International Science Council
The global voice for science

OPENING THE RECORD OF SCIENCE

MAKING SCHOLARLY PUBLISHING WORK FOR SCIENCE IN THE DIGITAL ERA

SUMMARY

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PREFACE

Many concerns have been expressed in recent decades about the extent to which scientific and scholarly publishing systems serve the needs of researchers and the public interest in accessing the results of scientific and scholarly inquiry. Such concerns were echoed in a consultation with the membership of the International Science Council (ISC), leading to its adoption of the 'future of scientific publishing' as a priority topic for its 2019–2021 Action Plan.

The present report is the culmination of the first phase of the resultant project. It was prepared as a discussion document in consultation with an international working group. The text was subjected to three phases of review followed by revision: involving an initial expert review group, the ISC membership including three virtual fora, and an expert team generously convened by the U.S. National Academies of Sciences, Engineering and Medicine[1], before being submitted to the ISC Governing Board for its agreement as an ISC Report.

The report is primarily directed towards the scientific community and its institutions, seeking to establish, as far as possible, a shared view of the principles and priorities of the system through which its work is disseminated, and as a precursor for action to promote beneficial change. It has a distinctive logic. It proposes a series of normative principles that should underlie the operation of scientific and scholarly publishing; describes the current publishing landscape and its trajectory of evolution; analyses the extent to which the principles are observed in practice; and identifies problematic issues that need to be addressed in realizing those principles. With a few exceptions it does not make recommendations about how to resolve problematic issues. The report will be used to set the agenda for a subsequent phase of discussion and action involving ISC Members and other stakeholders.

[1] This does not imply endorsement.

SUMMARY

WHY SCIENCE MATTERS

Science is indispensable to the human endeavour as a fundamental part of its intellectual infrastructure. Its distinctive value derives from open scrutiny of concepts based on evidence and tested against reality, logic and the scepticism of peers. The knowledge that has been accumulated since the earliest days of scientific practice is continually refreshed, renewed and re-evaluated by new experiments, new observations and new theoretical insights, and publicly communicated in the published **record of science**. This record exposes the logic and evidence of truth claims to scrutiny, making science accessible to all who would use it through processes of widely and openly accessible publication and with the potential for innovative use in a myriad of educational, social, economic and cultural settings. Publication processes that achieve these ends and are adapted to the needs and priorities of the disciplines of science and interdisciplinary collaboration are essential to the function of science as a global public good.

PRINCIPLES FOR SCIENTIFIC PUBLISHING

As a basis for analyzing the extent to which contemporary scientific and scholarly publishing serves the above purposes, a number of fundamental principles are advocated in the belief that they are likely to be durable in the long term. They follow, in abbreviated form:

I. There should be universal open access to the record of science, both for authors and readers.
II. Scientific publications should carry open licences that allow reuse and text and data mining.
III. Rigorous and ongoing peer review is essential to the integrity of the record of science.
IV. The data/observations underlying a published truth claim should be concurrently published.
V. The record of science should be maintained to ensure open access by future generations.
VI. Publication traditions of different disciplines should be respected.
VII. Systems should adapt to new opportunities rather than embedding inflexible infrastructures.

These principles have received strong support from the international scientific community as represented by the membership of the International Science Council (ISC).

THE EVOLVING LANDSCAPE

As the scientific effort expanded and diversified in the later 20th century, commercial publishers progressively displaced, with some exceptions, the role of learned societies in scientific publishing by entering the market at scale, increasingly coming to dominate it and progressively driving up prices at rates in excess of inflation.

As an open access movement developed in response to the opportunities offered by the digital revolution, major publishers added an open access, author-pays option based on article processing charges (APCs) to their existing subscription (reader-pays) models. Publisher profitability has been largely based on a combination of 'high-impact journals' and large volumes of journals of lesser standing, often bundled together in inflexible 'big deals' made with universities or national research bodies. The importance of scale in determining profitability has inhibited the role of other than a few learned societies in this market, distorting it to the advantage of publishers by the confusion of customer–supplier roles and through the freedom given by universities and research institutes to authors to publish where they wish.

