Open Access to Scientific Knowledge

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ABSTRACT

The open access movement, well known in the domain of journal articles, came about because of several reasons. These include scholars' and researchers' willingness to share knowledge, and advances in technology which enabled opening up free access to information. Journal publishers who raised the subscription rates exorbitantly also forced researchers to look for alternative ways of sustaining knowledge sharing. The paper discusses two ways of achieving open access (OA) and argues that sharing knowledge and building partnerships have been recognised as the best and most optimal means of creating and benefiting from knowledge. It focuses on various fronts where OA is making good progress, and also deliberates on issues like OA endeavours in India, OA and sustainable development and what needs to be done in India to promote OA activities.

Keywords: Open Access, scientific knowledge, Wellcome trust, OA in India

1. INTRODUCTION

Knowledge wants to be free! If, as Newton said, one can see further by standing upon the shoulders of giants, free and unfettered flow of knowledge can help maximise the creation and growth of knowledge. Knowledge production is a community activity and is at once a cooperative and competitive activity—cooperative in the sense that every scientist uses the work of many other scientists, both his contemporaries and those who have preceded them, and competitive in the sense that one is constantly trying to be recognised as the first to discover (or invent) something. In science, no one can claim to be a self-made man! One's thoughts and ideas are shaped by the literature one is exposed to, the talks one hears at conferences one attends, and the discussion one holds with other scientists in formal and often informal settings.

Although knowledge is essentially a matter of the intellect, both social organisation and technology help shape the growth of knowledge. Higher educational institutions, research laboratories, professional societies, journals, conferences, peer review, funding agencies, etc. are the more visible elements of 'social organisation'.

Shiyali R Ranganathan said that a library is a growing organism, meaning that knowledge and its use continue to grow all the time.

Our understanding of nature and the universe and what we can do with it has been getting better and better since ancient times, and especially since the time of the industrial revolution. Gutenberg's 'reinvention' of the Chinese technology of printing with movable types not only helped herald the Protestant Revolution but also democratised access to knowledge and revolutionised the spread of scientific knowledge and the way scientific inquiry is conducted. As pointed out by Peter Drucker, Gutenberg's technology became the third major revolution in communication (after speech and writing), and not only threw hundreds of monks who earned their living as scribes—mostly reproducing the Bible copy by copy—out of job, but also brought in its wake many revolutionary changes. For example, new seats of higher learning such as universities were set up all over Europe. The universities went beyond religion and theology and started teaching subjects which were never taught before. A whole new class of professionals thus emerged, and some of them such as the gentlemen printers rose to become part of the upper echelons of society.

Print-on-paper became the single most important means of knowledge exchange and dissemination. The first scientific journal appeared in 1665 and since then publishing journals became a key activity of learned academies and professional societies. With time, investors saw an opportunity for business and profit, and publishing STM journals emerged as a business with very high profit margins. Many professional societies handed over their journal publishing activity to commercial publishing houses, which not only started levying huge subscription prices for the journals they produced, but also started 'bundling', a practice by which subscribing libraries are made to buy a large number of journals not all of which may be found useful by their clients. In the past two decades, the average journal subscription prices have risen three to four times as fast as the general inflation rate. There arose a conflict of interests between free and unfettered dissemination of knowledge and making profit by restricting access by levying a toll for access. Unfortunately, even some professional societies chose profit making through toll-access journals rather than support the more egalitarian path of supporting open and unfettered dissemination of knowledge. Even affluent libraries in the advanced countries felt the pinch. Faced with rising journal prices and dwindling or at best constant allocation of funds for the purchase of books and journals, most libraries had to cut not only the number of books they bought but also the number of journals they subscribed to.

Added to this, copyright which ought to protect the interests of the 'creator'—the scientists who actually perform the research and write the papers (or the institutions which employ them)—is actually protecting an intermediary in the knowledge transfer chain, viz., the journal publisher. As the copyright rests with the publisher, scientists who wrote the papers in the first place have to seek the permission of the publisher if they want to make multiple copies of their own papers for distribution to the students whom they teach, and to use figures, tables and parts of the text in their subsequent writing, say a review article or a chapter in a book. To be fair, it is not commercial publishers alone who are exploiting science and scholarship by exploiting the copyright laws. Even some professional societies, ostensibly set up to promote scholarship and knowledge dissemination, follow similar practices.

