

Publications in Taxonomy as Scientific Papers and Legal Documents

Alessandro Minelli

*Department of Biology, University of Padova, Via Ugo Bassi 58 B
I 35131, Padova, Italy, E-mail: almin@bio.unipd.it*

Taxonomic papers are unique, in the world of scientific literature, because of their double status. In so far as these papers include descriptions of new taxa or other nomenclatural acts, they are not just scientific publications, but also legal documents. From the latter point of view, their value lasts forever, under the current Codes of Nomenclature. This is primarily due to the Principle of Priority, the single most important principle acknowledged by taxonomists when addressing nomenclatural conflicts due to homonymy or synonymy. Problems due to the burden of the old literature are worsened by the difficulty of accessing many old items and by the plurality of languages in which this literature is written. This is at the same time cause and effect of the low average profile of taxonomic literature as measured in terms of impact factor. Because of this odd marriage of scientific merit and legal significance in taxonomic papers, these are not subject to the Darwinian competition ruling over papers in other disciplines. A move towards uncoupling scientific content and legal value of taxonomic papers by adopting an efficient registration system of new names and nomenclatural acts would not simply help taxonomists in their daily work but also considerably raise the standard profile of their published work.

These are exciting but also critical times for taxonomy, man's oldest profession (Hedgpeth 1961). Happy times, on the surface. Major scientific journals like *Science* and *Nature* frequently feature commentary papers stressing the importance of the discipline, as a key tool to obtain a better grasp of the biosphere's whole biological diversity (e.g., Blackmore 2002). But the same papers also point to the impossibility for taxonomy to go ahead effectively so long as it is forced to rely on the current modest budgetary resources and decreasing human capital. To be sure, this is the single worst problem for taxonomy, but hardly one that can be effectively solved without a serious effort to make the public image of taxonomy to match the enormous scientific and social value of its century-old output.

Several papers (e.g., Gee 2000; Bisby et al. 2002; Godfray 2002a, 2002b) have stressed the need for taxonomy (especially animal taxonomy) to embark on an information revolution as the only possible way to make existing taxonomic knowledge immediately accessible, to substantially improve the current pace of species description and to be eventually acknowledged as big science, on a footing comparable to that of genomics, neurosciences, or space research.

I will not add more wood to this fire. Instead, I will focus attention on a well-entrenched set of sociological problems, whose consequences have been very heavy on the procedures by which taxonomists communicate among themselves, and with the remaining scientific community. In my opinion, the inadequate way taxonomists communicate the results of their research is impairing

their output to an increasingly damaging level. Adequate measures aiming to change this state of affairs can, and must, be rapidly enforced.

THE NATURE OF TAXONOMIC LITERATURE

Is a taxonomic paper like an average scientific paper? Yes and no.

It is, in so far as it describes selected features of the natural (biological) world, in a more or less formalized language, and according to generally agreed comparative schemes.

On the other hand, taxonomic literature differs from the equivalent product of other sciences' efforts in several important respects.

First, taxonomic literature is not written in a single, common language. Recommendation 13B of the International Code of Zoological Nomenclature (ICZN) states that "Authors should publish diagnoses of new taxa in languages widely used internationally in zoology. The diagnoses should also be given in languages used in the regions relevant to the taxa diagnosed." This means that if I describe a new centipede species from Southeast Asia in my mother language (Italian), which is still fairly widely used internationally in zoology, I should perhaps add a diagnose in Vietnamese. Is this right the way science advances in disciplines other than taxonomy?

Why is there no common language in our papers? Why have taxonomists failed until now to adopt English universally? (cf. McNeill 1997) The Bacteriological Code has tackled this problem and all species descriptions in this area are now expected to be in English, but things are different in zoology.