Article Processing Charges are unlikely to resolve many of the problems of the current system, and may even entrench commercial control over the publishing market. Problems of affordability, the lag-time from submission to publication and the opportunities offered by the internet have stimulated a much richer spectrum of dissemination modes beyond the traditional journal or book. An increasingly important and timely innovation has been of repositories that make 'preprints' available prior to peer review, increasingly involving learned societies and university repositories as parts of the effort to expand access for both scholars and the public. They increase the rate at which new findings are disseminated, thereby enhancing inter-activity between researchers and providing early evidence on urgent contemporary issues, whilst 'overlay journals' offer a peer review service for preprints. Publicly funded and scholar-led publishing infrastructures have developed, in Latin America in particular, as efficient non-profit repositories that provide holistic open access systems for scholarly communication. At the same time, 'publish or perish' regimes in universities have created a massive global demand for publishing outlets that has spawned so-called 'predatory' journals that offer rapid online publication but with low publishing standards and little, if any, peer review.

PUBLISHING THE DATA OF SCIENCE

Observations and experiments that reveal novel insights into reality are first-class scientific outputs and essential parts of the record of science. They should be credited as such. Moreover, data that underpin a published truth claim must be accessible, and 'FAIR' (Findable–Accessible–Interoperable–Reusable), so that the logic of the evidence–claim connection can be scrutinized and the observation or experiment repeated, as essential parts of the process of scientific self-correction. A process of 'binary publication' is advocated, whereby when the data are too numerous to be contained in the published truth claim, the data should be concurrently 'published' in a trustworthy repository so that there are pathways to access by reviewers and readers. Protocols should be developed whereby such publications are regarded as at least equivalent in value to the traditional article, with journals requiring related evidence and data to be available as a condition of publication, an approach that could be a powerful incentive for open data sharing. There is also a general case for opening access to data that are not used in a published article. Unless the habit and the means are developed of making scientific data openly and routinely available and interoperable, the opportunity will be lost to collate and integrate data from a variety of disciplinary sources to investigate the complexity at the heart of many of the major problems that confront humanity and to which science can make a vital contribution. Management of large data volumes and their fluxes can be an onerous task. An important challenge is to embed efficient data stewardship and FAIR procedures as normal functionalities of the research cycle, as the responsibility and the cost of doing science in the digital age rather than as an optional add-on.

BARRIERS TO OPEN ACCESS

There are a number of key issues that impede creation of, access to, and use of the record of science.

ASSESSMENTS AND INCENTIVES

The use of bibliometric indices, such as journal impact factors, as proxy metrics for the performance of researchers is a convenient index of assessment but deeply flawed. Most place a relentless focus on individual achievement, thin out research support through a university's interest in high impact metrics, pressurize all to 'tick boxes' and conform, whilst they play an important role in distorting the journal publication market. There is urgent need for reform.

PEER REVIEW
Peer review is currently under considerable stress because of the sheer volume of demand, such that an incentive or reward for undertaking the task is needed. The way in which peer review is related to the increasing significance of preprints, particularly at times of crisis when there is a demand for rapid access to work that has not yet been reviewed, is a pressing issue.

COPYRIGHT
The transfer of copyright to publishers as a condition of publication is a regressive practice, particularly when it involves privatization of publicly funded research results, and where parts of the record of science are denied, by high paywalls, for use by the very people that have created it.

INDEXING
Indexes to published work are important in signposting the existence of scientific knowledge. Many are owned by commercial publishers, and tend to favour their own journals and are reluctant to add new publishers. This particularly disadvantages publishing enterprises outside Europe and North America where all the 'high-impact' publishers are located, researchers from the 'Global South' who are unable to afford access to such publications and the journals in those regions.

COSTS AND PRICES
The digital revolution has reduced prices in most public and private sectors, but not in large parts of the scientific publishing sector. The high prices charged for access to high-impact journals, either for authors or readers, discriminates on the basis of ability to pay against many readers or researchers, institutions and particularly those in low- and middle-income countries. Although publishers have been reluctant to divulge their costs, there is evidence that prices for many journals are an order of magnitude higher than necessary costs, even for high-impact journals with high rejection rates. A variety of models that do not create such excessive prices have developed globally.