Pushed to the wall, enlightened individuals and institutions wanted to wrest science and scholarship from vested interests and give them back to the practitioners. For example, some scientists who were on the editorial boards of S&T journals published by commercial publishers quit the editorial boards en masse and started new journals in the same subject at a much lower subscription price. Such initiatives are being supported by the SPARC programme of the Association of Research Libraries (ARL). More importantly, the serials crisis, as it has come to be known, led to the birth of the OA movement. The Budapest, Berlin, Bethesda and Bangalore declarations and the recent signature campaigns in support of OA in the European Union and the USA are ample evidence of the worldwide support for keeping publicly-funded research in the open domain.

Institutions such as the Wellcome Trust and six of the seven research councils in the UK have mandated OA for all papers resulting from their funds. National Institutes of Health (NIH) in the USA requires, and may soon mandate, OA to research funded by it.

The OA movement, well known in the domain of journal articles, came about because of several reasons:

✺ Scholars and researchers have always been willing to share knowledge (more than making money). Indeed it is only through sharing knowledge and enlarging their audience can they increase the impact of their work and thus gain the recognition they value the most.

✺ Advances in technology enabled opening up free access. Unlike producing and distributing print-on-paper journals and papers, distributing papers and data in electronic form does not cost much in terms of money and effort. Also, the new technologies—especially the Internet, the World Wide Web and the semantic web—not only help speed up dissemination of knowledge at very low costs, but also facilitate doing research in unforeseen ways. Data mining, grid computing, eScience and international collaboration in virtual space come to mind readily.

✺ The journal publishers became too greedy and raised the subscription costs sky high forcing researchers to look for alternative ways of sustaining knowledge sharing.

2. OPEN ACCESS

Open access can be achieved in two ways: OA journals (Gold) and OA archives (Green). Today there are more than 2,700 OA journals [listed in the Directory of Open Access Journals (DOAJ) maintained at the Lund University] and over 1000 OA interoperable archives, most of them institutional and a few central subject-based ones.

Sharing knowledge and building partnerships have been recognised as the best and most optimal means of creating and benefiting from knowledge. Indeed, the development

sector has recognised the value of knowledge sharing and multi-stakeholder partnerships. For example, the Global Knowledge Partnership (GKP) has adopted "Sharing knowledge through building partnerships" as its motto. The Development Gateway set up by the World Bank and the Solution Exchange set up by the United Nations Development Programme share knowledge through electronic discussion lists that boast thousands of members around the world. Even a company like Novartis is willing to release drug-related genome data into the open domain.

But publishers are still fighting to retain control of the material they publish in their journals, although the authors who wrote the papers give them away free and the referees review them without charging any fee. Witness what happened in the last few months. The journal publishers, including societies such as the American Chemical Society (ACS), would not like to yield without a battle and have launched a war, no holds barred. They try to maximise the advantages they currently enjoy.

✺ They use the copyright laws to either not allow archiving of papers published in their journals or to delay archiving.

✺ Most researchers are unconcerned about the mechanics of knowledge dissemination and are ready to surrender copyright to publishers.

✺ Publishers win the support of many scientists by making them members of editorial boards of journals they publish.

✺ They employ public relation (PR) consultants and 'Trojan horse OA advocates' to confuse scientists and policy makers. For example, on the advice of one such consultant, the publishers equate 'peer review', which is valued by scientists and funding agencies, with toll access publishing, although OA journals have the same kind of peer review processes as toll access journals.

✺ They have succeeded in confusing many researchers into believing that self-archiving is a form of vanity publishing.

It is here institutions such as the Creative Commons, Science Commons and the iCommons, Alliance of Taxpayers and the Free Culture Movement in the United States, and the Alternative Law Forum and the Lawyers Collective in India can play a key role. They should lend support to enacting legislations in favour of mandating OA for all publicly funded research worldwide and in particular in the USA, UK, European Union and in key developing countries such as India, China, Brazil, and South Africa. They should ensure that universally copyright for research papers rests with the scientists (or the organisations they work for), and not surrendered to publishers.

The battle is not an easy one. OA advocates are spread all over the world and are mostly individuals. The publishers are corporate entities with considerable financial and PR muscle and are fighting for survival! David vs Goliath. The publishers have been able to stall or delay legislation in the UK, USA and the EU. Unless copyright and intellectual property rights are restored to the rightful owners through unambiguous reasoning, the battle cannot be won.

