

## **'Published Works' in the electronic age: recommended amendments to Articles 8 and 9 of the Code**

Jerald D. Harris

*Department of Earth and Environmental Science, University of Pennsylvania,  
240 South 33rd Street, Philadelphia, PA 19104-6316, U.S.A.*

(e-mail: [jdharris@sas.upenn.edu](mailto:jdharris@sas.upenn.edu))

### **Introduction: electronic documents and scientific publishing**

The advent of the Internet has brought about one of the most substantial revolutions in publishing since the invention of the printing press circa 1450 A.D. Internet (primarily World-Wide Web, or WWW) distribution of manuscripts has added an unprecedented degree of ease and freedom to the traditional publication process. Prior to widespread availability of, and access to, electronic publications, authors of virtually any type of document intended for widespread distribution were required to first find a publisher, and then undergo multiple reviews by editors before a final product could be produced. Distribution was then left entirely to the publisher. Alterations to finished products generally meant beginning the process over again and the issue of sequentially numbered editions. Publishing houses, with finite resources and funding, had to be highly selective of what, from a plethora of submissions, would and would not be published, and preference was generally given to manuscripts of particular importance, timeliness, or (in reality) marketability and promise of profit. Hence, not everything was published.

With the advent of the Internet, many aspects of this process could be avoided. Widely available WWW-authoring software allows authors to finalize manuscripts themselves, and ubiquitous web servers allow them to place their documents in a position of instantaneous and virtually universal distribution to readers. Thus, the author also became the publisher, printer, and distributor. Subsequent additions, corrections, and other editing could be done as and when necessary so an electronic document could be continually up-to-date. A reader has only to log in to see the latest version, though ideally new editions should be cited as such.

From the perspective of the scientist, electronic publishing and the Internet are not necessarily beneficial. The processes of peer-review and editing a manuscript are integral parts of scientific publishing. Prior to the Internet, it was extremely difficult for a non-scientist to publish the results of research in the formal, scientific literature ('primary sources') largely because of this reviewing and editing process. Today, in contrast, anyone can publish literally anything ('secondary sources'), either or both in print and, especially, on-line, regardless of its scientific quality or whether or not it has undergone peer-review. This is particularly troublesome for biologists and systematists because there is currently no universally recognized means of labeling what information has been peer-reviewed and thus invested with the 'official' approval of the scientific community. Scientists are fundamentally educators, whether educating other scientists or the general public, and it is the public in particular that is usually unable to distinguish between valid (primary) and questionable (secondary) scientific information sources on the WWW. Teachers and librarians often spend a great deal of time teaching students how to differentiate primary and secondary sources. The public (including neophyte biologists) may thus be easily

misinformed. This is a significant problem that continues to be addressed on many levels in the scientific and educational communities. Because of this, WWW sites, even if they contain valid scientific information, are rarely cited in the bibliographies of scientific papers and are generally viewed with some suspicion by scientists.

However, it must also be emphasized that the Internet carries a substantial boon to the scientific community (Godfray, 2002). Numerous WWW-based taxonomic initiatives already exist (see review in Mallet & Willmott, 2003), and it is becoming more widely recognized that electronic access to, and dissemination of, information will be critical to a more complete assessment of biodiversity (Wilson, 2003). There is, however, a more important and immediate benefit: specifically, the easy, instantaneous, widespread distribution of formal, peer-reviewed, scientific documents. The debate, as it presently stands, is 'Which is more powerful: the negative ability of the Internet to mass-produce fallacious, unfounded, and uncitable information, or its positive capacity to easily disseminate truly valuable scientific documents?'

