

NOMENCLATURE

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Report of the Special Committee on Electronic Publication

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Abstract The Special Committee on Electronic Publication was re-established at the XVII International Botanical Congress (IBC) in Vienna in 2005, with the mandate to consider on the issues relating to the electronic publication of nomenclatural novelties and to report to the XVIII IBC in Melbourne in 2011. With the global push to inventory biodiversity and to develop information systems to disseminate data, issues surrounding speed of publication, copyright and licensing, and permanence and accessibility of information have surfaced. Electronic publication is central to these issues, and the insistence of the *International Code of Botanical Nomenclature (Code)* on distribution of printed matter for effective publication is seen by many as a hindrance to progress. Against this backdrop, the Committee conducted extensive negotiations and discussions on a wide range of issues on electronic publication, which are here summarized in the Committee's report. The Committee unanimously supports the extension of effective publication to electronic publication, but in a well-regulated way that will establish the basis for long-term archiving and discovery. The Committee has put forward a set of eleven proposals (Special Committee on Electronic Publication, 2010) to amend the *Code* to permit electronic publications to be considered effectively published under specified conditions on or after 1 January 2013. It is proposed that electronic material will be effectively published only when distributed in Portable Document Format (PDF) in an online serial publication with an International Standard Serial Number (ISSN). An additional proposal extends this to PDF with an International Standard Book Number (ISBN). Further proposals strengthen this by forbidding post-publication alteration and by discounting preliminary versions as not effectively published. The current method for establishing the date of effective publication is amended to account for electronic material. These changes to the Articles of the *Code* are supported by a set of Recommendations for best practice for electronic publication of nomenclatural novelties, covering aspects of archiving and immutability, dissemination of data, and clear designation of versions as preliminary or final. This report provides the supporting documentation for the set of proposals that are also published in this issue. It is necessary that the two be read alongside each other.

Keywords electronic archiving; electronic publication; effective publication; immutability; *International Code of Botanical Nomenclature*; ISBN; ISSN; nomenclature; PDF; PDF/A

■ INTRODUCTION

The current Special Committee on Electronic Publication, re-established by the XVII International Botanical Congress in Vienna in 2005 (McNeill & al., 2005), is the third such Committee. The two previous Committees, established by the Tokyo and Saint Louis Congresses, respectively (Nicolson, 1994; Barrie & Nicolson, 2001), made proposals that would permit electronic publication to constitute effective publication under the *International Code of Botanical Nomenclature* (currently McNeill & al., 2006). However, these proposals received a more than 75% “no” vote in the preliminary guiding mail vote of both Congresses and were therefore ruled as defeated at the respective subsequent Nomenclature Sections of those Congresses (Barrie & Greuter, 1999 [Art. 29 Prop. C, Art. 32 Prop. H]; McNeill & al., 2005 [Art. 29 Prop. A–B]). Nevertheless, the Vienna Congress did modify the *Code* to include Recommendations on electronic publication, following additional proposals made from the floor of the Nomenclature Section by

an *ad hoc* group that included members of the Special Committee established in Saint Louis (McNeill & al., 2005).

The current Special Committee now believes it is time to take another step toward acceptance of electronic publication under the *Code*. The Committee has conducted extensive negotiations and discussions on a wide range of aspects of allowing electronic publication, including discovery, access, immutability, and archiving. The arguments both for and against many of these issues are documented below, with the reasons behind the agreed proposals given. The proposals are presented separately in an article under “Proposals to amend the Code” in this issue (Special Committee on Electronic Publication, 2010).

The Committee comprises 25 members, as follows: Mary E. Barkworth (UTC), Bernard R. Baum (DAO), William R. Buck (NY), Katherine M. Challis (K), Arthur D. Chapman (Toowoomba, Queensland, Australia), Laurence J. Dorr (US), Renée H. Fortunato (BAB), Susan Fraser (NY), Hugh F. Glen (NH), Martin J. Head (Brock University, St. Catharines, Ontario, Canada), Elvira Hörandl (WU), Douglas Holland (MO),

Victoria C. Hollowell (MO), Paul M. Kirk (IMI), Joseph H. Kirkbride, Jr. (NA), Sandra Knapp (BM), Pierre-André Loizeau (G), Karol Marhold (PRC/SAV), Peter Phillipson (MO/P), Peter A. Schäfer (MPU), Peter F. Stevens (MO), Nicholas J. Turland (MO), Mark F. Watson (Secretary, E), Karen L. Wilson (Convenor, NSW), and Richard H. Zander (MO).

There are also two *ex officio*, non-voting members: John McNeill (E), the Rapporteur-général of the Vienna and Melbourne Congresses, and Richard L. Pyle (Bishop Museum, Honolulu, Hawaii, U.S.A.), representing the zoological community.

The Committee's discussions and voting were conducted by e-mail in conjunction with a "Google Group" discussion forum (<http://groups.google.com>) set up and maintained by the Secretary, Mark Watson.

