the animals they study: if this resarch team is numerous, prolific and financially healthy, it will tend to publish numerous papers on these animals, and the local nomenclatural uses or habits of this team may tend to be presented as the 'common usage' of all zoologists, which may be wrong". As for the quantitative criteria proposed above, they are open to discussion among colleagues. In amphibians, a striking example comes to mind regarding this proposed Rule: that of **Batrachia** versus **Lissamphibia**. Both nomina were created as refering to the same protaxon, composed of all frogs and salamanders, but excluding the caecilians. For a long time, only the first of these nomina was used by zoologists: in the titles of all the references appearing in the ten volumes of the *Zoological Record* for the years 1969 to 1978, the nomen **Batrachia** appeared 61 times and the nomen **Lissamphibia** two times (Dubois 1984: 10). It is easy to find 100 titles of general (i.e. non-purely systematic) books and papers, published all around the world and over the last two centuries, containing the nomen **Batrachia** or its vernacular forms (see list of references in Dubois in prep.), but very few containing the nomen **Lissamphibia**. This is clearly a situation where, among these two nomina that originally designated the exactly same taxon, the first one should be protected as an eurydiaphonym, and the second rejected as a stenodiaphonym.

Schizeurydiaphonyms are nomina that have been significantly used as valid (according to the quantitative criteria proposed above for eurydiaphonyms) but in the case where two or more nomina have been used alternatively for the same taxon, like in the cases of **Urodela** and **Caudata**, or **Anura** and **Salientia**.

On the basis of the *objective* criteria above (universality of usage or quantitatively defined usage in non-systematic publications), it is possible to recognize nomina that should be protected. Such sozonyms should then be validated under the new Rules. Two different situations exist in this respect, as follows:

1) The sozonym was originally proposed for a protaxon that was isotaxic or endotaxic to the current ergotaxon: then this nomen should simply be fixed as the valid nomen of the taxon, whatever its date of creation (i.e. without taking into account priority). As soon as published, such a sozonym validation is irreversible, and the nomen is definitively fixed as kyronym of the taxon *in any taxonomy recognizing the latter*. All other available synonyms of this nomen must be rejected as hypnonyms (for subjective synonyms) or exoplonyms (for objective synonyms).

2) However, in some other cases, the sozonym was originally proposed for a protaxon that was xenotaxic, angiotaxic or gephyrotaxic to the current ergotaxon. According to the Rules proposed above (R11), such a nomen cannot be allocated to this ergotaxon, as its onomatophore was partially or totally excluded from the latter. However, in all such cases, it turns out that, subsequently to the original publication where the nomen had been created, one or several authors introduced a new, modified use of this nomen, corresponding to the current concept of the ergotaxon (isotaxic to it) or to a taxon included in the latter (endotaxic to it): thus doing, he/she/they introduced an *allotaxon* based on a *junior homonym* of the original nomen (see above), that corresponds totally or partly to the current ergotaxon designated by this nomen. In such cases, the *sozonym validation* results in *validating the junior homonym* and rejecting the senior homonym as an exoplonym. Such a rejection of a senior homonym is definitive, *whatever the subsequent changes in the taxonomies*. ***It is very important to note that, under the Rules presented here, this rejection of a senior homonym in order to validate a symphonym or paneurydiaphonym is the only case in which a senior homonym can be rejected as invalid in class-series nomenclature***: in all other cases, a junior homonym in the class-series is automatically and definitively rejected as an exoplonym, whatever the fate and situation (regarding validity and usage) of the senior homonym. Although this Rule is here clearly formulated for the first time, such an "implicit rule" was already followed by some careful authors in the past: e.g., by Kuhn (1965: 12) when he recognized a "Classis Amphibia Latreille 1825 (non Linné 1758)".

Rejection as invalid of all junior homonyms that are not sozonyms is an important Rule that must be strictly followed, without reluctance or hesitation. If it were not the case, all the Rules here proposed would rapidly be viewed simply as weak "recommendations" that taxonomists are free to follow or not, and the current chaos in higher zoological nomenclature would continue as before. Once agreed upon, the qualitative and quantitative criteria for the definition of eurydiaphonyms should be strictly applied in all cases. This means that some nomina, that may appear well known to some professional taxonomists but are ignored by virtually all "laymen", should be abandoned whenever they are found to be junior homonyms of other available class-series nomina. As shown in Dubois (2004b, in prep.), examples of such a situation in the amphibians include the nomina APODA, ARCHAEOBATRACHIA and NEOBATRACHIA, which, although used in a number of recent publications in the fields of systematics and phylogeny, have not been significantly used in non-purely systematic literature since 1900: these nomina being junior homonyms, they should be rejected as invalid.

An archaeonym and all its neonyms belong in the same taxomen. Therefore, invalidation of the former for validation of a sozonym also entails invalidation of all its neonyms, whatever their historical fate after their creations.

These provisions allowing the validation of sozonyms are presented in the *Rule of Sozonym Validation* (R13) below. Whenever working on the higher nomenclature of any zoological group, the first step to take is to check whether in this group some nomina qualify as *sozonyms*: if, for any ergotaxon in the group, a nomen is a symphonym or an eurydiaphonym, this nomen must be definitively fixed through sozonym validation as the kyronym of this taxon, with an author and a date corresponding

to its first use for a taxon isotaxic or endotaxic to the current ergotaxon. In all other cases, i.e. for all synoprotaxic nomina that are distagmonyms, none of these competing nomina qualifies for automatic protection, and this requires recourse to some criteria other than "usage" to choose between them. In other words, whenever no universality or quasi-universality of use of a nomen exists (i.e. if two or more stenodiaphonyms have been in use for the taxon), other Rules must be called upon. Before discussing these criteria however, a few further questions must be discussed.

Nomenclatural consistency

Progressive changes in animal taxonomy have involved several kinds of processes, including lumping of previous taxa into a single one, splitting of a previous taxon into several ones, suppression of taxa, and creation of brand new taxa fully different from the previous ones. Among this diversity of processes, that of splitting has played an important, and probably major, rôle. Despite the wish of "stability of nomina" of some, this splitting activity continues to be one of the major processes of modification of taxonomies, even within the frame of cladistic or "phylogenetic" conceptions of taxonomy: whenever what was believed to be a single taxon is dismantled because it is now considered polyphyletic or paraphyletic, we are in front of a process of taxonomic splitting.

Most taxonomists who recognize two or more higher taxa instead of a single one, or as subdivisions of a higher taxon, tend to propose new nomina for all the new taxa. This is a process different from that which prevails (and is nomenclaturally correct) in the case of nomina regulated by the *Code*, because of the existence of a Rule of Coordination for such nomina: when for example a family is split into two or more families, or divided in two or more subfamilies, one of the new taxa keeps the original nomen of the earlier family. Although this sometimes happened in the history of higher taxa nomina (e.g., in the case of the class Amphibia), in many cases the authors preferred to coin new nomina for the new taxa, and to abandon the earlier nomen, or to keep it but for a more comprehensive taxon including all the new ones.

I proposed elsewhere (Dubois 2005b) to call the taxa that compose such "couples" or "series", that were *created together* to split an earlier taxon, *didymoprotaxa* (from the Greek *didymos*, "twin"; see Note 4), and their nomina *didymonyms*. Given the history of such cases, it seems logical to consider both or more didymonyms created together as more or less undissociable couples or series of nomina. Ideally, this would mean that such nomina should be treated similarly (i.e. adopted altogether, or rejected altogether), at least as long as the corresponding taxa are considered valid (possibly with some minor modifications). However, in some cases this would be contradictory to some of the Rules already presented above, such as the Rule of Sozonym Validation (e.g., if one only of these taxa has long been universally known by a symphonym or paneurydiaphonym) or the Rule of Homonymy (e.g., if one only of the didymonyms is an invalid junior homonym). Nevertheless, a relative indissociability of these nomina should be maintained, in some special situations.

In various cases in animal taxonomy, the "same" couples or series of taxa were independently recognized by different authors under different couples or series of nomina. In this context, "same" means having exactly the same *contents* (isoprotaxa) or at least having exactly the same *onomatophores* (isonyms) – if the most recent nomen was created for a taxon angioprotaxic to the protaxon of the older nomen. This situation applies in particular to all cases where a couple or set of neonyms was substituted by an author for a couple or set of archaeonyms of identical or more restricted content. My suggestion here is that the nomina of either couples or sets can be validated altogether or in part, but that no mixture should be made in a given nomenclature between didymonyms of different origins. I propose the term *phobonyms* (from the Greek *phobos*, "fear") to designate such didymonyms, of different origins but having identical contents or onomatophores, that are incompatible in a given nomenclature, and to call *nomenclatural consistency* the fact of considering such couples or series of didymonyms as "nonmiscible", which is expressed in Rule (R14). In all cases of replacement of two or more didymonyms by two or more neonyms, both *didymarchaeonyms*

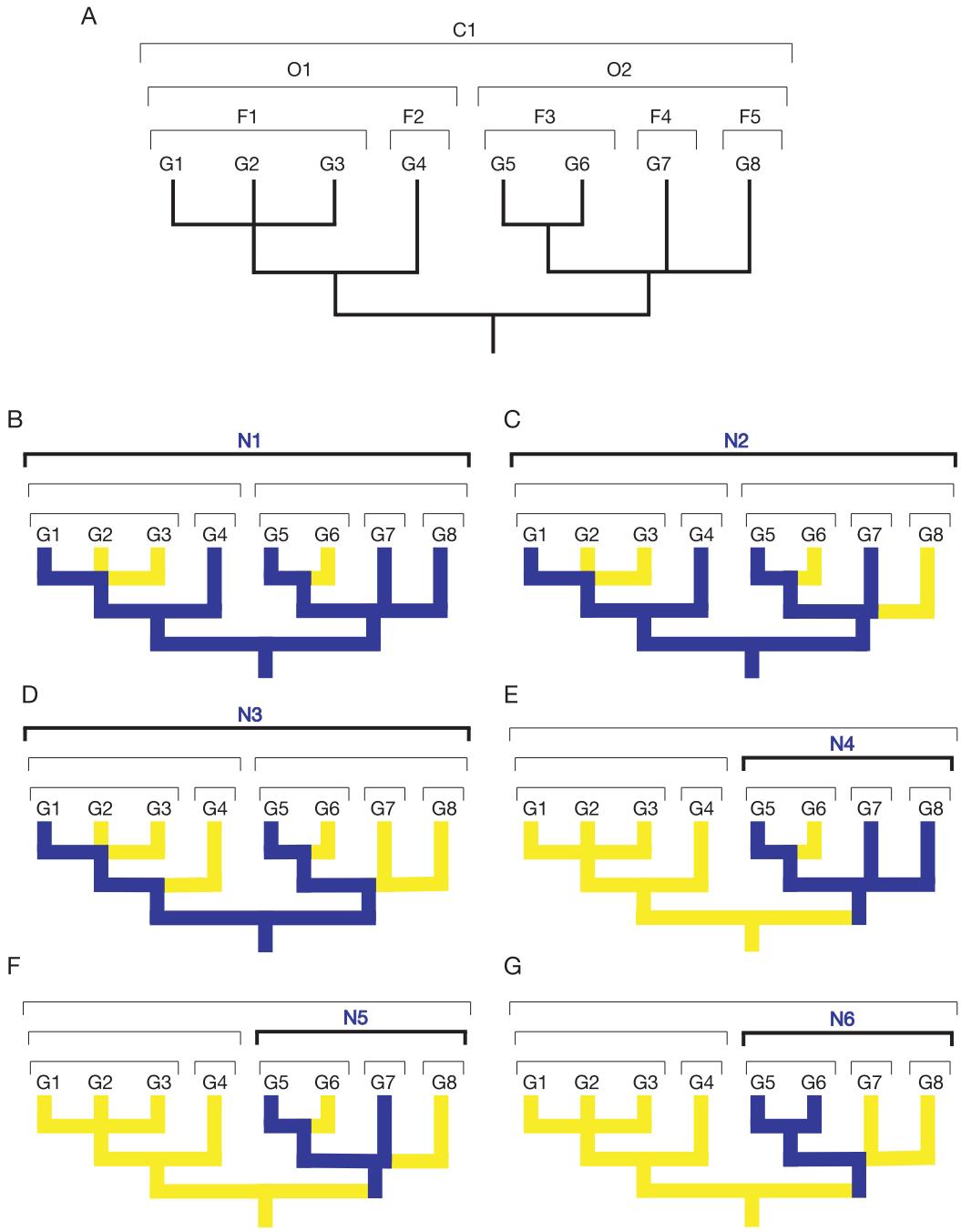


FIG. 2. — Diagrammatic illustration (as cladograms) of the different kinds of relationships between taxa in a given ergotaxonomy (**G1** to **G8** are genera; **F1** to **F4** are families; **O1** and **O2** are orders; **C1** is a class) and nesonyms (**N1** to **N6**) proposed for various protaxa composed of some of the genera **G1** to **G8**. See text for explanation.

or *didymoneonyms* can be validated together, but it is impossible to validate together some archaeonyms and some neonyms. Of course, such a Rule does not apply to didymonyms based on taxa whose original contents were completely different (xenoprotaxa) or whose onomatophores are different, the most recent being a xenoprotaxon, a gephyrotaxon or an endoprotaxon of the oldest one.

Menonym and auxonym of sozonym

As explained above, once a taxon and a nomen have been created, subsequent authors often modify the content and definition of the taxon whereas keeping the original nomen, sometimes also after having modified it. In zoological nomenclature, such changes are often referred to under the term of "emendation". This term is used in the literature with two different meanings: to designate a change in spelling of a nomen (a process that can be called a *nomenclatural emendation*), and to designate a change in the intension and/or extension of the taxon designated by this nomen (a *taxonomic emendation*). As for the change in spelling, it is more adequately referred to by the use of the term *aponym* (Dubois 2000). Concerning the change brought to the taxon itself, although widespread, the use of the undefined term "emendation" for this action is misleading, as in fact it covers three distinct situations: either the creation of an *allotaxon*, or that of a *menapotaxon*, or that of an *auxapotaxon*.

Because of the use of onomatophores to fix the status of nomina, there is a major difference between modification of a taxon by *exclusion* of originally included taxa or by *addition* of new taxa. In the three nominal-series covered by the *Code*, after the original publication, both additions and exclusions of taxa are possible without changing the nomen of a taxon *as long as* the onomatophore remains included in the taxon. In class-series nomenclature however, according to the Rules proposed here, all nomina originally included in a new taxon are part of its onomatophore, so that any exclusion of even a single of them results in the creation of a new taxon bearing the same nomen, i.e. of a junior homonymous allotaxon. The same is not true regarding addition of new taxa to the taxon: this does not result in the creation of a new taxon but in a modification of the former taxon, i.e. in the proposal of an apotaxon for the original protaxon. As long as addition of taxa in a class-series taxon remains limited to taxa of the lowest rank (genus) or of higher ranks but that remain included in all the original subordinate class-series or family-series taxa already present in the protaxon of the higher taxon, such a change is similar to that which occurs whenever new specimens are referred to a species, new species to a genus or new genera to a family: it has no significant nomenclatural consequences. According to the terminology introduced in Dubois (2005b), such a situation can be designated as the proposal of a new *menapotaxon* for the taxon, and its nomen qualifies as a *menonym*. But when new taxa of immediately subordinate ranks (ametoendotaxa) are added to a higher taxon, that were either previously part of another taxon or unknown to zoologists, this may result in a substantial change in the intension and extension of the taxon, and this is worth mentioning in subsequent works. In such a case, the original protaxon is merisotaxic, i.e. endotaxic at all hierarchical levels to the apotaxon resulting from the addition of included taxa. This situation can be described as the creation of an *auxapotaxon*, whose nomen is an *auxonym*. As this latter change is of more consequences than the first one, I suggest that in this case, but in this case only, the first-user (as defined by Dubois 2000) and date of the auxonym be indicated, between square brackets (i.e. […]), after the nomenclatural author and date of the protonym. This situation particularly concerns choronyms, for the reasons already tackled above (such nomina were often created for taxa much less inclusive than the current ergotaxa for which they remain the valid nomina).

Let us come back to the example of the nomen Amphibia. As was briefly mentioned above, several allotaxa bearing this nomen were proposed at the beginnings of zoology. The first ones (Amphibia Linnaeus, 1758; Amphibia Batsch, 1788) were proposed for taxa now considered to be highly heterogeneous, but the taxon Amphibia De Blainville, 1816 was composed only of recent genera that are still today considered to be amphibians. As this taxon's nomen is a choronym that has had a very wide use in zoology, including in non-systematic

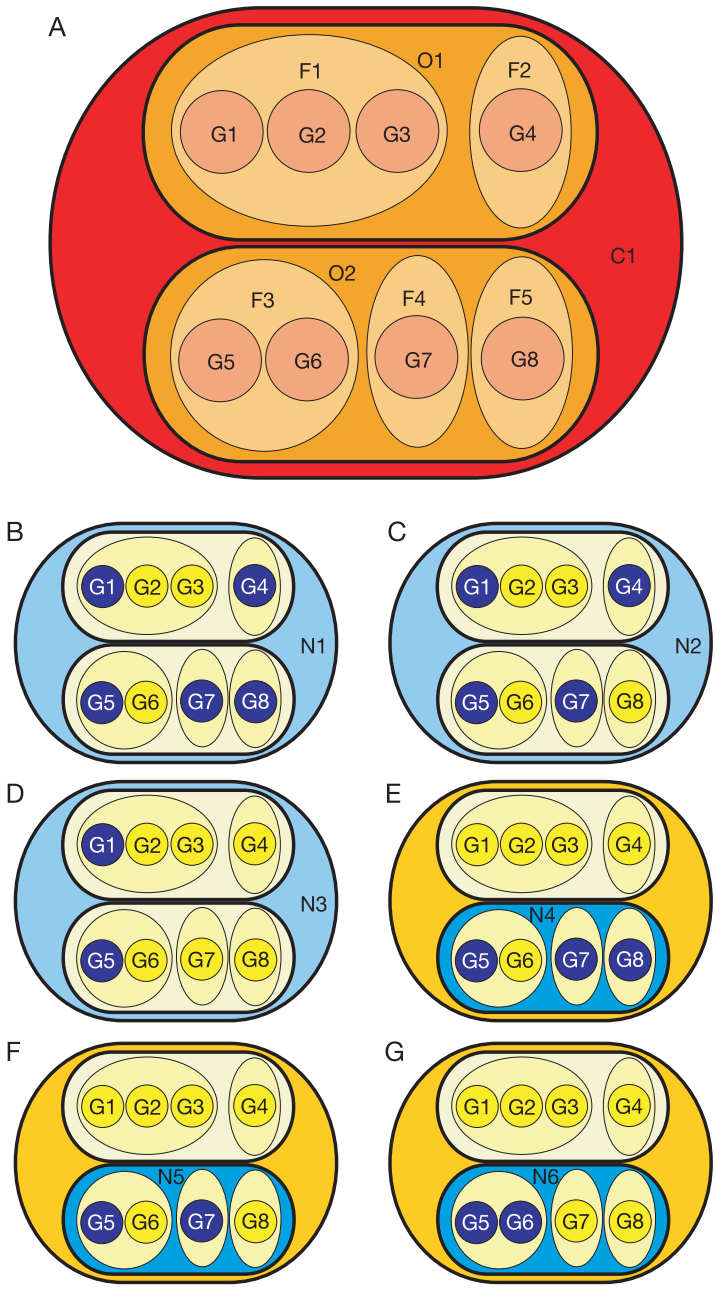


FIG. 3. — Same relationships as in Figure 2, but expressed under the form of a hierarchical inclusion of members into sets.

works, it qualifies as a sozonym and must be validated. Its validation as a sozonym ensures permanent use in zoology of a nomen AMPHIBIA for a taxon including the conucleogenera of AMPHIBIA De Blainville, 1816 and excluding the "reptiles", birds and mammals. However, it does not fix any

"upper limit" on the contents of this taxon. After De Blainville (1816), several groups of fossil animals were added to this taxon in subsequent works, but no general agreement exists among recent zoologists upon which of these fossil groups are indeed members of the same clade and taxon as the recent amphibians. As long as they included all the recent amphibians, the various taxa recognized by various authors after 1816 under the nomen AMPHIBIA must be considered only as auxapotaxa of AMPHIBIA De Blainville, 1816, not as new allotaxa bearing new nomina. Each of these different apotaxa has its *first-user* (*sensu* Dubois 2000). Validation of a choronym as a sozonym makes this nomen the valid one for the most inclusive taxon including all its conucleogenera and excluding all its extragenera. On the other hand, validation of a nesonym as a sozonym does not result in fixing the limit of the taxon to which this nomen applies, as these limits are a matter of taxonomy, not of nomenclature, and any taxonomist is free to use a given taxonomy for the studied group. However, if several hierarchically related taxa include its onomatophore, the nesonym should be applied to the least inclusive ergotaxon of this taxonomy; application of all other nomina (agathonyms) to all other taxa of the same ergotaxonomy is automatic and is fixed by the Rule of Agathonym Validation (see below).

In order to clarify in which sense an author is using a sozonym in his ergotaxonomy, it is here proposed that the nomen and date of this sozonym be written followed, between square brackets, by the name of the first-user of this nomen for an auxapotaxon panisotaxic to the currently recognized ergotaxon. Whenever a sozonym was created for a taxon already panisotaxic to the current ergotaxon at all class-series taxonomic levels above genus, the Latin nomen of the taxon is given followed only by its original author's name and its date. But as soon as the original protaxon for which the sozonym was created is merisotaxic to the current ergotaxon, i.e. endotaxic to it at higher hierarchical level, the Latin nomen of this taxon, as used in any given ergotaxonomy, should be given followed first by the author and date of the sozonym, and then, between square brackets, by the first-user's name and the date of the auxaponym. This is clarified in Rule (R15) below.

Choice of valid nomen among competing distagmonyms

When considering the status of an ancient class-series nomen, the situation is clear in one case only: if this nomen is a sozonym. In such a case, in order to maintain the stability of a universally accepted nomen (symphonym) or of a nomen unambiguously and widely known outside systematics (paneurydiaphonym), this nomen should be validated as a kyronym, through the new set of Rules presented above. However, in all other cases, i.e. as soon as there is no universal agreement regarding the use of nomina (i.e. in case of existence of schizeurydiaphonyms or stenodiaphonyms), further Rules must be provided to decide which of these nomina should be retained as kyronym through a first-reviser action. Most higher taxa nomina have been mentioned and used only in the taxonomic literature and, in this respect, are all equally "unknown" to laymen and do not deserve "protection" because of their "common usage". All the statements above give the bases for proposing Rules allowing validation of a distagmonym (schizeurydiaphonym, stenodiaphonym, aphonym or eneonym) among several: I propose to call the chosen distagmonym, validated through the use of the Rules detailed below (R16), an *agathonym* (from the Greek *agathos*, "good, appropriate"). Criteria for choice of the agathonym of an ergotaxon cannot rely only on the number of usages only (Dubois 2005b), but should rely on the original extension of the protaxon, on the date of the nomen, on the latter being or not being a neonym or a didymonym, and on its subsequent history.

Attention should first be paid to whether a nomen was proposed alone, or as a didymonym with another or other nomina. If didymonyms are involved, the status of all of them should be considered altogether. According to the *Rule of Nomenclatural Consistency* (R14), didymonyms of a given origin (proposed in a given publication) cannot be combined in any given taxonomy with phobonyms (isonymous didymonyms proposed in other publications), but may be combined with earlier or later nomina

that were not proposed as their didymonyms. This condition must be kept in mind before using the next criteria.

Among several nomina available for a given ergotaxon according to the criteria above (R11), the following two criteria and in the following hierarchical order should be used to determine the valid one (see Note 5): (H1) if several nomina are available for the ergotaxon, schizeurydiaphonyms have precedence over stenodiaphonyms, the latter over aphonyms and the latter over eneonyms; (H2) among schizeurydiaphonyms, then among stenodiaphonyms if no schizeurydiaphonyms are available, then among aphonyms, then finally among eneonyms, the Rule of Priority, based on the publication dates of nomina, applies (i.e. the first published one must be retained for the taxon); choice between competing nomina bearing the same date must be made by first-reviser action (an irreversible nomenclatural act).

Let us come back to the hypothetical example of Figures 2 and 3, and let us consider the six nomina N1 to N6 provided for protaxa containing some of the genera of class C1. We saw above that the nomina N1, N2 and N3 apply to class C1. Establishing which one of these synonymous nomina is the valid one for the class requires (H1) to know which are the categories of usage of these nomina and to follow the hierarchy schizeurydiaphonyms > stenodiaphonyms > aphonyms > eneonyms (where the sign > means "has precedence over"), and (H2) if several nomina are in the same situation regarding usage, to follow the priority of publication. The same procedure applies to the nomina N4, N5 and N6 which are synonyms that apply to order O2.