#### **Electronic publishing and the Code**

Although most biologists are not systematists (Garrity & Lyons, 2003), the act of naming new taxa remains a fairly common occurrence and is still a fundamental process. It must be emphasized that the International Code of Zoological Nomenclature does not concern itself with matters of quality (peer-review), only with the rules of establishing new, or emending existing, names. As a result, there is no real difference in content between a nomenclatural action that appears in a manuscript in a non-peer-reviewed journal, a non-peer-reviewed document that is self-published in a print medium (e.g. Olshevsky, 1991, an often cited palaeontological example) or an electronic document. (It should be noted that many electronic documents, particularly on-line versions of established journals, *are* peer-reviewed). However, because of the wide (and ever-growing) availability of Internet access and because of the establishment of a system for universal citability of on-line documents, Articles 8 ('What constitutes published work') and 9 ('What does not constitute published work') of the Code now contain a paradox that is more a response to one potentially harmful aspect of the Internet (lack of consistent citability) than an acknowledgement and acceptance of its greatest power (facilitating rapid and broad-scale distribution of systematic documents). Article 8 states that a published work must be (a) issued for the purpose of providing a *public and permanent* scientific record, (b) obtainable *free or by purchase*, and (c) produced in an edition containing simultaneously obtainable copies by a method that assures *numerous identical and durable copies* (emphasis here by the current author). Article 9 specifies numerous qualifications to Article 8 rules and outlines specific things that do *not* constitute a 'published work'; of particular interest here is Article 9.8, which specifies that 'text or illustrations distributed by means of electronic signals (e.g. *by means of the World Wide Web*)', does not constitute a 'published work'.

These rules were not, of course, created on a whim – there are sound, logical reasons behind them. A 'public and permanent' scientific record lies at the heart of scientific publishing, both for the education of the scientific community and public as well as for providing access to literature by future generations. 'Numerous identical and durable copies' again addresses the concept of long-term preservation for future

generations. Distribution 'by means of the World Wide Web' was undoubtedly singled out as an unacceptable means of taxonomic publishing for reasons of (1) long-term preservation, (2) accessibility, and (3) citability. The aforementioned paradox in the current Code is that none of these is any longer a substantial impediment to achieving the goals of the Code regarding zoological nomenclatural actions with respect to electronic documents.

### **Electronic documents and long-term preservation**

In the electronic age, the concept of 'long-term preservation' of a document containing information pertinent to zoological nomenclature must be viewed from two standpoints: one in comparison to hard-copy (i.e. print) preservation and one of the inherent properties of the electronic medium.

Numerous, widespread libraries, whose fundamental purpose is to preserve information, largely in hard-copy (print) publications, for long-term use by generations of readers continually deal with random factors that act to destroy such publications. These factors are numerous and range from internal paper acidity to external factors such as climate, consumption by a variety of organisms, etc. Frequently, important documents are reduced to 'rare' status, viewable only by a select (usually local) few and only under special circumstances. The Code has provisions dealing specifically with older (pre-1930) publications, but in the broader sense, any 'modern' publication will, in the long-term, be subjected to the same issues, and 100+ years from now, they may be in similar physical situations to what are currently considered 'old' publications. Certainly, concern over issues of paper quality, climate control, etc. have lessened as technology has advanced, greatly improving the preservability of many documents, but certainly not all: numerous documents covered under the post-1930 provisions of the Code will suffer as have many of their pre-1930 counterparts. In short, a document's existence in hard-copy form is not a guarantee of either its accessibility to the broadest possible range of the scientific community or its continued existence through time.

Electronic publications, while certainly not as subject to the physical entropies of paper quality, climate, etc., do indeed suffer from preservational issues. There is little disagreement that anything published electronically *must* be archived in some format. WWW addresses and accessibility have not yet achieved the stability enjoyed by more tangible institutions. The most important, and readily visible, issue is the continual change in preferred conservation media. Many electronic documents of just a few decades ago, preserved on such media as floppy disks and other removable cartridges, though 'preserved', are no longer accessible simply because the technology required to view them is not widely available. More recently, there has been a shift to storage on compact discs (CDs) and digital video discs (DVDs), as well as newer types of proprietary removable cartridges (e.g. flash drives, etc.), and there is a general sense of permanence. However, given the rate of technological change, there is no way to determine whether or not, even 10 or 20 years from now, anyone will have the ability to retrieve information from these media. It is an expensive proposition to continually update libraries of stored electronic data to the currently favored common medium, and few, if any, libraries have the funds or willingness to accept such responsibility. More worrying is the possibility, however unlikely, of some global catastrophe that disables electronic systems. In such a case, even if the instruments

exist to read electronically-stored information, it could not be activated. Hard-copy publications, of course, do not suffer this particular drawback.