■ THE NEED

With the push to inventory biodiversity and to develop tools to disseminate biological information in an accessible format, issues surrounding speed of publication, copyright and licensing, and permanence and accessibility of information have surfaced. These intersect in electronic publications, an increasing part of the scientific publishing scene. Currently, electronic publication is still explicitly prohibited from constituting effective publication under the *Code*, which requires "distribution of printed matter (through sale, exchange, or gift) to the general public or at least to botanical institutions with libraries accessible to botanists generally" (Art. 29.1).

This Committee is aware that the *Code* exists through the agreement and good nature of scientists and practising taxonomists around the world. It is not backed by any legislation, either nationally in any country, or internationally. The Committee believes that if the *Code* becomes an impediment to scientists publishing their work, then that agreement may break down and those scientists may decide to bypass the *Code* and publish anyway. With increasing ease of publishing electronically, there is the possibility of many more names being published in contravention of the *Code*. Also, because of the ease of distribution and access to these publications, many of the names so published may begin to be accepted by the broader public and scientific community, and this could lead to an increasing feeling of irrelevance of the *Code*. This is something that we do not want to see, as it would lead to chaos in the field of taxonomy and nomenclature and we will have a huge task trying to make sense of the names that are being used. With this in mind, this Committee has agreed that it is now an opportune time for the *Code* to allow for the effective electronic publication of names and other nomenclatural acts, but in a well-regulated way that will establish the basis for long-term archiving and discovery.

The cost of hard-copy journals has increased to the stage where many libraries, and especially those in developing countries, can no longer afford to subscribe to them. It has therefore become very difficult for taxonomists in these countries to be able to do their work. The *Code* was never meant to be an

impediment to the science of taxonomy, but in recent times, by not keeping up with changes in technology and the way taxonomists work, and by continuing to restrict publication to hard-copy journals and monographs, it has become so. Also, the cost of publishing in these international journals is becoming prohibitive to scientists and many of the institutions that employ them, with the result that scientists in developing countries are increasingly publishing in small, less expensive, in-country journals and monographs that have very limited circulation and very little international reach. This is increasing the difficulty for scientists all over the world to discover and gain access to publications. As stated by Knapp & al. (2007) "[t]he difficulty of tracking down taxonomic publications has rightly been identified as the greatest impediment to the work of taxonomists and its use by other biologists."

Another big advantage of electronic publication is that it allows the inclusion of information that is either too difficult or too costly to publish in hard copy – for example, full lists of specimens examined, large spreadsheets, high-quality colour images, or interactive keys. Indeed, many hard-copy journals will not accept much of this type of information for publication, except sometimes as electronic supplements.

Already, there are a number of high-quality electronic journals that allow for the publication of names of organisms. Some of these, such as *Biota Neotropica* (see below) are published in developing countries. It is estimated by one of the present Committee members (Challis) that there are currently about 150 electronic journals publishing vascular plant names. The majority of these publish both electronic and hard-copy versions, although the hard-copy versions are often in very low numbers.

To comply with effective publication under the current *Code*, some journals make printed copies available to a limited number of libraries. There is an extra burden and cost in doing this for the agencies responsible for these publications, and a new editor at some time in the future could decide to cease this practice because of the difficulties involved. There is also an extra burden placed on the libraries, which may not have the staff time or resources to catalogue and preserve an increased number of "reprints". It may be that the printed copies are received by the libraries but never properly catalogued, so that finding them is an extremely difficult task. Already there are examples of scientists publishing in electronic-only journals (i.e., one without a parallel printed version) and sending a few reprints to libraries to satisfy the *Code* – see, for example, articles by Cressey (2010) and Knapp & al. (2010), which discuss an electronic-only paper by Knapp (2010) on four new species of *Solanum* in the journal *PLoS ONE*. We quote here from Knapp (l.c.); this information is also in the instructions to authors of *PLoS ONE* (see <http://www.plosone.org/static/guidelines.action> and go to item no. 6, "Discipline-Specific Requirements"):

The electronic version of this document in itself does not represent a published work according to the International Code of Botanical Nomenclature ... Therefore, a separate edition of this document was produced by a method that assures numerous identical printed copies, and those copies were simultaneously distributed (on the

publication date noted on the first page of this article) for the purpose of providing a public and permanent scientific record, in accordance with Article 29 of the Code. ... The separate print-only edition is available on request from PLoS (Public Library of Science) ... In addition, new names contained in this work have been submitted to IPNI [The International Plant Names Index] (<http://ipni.org>), from where they will be made available to the proposed Global Names Index. The IPNI LSIDs (Life Science Identifiers) can be resolved and the associated information viewed through any standard web browser by appending the LSID contained in this publication to the prefix <http://ipni.org/>.

The online version of this work is archived and available from the following digital repositories: PubMedCentral (www.pubmedcentral.nih.gov/) and Solanaceae Source: a web resource for the nightshade family (<http://www.solanaceaesource.org>).

Knapp's article is most conveniently accessed through the World Wide Web (there had already been 1958 visits as of 10 September 2010), even if one cannot remember the exact title. It can be copied or otherwise widely disseminated subject only to mild restrictions such as the Creative Commons Attribution 3.0 license (<http://creativecommons.org/licenses/by/3.0/>). Furthermore, articles like these can be semantically tagged or otherwise semantically enhanced, so making the information very rapidly disseminated and used (Penev & al., 2010).

