

## Commentary: On the quality and costs of science publication

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## Commentary

# On the quality and costs of science publication

**N**ext to the spoken word, scholarly journals have always been the most immediate and important way for scientists to communicate. Maintaining their quality is therefore crucial to the success and advancement of the scientific enterprise. For centuries, learned societies have taken on the task of reviewing, producing, and monitoring publications for their field. By enabling publishing by scientists for scientists, they have helped the scientific community to self-organize.

Examples of such societies include the Royal Society, the National Academy of Sciences, the French Academy of Sciences, the American Association for the Advancement of Science, and the American Institute of Physics (which publishes *PHYSICS TODAY*). Also included are the many university presses—Cambridge, Oxford, Harvard, and others.

The society and university presses are nonprofit. Many have evolved over centuries, and each has a great tradition of reporting scientific advances and discoveries. Because scientists see the value in the scholarly publishing enterprise, they are willing to volunteer their time as journal editors, referees, or authors. Their input is invaluable in offering the scientific community a degree of quality control over publications.

In contrast, commercial publishers have discovered that there is money to be made in the growing market for science publications. Commercialization of journals has contributed significantly to an explosion in their price, their numbers, and the quantity of papers they seek to publish. As a consequence, college and university libraries often can no longer afford all the journals.

A way that commercial publishers have maintained their profits is to change



CYNTHIA B. CUMMINGS

the publishing concept from a pay-to-read strategy, which places the financial burden mostly on libraries and thus their universities, to a pay-to-publish scheme in which authors pay a fee to get their papers published. The pay-to-publish approach allows commercial publishers to circumvent quality control both for existing journals and for new journals that often have minimal pre-publication review. Thus both the number of publications—and of paying au-

thors—and the publishers' revenue are dramatically increased. The marketing strategy for pay-to-publish is to call it "open access." It plays on the idea that the results of research financed by the public should also be freely accessible to the public.

For more than 25 years, however, the scientific community has benefited from an effective solution to the problem of open, cheap, and easy access to scientific publications: The preprint server

arXiv.org and other open internet archives make freely available to everyone the contents of articles in an increasing number of science and engineering fields.

Presently, arXiv.org has operating costs, including salaries for five full-time staff members, that are less than \$1 million per year. Expenses are paid by Cornell University with funding from NSF, and the operation is transparent.

In physics, mathematics, astronomy, information science, and statistics, the vast majority of papers worldwide are already freely available on servers like arXiv.org. Other fields are catching up quickly.

Many journals from scientific societies—the Physical Review family from the American Physical Society, for example—accept submissions of papers already posted on arXiv.org. That process leads either to publication of an improved version of the paper in the journal and on the preprint server or to rejection by the journal. Thus journal publication provides the stamp of quality from the scientific community.

The refereeing process and the enhancement of a paper's quality and readability by and for the scientific community are critical for the community's advancement. In principle, that added value is also possible with the pay-to-publish concept, but not together with the for-profit goal of commercial publishers.

A pay-to-publish system will likely lead to two tiers of publications. In some instances, it already has. At the high end, respected for-profit and nonprofit journals will ask authors for exorbitant publication fees to cover costs of refereeing, selection, and marketing; authors will

want to publish in them to promote their careers and to secure funding.

At the low end, for-profit journals will publish basically anything, provided the authors pay a publication fee. The net result of the lower tier will be a major problem for the scientific community and a disaster for the public: A flood of publications with minimal quality control will erode the separation between legitimate and junk science and will extract vast additional publishing costs from the scientific community and thus from public coffers.

Plan S, proposed by a group of European funding agencies, would enforce the pay-to-publish model. (See "Concerns remain over European open-access proposal," *PHYSICS TODAY* online, 28 June 2019, and "Open access at a crossroads," *PHYSICS TODAY* online, 11 October 2018.)

The plan in its present form has several major problems. A glaring example is that it does not allow scientists with funding from Plan S—supporting organizations to publish in the leading scientific journals. In most cases, those journals are published by academic societies. Plan S raises other concerns, too:

- The plan ignores the enormous difference between commercial publishers, with their principal aim of making money, and academic societies, with their principal aim of advancing science.
- Plan S breaks with the centuries-old tradition of quality control in scientific society publishing. Instead, it enforces a top-down approach that effectively promotes publication of all submitted papers. Having a flood of papers that contain flawed or even wrong research but are freely available clearly is not in the interest of the general public, who through taxes still has to pay twice: once for the research itself and again for the pay-to-publish system.
- Plan S implies a redistribution of public research money to commercial publishers and away from support of the research itself. For example, a research group that produces about 20 papers per year would have to pay €100 000 (\$114 000) annually for the papers to be freely available in respectable journals. That's the approximate salary equivalent of at least two PhD positions, depending on the country.
- Authors who cannot pay cannot get published.