One way to avoid this problem is the dissemination of both hard-copy *and* electronic versions of a document. Provided these versions are identical in every aspect (including citability), the information contained in the manuscript is simultaneously widely available and preserved for long-term use. Printing electronic manuscripts is already commonplace with individual zoologists; its practice amongst archival institutions is unknown. Most electronic documents *do* exist in numerous hard-copy editions. This is particularly true of scientific journals that use the WWW to distribute papers contained in their issues while also producing printed, hard-copy editions of the journal. The only new problem created by this practice is one of timing (see below). In summary, electronic documents really are not any more or less preservable than hard-copies; the issues surrounding the means of preservation are simply different. But just as preservation issues do not prevent the use of print media, they should also not impede the publication of zoological nomenclatural actions in electronic media as long as archival requirements are met.

#### **Electronic documents and accessibility**

As before, issues of electronic document accessibility require comparison with print-only versions. One frequently encountered reservation about electronic documents and the WWW is that computer access is severely limited in many parts of the world. Electronic documents are simply unavailable to many researchers. While there can be no doubt of the truth of this fact, the argument is actually false because hard-copy manuscripts can be, and often are, just as inaccessible as (or even less accessible than) electronic media. This is particularly true of publications by small, regional institutions and small-press or self-published documents, both of which often suffer from severely restricted distributions. A few avenues are available for obtaining such materials (e.g. InterLibrary Loan programs) but, as noted above, some documents are too rare or too fragile to be copied or lent. Occasionally, even locating a subscribing institution proves impossible. In the end, some material simply cannot be accessed, regardless of whether it is electronic or in print. If anything, electronic media have an advantage over print in this respect; some programs (e.g. the United States Library of Congress National Digital Information Infrastructure and Preservation Program, <http://www.digitalpreservation.gov>, and the Million Books Project, <http://zeeb.library.cmu.edu/Libraries/LIT/Projects/1MBooks.html>) are in place to scan rare and fragile hard-copy manuscripts into an electronic form that can be instantly transmitted or from which copies can be printed at leisure without further need to access the original. Such copies can be easily lent, sold, or given on request.

#### **Electronic documents, timing, citability, and the concept of ‘Publication’: a case study**

In 2002, an issue arose concerning the name of a new fossil taxon that demands a re-examination of the Code’s rules concerning electronic documents. Zhang et al. (2002) established *Epidendrosaurus ningchengensis* based on a specimen of a peculiar, small, theropod dinosaur from the Upper Jurassic-Lower Cretaceous Daohugou Formation (a probable correlate of the Yixian Formation) of Nei Mongol Province, China. The paper defining and diagnosing the taxon was initially released in the

on-line version of the respected journal *Naturwissenschaften* on 21 August 2002. Because hard-copy publication and distribution necessarily take more time than electronic publication, the print version of the same article (indeed the same issue of the journal) did not appear until 30 September 2002 (D. Czeschlik, pers. comm., 2003).

At about the same time, Czerkas & Yuan (2002) introduced *Scansoriopteryx heilmanni* for a very similar specimen from the Yixian Formation in neighboring Liaoning Province. *S. heilmanni* was published in the inaugural issue of *The Dinosaur Museum Journal* of the Dinosaur Museum in Blanding, Utah, an auspicious publication that meets all the regulations of Article 8 of the Code. However, because it was distributed (largely by mail order) from a single locale by a small institution, it unfortunately suffered a reduced distribution compared with *Naturwissenschaften*. Although there has been no formal, published (in any format) comparison of the two specimens to determine whether or not they represent a single species, they bear certain unusual, probably autapomorphic features that suggest that they do in fact represent the same taxon. The question is: which name — *Epidendrosaurus ningchengensis* or *Scansoriopteryx heilmanni* — is valid for this taxon?