Some may see this growing trend as an example of the scientific community moving ahead when the Code has failed to keep up with the times. It is fortunate that, in this case, a "loophole" in the Code is being exploited, rather than the Code simply being ignored. But is this a good thing? Should the Code not provide what its users actually want, rather than impose anachronistic rules that have to be ingeniously circumvented?

PLoS ONE (<http://www.plosone.org/>) has become a world-renowned, interactive, open access journal for peer-reviewed papers from scientific and medical research. It has been able to establish excellent online systems for submission and peer review of papers; systems that improve the efficiency and speed of the review process and reduce the time needed for a paper to be published, thereby leaving more time for research.

The following are some further examples of electronic journals that are publishing new names while satisfying the Code by making available a limited number of offprints or hard copies to libraries:

- *Biota Neotropica* (<http://www.biotaneotropica.org.br/>) is published in Brazil and provides opportunities for publishing peer-reviewed papers in any of three languages (English, Portuguese, Spanish) with the abstracts available in all three languages. It is using the advantages of electronic publication to index all names occurring in a paper with XML (Extensible Markup Language), and is placing this index at the front of the document after the key words.

- *Opuscula Philolichenum* (<http://sweetgum.nybg.org/philolichenum/>) provides "an outlet for the publication of short papers in lichenology, especially small floristic works, checklists, and modest taxonomic revisions." It is published electronically in PDF (Portable Document Format) and has an ISSN (International Standard Serial Number).

- *PhytoKeys* (<http://pensoftonline.net/PhytoKeys.pdf>), which is currently in the process of being launched, "is a peer-reviewed, open access, rapidly produced journal launched to support free exchange of ideas and information in systematic botany and mycology ... All papers published in *PhytoKeys* can be freely copied, downloaded, printed and distributed at no charge for the reader."

- *Phytotaxa* (<http://www.mapress.com/phytotaxa/>) is a peer-reviewed international journal for rapid publication of high-quality papers on any aspect of systematic botany, with a preference for large taxonomic works such as monographs, floras, revisions, and reviews. It provides for both open access and subscription-only papers.

Open access journals are generally based on the model of "author pays, reader accesses for free" rather than "author pays no fee, reader pays through subscription"; fees in many open access journals are reduced or waived for authors from the developing world, but they can be an impediment.

Users of the Code should also be aware that users of the *International Code of Zoological Nomenclature* (ICZN – Ride & al., 1999) are currently discussing the issue of electronic publication. Proposals have been made to amend the ICZN so as to permit electronic publication (International Commission on Zoological Nomenclature, 2008; see also <http://iczn.org/content/availability-electronic-publication>). The main points of these proposals are that (1) electronic-only publications should be allowed, if mechanisms can be found that give reasonable assurance of the long-term accessibility of the information they contain; (2) some method of registration (e.g., ZooBank, see Polaszek & al., 2005) should be part of the mechanism of allowing electronic publication of names and nomenclatural acts; and (3) physical works that are not paper-based (e.g., CD-ROMs, DVDs) should be disallowed. Currently, works produced after 1999 by a method that does not employ printing on paper are permitted under Art. 8.6 of the ICZN.

■ ACCEPTABLE MATERIAL

The Committee discussed what kind of electronic material should be made acceptable for effective publication under the Code. It was obvious to us that publication online, i.e., material accessible electronically via the World Wide Web, was the only option that could serve the needs of scientists and other users of botanical nomenclature today. Electronic publication in offline media, such as CDs or DVDs, was regarded as obsolescent and sharing the limitations of printed matter, e.g., a physical object that required transportation to, and storage in, libraries. However, while we endorse online publication, we certainly do not want to encourage a proliferation of small, one-off, privately, casually, or even unintentionally published Web pages that may be hard to find, subject to changes, and not maintained online in the long term. We decided that there should be strict limits placed on what may be effectively published online. A central aspect of our proposals, therefore, is that electronic material be effectively published only if it is in an online serial publication (in most cases, a journal). Requiring publication in a journal

will provide an assurance of quality and will prevent much of the feared “grey literature”.

Not every online serial publication is suitable, though. To seek what would be acceptable, the Committee discussed three main options: (1) having an approval process whereby publishers could apply for their journals to be added to an approved list, and the only electronic material that could be effectively published under the *Code* would be in journals on that list; (2) requiring publishers to prove that their journals had been in operation for at least five years prior to their being allowed to publish electronic material effectively; and (3) requiring journals to have an International Standard Serial Number, or ISSN (ISSN International Centre, 2008a). The first option was seen to require a permanent or standing committee to examine each journal, approve it or reject it, and maintain the list indefinitely, thereby adding a considerable burden of work to the process of electronic publication. The second option was thought too difficult to police and would require considerable extra work by future taxonomists to determine retrospectively if names had been effectively published or not, i.e., had the journal been running for five years or not before those names were published? The third option, however, requiring a journal to have an ISSN, was unanimously supported by the Committee and is included in the core proposal (Prop. 203).

In addition, the Committee discussed permitting not only online serial publications with an ISSN but also online publications with an International Standard Book Number, or ISBN (e.g., monographs and floras). It was thought that in the short term there may be very few ISBNs, as most books published on the Internet will also be printed in hard copy. A majority of the Committee was in favour of including ISBNs, but there was not unanimous support. We therefore propose that two options should be put to the Congress as alternatives, i.e., ISSN only (Prop. 203) or both ISSN and ISBN (Prop. 204).

