

Open Access to New Knowledge

*More and more scientists are presenting their findings on the Internet – free of charge and accessible to all. In doing so, they are turning the idea of open access into reality – an idea that could turn the scientific publication system inside out. **ULRICH PÖSCHL**, a staff member at the **MAX PLANCK INSTITUTE FOR CHEMISTRY** in Mainz, is one of the founders of a magazine dedicated to the principle of open access.*



Information is a valuable commodity. For scientists, it is among the most valuable of all. They need to know and discuss the findings of their colleagues in order to obtain new findings themselves. And, of course, to avoid duplicating the work of the scientist in the lab next door. Researchers are measured by their contribution to the global fund of new knowledge. If their peers are to notice their achievements, they need to find appropriate ways to

publish their findings. Until a few years ago, the principal media comprised magazines, books and conference papers. Lately, however, an increasing number of scientists are turning to the Internet as a means of dissemination.

Using the idea of open access, these researchers want to make this knowledge freely accessible. Every producer of scientific findings and every administrator of cultural heritage, as well as the public at large,

should be able to access their work, including both original and metadata. Users can read, copy, distribute, print, search in, refer to and otherwise make use of the full texts without bumping up against financial, legal or technical barriers.

The Internet provides ideal conditions for open access. At the same time, there are those who shudder at the fact that unverified and incorrect information can be disseminated with relative ease. The pros and cons

of open access are the subject of numerous strategy papers and debates – at the Berlin Open Access Conference in the spring, for example, and most recently at the Euroscience Open Forum in Munich. Now, however, a large number of established online journals are putting the principle of open access into practice with a wide variety of models – the PUBLIC LIBRARY OF SCIENCE (PLOS) being just one of them.

One of the most successful of these online magazines is the journal Atmospheric Chemistry and Physics (ACP). Ulrich Pöschl, who heads a research group at the Max Planck Institute for Chemistry in Mainz, was one of its founders back in 2001, along with over 50 co-editors, including Nobel laureate Paul Crutzen. The majority of open access journals are published only on the Internet, though their approach to peer review is much the same as that of traditional

magazines. ACP, however, also uses the Internet to subject the submitted work to publicly visible review. In contrast to conventional journals that, printed and bound, find their way onto library shelves, articles in ACP are not appraised by just a few experts. Instead, the Net provides a forum to discuss the work.

In this way, ACP embraces the strengths of traditional peer review while attempting to balance its weaknesses with the aid of the Inter-

net. In Pöschl's view, one of the strengths of peer review – that is, an evaluation of the accuracy and relevance of research findings and publications by independent experts – is the possibility to anonymously assess the work submitted. However, this very anonymity also detracts from the transparency of assessment, which is one of the weaknesses of standard peer review. The system also suffers from the increasing specialization and ever more rapid development of science. Scientists find themselves inundated by a flood of publications that tend to "dilute knowledge rather than generate it," Pöschl believes.

OPEN ACCESS PROVIDES A GLOBAL FORUM

Articles are submitted for publication on subjects so specific that publishers of journals are no longer in a position to find, within a reasonable timeframe, appropriate specialists to review them. Consequently, authors have to wait a long time before they learn whether their paper has even been accepted. As Ulrich Pöschl thus confidently explains, "The issue of whether open access is compatible with the conventional quality assurance system is frequently disputed. But it is just the opposite is the case: in the future, open access will be the only way to safeguard the quality of scientific publications."

Upon closer examination, what initially sounds like a provocation becomes understandable. Free access to information is essential, argues the 36-year-old atmospheric chemist, if we are to master the flood of publications. For one thing, reviewers themselves need such access. They have to be able to compare works to which

an author refers without having to dip into their own pockets. For another, open access also helps to open up the review process and take advantage of the totality of knowledge in the research community.

Scientists in, say, Africa or Asia can also be better integrated into the community, even if they have fewer resources. "They have more time to ponder the published ideas and check the data," says Pöschl. Maybe they can then even publish contributions of their own more easily, without having to generate original data.

Peer review in ACP is a public process. Anyone can read the journal, and in addition, registered scientists can comment via an online forum and contribute their own slant on the topics under discussion. The comments by the reviewers appointed by the journal's editors are also available in this forum for all to read – with or without attribution, according to the reviewer's preference.