The volume in which the *S. heilmanni* paper appeared bears a publication date of 1 August 2002, and by Article 21 of the Code, this should be considered the ‘date of publication’ and obviously predates the 21 August appearance of *E. ningchengensis*. The issue of *The Dinosaur Museum Journal* appears, however, not to have become widely available (i.e. distributed or available for distribution by purchase) until about 2 September 2002, after the 21 August 2002 electronic *Epidendrosaurus* paper but before the 30 September 2002 hard-copy publication date. By strict letter of Article 21 of the Code, *S. heilmanni* should have priority over *E. ningchengensis*. However, while the Code goes to great lengths to describe what constitutes both the date of publication, and the criteria for publication, of taxonomic names, it does *not* discuss what is, in the ontological sense, a ‘publication’. A ‘publication’, as inferred from Article 8, can be defined as constituting either (a) the first *appearance* in print of a zoological taxon name that meets Article 8 specifications, regardless of whether or not that printing is distributed, or (b) the first actual, hard-copy release (distribution) of the manuscript defining and diagnosing the taxon that meets Article 8 specifications. As the *Epidendrosaurus/Scansoriopteryx* case highlights, there can be a substantial time difference between ‘publication’ as a matter of the date a paper came off the printing press, and ‘publication’ as a matter of distribution to the public. The difference is best illustrated by an extreme hypothetical situation: a ‘publication’ (e.g. the printing of hard copies) of a document occurs on 1 January 2005, but then all copies of the ‘publication’ are stored in a warehouse, wholly inaccessible to anyone. Distribution does not occur until a much later point in time — let us say, 1 July 2008. In accordance with Article 21, the date imprinted on the document (1 January 2005) is the date to be cited for the publication and any nomenclatural actions therein, and any competitive actions published after that date are subject to synonymy. Ostensibly, the document was printed with every intention of being issued for the purpose of providing a public and permanent scientific record (satisfying Article 8.1.1) and in simultaneously obtainable copies by a method that assured numerous identical and durable copies (satisfying Article 8.1.3) long before it is distributed. But this is nullified by the requirement of Article 8.1.2 because, as of the printed date, it was not available to the public.

In the real world, of course, it is unlikely that anyone would purposefully delay distribution of a document. However, a myriad of factors (mechanical, operational, logistical, etc.) can delay the actual distribution of an end product. Because of the potential, either accidental or deliberate, for delay between the dates of printing and distribution, it is clear that the date of actual production (i.e. emplacement on a hard-copy medium) *cannot* satisfy Article 8.1.2. Only the date of *issue* to the public can fulfil this criterion, and thus create a ‘published work’ as defined by Article 8. In short, if it is not available to be viewed by the public, then it cannot be considered ‘published’. (Incidentally, this is already something of a dispute when citing some papers. Journals that are issued on a periodic but regular basis frequently print the final yearly issues of a journal in December of one year, with the date of that year imprinted on the cover along with the volume number, but it often takes enough time for the issue to circulate to libraries and other subscribers that it effectively only becomes viewable in January of the next year. The debate centres on the proper citation of the issue: does it include the year in which the issue was printed or the year it was distributed? Conversely, issues of some publications bearing a ‘January’ date are available in the preceding December, and similar issues arise). There are, however, valid concerns over how to pinpoint a date of ‘publication’, in terms of distribution and broad availability, because (a) distribution would depend entirely on the time of its first mailing to subscribers, first customer order, or first shipment to a public library, and (b) distribution time increases with distance from the distribution center. The latter would require an arbitrary delineation of some geographic radius from the distribution center that would constitute an equally arbitrarily defined ‘sufficient’ number of people to constitute the ‘public’ specified in Article 8.1.1. This issue remains to be resolved.

Given this, it seems that *E. ningchengensis* should have priority over *S. heilmanni*, since it was the first name issued in proper format to the public in a manner that meets *all* the criteria of Article 8. In point of fact, between 21 August and 30 September 2002, downloads of the electronic version of the *E. ningchengensis* paper formed a noticeable percentage of the total number of downloads from the relevant issue of *Naturwissenschaften* (D. Czeschlik, pers. comm., 2003) — it was thus both widely available and broadly distributed. The only remaining impediment for the nomenclatural validity of *E. ningchengensis* is that the paper falls under the purview of Article 9.8: its initial release on 21 August was in electronic format. The electronic version of the *E. ningchengensis* paper is identical in all respects to the hard-copy, printed version issued later by *Naturwissenschaften* except in two ways: (1) the time of issue, and (2) the ISSN number of the issue (the electronic version is 1432–1904, while the printed copy is 0028–1042). The latter is unimportant since ISSN numbers are rarely provided in bibliographic citations. However, the identical content of both versions do share a unique means of being cited: the Digital Object Identifier (DOI) code. DOIs provide a means of referencing the same body of information, regardless of its existence in electronic and/or printed format.

