



Why you can't access papers and what you can do about it

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Closed access publication is a significant problem for: public education and engagement, accessibility of science in developing countries, freedom of thought and the scientific method. But how can time-costly high quality peer-review, reproduction of science, and dissemination be paid for?

Keywords: Open-access, Open-science, Publishing, Meta-Science

Video:

Publishing Science

The core of the scientific method is falsifiability of theory and reproducibility of results. In short, if a theory can never be contradicted theoretically or by real measurement data it is un-scientific. If experimental or theoretical results cannot be replicated by independent parties, the theory or results are at best wrong and at worst fundamentally un-scientific. Key to reproducibility is clear and open communication of scientific theories, experiments, and nascent ideas; Open dialogue and transparency about science and it's methods.

Historically and today two main sources of scientific dialogue are publishing research and attending/ presenting at scientific conferences. Groups of academics have long gathered to discuss science as evidenced by The Academy founded by Plato, Aristotle's teaching in The Lyceum and the platonic-socratic dialogues, or wrote books archived in places such as the Academy and the Library of Alexandria [1] (p8-53).

The first universities were founded in e.g Bologna (c. 1088) and Oxford (c. 1096). But it was not until the foundation of learned Academies, e.g Accademia dei Lincei (Italy, 1603), or the Royal Society of London (1660) and the French Academy of Sciences (1666), that academic journals ([Publishing Lingo](#)) began to surface. One of the first being Philosophical Transactions of the Royal Society of London (1665), which is still going today. The first issue can be found online [2]. Prior and even after the appearance of journals, the greatest scientific minds published their best work as books e.g Gauss [3], Euler [4], and Darwin [5] to name a few, with much communication occurring via letters and meetings at learned societies.

The Cost of Publishing

Early on academic journals such as the Philosophical Transactions of the Royal Society were printed first as a commercial experiment, then to cost for the good of science, and then back again to commercially minded projects due to the inadequacy of private funding. In particular, Transactions began as a commercial experiment, not formally part of the Society by Henry Oldenburg the then Secretary. By the 1700's the journal was still an informal part of the Society funded by private benefactors, including Hans Sloane who paid £1500 (worth £300,000 in today's money) for it's upkeep over a 20 year period. [6]

During the 1800's Transactions became a formal part of the Society, including a reformed and rigorous peer-review process by the mid 1800's. These reforms being proposed in 1820 by a group including Charles Babbage, stating that fellows of the society should be judged by their prior publication record, meaning a knew need for rigour. In those days a paper would be reviewed by a committee to determine its worthiness for presentation at The Society in person, these presentations being mentioned in the newly formed journal Proceedings of the Royal Society [7]. The best, subject to a further committee were accepted for review for potential publication in Transactions itself. That peer-review process included a detailed register of submissions, their fates, and a committee responsible for the final decision on receipt of two reviewers reports, the reviewers normally being fellows of the society. That process of review typically took around 5 weeks, with reports ranging from a few sentences to dozens of pages in length. Even with mechanisation and efficient structure, the ratio of fellows (i.e reviewers) to submission quickly dwindled.

Before 1900 "The Society supported the publication and circulation of scientific knowledge and did not expect to recoup much of the cost from sales" [6]. By the 1920's funding via government grants and private donation came under strain leading to a focus on the financial enterprise of publishing, meaning price increases. In 2014 The Royal Society (a charity [8]) reported £2.6 million in profit from publishing activities, 1/5 of income [6].

As a registered charity, the royal society uses it's profits and donations for the public good and promotion of science. As a publishing body the societies journals operate under a Hybrid Open Access approach. Similar organisations exist across the world such as the American Physical Society.

The move to subscriptions and above cost publishing does reflect the fact that printing costs time and money, not to mention the editing and peer-review processes necessary for maintaining quality academic content (although peer-reviewers are unpaid), and electronic or physical dissemination. The cost to authors (APCs, [Publishing Lingo](#)) is sometimes levied through their institution subscription instead, but not all institutions pay for this, hence some science is not open.

For Profit Publishing

Springer-Nature (known for the journal Nature) and Elsevier are the two largest publishers focusing on for-profit (i.e they are not charities like the Royal Society) publishing of academic work. Each make over a billion dollars in revenue with profit margins around 20-30% [9, 10]. Both do have the possibility of open access for a hefty levy on the authors of submitted work, Nature for example charges €9,500 (≈ \$10,000) for an accepted paper to be published as open-access, and Elsevier charges on average \$2658 across it's journals. These should be contrasted with the not for-profit publishers in table 1, and their impact factors.