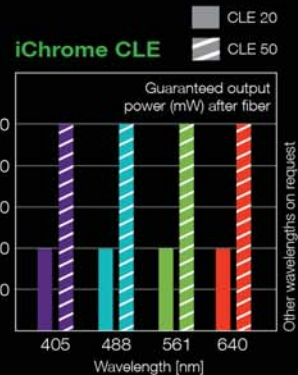
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- Plan S will isolate countries that sign onto it from the rest of the international research community. It will lead to a loss of collaborations because researchers from Plan S—supporting countries will not be able to easily publish with colleagues from nonparticipating nations.

- The plan will inhibit the influx of international talent into countries that are under Plan S.

- Young scientists from countries whose funding agencies have signed onto Plan S will have difficulty finding positions abroad because they have not been able to publish in leading society journals.

- Plan S offers insufficient cost and quality controls. In fact, Plan S in its current form undermines both cost and quality controls.

A practical alternative to rapidly reduce the costs of scientific publishing is for libraries to take coordinated action and simply unsubscribe from high-cost for-profit journals. The incentive for researchers to publish in such journals would then quickly disappear. The Max Planck Society in Germany and many German universities have taken the lead on that approach; as of 1 January 2019, they ceased subscribing to all Elsevier journals. Such a coordinated action will strengthen the position of academic-society journals and will help them preserve the peer-review system and thus maintain quality control. The overall costs of journals then would fall quickly and dramatically.

Good scientific publishing is led by and for the scientific community through its academic societies and university presses. We scientists should be highly skeptical about both commercially driven and ideologically driven movements in scientific publishing. Preprint servers like arXiv.org can make open access easy and inexpensive, and coordinated efforts to avoid for-profit journals can support the tradition of refereed, quality-controlled scientific papers. Ready access and availability have already been achieved in many fields; remaining fields should follow their example.

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## LETTERS

# Let's expand the vision of a new Bell Labs!

**M**ark Raizen's commentary "Let's recreate Bell Labs!" appeared in the October 2018 issue of PHYSICS TODAY (page 10). I liked his idea and was quite taken by the scope of his vision. Unfortunately, my enthusiasm was dampened when I read the details of how his idea would work. I understand his desire that fellows "be selected for their track record of exceptional creativity." However, his assumption that they "could utilize the significant resources of their home institutions for fabrication and diagnostics" means that the research foundation and its fellowships would be available only to scientists at major, research-focused universities.

During my career at public regional universities, I have met many physicists who have great ideas. But due to the lack of resources, high teaching loads, few to no graduate students, and difficulties competing for grants, they never could capitalize on them. Since a large number of physicists work at smaller institutions, the structure that Raizen proposes for research at his Pointsman Foundation simply becomes a continuation of the conceit that only scientists at major institutions have anything to contribute.

I challenge Raizen to broaden his vision to truly maximize the impact of his lab. I recommend creating some fellowships—initially one or two but expanding to 10–20% of the total—explicitly for physicists from less affluent institutions. The new fellowships would, of necessity, be more expensive to implement than the other fellowships, since the foundation would have to provide the additional support that Raizen currently expects from home institutions.

Expanding the cadre of fellows and helping to strengthen research capabilities at smaller institutions offsets the added expense and would have an impact beyond the original intent outlined in the commentary. A research institute that includes the broadest possible group

of physicists maximizes the potential for discovery and innovation and also significantly benefits students at all levels as faculty return to their home institutions.

Raizen ends his commentary with a rousing call for action. Expanding his proposal to physicists across the profession would make his foundation even more successful.

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► **Raizen replies:** I thank Daniel Suson for his comments, and I agree that we must cast the broadest net possible to identify and promote creativity. That will include not only major research universities but smaller institutions where resources are scarcer and teaching loads are higher. We will make resources available at the Pointsman Foundation's laboratory by a combination of internal funding and facilities at nearby institutions. For example, the new Advanced Science Research Center at the Graduate Center, City University of New York, has state-of-the-art facilities available to other institutions and companies for a user fee. Having nearby facilities will be important to Pointsman fellows and to the lab's permanent scientific staff and will be a determining factor in the lab's location.

Another activity we will pursue is incubation of patented inventions that are aligned with the foundation's mission. We will license the intellectual property from the institutions, regardless of their size, and pay the inventors as consultants.

I must differ with Suson on one point: We will not apply quotas for any Pointsman fellows but simply look for the best ideas that can lead to breakthroughs and discoveries.

**Mark G. Raizen**  
([raizen@physics.utexas.edu](mailto:raizen@physics.utexas.edu))  
University of Texas at Austin  
and the Pointsman Foundation

## Corrections

**June 2019, page 42**—In the caption for figure 1, the image should be attributed to Yasunobu Miyoshi.

**May 2014, page 20**—The length scale in the lower right panel of the figure should be given as 1 mm. PT