To be sure, the suggestion to abandon all other languages once and forever, in taxonomic papers, has been floated in the recent past, when drafts were circulated of what eventually became the current fourth edition of the ICZN, published in 1999 and in force since January 1, 2000. The ado of the opposing comments and the wild diversity of alternative solutions proposed at that time were such as to invite the International Commission on Zoological Nomenclature to refrain, for the time being, from putting into the Code an Article enforcing English as the universal language of taxonomy. Were the same question discussed today, however, the chances would be much higher that such a decision would be eventually adopted. One may wonder from where such objections to English as the universal language of animal taxonomy were actually raised. As expected, the strongest voices came from those European countries whose national languages have a long history of use in taxonomic literature. Less expected, however, is the fact that this reaction involved professionals and amateurs alike. This fact, however, opens an important perspective on the sociology of taxonomy. This is, indeed, a field in which, even today, at the beginning of the third millennium, there is still an active and most welcomed input from non-professionals. I shall return to this point again.

But let's go back to the original question, whether or not taxonomic literature has the same nature as the printed output of the other scientific disciplines.

Besides the difference due to the lack of adoption of a single international language, there is another unusual circumstance that, again, impairs the spread of taxonomic information. Ironically, this problem derives from the very adoption of provisions originally devised to give taxonomy rules for making internal and external communication more easy and straightforward. Nomenclature is ruled by international codes: for animals (International Code of Zoological Nomenclature, ICZN), plants (International Code of Botanical Nomenclature), and prokaryotes (International Code of Nomenclature of Bacteria), whose declared aim is to promote the universality (and stability) of the scientific names of organisms.

This means, for example, that there are internationally agreed principles according to which

we can decide which of two synonyms has to be used, or which of two homonymous species may retain the name they have inappropriately shared for a while. These rules, and the many other and sometimes cumbersome ones contained in the Codes, are certainly useful. Necessary, indeed, but the very existence of codes to which zoological or botanical nomenclature should adhere has a generally ignored consequence. All taxonomic papers, in so far as they include the description and naming of a new taxon, or any other act of nomenclatural relevance, are something more than ordinary pieces of scientific information. In so far as they cope with the requirements of the codes, they are also a kind of legal documents. The ICZN, for instance, fixes a series of criteria to be met (Articles 7-9) for a publication to be regarded as published for the purposes of zoological nomenclature, and other criteria (Articles 10-20) for determining the availability of published names or nomenclatural acts, while two more articles (Articles 21-22) specify how the publication date has to be determined, something of fundamental importance for the application of the Principle of Priority, the veritable keystone of the whole system.

All this is good, in principle. The codes provide rules for getting nomenclature as straight and stable as we need to have. But we are paying an exorbitant price for that. If a taxonomic paper containing a little bit of nomenclatural information is a legal document, we must keep it forever. And to read through it, whenever we think that a new name or another nomenclatural act it might contain should be compared, in the light of the code, with other names or acts that possibly interfere with the name(s) of the taxon with which we are concerned. Partial and well-qualified limitations to the Principle of Priority, such as those embodied in Article 23 of the current edition of the ICZN, hardly lower this burden. To legitimate the use of a name in prevailing use without the need to apply to the International Commission for a special ruling, a taxonomist has to state that the senior forgotten synonym has never been used as a valid name since 1899, whereas its junior synonym has been used for that species in at least 25 different works by at least ten authors in the immediately preceding fifty years and for a time span of not less than ten years. Let's imagine how extensive bibliographic research through our "legal papers" this may require.

WHY DID TAXONOMIC LITERATURE DEVELOP THIS WAY?

In an ideal world, one could imagine that the scientific nomenclature of organisms could move towards a very simple set of internationally agreed upon rules and the simultaneous establishment of a central office where all new names are immediately registered as soon as they are proposed. Still better would be a system where new names take existence from the time they are registered and simultaneously made available, on line and for free, to all interested users. One may wonder whether a real, adequately staffed registration office would be actually required. In principle, registration could be, or become, automatic. A taxonomist ready to add a new entry to the official record of existing animal names would find, at the official registration website, a suitably arranged input form, with compulsory fields corresponding to all Code's requirements for name availability. At the same time, automatic check of the proposed new entry against the names already in store would prevent primary homonymy, including cross-kingdom identity of genus names. Such an automatic procedure could be probably set up following a reasonable time of trial with assisted registration and optimization of the input form.

The relationship between the registration of a new name and publication of the taxonomic paper connected to it would be similar to the relationship between placing a new protein or nucleotide sequence in one of the internationally recognized molecular databases and publishing a paper where the molecule is discussed in terms of structure, or exploited for its phylogenetic significance.