OA is making good progress on another front, viz., Open Course Ware. Massachusetts Institute of Technology (MIT), Cambridge, pioneered the movement and virtually every one of their courses is available on their OCW programme. Many other universities, both in the US and elsewhere, have followed the MIT example. In India, the seven Indian Institutes of Technology and the Indian Institute of Science have a programme called NPTEL under which undergraduate and postgraduate courses in engineering and science by outstanding teachers are offered on the web as well as in the video format. The quality of these programmes, both in terms of content and technology, is comparable to the best in the world.

3. OA BOOKS

Books are different from journals. Both authors and publishers survive by the income they receive from books. Even so, many authors and publishers are willing to make their books available for free on the public domain. Authors and publishers of OA books use alternatives to conventional copyright (such as the Creative Commons licensing). There is no problem in digitising out-of-copyright books. But to digitise current or orphan books one needs to follow the provisions of copyright laws.

Many books are now available as open access texts on Internet. Many authors and publishers have released full or partial versions of current works. For some this is an advertising scheme to create demand for print versions. Others are more interested in presenting their content to the widest possible audience. Here is a brief list of sources of OA books.

- **The Online Books Page** (http://digital.library.upenn.edu/books/)

- **Internet Archive: Text Archive** (http://www.archive.org/texts/texts.php)—includes the Million Book Project and Project Gutenberg. Searchable by keyword.

- **Project Gutenberg (**http://www. gutenberg. org/catalog)—one of the oldest and most famous online book collections.

- **Renascence Editions** (http://darkwing. uoregon.edu/~rbear/ren.htm)—works printed in English, 1477–1799.

- **O'Reilly Open Books Project** (http://www.oreilly.com/openbook)—computer and technology related books.

- **Literature for Children (**http://palmm. fcla.edu/juv)—a collection of children's books published in the US and Great Britain roughly between 1850 and 1950.

- **eScholarship Editions** (http://texts.cdlib. org/escholarship)—from the University of California Press. Some are public, others are for the UC community only. A public title list is available of only publicly accessible books.

- **National Academies Press** (http://www. nap.edu)—thousands of books and reports by the National Academies of the USA.

- **HEARTH: Home Economics Archive: Research, Tradition, and History** (http://hearth.library.cornell.edu)—over 1,000 volumes on home economics from 1850–1950. Includes journal articles as well.

※ **Terrapub e-Library** (http://www. terrapub. co.jp/e-library)—several books in PDF format from Terra Scientific Publishing of Japan, on environmental and computer modelling topics.

※ **Books by CalTech Authors** (http:// caltechbook.library.caltech.edu/view/ subjects/)—part of CalTech CODA, full books by faculty at CalTech, in the sciences and mathematics. Most would be suitable for textbooks; some are older editions.

※ **The Assayer** (http://theassayer.org)— very large catalogue of free books (and reviews).

Both Microsoft and Google have major digitising programmes in collaboration with major university libraries in North America and Europe. The Internet Archive, pioneered by Brewster Khale, is another major initiative in bringing books on OA.

Here are some references on OA issues:

Okerson, A.S. & O'Donell, J.J. (1995) (Eds.) Scholarly Journals at the Crossroads: A Subversive Proposal for Electronics Publishing. http://www.arl.org/scomm/subversive/intro.html

Willinsky, J. (2005) The Access Principle: The case for Open Access to Research and Scholarship.

http://mitpress.mit.edu/catalog/item/ebook. asp?ttype=2&tid=10611

http://mitpress.mit.edu/books/willinsky/The AccessPrinciple_TheMITPress_0262232421.pdf

Peter Suber's blog: Open Access News, and the open access timeline http://www.earlham.edu/ ~peters/fos/timeline.htm

4. OA IN INDIA

※ The Million Books Project headed by Prof. N. Balakrishnan of the Indian Institute of Science.

※ More than 100 OA journals—published by the Indian Academy of Sciences (IASc), Indian National Science Academy (INSA), National Informatics Centre (NIC), MedKnow, Calicut Medical College, etc.

※ Many newspapers and magazines.

※ Not many current in-copyright books yet!

※ We need to improve our understanding of copyright laws and opportunities presented by OA. Legal experts like Lawrence Liang, Siva Vaidyanathan, and Achal Prabhalaa can help.

5. OA AND SUSTAINABLE DEVELOPMENT

Knowledge is becoming increasingly important. Indeed, the future of food security may depend less on resource-intensive agriculture and more on knowledge intensity, says Prof. M.S. Swaminathan.