A CHANGING WORLD OF SCIENCE
There are major trends in science and society that create a vital context for scientific publishing. The value of science to national economies and in confronting global challenges demands more efficient processes of knowledge dissemination. The era of big data permits science to address the complexity inherent in such challenges in unprecedented ways, but requires access to and publication of data as a norm of scientific inquiry. The web has democratized information, creating both opportunities for the dissemination of scientific knowledge and problems in coping with vast networks of misinformation. These trends underline the fundamental need for scientific publishing to develop in ways that facilitate global cooperation; ensure that the richness of diverse global perspectives is drawn on in developing global solutions; create ready access to the record of science and its data to enable deeper understanding of complexity; enable open access to the record of science to citizens and other stakeholders, particularly in areas of contemporary public concern; and ensure that a scientific voice is effective in combating the global 'infodemic' of misinformation. The movement for a new era of open science is seen by many as a means of achieving such objectives, powerfully illustrated in the global scientific response to the COVID-19 pandemic, although it is a movement not without critics.

EXPLOITING DIGITAL POTENTIAL

All disciplines, whether or not data-intensive, operate in a digital world where all the elements of the research process are connected or connectable in ways that permit them to be linked together as parts of a research workstream, with the possibility of digital interoperability across the 'research cycle'. These linked digital infrastructures also provide information about the research process that can help in managing and evaluating research by researchers, universities and funders.

Major commercial publishers are moving to monetize the research cycle by providing evaluation and management tools for institutions and funders, thus giving them the potential to develop a dominant position in the research system and to create science-knowledge platforms analogous to other digital platforms that are currently of concern to antitrust regulators. Should the governance of such systems be in the hands of private companies, or should they be governed from within the scientific community and its institutions to protect the public interest and those that seek to deliver it? A resounding response from the Members of ISC that responded to a consultation survey was that it should be the latter. Change in the former direction is rapid, however, and any alternative options need to be undertaken with urgency.

SUMMARY ASSESSMENT

The above analysis leads to an assessment of the extent to which the current system serves the interests of science as reflected in the principles set out in section 2 and identifies the following needs for reform:

I. Many business models inhibit access to the record of science by researchers and/or the public, and exclude authors from poorly-funded institutions and low- and middle-income countries.

II. Copyright transfer to publishers inhibits access to the record of science, reducing its reuse or mining for the knowledge it contains or in response to emergencies.

III. Peer review needs to adapt to increasing volumes of work, to diverse modes of scientific publishing and to demands for rapid access to emerging knowledge.

IV. The data/observations underlying a published truth claim should be concurrently published, with a need for normative procedures as prerequisites for publication.

V. The further development, federation and interoperation of digital libraries, governed by the global public interest, are important priorities for the long-term record of science.

VI. Reflection is required about norms and priorities for open access for individual scholarly disciplines and how they can best be delivered whilst also facilitating interdisciplinary publication.

VII. The potentials of the digital revolution for scholarly publishing have not been fully realized, and moves towards monopolistic platforms threaten innovation and the global public good.

PRIORITIES FOR ACTION

The current system of scientific and scholarly publishing is a ‘mixed economy’ of for-profit and not-for-profit operations, variously involving private sector commercial bodies, publicly funded systems and institutionally based, learned society and independent operations. We expect this mix to be maintained whilst advocating that there should be a shared view of purpose in serving the global public good by adhering to Principles I–VII in section 2. The market needs reform in ways that increase efficiency and avoid monopolistic behaviour through a more rational relationship between its customers (the scientific community) and suppliers. The opportunities offered by the digital revolution must be grasped, which involves questioning some of the assumptions that underlie a system that is still based on norms from the era of print and paper. System governance should primarily lie in the hands of the scientific community and its institutions rather than those of private companies. The ISC will work with its Members, national academies, international scientific unions and associations, other regional and national science bodies and publishers to seek tractable solutions to the major problems of scientific and scholarly publishing identified by this report.

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