In such an ideal world, the use of names would not necessarily require reading, or citing, the taxonomic papers. In many cases, referring to the data in storage at the web-based registration database would cover all needs of documentation. Reading and citing papers, of course, would still be needed for additional, critical information. The point to be emphasized is that a first-rate taxonomic paper would continue to be read and cited, whereas poor papers would reasonably fall into irretrievable oblivion. Not surprisingly, this holds true today for papers in nearly all biological disciplines other than taxonomy.

Taxonomy's real world, however, is very different from that ideal condition. It is a world where bad old papers may have a high chance of being cited (even if, perhaps, not read) only because of the names first proposed there, that is, because of their legal value, as opposed to their intrinsic scientific value.

We have internationally accepted rules of nomenclature, but these rules were established *post factum*, that is, at a time zoologists and botanists already had to cope with a few million names, originally proposed outside any agreed set of rules. This is while the basic philosophy behind the zoological (and botanical) code is still one of "let's do our best with what we have inherited from the past", rather than "let's set up the most efficient structure for the present and the future."

The only major effort towards a rational management of scientific names of organisms has been accomplished by bacteriologists. Until 1979, the Bacteriological Code operated in a way similar to the Botanical Code, from which it was derived. Originally covered under the Botanical Code, the initiative to start a Bacteriological Code took form in the 1930s, with the first draft Code being produced by 1939. The first published version was issued in 1948, with revisions being published in 1958 and 1966. The radical break with the past came with the 1976 revision which was re-worded, simplified, where possible, and the concept of the "valid publication of a name" (i.e., registration/official indexing) was introduced. It is this system which was the model for the BioCode and has, in turn, influenced the PhyloCode. The new starting date is January 1, 1980, but care has been taken to retain reference to the older names, authors and literature which should be carried forward into the future. From that date, all new names or nomenclatural acts take effect following their "registration" publicized through one of two systems via one journal, the *International Journal of Systematic and Evolutionary Microbiology* (formerly, *International Journal of Systematic Bacteriology*). In one system, original publications in the journal may be used as the vehicle of registration, providing the rules of the Bacteriological Code are followed, and in the other, names published outside the journal may be entered in a list, which gives them the status of being registered. This is, indeed, something that is fairly close to the ideal world I have just sketched. But this may be describing an ideal world, one that is, unfortunately, still very far from today's zoological and botanical nomenclature. To be sure, repeated efforts have been made, for animals and plants alike, to update the codes in the same sense as bacteriologists did. No workable solution, however, has been found until now, for a complex and ill-defined mixture of technical and political problems: *Technical* — to produce a list of all existing names is certainly not a problem of data base management, but one of critical data mining in an already enormous literature; *Political* — Some people fear that registration might, in fact, become a kind of censorship that would limit the current extensive freedom taxonomists enjoy in writing their papers. Censorship, however, should occur at the peer review stage, if necessary, not on registration. All names meeting the requirements of the Code must be acceptable for registration without any other argument.

TAXONOMISTS, POOR BUT PROUD

The impact factor of the journals in which you publish your papers is often used as the most

reliable proxy of your scientific status by panels empowered to assign research grants and even to decide on appointments and promotions. This is a serious drawback for taxonomists, as the access to the highest impact factor journals is forbidden even to the best papers they may produce (Krell 2002), with the exception, perhaps, of the first description of some new fossil hominid or feathered dinosaur. If we take as the reference point the journal ranking provided by the *Journal of Citation Report* for 2001, the highest ranking zoological journals (in term of impact factor) where you may possibly publish the description of some new taxa are probably (Minelli 2003) *Zoologica Scripta* (rank 6), *The Journal of Mammalogy* (rank 12) and *The Zoological Journal of the Linnean Society* (rank 22). The same is true, if not worse, for entomology (*Systematic Entomology*, rank 6; *Annals of the Entomological Society of America*, rank 22; *Entomologica Scandinavica*, rank 28) or for botany (*Annals of the Missouri Botanic Garden*, rank 13; *American Journal of Botany*, rank 17; *Systematic Botany*, rank 22).