How do we ensure that common people obtain the knowledge they need? How do we reach the unreached with knowledge that is relevant to their daily lives, knowledge that can improve their standards of living? How do we make development inclusive? How do we get rid of poverty and disease? How can we ensure that the benefits of science and technology percolate to the people at the bottom of the pyramid?

Said Jawaharlal Nehru "It is science alone that can solve the problems of hunger and poverty, insanitation and illiteracy, of superstition and deadening custom and tradition, of vast resources running to waste, … Who indeed could afford to ignore science today? At every turn we have to seek its aid…the future belongs to science and to those who make friends with science". It is mastery over technology that enabled the early adopters of industrial revolution technologies to colonise and exploit the rest of the world. If the developing countries do not take to science and technology they will continue to remain intellectually and economically dependent.

The advanced countries need to promote OA as well. Said Bruce Alberts, former president of the National Academy of Science, USA, after the 9/11 tragedy, "We now know for certain that, if our grandchildren are to live in an open, free society and not inside a walled fortress, we must devote even more

energy to using science and scientific values to ensure the safety, stability and productive development of peaceful democratic nations throughout the world". Thus OA is of particular importance not only to the developing world but also to preserve peace and harmony in the world as a whole.

We are in an ever shrinking world where SARS and avian flu take just a few days to spread from East Asia to North America, and disasters like the Tsunami of December 2004 take just a day or two to wreak havoc in locations as far away as Indonesia and eastern coast of Africa. To have even the slightest chance of dealing with such disasters it is important for every nation in the world to have some scientific competence.

As Bruce Alberts says, we need not only to open up the flow of scientific knowledge, but also make available the technologies such as computers and broadband Internet access to the less developed countries. And not embargos and restrictive copyright practices.

6. WHAT NEEDS TO BE DONE IN INDIA?

Indian scientists, the rank and file as well as those who hold high positions, should take a principled stand on OA. After all OA to scientific literature benefits them the most. A few months ago, twenty-six Nobel laureates in the US signed a letter sent to every member of the US Congress urging them to support a bill that would mandate OA to government-funded research. About a year ago, when the Royal Society issued a statement on OA, obviously without consulting the Fellowship, more than 45 Fellows of the Society wrote to the President of the Society expressing their displeasure and asserting their support to OA. Not one of them was from India. Till today, as far as I know, not many leaders of Indian science have come out in the open in support of OA.

The major science academies, viz., the INSA and the IASc, both of which have made the journals they publish OA journals, should proactively promote OA in the country.

1. The two Academies should recommend to the Ministry of Science and Technology (MoST), DAE, DRDO, ISRO, ICAR and ICMR to come up with an OA policy and a plan of action for implementing the policy. Fortunately for these Academies almost all the Secretaries in the MoST and heads of other science related departments are Fellows of either INSA or IASc or both. The Academies should recommend that MoST [and its different agencies such as Department of Science & Technology (DST), Department of Scientific & Industrial Research (DSIR), Department of Biotechnology (DBT), Department of Earth Sciences] and other science related departments mandate OA for all research publications resulting from work performed in their own laboratories and extramural projects funded by them. Ideally, each individual institution, where research is performed, should also have an OA mandate. The National Institute of Technology, Rourkela, is the only Indian institution to have a mandate for OA. While the scientists should enjoy the freedom to choose the journals for publishing their work, they should be encouraged to publish in OA journals, and if they choose to publish in toll-access journals they must be required to place the full text of the papers in an interoperable OA repository, preferably in the researcher's own institution's.

2. The Academies should also recommend the gathering of impact metrics (downloads, citations, co-citations, chronometrics, semiometrics) via tools like Citebase and weblogs, so that the enhanced impact of OA research can be measured. There is growing evidence for the OA impact, as can been seen from: http//opcit.eprints.org/oacitation-biblio.html. For the many journals self-archiving policies, please see http://romeo.eprints.org, and for institutio/funder mandates, http://www.eprints.org/signup/fullist.php. For a list of archives that are active, please see http://roar.eprints.org.

3. The Academies and the funding agencies should persuade research laboratories

and universities (and other institutions of higher learning) to set up their own interoperable institutional OA repositories (similar to the one at the Indian Institue of Science), and persuade the heads of these institutions to ensure that the full text of every research publication from their institutions is placed in these repositories. Funding for research should depend on the applicant's past papers being available through OA channels. Evaluation of individuals could be based on only papers that are available through OA channels.

4. The Academies should recommend to the government to enact legislation, in the lines of the Right to Information Act, that would mandate OA to all publicly funded research.