ISSN is an international standard that was first published as such in 1975 (ISO 3297-1975) (ISSN International Centre, 2008b). ISSNs can be used for electronic journals in the same way that they can be for paper journals (ISSN International Centre, 2008c). If a publication is published in both electronic and paper versions, then the two versions are given separate ISSNs (ISSN International Centre, 2008b). Electronic publications often include the ISSN as “e-ISSN” or “eISSN”; however, there is no difference between this and an ordinary ISSN and the ISSN International Centre (2008b) simply recommends the use of ISSN.

ISBN was first published as an international standard in 1970 (ISO 2108-1970). ISBNs can be assigned to electronic publications as well as print publications (International ISBN Agency, 1999). To quote from the International ISBN Agency (International ISBN Agency, 2010):

One of the principles of ISBN has been that it identifies a unique product (e.g. an edition of a book). This has facilitated discovery and acquisitions, and enabled e-commerce, distribution and aggregation of product information, and sales data reporting. The ISBN standard, ISO 2108, has always required that different product forms of a publication, where these are made separately available, be assigned separate ISBNs.

Where electronic books are split up and the various chapters are then distributed as separate parts, the International ISBN Agency (2010) recommends that each part so distributed should have its own ISBN.

ISSNs and ISBNs are assigned by a network of national centres. ISSNs are coordinated by the International ISSN Centre in Paris, while ISBNs are coordinated by the International ISBN Agency in London. These two international agencies maintain respective databases of all ISSNs and ISBNs assigned worldwide. Therefore, a publication with an ISSN or an ISBN can be easily discovered using these databases or through the services of libraries throughout the world. The ISSN Register, for example, had listed over 1.4 million ISSN codes by 2009 (ISSN International Centre, 2010).

Furthermore, the modest effort and sometimes also cost of obtaining an ISSN or ISBN demonstrate that an online journal or book intends to be recognized as such and is not merely a casual publication.

An alternative suggestion to mandatory approval of electronic journals was the creation of a list of such journals in which plant and fungal names and other botanical nomenclatural acts have been published; that being the only criterion for inclusion on the list. The list would be purely for reference purposes. Such a list could possibly be created and maintained by IPNI (<http://www.ipni.org>) as a by-product of the indexing of names that is already being done by that indexing centre. As names were found published in a new electronic journal, that journal could be added to the list, which could be made available online. This would facilitate the discovery process for nomenclatural novelties published electronically. It would, of course, need the agreement and support of IPNI, so we do not formally propose it here.

Finally, we must emphasize that we are not proposing that effective electronic publication should be in any way retroactive if approved by the Melbourne Congress, as that would render an unknown amount of material effectively published and could cause untold problems. We therefore propose a starting date of 1 January 2013, i.e., the beginning of the year following the publication of the *Melbourne Code* (Prop. 206).

■ IMMUTABILITY

One of the issues raised by the Committee was the need for immutability, i.e., for an electronic publication to be unchangeable after it is first issued, as is a printed publication in most cases. Put simply, nomenclatural stability would not be served by published nomenclatural acts (principally new names and typifications) that are subject to unrecorded modifications. This issue has been raised in the previous Committees and at previous Congresses.

To overcome the immutability issue, the Committee is proposing that electronic material must be in Portable Document Format (PDF) to be effectively published. PDF is an open standard for document exchange. It was developed by Adobe Systems in 1993 (Adobe Systems Inc., 2003) for exchanging documents in a manner independent of the application of specific software, hardware, or operating systems. Originally it

was developed as a proprietary format, but it was released as an open standard on 1 July 2008, when it became an international standard (ISO/IEC 32000-1:2008).

According to the official documentation on the International Standards Organisation Website (ISO, 2008):

ISO 32000-1:2008 specifies a digital form for representing electronic documents to enable users to exchange and view electronic documents independent of the environment in which they were created or the environment in which they are viewed or printed. It is intended for the developer of software that creates PDF files (conforming writers), software that reads existing PDF files and interprets their contents for display and interaction (conforming readers) and PDF products that read and/or write PDF files for a variety of other purposes (conforming products).

Currently, almost all publishers of electronic journals and books distribute their material via the use of PDF, and almost every day we all use PDF on our own desktops. Even before PDF became an international standard, it had become a *de facto* standard for distributing and exchanging documents in an unchangeable manner.

Anyone may create applications that can read and write PDF files. Although Adobe holds patents to PDF, it licenses them for royalty-free use in developing software that complies with its PDF specification. By releasing PDF as an open standard, this situation will not change in the future (Adobe Systems Inc., 2009). PDF documents can also be made 100% self-contained, i.e., all the information necessary for displaying the document in the same way every time (such as fonts, colours, raster images, and text) are embedded within the electronic file itself (Adobe Systems Inc., 2003; Drümmer & al., 2009).

