

Opening the record of science: Priorities for reform of scientific publishing (zero draft)

A working paper of the Steering Group for the ISC project on the future of scientific publishing

1. Scientific publishing is indispensable to the advancement of science as a global public good, but contemporary publishing systems are in urgent need of reform

Publication is essential to the method of science¹. It exposes knowledge claims to sceptical scrutiny, which is the bedrock of the self-correcting nature of science and the essence of its value to society as a global public good [1]. It makes knowledge available to those who may wish to access it, and contributes to the “record of science”: the ideas, the knowledge and the theories that have accumulated since the earliest days of scientific inquiry. This record is continually refreshed, renewed, re-evaluated, or rejected by new experiments, new observations, and new theoretical insights. It underpins the international scientific collaborations that are essential in tackling the challenges facing humanity.

Yet there are deep concerns within the scientific community that contemporary publishing systems fall far short of the needs of global science². A small number of hegemonic corporations control access to much scientific publishing and to the record of science. At the same time, large numbers of so-called predatory publishers exploit increasing demand by providing unscrutinised routes to easy publication. Business models of major commercial publishers are based on a highly asymmetric market and flawed proxy bibliometrics that lock scientists into use of their products. Major reform of the system is long overdue. The current system of publishing has deep and perverse consequences for science, and needed changes go far beyond normal calls for “open access”. Without reform, the aspirations of UNESCO’s recent Recommendation on open science [2], endorsed by all its 193 member states, will remain beyond reach.

These were the broad conclusions of the International Science Council (ISC)’s 2021 [report](#) [3], which was developed in consultation with the Council’s Membership, made up of the major representative bodies of global science, particularly the international unions and associations of science and national academies.

The scientific community’s response to the COVID-19 pandemic provided a successful example of open science in action, whilst also exposing some of the processes that inhibit the effectiveness of science in contributing to the global public good. Scientists from many disciplines and countries creatively deployed and applied their knowledge, produced databases and websites, short-circuited cumbersome processes of conventional publication through the use of preprints, and shared data and ideas with unprecedented openness in ways that set aside conventional constraints, working across the public-private interface. The experience should be used as a springboard from which to create a ‘new normal’ that advances open science.

Subsequently, the Council’s Membership has committed itself to work towards necessary change and has overwhelmingly endorsed eight fundamental principles which frame the key targets for reform of scientific publishing².

¹ The word **science** is used to refer to the systematic organization of knowledge that can be rationally explained and reliably applied. It is inclusive of the natural (including physical, mathematical and life) science and social (including behavioural and economic) science domains, which represent the ISC’s primary focus, as well as the humanities, medical, health, computer and engineering sciences (ISC, 2018). It is recognized that there is no single word or phrase in English (though there are in other languages) that adequately describes this knowledge community. It is hoped that this shorthand will be accepted in the sense intended.

² In October 2021 Members of the International Science Council voted to endorse eight principles for reform of scientific publishing, and committed to work together for change. See: <https://council.science/current/news/members-vote-to-reform-scientific-publishing/>

The eight principles outlined below are essential to meeting key requirements that need to be satisfied if science is to be a global public good. These can be summarised as:

- to maintain the self-correcting rigour of scientific procedures;
- to disseminate the results of scientific inquiry freely, quickly and efficiently to all who may wish to have access to them;
- to ensure global inclusivity that provides a voice for all and is sensitive to diverse perspectives;
- to conserve the record of science in an open and readily accessible form for successive generations.

2. Fundamental Principles for Scientific Publishing

The principles are summarised in bold in the following box, followed by a brief assessment of the extent to which they are observed in practice, based on the 2021 report.

1: There should be universal, prompt open access to the record of science, both for authors and readers, with no barriers to participation, in particular those based on ability to pay, institutional privilege, language or geography.

Excessive prices, far in excess of the necessary costs of production, place much of the record of science beyond the reach of many who would wish to access it, either as authors or readers. Many in low- and middle-income countries are excluded, resulting in a fractured international scientific community. Almost every major national agreement struck between the science systems of the global north and major commercial publishers increases the height of an inequitable barrier to access by those of the global south. Open access to readers only, based on excessive up-front article processing charges (APCs), is open in name only. True open access is affordable to both readers and authors.

2: Scientific publications should carry open licences that permit reuse and text and data mining. Too much of the record of science is inaccessible for reuse and the application of modern methods of knowledge discovery because of restrictive licences that sustain high paywalls. Some publishers seek to monopolize metadata in monetizing and controlling access to knowledge.