Unlike a sozonym, which can be protected to designate a taxon that is largely angiotaxic to the original protaxon for which the nomen was coined, an agathonym can be used only for an ergotaxon that corresponds to its protaxon or to a menapotaxon of the latter, never for an auxapotaxon. An agathonym is to be protected only as long as the ergotaxonomy in use requires this nomen, but must be abandoned whenever a change in ergotaxonomy results in validating another agathonym or other agathonyms. Therefore, unlike sozonyms, agathonyms can be used only as menonyms, never as auxonyms: these nomina are always presented followed only by their author's name and date, never by the names of first-users and dates of auxonyms.

Before closing the study of agathonym validation for an ergotaxon, particular attention should be paid to two final questions: 1) if applying the Rules above results in validating phobonyms, then the most recent phobonym should be rejected as an exoplonym, and replaced by the next available nomen according to the Rules above; and 2) the case of neonyms is particular, and deserves a special discussion (see below).

Rule (R16) below summarizes these criteria of choice of an agathonym among alternative distagmonyms available for the same taxon.

Status of neonyms in higher nomenclature

A particular case of synonyms is that of *neonyms* versus *archaeonyms*. As explained above, when first proposed, a neonym may have been so for a taxon identical or slightly or largely different from that covered by the archaeonym, but having the same onomatophore. In many cases, the most recent nomen is an euridiaphonym or a stenodiaphonym whereas the archaeonym is an aphonym or an eneonym, often because the neonym was coined for a taxon of wider extension and closer to our current taxonomic concepts: in such cases, the neonym should be validated, through agathonym validation following the Rules above. However, it should be clear that both nomina remain permanent synonyms and cannot be used together in a given taxonomy: both nomina of such a "neonym-archaeonym" couple being definitive synonyms, retention of one of the two nomina as the valid nomen of a taxon (because of either sozonym or agathonym validation) definitively excludes the other nomen from validity, whatever the subsequent fate of the nomen then validated. This is expressed in the *Rule of Neonym or Archaeonym Validation* (R17) below.

Introducing a Rule of Coordination in higher nomenclature

One of the major differences between class-series nomenclature and the nomenclature of the three nominal series covered by the *Code* is that the Rule of Coordination has never been used in higher

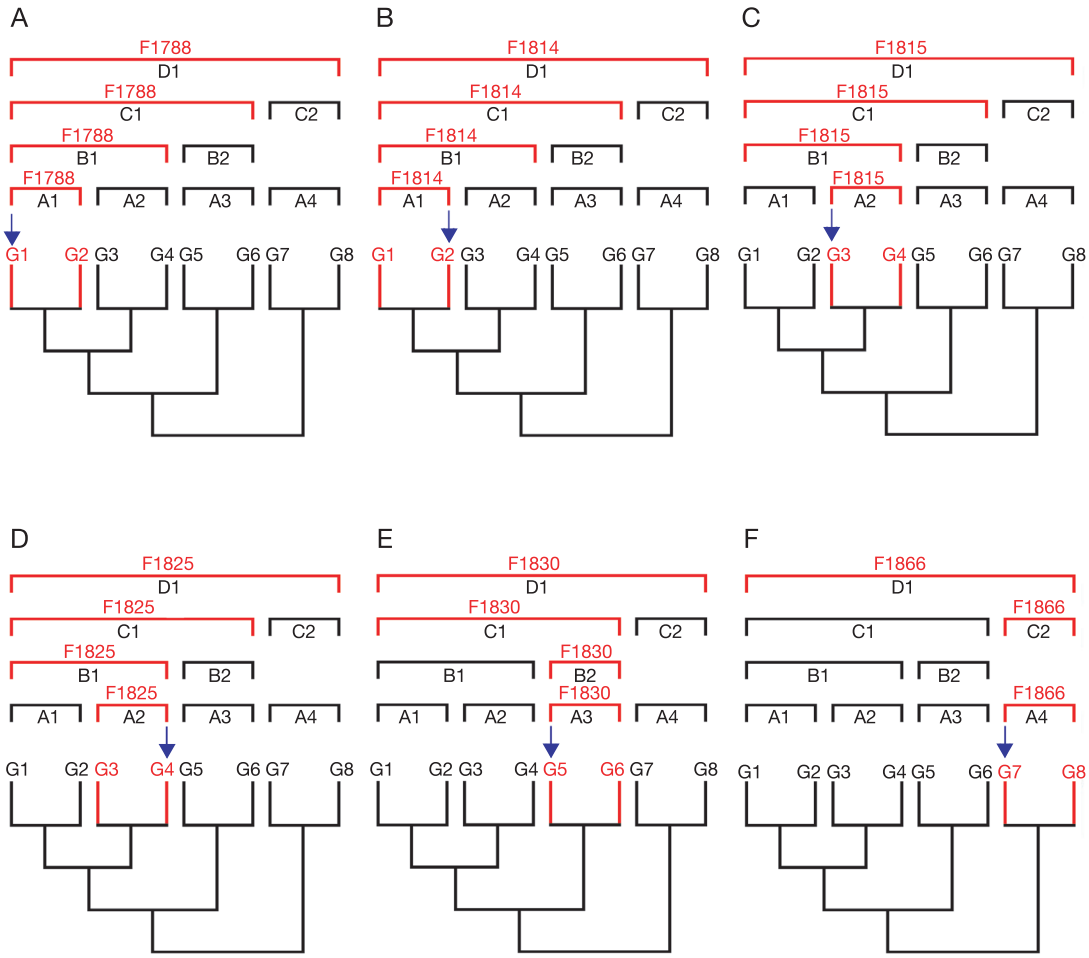
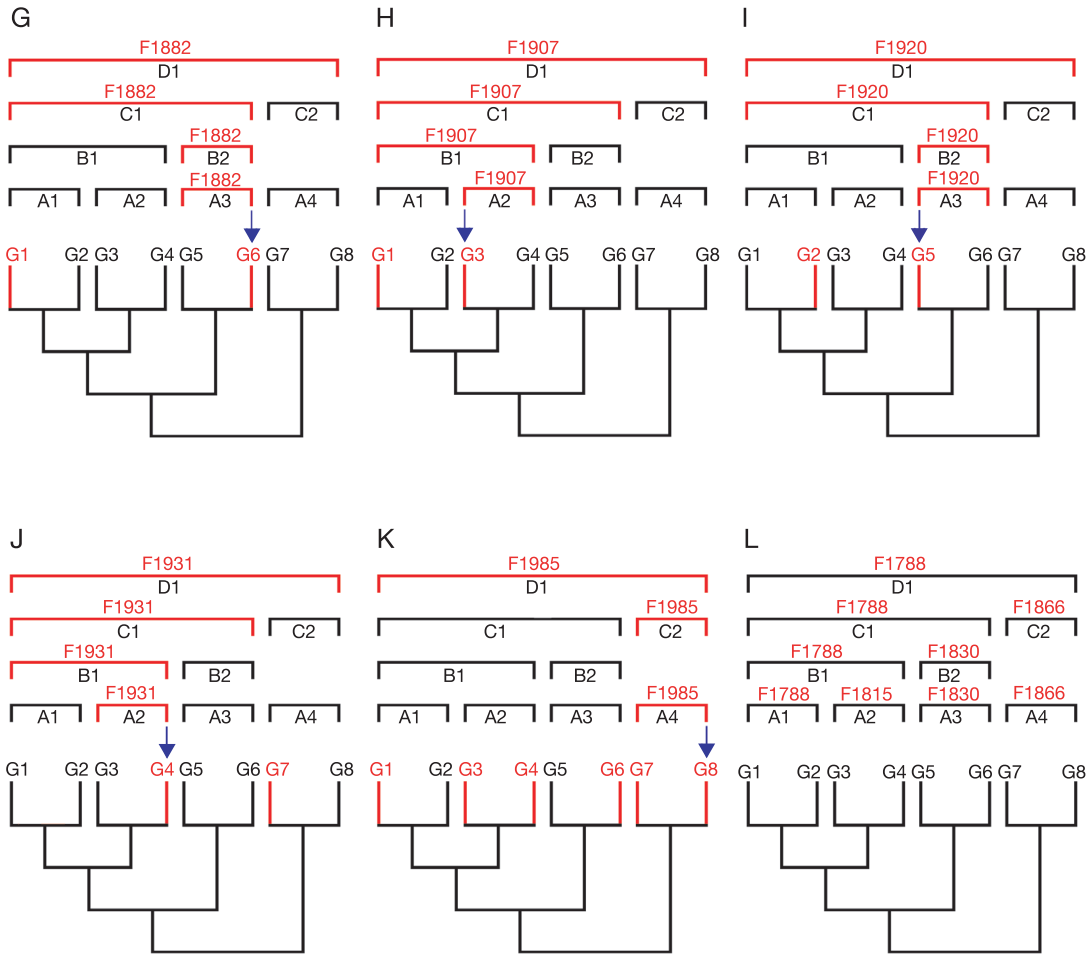


FIG. 4. — Diagrammatic illustration (as cladograms) of the status of 11 family-series nomina according to a given ergotaxonomy and following the Rules of the *Code* (Anonymous 1999). **G1** to **G8** are taxa of rank genus, **A1** to **A4** taxa of rank tribe, **B1** and **B2** taxa of rank subfamily, **C1** and **C2** taxa of rank family, and **D1** a taxon of rank superfamily. **A**-**K**, status of 11 familiomina **F1788** to **F1985** ▸

nomenclature, for reasons that were explained above. I here propose to introduce such a Rule in class-series nomenclature for a limited use in a special, but not exceptional, situation in higher taxonomy, i.e. when several hierarchically related class-series taxa have exactly the same content.

Any balanced and coherent hierarchical system of taxonomic-nomenclatural ranks requires that each taxon be referred to a higher taxon of the next higher rank, even when the latter includes no other subordinate taxon of the same rank. This is due to the fact that some groups or clades are more species-rich or diversified, and deserve more taxonomic subdivision, than others. Let us take the example of recent amphibians, discussed in more detail below. Most current authors consider that this group consists of two major clades, one small and rather homogeneous (caecilians) and one larger and containing two major subclades (frogs and salamanders). Many authors afford the rank order to the three groups caecilians, frogs and salamanders, and the rank superorder to the group consisting



(designated by their dates of original publication) according to their original nucleogenera: generomina originally included in the taxon designated by a nomen are shown in red, and nucleogenera of familiomina are pointed to by a blue arrow. **L**, valid nomina of all nine family-series taxa recognized in this ergotaxonomy. See text for more details.

of frogs and salamanders. To have a balanced and coherent taxonomy, however, it is necessary to recognize another superorder for caecilians alone. The superorder and the order "caecilians" have exactly the same content (and definition), but they both need to be named. According to the Rules above, both these taxa should bear the same kyronym and there is no way, and no necessity, to establish different kyronyms for them and to establish an order of precedence between these two nomina. I therefore propose that, in such cases, both taxa bear the same nomen, with the same author and date, but simply a different rank in the nomenclatural hierarchy. However, if in the future the superorder of caecilians had to be divided into two distinct orders, then the usual Rules above would be in force again, and the superorder would have to bear a nomen different from those of both included taxa. This is summarized in Rule (R18).

Incidentally, this new proposal solves a problem raised repeatedly by supporters of the "*Phylocode*" (Cantino *et al.* 1997; Cantino 2000; De Queiroz &

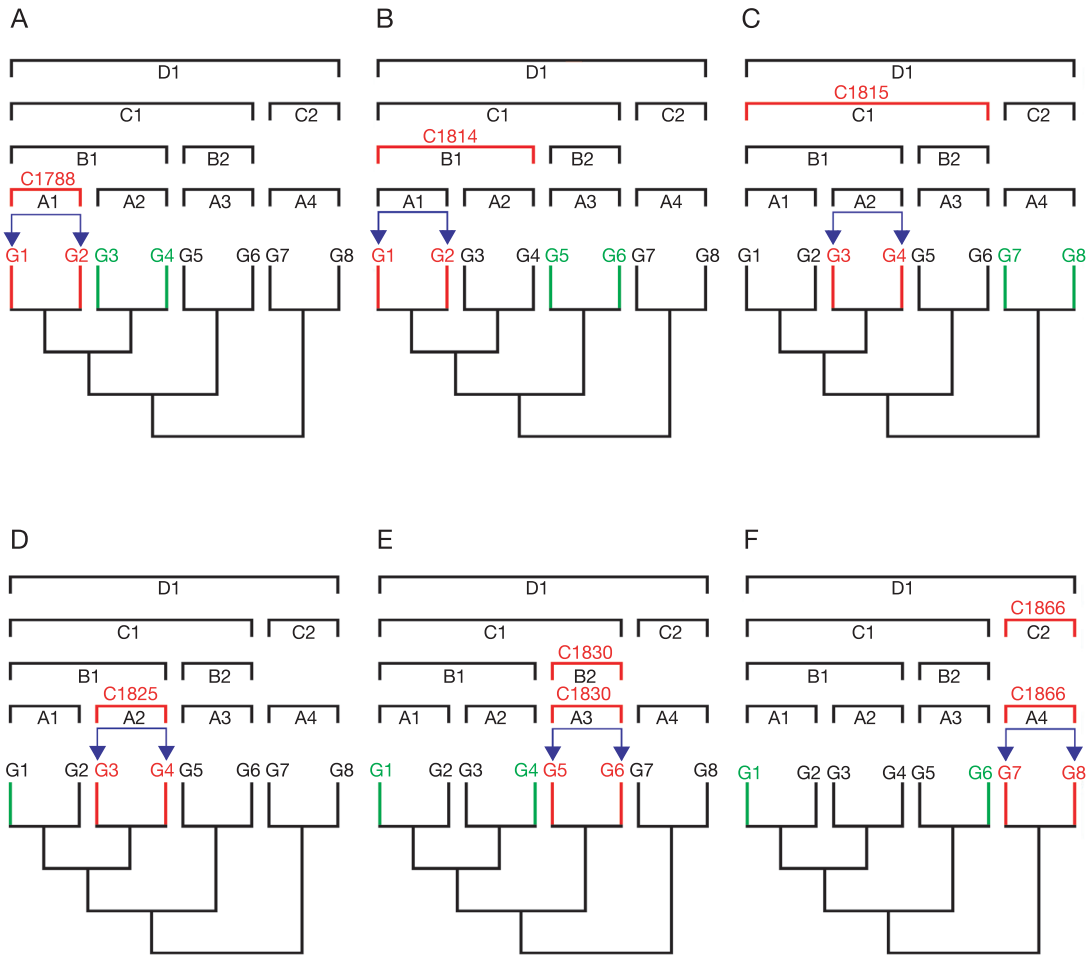
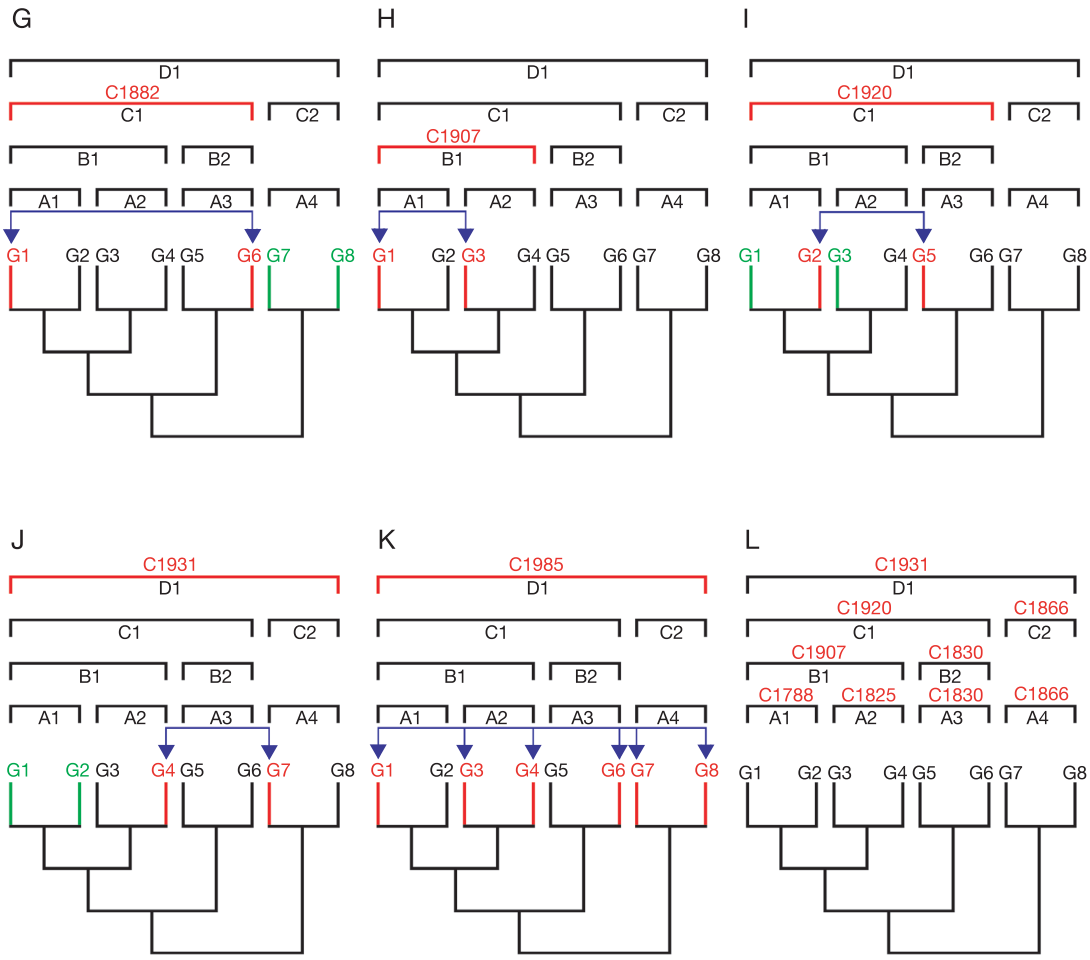


FIG. 5. — Diagrammatic illustration (as cladograms) of the status of 11 class-series nomina according to a given ergotaxonomy and following the Rules here proposed for class-series nomenclature. **G1** to **G8** are taxa of rank genus, **A1** to **A4** taxa of rank order, **B1** and **B2** taxa of rank superorder, **C1** and **C2** taxa of rank subclass, and **D1** a taxon of rank class. **A**-**K**, status of 11 classomina **C1788** to **C1985** ▸

Cantino 2001; Pleijel & Rouse 2003), i.e. that of redundancy of ranks in the case of any higher taxon including only one taxon of next lower rank. Such a redundancy is not a problem as far as taxonomy is concerned, as pointed out by Moore (1998: 563): "I fail to see why such redundancy – a necessity when taxa of different ranks have the same content – is disturbing". However, from a nomenclatural point of view it results in an unnecessary multiplication of distinct nomina for the same taxon. The system here proposed allows to make clear the difference between *definition* of a taxon and its *rank*. If the Rules asked that a different nomen be given to the different ranks, there would indeed be redundancy and a useless increase in the number of nomina, but with the proposed Rules it is clear that a single taxon is involved, but that it occupies simultaneously several distinct ranks in the hierarchy.

RECAPITULATION: COMPARISON BETWEEN FAMILY-SERIES AND CLASS-SERIES NOMENCLATURES

As several of the ideas and proposals above are new, it may be useful to restate them in different terms.



(designated by their dates of original publication) according to their original conucleogenera and alienogenera: conucleogenera (generomina originally included in the taxon designated by a nomen) are shown in red and pointed by blue arrows, whereas alienogenera, whenever available, are shown in green. **L**, valid nomina of all nine class-series taxa recognized in this ergotaxonomy. See text for more details.

This will be done using imaginary examples, that will also allow to compare the process of establishing the valid nomen of a taxon, according to the Rules here proposed, for the class-series, with that used in the family-series according to the Rules of the *Code*. Figures 4 and 5 present several nomina of both nominal-series and their final status as kyronyms, within the frame of a phylogenetic taxonomy based on a given cladistic hypothesis involving eight genera G1 to G8.

Figure 4A-K presents 11 familiomina designated by the letter F followed by the year of their first publication (F1788 to F1985). Each nomen, when first published, was proposed for a taxon including several genera (shown in red), but only one of the generomina at stake (pointed to in blue) was designated (usually by implicit etymological designation) as nucleogenus of the familiomen. As shown in these figures, each nomen applies potentially to all taxa at various ranks (e.g., A, tribe; B, subfamily; C, family; D, superfamily) that include this nucleogenus. Figure 4L shows the valid nomina of all the taxa recognized at each rank. Among all nomina that potentially apply to a given taxon in

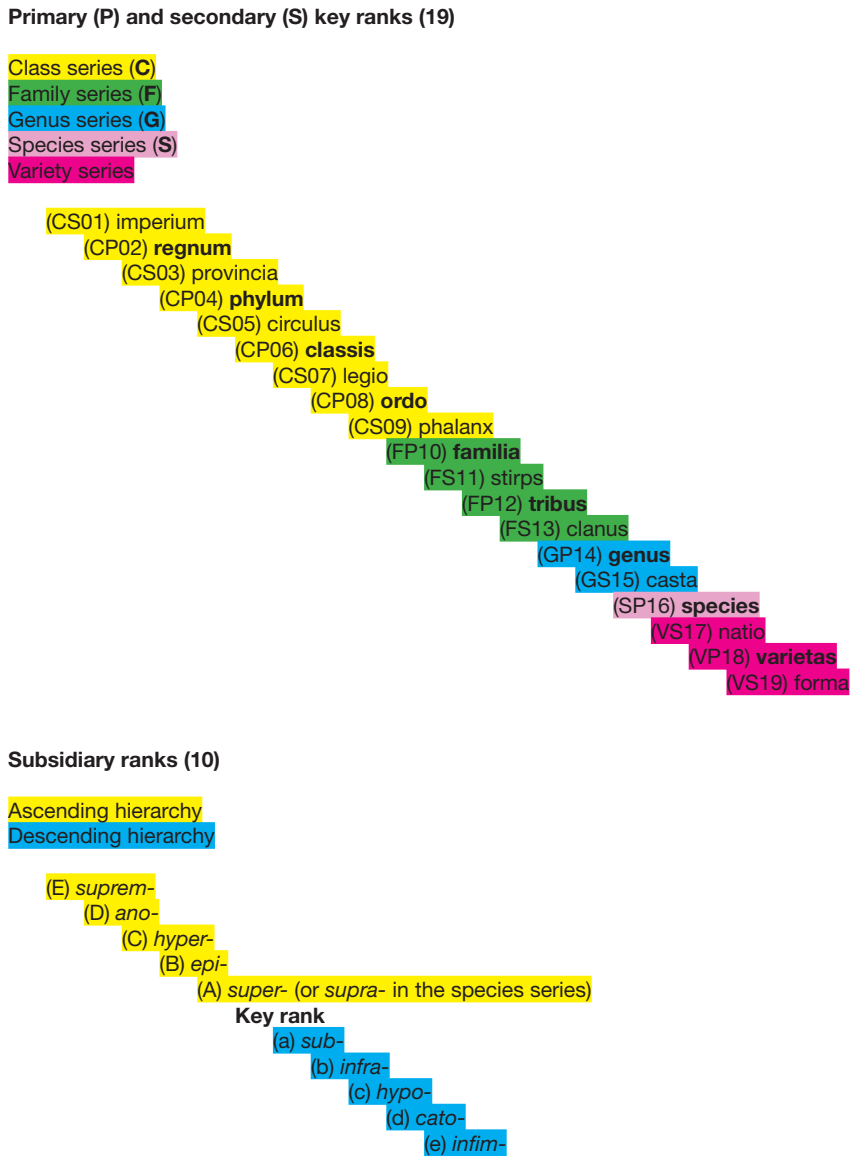


FIG. 6. — The universal system of nomenclatural ranks proposed in this paper for zoological nomenclature: 19 key ranks + 10 × 19 subsidiary ranks = 209 potential ranks. See text for explanations.

this hierarchy, the valid one is determined by priority of publication. So F1814 is an invalid junior synonym of F1788; F1825, F1907 and F1931 are junior synonyms of F1815; F1882 and F1920 are synonyms of F1830; and F1985 is synonym of F1866. Because of the Rule of Coordination, the same nomen may apply to several nomina of the hierarchy, up to four in this case, for the oldest nomen (F1788). This system is particularly economic in term of the number of nomina needed, as in this case four nomina are enough to nominate nine taxa without any ambiguity.

Because of the absence of a Rule of Coordination, the situation is quite different in the class-series, as shown in Figure 5. All 11 classomina C1788 to C1985 shown in Figure 5A-K were created with the exactly same original generic contents as the parallel familiomina F1788 to F1985 in Figure 4A-K. Here however, no single nucleogenus can be designated and all these originally included generomina remain forever together the conucleogenera of their classomina. Furthermore, to establish their status, it is necessary to know their alienogenera, shown in green in Figure 5A-G, I, J. In this example, nomina C1907 and C1985 were supposedly created as eremoprotaxa. Several steps are needed to find the valid nomen for each taxon:

(S1) *Establish whether each nomen is a choronym or a nesonym*. The following seven nomina are choronyms, as all their alienogenera are now extragenera: C1788, C1814, C1815, C1825, C1830, C1866 and C1882. The following two nomina are nesonyms, as their alienogenera include both intragenera and extragenera: C1920 and C1931. The following two nomina are also nesonyms, as no information was provided on their alienogenera, i.e. on their place in the taxonomy: C1907 and C1985.