PDF allows for immutability in a number of ways. It incorporates metadata (i.e., information embedded in the electronic file but not part of the visible content, such as date of creation, date of modification, etc.). Additional metadata can be added following a range of metadata and library standards, including Resource Description Framework (RDF), a framework for describing Web resources, such as the title, author, modification date, content, and copyright information of a Web page (RDF Working Group, 2004), and Dublin Core (Dublin Core Metadata Initiative, 2010). PDF metadata must be in text format and are stored in XML. In addition, there are a number of tools that allow the inclusion of digital signatures within a PDF file (including PDF/A, see below). A digital signature is like a paper-based signature providing a method for adding a unique identifier to a document, and it can, by being incorporated through encryption, ensure that the document content has not been tampered with after it was signed (Johnson, 2006; PDF/A Competence Centre, 2010). In addition, there is an archiving format (PDF/A) based on PDF which allows for the long-term archiving of PDF documents. This Committee is proposing a Recommendation (Prop. 210) that documents be stored in this format for digital archiving for the long term (see Archiving, below).

PDF/A is a file format for long-term archiving of electronic documents and has been an International (ISO) Standard since 1 October 2005 (ISO 19005-1:2005). Although based on Adobe

PDF (Version 1.4), Adobe released the format to allow it to become an international standard and thereby allow others to develop software to create and/or read documents using the standard. Most publishers are now using PDF and they are likely to continue to do so into the future. Following ISO standard practice, any new additions to the standard will be backward compatible to the earlier version (i.e., the later version will provide all the functionality of the earlier version, and software that creates documents in the later version of the standard will also be able to read documents created in the earlier version). One big advantage of recommending the PDF/A standard is that it is not owned by any software company, and anybody is able to develop software that conforms to the standard. Much of the software so developed is in the public domain and is open source, which means that the programming code is publicly available, and anyone will be able to use that code to read the documents long into the future, irrespective of what versions of software were used to write the documents.

The PDF/A standard is neither “platform dependent” (i.e., compatible with only certain configurations of hardware and software) nor is it software itself. For example, it imbeds all fonts and metadata within the document (PDF/A Competence Centre, 2009; Drümmer & al., 2009), allowing it to be read at some future date without having to have specific fonts available in an operating system. There is a large range of software that can write PDF/A-compliant documents, including both proprietary and open-source software, and there are many products that can convert documents from non-compliant PDF versions to PDF/A, or from Microsoft Word documents, OCR (optical character recognition) documents, etc. Microsoft Word (2007 Version onward) and versions of Open Office (from Version 2.4 onward) can produce PDF/A-compliant documents – usually done by printing to a PDF document and selecting PDF/A as an option. Earlier versions of Microsoft Word also allow saving as PDF Version 1.4 which is PDF/A compliant (Drümmer & al., 2009). Documents can also be prepared directly from XML. Further information on the PDF/A standard can be found on the International Standards Web site (ISO, 2005, 2008), the PDF/A Competence Centre website (<http://www.pdfa.org>), or by reading the book by Drümmer & al. (2009).

Another issue raised was the problem of errata. When corrections are needed in a printed publication, we typically issue an erratum in the next or a later issue or edition. Sometimes an erratum slip is inserted in the original publication, perhaps even pasted over the original text. In all these cases it is possible to see that a correction has been made. With electronic material, however, there would be a natural temptation simply to make the correction in the original publication. As noted above, such practice does not serve nomenclatural stability and the principle of priority in particular. The Committee therefore proposes a new Article (Prop. 205) to prohibit changes being made to a particular electronic publication, ruling that any such changes are not themselves effectively published, and instead corrections and revisions must be published separately, as is done in printed matter. We realize that this rule is enforceable only when changes made to a publication can be detected, but our intention is a more practical and realistic one, i.e., to deter

accidental or well-intentioned changes to electronic publications. Certainly anyone determined to falsify the published record will find a way to do so, as indeed is currently possible with hard-copy publication, although including a digital signature in a PDF can make it almost impossible to modify without the changes being apparent (PDF/A Competence Centre, 2010).

■ ARCHIVING

The Committee saw archiving as one of the most important aspects of electronic publication. While some printed matter has persisted in libraries and/or private collections for more than 500 years, it is generally felt that electronic matter may prove less long lived. Partly, this concern results from the relative youth of electronic material, with the oldest files handled by most scientists little more than 25 years old. The great changes that have occurred in computer technology during this time have contributed to a belief that anything we accept as standard today will be obsolete within a decade. However, it is important to remember that in recent years considerable advances have been made in the archiving of electronic material, with excellent digital repositories now available in numerous countries (see also Storage media, below). The Committee felt that actually mandating the archiving of electronic material in digital repositories could not be an enforceable rule. If, for example, it was required to place material in a specified number of repositories, how could it be verified that that requirement had been met, especially for a publication being evaluated many years after it was issued? Hence, instead, our proposed Recommendation (Prop. 211) that publishers and authors ensure that effectively published electronic material be placed in multiple online digital repositories that are located, as far as is practical and permitted by copyright and licensing laws, in more than one area of the world and preferably on different continents.

Among the many examples of working repositories and digital preservation strategies, the following are particularly relevant to the biological sciences and are briefly described below: PubMedCentral, JSTOR, BioOne, Portico, SciELO, LOCKSS, and BHL.