3: Rigorous, timely and ongoing peer review must continue to play a key role in creating and maintaining the public record of science. Conventional peer review is foundering under pressure. It is often slow, ineffectual and inefficient. It is estimated that current peer review mechanisms represent a donation of at least US\$ 2 billion per year, largely from academic researchers, to mainly commercial publishers [4]. Reforms are required to better respond to the needs of science and scientists, utilize the resources of scientific institutions and mobilize the potential of automated procedures.

4: The data and observations on which a published truth claim is based should be concurrently accessible to scrutiny and supported by necessary metadata. It is a fundamental tenet of the scientific method that evidence supporting a published truth claim must be concurrently available for peer scrutiny. Data are in principle as important an output of science as text articles. They should be concurrently accessible under FAIR (Findable–Accessible–Interoperable–Reusable) principles [5], and with securely managed routes to access where general access needs to be restricted because of considerations of safety, security or privacy. Failure to disclose evidence makes falsification so much more difficult, and burdens science with issues that proper disclosure would dispense with. It diminishes the power of science as a special form of knowledge [6].

5: The record of science should be maintained in such a way as to ensure open access by future generations. With the demise of the physical ‘library of record’, it is vital to develop digital means of ensuring sustainable, enduring access to the global record of science and the means of identifying and accessing its content.

6: Publication traditions and bibliodiversity of different disciplines and regions should be respected. Given the diversity of needs, of discipline or geography, no one size fits all. Efficient adaptation of publishing systems to different needs is a priority. The development of procedures to facilitate inter-operability between different disciplines of the scholarly record is under-developed, including procedures that could support multi-lingual communication.

7: Publication systems should be designed to continually adapt to new opportunities for beneficial change rather than embedding inflexible systems that inhibit change. Outmoded forms of publication derived from the print and paper era dominate much current publishing. They should be replaced by more efficient and flexible forms that exploit the developing capacities of digital technologies.

8: Governance of the processes of dissemination of scientific knowledge should be accountable to the scientific community. Access to scientific knowledge, and strategic knowledge about science is increasingly monopolized by major commercial publishers/technology companies whose principal responsibility is to their investors rather than to science.

3. Aspiration for change: developing a common purpose amongst stakeholders

Implementing these principles will challenge aspects of the culture and practice of science that have developed in recent decades and will require bold and ambitious action from all core players in the scientific process, particularly researchers, their universities and institutes, learned societies and research funders. Their common interests lie in maintaining the rigour and creative potential of science, in globally disseminating new knowledge and ideas as widely and efficiently as possible, in making access easier for both readers and authors, in minimising unit costs, in more efficient peer review systems, in making use of innovative technologies and processes to improve efficiency, and in ensuring that access to knowledge is not inhibited by sectional interests but is accountable to the scientific community. These are also the shared interests of national governments, as exemplified by unanimous endorsement of the UNESCO Recommendation on Open Science. Moreover, in an age where difficult political decisions are increasingly informed by research findings, and where public support is vital for policy implementation, finding effective ways to make research outputs accessible to a wider community, including small and medium enterprises and civil society groups, must be a priority.

There are a number of particularly complex issues that are major barriers to necessary change and will require creative solutions if reform that delivers the above outcomes is to be achieved:

- One of the most problematic issues is the pressure on researchers from assessment systems based on bibliometric indices as proxies for scientific achievement, which incentivise perverse behaviours and prop up a large part of the costly commercial publishing model. There are currently several ongoing efforts to reform these systems (e.g. [7, 8, 9]), but these will only be successful if institutions and funders act in concert to implement reform.
- There are two major economic challenges to development of an efficient and equitable global scientific publishing system. Firstly, to drive down excessive profits through researchers and their institutions exercising consumer power more effectively. Secondly, to recognize that even if this were done, financial barriers to access would remain for many low- and middle-income countries and poorer institutions. There are ongoing initiatives which attempt to overcome this problem in several disciplines [10]. This project will explore how such innovations could operate across the spectrum of scientific publishing.
- There are many high-quality journals published by or for learned societies that are a source of income that supports the work of these societies. The societies' commitments to the highest possible scientific standards in their journals, and their ability to draw on a skilled membership as a source of reviews, make many such journals exemplars of scientific publishing at its best. However, the transition to open access for these journals is particularly difficult and can threaten an important source of income that supports their scientific activities.