On the other hand, the taxonomist can always look forward to a unique long-term reward. Owing to their status as legal documents, taxonomic papers last virtually forever. Linnaeus and his followers are the true immortals of scientific literature. It is perhaps a pleasant feeling, to think that somebody will probably need to look into the slimmest of your papers in one or two centuries from now, whereas the overwhelming majority of papers in chemistry or physics, but also in experimental biology, definitely will be buried within a short time. How large, however, is the cost of this personal ambition in terms of efficiency in communication and intellectual progress?

CHANGING THE RULES

Inevitably, we must change the rules, without further delay. We need fast, efficient and exhaustive access to everything which matters in science, and freedom from never-ending bibliographic searches on scientifically uninteresting papers.

To be sure, these needs are shared by all scientists, in all scientific disciplines. The problem is, that taxonomists have some practical problems peculiar to them, and these problems must be quickly and adequately solved by getting rid of persisting old-fashion procedures, nevertheless paying due attention to the peculiarities of this discipline. A critical reading of the current codes of nomenclature will provide useful insights. For example, why are taxonomists uniquely concerned with the durability of the media in which their data are published, that is either ink on paper, or some of the modern electronic supports? Why is this concern not shared by other scientists? What every taxonomist wants is correct bibliographic information acknowledging priority, but pure temporal priority should not overcome scientific merit. As a former President of the International Commission on Zoological Nomenclature once put it, is it more important to serve the living or to respect the dead? (Ride 1991).

A PROPOSAL

I firmly believe that taxonomy will make a very long leap ahead if provisions are taken soon for uncoupling the scientific from the legal aspects of taxonomic papers (Minelli 2003). All kinds of information relevant to the application of the Principle of Priority, and the other rules of the Codes which are intended to promote stability and universality of scientific nomenclature, should be stored in a public, freely accessible, and durable database. That is, all legal aspects deriving from the proposal of a new name, or other nomenclatural act, should not be linked to the publication of the paper in a conventional journal, or on the web, but the relevant information should be deposited in this internationally recognized database. The procedure would be similar to depositing a new

nucleotidic or aminoacidic sequence in one of the major molecular data banks, to accompany a paper where this sequence is analyzed and discussed. In the case of names, however, entering the data in the official database would be much more than a condition to be discharged before the paper goes eventually to the press, or to the website, because of the legal implications deriving from the existence of the international codes of nomenclature with which scientific names must comply.

On the other hand, taxonomic papers would enjoy, at last, the same fate of all other scientific papers. As publications in the Darwinian world of scientific literature, they will continue to be read and cited according to their intrinsic value, thus contributing in a less biased way to raise or lower the impact factor of the journals where they will be published. We can expect that in the long run, higher-profile, higher-impact factor journals will increasingly host high-quality taxonomic papers.

Thus, adopting these new procedures would doubly benefit our research. First, and immediately, by providing a much more effective and less time-consuming use of the literature. Second, over a longer time span, by raising the status of taxonomy and taxonomists and, thus, the chances of getting better footing in many research institutions.

Enforcing the measures I am suggesting here means, basically, to establish an effective system for the registration of names and nomenclatural acts. As mentioned before, bacteriologists have already adopted these kinds of procedures and their example will provide useful advice to zoologists and botanists. To be sure, the much larger number of animal and plant names still in existence, compared to those with which bacteriologists currently have to deal with, will require much more expensive and more articulated solutions. Expensive, however, does not mean impossible. To name just two recent successful exercises, recall that with a four-year effort a team of 272 zoologists managed to produce a list of the more than 55,000 animal species recorded for Italy (*cf.* <http://www.faunaitalia.it/checklist/>), a result that provided impetus for the more ambitious project of listing — with the added bonus of distribution data by country — all animal species of Europe, a project completed in late 2004 (*cf.* <http://www.faunaeur.org>).

Any registration system will necessarily have two components: a thesaurus of existing names (at the starting date of the new regime) and a procedure for the validation of the new names, according to a suitable protocol.

A first task would be thus to mine the literature for legally relevant information. Retrieving the legally relevant information contained in the taxonomic literature is a far from trivial job; it requires adequate professional skills.