(S2) *Establish which ergotaxon each nomen applies to*. Each of the seven choronyms applies to the most inclusive ergotaxon including its conucleogenera and excluding its extragenera, as shown in Figure 5A-G. Each of the four nesonyms applies to the least inclusive ergotaxon containing its conucleogenera, as shown in Figure 5H-K. Let us note that, in contrast with the situation in Figure 4 (where each nomen applied potentially to several taxa at different ranks), each nomen here only applies to a single taxon at a given rank, except in cases of taxa including a single subordinate taxon (C1830 and C1866).

(S3) *Establish the status of each nomen regarding usage*. This is not shown on Figure 5, as it depends on an analysis of the existing literature, an information external to the cladogram. Let us consider that, in the present case, the nomen C1920 is a paneurydiaphonym, C1907 is a schizeurydiaphonym and all other nine nomina stenodiaphonyms.

(S4) *Establish the valid nomen of each ergotaxon*. This is done according to Rules (R13) and (R16). For complete clarity and full understanding, let us consider successively the nomina of all nine taxa recognized in the taxonomy of Figure 5L. Let us consider that taxa of rank A are orders, taxa of rank B superorders, C subclasses and D classes (this is arbitrary, e.g., linked to "tradition" in the zoological group studied, and of no relevance to the nomenclatural conclusions below):

(Order A1) A single nomen (C1788) is available, and therefore valid, for this taxon.

(Order A2) A single nomen (C1825) is available, and therefore valid, for this taxon.

(Order A3) A single nomen (C1830) is available, and therefore valid, for this taxon.

(Order A4) A single nomen (C1866) is available, and therefore valid, for this taxon.

(Superorder B1) Two nomina (C1814 and C1907) are available for this taxon. However, one of them only (C1907) is a schizeurydiaphonym, the other one being a stenodiaphonym. Therefore C1907 is the valid nomen of the taxon according to Rule (R16).

(Superorder B2) This taxon is identical in extension and intension to taxon A3. Therefore it bears the same nomen C1830, but with a different rank.

(Subclass C1) Three nomina (C1815, C1882 and C1920) are available for this taxon. One of them (C1920) is a paneurydiaphonym, and has therefore precedence over the other two that are stenodiaphonyms, according to Rule (R13). Relative precedence between these two other nomina is fixed by their dates of publication, according to Rule (R16), so that, in the absence of C1920, C1815 would have priority over C1882.

(Subclass C2). This taxon is identical in extension and intension to taxon A4. Therefore it bears the same nomen C1866, but with a different rank.

(Class D1) Two nomina (C1931 and C1985) are available for this taxon. Both are stenodiaphonyms, so that precedence is fixed by publication dates, and C1931 is the valid nomen of the taxon according to Rule (R16).

This example illustrates several important particularities of class-series nomenclature as proposed here, that make it different from family-series nomenclature: 1) two nomina may apply to different ergotaxa although they had been coined for taxa including exactly the same genera but excluding different genera (e.g., C1788 and C1814, or C1815

and C1828); 2) priority is not the only tool allowing to fix the validity of nomina, as it is used only among nomina that have the same status regarding the categories of usage; and 3) because of the absence in most situations of the Rule of Coordination, this system is much less economic in term of the number of nomina needed, as in this case seven distinct nomina are needed to nominate nine taxa without ambiguity.

Restoration of invalid class-series nomina

The purposes of the Rules proposed here are double: to stabilize the nomina of taxa which for the time being are afforded different nomina by different authors, and to avoid the multiplication of nomina as taxonomy progresses. The latter aim can be reached only if, rather than creating a new nomen as soon as a slightly new taxonomy is proposed, Rules are provided to allow new uses of previously invalidated nomina, a frequent process in the nomenclature of the three nominal-series covered by the *Code*. The Rules presented above allow fixation of the valid nomina within the frame of a given taxonomy of a group. But what happens whenever this taxonomy changes? What is the status of the nomina which, according to the Rules above, have become hypnonyms (invalid, although available, nomina)? How could such nomina be restored ("resurrected") later, i.e. used for new taxa that may have to be erected during the progress of the taxonomy of the group? Again, this will depend on the original definition and content of the taxon (protaxon) as compared with the current ergotaxonomy, i.e. on the onomatophore and onomatostasis of the nomen.

Any new taxonomy may result in 1) suppression of taxa (usually by lumping), 2) changes in the definitions and contents of taxa, and 3) establishment of new taxa. Suppression of a taxon through lumping of two or more taxa does not raise particular problems: sozonyms should be protected first; if two of them are in competition, the Rule of Priority should be used and the oldest nomen kept for the remaining taxon; the same should apply between distagmonyms if only such nomina are involved, the most recent nomina being referred to their proper synonymies. Change in definition/content of a taxon should not raise more difficulties: just like for all other nomina regulated by the *Code*, such a change should not result in a change of nomen as long as the onomatophore remains included in the taxon; if all or part of the onomatophore moves to another taxon (which may be a more inclusive one), the nomen should follow it there and be treated according to the Rules above.

The most difficult and interesting situation is that in which a new taxon is proposed, e.g., as a result of a cladistic analysis. Rather than coining a new nomen for this taxon, it should be compulsory, when this is possible, to use an existing nomen, among the hypnonyms that were standing in the current synonymies of taxa recognized until then. The onomatophore of this nomen should be entirely included in the proposed new taxon. If several such nomina are available, the hierarchy of criteria proposed above for the fixation of a kyronym among distagmonyms should be implemented. While doing this, however, attention should be paid to the following questions, that may act as "traps": distinction must be made between three kinds of nomina resulting from previous nomenclatural actions or simply from the Rules, i.e. *anoplonyms*, or unavailable nomina, *hypnonyms*, or conditional akyronyms, and *exoplonyms*, i.e. nomina definitively invalidated in zoological nomenclature. Particular care should be taken to follow the Rules above concerning *neonyms* and *archaeonyms* on one hand, and concerning *didymonyms* on the other. The following statements, which are not new rules but simple "rewordings" of Rules presented above, are aimed at avoiding falling into such "traps":

1) Any nomen that had been proposed for exactly the same protaxon as that of a currently valid nomen (isoprotaxa), i.e. with the same onomatophore (isonyms), will remain invalid in all cases: it will stand permanently in the synonymy of the valid nomen, as an *exoplonym*, i.e. a definitively invalidated nomen. In case of validation (following the Rules of Sozonym or Agathonym Validation) of the junior nomen, the senior one has definitively become a senior exoplonym through a process of *juniorization* (Dubois 2000).

TABLE 3. — Standard endings proposed for nomina of taxa of various ranks in the family-series. Each ending consists of two parts (Alonso-Zarazaga 2005), the *connector* (shown on first column) followed by the *ending proper* (shown in first line of table). This system, derived from that of Bour & Dubois (1985), is mnemonic as this table can be read from left to right and from up to down, with no reversal to the left or to an upper line, like the course of a river descending a mountain. Ranks and endings shown in bold are those that are mentioned in the *Code*.

	-AI	*-IA*	*-EA*	*-AE*	*-EI*	***-I***	***-A***	*-OI*	*-OA*
-AID-	*-AIDAI* Anofamilia	*-AIDIA* Hyperfamilia							
-OID-		*-OIDIA* Epifamilia	***-OIDEA*** **Superfamilia**						
-ID-				***-IDAE*** **Familia**					
-IN-				***-INAE*** **Subfamilia**	*-INEI* Infrafamilia	***-INI*** **Tribus**	***-INA*** **Subtribus**		
-IT-							*-ITA* Infratribus	*-ITOI* Clanus	
-IL-								*-ILOI* Subclanus	
-IS-								*-ISOI* Infraclanus	*-ISOA* Hypoclanus

2) However, any nomen that had been proposed for a protaxon different from that of the current valid nomen, i.e. with a different onomatophore (doxisonyms), should be treated as a senior or junior *hypnonym* in the synonymy of the valid nomen as long as its onomatophore belongs in the current ergotaxon designated by this nomen (Dubois 2000). This nomen temporarily invalidated in zoological nomenclature may have to be revalidated later if taxonomy of the group changes.

These detailed criteria are summarized in Rule (R19) below.

RANKS

For reasons discussed in Dubois (2005b) and above, the nomenclatural system advocated here for higher taxa is a hierarchical system of *ranks*, just like the system used for the nomina of all other nominal-series according to the *Code*. Except for the lowest ranks, allocation of a taxon to a rank is not part of the taxon's *definition*: the taxon and its definition may remain the same, but the rank may change, e.g., according to changes in the hypothesized relationships of the taxon. In most cases, at least above the rank genus, the rank does not carry any special biological, evolutionary or phylogenetic information, as there is no conceptual difference between a class, an order or a family: this system is simply a system of *indexation of data* that is justified only on practical grounds, as it facilitates the storage and retrieval of information (Mayr 1981). In the family-series, the *Code* currently supports the use of five ranks, i.e. following an ascending hierarchy, subtribe, tribe, subfamily, family and superfamily, for the nomina of which the standard endings are *-INA*, *-INI*, *-INAE*, *-IDAE* and *-OIDEA*. However, in many zoological groups, more ranks need to be used to account for the hierarchical relationships between taxa or cladons. Different systems have been used by different authors for this purpose. Bour & Dubois (1985, 1986) proposed a system of ranks and of endings that is presented here, slightly modified, in Table 3. The nomina of all these taxa are based on the stems of available generomina, to which standard endings are added to indicate the rank. According to this system, the endings of familiomina are all composed of a first part or *connector* (Alonso-Zarazaga 2005), which is either *-AID*, *-OID*, *-ID*, *-IN*, *-IT*, *-IL* or *-IS*, and of a second part or *ending proper*, which is either *-AI*, *-IA*, *-EA*, *-AE*, *-EI*, *-I*, *-A*, *-OI* or *-OA*.

For reasons explained above, the suggestion to use standard *endings* for nomina of given ranks in the class-series is not supported here. However, use of

TABLES 4-6. — Hierarchies of basic taxonomic-nomenclatural ranks used in various zoological works. Names of ranks printed in **bold** are proposed as primary key ranks, those in *italics* as secondary key ranks, and those in normal font are not retained in the system supported here. Names of ranks underlined are terms in languages other than Latin that do not have exact Latin equivalent. All other names are either Latin or exact equivalent of Latin terms in recent languages. Codes designating the ranks in column headings include a number between 01 and 19 (from most inclusive to least inclusive rank), preceded by two letters, one designating the nominal-series (**C**, class; **F**, family; **G**, genus; **S**, species; **V**, variety) and one whether this is a primary (**P**) or secondary (**S**) key rank. Whenever, in a given publication, several subordinated ranks are recognized in one of these columns, their hierarchy is indicated by the sign **>**: thus, "Gradus > Circulus" means that, in this work, the rank Circulus is used as subordinate to the rank Gradus. In contrast, the sign **/** between two terms indicates that the latter were used alternatively for the same rank in this publication.

TABLE 4. — Names of key ranks in the class-series: from imperium to classis.

Reference	CS01	**CP02**	CS03	**CP04**	CS05	**CP06**
Linnaeus 1758		**Regnum**				**Classis**
Brisson 1762						**Classis**
Scopoli 1777			Tribus		Gens	
Batsch 1788						**Classis**
De la Cepède 1788a, b						**Classis**
Latreille 1800						Classe
Sonnini & Latreille 1801a, b						Classe
Desmarest 1804						Classe
Latreille 1804a, b						Classe
Oken 1811, 1815		Reich			Land > Kreis	Classe
Oppel 1811a-f						**Classis**
Rafinesque-Schmaltz 1814b		Règne				Classe
Wilbrand 1814					Thierstufe > Gradus	**Classis**
De Blainville 1816	Empire	Règne			Type	Classe
Oken 1821a		Règne			Terre > Degré	Classe
Oken 1821b					Land > Stuffe	Classe
Latreille 1825					Gens > Race > Branche	Classe
Fitzinger 1826						**Classis**
Van der Hoeven 1828, 1833						**Classis**
Wilbrand 1829					Thierstufe > Abstufung	Klasse
Wagler 1830						**Classis**
Oken 1831					Land > Kreis	Classe
Bonaparte 1832						Classe
Wiegmann & Ruthe 1832						Klasse
Oken 1833					Land > Thierstuffe	Classe
Swainson 1835		Kingdom				Class
Oken 1836, 1843					Land > Kreis	Classe
Hogg 1841					Division	Class
Fitzinger 1843			*Provincia*		Gradus > *Circulus*	**Classis**
Gravenhorst 1843						Klasse
Bonaparte 1845						**Classis**
Giebel 1846			Abtheilung		Typus > Stufe > Kreis	
De Blainville 1847	*Imperium*	**Regnum**			Typus	**Classis**
Stannius 1856						**Classis**
Haeckel 1866				**Phylum** / Stamm	Cladus > Series	**Classis**
Garrod 1874						Class
Zittel 1887-1890				Stamm		Classe
Nicholson & Lydekker 1889		Kingdom			Division	Class
Haeckel 1902				Phylon	Cladoma	**Classis**

Reference	CS01	**CP02**	CS03	**CP04**	CS05	**CP06**
Börner 1904						**Classis**
Grobben 1909			Subregnum > Divisio	**Phylum** / Typus	Subtypus > Kladus	**Classis**
Poche 1911		**Regnum**		**Phylum**		**Classis**
Ferris 1928						Class
Petrunkevitch 1952				**Phylum**		Class
Mayr *et al.* 1953		Kingdom		**Phylum**		Class
von Kéler 1956		**Regnum** / Reich		**Phylum** / Typus, Stamm	Divisio / Abteilung > Cladus / Zweig	**Classis** / Klasse
Chester Bradley 1958		Kingdom		**Phylum**		Class
Simpson 1961		Kingdom		**Phylum**		Class
Bey-Biyenko 1962						**Classis**
Honigberg *et al.* 1964				**Phylum**		Class
Hu 1965		Status / State	Divisio / Division			
Blackwelder 1967		Kingdom		**Phylum**		Class
Nelson 1969				**Phylum**		Class
Whittaker 1969		Kingdom	Branch > Grade	**Phylum**		
Crowson 1970		Kingdom		**Phylum**		Class
Margulis 1974		Kingdom	Branch > Grade> Division	**Phylum**		Class
Farris 1976		Kingdom		**Phylum**		Class
Margulis 1976		Kingdom		**Phylum**		Class
Rodendorf 1977a, b				**Phylum**		Class
Boudreaux 1979				**Phylum**		Class
Wiley 1979				**Phylum**		Class
Cracraft 1981						Class
Jeffrey 1982		Kingdom		Division / **Phylum**		Class
Brothers 1983a		Kingdom		**Phylum**		Class
Starobogatov 1984, 1991			Division	**Phylum**		Class
Haszprunar 1985, 1986				**Phylum**		Class
Jamieson 1988				**Phylum**		Class
Mayr & Ashlock 1991		Kingdom		**Phylum**		Class
Panchen 1991						Class
Quicke 1993					Division	Class
Rasnitsyn & Quicke 2002						Class
Present paper	*Imperium*	**Regnum**	*Provincia*	**Phylum**	*Circulus*	**Classis**

a standard *hierarchy* by all authors would appear to be a useful improvement of the current situation. Few authors (e.g., Ferris 1928) proved interested in trying to promote such a standardisation. Just like in the family-series, some ranks (kingdom, phylum, class, order) appear more "universal" than others. Many additional ones have been recognized by zoologists in the past, but are much less general. Beside these basic ranks that are designated by special terms (classis, ordo, etc.), many authors in the past used an additional hierarchical system using optional ranks (superordo, subordo, etc.), indicated by prefixes or *modifiers* that are directly (i.e. without hyphen) attached to the names of the basic ranks.

Tables 4-7 present examples of hierarchies of ranks appearing in a number of zoological classifications since Linnaeus (1758). This is far from an exhaustive survey of the hierarchies and terms that have been used in the past (preparing such a survey would be a gigantic endeavour), but a selection of examples that is hopefully representative of a large part of

TABLE 5. — Names of key ranks in the class-series: from classis to familia.

Reference	CP06	CS07	CP08	CS09	FP10
Linnaeus 1758	**Classis**		**Ordo**		
Brisson 1762	**Classis**		**Ordo**	Sectio	
Scopoli 1777		Divisio	**Ordo**		
Batsch 1788	**Classis**				**Familia**
Latreille 1800	Classe	Section	Ordre		
Sonnini & Latreille 1801a, b	Classe	Division > Section			
Desmarest 1804	Classe	Section > Division	Ordre		Famille
Latreille 1804a, b	Classe	Section	Ordre	Section	
Oken 1811, 1815	Classe		Ordnung	Zunft	Sippschaft
Oppel 1811a-f	**Classis**		**Ordo**	Sectio	**Familia**
Rafinesque-Schmaltz 1814b	Classe		Ordre		Famille
Wilbrand 1814	**Classis**		**Ordo**	Subdivisio	**Familia**
De Blainville 1816	Classe	Tribu	Ordre		
Oken 1821a	Classe		Ordre	Tribu	Famille
Oken 1821b	Classe		Ordnung	Zunft	Sippschaft
Latreille 1825	Classe	Section	Ordre		Famille
Fitzinger 1826	**Classis**		**Ordo**	Tribus	**Familia**
Van der Hoeven 1828, 1833	**Classis**		**Ordo**	Sectio	**Familia**
Wilbrand 1829	Klasse		Ordnung	Gruppe	Familie
Wagler 1830	**Classis**		**Ordo**		**Familia**
Oken 1831	Classe	Land	Ordnung	Zunft	
Bonaparte 1832	Classe	Sezione	Ordine		Famiglia
Wiegmann & Ruthe 1832	Klasse		Ordnung		
Oken 1833	Classe		Ordnung / **Ordo**	Zunft / Tribus	Sippschaft / **Familia**
Swainson 1835	Class		Order	Tribe	Family
Oken 1836, 1843	Classe	Horde	Ordnung	Zunft	Sippschaft
Hogg 1841	Class		Order	Tribe	**Familia**
Gray 1842	Class	Section	Order		Family
Fitzinger 1843	**Classis**	Series	**Ordo**	Sectio > Tribus	**Familia**
Gravenhorst 1843	Klasse		Ordnung	Zunft	Familie
Bonaparte 1845	**Classis**	Sectio	**Ordo**	Tribus	**Familia**
De Blainville 1847	**Classis**		**Ordo**	Tribus	**Familia**
Stannius 1856	**Classis**	Sectio	**Ordo**	Tribus > Sectio	**Familia**
Günther 1859			Order	Series > Section	Family
Haeckel 1866	**Classis**	*Legio*	**Ordo**	Sectio	**Familia**
Huxley 1867			Order	Group	
Mivart 1869			Order	Section > Division > Subsection	**Familia**
Sundevall 1872		Agmen	Order	Series > Cohort	
Garrod 1874	Class		Order	Cohort	
Zittel 1887-1890	Classe		Ordnung	Section	Familie
Fürbringer 1888			Order	Gens	
Nicholson & Lydekker 1889	Class	Branch	Order	Section	Family
Gadow 1893	Class	Division > Brigade > Legion	Order		
Haeckel 1902	**Classis**	*Legio*	**Ordo**		**Familia**
Börner 1904	**Classis**	Sectio	**Ordo**		**Familia**
Ferris 1928	Class		Order		Family
Huene 1952		Tribus > Ramus	Order		
Petrunkevitch 1952	Class		Order	Branch	
Mayr *et al.* 1953	Class	Cohort	Order		
von Kéler 1956	**Classis** / Klasse	*Legio* / Legion	**Ordo** / Ordnung	Cohors / Cohorte > *Phalanx* / Phalange	**Familia** / Familie

Reference	CP06	CS07	CP08	CS09	FP10
Chester Bradley 1958	Class		Order		
Simpson 1961	Class		Order		Family
Bey-Biyenko 1962	**Classis**	Divisio	**Ordo**		
Honigberg *et al.* 1964	Class		Order		
Blackwelder 1967	Class		Order		Family
Nelson 1969	Class	Division > Cohort	Order	Series	Family
Crowson 1970	Class	Cohort	Order	Section	Family
Griffiths 1972			Order	*Phalanx*	
Farris 1976	Class	Cohort	Order		Family
Margulis 1976	Class		Order		
Rodendorf 1977a, b	Class	Cohort	Order		
Boudreaux 1979	Class	Section > Cohort	Order		Family
Wiley 1979	Class	Division > Cohort > Section	Order		
Cracraft 1981	Class	Division > Cohort	Order		Family
Gardiner 1982	Class	Division	Order	Cohort	
Jeffrey 1982	Class		Order		
Brothers 1983a	Class	Cohort	Order		
Starobogatov 1984, 1991	Class	Cohort	Order		
Haszprunar 1985, 1986	Class	Cohors	Order		Family
Jamieson 1988	Class		Order	Cohort	Family
Milner 1988		Division	Order		**Familia**
Gaffney & Meylan 1988			Order		
Mayr & Ashlock 1991	Class	Cohort	Order		Family
Panchen1991	Class	Division > Cohort	Order		
Quicke 1993	Class		Order		
Szalay 1993	Class	Cohort	Order		Family
Rasnitsyn & Quicke 2002	Class	Cohors	Order		
Present paper	**Classis**	*Legio*	**Ordo**	*Phalanx*	**Familia**

zoological literature (although many of them are from herpetology, my own speciality). The hierarchy considered in Tables 4-6 deals only with basic ranks designated by special terms, that I propose to call *key ranks*. These tables cover the whole zoological taxonomic hierarchy, from imperium to forma, i.e. including the three nominal-series ruled by the *Code* (family-, genus- and species-series), as well as the two nominal-series currently excluded from the *Code* (class- and variety-series). It should be noted again here that excluding variety-series nomina from zoological nomenclature is contradictory with the *Preamble* of the *Code* as it "restricts the freedom of taxonomic thoughts or actions" (see e.g., Deuve 1994, 2004), and time will probably come when zoologists also decide to expand the *Code* to include lower ranks' nomina like those of varieties and forms, as is the case in botanical nomenclature (Dubois 2005b). Table 7 presents examples of hierarchies of modifiers used by various authors to designate additional ranks above and below the key ranks of Tables 4-6. I propose to call these additional ranks *subsidiary ranks*. For each reference mentioned in these tables, combination of the two systems gives its complete potential hierarchy, although a number of ranks may not have actually been used until now.

These data can be used to propose some standardization of terms designating the taxonomic ranks in zoology. In order to comply with the aim of universality of any system of biological nomenclature, and with the long use of Latin in zoological nomenclature, I suggest that the ranks of zoological taxa be designated by Latin or latinized terms (from classical Greek terms or other languages), but not terms in any current living language. Translations of these terms can be made in any other language as needed, as exemplified below for English.

Primary key ranks

Tables 4-6 confirm that some key ranks have been much more used than others in the zoological

TABLE 6. — Names of key ranks in the family-, genus-, species- and variety-series.