- Currently over 1000 journals can be freely accessed from anywhere in the world through PubMedCentral (<http://www.ncbi.nlm.nih.gov/pmc/>), the U.S. National Institutes of Health (NIH) digital archive of biomedical and life sciences journal literature, although not all of these are immediate open access.

- JSTOR (<http://www.jstor.org/>) is a not-for-profit, U.S.-based online system for storing academic journals that helps scholars, researchers, and students discover, use, and build upon a wide range of content in a trusted digital archive of more than 1000 academic journals and other scholarly content.

- BioOne (<http://www.bioone.org/>), also based in the U.S.A., is a global, not-for-profit collaboration bringing together scientific societies, publishers, and libraries to provide access to critical, peer-reviewed research in the biological, ecological, and environmental sciences.

- Portico (<http://www.portico.org/>), again based in the U.S.A., is among the largest community-supported digital

archives in the world. Working with libraries, publishers, and funders, they preserve electronic journals, electronic books, and other electronic scholarly content to ensure that researchers and students will have access to it in the future. Portico is used by many major scientific journal publishers. It is funded and endorsed by the Andrew W. Mellon Foundation, The Library of Congress and the National Endowment for the Humanities.

- Based in Brazil, SciELO, or The Scientific Electronic Library Online (<http://www.scielo.br/>), is an electronic library covering a selected collection of scientific journals. The library is an integral part of a project being developed by Fundação de Amparo à Pesquisa do Estado de São Paulo, in partnership with the Latin American and Caribbean Center on Health Sciences Information (BIREME). Since 2002, the Project has also been supported by Conselho Nacional de Desenvolvimento Científico e Tecnológico. The Project envisages the development of a common methodology for the preparation, storage, dissemination, and evaluation of scientific literature in electronic format.

- LOCKSS, or Lots of Copies Keep Stuff Safe (<http://lockss.stanford.edu/lockss/Home>), based at Stanford University Libraries (California, U.S.A.), is an international, community-based initiative that provides libraries with digital preservation tools and support so that they can easily and inexpensively collect and preserve their own copies of authorized electronic publications. LOCKSS, now in its eleventh year, provides libraries with the open-source software and support to preserve today's Web-published materials for tomorrow's readers. It is being used extensively by the publishing industry as a preservation strategy for digital content.

- BHL, or The Biodiversity Heritage Library (<http://www.biodiversitylibrary.org/>), is the literature digitization component of the Encyclopedia of Life. BHL is a consortium of twelve major natural history museum libraries, botanical libraries, and research institutions organized to digitize, serve, and preserve the legacy literature of biodiversity. The European Commission's eContentPlus program has recently funded the BHL-Europe project, with 28 institutions, to assemble the European-language literature. In addition, negotiations are being pursued with the Chinese Academy of Sciences, the Atlas of Living Australia, and Brazil to join the BHL consortium. These projects will work together to share content, protocols, services, and digital preservation practices. BHL has expressed a strong interest in being a repository for e-journals that publish botanical nomenclatural acts. Technological details as well as rights and responsibilities will need to be established, but collecting this type of content is exactly within the mission and goals of this project.

Effective archiving will be facilitated by our proposed requirement (Prop. 203) for electronic publications to be in the Portable Document Format (PDF). The Committee felt that, in addition, the PDF/A standard for archiving should be strongly recommended (Prop. 210), but not mandated: it would not be feasible to require users of the *Code* to determine whether a PDF file was PDF/A-compliant in order to know if the document had been effectively published.

PDF/A is the current international standard for long-term archiving of electronic documents (see Immutability, above).

PDF/A has been accepted by agencies, companies, and governments around the world as the basis for their long-term archiving strategies. Many national libraries and archiving centres have a role (sometimes legislated) to collect, and provide long-term access to information resources that relate to that country. For example, the National Library of Australia has this role for Australia, and “[t]his responsibility extends to published information in digital form” (National Library of Australia, 2002). The National Library of Australia has been archiving selected Australian online publications (individual documents, collections, electronic journals and Web pages) in its PANDORA Archive since 1996 (National Library of Australia, 2010). The National Library also provides a summary of national and international initiatives for preserving digital information, with case studies from 17 countries and a number of international collaborative projects (National Library of Australia, undated). This document shows that numerous countries have already established long-term strategies for digital archives which will provide a firm basis for the needs of scientific electronic publishing.

As the world becomes more dependent on, and expectant of, the ongoing availability of digital resources, there is no reason to think that repositories such as the examples above will be less secure and stable than a traditional library. In fact, the duplication and dissemination of information available in these repositories is trivially easy. This attribute will form a remarkably extensive safety net by cheaply and efficiently creating a multitude of digital copies available around the world, far surpassing the deposition of (minimally) ten printed copies as recommended by the *Code* and of only two printed copies as implicitly mandated by the *Code*.

