

released slowly over thousands of years, disturbing the seabed just adjacent to the seepage site. As for the tube-like structures are concerned, they are undoubtedly seep-related and cannot be equated to fossil remains, which are not expected in Neoproterozoic examples.

The late Neoproterozoic glaciation and associated carbonates have been generating a fresh controversy just when the earlier one is about to be settled. Now, the newly proposed 'methane hydrate' model opposing the 'snowball earth' model, which is quite popular among earth scientists, has kept alive the unending debate. The abundance of methane in early earth atmosphere, both volcanogenic and biogenic, is well-documented²¹⁻²³. Its role not only in cap carbonate genesis, but also as an effective greenhouse gas in addition to CO₂ to inhibit ocean-freeze, a vital requirement for the 'snowball earth' model, seems to favour the methane-cap carbonate link. Unless more data from similar carbonates formed during younger-period ice ages become available, an answer to which one of these two routes is likely to have had a part in the genesis of cap carbonate, will have to wait.

1. Kaufman, A. J., Knoll, A. H. and Narbonne, G. M., *Proc. Natl. Acad. Sci. USA*, 1997, **94**, 6600–6605.

2. Jacobsen, S. B. and Kaufman, A. J., *Chem. Geol.*, 1999, **161**, 37–57.
 3. Kirschvink, J. L., in *The Proterozoic Biosphere* (eds Schopf, J. W. and Klein, C.), Cambridge University Press, NY, 1992, pp. 51–52.
 4. Sankaran, A. V., *Curr. Sci.*, 2000, **79**, 101–104.
 5. Caldeira, K. and Kasting, J. F., *Nature*, 1992, **359**, 226–228.
 6. Sagan, C. and Chyba, C., *Science*, 2001, **276**, 1217–1220.
 7. Williams, G. E., *Earth Sci. Rev.*, 1993, **34**, 1–45.
 8. Jenkins, J. S., *J. Geophys. Res.*, 2000, **105**, 7357–7372; *Science*, 2000, **288**, 975–976.
 9. Harland, W. B. and Rudnick, M. J. S., *Sci. Am.*, 1964, **211**, 28–36.
 10. Hoffman, P. F., Kaufman, A. J., Halverson, G. P. and Schrag, D. P., *Science*, 1998, **281**, 1342–1346.
 11. Chandler, M. A. and Sohl, L. E., *J. Geophys. Res.*, 2000, **105**, 20737–20756.
 12. Hyde, W. T., Crowley, T. J., Baum, S. K. and Peltier, W. R., *Nature*, 2000, **405**, 425–429; *Nature*, 2001, **409**, 306.
 13. Poulsen, C. J., Jacob, R. T., Pierrehumbert, R. T. and Huynh, T. T., *Geophys. Res. Lett.*, 2002, **29**, 101–104.
 14. Poulsen, C. J., Pierrehumbert, R. T. and Jacob, R. T., *Geophys. Res. Lett.*, 2001, **28**, 1575–1578.
 15. Kennedy, M. J., Christie-Blick, N. and Prave, A. R., *Geology*, 2001, **29**, 1135–1138.
 16. Condon, D. J., Prave, A. R. and Benn, D. I., *Geology*, 2002, **30**, 35–38.

17. Kennedy, M. J., Christie-Blick, N. and Sohl, L. E., *Geology*, 2001, **29**, 443–446.
 18. Shapiro, R. S., *Geology*, 2002, **30**, 761.
 19. Hoffman, P. F., Halverson, G. P. and Grotzinger, J. P., *Geology*, 2001, **30**, 286–287.
 20. Kennedy, M. J., Christie-Blick, N. and Sohl, L. E., *Geology*, 2002, **30**, 763.
 21. Pavlov, A. A., Hurtgen, M. T., Kasting, J. F. and Arthur, M. A., *Geology*, 2002, **31**, 87–90.
 22. Habicht, K. S., Gade, M., Thamdrup, B., Berg, P. and Canfield, D. E., *Science*, 2002, **298**, 2372–2374.
 23. Catling, D. C., Zahnle, K. J. and McKay, C. P., *Science*, 2001, **293**, 839–843.
 24. Dubey, V. S. and Chaudhry, M. S., *Curr. Sci.*, 1952, **21**, 331–332; Ahmed, F., *Curr. Sci.*, 1955, **24**, 231.
 25. Kumar, A., Kumari, V. M. P., Dayal, A. M., Murthy, D. S. N. and Gopalan, K., *Precambrian Res.*, 1993, **62**, 227–237.
 26. Williams, G. E. and Schmidt, P. W., *Precambrian Res.*, 1996, **79**, 307–325.
 27. Sreenivas, B., Das Sharma, S., Kumar, B., Patil, D. J., Roy, A. B. and Srinivasan, R., *Precambrian Res.*, 2001, **106**, 277–290.