At some level costs must be recouped or no publishing will happen, in both for- or non-profit cases. But this should not come at a cost of blocking open science and public participation. The

Journal	Impact Factor	Company	For Profit?	Fee for OA/ APC
Nature	49.96	Springer-Nature	Yes	\$10718.61 [11]
All	8.7 (Avg.)	American Physical Society	No	\$2280 (Avg.) [12]
All	3.703 (Avg.)	The Royal Society	No	\$2040 (Avg.) [13]
All	Various	Elsevier	Yes	\$2658 (Avg.) [14]
PNAS	11.2	American Academy of Sciences	No	\$2,575 (delayed OA) \$4,975 (Immediate OA) [15]
Science	41.84	American Association for the Advancement of Science	No	≈\$2200 Subscription + Figure charges [16]
Science Advances	14.4	American Association for the Advancement of Science	No	\$4,500 [17]
ArXiv	N/A	Cornell University	No	\$0, costs \$10 per article to host, i.e. \$800,000 per year[10]

Table 1: The Cost of Open Access

real issues are how much higher for-profit publishers profit margins are compared to non-profit publishers, especially since non-profits fund the scientific community, after costs are recouped, and the weak link between journal quality and fees as well as the notable price differences between subscription and open access journals [10].

Further the real cost of publishing is opaque. For profit institutions regularly impose non-disclosure agreements on institutional subscribers and refuse to release details on profit margins or on the actual cost of bringing articles to print. Nature claimed each article costs \$30,000 to \$40,000 to bring to print in 2013, but now charges ≈ \$10,000 per article for Open Access, the average cost per article reported by Open Access journals was \$660 in 2013 [10].

What you can do

Firstly most publishers will allow authors to send copies when asked directly, e.g via email or on social media, and some will do so on principal even if not (on twitter #ICanHazPDF evolved for this purpose in 2011, and Sci-Hub). Additionally searching on Google Scholar, ArXiv, medRXiv, or bioRXiv will likely produce a “Green Open Access” version of a paper (it *may not* be peer reviewed!) or on a University or Research Institute’s own archive system.

In the longer term pressuring local and national political representatives to fund science could have a large impact; government funding could go towards insuring open access. In a sense most research will be at least partially funded by a government or government backed research funding organisation such as UK Research and Innovation (UKRI) a publicly funded director of research funding in the United Kingdom. So arguably, the public is already paying for the research and are morally entitled to Open Access.

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Publishing Lingo

- **Journal** - a periodically published body of academic research (papers)
- **Open Access (OA)** - Academic works being freely available, this can mean any combination of: free-to-read, free-to-share, and free-to-reuse.
- **Closed Access (CA)** - Academic works inaccessible except by paid subscription or blocked for other reasons.
- **Peer Review** - Critical assessment of an academic work by notable academics with relevant subject knowledge
- **Reproducibility** - Whether an academic work’s results can be independently replicated.
- **Article Processing Charges (APC’s)** - a fee charged by an academic journal for publishing an academic work, charged to the authors/authors institution. Can be \$100’s – \$1000’s.
- **Pre-print** - A copy of an academic work prior to peer-review, usually posted on a public database such as ArXiv, medRXiv, or bioRXiv
- **Post-print/Accepted Author Manuscript** - A copy of an academic work posted on a public database (or otherwise shared) after peer-review.
- **Diamond OA** - A journal publishing OA without charging APC’s and allowing sharing and reuse, Authors maintain copyright
- **Gold OA** - A journal publishing OA and allowing sharing and reuse, sometimes the journal charges APC’s, Authors maintain copyright
- **Green OA** - A journal publishes CA, but allows authors to self-archive pre- and post-prints. APCs are charged. Authors loose copyright of the CA version. May allow reuse.
- **Hybrid OA** - A journal publishes a mixture of OA and CA articles. May allow reuse.
- **Bronze OA** - A journal publishes OA content but does not have a clear license, usually not reuse-able
- **Black OA** - “illegal” publishing of copyrighted/ CA academic works on public databases. i.e a person with access posts a copy of a work online. See Sci-Hub.