It is also possible to cite any of the individual comments. Reviewers and other authors of comments are aware of the public nature of the forum, Pöschl maintains, and therefore generally make only qualified remarks. "Statements like 'rubbish, should be taken down at once' are virtually unheard of." Of the several thousand comments that have been contributed to date, favorable or otherwise, he and the other editors have had only two deleted so far: "One was below the belt, and in the other case, it was obvious that the author simply wanted to sing his own praises," says Pöschl.

Just as the publishers hoped and expected, the system is proving to be self-regulating. Quality is high, as confirmed by the journal's ranking in

ILLUSTRATION: CORBIS



The subject of free access to knowledge was also on the agenda at the Euroscience Open Forum 2006, which was held in Munich this summer and attracted more than 2,000 scientists and journalists.

the Scientific Citation Index. This is no doubt attributable to the fact that the authors are aware of their increased responsibility. Work is submitted only when it is truly complete, properly thought through and polished. After all, anyone can read the paper immediately. It is now rare for a professor to encourage doctoral candidates to “just submit something, we can always correct it later.” Not so in the conventional system.

Consequently, the proportion of submissions rejected by ACP is only around 10 percent – despite the aspiration to maximum quality. “If we can achieve the same or even higher quality with a lower rejection rate than other journals, then we are making more efficient use of our reviewers’ capacities,” maintains Ulrich Pöschl. In other words, this limited resource that safeguards scientific quality is not being squandered on poor submissions: “What we offer our authors is speed and free speech, and in return for that, they must accept greater responsibility.” And on the other side: “What we offer our reviewers is anonymity, which they may also waive if they wish, as well as a public archive of their citable comments. This ensures the trans-

parency and plausibility of scientific evaluation and discussion.”

This review procedure, which is already being emulated by a journal devoted to economics, is attracting increasing interest in the expert community. Johannes Fournier, who heads the Electronic Publications strategic funding program run by the Scientific Library Services and Information Systems Division of the German Research Foundation (DFG), states: “I am not the only one who is impressed by this approach. Even though the journal has been in existence for only a short time, it has already achieved the maximum impact factor in the areas it covers – among both electronic and conventional publications.” This speaks to the high quality of the work it publishes. Furthermore, the opportunities to comment on an article frequently stimulate scientific discourse.

This last point is one that Ulrich Pöschl finds particularly pleasing. On more than one occasion, work that was originally pub-

lished in Nature or Science has been “picked up and discussed in our journal and set to rights.” Given the success of ACP and its now five sister journals published by the European Geosciences Union, Pöschl is confident that more publishers will follow suit.