■ OTHER ISSUES

Registration of names. — Among the first issues discussed by the Committee was the idea of some form of mandatory registration of names that are effectively published electronically. The idea was that registration would aid discovery of names and could provide a permanent record of what was published, where, when, and by whom. We were well aware of the views of the Saint Louis Congress on the concept of mandatory registration (Greuter & al., 2000: 159–165) and therefore felt that any such proposal would be unwelcome. We did, however, consider requiring names published electronically to be included in The International Plant Names Index (IPNI; <http://www.ipni.org/>) or Index Fungorum (<http://www.indexfungorum.org>) in order to be validly published under Art. 32. However, IPNI includes vascular plant names only, so that names of bryophytes, algae, and fossil plants would not be covered by such a rule. We felt that the rule would only become more awkward if other indexes were added, e.g., Index Hepaticarum (<http://www.ville-ge.ch/musinfo/bd/cjb/hepatic/index.php>) for hepatics, Tropicos (<http://www.tropicos.org>) for all bryophytes, Index Nominum Algarum (<http://ucjeps.berkeley.edu/INA.html>) for algae, and *Fossilium Catalogus II: Plantae* for fossil plants. Because Tropicos and IPNI both

cover names of vascular plants, should the requirement be that those names be included in one index or the other, or both? The *Code* should not appear to endorse a particular organization. Moreover, the fossil index is a printed serial publication (Pars 1–109. 1913–2008), which is not issued every year and is not yet online. The period pending publication of the latest volume would cause undesirable delay between effective and valid publication of fossil plant names. The Committee therefore decided that no form of registration should be proposed for electronic publication of names under the *Code*.

The *Code* already includes a Recommendation (Rec. 30A.2) that publications containing nomenclatural novelties should be deposited with a name-indexing centre appropriate to the taxonomic group when those novelties are not in periodicals that regularly publish taxonomic articles. We propose to preserve that Recommendation (Prop. 213), adjusted to account for effective electronic publication.

Peer review. — The Committee examined the issue of mandating peer review for electronic journals but rejected it for a number of reasons. Firstly, it would be impractical to police, and difficult to decide retrospectively if a particular article in a particular electronic journal had been peer-reviewed or not. It was also argued by some members that there are many degrees of peer review, and it could be seen to cover everything from internal peer review by editors of a journal to external peer review in all its levels of competence. Secondly, the Committee felt, as with date-stamping (see Date of effective publication, below), that we should not apply restrictions to electronic publications that we do not also apply to printed publications, as that would merely add an unnecessary layer of complexity to an already complex *Code*. Indeed, the Committee felt it was beyond its mandate to propose any general rules or recommendations on peer review, date-stamping, or any other issue that would apply equally to both electronic and hard-copy publications.

Open access. — The Committee also examined the issue of requiring open access to electronic publications, i.e., that they must be at least viewable, and ideally also printable and downloadable, without any payment being required from readers above that needed to access the Internet. Open access not only facilitates immediate access to publications for research, but helps insure long-term preservation and availability of the material. Open access provides the unrestricted right to copy and redistribute publications and deposit them in multiple repositories, thereby reinforcing their permanence compared with publications held in password-protected locations.

However, it was thought that a rule mandating open access would be difficult to enforce and would cause problems for a considerable number of well-known journals that do not have open access, e.g., *Taxon*. Essentially we would be unwisely and unfairly excluding important, mainstream journals from effective electronic publication, or else unrealistically asking them to embrace open access. Either way, it was thought that, again, we should not impose restrictions on electronic publication that we do not also impose on hard-copy publication. Laudable as it may be to urge electronic journals to be freely available, the reality is that many such journals rely on subscription services to survive, just as many hard-copy journals do now. There are also

costs in publishing an electronic monograph, and it is reasonable that a publisher should be able at least to recover those costs.

It was pointed out that precisely defining what constitutes open access and what does not is far from straightforward, and the term, even qualified by a definition, could be open to varying interpretations if incorporated into the *Code*. Also, there could be practical problems in requiring that electronic material be open access to be effectively published, especially in evaluating publications in years to come. How easy would it be to verify that a particular journal had been open access at the time when the publication was issued?

The Committee also considered if publishers should be required or requested to archive copies of electronic publications in publicly available digital repositories after a finite period during which their costs could be recovered, but exactly how this could be achieved was not solved. Suggestions ranged from requiring submission to such repositories (e.g., the Biodiversity Heritage Library) after one year, three years, or five years. It was suggested that most publishers recover the majority of their costs in the first year after publication, and that currently many subscription-only electronic journals do make issues freely available after one or more years.

The Committee finally decided that a rule or recommendation on open access was neither workable nor appropriate.

Storage media. — The Committee felt that the *Code* should not include any rules about digital storage media and/or software, as the use of standards such as PDF (a format, not a medium) in conjunction with archiving in digital repositories (both discussed above), mean that the media used for storage are irrelevant. Some media do have long-term survival rates, but the main issue may not be the longevity of the storage medium but the means of accessing the information stored on it. For example, CDs and DVDs may last for 100 to 200 years (Byers, 2003), but will the hardware and software still be available to read them after 100 to 200 years? It is for this reason that digital repositories have long-term archiving strategies in place that include regular refreshing and renewal. This may include replacement of the old media with new media of the same type, migration to newer types of media, archiving of software to access and read the stored data, and physical storage of the media in a safe environment protected from fire, flood, electronic pulse, etc. For example, see Council of Australasian Archives and Records Authorities (2006).