Reference	FP10	FS11	FP12	FS13	GP14	GS15	SP16	VS17	VP18	VS19
Linnaeus 1758					**Genus**		**Species**		**Varietas**	
Brisson 1762					**Genus**					
Scopoli 1777					**Genus**					
Batsch 1788	**Familia**				**Genus**		**Species**			
De la Cepède 1788a, b					**Genus**	Divisio	**Species**			
Latreille 1800					Genre	Famille	Espèce		Variété	
Sonnini & Latreille 1801a, b					Genre	Famille	Espèce			
Desmarest 1804	Famille	Section			Genre		Espèce			
Latreille 1804a, b					Genre	Section	Espèce			
Oken 1811, 1815					Gattung					
Oppel 1811a-f	**Familia**				**Genus**		**Species**			
Rafinesque-Schmaltz 1814b	Famille				Genre		Espèce			
Wilbrand 1814	**Familia**				**Genus**					
De Blainville 1816										
Oken 1821a	Famille									Race
Oken 1821b	Sippschaft				Sippe		Art			
Latreille 1825	Famille		Tribu		Genre		Espèce			
Fitzinger 1826	**Familia**				**Genus**		**Species**			
Van der Hoeven 1828, 1833	**Familia**	Sectio > Phalanx								
Wilbrand 1829	Familie	Zunft			Gattung		**Species**			
Wagler 1830	**Familia**		**Tribus**	Divisio	**Genus**		**Species**			
Oken 1831										
Bonaparte 1832	Famiglia				Genero					
Wiegmann & Ruthe 1832										
Oken 1833	Sippschaft / **Familia**				Sippe / **Genus**		Gattung / **Species**		Abart / **Varietas**	
Swainson 1835	Family				**Genus**		**Species**			
Oken 1836, 1843	Sippschaft									
Hogg 1841	**Familia**				**Genus**					
Gray 1842	Family									
Fitzinger 1843	**Familia**				**Genus**		**Species**			
Gravenhorst 1843	Familie	Linie			Gattung		**Species**			
Bonaparte 1845	**Familia**									
Giebel 1846	Familie				Gattung					
De Blainville 1847	**Familia**				**Genus**		**Species**			
Stannius 1856	**Familia**									
Günther 1859	Family				**Genus**		**Species**			
Haeckel 1866	**Familia**		**Tribus**		**Genus**	Cohors	**Species**		**Varietas**	
Nicholson & Lydekker 1889	Family				**Genus**		**Species**			
Haeckel 1902	**Familia**				**Genus**					
Börner 1904	**Familia**									
Ferris 1928	Family		Tribe		**Genus**	Group	**Species**			
Berg 1932							**Species**	*Natio*		Morpha > *Forma* > Aberratio > Monstrositas
von Kéler 1956	**Familia** / Familie		**Tribus** / Sippe		**Genus** / Gattung	Series / Serie > Sectio / Sektion	**Species** / Art			
Simpson 1961	Family		Tribe		**Genus**		**Species**			
Blackwelder 1967	Family		Tribe		**Genus**		**Species**			
Nelson 1969	Family				**Genus**					
Crowson 1970	Family		Tribe		**Genus**		**Species**			
Farris 1976	Family		Tribe		**Genus**		**Species**			
Margulis 1976					**Genus**		**Species**			
Boudreaux 1979	Family									

Reference	FP10	FS11	FP12	FS13	GP14	GS15	SP16	VS17	VP18	VS19
Cracraft 1981	Family		Tribe							
Bour & Dubois 1985	**Familia**		**Tribus**	*Clanus* > Casta						
Mayr & Ashlock 1991	Family		Tribe		**Genus**		**Species**			
Present paper	**Familia**	*Stirps*	**Tribus**	*Clanus*	**Genus**	*Casta*	**Species**	*Natio*	**Varietas**	*Forma*

literature over 250 years, some of which are furthermore recognized by the *Code*. I propose to call these consensual ranks *primary key ranks*. The *Code* recognizes four such key ranks: 1) two in the family-series: *familia* (family) and *tribus* (tribe); 2) one in the genus-series: *genus* (genus); and 3) one in the species-series: *species* (species). In the class-series, among the many ranks used by various authors in the past (Tables 4, 5), four are much more common and were once recognized officially in the "*Règles*" (Hemming 1953), the ancestor of the *Code*, so that they should also be considered primary key ranks: *regnum* (kingdom), *phylum* (phylum), *classis* (class) and *ordo* (order). Finally, in the perspective of a possible incorporation of variety-series nomina in the *Code*, the rank *varietas* (variety) should be considered a primary key rank. On the whole, I suggest that nine primary key ranks should be recognized in zoology.

Except for a few poorly known organisms (especially extinct taxa with incomplete fossils), all living organisms are referable to all four key ranks of the class-series, as well as to family, genus and species. Ranks tribe and variety are less universal. Tribe is widely used in some zoological groups but ignored in many other ones. Variety would be potentially usable in many cases, but for the time being zoologists tend to refrain from recognizing infrasubspecific taxa as their nomina are not recognized by the *Code*, a situation that might change in the future, if taxonomic recognition of such units was found useful (see e.g., Deuve 1994, 2004), in particular for conservation biology purposes (see e.g., Mace 2004; Zink 2004).

Secondary key ranks

As shown by the (certainly incomplete) survey of Tables 4-6, many other terms have been used by zoologists for ranks intermediate between the nine ranks above. Few authors, however, found it necessary to use more than one rank between two subsequent primary key ranks, and this does not seem useful, given the wide possibilities offered by modifiers to increase the number of additional ranks (see below). I therefore propose to keep only one possible intermediate rank between any two subsequent primary key ranks, and to call these intermediate ranks *secondary key ranks*. These are potentially ten in number, including one above the highest class-series primary key rank and one below the variety key rank. Secondary key ranks that are between two primary ranks belonging to the same nominal-series are unambiguously referred to this series. Ranks between two primary ranks belonging to different nominal-series must be referred to one of these. Article 35.1 of the *Code* expressly includes ranks "below superfamily and above genus" in the family-series, so that the secondary rank between order and family belongs to the class-series, and that between tribe and genus to the family-series. Similarly, Article 45.1 restricts the species-series to nomina of "taxa at the ranks of species and subspecies", so that the possible intermediate secondary key rank between genus and species must be referred to the genus-series, and that between species and variety to the variety-series.

Nineteen key ranks can therefore be potentially recognized in any zoological group. These can be numbered from 01 to 19. Each of these numbers can be preceded by two letters, one designating the nominal-series (C, class; F, family; G, genus; S, species; V, variety) and one whether the rank is a primary (P) or secondary (S) key rank: thus, CP04 designates the phylum and CS07 the secondary rank between class and order. Primary ranks have even numbers and secondary ranks uneven numbers.

No universal use exists for the terms designating secondary ranks in zoology, and I suggest that choice among several existing terms be done according to three simple principles, as explained below.

(P1) Some terms should be avoided for rank names because of their ambiguity, as they have been significantly used for several distinct intermediate ranks in the hierarchy of Tables 4-6. A few of these terms should be maintained as they have been officially attached to a rank by the *Code*: thus, familia has been attached to rank FP10 although it had also been used for rank GS15, and *tribus* has been attached to rank FP12 athough it had in the past been used for the rank CS03, CS07 and CS09. To avoid further possible confusions however, all other terms that have been significantly used for several distinct ranks should now be excluded from this terminology of ranks. I suggest that the qualification "significantly" should mean that the term has been used in three distinct ranks at least. According to the data of Tables 4-6, the following terms are to be rejected for being in this situation:

– *Cohors* (cohort) has been employed in zoology by different authors at least for ranks CS07, CS09 and GS15. In botany (e.g., Crane & Kenrick 1997), it has also been used below CP02 (regnum) and above CP04 (divisio), i.e. for a rank equivalent to CS03 in zoology.

– *Divisio* (division) or its German equivalent *Abteilung* was used in zoology at least for ranks CS03, CS05, CS07, CS09, FS13 and GS15. Furthermore, in botany (e.g., Bremer 1985) it is often used for a rank between regnum and classis, equivalent to CP04 (phylum) in zoology.

– *Sectio* (section) was used in zoology at least for ranks CS07, CS09, FS11 and GS15.

– *Series* (series) was used in zoology at least for ranks CS05, CS07 and CS09.

– *Ramus* (branch) was used in zoology at least for ranks CS03, CS05, CS07 and CS09.

(P2) Other terms should be discarded as they are ambiguous for another reason, having long been used in systematics with other meanings. This is the case of the following terms:

– *Cladus* (clade), used by some authors for rank CS05, is ambiguous as it has often been used to designate any holophyletic group, whatever its taxonomic rank. The related term *cladoma* (Haeckel 1902) should also be avoided for the same reason.

– *Gradus* (grade), used by some authors, sometimes in German (as *Stufe* or *Stuffe*), for ranks CS03 or CS05, is similarly ambiguous as it has been used to designate a "level of organisation", irrespective of its taxonomic rank.

– *Typus* (type), also used by some authors for rank CS05, has had many different uses in zoology, taxonomy and nomenclature (see Dubois 2005b) and it would only add to confusion to use it nowadays for a taxonomic rank.

(P3) Among the remaining terms, it is simply proposed to choose among the terms already used for each rank, according to several criteria discussed below.

Application of these three principles to the ten secondary ranks here recognized allows to suggest standard designations for these ranks, as follows:

– Rank CS01. A single term seems to have been used in the 19th century for a rank above regnum: *imperium* (empire). It would be available for any taxonomic scheme that would recognize taxa above kingdom or superkingdom. To place empire above kingdom is not illogical as in human societies many empires of the past were composed of kingdoms.

– Rank CS03. Beside a few other terms rejected above, the term *provincia* (province) has had a limited use in the 19th century for a rank between regnum and phylum. Here also this is fully acceptable, as kingdoms are often divided in provinces.

– Rank CS05. Several terms have been used for this rank during the history of zoology. Some authors even recognized up to three major ranks (i.e. bearing unrelated names, unlike *subphylum* or *superclass*), between phylum and class. According to the criteria discussed above, three terms remain available for this rank: *circulus* (circle), *gens* (race, ethnic group) and *terra* (land). I suggest to keep the first of them. The term *gens* is slightly ambiguous as it was also used at least once for rank CS 09, and one of its possible English equivalents, *race*, that has also been used for the lowest taxonomic rank VS19, has a very unpleasant connotation within the frame of recent human history. Furthermore it is very similar to *genus*, which is liable to cause confusion. The term *terra* (land) was used in zoology in German language (as *Land*) and in French (as *terre*), but apparently never in its Latin form; furthermore it is also slightly ambiguous, having being used at least once for rank CS07. Finally,

the term *circulus*, or its German equivalent *Kreis*, have been used in a number of works in the 19th century, and can be retained for this rank.

– Rank CS07. Here also, up to three major ranks with unrelated names were recognized by some authors of the past. Most of these terms were rejected above, and we are left with three terms, two Latin ones, *agmen* and *legio*, and a German one, *Horde*. The latter term designates a crowd or a troop of barbarian soldiers and could be translated into the Latin term *caterva*, which does not seem to have ever been used in zoological nomenclature. The Latin term *agmen* designates a herd or an army on the march, and *legio* a division of the Roman army. This latter term having being used a little more, earlier and later (until the beginning of the 20th century), it is here preferred and retained for this rank.

– Rank CS 09. Up to three major ranks were also recognized by some authors of the past between order and family. After enforcement of the criteria above, three terms remain available: *group*, *phalanx* and *Zunft*. The latter German term was rather often used in the 19th century, but ambiguously, as it was either for rank CS09 or FS11. This term would be better translated into English by *corporation*, *association* or even *club*, and in Latin by *sodalitas*, a term that was apparently never used as such to designate a taxonomic rank. The term *group* does not have an exact Latin equivalent, but could be translated by *caterva*, *globus* or *circulus*. The latter term was retained above for rank CS05, and the other two do not seem to have been ever used in zoological taxonomy. Remains the term *phalanx*, that is slightly ambiguous as it was used at least by one author for rank FS11, but that was used for rank CS09 by some authors until late in the 20th century, and which is preferred on that account. This term designated a division of the Greek army and was used in Latin to designate an array of soldiers in close order.

– Rank FS 11. Few authors recognized major ranks between family and tribe. After use of the criteria above, a single one remains, the German term *Linie*, that should be taken here in the sense of *lineage* in English, and would be best translated by the Latin term *stirps*. Although this term does not seem to have been used in zoological taxonomy until now, its adoption is proposed here as this term is unambiguous and corresponds to an important concept of biological systematics (the lineal descent from an ancestor), but cannot be mistaken for the term used to designate this concept in evolutionary biology (clade).

– Ranks FS13 and GS15. Few authors recognized major intermediate ranks between tribe and genus, and between genus and species, which suggests that such ranks have not yet been considered very useful. They might become so in the future, with the refinement of lower level cladistic analyses of zoological groups. A formal key rank between genus and species, to which subsidiary ranks could possibly be added through the use of modifiers, would allow to replace the vague designations *species group* and *species complex*, used by a number of authors to designate a taxonomic rank below subgenus, whereas others use them merely to indicate informal groupings of species provisionally recognized for special purposes (e.g., ecological), but which do not qualify as taxa. Most of the few terms used by previous authors to designate these two secondary key ranks were rejected above, and only two remain available, *clanus* and *casta*. Both terms were proposed by Bour & Dubois (1985) for ranks between tribe and genus, but do not seem to have been used much since then. The term *clanus* is a latinization of the Gaelic term *clann*, "clan", and *casta* is a Latin-like term from the Spanish *casta*, "caste". I hereby propose to keep the first one, *clanus*, for rank FS13, between tribe and genus, and to transfer *casta* to rank GS15, between genus and species. Even if these ranks are not likely to be much used in the coming years, they will be available for authors who may wish to use them in the future.

– Ranks VS17 and VS19. Most authors who recognized distinct categories for taxa below species used for them the term species combined with modifiers (e.g., quasispecies). However, an important distinction must be made here: most of these categories are not hierarchically *subordinate* ranks, but *alternative* categories of the same rank in the hierarchy, hence the distinction proposed (Dubois 2005b) between *taxonomic category* and *nomenclatural rank*. Actually, in the species- and variety-series,

unlike in higher nominal-series, categories may play a double rôle, both purely nomenclatural (for indexation of information, as is the case in higher ranks) and taxonomic (for providing biological information on the *kind* of taxon recognized). Being distinct, these two functions can be dissociated. For many purposes, it is only necessary that organisms be referred to a taxon of a given *rank*, whatever its special biological properties. Thus, for commercial, medical, agricultural, legal or conservation biology purposes, it is necessary that all organisms be referred to a taxon of rank species or in some cases of a lower rank. This is distinct from the fact that some of these organisms may be referred to "particular" kinds of species, such as dualspecies, prospecies, klepton or klonon, or of "particular" kinds of infraspecific taxa, such as quasispecies or vicespecies (Bernardi 1956, 1957, 1980; Vuilleumier 1976; Eck 1977; Haffer 1986; Dubois 1991): the latter are distinct taxonomic units that are referred to the same nomenclatural level. Thus, for the purpose of the present discussion, only hierarchically subordinate nomenclatural ranks are considered. Few special terms have been used by zoologists of the past for the ranks between species and variety, and below variety. The term *natio* has been used by a number of authors for a rank below subspecies and above variety, and its use is here supported for secondary key rank VS17. For the rank VS19, below variety, very few zoologists used special ranks. For sake of homogeneity with the botanical code, it is here suggested that the term *forma* be retained for this rank. Although currently "forbidden" by the zoological *Code*, this rank can be used by zoologists as an "informal rank" (i.e. not regulated by the *Code*), pending a possible incorporation of variety-series nomina in the *Code*. As suggested by Deuve (1994, 2004), the nomina of such taxa should follow the same basic rules as those of taxa of the species-series (original authorship, date and onomatophore, Rule of Priority, Rule of Homonymy among nomina of this nominal-series).

In conclusion, for the whole animal kingdom, the following hierarchy, in descending order, is proposed for key ranks (primary key ranks in **bold**, secondary key ranks in *italics*): (CS01) *imperium*; (CP02) **regnum**; (CS03) *provincia*; (CP04) **phylum**; (CS05) *circulus*; (CP06) **classis**; (CS07) *legio*; (CP08) **ordo**; (CS09) *phalanx*; (FP10) **familia**; (FS11) *stirps*; (FP12) **tribus**; (FS13) *clanus*; (GP14) **genus**; (GS15) *casta*; (SP16) **species**; (VS17) *natio*; (VP18) **varietas**; (VS19) *forma*. Most of these ranks are optional, but one would expect, except for very poorly known organisms such as some fossils, that most organisms can be referred to taxa of ranks regnum, phylum, classis, ordo, familia, genus and species.

Subsidiary ranks

There is a long tradition in taxonomy to use additional intermediate ranks between the "major" ones, adding prefixes to the designations of the latter: thus, "superfamily", "suborder" or "infraclass". This should be maintained, as it allows the taxonomic system to be highly flexible and adaptable to the peculiarities of all existing taxonomies in various zoological groups. I propose to call these optional ranks *subsidiary ranks*. For clarity, homogeneity and universality of use, such ranks should always be indicated by the same prefixes, immediately connected (i.e. either superordinate or subordinate) to the names of the key ranks, and the prefixes should always be used in the same sequence (thus, first *sub-* then *infra-*, but no *infra-* if there is no *sub-*). Table 7 present examples of prefixes added to the names of key ranks (Tables 4-6) by various zoologists. It is here proposed that a standard hierarchy among subsidiary ranks be implemented for all key ranks in the whole animal kingdom.

Two hierarchies are proposed, an ascending one (ranks A, B, C, etc.) and a descending one (a, b, c, etc.), both starting from the key rank to which they are connected. This system is derived from that proposed by Bour & Dubois (1985, 1986), expanded and slightly modified (Table 3) according to several criteria. First, for sake of homogeneity, it is suggested to retain only Latin-based or latinized Greek-based terms, but no terms derived from other languages.

It is here proposed to keep only five subsidiary ranks in the ascending hierarchy (A-E) and five in the descending hierarchy (a-e). This is much more than needed in most situations, as very few authors in the past used more subsidiary ranks. Combined

TABLE 7. — Prefixes used in ascending (**A**-**F**) and descending (**a**-**f**) hierarchies used for subsidiary ranks (modifiers) in taxonomic hierarchies used in various zoological works. The two most frequently used prefixes, sub- and super-, have been used either in first or second rank of both hierarchies. The system of Farris (1976), supported by Kron (1997), is even more complicated as it allows creation of still many additional intermediate ranks by combining the prefixes: e.g., "gigainfraorder" or "picosuborder". Prefixes of ranks printed in **bold** are retained for the subsidiary ranks of their columns in the system supported here. Prefixes between square brackets, e.g., [crown], are from various languages and are not Latin or Latin-like.

Reference	F	E	D	C	B	A	Primary rank	a	b	c	d	e	f
Desmarest 1804, Latreille 1804b							–	[Sous]					
Rafinesque-Schmaltz 1814a						[Sopra]	–	[Sotto]					
Rafinesque-Schmaltz 1814b						[Sur]	–	[Sous]					
Schultze 1851							–	**Sub**					
Zittel 1887-1890							–	[Unter]					
Börner 1904						**Super**	–	**Sub**					
Poche 1911				Supersuper	Super	Subsuper	–	Supersub	Sub	Subsub			
Zittel 1911						**Super**	–						
Berg 1932							–	**Sub**	**Infra**				
Hennig 1950							–	**Sub**	**Infra**	Micro			
Romer 1950						**Super**	–	**Sub**	**Infra**				
Stenzel 1950						**Super**	–	**Sub**					
Kuhn 1960						**Supra**	–	**Sub**					
Bey-Biyenko 1962						**Super**	–	**Sub**	**Infra**				
von Kéler 1963					Super	**Supra**	–						
Hu 1965						**Supra**	–	**Sub**					
Blackwelder 1967						**Super**	–	**Sub**	**Infra**				
Griffiths 1972					Super	Pre	–	**Sub**	**Infra**				
Gaffney 1975							–	**Sub**	**Infra**	Parv			
McKenna 1975				Magna	Super	Grand	–	**Sub**					
Farris 1976			Giga	Mega	Hyper	**Super**	–	**Sub**	**Infra**	Micro	[Pico]		
Platnick 1977						**Super**	–	**Sub**	**Infra**	Micro	[Gigapico]	[Megapico]	[Hyperpico]
Rodendorf 1977a, b						**Super**	–	**Sub**	**Infra**	Micro			
Boudreaux 1979						**Super**	–	**Sub**	**Infra**	Subter			
Cracraft 1981					Super	Infrasuper	–	**Sub**	Infrasub	Infra			
Gardiner 1982						**Super**	–	**Sub**	**Infra**				
Möhn 1984 in Minelli 1993				Super	Supra	[Mid]	–	Inter	**Infra**				
Starobogatov 1984, 1991						**Super**	–	**Sub**	**Infra**				
Bour & Dubois 1985, 1986				**Hyper**	Super	Epi	–	**Sub**	**Infra**	Parv	Mini	Micro	Nano
Milner 1988						**Super**	–	[Crown]					
Gaffney & Meylan 1988	Giga	Mega	Capax	**Hyper**	Super	Epi	–	**Sub**	**Infra**	Parv	Micro		
Sibley & Ahlquist 1990						**Super**	–	**Sub**	**Infra**	Parv			
Beard 1993						Mir	–	**Sub**	**Infra**				
Szalay 1993							–	Semi	Sub	Semisub	Infra		
Cantino *et al.* 1997						**Super**	–	Supersub	Sub				
Kron 1997						**Super**	–	**Sub**					
Present paper		**Suprem**	**Ano**	**Hyper**	**Epi**	**Super / Supra**	–	**Sub**	**Infra**	**Hypo**	**Cato**	**Infim**	

with the 19 key ranks reviewed above, this provides a total of 209 potential ranks for the whole taxonomic hierarchy (Fig. 6), which is probably much more than will ever be needed, even in very rank-rich taxonomies. This is much more than proposed by authors of the past: for example Ferris (1928: 112, 113), using seven key ranks and three modifiers, only recognized 17 ranks. For the standard prefixes designating the subsidiary ranks, a choice has to be made between the various prefixes that have been used in the past (Table 7), or new prefixes must be proposed. These prefixes are of various kinds:

1) Prefixes indicating hierarchy or "nobleness" (Dupuis 1988: 64): *epi-* (Greek *epi*, "above"), *hyper-* (Greek *huper*, "above, beyond"), *infra-* (Latin *infra*, "below"), *sub-* (Latin *sub*, "below"), *subter-* (Latin *subter*, "beneath, below"), *super-* (Latin *super*, "above"), *supra-* (Latin *supra*, "above"). According to Dupuis (1988: 64), such prefixes would be the only ones that rightly apply to ranks, as they clearly describe a hierarchy between *ranks*. The English term *crown*, used by a few authors, also refers to "nobleness" or "authority", but there are two problems with this prefix: it seems to have never been used in the literature under its Latin form (*corona*); it was applied to taxa below the key rank, although its meaning suggests that it should rather be used for the highest rank in the ascending hierarchy. The seldom used prefix *mir-* (Latin *mirus*, "wonderful, extraordinary") could also possibly be referred to this category.

2) Prefixes indicating dimension or size (Dupuis 1988: 64): *capax-* (Latin *capax*, "broad, wide"), *gig-* (Greek *gigas*, "giant"), *grand-* (Latin *grandis*, "full-grown, great, large"), *magn-* (Latin *magnus*, "great, large"), *meg-* (Greek *megas*, "large"), *micr-* (Greek *mikros*, "small"), *min-* (Latin *minor*, "smaller"), *nan-* (Greek *nannos*, "dwarf"), *parv-* (Latin *parvus*, "small"), *pico-* (Spanish *pico*, "small amount of money"). Dupuis (1988: 64) is of the opinion that such prefixes would better apply to taxa than to ranks, as the latter have no "sizes". In fact, strictly speaking, they do not apply either to taxa, whose "sizes" are not readily comparable: a genus is not "greater" than a species, as they are composed of different kinds of basic units (species vs. individuals).

3) Prefixes indicating anteriority or priority: *pre-* and *post-*. Rarely employed (e.g., "*prefamily*" as used by Griffiths 1972: 78), such prefixes do not appear appropriate, as it is not quite clear which direction should be considered "anterior" and "posterior" in a taxonomic hierarchy. The rarely used prefixes *inter-* (Latin *inter*, "between"), *mid-* (English term that could be latinized in *medius*) and *semi-* (Latin *semi*, "half") , could also be referred either to this group of prefixes, or to that of prefixes indicating hierarchy, but at any rate they do not appear adequate, as the "intermediate" or "mean" rank of a double ascending-descending hierarchy is neither ascending nor descending, but is the key rank from which both hierarchies start.

Taking into account the remarks of Dupuis (1988: 64), it seems better to use only prefixes indicating hierarchy to designate successive subsidiary ranks. These prefixes are examined successively below. It results from this survey that, among the prefixes already used in the literature and retained here, only three are available in the ascending hierarchy, and two in the descending hierarchy. The five ranks thus available will be much enough to deal with most zoological taxonomies. In case more are needed, five new terms are introduced below, for the extremities of these hierarchies. These five terms, just like those already used and retained here, point to hierarchy and not to dimension or to anteriority. The standard prefixes here proposed are as follows:

– Ascending subsidiary rank A. The prefix *super-* has had a very large, although not fully universal, use, for this rank, and should be kept. It is part of the term *superfamily*, officially recognized by the *Code* for the first rank above family. However, a special problem is posed by application of this modifier to the key rank *species*. The term *superspecies* that would result from this application would be confusing, as the same term has had a rather wide use in zoological taxonomy to designate an evolutionary taxonomic category (*sensu* Bernardi 1980), i.e. a group of *prospecies* or *semispecies* (for details, see Bernardi 1980). It would not be appropriate to use the same term for a rank having merely a nomenclatural rôle of indexation in a hierarchy but no biological meaning. In this case, it is proposed to leave the term superspecies for the

evolutionary category, and to use the term *supraspecies* for the nomenclatural rank. As rightly pointed out by Griffiths (1972: 78), "the prefix '*supra-*' is merely a variant of '*super-*' and does not seem sufficiently distinctive", although both terms have a distinct etymological origin. The term *supraspecies* was already used by Génermont & Lamotte (1980) for the purely nomenclatural rank above species, irrespective of possible recognition of an evolutionary taxonomic category for the taxa referred to this rank. Although also used in another sense (d'Hondt 1988), the term supraspecies has been very little used in zoological taxonomy, and its use for a nomenclatural rank above species is not liable to cause confusion.