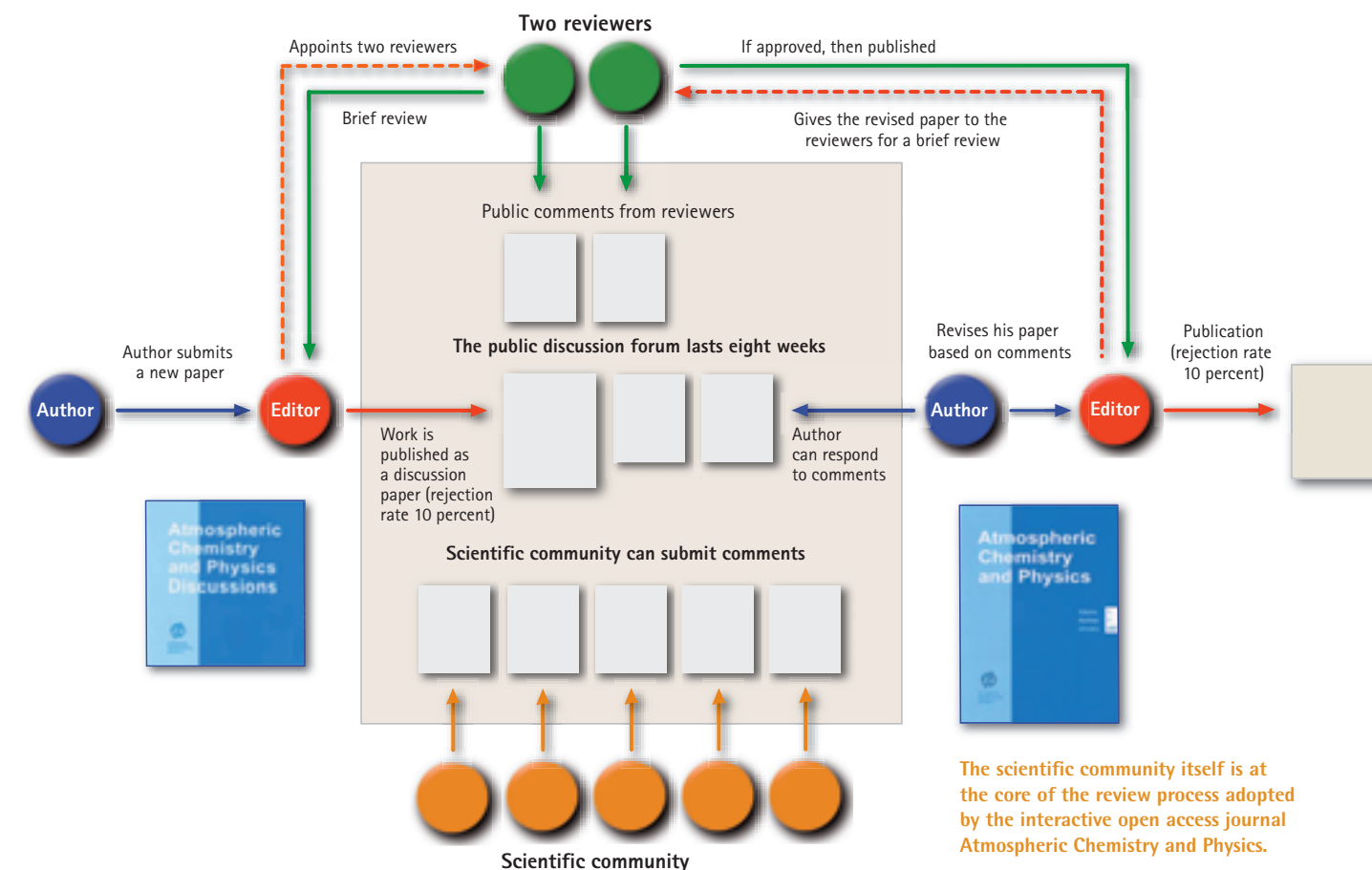
FAKES, TOO, ARE EASIER TO SPOT

The Max Planck researcher has experienced personally how conventional publishing practices can impede scientific progress. It was this frustration that ultimately led him to found an interactive open access journal. At the time, he was working on ozone, and discussion was rife among experts as to why soot particles had not long since adsorbed (that is, bound) all of the ozone in the atmosphere.

But while Pöschl was writing an article in 2000, after thoroughly researching the literature on the subject, he discovered publications dating back to the 1980s that explained the issue. They provided proof that there was a saturation effect beyond which no more ozone is broken down. “It was frustrating,” says the chemist. “Even though there was clear proof, speculation still continued in the 1990s. Things that had been known for two decades were being completely negated due to a lack of communication. Everyone was doing their own thing, writing their papers and going around in circles with their two referees.”



Established journals such as NATURE and SCIENCE are watching the development of open access with a bit of skepticism.



The scientific community itself is at the core of the review process adopted by the interactive open access journal Atmospheric Chemistry and Physics.

Fakes, too, would stand less chance if the review process were opened up, Pöschl maintains, citing the example of Jan Hendrik Schön. The physicist came to light in 2002 after publishing faked papers on organic conductors in Science and Nature, as well as other journals. In his case, many readers probably noticed that the same data kept turning up in his publications, but no one said anything because, in the traditional peer review process, there is no room for quick-fire comments. In contrast, says Pöschl, an interactive commentary via an online forum is much more easily written, and is more likely to have a constructive effect.

The fact that numerous scientists interactively discuss work published online in an open access environment and, in so doing, contribute their own competence, is one of the key advantages of this new publication channel. At the same time, this field also holds many imponder-

ables. For atmospheric researchers and geophysicists, it would seem to be exclusively beneficial – but they constitute a relatively small community.