Date of effective publication. — There was some discussion by the Committee on whether date-stamping, i.e., including the date of issue in the content of the publication, should be made mandatory, but again it was thought we should not propose rules for electronic publication that could apply also to publication in hard copy, and the *Code* does not currently rule that a publication must contain the date of issue. Nowadays it is so rare for the date to be omitted from a hard-copy publication—and an electronic publication should be no different—that this seemed not to be a problem. The Committee noted that it is far easier to incorporate a date of issue into an electronic publication than it is into a hard-copy publication because it can be added at the last minute. Hard-copy publications have to undergo the process of printing and distribution, which

may take days (or months), making it much more difficult to incorporate the correct date of issue into the publication itself.

At previous Congresses, and during this Committee's discussions, determining which was the earlier of parallel electronic and printed versions was seen as a possible problem. Of course, the logical consequence of permitting electronic matter to be effectively published is that *both* versions are effectively published. The date of effective publication is then established by applying Art. 31.1 (Prop. 208). In the unlikely event that Art. 31.1 fails to establish a date for both versions, then we propose that they be treated as having been published on the same date (Prop. 209).

Preliminary and final versions. — Problems could arise from preliminary drafts being placed online by a journal upon acceptance of a paper for publication. Normally such preliminary versions are superseded by a final version, which may be electronic or printed, or both. Two examples of journals that place preliminary versions online and that also publish nomenclatural novelties under the *Code* are *Fungal Biology* and *Review of Palaeobotany and Palynology* (see <http://www.sciencedirect.com/science/journal/18786146> and (<http://www.sciencedirect.com/science/journal/00346667>, respectively, under “Articles in Press”). These drafts would be effectively published as soon as they were issued online, even though effective publication would be intended only for the final version. Our proposed rule prohibiting changes to a particular electronic publication (Prop. 205) could even prevent subsequent drafts from being effectively published, or, if preliminary and final drafts were instead separate editions, all would be effectively published. Then, if nomenclaturally relevant details were different, e.g., the spelling of a name or, worse, the details of a type, the consequences could be confusing or disruptive. Additionally, publishers often remove the earlier draft version from the Internet when the final version is published. Access to the draft version could then become very difficult, which would be a problem if that draft had been accepted as effectively published. We therefore propose a rule modelled on Art. 30.5 which would prevent an electronic publication that was evidently merely a preliminary version from being effectively published (Prop. 207). In such a case, only the version evidently considered final by the publisher would be effectively published. This rule would also apply to electronic preliminary versions of a printed publication and, if electronic publication were to include material with an ISBN (Prop. 204), electronic preliminary drafts of monographs and floras.

The *American Journal of Botany* provides an example of electronic publications that are evidently preliminary and final versions. At the top of its “advance access” page (<http://www.amjbot.org/papbyrecent.dtl>) it is stated:

The AJB Advance Access articles have undergone peer review, copyediting, and approval by authors but have not yet been printed or posted online by issue. Minor corrections may be made before the issue is released.

The Committee considered requiring an explicit statement when an electronic publication is preliminary or final,

or intended as not effectively published under the *Code*, but decided that the consequences of publishers neglecting to include such a statement would cause problems. Instead, we propose a Recommendation that such preliminary and final versions be indicated as such when they are first issued (Prop. 212).

Pagination. — The Committee discussed whether or not electronic publications need to include pagination. While page numbers are obviously useful in references to printed publications, pagination in electronic material is less important because a PDF file can be searched for specific strings of text. Actually, this is a far more powerful tool than an index in a printed publication. Even so, there needs to be some means of referring to particular publication other than a Web address, which might change over time. The obvious and simple solution is to assign volume, issue, and/or article numbers to the electronic journal. Most electronic journals that publish in PDF do currently include volume and/or issue numbers and pagination.

The *Code* does not currently require a publication to have page numbers, or even to have multiple pages, although it does require a “page or plate reference” to be included in a “full and direct reference” (Arts. 9.19, 32.5, 33.4, and 45.1), but only when a publication is consecutively paginated (see Art. 33 Note 1). In the absence of such pagination, this reference can be provided in some other way, e.g., counting the pages (if such exist) and citing them as “[*n*]” or “[*n*–*n*]”. The Committee felt that, while pagination is useful, to rule on it would be neither necessary nor appropriate. Moreover, formulating any Recommendation would be beyond the Committee’s mandate because the issue applies to both electronic and printed publications.

■ PROPOSALS

The Committee has put forward eleven proposals to amend the *Code* which, if passed, would permit electronic publications on or after 1 January 2013 to be effectively published under specified conditions. The main proposal limits effective publication of electronic material to that distributed in PDF in an online serial publication with an ISSN, with an additional proposal to extend this to PDF with an ISBN. Further proposals strengthen this by forbidding post-publication alteration and discounting preliminary versions as not effectively published. The current method for establishing the date of effective publication is amended to include electronic material. These changes to the Articles of the *Code* are supported by a set of Recommendations for best practice for electronic publication of nomenclatural novelties, covering aspects of archiving and immutability, dissemination of data, and clear designation of versions as preliminary or final. The proposals and results of the Committee votes are presented in the column “Proposals to amend the Code” in this issue (Special Committee on Electronic Publication, 2010).

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