Storing all legally relevant nomenclatural information in a public database will have important consequences for other aspects of taxonomic practice. For example, it seems sensible to suggest that all type specimens, which are the material vouchers of species names, should belong to public collections. One could object that many private collections are better curated than many public collections are, but things may change if an international effort were to be made to ensure a suitable location for these precious materials. To be sure, there might be serious problems with the existing type specimens which belong to private collections. Provisions to move them to public collections may find strong resistance that could translate into an enormous increase of their market value.

On the other hand, I do not think that the new measures I am suggesting, in particular the requirement for type specimens to be put in public collections, would cause major troubles in that precious workforce of amateur taxonomists which is still so strong in several European countries and especially active in entomology and malacology. Cooperation between professionals and amateurs is often excellent. For example, public collections host nearly all the types of the taxa described by one of the most prolific descriptors of our times, the Italian amateur entomologist Roberto Pace, the author — until June 2003 — of 3472 insect species (mostly, aleocharine rove beetles). And in malacology, Bouchet (1997) documented that amateurs currently contribute some

28% of the new species descriptions, whereas only less than 1% of the corresponding types are kept in private collections.

WILL IT BE EASY TO CHANGE?

Summing up, I think that taxonomists face the opportunity of improving dramatically both their status and the quality and quantity of their output if they are ready to establish effective measures for uncoupling the legal aspects from the scientific content of their publications. This will require a few changes in the Codes, but this is far from being the most difficult problem. At the core of the change there must be a true revolution in the attitudes of taxonomists towards their work and the work of their peers. Taxonomists must become aware that their work is a part of the human collective endeavor to obtain a better knowledge of the world. In this endeavor, the intrinsic value of one researcher's contribution, thus, will be multiplied by the links he or she develops to the works of others, and even if, over a shorter or longer time span, the original papers are not cited anymore, their contents will be found, improved and reworked, in papers of their successors.

The key question to be addressed by taxonomists is not so much how to best exploit the potentiality of the Web, but how to overcome the cumulative burdens of taxonomic tradition, individuality, the resistance to adopt a common language, and the odd two-sided status of the taxonomic literature.

ACKNOWLEDGMENTS

I am very grateful to Nina Jablonski and Michael T. Ghiselin for inviting me to the Symposium, to the California Academy of Sciences for generously sponsoring my participation, and to Philippe Bouchet, Brian Tyndall, and three anonymous referees for their very useful comments on a previous draft of this paper, but the full responsibility for the present version still remains with me alone.

LITERATURE CITED

- BISBY, F.A., J. SHIMURA, M. RUGGIERO, J. EDWARDS, AND C. HÄUSER. 2002. Taxonomy, at the click of a mouse. *Nature* 418:367.
- BLACKMORE, S. Biodiversity update — progress in taxonomy. *Science* 298: 365.
- BOUCHET, P. 1997. Inventorying the molluscan diversity in the world: what is our rate of progress? *Veliger* 41(1):1–11.
- GEE, H. 2000. Online naming of species opens digital age for taxonomy. *Nature* 408:278.
- GODFRAY, H.C.J. 2002a. Challenges for taxonomy. *Nature* 417:17.
- GODFRAY, H.C.J. 2002b. Towards taxonomy's "glorious revolution". *Nature* 420:461.
- HEDGPETH, J.W. 1961. *Taxonomy: Man's Oldest Profession*. 11th Annual University of the Pacific Faculty Lecture, Stockton, California, USA. 19 pp.
- KRELL, F-T. 2002. Why impact factors don't work for taxonomy. *Nature* 415:957.
- MCNEILL, J. 1997. Latin, the Renaissance lingua franca, and English, the 20th century language of science: their role in biotaxonomy. *Taxon* 46:751–757.
- MINELLI, A. 2003. The status of taxonomic literature. *Trends in Ecology and Evolution* 18:75–76.
- RIDE, W.L.D. 1991. Justice for the living: A review of bacteriological and zoological initiatives in nomenclature. Pages 105–122 in D. L. Hawksworth, ed., *Improving the Stability of Names: Needs and Options* (Regnum Vegetabile 123.). Koeltz Scientific Books, Königstein, Germany.