– Ascending subsidiary rank B. The prefix *epi-*, from the Greek *epi-* ("above") but that also appears in many classical Latin terms including a few that are not directly Greek-derived (such as *epiclinium* or *epitogium*), was used by Bour & Dubois (1985, 1986) in the term "*epifamily*". The latter term designated a facultative rank between family and superfamily, that was employed in several recent taxonomies (Gaffney & Meylan 1988; Dubois 1992; Meylan 1996; Shaffer *et al.* 1997; Vences & Glaw 2001). This prefix was thus used for the first rank A of the ascending subsidiary hierarchy, which is not appropriate, as the prefix *super-* (or its equivalent *supra-*) should be conserved for this rank: in the many situations where a single subsidiary rank is needed, it should be designated by a term beginning with *super-*, not by *epi-*. However the prefix *epi-* is short, clearly distinct from *super-* and of clear meaning, so it is here proposed to transfer it to rank B of the ascending subsidiary hierarchy.

– Ascending subsidiary rank C. A few authors used the prefix *hyper-* for either rank B or C. When used together with *epi-*, it was considered to designate a rank above the latter. This term is of Greek origin but was used as a prefix in a number of classical Latin terms. Its use for rank C is supported here.

– Ascending subsidiary ranks D and E. These ranks will probably have to be used very rarely, if ever. For these ranks, no other prefix indicating hierarchy used by previous authors remains available. I propose to use the prefix *ano-* (Greek *ano*, "above") for rank D, and *suprem-* (Latin *supremus*, "the highest", superlative of *superus*, "superior") for rank E.

– Descending subsidiary rank a. The prefix *sub-* has had a very large, although not fully universal, use, for this rank, and should be kept. It is part of the terms *subfamily*, *subtribe* and *subspecies*, officially recognized by the *Code*.

– Descending subsidiary rank b. Likewise, the prefix *infra-* has had a large use for this rank, and should be conserved.

– Descending subsidiary rank c. The only remaining prefix indicating hierarchy that has been used by previous authors, although rarely, is *subter*. This classical Latin term is liable to be confused with *sub-* and its subordination relative to the latter and to *infra-* is unclear, so its use is not supported here. Instead, the prefix *hypo-* (Greek *hupo*, "below") is introduced here for rank c. It occupies a symmetrical position (third rank) to the prefix *hyper-* in the ascending hierarchy, and both are similar in aspect.

– Descending subsidiary ranks d and e. Just like ranks D and E, these ranks will probably have to be used very rarely, if ever. In these cases also, no other prefix already used remains available. I propose to use the prefix *cato-* (Greek *cato*, "below") for rank d, and *infim-* (Latin *infimus*, "the lowest", superlative of *inferus*, "inferior") for rank e.

In conclusion, for the whole animal kingdom, the following hierarchies are proposed for subsidiary ranks: 1) ascending hierarchy: (A) *super-* (or *supra-* in the species-series), (B) *epi-*, (C) *hyper-*, (D) *ano-* and (E) *suprem-*; 2) descending hierarchy: (a) *sub-*, (b) *infra-*, (c) *hypo-*, (d) *cato-* and (e) *infim-*.

All the ranks discussed above are facultative, but, whenever either the ascending or the descending hierarchy is used, it is here proposed that it should always be used in the hierarchical order, i.e. (A), then (B), then (C), etc., or (a), then (b), etc.: it would thus be impossible to recognize directly a taxon of rank infraordo if no subordo exists in the same ordo, or a taxon of rank supremclassis if no anoclassis, hyperclassis, epiclassis and superclassis are recognized.

For reasons explained by Chester Bradley (1958), compound terms designating the subsidiary ranks

should be written without hyphens or capitals: "superorder", not "super-order" or "Super-Order".

Any subsidiary rank can be designated either by its name or by a code referring to its key number followed by a letter indicating its subsidiary rank: thus, CP06C for hyperclassis, CS09b for infraphalanx or FP12a for subtribus.

The new standards here proposed lead to a few modifications in the designations of the subsidiary ranks as proposed by Bour & Dubois (1985, 1986). These modified terms are given in Table 3 above, where a few changes have also been brought to the endings of some ranks, in order to have only endings finishing with one or two vowels. However, on the whole, the mnemonic system of Bour & Dubois has been conserved.

As we have seen, some class-series nomina currently in use in zoology, or currently unused but available according to the Rules here proposed, were based on the stems of available generic taxa, just like family-series nomina. In order to avoid possible confusion with family-series nomina, including the risk of homonymy between nomina of both nominal-series (see Melville 1958b), it is here proposed that class-series nomina should not end with any of the endings used for family-series nomina in Table 3, i.e. should not be composed of a combination of a connector being either -AID, -OID, -ID, -IN, -IT, -IL or -IS, *and* of an ending proper being either -AI, -IA, -EA, -AE, -EI, -I, -A, -OI or -OA. Many other possible endings remain, such as -ACEA, -ACEAE, -ADEA, -ADEAE, -ADES, etc., among which, according to usage, one must be fixed as the eunym for each such class-series nomen (see below).

All the proposals above concerning ranks are summarized in Rules (R20) and (R22) below.

The standardisation proposed here is just meant to homogenize the designation of ranks over the whole animal kingdom, rather than having fully different hierarchies in different groups or papers. However, there is no need of a robustness in the *ranks of taxa* such as there is for the *nomina of taxa*. Many new cladistic analyses result in the addition or suppression of nodes in the cladograms, and by way of consequence of ranks in the hierarchy of ranks, at least for all taxonomists who think that each node is to be denoted by a distinct rank, but in many cases this does not result in major changes in the contents and definitions of most taxa. Changes in the ranks of taxa resulting from such changes in cladistic hypotheses are trivial, as these ranks do not carry any biological information on taxa, but only a practical information on the hierarchical relationships between these taxa. The only, and relatively minor, constraint in this respect is that *very well known taxa*, whose nomina are sozonyms, i.e. nomina used in many textbooks or as titles of volumes of series like the *Zoological Record*, should, as far as possible, be ascribed *primary key ranks* as defined above, such as phylum, classis or ordo. This is exemplified in the ergotaxonomy used in the present work, and presented in Table 2, where the rank classis was fixed on well known taxa like AMPHIBIA, and the rank ordo on well known taxa like ANURA. The minor ranks of the other immediately subordinate and superordinate taxa are given automatically by the hierarchical structure of the taxonomy, but they have little importance as these taxa are seldom mentioned outside the proper field of cladistics and taxonomy.

A final point must be made here. This question is only briefly tackled here, as it deserves a full development by itself but falls outside the major topic of the present work. For clarity of use, it is necessary that no additional ranks bearing unrelated names be interpolated between subsidiary ranks and their key ranks. This has no bearing on nomenclatural schemes as usually employed in higher taxonomy, but it has some on the taxonomy of lower ranks, at least in some zoological groups, where some unusual category designations are used by some authors. Some of these categories, such as *exerge* or *grex* used at levels intermediate between species and subspecies (Bernardi 1980), are not concerned by this point, as they are clearly evolutionary taxonomic *categories* without nomenclatural hierarchical status. But in some other cases, special designations are clearly used for mere hierarchical nomenclatural *ranks* without special biological meaning. Some of these systems are furthermore unacceptable for a second reason, whenever nominative plural nomina are used for taxa: such nomina are highly liable to cause confusion as they are similar to nomina of the family-series. This is the case of the "groups",

"sections" and "subsections" recognized within genera by some botanists (e.g., Ahrendt 1961), or of "collective names" sometimes given to taxa of ranks between genus and subgenus or at other levels in zoology, especially in entomology (e.g., Deuve 1994, 2004). For sake of homogeneity with the nomenclatural system of ranks here proposed, such systems should be abandoned, and these nomina in the nominative plural should be replaced by nomina of the nominal-series concerned, following the Rule of Coordination. Thus, if a genus has to be divided in taxa of different successive ranks above the species rank, these taxa should either be referred to the ranks subgenus, infragenus, hypogenus, catogenus or infimgenus, or to the rank casta or one of its coordinate subsidiary ranks. The same line of reasoning should be followed for taxa below the rank species and above the rank variety, or below the rank variety.

SPELLING

A particularity of class-series nomina is that, at least in the older works (18th and early 19th centuries), a rather high proportion of these nomina were first proposed in a "vernacular" form, i.e. a term in some recent language (French, German, English, etc.), not a Latin or latinized term. This was a common practice then, and all zoologists did agree that nomina first published in this form were nevertheless available in zoological nomenclature. It seems therefore most appropriate to apply to class-series nomina a rule similar to that of Article 11.7.2 of the *Code* for family-series nomina, but I propose that in this case the deadline, because class-series nomina were not previously regulated by the *Code*, be fixed at 31 December 2006: after that date, to be available a class-series nomen should be Latin or latinized, as stated in Rule (R3).

In zoological nomenclature, a common situation is that of a nomen having been used under different spellings, either in the original publication (where the nomen was created, i.e. first published) or in subsequent publications. These different spellings do not have separate status in nomenclature, but are different *morphonyms* of the same nomen (see Dubois 2000: 42, 92). Identification of the original spelling or *protonym* of a nomen is easy only when a single spelling was used in the original publication where this nomen first appeared. However, especially in the class-series, cases are rather numerous where a nomen was first proposed under several spellings. This includes several different situations. In some cases, the original author used several spellings for the new nomen: e.g., **Reptiles*** and **Reptilia*** in Linnaeus (1758). This may be due to inadvertence on the part of the author, editor or printer, or to some other reason. This situation is similar to that found in other nominal-series when a new nomen appears under several distinct spellings, which are to be considered as *multiple original spellings*: then the original spelling is fixed by the first-reviser action of the original author or of any other subsequent author (Articles 24.2.3-4 of the *Code*). Another common situation in the class-series is that of a nomen which appeared in the original publication both as a Latin or latinized term, and as a "vernacular" non-Latin term: these different writings must be considered as different morphonyms of the same nomen. As in nomenclature nowadays only Latin terms are acceptable, it is logical to consider that in such cases the protonym is the Latin term, and the "vernacular" term its aponym, and this automatically and in all cases, without having to consider any subsequent first-reviser action. These criteria are summarized in rule (R21) below.

To designate a given taxon, only one morphonym, the *eunym*, is the *valid* and *correct* one (Dubois 2000: 54, 90, 97). In the species-, genus- and family-series of nomina, the eunym is usually the protonym (Dubois 2000: 51, 94, 96), except when this spelling is incorrect under the rules of the *Code* and must be replaced by a "mandatory spelling" or a "justified emendation". Introduction of such a rule in the nomenclature of class-series taxa, which until now was not regulated by any rule, would not be an appropriate change, as it would entail many changes in the spellings of widely and long-used nomina: many such nomina are traditionally used under a spelling that appeared subsequently to the original publication of the nomen, i.e. an *aponym* of the latter (Dubois 2000: 52, 89, 96). Such *universally* used spellings should be protected, but in

case of several spellings having been regularly used, priority should become the criterion of choice between them.

Finally, a particular case is that of class-series nomina that are based on the stems of available generic nomina. As explained above, in order to avoid possible confusion with family-series nomina, in the class-series the endings of such nomina should not be composed of a combination of a first part (connector) being either -AID, -OID, -ID, -IN, -IT, -IL or -IS, *and* of a second part (ending proper) being either -AI, -IA, -EA, -AE, -EI, -I, -A, -OI or -OA. Many other possible endings remain, *among which*, according to usage and priority, one must be fixed as the eunym for each such class-series nomen.

All these proposals are summarized in rule (R22) below.

TRANSITION FROM INFORMAL "HIGHER NOMENCLATURE" TO FORMAL CLASS-SERIES NOMENCLATURE

The present set of Rules is the first complete system ever proposed, within the frame of the current zoological *Code*, to establish objectively, i.e. through formal Rules instead of following one's personal "impressions", "tastes" or opinions, the valid nomen (kyronym) of any zoological taxon above the superfamily. According to these Rules, there are only two possibilities for *kyronym validation*: sozonym validation or agathonym validation. Although strictly regulated by the present Rules, sozonym and agathonym validations are *nomenclatural acts*, that must be announced as such in a publication, and that become effective only as a result of this publication. Before this publication, the higher nomenclature of any zoological group cannot be stated to be "stabilized" or "consensual". These two kinds of nomenclatural acts are important as they realize a transition from a "higher nomenclature" dominated by a vague "consensus among authors" to a formal *class-series nomenclature* regulated by precise, stringent Rules. To be acceptable however, such kyronym validations must be done strictly under the Rules proposed (or of subsequent, modified Rules that may develop from them), and in particular they must rely on a *complete survey* of all class-series nomina available in the zoological group under study, of the allocation of these nomina to nominal series and to ergotaxa, and of their status regarding usage, priority, didymonymy and homonymy. They must be accompanied by a complete presentation of all these data and particularly of *lists of references* establishing that any given nomen was indeed a symphonym, a paneurydiaphonym, a schizeurydiaphonym or a stenodiaphonym *at the time of publication of the kyronym validation* (i.e. not later, of course; see Note 6). Any kyronym validation published without this information is *void*, and subsequent authors must replace it by another kyronym validation. In particular, statement that a nomen is a sozonym without providing a list of references following the criteria of Rule (R12) makes the sozonym validation void. Similarly, whenever a kyronym is validated, a list of invalid synonyms of this nomen should be provided: this list should be as complete as possible, and above all it should not ignore nomina which, if considered, would modify the nomenclatural proposals made. It is of course virtually impossible to be sure that all aphonyms, eneonyms and junior homonyms (based on allotaxa) have been surveyed, but usually this has no nomenclatural consequences. However, ignorance of some diaphonyms may induce wrong nomenclatural conclusions. Therefore, demonstration by a subsequent author that a kyronym validation was published that ignored some important information (such as the existence of senior homonyms, of some diaphonyms or of references to the use of some nomina) or Rules (such as the order of precedence between nomina as given in Rule R16), which resulted in incorrect nomenclatural conclusions according to the present Rules, results in the simple *annulment* of that kyronym validation, which has to be replaced by a new one. This is stressed in Rule (R23) below.

It is important to realize that the fact that the transition to formal class-series nomenclature has been effected does not result in *freezing* the taxonomy and nomenclature of the taxonomic group concerned. Taxonomic changes remain permanently possible, and should be followed by the appropri-

ate changes in nomenclature following the Rules presented here. These changes may result in validating hypnonyms, and conversely in invalidating agathonyms or even sozonyms as junior synonyms. However, sozonym invalidation is only possible through synonymization with another sozonym: a sozonym should never be invalidated to protect an agathonym. Another possible change is for a nomen that was previously an agathonym to obtain the status of sozonym, according to the criteria of Rule (R13): to become effective, such a change in status must be expressly published with the needed bibliographical information.

CONCLUSION: RULES AND WORKING METHODOLOGY

The proposed set of 24 Rules for the nomenclature of class-series taxa, that take all the considerations above into account and summarize the preceding discussion, is given below and repeated in Rule (R24).

Practically, whenever starting work on the class-series nomenclature of a zoological group, the following steps must be taken: (S1) to choose an ergotaxonomy for this group; (S2) to establish a (hopefully) complete list of class-series nomina potentially applying to the ergotaxa of this taxonomy; (S3) to check whether each of these nomina is a hoplonym or an anoplonym, and whether it is or not a neonym, an archaeonym, a didymonym, an allelonym, or a junior homonym; (S4) to examine carefully the first publication where each of these nomina was first created and to establish the complete lists of its conucleogenera and alienogenera; (S5) for each nomen, to establish its allocation (as a choronym or as a nesonym) to an ergotaxon in the frame of the chosen ergotaxonomy; (S6) to find out which of these nomina qualify as sozonyms, to provide a list of references documenting this statement, and to validate these nomina following the Rule of Sozonym Validation; (S7) for each of the remaining ergotaxa, to establish a list of available distagmonyms; (S8) for each distagmonym, to establish whether it is a schizeurydiaphonym, a stenodiaphonym an aphonym or an eneonym; (S9) to establish the kyronym of the ergotaxon following the Rule of Agathonym Validation; (S10) to publish the results of this survey in order to make the kyronym validations effective. Once this is done, the transition from informal "higher nomenclature" to formal class-series nomenclature is realized for the zoological group concerned, and subsequent authors just have to follow the normal provisions of the Rules to update the nomenclature every time changes are brought to the taxonomy of the group.

This theoretical process is illustrated for the higher nomenclature of recent amphibians in Dubois (2004b, in prep.).

Formal definitions of all the technical onymological terms used above, whether new, proposed in Dubois (2000, 2005a, b) or already used by previous authors, are provided below in Appendix.

RULES PROPOSED FOR THE NOMENCLATURE OF CLASS-SERIES TAXA

For the definitions of the unusual or new technical terms used in the Rules below, see Appendix.

(R1) **Definition of class-series nomina in zoology**. Class-series nomina are scientific nomina of zoological taxa referred to higher taxonomic ranks, i.e. above the superfamily and all other family-series nomina regulated by the *Code* (Anonymous 1999).

(R2) **Availability of class-series nomina proposed from 1758 to 2006**. Before 2007, to be available in zoological nomenclature (hoplonym), a class-series nomen must have been published after 31 December 1757 and before 1st January 2007, as a uninomen, and for a taxon (not an informal group) characterized by its intension and/or (complete or partial) inclusive extension (at least one included taxon). If originally published in a language other than Latin, it should have been latinized before 1st January 2007.

(R3) **Availability of class-series nomina proposed after 2006**. After 31 December 2006, to be available in zoological nomenclature (hoplonym), a new class-series nomen should be a Latin or latinized uninomen accompanied by a definition based on

characters (description, diagnosis or apognosis) of the taxon, and by a clear designation in full words of a nucleogenus or of a set of conucleogenera. It should have been proposed for a taxon (not an informal group) within the frame of "traditional" or "Linnaean" nomenclature, in agreement with the *Code*, and not of a system expressly proposed as alternative to it.

(R4) **Allocation of nomina to the family-series or to the class-series**. Whenever a single new suprageneric nomen of a given taxonomic rank was established in a publication, this nomen must be referred to the family-series if both following conditions are fulfilled: A) it was proposed for a taxon of a rank usual within the family-series or of an unusual rank but clearly presented as being hierarchically subordinate to a usual rank of that series although above the genus; and B) it was coined by addition of a simple suffix denoting the plural to the stem of an available genus-series nomen. In all other cases, the nomen must be referred to the class-series. Whenever several new suprageneric nomina of the same rank were established in a publication, they must all be referred to the same nominal-series; if they were treated heterogeneously with regard to the criteria above, they must follow the Rule of Taxonomic Consistency (R5).

(R5) **Rule of Taxonomic Consistency**. All suprageneric nomina created in the same publication for taxa that were afforded the same taxonomic rank must be referred to the same nominal-series. In case of conflict between their allocation to nominal-series according to Rule (R4), the family-series takes precedence over the class-series, and nomina that, being incorrectly formed (arhizonyms or caconyms), cannot be considered as belonging to that series, must be treated as nomenclaturally unavailable (anoplonyms).

(R6) **Originally or subsequently included and excluded taxomina**. Whenever established, a new class-series taxomen (classomen) is characterized by its originally included and excluded taxomina: generomina, speciomina, familiomina and/or classomina. These originally included and excluded taxomina of the new taxomen form a closed list which contains the nucleogenus or conucleogenera of the new taxomen (Rule R7) and its alienogenus or alienogenera (Rule R10). All *available nomina* (hoplonyms) listed in the original publication as *valid* and *unambiguously included* in the new taxomen, and only them, are to be considered as originally included; similarly, only those clearly listed as excluded from the new taxomen are to be considered as originally excluded. *Unavailable* nomina (anoplonyms), as well as nomina listed as *invalid synonyms* in the original publication, or nomina listed as *incertae sedis* or *nomina dubia*, are not to be considered as originally included or excluded. If no included or excluded taxomina were listed at the creation of the new classomen, the first subsequent publication of a list of included or excluded taxomina fixes the subsequently included or excluded taxomina of the latter. Four different situations can be distinguished: A) if the original or subsequent publication mentioned one or several available generic nomina as valid (situation of generic monophory or symphory), this is or these are the originally or subsequently included or excluded genus/genera; B) if the original or subsequent publication mentioned only family-series nomina (situation of familial monophory or symphory), their nucleogenera are the originally or subsequently included or excluded genera of the new higher taxomen; C) if the original or subsequent publication mentioned only class-series nomina (situation of class-series monophory or symphory), their nucleogenera are the originally or subsequently included or excluded genera of the new higher taxomen; and D) if the original or subsequent publication mentioned only specific nomina (situation of specific monophory or symphory), the genera to which these species were allocated *in the original publication where the class-series nomen was created* (or in the first subsequent publication where included or excluded taxomina were listed) are to be considered the originally or subsequently included or excluded genera.

(R7) **Onomatophores**. The onomatophore of a class-series taxomen (classomen) is either one (*nucleogenus*) or several (*conucleogenera*) available genus-series taxomen/ina (generomen/ina). The fixation of the nucleogenus or conucleogenera of a classomen is determined by the following hierarchy of criteria: A) original designation, with six hierarchically ordinated cases: A1) clear designation in full words of a nucleogenus or of a set of conucleogenera; A2)

implicit designation of a nucleogenus or of a set of conucleogenera by generic monophory or symphory; A3) implicit designation by familial monophory or symphory: then the nucleogenus/genera of this/these family-series-taxomen/ina is/are also the nucleogenus/era of the higher taxomen by implication; A4) implicit designation by class-series monophory or symphory: then the nucleogenus/genera of this/these class-series taxomen/ina is/are also the nucleogenus/era of the higher taxomen by implication; A5) implicit designation by specific monophory or symphory: then the generic substantive(s) with which the epithet(s) of this/these bi/trinomen/ina was combined *in the original publication where the class-series nomen was created* (or in the first subsequent publication where included taxomina were listed) designate(s) the nucleogenus/enera of the latter taxomen by implication; A6) implicit etymological designation (when the class-series nomen was based on the stem of an available genus-series nomen, even if this nomen was not mentioned in the publication where the new class-series nomen was created); B) subsequent designation, with the same hierarchy of cases as in A except the last. As usual in zoological nomenclature, the nomenclatural status of (co)nucleogenera is fixed by their *onomatophores*, i.e. by their nucleospecies *and not* by their original intension or extension.

(R8) **Rule of Preoccupation**. Once created, any class-series nomen is deemed to preoccupy all possible spellings derived from the same root, and applying to taxa of any rank within the class-series *including the onomatophore of the original taxomen*, except in case of creation of a junior homonym. In other words, any subsequent "creation" of a nomen based on a given root will be deemed to be: either A) an aponym of the first created higher-series nomen, thus having the same onomatophore, nomenclatural author and date as the latter, albeit with a different first-user; or B) a distinct nomen (allonym) being a junior invalid homonym of the senior one (Rule R9).

(R9) **Rule of Homonymy.** To be considered an allonym and a junior homonym of another class-series nomen, a nomen must meet at least one of the following criteria: either A) clear information was provided in the original publication, in full words or indirectly but clearly, to show that this nomen was considered a new nomen by its author; or B) the nomen was used for a taxon xenoprotaxic, endoprotaxic or gephyroprotaxic to the taxon for which the original nomen was coined, i.e. for an allotaxon relative to the latter. Whenever two or more distinct homonymous class-series nomina have been proposed in zoology, only the senior one may be valid (if not invalidated for other reasons), and all other junior ones must be definitively rejected as permanently invalid. ***The only possible exception to this Rule in class-series nomenclature is the rejection as invalid of a senior homonym in order to validate a junior homonym being a symphonym or a paneurydiaphonym according to Rule (R13).***

(R10) **Xenoprotaxa**. The xenoprotaxa of a class-series taxomen (classomen) are the taxa expressly excluded from the protaxon for which the taxomen was originally proposed. They can be expressed as a set of available genus-series taxomen/ina (generomen/ina), the *alienogenera*. The fixation of the alienogenera of a classomen is determined by the following hierarchy of criteria: A) original designation, with four hierarchically ordinated cases: A1) clear designation of a set of alienogenera listed as members of the xenoprotaxa of the classomen; A2) implicit designation when only familiomina are listed as members of the xenoprotaxa of the classomen: then the nucleogenera of these family-series taxomina are also the alienogenera of the classomen by implication; A3) implicit designation when only classomina are listed as members of the xenoprotaxa of the classomen: then the nucleogenera of these class-series taxa are also the alienogenera of the higher taxomen by implication; A4) implicit designation when only speciomina are listed as members of the xenoprotaxa of the classomen: then the generic substantives with which the epithets of these bi/trinomina was combined *in the original publication where the class-series nomen was created* designate the alienogenera of the latter taxomen by implication; B) subsequent designation, with the same hierarchy of cases as in A. As usual in zoological nomenclature, the nomenclatural status of alienogenera is fixed by their *onomatophores*, i.e. by their nucleospecies *and not* by their original intension or extension.