#### **Electronic documents, citability, DOIs and the Code**

The DOI system is commissioned and managed by the not-for-profit International DOI Foundation (for detailed information, see <http://www.doi.org>). A DOI consists

of a series of numbers and letters that is unique to any one document (one unique set of documents), regardless of format. Technically, DOIs are not limited to text-based publications, but can be issued to photographs, etc. For the purposes of this proposal, only scientific publications will be considered. The DOI consists of a prefix and a suffix, each with no length requirement. The prefix refers to any issuing organization; an organization may have more than one, but for the purposes of zoological nomenclature, it is probable that all issues of a journal series would have the same prefix. The suffix identifies the individual document and its characters can contain the name of the journal as well as the date of issue along with the unique code for each individual document. For electronic documents, the DOI can be coupled with a Uniform Resource Locator (URL, or WWW address) to become 'actionable': one can simply click on the DOI to be brought directly to the relevant document (assuming subscription access is available, an obstacle shared with print media). As an example, the DOI number for the *E. ningchengensis* article is doi:10.1007/s00114-002-0353-8, and its citable URL affiliate would be <http://dx.doi.org/10.1007/s00114-002-0353-8>. The reader is referred to the list of cited references below to view an example of the inclusion of a DOI in a bibliographic citation. In essence, the DOI is a 'supercharged bar code' (Walter, 2001) for publications and, more importantly, content. (The electronic version of a document accessed via its DOI number has an additional advantage over traditional, paper documents in that the electronic version can contain links to other DOI material — in essence, a document can 'contain' its referenced documents for easy access (Walter, 2001)). Because both the 21 August electronic and 30 September printed versions of the *E. ningchengensis* article have the same DOI number, they are cited identically, and the dual 'publication' dates become irrelevant; only the first one matters, and the date of publication is firmly defined as 21 August 2002.

Archival systems (e.g. CrossRef) currently register DOIs for journal articles, and those registrations are carried into databasing systems (e.g. MedLine, ISI); future expansion of this system may include book chapters, conference proceedings, etc. (Paskin, 2002). Of more immediate significance, an increasingly large number of journals relevant to the zoological community are registering DOI numbers for their content, including *Nature* and *Science*. Although no zoological journal has yet taken this step, DOI numbers are succeeding even page numbers in some prominent journals (e.g. *Physical Review* of the American Physical Society (APS) — articles are cited using *only* their unique DOI suffixes, e.g. *Physical Review A* 67: 050301 [2003] — readers can examine this practice first hand via the APS publications web site at <http://pra.aps.org>). This practice, probably appearing ungainly to readers unfamiliar with it, alleviates the need to await a hard-copy publication to establish page numbers for a 'complete' bibliographic citation of a paper. This allows for easier and faster incorporation of newly published material into manuscripts and thus the more rapid completion of manuscripts for submission, keeping submitted content timelier. In a somewhat less radical step, *Nature* provides DOI numbers for articles available on-line prior to hard-copy issuance and recommends that, until a printed copy with page numbers is available, on-line articles be cited using only the DOI number (this directive is spelled out at *Nature's* Advance On-line Publication (AOP) site, [http://www.nature.com/cgi-taf/DynaPage.taf?file=/nature/journal/vaop/ncurrent/toc\\_r.html](http://www.nature.com/cgi-taf/DynaPage.taf?file=/nature/journal/vaop/ncurrent/toc_r.html)). *Nature* also specifies (<http://www.nature.com/nature/journal/>

vaop/ncurrent/about.html) that their AOP versions of an article are definitive *because* of their DOI numbers. (At the same site, *Nature* also discusses the increasing irrelevance of the date of printing as a 'publication date' owing to the advent of electronic publication). In the case of *E. ningchengensis*, *Naturwissenschaften* makes the same statement at <http://www.springeronline.com/sgw/cda/frontpage/0,10735,5-113-2-99044-0,00.html>; undoubtedly, other journals have similar proclamations. The 21 August, electronic version of the *E. ningchengensis* paper, is, therefore, definitive in all the same ways as would be any hard-copy release. In a move perhaps highly significant for the Code, steps are currently under way to utilize the DOI system to establish new standards for the International Code of Prokaryotic Nomenclature (Garrity & Lyons, 2003).