A. V. Sankaran lives at No. 10, P and T Colony, I Cross, II Block, RT Nagar, Bangalore 560 032, India.
 e-mail: sankaran@bgl.vsnl.net.in

COMMENTARY

The future of scholarly publishing

John Willinsky

The academic journal has been the mainstay of scholarly publishing for some 350 years, with its current crop of articles bound and printed, issued periodically and serially, from weekly to annually. The journal's print run will continue for some time, it seems certain, but just as certainly, the journal is moving on-line with a rapidity and thoroughness that suggest that this where its future lies, in a way that is not at all so apparent for the scholarly book or any book, for that matter. In the course of the World Wide Web's first decade, at the close of the

twentieth century, it has been estimated that some 75% of academic journals are offering some form of on-line access with more than a 1000 peer-reviewed journals publishing only on-line. This immediate, hyperlinked, multimedia environment appears to serve the journal well.

Although much of this shift in publishing mediums amounts to old-wine-in-new-bottles, one radical variation has emerged in the economics of this knowledge. While most journals simply stayed with their subscription model in the great on-

line migration of the 1990s, many experimented with free on-line access on first going electronic. That utopian moment soon passed, and on-line editions were restricted to subscribers, and prices rose for print-plus-on-line-access subscriptions, while revenue innovations, such as pay-per-view and site licensing were introduced.

Yet, from the beginning of the Internet, many of those involved in scholarly publishing – and which researcher or faculty member is not in some way – could not help but notice the ease with

which a document could be posted to the web, where it was immediately and freely available to everyone one might hope to reach. The web in those early, heady days was everywhere about free access and open exchanges of information. It was a small step from observing the ease with which items are posted to the web to the idea that perhaps the academic journal – even with its editorial overlay of peer-review and standardized formats – could dispel with subscriptions, and make itself immediately and freely open to all readers with access to this new medium. Alternatively, authors could deposit work, published in journals only available to subscribers, in open access and indexed eprint archives.

Open access appears to be the perfect counter-measure to the ongoing serial crisis of increasing subscription prices and journal proliferation, which erodes the access of research libraries around the world to the available scholarly literature. With print production and distribution costs eliminated for the on-line edition, it was possible to make the journal free to read. This form of *open-access* publishing has enabled journal editors to better serve their authors by increasing readership and citation rates, as well as reducing the digital divide in information access.

Now, for all that the Internet promises to do for scholarship, I would hold that *open-access* publishing possesses the radical potential to change the nature of this work. I do not see *open-access* offering some idealistic form of universal access to knowledge, but as part of a historical development, in which innovations both technical and social have expanded the range of intellectual participation in research and scholarship. *Open-access* could well prove to be another step, following on all that the printing press and penny post, public libraries and schools have done to improve the democratic circulation of knowledge, and all that this increased access has done for the

state of that knowledge. On-line publishing can clearly provide *faster research and more of it*, but it could offer far more than this, if researchers, editors, scholarly associations and librarians work together to develop more open models of access to knowledge.

In my recent visit to Bangalore and Chennai, I was deeply impressed by the open access initiatives already under way. To name just a few, the Indian Academy of Sciences, Bangalore has made the on-line editions of its journals free to read. T. B. Rajashekar, National Centre for Science Information, has established an *open-access* eprint archive at the Indian Institute of Science, Bangalore that enables faculty there to easily post copies of their papers for others to read. Sudha S. Murthy, National Tuberculosis Institute, Bangalore is providing open access to the institute's journal, as well as providing a free article service for its programme workers in the field. India is clearly in a position to lead by example and vision in the development of this greater global knowledge exchange.

Now the research that I have been doing through the Public Knowledge Project at the University of British Columbia in Canada has been focused on mustering the legal, economic, technical, social, career arguments for creating *open-access* journals, archives and other scholarly resources (see <http://pkp.ubc.ca>). In my work, I have tried to establish how current copyright practices in scholarly publishing work against the best financial and altruistic interests of authors, whose principal goal, after all, is to increase the circulation and growth of knowledge. I have worked with the financial records of scholarly associations in an effort to demonstrate how traditional forms of print publishing and selling membership subscriptions are no longer financially viable, and that new ways need to be developed to serve members better in an age of potentially extended electronic readership that could improve the public

presence of the discipline. I have also explored the democratic dimensions of making knowledge that has been publicly funded as a public good, freely available to students, amateurs, policy-makers, and the public, as part of a basic right to know in an age of increasing democratic accountability.

And finally, a team of students and I have built both journal and conference software systems that manage on-line peer-reviewing, editing, indexing and publishing, while helping to reduce the costs and technical skills involved. Open Journal Systems and Open Conference Systems are open-source, free to download, and are designed to improve the quality of knowledge that is published by providing not only well-indexed and *open-access* to research, but as well to a study data, related studies, background sources, forums and other materials in a way that will allow both experienced and novice readers of research to interpret and position the study in hand.

Open-access publishing, then, is not just about budgetary concerns or obtaining a wider readership. It could yet prove a critical turning point for the place and role of research in the world, placing this digital transformation on par with the very introduction of the scholarly journal way back in 1665, which turned the private correspondence of scientifically inclined gentlemen into a form of public inquiry. *Open-access* publishing is one means of advancing the circulation, verification and utilization of knowledge. In support of a more open future for scholarly publishing, I continue to seek interested faculty, students and librarians to collaborate with, in realizing such a future.

John Willinsky is in the Department of Language and Literacy Education, University of British Columbia, Vancouver, BC, Canada V6T 1Z4. (e-mail: john.willinsky@ubc.ca)