(R11) **Allocation of a nomen to a taxon**. Allocation of a class-series nomen to a taxon currently recognized as valid (ergotaxon) is made according to the following hierarchy of criteria: A) to be potentially applicable to an ergotaxon, a nomen must have been created for a protaxon isotaxic or endotaxic to the latter; B) whenever *all* alienogenera of a protaxon are extragenera, the nomen of this protaxon qualifies as a *choronym* and applies to the most inclusive ergotaxon including all its conucleogenera and excluding all its extragenera; and C) whenever *at least one* of the alienogenera of a protaxon is an intragenus, the nomen of this protaxon qualifies as a *nesonym* and applies to the least inclusive ergotaxon including all its conucleogenera (i.e. in a hierarchy of current subordinate taxa, when available a nesonym endotaxic to several ergotaxa must be allocated to the taxon of lowest hierarchical level among them). A choronym has an onomatostasis, whereas a nesonym does not. The onomatostasis of a choronym is its getextragenus or getextragenera.

(R12) **Categories of nomina regarding usage**. Whenever working on the class-series nomenclature of a given zoological group, all nomina must be referred to one of the following categories: A) *symphonym*: nomen used as *valid* for the taxon it denotes or for synotaxic taxa by *all* authors and in *all* publications after 31 December 1899; B) *aphonym*: nomen considered as *available* (in some cases as an available senior homonym making a junior homonym invalid) but *invalid* (for being a junior synonym or homonym a of valid nomen) by *at least one* author and in *at least one* publication after 31 December 1899; C) *eneonym*: nomen never mentioned as *available* by *any* author and in *any* publication after 31 December 1899; D) *diaphonym*: nomen used as *valid* by *at least one* author and in *at least one* publication after 31 December 1899. The last category of nomina includes two major subcategories: D1) *eurydiaphonym*: nomen that has been *significantly* used as valid for a given taxon or for synotaxic taxa in *non-systematic* literature after 31 December 1899; D2) *stenodiaphonym*: nomen that has *not* been *significantly* used as valid in non-systematic literature after 31 December 1899. The subcategory of eurydiaphonym consists of two further infracategories: D1a) *paneurydiaphonym*: eurydiaphonym that is *the only one* to have been used as valid for a given taxon or for synotaxic taxa in *non-systematic* literature after 31 December 1899; D1b) *schizeurydiaphonym*: eurydiaphonym that has been used as valid for a given taxon or for synotaxic taxa in *non-systematic* literature after 31 December 1899, but *alternatively* to another eurydiaphonym for the same taxon or for synotaxic taxa. Symphonyms and paneurydiaphonyms are two subcategories of *sozonyms*, whereas schizeurydiaphonyms, stenodiaphonyms and aphonyms are three subcategories of *distagmonyms*. For the purpose of this Rule, the term *significantly* is to be understood as follows: to be considered an eurydiaphonym, a nomen should have been used for a taxon, either in its Latin form or as a vernacular nomen in any recent language either A) in the *titles* of at least *twenty-five* non-purely systematic *books*, written by at least *twenty-five independent-authors* and published in at least *ten different countries* after 31 December 1899, or B) in the *titles* of at least *one hundred* non-purely systematic *publications* (books, book chapters or periodical articles) written by *one hundred independent-authors* and published in at least *ten different countries* after 31 December 1899. In what precedes: a) *purely systematic publications* are publications dealing only or mostly with taxonomy, phylogeny and/or faunistics; b) *non-purely systematic publications* are publications a significant portion of which (i.e. at least half of their total volume) deals with non-systematic matters, such as various fields of biology, medicine, agronomy, etc., or even is addressed to non-scientific users, such as members of administrations, governments, customs, conservation organizations, etc.; c) *independent-authors* are defined as *authors who never published together* (as co-authors) on the zoological group concerned before the case is considered.

(R13) **Rule of Sozonym Validation**. In class-series nomenclature, whenever a given nomen has been used after 31 December 1899 as a sozonym (symphonym or paneurydiaphonym) for a given class-series taxon or a partially distinct but synotaxic taxon, this nomen must be conserved through *sozonym validation* as the kyronym of the taxon, whatever its original date and kind of synoprotaxy

to this current taxon, i.e. A) even if its current use is quite far from its original meaning, B) even if it was not the first one to have been proposed for this taxon, and C) even if it is a junior homonym of another nomen (which is therefore invalidated). If the current meaning of the nomen is different from the original one, the original protaxon being angioprotaxic, gephyroprotaxic or xenoprotaxic to the current ergotaxon, the sozonym validation results in validating a junior homonym of the original nomen, with its own onomatophore, author and date, and in rejecting the senior homonym as an exoplonym. Such a rejection of a senior homonym is definitive, whatever the subsequent changes in the ergotaxonomies. ***This rejection of a senior homonym in order to validate a symphonym or paneurydiaphonym is the only case in which a senior homonym can be rejected as invalid in class-series nomenclature (see R9)***.

(R14) **Rule of Nomenclatural Consistency**. Whenever two or more neonyms were proposed for two or more *didymonyms* (nomina created together during the process of splitting an existing taxon), *either* the didymarchaeonyms *or* the didymoneonyms can be validated together, but it is impossible to validate together some didymarchaeonyms and some didymoneonyms proposed for the same taxa. The latter nomina are *phobonyms*, i.e. nomina that cannot be validated together. This Rule also applies to sets of didymonyms that are strict isonyms (i.e. that have exactly the same onomatophores), even if the most recent ones were not proposed as neonyms for the oldest ones.

(R15) **Menonym and auxonym of sozonym.** Whenever a class-series sozonym was created for a protaxon isotaxic to a current ergotaxon at higher class-series taxonomic levels, its nomen (*menonym*) is written followed only by its original author's name and its date. In contrast, as soon as the protaxon of this sozonym was merisotaxic to the current ergotaxon at higher hierarchical levels, its nomen (*auxonym*), as used in any given ergotaxonomy, should be given followed first by the author and date of the sozonym, and then, between square brackets, by the first-user's name and date of this nomen with this extension (i.e. for an auxapotaxon of the original protaxon).

(R16) **Rule of Agathonym Validation**. In a given higher taxonomy, among competing distagmonyms (schizeurydiaphonyms, stenodiaphonyms, aphonyms and/or eneonyms) available for a class-series ergotaxon, only one qualifies as the valid one (kyronym): the *agathonym*, i.e. valid distagmonym. *Agathonym validation* must respect the following criteria, in the following order: A) if several nomina are available for the ergotaxon, schizeurydiaphonyms have precedence over stenodiaphonyms, the latter over aphonyms and the latter over eneonyms; and B) among schizeurydiaphonyms, then among stenodiaphonyms if no schizeurydiaphonyms are available, then among aphonyms, then finally among eneonyms, the Rule of Priority, based on the publication dates of nomina, applies (i.e. the first published one must be retained for the taxon), and if necessary choice between competing nomina bearing the same date must be made by first-reviser action (an irreversible nomenclatural act). In the case of didymonyms, care should be taken to apply the Rule of Nomenclatural Consistency (R14): junior phobonyms should be rejected as exoplonyms. For the application of these Rules whenever a neonym was proposed to replace an existing nomen, see the Rule of Neonym or Archaeonym Validation (R17).

(R17) **Rule of Neonym or Archaeonym Validation**. Whenever a neonym was proposed for a class-series nomen, both the archaeonym and the neonym are based on the same onomatophore and are definitive synonyms: fixation, through a sozonym or agathonym validation, of one of these two nomina as the valid nomen (kyronym) of a taxon rejects the other nomen as definitively invalid (exoplonym), whatever the subsequent changes in the taxonomy of the group considered, and even if the other nomen is also subsequently made invalid for some other reason. For the application of this Rule to didymonyms, see the Rule of Nomenclatural Consistency (R14).

(R18) **Rule of Coordination**. Whenever a class-series taxon contains a single class-series ametoendotaxon (taxon of the immediately subordinate rank), both these coordinate taxa of different ranks, having exactly the same content and definition, must bear the same nomen, with the same onomatophore, author and date, following Rules (R13) to (R17).

If the former higher taxon is subsequently divided in two or more ametoendotaxa, the Rule of Coordination no longer applies and taxa of different ranks must bear different nomina, following Rules (R13) to (R17).

(R19) **Kinds of invalid nomina and restoration of class-series nomina**. Following a sozonym or agathonym validation as regulated in Rules (R13) and (R16), invalid class-series nomina (akyronyms) are of three kinds: A) anoplonyms, i.e. unavailable nomina, that must remain so; B) hypnonyms, i.e. conditional akyronyms, that can be restored if the evolution of taxonomy requires it; and C) exoplonyms, i.e. definitive akyronyms, that cannot be restored. Class-series *exoplonyms* are: a) either junior homonyms of *available* (i.e. either valid or invalid) class-series nomina; b) or rejected nomina in the case of neonyms (R17) or because of the Rule of Nomenclatural Consistency (R14); c) or nomina that are isonyms of valid nomina (having the same onomatophore). All other akyronyms are *hypnonyms* (conditional synonyms), i.e. nomina that are doxisonyms of valid nomina. Hypnonyms may be reinstated as valid nomina (kyronyms) whenever new taxa are established that are isotaxic or angiotaxic to them. In this case, the same hierarchy of criteria as in Rule (R16) must be used to establish the nomen that should be restored for that purpose. Only when no isoprotaxic or endoprotaxic hypnonym is available should a new nomen be coined for a newly recognized taxon. Subsequently, in case of further changes in the taxonomy, the Rule of Priority must be strictly applied to establish the valid nomen (kyronym) among competing synonyms.

(R20) **Ranks**. The ranks of class-series taxa should be designated by Latin or latinized terms. They include key ranks and subsidiary ranks. Key ranks include primary key ranks (CP) (such as **classis**) and secondary key ranks (CS) (such as *legio*). Subsidiary ranks (such as superclassis or subclassis) (ascending ranks A-E, descending ranks a-e) are indicated by prefixes and are immediately connected (i.e. either superordinate or subordinate) to the key ranks. Key ranks include those of the following hierarchy, in descending order: (CS01) *imperium*; (CP02) **regnum**; (CS03) *provincia*; (CP04) **phylum**; (CS05) *circulus*; (CP06) **classis**; (CS07) *legio*; (CP08) **ordo**; (CS09) *phalanx*. All organisms should be referred to the four primary key ranks, but all other ranks are optional. Additional ranks can be used if necessary. For each of the key ranks, subsidiary ranks can be recognized, according to two distinct hierarchies, an ascending one and a descending one. The ascending hierarchy is: (A) *super-*; (B) *epi-*; (C) *hyper-*; (D) *ano-*; (E) *suprem-*. The descending hierarchy is: (a) *sub-*; (b) *infra-*; (c) *hypo-*; (d) *cato-*; (e) *infim-*. All these ranks are optional, but, whenever either the ascending or the descending hierarchy is used, it should always be in hierarchical order, without ignoring intermediate secondary ranks: i.e. (A), then (B), then (C), etc., or (a), then (b), then (c), etc.

(R21) **Protonym of a class-series nomen**. The protonym of a class-series nomen is the original spelling used in the original publication where this nomen was created. In case of multiple original spellings, the protonym is the spelling fixed by the first-reviser action, either of the original author or of a subsequent author (see Art. 24 of the *Code*); the other original spelling(s) are to be treated as aponyms. In case these multiple spellings include Latin and non-Latin spellings, the Latin spelling must be considered the protonym.

(R22) **Eunym of a class-series nomen**. The valid spelling (eunym) of a class-series nomen is the spelling used *universally* by all taxonomists after 31 December 1899. If several spellings have been used by taxonomists after that date, the following order of precedence must be used for fixation as the eunym: first, the protonym, if it was one of the spellings used after that date; then, the senior aponym, if used after that date; then, if several aponyms were created together and used after that date, that chosen by the first-reviser. In the particular case of class-series nomina that are based on the stem of an available generic nomen, in order to avoid possible confusion with family-series nomina, the endings of such nomina should not be composed of a combination of a first part (connector) being either -AID, -OID, -ID, -IN, -IT, -IL or -IS, *and* of a second part (ending proper) being either -AI, -IA, -EA, -AE, -EI, -I, -A, -OI or -OA. Many other possible endings remain, *among which*, according either to general usage or to priority (in case of absence of

general usage), one must be fixed as the eunym for each such class-series nomen.

(R23) **Transition from informal "higher nomenclature" to formal class-series nomenclature**. According to the present Rules, there are only two possibilities for *kyronym validation*: sozonym validation or agathonym validation. Although strictly regulated by the present Rules, these kyronym validations are *nomenclatural acts*, that must be announced as such in a publication, and that become *effective* only as a result of this publication. These two kinds of nomenclatural acts realize a transition from a higher nomenclature dominated by a vague "consensus among authors" to a formal class-series nomenclature regulated by precise, stringent Rules. To be acceptable however, such kyronym validations must be done strictly under the present Rules, and in particular they must rely on a *virtually complete survey* of all class-series nomina available in the zoological group under study, of the allocation of these nomina to nominal series and to ergotaxa, and of their status regarding usage, priority, didymonymy and homonymy. They must be accompanied by a complete presentation of all these data and particularly of *lists of references* establishing that any given nomen was indeed a symphonym, a paneurydiaphonym, a schizeurydiaphonym or a stenodiaphonym *at the time of publication of the kyronym validation*. Any kyronym validation published without this information is *void*, and demonstration by a subsequent author that a kyronym validation was published that ignored some important information (such as the existence of senior homonyms, of some diaphonyms or of several references to the use of some nomina) or Rules (such as the order of precedence between nomina as given in Rule R16), which resulted in incorrect nomenclatural conclusions according to the present Rules, results in the simple *annulment* of that kyronym validation, which has to be replaced by a new one.

(R24) **Working methodology**. Whenever starting work on the class-series nomenclature of a zoological group, the following steps must be taken: (S1) to choose an ergotaxonomy for this group; (S2) to establish a (virtually) complete list of class-series nomina potentially applying to the ergotaxa of this taxonomy; (S3) to check whether each of these nomina is a hoplonym or an anoplonym, and whether it is or not a neonym, an archaeonym, a didymonym, an allelonym, or a junior homonym; (S4) to examine carefully the first publication where each of these nomina was first created and to establish the complete lists of its conucleogenera and alienogenera; (S5) for each nomen, to establish its allocation (as a choronym or as a nesonym) to an ergotaxon in the frame of the chosen ergotaxonomy; (S6) to find out which of these nomina qualify as sozonyms, to provide a list of references documenting this statement, and to validate these nomina following the Rule of Sozonym Validation; (S7) for each of the remaining ergotaxa, to establish a list of available distagmonyms; (S8) for each distagmonym, to establish whether it is a schizeurydiaphonym, a stenodiaphonym, an aphonym or an eneonym; (S9) to establish the kyronym of the ergotaxon following the Rule of Agathonym Validation; (S10) to publish the results of this survey in order to make the kyronym validations effective. Once this is done, the transition from informal "higher nomenclature" to formal class-series nomenclature is realized for the zoological group concerned, and subsequent authors just have to follow the normal provisions of the Rules to update the nomenclature every time changes are brought to the taxonomy of the group.

DISCUSSION AND CONCLUSIONS

Are all these new terms really necessary?

"No one wants to alter the language of common sense, any more than we wish to give up talking of the sun rising and setting. But astronomers find a different language better, and I contend that a different language is better in philosophy. […] I conclude that common sense, whether correct or incorrect in the use of words, does not know in the least what words are. I wish I could believe that this conclusion would render it speechless".
Bertrand Russell 1953: 306-307
"Je me dis, on reproche parfois aux philosophes de créer des mots barbares. Mais, moi, mets-toi à ma place. Pour des raisons données, je tiens à réfléchir à cette notion de territoire, et je me dis que le territoire n'a de sens que par rapport à un mouvement par lequel on en sort. Il faut donc réunir ça. J'ai besoin d'un mot en apparence barbare. Dès lors, avec Félix, on a construit un concept

que j'aime beaucoup qui est celui de déterritorialisation. On nous dit là-dessus, 'c'est un mot dur à dire' et puis 'qu'est-ce que ça veut dire, quel besoin', etc. Là c'est un très beau cas où un concept philosophique ne peut être désigné que par un mot qui n'existe pas encore, même si l'on découvre ensuite que dans d'autres langues il y avait l'équivalent. Par exemple ensuite je me suis aperçu que dans Melville revenait tout le temps le mot 'outlandish', et 'outlandish', […] c'est exactement le déterritorialisé, mot à mot. Alors je me dis que, pour la philosophie […] c'est très frappant : on a parfois besoin d'inventer un mot comme barbare pour rendre compte d'une notion à prétention nouvelle".
Gilles Deleuze 1997

It is likely that the new terms proposed above, as well as in previous papers (Dubois 2000, 2005a, b), will appear unwarranted and/or too numerous to some zoologists, who furthermore may be shocked by their "esoteric" aspect, as these terms were directly coined from Greek or Latin roots and are not immediately "transparent" and understandable. No doubt some of these terms could be spared, if the concepts for which they were coined were designated by compound words or periphrases using only common language terms. It is quite deliberately that this course was not followed here.

Although science deals with observations, data, hypotheses, experiments, calculations, this is not the whole story. An important, if not major, dimension of science lies in its use of language. To be useful in our analysis and understanding of the world, scientific concepts must be precisely defined and consensually used and understood by all scientists. In fact, a striking conclusion of many works of history of science is that many disagreements between scientists, many polemics, took their roots in purely semantic disputes or misunderstandings, the same word being used by different people with different meanings, to designate different concepts (several good examples of this situation are analysed in the book of Mayr 1997). Systematics is a domain that did not escape this problem, as exemplified by the polemics around the sense of the term "monophyletic" (see e.g., Ashlock 1971, 1984; Dubois 1986). Some think that a way to escape the possible confusion on the meaning of scientific terms is to use "common language" terms, that would be "evident" to all readers and could be understood without particular effort. I am exactly of the opposite opinion. I think that scientific concepts need precise definitions and special scientific terms, which will avoid confusion with related or similar concepts or "common sense" ideas. This is particularly true regarding the field of biological nomenclature. As this field appears obscure and difficult to some, members of ICZN have apparently thought that, in order to make zoological nomenclature, not really "appealing", but at least "not too repulsive", it would be better to use simple terms of common language, seemingly understandable to all, rather than special technical terms. This probably explains largely the choice of the (unfortunate, for reasons explained in Dubois 2005b) formula "name-bearing type" instead of onomatophore, and various other similar cases in the *Code*. However, a result of this attitude has been that many zoologists have believed that zoological nomenclature was a scientific domain that could be mastered through simple intuition and common sense, without special information and training, and even without opening the *Code*. Some of the resulting confusions are sometimes quite funny, when for example the formula "junior objective homonym" is inadvertently coined as a result of a lumping between "junior primary homonym" and "junior objective synonym" (see Dubois & Ohler 1997: 307), or when a *nomen novum* (new replacement nomen) is credited to the author and date of the original, replaced nomen (Schleich & Kästle 2002: 283; Dubois 2004a), to take only two examples (for a list of other examples, see Dubois 2003). But more broadly this results in many zoologists, or even professional taxonomists, ignoring some major provisions of the *Code* in their publications. Giving "esoteric" names to some of the concepts and tools of zoological nomenclature may be a way to limit the number of these problems: to use terms like sozonym, apotaxon or taxomen requires inquiry about the definitions of these terms and hence devotion of at least some time to study the theory and terminology of zoological nomenclature. No zoologist questions the need to spend time or energy to learn some basic theory before starting statistical tests, DNA sequencing or cladistic analysis, so the time should come when the need for specific training in nomenclature will be seen similarly compulsory for all taxonomists.

As for the biologists who are not taxonomists and not willing to learn the discipline, they should progressively admit that they should leave this field to specialists, rather than expressing (sometimes peremptory) opinions on matters, like "usage" or "stability", which they do not master: the use of "esoteric" terms for nomenclatural concepts and tools is a clear way of showing to all that zoological nomenclature is a specific discipline that needs a special effort to be mastered.

Giving short, uninominal, names to technical concepts, is a way to shorten, simplify and enhance communication between specialists. If the idea is accepted that zoological nomenclature is a special technical field that needs special training, then the advantage of having short terms to designate its concepts is quite clear. The alternative solution, through the use of detailed plurinominal formulae or periphrases, is much more cumbersome, and ultimately may be less clear. Let's take the example of the Rule (R13) proposed above, which starts with the following sentence:

"In **class-series** nomenclature, whenever a given **nomen** has been used after 31 December 1899 as a **sozonym** (**symphonym** or **paneurydiaphonym**) for a given **class-series** taxon or a partially distinct but **synotaxic** taxon, this **nomen** must be conserved through **sozonym validation** as the **kyronym** of the taxon, whatever its original date and kind of **synoprotaxy** to this current taxon".

In the sentence above, terms printed in bold are technical terms defined in this paper, that could be "translated" into common language (or in the language of the *Code*) using longer formulations. This sentence would then become:

"In the nomenclature of taxa above the family-group, whenever a given scientific name has been used, either in its Latin form or as a vernacular name, as valid for a taxon whose content is totally or partially identical with its own original content, by *all* authors and in *all* publications after 31 December 1899, or is the only one to have been used, as valid for this taxon either A) in the *titles* of at least *twenty-five* non-purely systematic *books*, written by at least *twenty-five* authors who never published together (as co-authors) on the zoological group concerned before the case is considered, and published in at least *ten different countries* after 31 December 1899, or B) in the *titles* of at least *one hundred* non-purely systematic *publications* (books, book chapters or periodical articles) written by *one hundred* authors who never published together (as co-authors) on the zoological group concerned before the case is considered, and published in at least *ten different countries* after 31 December 1899, this name must be conserved as the valid name of the taxon, whatever its original date and the kind of overlap between its original content and the content of the current taxon".

All other Rules proposed above could be similarly "translated" into "common language". Although it would avoid the use of new, strange technical terms, it would not save space and bring more immediate clarity to their reading. One has to admit that zoological nomenclature, being regulated by a set of Rules largely similar to those of juridical texts, requires precise wording and sometimes a special effort to get accustomed to this special language.

Are the proposed Rules compatible with "phylogenetic systematics"?

The proponents and supporters of Queirauthian nomenclature (Dubois 2005b; see Note 7) claim that their system of nomenclature is the only one that allows unambiguous and stable designation of taxa under a conception of taxonomy reflecting the topology of cladograms, i.e. "phylogenetic systematics" (De Queiroz & Gauthier 1990, 1992, 1994), "cladification" (Mayr 1997) or "cladonomy" (Brummitt 1997; Dubois 1997b). This is simply not true. As discussed in Dubois (2005b), the only way to have definitively unambiguous and stable allocation of nomina to taxa would be to tie the nomen to a given *inclusive extension* of the taxon, i.e. to a closed list of included organisms and subordinate taxa, and to require the introduction of a new nomen as soon as this content changes, even slightly: such a system would no doubt introduce absolute unambiguity and complete stability in zoological nomenclature, but at the expense of one of its major rôles, that of being a long-term system of storage and retrieval of information about living organisms. As soon as this idea is abandoned, absolute unambiguousness of nomen allocation must

be abandoned altogether, but this does not mean that relative unambiguousness is impossible. As discussed above, the current nomenclatural system of the *Code*, expanded here to class-series nomina, allows unambiguous allocation of nomina to organisms *within the frame of any given taxonomy*. The situation is exactly similar under a Queirauthian nomenclatural system, except that here the allocation of a nomen to given organisms is unambiguous only *within the frame of given hypothetical cladistic relationships*: whenever the topology of the cladogram changes, the extensions of some taxa may change, even if the "phylogenetic definitions" of taxa do not change. Even the suppression of ranks advocated in this system does not solve this problem if one admits that giving a nomen to each cladogenesis in the tree of life would result in an unpalatable taxonomy with millions of higher taxa which could not be used as a system of storage and retrieval of information: as soon as proposents of Queirauthian nomenclature reckon that "it is not necessary that all clades be named", a proportion of arbitrariness in the relation between hypothesized cladistic relationships and taxonomy is unavoidable and requires a knowledge of the taxonomic frame adopted to know the allocation of nomina to organisms.

Under any taxonomic system and following the nomenclatural rules of the *Code*, the content of a taxon is not given by its nomen, but by the taxonomic arrangement: however, as soon as this arrangement is known, the nomenclatural Rules allow unambiguous allocation of a nomen to this taxon. Similarly, under a system of "phylogenetic systematics" and of Queirauthian nomenclature, the "phylogenetic definitions of nomina" do not allow to know which organisms are to be designated by each nomen: to know this, one has to know which cladistic hypothesis was adopted by the author using this nomen. This is unavoidable but it is not really a problem as soon as one admits that we have not reached "the end of science" and that cladistic hypotheses, as well as taxonomic systems, are provisional working hypotheses that must continuously be modified and improved.