The DOI system also alleviates the ephemeral nature of the URL system — the DOI number will always 'point' to the same content regardless of whether the URL of the issuing organization or journal changes or disappears. DOIs thus act as a single, authoritative repository for data (Paskin, 2002). It thus *increases* the long-term preservability of electronic media while simultaneously not interfering with its ability to be used for active research (Paskin, 2002). Although it does not address the concept of long-term archiving of electronic documents on some storage medium, the nature of DOI architecture is such that new means of accessing data can be created at any point in time to access the same raw data (i.e. document content) (Paskin, 2002 and references cited therein). This goes a long way toward addressing issues of publication availability in the face of rapidly-changing technology, and provides electronic documents a longevity similar to that of traditional, hard-copy publications.

### Conclusions

I propose to the Commission that, under Article 78.3 ('Amendments to the Code'), Articles 8 and 9 of the current Code require both pro- and retroactive (to the effective date of the Fourth Edition, 1 January 2000) modification to accommodate the following issue: documents published electronically *with DOI numbers and that are followed by hard-copy printing and distribution* be exempt from Article 9.8 and be recognized as valid, citable sources of zoological taxonomic information and that their electronic publication dates be considered definitive. Note that this does not *require* electronic publications to have DOI numbers; only that any paper appearing in electronic format that *does* have a DOI number, and is followed by traditional, hard-copy issuance, is an acceptable place for the appearance of zoological nomenclatural action. Electronic publications lacking DOI numbers lack the citability benefits enjoyed by DOI registered documents and, regardless of whether followed by hard-copy release, will still be subject to Article 9.8 and be considered invalid for zoological nomenclatural actions. Such a change may be issued as a Declaration (Article 78.3.3 and subject to the provisions of Article 80.1), since it entails only minor changes to Articles 8.1.3 and 9.8, as follows (recommended additions in italics):

Article 8.1.3. It must have been produced in an edition containing simultaneously obtainable copies by a method that assures numerous identical and durable copies, *including documents that contain identical Digital Object Identifier numbers and for which electronic documents are followed by hard-copy release.*



Article 9.8. Text or illustrations distributed by means of electronic signals (e.g. by means of the World Wide Web), *except where such material meets the provisions of Article 8.1.3; or . . .*

No change is required to Article 21 because the date inherent to a DOI assignment falls within the scope of Article 21.2, as worded.

The clause added to Article 8.1.3 may, to ensure incentive is provided to follow electronic copies with paper printing for additional archival security, have inserted a specified maximum amount of time after which a hard copy *must* follow the electronic version, failing which any nomenclatural action in the electronic version becomes void. A name published electronically but never followed by hard copy issue would be invalid, and the validity of any names (potential synonyms) proposed subsequent to its electronic issue would follow their chronological issue. This would create brief periods (the time frame between electronic issue and the final date during which the name would be valid only if subsequently issued in print) during which synonymy could not be established because one criterion (the time aspect) has not been fulfilled — the electronic name would be ‘conditionally available’. No ready solution to this problem presents itself, though the author notes from personal observation that, for most journals, the amount of time separating electronic and hard copy publication is usually less than three months. Longer mandated periods of time would increase the potential for this type of problem to occur, but longer periods would be desirable because they allow temporary hard copy publication problems to be overcome. The establishment of a formal, mandatory registry of animal names as part of the Code (present or future), as has been suggested on many past occasions (e.g. Thorne, 2003), would help alleviate the problem by tracking the validity of names and their dates of description (which can be based on, and easily tied to, a DOI), making it easier to determine whether or not a conditionally available name ever becomes fully available and, if not, which subsequently proposed name would become the senior synonym. The same principle would apply to any junior homonym published during this period of conditional availability; such a homonym would not be valid unless or until the senior homonym lost its validity by which time a substitute name might have been proposed for the junior name.

With the ever increasing number of researchers working on a finite set of zoological taxa, combined with the advent (and increasing prevalence) of electronic publication, situations such as that exemplified by the *Epidendrosaurus ningchengensis*/*Scansoriopteryx heilmanni* case could easily become more common. It is thus critical that the Commission takes steps to alleviate such situations and regulate taxonomic synonymies by recognizing that some electronic publications (those with DOIs) constitute ‘publication’ as much as any printed manuscript does. Should the Commission adopt the recommended changes, the *E. ningchengensis*/*S. heilmanni* case (should they prove to represent the same taxon) is readily resolved without further involvement by the Commission, as *E. ningchengensis* is demonstrably the senior name.