5. DST, DSIR, and DBT should launch a massive training programme, in partnership with the National Centre for Science Information at the Indian Institute of Science, Documentation Research and Training Centre (DRTC) of the Indian Statistical Institute, and the NIC, to help nominees from different institutions learn to set up OA institutional archives (using open source software such as EPrints and DSpace). To start with DBT can conduct such programmes for the staff of more than 60 Bioinformatics Centres they support. CSIR, ICAR and ICMR can hold such training programmes for their many laboratories.

6. Eminent Indian scientists and leaders of science should advise Indian researchers to make their work freely available either through publishing their work in OA journals or through placing all their papers in OA repositories.

7. Indian researchers should be advised not to surrender copyright to journal publishers. It is an irony that the copyright to the results of research performed by Indian researchers with Indian taxpayers' money is being gifted to journal publishers abroad without batting an eyelid. Indian researchers should be made aware of the different addenda to copyright agreements prepared by Creative Commons, Science Commons, etc. Under the US laws, research performed in government laboratories is non-copyrightable. The Government of India should consider enacting such a law in India. Fortunately, the Minister for Science & Technology is an eminent lawyer. The Principal Scientific Adviser to the Cabinet and the Chairman of the Scientific Advisory Council to the Prime Minister may take the lead.

Indian science policy is notorious for delayed action and response. A proposal was made to the DST in the mid-1990s for setting up an Observatory for Science and Technology; the Director of IIT, Madras, was willing to host it. The proposal was accepted by a senior officer of DST in principle, but the Observatory never came into being. Now, more than a decade later, one understands that an Observatory is likely to be set up at the Indian Institute of Science with DBT support. Better late than never. About five or six years ago, the subject of OA was discussed at the annual get together of heads of Bioinformatics Centres held at the University of Poona and it was decided that DBT would support setting up institutional OA archives in all the institutions hosting Bioinformatics centres. Again two years ago the topic was discussed at the annual get together held at Kasaragod. Till this day no action has been taken. More than five years ago a brief note in *Current Science* pointed out, with ample evidence, that China, South Korea and to some extent Brazil were racing ahead in science (as seen from the world share of research papers indexed in *Science Citation Index, MathSciNet, Chemical Abstracts, PubMed*, etc). It attracted the attention of leaders of Indian science, but sadly, apart from the author coming in for some criticism, it did not lead to any worthwhile action. Much later the Scientific Advisory Council to the Prime Minister (SAC-PM) woke up to the fact that India was lagging behind China and made a plea for increasing funds for research. The media gave wide coverage to the SAC's statements and requests. Unfortunately who says is far more important than the truth of what is said. One hopes, history does not repeat and that India adopts

and reaps the benefit of OA well ahead of China.

7. CONCLUSION

OA is not about publishers and profit or about libraries and budgets. OA is about increasing access to knowledge, especially current advances, for scientists and scholars, teachers and students. OA is about making the field level playing for scientists and scholars who cannot afford to pay for accessing information relevant to their research. It is about increasing the rate at which new knowledge can be created and applied to the benefit of humanity. It is about facilitating exchange of research publications and data and enabling collaboration with others located in distant places. It is about saving the world from poverty and terrorism.

If science is very important, and if science can flourish only if knowledge flows freely and unfettered, then it is absolutely essential for all nations to mandate OA to publicly-funded research.

Advances in technology have made this possible but some vested interests and (il)legal squibbles are holding us to ransom and stalling progress. Till recently that was a great concern, but now that students in the American universities have taken up the cause, through the Free Culture movement, there is great hope. Of course, there is considerable indifference from scientists and scholars themselves, and in particular in developing countries there is often inexplicable delays in taking action!

One thing is for sure. Future historians of Indian science will find it extremely difficult to explain why Indian researchers and their science managers failed to adopt and take full advantage of OA for long after they were told of its advantages.

About the Author

Subbiah Arunachalam is an information scientist based in Chennai, and has been associated with the Indian academic and scholarly communities for over three decades. He also has been an Editor of scientific journals (*Indian Journal of Technology, Journal of Scientific & Industrial Research, Indian Journal of Chemistry, Proceedings of the Indian Academy of Sciences*, and *Pramana– Journal of Physics*), a science writer, a researcher in chemistry, a teacher of information science, a librarian in a national laboratory, the executive secretary of the Indian Academy of Sciences, and a member of the Editorial Boards of scientific journals.

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