More serious is the question whether the Rules of the *Code* and the new ones presented above are susceptible to being applied to a cladonomy or if, as argued by De Queiroz & Gauthier (1990, 1992, 1994), they can be applied only to "Linnaean", preevolutionary taxonomies. As discussed in Dubois (2005b), this statement is based on a confusion between taxonomy and nomenclature. The *Code* currently in force does not include any rule concerning the criteria used to build a taxonomy and to recognize taxa: it only provides Rules for naming these taxa once their *contents* (in terms of inclusive extension, i.e. of included organisms) are given. As explained in Dubois (2005b), in this three-storey nomenclatural system, allocation of nomina to taxa relies on three specific tools (onomatophores, taxomina and coordinate ranks), and establishment of the valid nomen of a taxon among competing synonyms is usually based on a single criterion, Priority. These Rules can fully apply to any taxonomy based on the topology of a cladogram, and there is no need to replace the current Rules by a completely new rationale, based on "phylogenetic definitions of nomina". Let us examine an example to illustrate this: the case of the status of the nomen **Amphibia**.

The ergotaxonomy used in the present work, and presented in Table 2, follows a rather consensual interpretation of the cladistic relationships among vertebrates, recently developed (with some minor differences) by Tudge (2000) and by Lecointre & Le Guyader (2001), among others. According to this ergotaxonomy, as shown above (and discussed in more detail in Dubois in prep.), the sozonym **Amphibia** De Blainville, 1816 is the valid nomen for a taxon including all recent amphibians and two entirely fossil groups, provisionally designated here (following tradition, e.g., in the recent volumes of the *Zoological Record*) as |**Labyrinthodontia**| and |**Lepospondyli**|. Both these fossil groups include a number of subgroups, not detailed here, but let us just note that the major group of |**Labyrinthodontia**| is usually known as |**Temnospondyli**|. However, if another ergotaxonomy was adopted, the meaning of the nomen **Amphibia** could be somewhat different. Let us consider for example the cladogram of tetrapods recently proposed and discussed by Laurin & Reisz (1997, 1999) and Laurin (1998, 2001, 2002). According to this hy-

pothesis, whereas the recent amphibians and the |LEPOSPONDYLI| are indeed closely related, this is not the case for the |TEMNOSPONDYLI|, which occupy a very basal position in the cladogram, much more basal than the |AMNIOTA|. Within the frame of Queirauthian nomenclature, supported by these authors, this new cladogram resulted in new definitions for several nomina of taxa, discussed in detail in the papers just quoted. What would be the status of the sozonym AMPHIBIA De Blainville, 1816 under such a cladistic hypothesis and within the frame of the new nomenclatural Rules proposed above? As shown above, this nomen applies to the most inclusive group including all the recent amphibians and excluding all the recent reptiles: it would then be the group including the NEOBATRACHI Sarasin & Sarasin, 1890 and several fossil groups usually known as |LEPOSPONDYLI|, but excluding all other tetrapods. Thus, any change in the cladistic hypothesis and consequently in the taxonomy is immediately followed by a change in the content of some taxa, just like in Queirauthian nomenclature, but the nomen remains attached to the taxon including its onomatophore and excluding its onomatostasis. Taxonomists are fully free to use "phylogenetic definitions of taxa" to build their taxonomy, but there is no need to have "phylogenetic definitions of nomina" to have an unambiguous allocation of a nomen to a taxon within the frame of a given taxonomy. As for the statement of De Queiroz & Gauthier (1990) that taxa, being "things" and not concepts, cannot be defined, it must be rejected (Dubois 2005b), as coming from a confusion between reality and our (necessarily imperfect) representation of this reality by the way of science.

In conclusion, the Rules presented above are fully compatible with "phylogenetic systematics" and do not have the drawbacks of Queirauthian nomenclature discussed by Dubois (2005b) and others. As they are not linked to any theory of systematics (except very minimal requirements such as universality, unicity, exhaustiveness and hierarchical structure; see Dubois 2005b), they are indeed acceptable by all taxonomists, whatever their school of thought, and will be acceptable in the future by any taxonomic school that might develop. They maintain the continuity with all the previous traditions of use of nomina in higher nomenclature, but introduce a strict and coherent system for the unambiguous allocation and validation of nomina that may follow the evolution of cladistic studies and taxonomies. Their discussion, modification and later adoption by the community of zoologists would avoid the progressive nomenclatural chaos in higher nomenclature which would follow the continued absence of rules, or the adoption of fully new rules that would break all continuity with the corpus of millions of zoological publications of the last two and a half centuries.

PROPERTIES OF THE PROPOSED NOMENCLATURAL SYSTEM

Eleven properties that seem desirable for any efficient and long-lasting nomenclatural system can be pointed out (Dubois 2005b). The system here proposed meets these requirements, as briefly reviewed below:

(N1) *Independence*: the nomenclatural system proposed does not to infringe upon the independence of taxonomic thought and action. As shown above, it can be used with any kind of taxonomy, including cladonomy or any future taxonomic system that might appear or develop.

(N2) *Exhaustiveness*: the nomenclatural system proposed is able to accomodate all animal organisms ever to be found in the real world.

(N3) *Simplicity*: the system proposed is the simplest possible that provides both a general set of Rules for most nomina, and a special set of Rules for the conservation of nomina that have been widely used outside systematic literature. Although these Rules may appear rather complicated at reading, that have a strong internal logic and coherence, that can be understood by anyone takes the time to study them. Furthermore, as discussed below, automatisation of the procedure proposed for the integration of the nomina of the past into the system will facilitate adoption of the latter. For nomina of the future, the proposed Rules should work easily as no special rules will be needed for exceptions.

(N4) *Unicity*: the Rules proposed apply to all nomina of higher taxa of animals.

(N5) *Universality*: the system proposed has universal value for all zoologists of the world, whatever their country, language, conception of taxonomy, etc.
(N6) *Univocality*: in the proposed nomenclatural system, allocation of a nomen to a taxon is univocal: given a taxonomy, a taxon must receive one single nomen, in all countries worlwide and by all taxonomists, whatever their opinions or tastes.
(N7) *Automaticity*: the Rules that command the allocation of nomina to taxa in the proposed system work in an automatic way, without leaving place to arbitrary or bureaucratic decisions. This allocation is simply determined by the original (or first subsequent, in the rare cases of higher taxa created without included lower taxa) taxonomic content of the taxon for which the nomen was created, and the original (or first subsequent) exclusion of taxa from the higher taxon. It does not take into account the subsequent history of the nomen.
(N8) *Deontology*: the Rules proposed allow to render unto Caesar the things that are Caesar's. Nomina are credited to their original authors (in the precise, technical, nomenclatural sense of the term), not to subsequent users or "emendators". Validity of nomina is fixed by Priority, except in the case of widely used nomina, but then, anyway, authorship is credited to the first user of the nomen in its current sense (i.e. for a taxon including its onomatophore and excluding its onomatostasis), not to the first provider of a "good definition" of the taxon, whatever the criteria used to recognize such a "good definition".
(N9) *Hierarchy*: the use of conucleogenera, in some cases combined with the use of extragenera, allows a clear, unambiguous allocation of nomina to subordinate taxa of different ranks, even in the absence of a Rule of Coordination and of standard endings.
(N10) *Homogeneity*: in the proposed nomenclatural system, just like in all zoological literature until now, the ranks of higher taxa cannot be recognized by the form of their nomina. In order to facilitate recognition of these ranks, it is here proposed to write these nomina preceded by the clear designation of their ranks, and a standardized hierarchy of primary and secondary ranks is proposed. Ranks are not important by themselves, i.e. their indication does not provide any information on the "nature" of the taxa concerned, but they are useful in providing information on the *relative* situation of different taxa in a hierarchical taxonomy: an order is always subordinate to a class, and a suborder to an order, which means that members of the former are also members of the latter; in contrast, members of a given suborder of a given order are by definition not members of any other suborder of the same order, or of any other order.
(N11) *Robustness*: the Rules proposed allow to "protect" and keep the nomina of higher taxa that are widely known and have been largely used outside zoological systematics, even if they were junior synonyms or homonyms of other nomina. All other nomina, unknown of most non-specialists, must follow the "normal" Rules of availability and validity. As nomina are not linked to taxa by "closed definitions", they will show a high nomenclatural robustness as long as the taxonomic structure of the group considered remains similar or rather similar to that used when the transition from "informal higher nomenclature" to formal class-series nomenclature took place. So robustness will be stronger in groups that have been submitted to recent cladistic studies and taxonomic revision, but in the long run robustness under the system proposed should be high. The most important point in this respect is *stability in the rules* of allocation and validity of nomina. In order to obtain a long-term robustness of zoological class-series nomenclature, it appears urgent for the community of zootaxonomists to abandon the current habits, where "consensus" and "usage" are supposed to stabilize the use of nomina for higher taxa (a stabilisation which in fact never occurred), and to adopt formal Rules for this purpose. The Rules here proposed, or other improved Rules, could play this rôle, but the Rules once adopted should not be changed, at least in their major aspects, as frequent changes in the Rules is a major and particularly pernicious cause of nomenclatural changes, that should be avoided as far as possible (see Dubois 2005b).

Perspectives

Establishing the status of class-series nomina according to the Rules above is an intellectually simple

process, which requires only care and rigour, and respect of the working methodology in ten steps (S1) to (S10) presented above (Rule R24). These Rules are largely automatic in their application and require only a few active decisions to be taken, in only a few specific situations. However, the practical work of data collecting (tracing and analysing original publications, checking the status in the current taxonomy of all generic nomina used as conucleogenera and alienogenera for classomina, looking for evidence that some nomina qualify as sozonyms, etc.), of building synonymies and finally of establishment of the valid nomen of each taxon will be quite time and energy consuming. In the future, it would be useful to develop projects facilitating such work.

First of all, a very useful tool would be the preparation of a list of available class-series nomina published in zoology since 1758, similar to the *nomenclatoris zoologici* of the 19th (e.g., Agassiz 1846) and of the 20th century (e.g., Neave 1939 and following volumes). The absence of such a recent list for nomina of higher taxa (family and above) has long been considered an obstacle to the implementation of nomenclatural rules for these nomina (Hemming 1958a: 193, 1958b: 490). Such an endeavour may appear enormous, but it would seem that what was possible then, without the help of computers, would be easier to realize today with the help of our technology, all the more so since the number of class-series nomina available is much lower than that of genus-series nomina. However, to be fully useful, such a database should not only include the nomina and their original references, but, for each nomen, a number of pieces of information concerning its onomatophore and onomatostasis, and other nomina used in the original publication, i.e. all the information necessary to establish the status of all nomina.

A second help could be provided by devising softwares allowing automatic performance of most of the work described in the working steps (S1) to (S10) above. A large-scale program of work devoted to this question would certainly allow rapid ascertainment of the status of all available class-series nomina, publication of these results with first-reviser actions as needed, and transition from informal higher nomenclature to formal class-series nomenclature.

Both the work of storage of information on nomina in databases, and the computer-assisted work of analysis of the status of these nomina, would be much more efficient and less time and energy consuming if carried out at once and altogether for all taxa and nomina of large zoological groups (such as the vertebrates or the arthropods) rather than for small groups like the amphibians used here as an example: this would avoid redundant work as it would require only one survey of the whole literature by a team of people well informed of all details of the analysis as described above.

In the course of such a large program, the weaknesses of the system presented above would become apparent and solutions to these problems could be proposed. When a consensus on a satisfactory system is reached among participants, the improved Rules could be submitted to ICZN for formal incorporation into the *Code*. As for the work on the lists of available nomina, once it is done and stored in databases, it would be available for all taxonomists. It could then be used as a basis for all subsequent works and would only need to be updated regularly following new taxonomic works and according to the new Rules. No doubt, taxonomic changes will be needed as long as we don't have the "final taxonomy" of the whole animal kingdom… a legitimate goal that may never be reached by science, but, in the meanwhile, we have to work…

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NOTES

1. The question addressed here, and in fact in the whole of this work, is how to designate a taxon in a written text of any kind, not only in taxonomic or evolutionary literature. The suggestion is sometimes made that taxa can be designated by other means, such as "diagrams, alphabetic or numeric position markers, or indentation" (De Queiroz 1997: 126). Indentation in particular was supported by several authors (e.g., Wiley 1979, 1981; Crane & Kenrick 1997), as it avoids putting emphasis on formal ranks. However, such suggestions have no generality, as they can be used only in specialised taxonomic or phylogenetic works. It is not envisionable to designate a taxon in a biochemical, ecological or medical publication by a single uninominal nomen and to add a cladogram to show the place of this taxon in the hypothesised phylogeny! As reckoned by Kron (1997: 109), "codes or strings of numbers are not the best way to communicate a classification because they are difficult to verbalize or use in a written discussion […]. They are also nearly impossible to use in teaching systematics or biology in general".
2. If we read the ancient myths, the first human (not divine) taxonomist ever was the man known under the Sumerian name Ziusudra (which, being the oldest remembered, has priority!), the Babylonian name Utnapishtim, the Indian names Manu and Satyavrata, the Persian name Yima, the Greek name Deucalion and the Hebrew name Noakh or Noah (that appears in the Bible): in order to place a pair of each species in his arch, he must have developed a species-level taxonomy of animals, and, in order to be able to call them, also probably a nomenclature!
3. Other cases exist in zoological nomenclature of "virtual creation" of a nomen or of a morphonym not mentioned in the text: this applies in particular to the situations of "virtual secondary homonymy" (see Dubois 1995), and to some cases of neonyms proposed for nomina considered invalid for some reason, as analysed in detail for the amphibian generic nomen *Cacopus* by Dubois (1984: 14; 1987c: 44).
4. Such "twin taxa" as understood here are taxa created together *by taxonomists*, in any given taxonomic system, i.e. under a given philosophy of biological classification. As a matter of fact, although clades no doubt exist in the real world, taxa do not: the latter are not creations of biological evolution, but of human mind, in a system of storage of data that is purported to allow retrieval of biological information of various kinds (including cladistic) on living beings. The terms "sister taxa", "brother taxa" or "*adelphotaxa*" (Ax 1984) are currently used by some authors to designate clades that are supposed, in a given hypothetical phylogeny, to be derived from a common ancestor, i.e. results of biological evolution: these terms therefore refers to a phylogenetic, not primarily taxonomic, concept. For this concept, the formulae "twin cladons" or *didymocladons*, would be much more appropriate, and I propose to substitute the latter term to Ax's (1984) term *adelphotaxa*. In contrast, the term *adelphoprotaxa*, proposed by Dubois (2005b), and used here, clearly refers to a taxonomic concept. I take this opportunity to point out that the terms "brother" or "sister", or their Greek equivalent *adelphos*, are not well chosen to designate children born *at the same time* from the same parents: thus my proposal to replace them by the term "twin" or its Greek equivalent *didymos*.
5. In a first preliminary version of these Rules (Dubois 2005a), I had considered a more complex system. After establishing the categories of usage of nomina and before applying priority, this system would take into account whether nomina had been proposed for taxa strictly or only partly identical to the current ergotaxon (isotaxic or endotaxic to the latter). I abandoned this idea for two basic reasons: a) this system would be much more complex and cumbersome to use, and likely to discourage future taxonomists, being mostly usable with the help of a special software that would have to be devised for this purpose; and b) this system would encourage a confusion between onomatophores (that provide "ostensive definitions" or "labelling" of nomina) and "intensional definitions" of nomina (see Dubois 2005b).
6. This qualification may sound a bit "crazy", but recent examples in zoological nomenclature show that it is not: see in particular the recent cases *HEMIDACTYLIINI* and *PETROPEDETINAE* in amphibians (see Note 16 in Dubois 2005b: 426).
7. An unfortunate repeated mistake resulted in the new term "Queirauthian", introduced in Dubois (2005b: 387), being misprinted "Querauthian" on several occasions in this original paper. Among these two spellings, that would qualify as "multiple original spellings" if this term was a scientific nomen, the correct one is "Queirauthian". My apologies to Kevin De Queiroz for this misprint.

APPENDIX

Suggested terms for the designation of onymological concepts.
Ref.: **[R-01]**, term of traditional use in zoology or in philosophy, but used here in a precise technical meaning; **[R-02]**, term proposed by Haeckel (1868); **[R-03]**, term proposed by Hitchcock (1905); **[R-04]**, term proposed by Simpson (1940); **[R-05]**, Term proposed by Hennig (1950); **[R-06]**, term proposed by Moore & Sylvester-Bradley (1957); **[R-07]**, term proposed by Schopf (1960); **[R-08]**, term proposed by Ashlock (1971); **[R-09]**, term proposed by Ax (1984); **[R-10]**, term proposed by Dubois (1986); **[R-11]**, term proposed by Smith & Perez-Higareda (1986); **[R-12]**, term proposed by Dubois (1991); **[R-13]**, term proposed by Mayr & Ashlock (1991); **[R-14]**, term proposed by Mayr (1995); **[R-15]**, term proposed by Dubois (1997a); **[R-16]**, term proposed by Mayr (1997); **[R-17]**, term proposed by Brummitt (1997); **[R-18]**, term proposed by Dubois (1997b); **[R-19]**, term recognized by the *Code* (Anonymous 1999); **[R-20]**, term proposed or redefined by Dubois (2000); **[R-21]**, term recognized by the botanical code (Greuter *et al.* 2000); **[R-22]**, term proposed by Dubois (2005a, b); **[R-23]**, new term proposed in the present paper.
The plurals of all terms ending in *-genus* end in *-genera*, those of all terms ending in *-omen* end in *-omina*, and those of all terms ending in *-taxon* end in *-taxa*.

Term	Ref.	Definition
Act, action	R-19	*Nomenclatural* act or action: any published action proposing a new taxomen or modifying the status of a taxomen (e.g., a subsequent onomatophore designation for a taxomen, or a first-reviser action)
Adelphonym	R-22	One of two or more nomina given simultaneously by an author to adelphoprotaxa
Adelphoprotaxon	R-22	One of two or more ametoxenoprotaxa created together by an author as subdivisions of an earlier taxon, but which share this rank with other taxa of earlier creation
Adelphotaxon	R-09	One of two clades that are supposed, in a given hypothetical cladogeny, to be derived from a common ancestor: see *didymocladon*
Agathonym	R-23	Kyronym of a taxon among several distagmonyms according to the present Rules
Akyronym	R-20	Invalid hoplonym of a taxon; the invalidation may be *permanent* (exoplonym) or *conditional* (hypnonym), *total* or *partial*
Alienogenus	R-23	Generomen expressly excluded from a protaxon of the class-series at its creation
Allelonym	R-23	One of two or several alternative nomina proposed for the same taxon (same content, same taxonomic rank) in the same publication, having the same content and the same onomatophore
Alloneonym	R-20	Neonym not directly derived from an archaeonym through unjustified emendation
Allonym	R-23	Junior homonym of a nomen, proposed for an allotaxon of an already existing taxon
Allotaxon	R-23	New taxon, with its own taxomen and onomatophore, proposed with a nomen identical, or very similar, to that of an already existing taxon (i.e. a junior homonym of the nomen of the latter)
Allotype	R-19	Paratype of sex opposite to the holotype of a species-series taxon
Ametoangioergotaxon	R-22	An ergotaxon that is immediately superordinate to another ergotaxon, its ametoendoergotaxon
Ametoangioprotaxon	R-22	A protaxon that is immediately superordinate to another protaxon, its ametoendoprotaxon
Ametoangiotaxon	R-22	A taxon that is immediately superordinate to another taxon, its ametoendotaxon
Ametoendoergotaxon	R-22	An ergotaxon that is immediately subordinate to another ergotaxon, its ametoangioergotaxon
Ametoendoprotaxon	R-22	A protaxon that is immediately subordinate to another protaxon, its ametoangioprotaxon
Ametoendotaxon	R-22	A taxon that is immediately subordinate to another taxon, its ametoangiotaxon
Ametoperiergotaxon	R-22	A taxon involved in a relationship of immediate periergotaxy, i.e. of inclusion between an *ametoangioergotaxon* and its *ametoendoergotaxon*
Ametoperiprotaxon	R-22	A taxon involved in a relationship of immediate periprotaxy, i.e. of inclusion between an *ametoangioprotaxon* and its *ametoendoprotaxon*
Ametoperitaxon	R-22	A taxon involved in a relationship of immediate peritaxy, i.e. of inclusion between an *ametoangiotaxon* and its *ametoendotaxon*

Term	Ref.	Definition
Ametoxenoergotaxon	R-22	Any of two or more ergotaxa of same rank that are immediately subordinate to the same ametoangioergotaxon
Ametoxenoprotaxon	R-22	Any of two or more protaxa of same rank that are immediately subordinate to the same ametoangioprotaxon
Ametoxenotaxon	R-22	Any of two or more taxa of same rank that are immediately subordinate to the same ametoangiotaxon
Angioergotaxon	R-22	Ergotaxon being angiotaxic to another ergotaxon
Angioprotaxon	R-22	Protaxon being angiotaxic to another protaxon
Angiotaxon	R-22	Any taxon whose inclusive extension includes that of another taxon, its endotaxon
Anisonym	R-20	Any of two or more nomina based on different onomatophores
Anisoprotaxon	R-22	Any of two or more protaxa whose extensions are not completely identical
Anisotaxon	R-22	Any of two or more taxa whose extensions are not completely identical
Anoplonym	R-20	Published but nomenclaturally unavailable nomen according to the Rules of the *Code* for nomina regulated by this text, or according to the Rules here proposed for class-series nomina
Aphonym	R-22	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 (see Rule R11)
Aphory	R-22	Qualification of a nomen created without onomatophore
Apognosis	R-18	Apognosis *of a taxon*: list of known or supposed autapomorphies that are considered by a taxonomist to establish the fact that this taxon corresponds to a clade of its own
Aponym	R-20	Any subsequent modified morphonym of a protonym
Apotaxon	R-22	Any subsequent modified morphotaxon of a protaxon (see *Auxapotaxon* and *Menapotaxon*)
Apotaxonomy	R-22	Any classification using an apotaxon
Archaeonym	R-22	Original nomen that has been replaced by a neonym
Arhizonym	R-23	Familiomen incorrectly formed, as not being based on the stem of an available generomen, and therefore nomenclaturally unavailable (anoplonym)
Author	R-19	Person(s) to whom a published work, protonym, protaxon or nomenclatural act is attributed
Autoneonym	R-20	Neonym directly derived from an archaeonym through unjustified emendation
Auxapotaxon	R-22	Apotaxon obtained by addition of new immediately subordinate taxa (ametoendotaxa) to a protaxon, so that the protaxon is endotaxic to the apotaxon at higher taxonomic levels
Auxonym	R-22	Protonym or aponym used for an auxapotaxon
Available	R-19	Available *nomen*: hoplonym
Binomen	R-20	Scientific name of a taxomen of rank species, composed of two terms
Caconym	R-23	Familiomen incorrectly formed, as formed through addition to the stem of a generomen of a complex suffix (such as *-forma*, *-morpha*, etc.), and therefore nomenclaturally unavailable (anoplonym)
Category	R-01	*Taxonomic* category: a category of taxa in a taxonomy. A category may be *ranked* (categories corresponding to ranks of the nomenclatural hierrachy: e.g., species, family, suborder) or *unranked* (categories that do not correspond to nomenclatural ranks: e.g., semispecies, klepton, plesion)
Choronym	R-23	Nomen of a choroprotaxon
Choroprotaxon	R-23	Protaxon created as ametoxenoprotaxic to one or several other taxon/a which are all xenotaxic to this protaxon in the frame of a given ergotaxonomy
Circumscription	R-01	See *Extension*
Cladification	R-16	Classification system of organisms recognizing only holophyletic taxa (cladons)
Cladon (pl. cladons)	R-14	Holophyletic group (complete lineage or historical entity)