4. Promoting change

The International Science Council is working on this issue with a two-pronged approach. Firstly, it is working with key stakeholders (including the international scientific unions and associations, the national learned societies that they represent, and the national academies and regional scientific organizations that make up the ISC's membership; with funding bodies, universities and institutes and their international representative bodies; with open access publishers and NGOs that promote open science and open access) to develop a common purpose for reform and for implementation of the above eight principles. Secondly, the Council seeks to stimulate disruptive change by working with the above mentioned stakeholders along the following axes:

a) Normalise existing creative innovations among researchers and their institutions

- Rapid communication to disciplinary peers through preprint servers
- Overlay processes for refereeing pre-prints
- New approaches to peer review and quality control
- Rights retention strategies and open licences
- Concurrent deposition of relevant data/evidence in line with FAIR principles as a condition of publication
- Support for groups of disciplines in "flipping" to a publication mode that incorporates the above procedures

b) Develop and implement

- Funding models that support the eight principles, that are globally accessibility irrespective of ability to pay, for both authors and readers, for example through so-called diamond models
- Sustainable funding models for learned society open access publishing
- Publication modes that reflect diverse needs

- Reformed peer review
- Platform-agnostic discovery services
- Global curation infrastructures for the record of science
- Infrastructure to support publishing as a record of versions, not a version of record
- Reformed incentives that are less reliant on bibliometrics (currently being addressed through an existing projects [7, 8, 9])

5. Towards a possible governance model

A major impact of digitalization has been to fuel the growth of so-called tech giants that exercise product monopoly. Commercial publishers are currently transforming themselves into technology platforms designed to dominate and control awareness of new science and access to it, whilst at the same time monetizing the data about science that they collect from their publishing activities as a basis for assessment of science and scientists, and the management of and strategies for science [11].

Such approaches threaten to privatize key aspects of the scientific enterprise that are typically determined within national science systems by governments, arm's length funding agencies, and, largely, universities, based on a shared commitment to the public good.

Governance of the publishing process should be accountable to the scientific community and its institutions. UNESCO has taken a similar stance [2] in calling for the monitoring of open science to be explicitly kept under public oversight – to include the scientific community – and whenever possible, to be supported by open, non-proprietary and transparent infrastructures. UNESCO further cautioned that while this monitoring aspect could include representatives from the private sector, it should not be left under their control. To ensure that the governance of scientific publication systems is designed and sustained by the community it is intended to serve, the following steps should be considered:

- Adoption of a governance model in which the global research community creates a new global facility/service that operates under the auspices of key international scientific organizations as custodians of the international scientific interest, with a mandate to secure open access to the record of science and its independent, shared governance and resourcing. Such a model should achieve compliance through a minimal central governing body, adherence to agreed open science principles, diversified sources of funding, and promotion of decentralized infrastructures that interoperate through adherence to open standards.
- Sensitivity to different disciplinary traditions and needs, and to varying regional and national priorities and ways of working. Major international representative bodies of science tend to have disciplinary and regional/national representation that already recognizes this variability, and which could readily be adapted to support federated governance mechanisms.
- Development of concrete examples of new models and infrastructures that can flourish under the envisioned governance conditions.
- Explicit adherence to the UNESCO Open Science core values and guiding principles, namely: quality and integrity, collective benefit, equity and fairness, diversity and inclusiveness, transparency-scrutiny-critique-reproducibility, equality of opportunity, responsibility respect and accountability, collaboration-participation-inclusion, flexibility, and sustainability.
- Modelling a proposal based on what can be learned from other consortium-based efforts.
- Foregrounding the role and responsibilities of academic institutions as sources of distributed innovation and investment, on a par with the role that funders have begun to play in supporting open science and re-designing academic incentives.

6. The potential of community-owned infrastructures

Community-owned infrastructures have the potential to play a transformative role in establishing and sustaining a more open and equitable research ecosystem for readers and authors of published scientific output. Tools such as open standards and protocols, and processes for interoperability and information flow among component solutions can help to support rapid open access to publications, management of open data, and help ensure appropriate credit is given to those who contribute to the scientific record. Many infrastructural solutions that support inclusive, community-led publishing efforts already exist, such as Creative Commons licenses, persistent identifier solutions such as ORCID, or the Open Journal Systems Public Knowledge Project.

The ISC and its Steering Group on Scientific Publishing, in partnership with like-minded policy initiatives around the world, will work to develop governance and sustainability frameworks for infrastructure reform. By supporting a move away from reliance on commercially controlled publishing infrastructures and practices, the Council aims to encourage the development of systems that are resistant to capture and control by any single entity – commercial or non-commercial.

The scientific community is, in principle, powerfully positioned to drive reform, being both the creator and major consumer of the products of publication. It has however permitted itself to be increasingly locked-in to a position where much control of access to knowledge is in commercial hands and is largely unresponsive to the contemporary needs of science. As these processes intensify, the window of opportunity for reform narrows. There is a vital need for scientists, their institutions and other stakeholders, including governments and intergovernmental organizations, to collaborate urgently in the project of reform.

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Find out more about this project: <https://council.science/actionplan/future-of-scientific-publishing/>