

Open sesame

Government influence favouring enhanced openness is rightly diversifying practices in science publishing.

The rise of the Internet in the 1990s helped spark a radical idea for turning primary science publishing on its head. If journals charged authors a fee to publish, instead of charging readers and libraries a fee to subscribe, said the advocates, published peer-reviewed papers could be provided free to anyone in the world.

This simple-sounding notion provoked visceral debate, resulting in extensive multisided arguments and antagonism among advocates of this and other forms of 'open access' and publishers, librarians and funders. Most of that rancour has now given way to greater pragmatism, dialogue and compromise. There is a broad appreciation that change is inevitable, but that constructive change takes time, thought and experimentation.

Open-access pioneers such as the not-for-profit Public Library of Science (PLOS) and its commercial cousin BioMed Central have successfully shown that the author-pays model can be financially viable in the real world — something many had doubted. But the demonstration also offers a dose of reality. PLOS's goal when it launched in 2003 was to prove that high-impact journals could be paid for by author fees of just US\$1,500 per paper. Yet author fees for its top journals have risen to \$2,900 per paper, and the organization's finances are critically dependent on the high volume of papers published in its online journal *PLOS ONE*. This low-overhead journal, which charges \$1,350 per paper, does not make editorial judgements about its papers' merits, it simply passes them through peer review to certify that they are technically sound.

The PLOS experience highlights the challenge in applying the author-pays model universally. Many journals, such as *Science* or *Nature* and its sibling journals, rely on their subscription fees to support the costs of high selectivity, added-value editorial content, such as reviews, and online enhancements. Such journals would need to charge fees several times that of *PLOS ONE* to cover their costs and support investment. So although author-pays could be a viable model for many lower-overhead journals, its broader uptake within the publishing industry will depend on the level of funds that research agencies are willing to make available for scientists to pay publishing fees.

One valuable and established intermediate model is the hybrid approach, in which subscription journals give authors the option to pay a fee to make their article freely available instantly. Nature Publishing Group will soon be launching its first Nature research journal of this sort, *Nature Communications*. Economists who have studied the science publishing industry argue that the sector will ultimately evolve into a mix of open-access, subscription and hybrid journals, rather than a monoculture.

In the meantime, there is a growing demand among lawmakers and funders for greater public access to the literature, in particular in fields where public interest is strong, such as biomedicine. This demand seems most likely to be met at least for the foreseeable

future by a different model of openness, which was articulated in a 2007 bill requiring researchers at the US National Institutes of Health (NIH) to make authors' or publishers' versions of research papers publicly available in the PubMed Central repository within 12 months of publication. There is speculation that President Barack Obama might soon issue an executive order extending this requirement to all federal research agencies (see page 822). Legisla-

tion to that effect has also been introduced in the US Senate, and may soon be introduced in the House of Representatives.

Nature's publishers have consistently backed the NIH mandate, and support its extension to other agencies. But whatever form the extension takes, it should be flexible about the compulsory time limit within which papers must be deposited in archives following

their publication in journals. The NIH initially insisted on a 6-month embargo interval, but agreed to extend this to 12 months after protests from some publishers. Governments must not impose a one-size-fits-all embargo interval. At a time when many academic libraries are facing deep budget cuts, they may be tempted to axe subscriptions to many journals on the grounds that all but the most recent content is freely available in archives such as PubMed Central. And that, in turn, could particularly hurt journals in disciplines such as the social sciences, in which researchers use older material far more frequently than do those in fast-moving fields such as molecular biology. Publishers must be able to negotiate embargo intervals that will fulfil their obligation to allow greater public access but not jeopardize their businesses. And publishers, in turn, need to recognize that science's social contract is evolving towards greater openness. ■

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Learning in the wild

Much of what people know about science is learned informally. Education policy-makers should take note.

The seemingly endless debate about how to improve US science education seems to make the tacit assumption that learning happens only in the classroom. As a result, the arguments tend to focus on issues such as curricula — specifying, say, what information pre-college students should be expected to learn at each grade level — and, as in US President Barack Obama's recent proposals to reform the No Child Left Behind policy, on the best way to hold schools to rigorous standards of student achievement.

However, researchers who study learning are increasingly questioning this assumption. Their evidence strongly suggests that most of what the general public knows about science is picked up outside school, through things such as television programmes, websites,