The flagships among the scientific journals, SCIENCE and NATURE, in which researchers in all disciplines yearn to publish, have serious reservations as to whether their quality can be preserved in an open access medium, and above all in a more or less public review process on the Internet. They thus still find it hard to come to grips with the idea of open access. However, it became clear at the Euroscience Open Forum in Munich that open access is expected to prevail at NATURE, too.

After all, back in June, its publishers began a three-month trial in which they offered the option of public peer review including an online debate. Provided the authors were in agreement, articles submitted and passed on by NATURE in the usual way to anonymous reviewers

were simultaneously posted on the Internet for public discussion.

PUBLISHING HOUSES, TOO, MUST OPEN UP

But that has nothing to do with open access, contends Allison Abbott of Nature's German office in Munich. That would mean a free magazine that is accessible to everyone. At present, however, there are no plans to change the way the journal is financed. “Our theory is that we have a certain number of pages per year and we want to fill these with the best articles. That's what our subscribers pay for.” They plan to first monitor the public debate over peer review, and at the same time test how many authors participate and what quality of comments are submitted.

Scientists and publishing houses alike are watching Nature's first steps with keen interest. “That's a very good thing,” says Johannes Fournier of the DFG. Even if NATURE does not view its online experiment

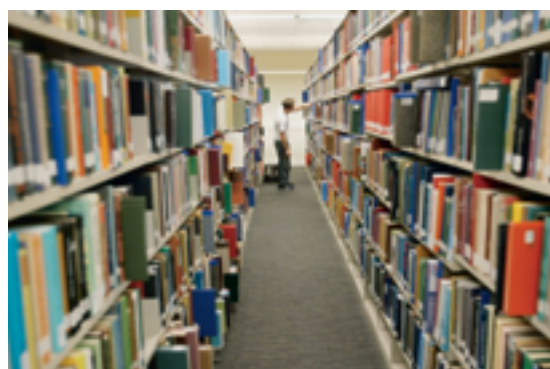


Photo: Corbis

All the world's knowledge arrayed on shelves: Will electronic media one day entirely displace the printed word?

as a step toward open access: "It is an opportunity to try out new methods. The subject of open access is there and it will likely prevail." It is thus time for publishers to develop new business models based on freely available content. According to Fournier, "In the long term, it will no longer be enough just to market usage rights. Instead, publishing houses should offer specifically tailored services, such as databases and statistics, that go far beyond the mere dissemination of information."

This could increase the demands made on publishers, as well as those made on research institution libraries. This is because free access to publications can be achieved, not only via online journals, but also in the form of self-archiving, where authors post copies of their papers printed in traditional journals on freely accessible open access platforms that are maintained by their universities. An increasing number of universities are currently adopting such open access initiatives, developing their own rules regarding usage, and encouraging scientists to use these platforms or publish directly in open access journals.

Posting publications on the Net and developing platforms for communication would be a new task for libraries and could also create new jobs in them. This would ensure global availability as well as archiving articles for the long term. At the

same time, libraries could, for instance, prepare statistics for their own scientists on how often a publication is cited or downloaded.

The online journals, too, will create jobs: "We are proud of the fact that setting up our open access journals created future-oriented employment opportunities. The number of new jobs has grown from the initial two to currently ten," says Ulrich Pöschl. These include hardware and software developers to create the necessary infrastructure, as well as compositors who lay out the manuscripts in the desired form.

The Copernicus Gesellschaft that performs these tasks for ACP and the other European Geosciences Union (EGU) journals began as a spin-off from the Max Planck Society. It is now a small independent publishing company in its own right and also provides services to other publishers, for instance in the field of sociology. Naturally these services have to be paid for, which is why even open access journals cost money.

COSTS ARE HARDLY A PROBLEM

However, the journals are not financed by reader subscriptions (that is, by selling the right to access print and online formats). Instead, it is the authors who pay. Publishing an article in an EGU journal currently costs 500 to 1,000 euros. For the authors, this takes some getting used to, but "measured against the amount invested in conducting the research whose findings are being published, that isn't much," believes Pöschl.