Term	Ref.	Definition
Cladonomy	R-17, R-18	Taxonomy recognizing only holophyletic taxa (cladons)
Class-series	R-20	*Class-group* in Dubois (1984): in the hierarchy of classification, the set of taxa ranked above the family-series, whose nomina are not fully regulated by the *Code*; it includes higher taxa at the ranks of class, order, kingdom, and any additional ranks that may be required
Classification	R-01	Any system of ordering objects according to *a priori* criteria
Classomen	R-20	Any taxomen of the class-series (nominal-class, nominal-order, etc.)
Comprehension	R-01	See *Intension*
Conditional	R-20	Conditional *synonymy*, *homonymy*, *seniorization* or *invalidation* of a hoplonym, etc.: liable to change as taxonomy changes
Consistency	R-23	1) *Nomenclatural* consistency: the fact that, in any given class-series taxonomy, didymonyms of the same origin must be either used together, or rejected, or used isolately, but not used along with phobonyms. 2) *Taxonomic* consistency: the fact that all suprageneric nomina created in the same publication for taxa of the same taxonomic rank must be referred to the same nominal-series, with precedence of the family-series over the class-series in case of conflict between their allocation to one of these two nominal-series
Content	R-01	See *Extension*
Conucleogenus	R-22	One of several originally included generomina of a new class-series taxomen in the case of generic symphory, that must remain its onomatophore collectively and indissolubly and cannot be dissociated through designation of a single nucleogenus
Coordinate	R-19	Coordinate *nomina*: nomina that are in a situation of coordination within a nominal-series
Coordination	R-19	The fact that any nomen established for a taxon of any rank within a nominal-series is deemed to have been simultaneously established for all taxa of other ranks within that series
Cotype	R-03	An obsolete term, rejected by the *Code*, for *symphoront*
Definition	R-01	Definition *of a taxon*: either 1) description, diagnosis or apognosis of this taxon, i.e. list of the characters that are considered by a taxonomist to define the taxon and distinguish it from all other taxa; or 2) “phylogenetic definition” of this taxon, i.e. a statement about its cladistic relationships
Description	R-01	Description *of a taxon*: list of all “known” or “relevant” characters of the taxon, whether proper to this taxon or common with other taxa
Designation	R-01	*Onomatophore* designation (*typification* in the *Code*): statement of the specimen or of the taxomen that will stand as the onomatophore of a taxomen; process by which a specimen or a series of specimens is fixed as the onomatophore of a speciomen; or by which a taxomen is fixed as the onomatophore of a taxomen of a higher nominal-series (e.g., a speciomen as onomatophore of a generomen, or a generomen or generomina as onomatophore of a familiomen or of a classomen)
Diagnosis	R-01	Diagnosis *of a taxon*: list of all known characters that are considered by a taxonomist to distinguish this taxon from all other taxa
Diaphonym	R-22	Nomen used as valid by *at least one* author and in *at least one* publication after 31 December 1899 (see Rule R11)
Didymarchaeonym	R-23	One of two or more archaeonyms given simultaneously by an author to didymoprotaxa
Didymocladon	R-22	One of two clades that are supposed, in a given hypothetical cladogeny, to be derived from a common ancestor
Didymoneonym	R-23	One of two or more neonyms given simultaneously by an author to didymoprotaxa
Didymonym	R-22	One of two or more nomina given simultaneously by an author to didymoprotaxa
Didymoprotaxon	R-22	One of two or more ametoxenoprotaxa created together by an author in the process of splitting and redefining an earlier taxon, and which together cover the whole inclusive extension of the latter as redefined

Term	Ref.	Definition
Distagmonym	R-22	Nomen that can be conserved only if it is the valid one according to the present Rules, being a schizeurydiaphonym, a stenodiaphonym or an aphonym (see Rule R11)
Doxisonym	R-20	*Subjective synonym* in the *Code*: any of two or more nomina based on different onomatophores but considered, for subjective (taxonomic) reasons, to denote the same taxon, whose inclusive extension includes both their onomatophores
Emendation	R-01	1) *Nomenclatural* emendation: any change in the spelling of a nomen (see *Aponym*): according to the *Code*, such an emendation may be *justified* (and must therefore be adopted by all subsequent authors) or unjustified (and is therefore an *autoneonym*). 2) *Taxonomic* emendation: any change in the intension and/or extension of the taxon designated by a nomen (see *Allotaxon* and *Apotaxon*)
Endoergotaxon	R-22	Ergotaxon being endotaxic to another ergotaxon
Endoprotaxon	R-22	Protaxon being endotaxic to another protaxon
Endotaxon	R-22	Any taxon whose inclusive extension is included in that of another taxon, its angiotaxon
Eneonym	R-22	Nomen never mentioned as nomenclaturally available by *any* author and in *any* publication after 31 December 1899 (see Rule R11)
Epithet	R-01	Specific or subspecific name being part of a binomen or trinomen
Epitype	R-21	In the botanical code, specimen that allows clarification of the taxonomic status of a taxomen of rank species or below, when the holotype does not allow unambiguous interpretation of this status
Eremoprotaxon	R-22	A taxon created by an author as isolated, without other taxa of the same rank subordinate to the same immediately higher taxon
Ergotaxon	R-22	Taxon *in current use* in zoological taxonomy
Ergotaxonomy	R-22	Classification used by a given author in a given work
Ergotopotaxy	R-22	The relationship between two ergotaxa regarding their contents: they may be either *xenoergotaxic* or *synoergotaxic*
Eunym	R-20	Correct spelling, onymorph and rank of a nomen
Eurydiaphonym	R-22	Nomen that has been *significantly* used as valid for a given taxon or for synotaxic taxa in *non-systematic* literature after 31 December 1899. In class-series nomenclature, i.e. for the purpose of Rule (R12), to be considered an eurydiaphonym, a nomen should have been used, either in its Latin form or as a vernacular nomen in any recent language: either A) in the *titles* of at least *twenty-five* non-purely systematic *books*, written by at least *twenty-five independent-authors* and published in at least *ten different countries* after 31 December 1899; or B) in the *titles* of at least *one hundred* non-purely systematic *publications* (books, book chapters or periodical articles) written by *one hundred independent-authors* and published in at least *ten different countries* after 31 December 1899
Exclusive	R-22	Exclusive *extension* of a taxon: the list of the individuals or taxa excluded from it
Exonymophoront	R-22	*Paralectotype* in the *Code*: any specimen rejected from a series of symphoronts through designation of a lectophoront as onomatophore of a species-series taxomen
Exoplonym	R-20	Permanent akyronym
Extension	R-01	Extension (or circumscription, or content, or extensional definition) *of a taxon*: its content and boundaries, i.e. the list of its included members (individuals or taxa) (*inclusive extension*) or of the individuals or taxa excluded from it (*exclusive extension*)
Extragenus	R-23	Alienogenus that is currently excluded from a class-series ergotaxon
Familiomen	R-20	Any taxomen of the family-series (nominal-family, nominal-tribe, etc.)
Family-series	R-20	*Family-group* in the *Code*: in the hierarchy of classification, the highest-ranking set of taxa whose nomina are fully regulated by the *Code*; it includes taxa at the ranks of family, subfamily, tribe, superfamily, and any additional ranks that may be required
First-reviser	R-19	Author of a nomenclatural act modifying the status of a taxomen

Term	Ref.	Definition
First-user	R-20	Person(s) to whom the first publication of an aponym is attributed
Generomen	R-20	Any taxomen of the genus-series (nominal-genus, nominal-subgenus)
Genus-series	R-20	*Genus-group* in the *Code*: in the hierarchy of classification, the set of taxa ranked between the species-series and the family-series; it includes taxa at the ranks of genus and subgenus
Gephyroergotaxon	R-22	Ergotaxon being gephyrotaxic to another ergotaxon
Gephyroprotaxon	R-22	Protaxon being gephyrotaxic to another protaxon
Gephyrotaxon	R-22	Any of two taxa whose inclusive extensions overlap partially
Getextragenus	R-23	Any extragenus of a given class-series ergotaxon that is a member of its ametoxenotaxon or of one of its ametoxenotaxa
Hapantotype	R-19	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 protistan according to the current *Code*
Heterophyletic	R-10	See *Polyphyletic*
Holophyletic	R-08	Holophyletic *taxon*: homophyletic taxon including *all* the descendants of its most recent common ancestor
Holophoront	R-22	*Holotype* in the *Code*: single specimen designated as onomatophore of a species-series taxomen
Homonym	R-19	Any of two or more nomina established for different taxomina and having the same spelling or spellings "deemed to be identical" according to the *Code* for nomina regulated by this text, or according to the Rules here proposed for class-series nomina
Homonymy	R-19	Relationship between homonyms
Homophyletic	R-10	Homophyletic *taxon*: taxon including its most recent common ancestor
Hoplonym	R-20	Nomenclaturally available nomen according to the *Code* for nomina regulated by this text, or according to the Rules here proposed for class-series nomina
Hypnonym	R-20	Conditional akyronym
Hypodigm	R-04	Set of specimens used by an author to establish and describe a new species-series taxon
Inclusive	R-22	Inclusive *extension* of a taxon: the list of its included members (individuals or taxa)
Independent-authors	R-15	In class-series nomenclature, i.e. for the purpose of Rule (R12), authors who never published together (as co-authors) on the zoological group concerned before the case is considered
Intension	R-01	Intension (or intensional definition) *of a taxon*: its definition, description or diagnosis
Intragenus	R-23	Alienogenus that is currently included in a class-series ergotaxon
Invalid	R-19	Invalid *hoplonym* (akyronym): hoplonym not to be used to denote a taxon, having been invalidated as a result of application of the *Code* for nomina regulated by this text, or of the Rules here proposed for class-series nomina
Invalidation	R-20	Process by which a hoplonym is rendered invalid; this invalidation may be *permanent* or *conditional*, *total* or *partial*
Isoergotaxon	R-22	Any of two or more ergotaxa whose extensions are completely identical
Isonym	R-20	*Objective synonym* in the *Code*: any of two or more nomina based on the same onomatophore
Isoprotaxon	R-22	Any of two or more protaxa whose extensions are completely identical
Isotaxon	R-22	Any of two or more taxa whose extensions are completely identical
Junior	R-19	Junior *nomen* (synonym or homonym): published after the senior one
Juniorization	R-20	A particular case of *invalidation*: process by which a senior nomen is withdrawn priority over a junior nomen as a result of application of some Rules of the *Code* for nomina regulated by this text, or of some Rules here proposed for class-series nomina; the juniorization may be *permanent* or *conditional*, *total* or *partial*
Kyronym	R-20	Valid hoplonym of a taxon

Term	Ref.	Definition
Kyrotaxon	R-23	Ergotaxon to which a nomen must be allocated under the Rules presented here and within the frame of a given ergotaxonomy
Lectophoront	R-22	*Lectotype* in the *Code*: single specimen chosen in a series of symphoronts for designation as onomatophore of a species-series taxomen
Logonymy	R-20	Any list of nomina and/or nomen uses
Macrotaxonomy	R-13	Taxonomy of taxa of the genus-, family- and class-series (also called *high-level taxonomy*; Whitehead 1972)
Menapotaxon	R-22	Apotaxon obtained by addition of new lower level taxa but no ametoendotaxa to a protaxon, such that the protaxon remains isotaxic to the apotaxon at higher taxonomic levels
Menonym	R-22	Protonym or aponym used for a menapotaxon
Merisoprotaxon	R-22	Protaxon being merisotaxic to another taxon
Merisotaxon	R-22	Any isotaxon containing representatives (members) of *some* only of its subordinate taxa, at some ranks of the taxonomic hierarchy only
Merophyletic	R-10	Merophyletic *taxon*: non-holophyletic, i.e. either paraphyletic or polyphyletic taxon
Metrotaxon	R-23	In a given class-series ergotaxonomy, least inclusive (lowest ranked) ergotaxon including all the conucleogenera of a nesoprotaxon
Microtaxonomy	R-13	Taxonomy of taxa of the species-series (also called *low-level taconomy*; Whitehead 1972)
Monophory	R-22	*Monotypy* in the *Code*: qualification of a nomen created with a single onomatophore. The following uses of the term apply in class-series nomenclature: 1) *Generic* monophory: qualification of a classomen created with a single included taxomen being a generomen: the latter is its nucleogenus. 2) *Familial* monophory: qualification of a classomen created with a single included taxomen being a familiomen: the nucleogenus of this familiomen is also the nucleogenus of the classomen. 3) *Class-series* monophory: qualification of a classomen created with a single included taxomen being a classomen: the nucleogenus or the conucleogenera of the latter classomen is/are also the nucleogenus or the conucleogenera of the new classomen. 4) *Specific* monophory: qualification of a classomen created with a single included taxomen being a speciomen: the generomen used as substantive for this speciomen in this publication is the nucleogenus of the new classomen
Monophyletic	R-02	Ambiguous term, rejected here, as used with two different meanings in biological literature: 1) homophyletic; 2) holophyletic
Morphonym	R-20	Any particular spelling, onymorph or rank of a given nomen
Morphotaxon	R-22	Any particular intension (definition) and/or extension (content) of a taxon
Neonym	R-20	*Nomen novum* in the *Code*, or *new replacement nomen*, or *nomen substitutum*: nomen established expressly to replace an already established nomen (its archaeonym), and having the same onomatophore.
Neonymy	R-23	*Rules* of neonymy: all Rules concerning the properties and management of neonyms and archaeonyms
Neophoront	R-22	*Neotype* in the *Code*: single specimen designated as onomatophore of a species-series taxomen when the original onymophoront has been lost or destroyed
Nesonym	R-23	Nomen of a nesoprotaxon
Nesoprotaxon	R-23	Protaxon created as ametoxenoprotaxic to one or several other protaxon/a, one of which at least is synotaxic to this protaxon in the frame of a given ergotaxonomy
Nomen	R-20	Scientific name of a taxomen as defined by the *Code* (uninomen, binomen or trinomen) for nomina regulated by this text, or as defined by the Rules here proposed for class-series nomina (uninomen)
Nomenclature	R-20	Biological nomenclature: system of scientific names (nomina) for taxomina and taxa, including information attached to these nomina
Nomenifer	R-07	See *Onomatophore*

Term	Ref.	Definition
Nominal	R-19	1) *Nominal taxon* in the *Code*: taxomen. 2) *Nominal-species*, *nominal-genus*, *nominal-family*, etc.: taxomen of rank species, genus, family, etc.
Nominal-series	R-20	Set of nomina applying to any of the following sets of taxa: the *species-series*, the *genus-series*, the *family-series* or the *class-series*
Nominotypical	R-19	Nominotypical *taxon*: in a taxonomic hierachy, subordinate (endotaxic) taxon having the same onomatophore as its superordinate (angiotaxic) taxon
Non-purely systematic publication	R-23	In class-series nomenclature, i.e. for the purpose of Rule (R12), any publication a significant portion of which (i.e. at least half of its total volume) deals with non-systematic matters, such as various fields of biology, medicine, agronomy, etc., or is even addressed to non-scientific users, such as members of administrations, governments, customs, conservation organizations, etc.
Nucleomen	R-22	Onomatophore(s) of a taxomen of the nominal-series above the species-series: one or several nucleospecies for a generomen; a nucleogenus for a familiomen; either a single nucleogenus or a set of several conucleogenera for a classomen
Nucleogenus	R-22	*Type-genus* in the *Code*: generomen designated as onomatophore of a familiomen or of a classomen
Nucleospecies	R-22	*Type-species* in the *Code*: speciomen designated as onomatophore of a generomen
Onomatophore	R-04	Objective standard of reference of *inclusive extension* whereby the application of a nomen to an ergotaxon can be determined: the nomen can be applied only to an ergotaxon that includes the complete onomatophore. Onomatophores are used in all nominal-series. An onomatophore may be one or several specimen(s), the *onymophoront(s)*, or one or several taxomen/mina, the *nucleomen/mina*
Onomatostasis (pl. onomatostases)	R-23	Objective standard of reference of *exclusive extension* whereby the application of a nomen to an ergotaxon can be determined: the nomen can be applied only to an ergotaxon that excludes the complete onomatostasis. Onomatostases are used only in the class-series. An onomatostasis may be one or several taxomen/mina, the *getextragenera*
Onymological	R-20	Of or relating to onymology
Onymology	R-20	The study of concepts and theory of biological nomenclature
Onymophoront	R-22	Onomatophore(s) of a taxomen of the species-series, which may be either a specimen (holophoront, lectophoront or neophoront) or a series of specimens (symphoronts)
Onymorph	R-11	Any particular association between genus-series substantive(s) and species-series epithet(s)
Onymotope	R-22	*Type-locality* in the *Code*: place of collection of the specimen(s) designated as phoront(s) of a speciomen
Onymotopic	R-22	*Topotypic* in the *Code*: collected at the onymotope; *topotype* in the *Code*: onymotopic *specimen*
Original	R-19	1) Original *publication*: work where a protonym or a nomenclatural act was first published. 2) Original *spelling*, *onymorph* or *rank* of a nomen, *onomatophore designation*, *description*, etc.: appearing in the original publication
Orotaxon	R-23	In a given class-series ergotaxonomy, most inclusive (highest ranked) ergotaxon including all the conucleogenera of a choroprotaxon and excluding all its extragenera
Paneurydiaphonym	R-22	Eurydiaphonym that is the only one to have been used as valid for a given taxon or for synotaxic taxa in non-systematic literature after 31 December 1899 (see Rule R11)
Panisoprotaxon	R-22	Protaxon being panisotaxic to another taxon
Panisotaxon	R-22	Any isotaxon containing representatives (members) of *all* its subordinate taxa, at all ranks of the taxonomic hierarchy
Paraphyletic	R-05	Paraphyletic *taxon*: homophyletic taxon including *a part only* of the descendants of its most recent common ancestor
Parataxon	R-06	Classificatory unit that does not apply to living organisms but to parts of organisms or to traces left by living organisms: see *pseudotaxon*

Term	Ref.	Definition
Paratype	R-19	Specimen member of the hypodigm of a new protaxon but not originally designated as onomatophore
Paronym	R-20	Protonym or one of its aponyms (or anoplonyms if relevant)
Parotaxon	R-22	Protaxon or one of its apotaxa
Partial	R-20	Partial *invalidation* of a hoplonym: for only one or two nomenclatural purposes (among priority, homonymy and typification)
Periergotaxon	R-22	Any ergotaxon involved in a relationship of peritaxy
Periprotaxon	R-22	Any protaxon involved in a relationship of peritaxy
Peritaxon	R-22	Any taxon involved in a relationship of peritaxy, i.e. of inclusion between an *angiotaxon* and its *endotaxon*
Permanent	R-20	Permanent *synonymy*, *homonymy*, *seniorization* or *invalidation* of a hoplonym, etc.: definitive, not liable to change as taxonomy changes
Phobonym	R-23	Didymonym of different origin from that of a didymonym retained as kyronym, that cannot be used along with the latter in a given taxonomy
Phylon (pl. phylons)	R-12	See *Cladon*
Polyphyletic	R-02	Polyphyletic *taxon*: taxon not including its most recent common ancestor
Prenucleogenus	R-22	One of several originally included generomina of a new family-series taxomen in a case of generic symphory, before subsequent designation among them of a single nucleogenus
Prenucleomen	R-22	One of several originally included taxomina of a new superordinate taxomen, before selection among them of a single nucleomen
Prenucleospecies	R-22	One of several originally included speciomina of a new genus-series taxomen in a case of specific symphory, before subsequent designation among them of a single nucleospecies
Preoccupation	R-01	The fact that, once established, any class-series nomen is deemed to preoccupy all possible spellings derived from the same root, except in the case of junior homonymy
Priority	R-19	Precedence of a nomen over another, fixed either by their respective dates of publication or by seniorization of the junior one
Protaxon	R-22	Original morphotaxon of a taxon
Protaxonomy	R-22	Original classification used by an author in the work where he/she created a protaxon
Protonym	R-20	Original morphonym of a nomen
Protopotaxy	R-22	The relationship between two protaxa regarding their contents: they may be either *xenoprotaxic* or *synoprotaxic*
Pseudotaxon	R-22	Replacement term proposed for the term *parataxon*
Purely systematic publication	R-23	In class-series nomenclature, i.e. for the purpose of Rule (R12), any publication dealing only or mostly with taxonomy, phylogeny and/or faunistics
Rank	R-01	*Nomenclatural* rank: any particular hierarchical level either within a nomenclatural nominal-series (e.g., superfamily, family, subfamily, tribe) or in different nomenclatural nominal-series (e.g., class, order, superfamily)
Schizeurydiaphonym	R-22	Eurydiaphonym that has been *significantly* used as valid for a given taxon or for synotaxic taxa 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 synotaxic taxa (see Rule R11)
Semaphoront	R-05	Any specimen from a given population and of a given sex, stage and age, that bears an indefinite number of characters
Senior	R-19	Senior *nomen* (synonym or homonym): published before the junior one
Seniorization	R-20	Process by which a junior nomen is afforded priority over a senior nomen as a result of application of some Rules of the *Code* for nomina regulated by this text, or of some Rules here proposed for class-series nomina; the seniorization may be *permanent* or *conditional*, *total* or *partial*

Term	Ref.	Definition
Sozonym	R-22	Nomen that must be conserved even if this needs an exception to the Rules, being a symphonym or a paneurydiaphonym (see Rule R11)
Species-series	R-20	*Species-group* in the *Code*: in the hierarchy of classification, the lowest-ranking set of taxa whose nomina are fully regulated by the *Code*; it includes taxa at the ranks of species and subspecies, as well as aggregates of species or of subspecies
Speciomen	R-20	Any taxomen of the species-series (nominal-species, nominal-subspecies, etc.)
Specimen	R-01	An individual organism used for establishment of a protaxon and a protonym, or for subsequent taxonomic studies
Spelling	R-19	Any particular association and arrangement of letters that form a nomen
Stenodiaphonym	R-22	Nomen that has *not* been *significantly* used as valid in non-systematic literature after 31 December 1899 (see Rule R11)
Subordinate	R-19	Subordinate *taxon*: in a taxonomic hierachy, taxon endotaxic to another taxon
Subsequent	R-19	1) Subsequent *publication*: any publication mentioning a nomen published after the original publication. 2) Subsequent *spelling*, *onymorph* or *rank* of a nomen, *onomatophore designation*, *description*, etc.: appearing in a subsequent publication
Substantive	R-01	Generic or subgeneric name being part of a binomen or trinomen
Superordinate	R-22	Superordinate *taxon*: in a taxonomic hierachy, taxon angiotaxic to another taxon
Symphonym	R-22	Nomen used as valid for the taxon it denotes or for synotaxic taxa by *all* authors and in *all* publications after 31 December 1899 (see Rule R11)
Symphoront	R-22	*Syntype* in the *Code*: one of several specimens designated together as onomatophore of a species-series taxomen
Symphory	R-22	Qualification of a nomen created with and supported by several onomatophores
Synoergotaxon	R-22	Any of two or more ergotaxa whose extensions are partially or totally identical
Synonym	R-19	Any of two or more nomina considered, either for *objective* (isonym) or for *subjective* (doxisonym) reasons, to denote the same taxon
Synonymization	R-20	Statement that two or more nomina are synonyms and of the valid one (kyronym) for the taxon they denote
Synonymy	R-19	1) List of synonyms of a nomen (protonyms and anoplonyms only). 2) Relationship between synonyms
Synoprotaxon	R-22	Any of two or more protaxa whose extensions are partially or totally identical
Synotaxon	R-22	Any of two or more taxa whose extensions are partially or totally identical: they may be *isotaxic*, *peritaxic* or *gephyrotaxic*
Taxomen	R-20	Onymological tool, designated as *nominal taxon* in the *Code*: the permanent association between a nomen (hoplonym) and an onomatophore, allowing objective, non-ambiguous and stable allocation of nomina to taxa; the onomatophore may be actual or potential (e.g., specimens lost or destroyed, but known from their description or illustration); unlike a taxon, a taxomen has no intension (diagnosis, definition or description) or extension (content and taxonomic boundaries)
Taxon	R-19	Any taxonomic unit recognized by a zoologist, whether named or not; a taxon is a class having an intension (diagnosis, definition or description) and an extension (content and taxonomic boundaries); when validly named according to the *Code*, it is denoted by its kyronym
Taxonomy	R-01	The discipline of systematics that deals with the theory and practice of biological classification
Telextragenus	R-23	Any extragenus of a given class-series ergotaxon that is a member of one of its telergotaxa
Telergotaxon	R-22	Any of two or more ergotaxa, whether of the same rank or not, that are not members of the same immediately superordinate ergotaxon in a given ergotaxonomy
Teleprotaxon	R-22	Any of two or more protaxa, whether of the same rank or not, that are not members of the same immediately superordinate taxon in a given protaxonomy
Teletaxon	R-22	Any of two or more taxa, whether of the same rank or not, that are not members of the same immediately superordinate taxon in a given taxonomy

Term	Ref.	Definition
Topotaxy	R-22	The relationship between two taxa regarding their contents: they may be either *xenotaxic* or *synotaxic*
Total	R-20	Total *invalidation* of a hoplonym: for all nomenclatural purposes, i.e. for priority, homonymy and typification
Trinomen	R-20	Scientific name of a taxomen of rank subspecies, composed of three terms
Typification	R-19	See *Designation*
Unavailable	R-19	Unavailable *nomen*: anoplonym
Uninomen	R-20	Scientific name of a taxomen of rank above species, composed of a single term
Universal	R-01	Universal *use* in nomenclature: use of a nomen as valid for the taxon it denotes by *all* authors and in *all* publications over a given period of time
Universally	R-01	By *all* authors and in *all* publications over a given period of time
Valid	R-19	Valid hoplonym (kyronym): hoplonym to be used to denote a taxon, not having been invalidated as a result of application of some Rules of the *Code* for nomina regulated by this text, or of some Rules here proposed for class-series nomina
Variety-series	R-22	In the hierarchy of classification, the set of taxa ranked below the species-series, whose nomina are not regulated by the *Code*; it includes lower taxa at the ranks of variety, form, morph, phase, and any additional ranks that may be required
Xenoergotaxon	R-22	Ergotaxon whose inclusive extension is completely distinct, without any overlapping with that of another ergotaxon
Xenonym	R-22	Any of two or more nomina based on different onomatophores and considered, for subjective (taxonomic) reasons, to denote different taxa whose inclusive extensions mutually exclude their onomatophores
Xenoprotaxon	R-22	Protaxon whose inclusive extension is completely distinct, without any overlapping with that of another protaxon
Xenotaxon	R-22	Any of two or more taxa whose inclusive extensions are completely distinct, without any overlapping