Recognizing DOIs as a suitable means of identifying content that contains nomenclatural actions in joint electronic and paper publishing enables zoological systematists to take advantage of accelerated publishing and more widespread and rapid distribution of zoological matter to both the scientific community and the

public. Furthermore, it would be a logical amendment in light of the fact that the scientific publishing community, as exemplified by *Nature*, *Naturwissenschaften*, and numerous others, has itself redefined the term ‘published’ to include electronic publications. The amendments recommended here target the distinctive — and highly desirable — benefits inherent in coupling rapid on-line publication and widespread distribution with the traditional benefits enjoyed by print media and serve to augment the purpose of the Code: the stability of zoological nomenclatural actions.

### Acknowledgements

The formulation of the amendments proposed herein resulted from numerous, educational conversations with Dr Norman Paskin and Miss Nadia Halabi (International DOI Foundation), Drs Tatiana and Dieter Czeschlik (*Naturwissenschaften*), and Ed Pentz (CrossRef) concerning the use of DOIs in publication, databasing, and archiving. Miss Jean Lacovara (Bryn Mawr College) graciously provided the perspective of the library community on archiving and the use of libraries as research institutions. Drs Zhang Fucheng and Zhou Zhonghe (Institute of Vertebrate Paleontology and Paleoanthropology) welcomed discussion of their experience with international publication issues. On-line conversations with Drs Robert Güsten (Hessisches Landesmuseum), Bill Eschmeyer (California Academy of Sciences), Neal Evenhuis (Bishop Museum), and Ron Gatrell (The International Lepidoptera Survey) provided excellent feedback and food for thought. Valuable discussions and comments on earlier versions of this manuscript were provided by Dr Peter Dodson, Miss Barbara Grandstaff, Dr Matt Lamanna, Miss Suzanna Richter, and Miss Lisa Rodrigues (University of Pennsylvania), and Drs Neal Evenhuis and Andrew Polaszek (International Commission on Zoological Nomenclature). The author declares that he is in no way affiliated with, nor was he approached by, the IDF.

### References

- Czerkas, S.A. & Yuan, C. 2002. An arboreal maniraptoran from northeast China. Pp. 63–95 in Czerkas, S.J. (Ed.), *Feathered Dinosaurs and the Origin of Flight*. The Dinosaur Museum Journal 1. The Dinosaur Museum, Blanding, U.S.A.
- Garrity, G.M. & Lyons, C. 2003. Future-proofing biological nomenclature. *OMICS*, 7: 31–34.
- Godfray, H.C.J. 2002. Challenges for taxonomy. *Nature*, 417: 17–19. doi: 10.1038/417017a.
- Mallet, J. & Willmott, K. 2002. Taxonomy: renaissance or Tower of Babel? *Trends in Ecology and Evolution*, 18(2): 57–59. doi:10.1016/S0169-5347(02)00061-7.
- Olshevsky, G. 1991. A revision of the Parainfraclass Archosauria Cope, 1869, excluding the advanced Crocodylia. *Mesozoic Meanderings*, 2: 1–196. (Self-published).
- Paskin, N. 2002. Digital Object Identifiers. *Proceedings of ICSTI Seminar: Symposium on Digital Preservation of the Record of Science, ICSTI, 14–15 February 2002*. [http://www.doi.org/topics/020210\\_CSTI.pdf](http://www.doi.org/topics/020210_CSTI.pdf).
- Thorne, J. 2003. *Zoological Record* and registration of new names in zoology. *Bulletin of Zoological Nomenclature*, 60(1): 7–11.
- Walter, M. 2001. E-book project highlights role of DOI in selling digital content. *The Seybold Report*, 1(6): 8–12.
- Wilson, E.O. 2002. The encyclopedia of life. *Trends in Ecology and Evolution*, 18(2): 77–81. doi:10.1016/S0169-5347(02)00040-X.

**Zhang, F., Zhou, Z., Xu, X. & Wang, X.** 2002. A juvenile coelurosaurian theropod from China indicates arboreal habits. *Naturwissenschaften*, **89**: 394–398. doi:10.1007/s00114-002-0353-8.

---

Comments on this article are invited for publication (subject to editing) in the *Bulletin*; they should be sent to the Executive Secretary, I.C.Z.N., The Natural History Museum, Cromwell Road, London SW7 5BD, U.K. (e-mail: iczn@nhm.ac.uk).