He and his colleagues hope that both scientists and financial sponsors will change their attitudes on this matter in years to come. Thus far, sponsors such as the German Research Foundation have covered the cost of the subscriptions typically paid to publishing houses by libraries. This leaves scientists with the impression that they don't have to pay for literature. Nor is there any apparent cost

in publishing their own work. However, subscriptions earn the publishers the equivalent of between 3,000 and 5,000 euros per publication.

Thus, the net profit of a publishing house that typically publishes several periodicals ultimately comes from public funds and can be as much as 30 percent of sales. There are publishers who make up to a billion euros a year, says Pöschl – more than some oil companies. "There is plenty of money available within the system, but it is currently being pocketed by those who sell traditional subscriptions." With open access, publishers would still earn money, but their profits might shrink from 30 percent of sales to 10 percent.

Sponsors of science, on the other hand, support the idea. At the beginning of this year, the Joint Committee of the German Research Foundation adopted guidelines that advise scientists whose research is funded with DFG money to provide open access to their work. Johannes Fournier confirms that it is already possible to apply for a flat-rate publication fee for this. However, a new financing system aligned with open access journals would need to be carefully thought out. "We can't grant limitless publication costs, otherwise we run the risk of a windfall effect, with publishing houses quoting sums that cease to be justifiable.

There are huge differences even now. Springer, for example, charges 3,000 euros if an author wishes to make his work freely available on the Internet. However, the company is planning, at least according to official statements, to reduce its prices if a lot of authors take part. Elsevier has not yet made any such announcement. It charges 3,000 dollars to publish a free-access paper. Additional costs are incurred if the text involves a difficult layout, for example if illustrations have to be specially processed for online publication.

Articles in the best-known journals of the PUBLIC LIBRARY OF SCIENCE,

PLoS BIOLOGY and PLoS MEDICINE, cost 2,500 dollars. That isn't much less than Elsevier and Springer charge for online publishing, but PLoS is financed exclusively through these payments, whereas Elsevier and Springer earn most of their money from subscriptions. It is not yet possible to predict where costs will stabilize. Nevertheless, more scientists are already willing to publish in open access journals.

The 2005 international CIBER study commissioned by the Publishers Association shows that 29 percent of the 5,513 authors surveyed have already published in such journals. In 2004, the figure was just 11 percent. In the opinion of Ralf Schimmer, head of the Max Planck Society's Electronic Library, this trend is not surprising.

Schimmer firmly believes that, in the end, costs will not be the deciding factor in whether open access prevails. It is much more a question of science itself: the nature of the work has changed so rapidly in recent years and virtually screams for open access to information. "If one considers how laborious it was to research information – bibliographic data, for example – just 15 years ago, and how easy it is today with the Internet, it is obvious what a radical change this medium has wrought."

CLEARER RULES ON COPYRIGHT

These days, scientists use it for much more than just writing e-mails. They can work together interactively, share raw data and perform simulations even though they may be continents apart. "Open access goes hand in hand with clearer copyright



WWW. The Copernicus Gesellschaft Web site: <http://www.copernicus.org/>

Information on the Max Planck Digital Library: www.mpd.l.mpg.de

The Max Planck Society's eDoc server: <http://edoc.mpg.de>

The Sherpa/Romeo list of terms under which individual publishing houses permit self-archiving or secondary publication of printed articles: <http://www.sherpa.ac.uk/romeo.php>

Variety on the Net: The Max Planck Society is moving into the electronic information age with Internet platforms such as the Digital Library and eDoc.

orientation that promotes this effort and affects every aspect of scientific work." The Max Planck Society supports the cause of open access. Ralf Schimmer emphasizes that working with the Internet has created entirely new needs – and this is what motivated the development of the Max Planck Digital Library (MPDL) that will be launched on January 1, 2007. Until 1999, each institute was responsible for ordering and taking delivery of its own literature, whether books and journals or CD-ROMs. Network solutions had to be implemented at 80 locations.

Today, one central unit ensures that every scientist working at a Max Planck institute can access more than 20,000 journals right from his workstation. In the future, ensuring such mass access and providing the server capacities will be just one of the tasks of the MPDL. In this respect, the library is a service unit that the Max Planck Society urgently needs, irrespective of open access. At the same time, however, it is a tool that promotes free access to knowledge.

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