Why Is Science Behind a Paywall?

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Scientists' work follows a consistent pattern. They apply for grants, perform their research, and publish the results in a journal. The process is so routine it almost seems inevitable. But what if it's not the best way to do science?

Although the act of publishing seems to entail sharing your research with the world, most published papers sit behind paywalls. The journals that publish them charge thousands of dollars per subscription, putting access out of reach to all but the most minted universities. Subscription costs have risen dramatically over the past generation. According to critics of the publishers, those increases are the result of the consolidation of journals by private companies who unduly profit off their market share of scientific knowledge.

When we investigated these alleged scrooges of the science world, we discovered that, for their opponents, the battle against this parasitic profiting is only one part of the scientific process that needs to be fixed.

Advocates of “open science” argue that the current model of science, developed in the 1600s, needs to change and take full advantage of the Internet to share research and collaborate in the discovery making process. When the entire scientific community can connect instantly online, they argue, there is simply no reason for research teams to work in silos and share their findings according to the publishing schedules of journals.

Subscriptions limit access to scientific knowledge. And when careers are made and tenures earned by publishing in prestigious journals, then sharing datasets, collaborating with other scientists, and crowdsourcing difficult problems are all disincentivized. Following 17th century practices, open science advocates insist, limits the progress of science in the 21st.

The Creation of Academic Journals

> “If I have seen further it is by standing on the shoulders of giants.”
>
> ~ Isaac Newton

Into the 17th century, scientists often kept their discoveries secret. Isaac Newton and Gottfried Leibniz argued over which of them first invented calculus because Isaac Newton did not publish his invention for decades. Robert Hooke, Leonardo da Vinci, and Galileo Galilei published only encoded messages proving their discoveries. Scientists gained little by sharing their research other than claiming their spot in history. As a result, they preferred to keep their discoveries secret and build off their findings, only revealing how to decode their message when the next man or woman made the same discovery.

Public funding of research and its distribution in scholarly journals began at this time. Wealthy patrons pooled their money to create scientific academies like England’s Royal Society and the French Academy of Sciences, allowing scientists to pursue their research in a stable, funded environment. By subsidizing research, they hoped to aid its creation and dissemination for

society's benefit.

Academic journals developed in the 1660s as an efficient way for the new academies to spread their findings. The first started when Henry Oldenburg, secretary of the Royal Society, published the society's articles at his own expense. At the time, the market for scientific articles was small and publishing a major expense. Scientists gave away the articles for free because the publisher provided a great value in spreading the findings at very little profit. When the journals market became more formal, almost all publishers were nonprofits, often associated with research institutions. Up until the mid 20th century, profits were low and private publishers rare.

Universities have since replaced academies as the dominant scientific institution. Due to the rising costs of research (think linear accelerators), governments replaced individual patrons as the biggest subsidizer of science, with researchers applying for grants from the government or foundations to fund research projects. And journals transitioned from a means to publish findings to take on the role of a marker of prestige. Scientists' most important qualification today is their publication history.

Today many researchers work in the private sector, where the profit incentives of intellectual property incentivize scientific discovery.

But outside of research with immediate commercial applications, the system developed in the 1600s has remained a relative constant. As physicist turned science writer Michael Nielsen notes, this system facilitated "a scientific culture which to this day rewards the sharing of discoveries with jobs and prestige for the discoverer… It has changed surprisingly little in the last 300 years."

The Monopolization of Science

In April 2012, the Harvard Library published a letter stating that their

subscriptions to academic journals were “financially untenable.” Due to price increases as high as 145% over the past 6 years, the library said that it would soon be forced to cut back on subscriptions.

The Harvard Library singled out one group as primarily responsible for the problem: “This situation is exacerbated by efforts of certain publishers (called “providers”) to acquire, bundle, and increase the pricing on journals.”

No One to Blame but Ourselves

For critics of private publisher’s monopolization of the journal industry, there is a simple solution: open access journals. Like traditional journals, they accept submissions, manage a peer review process, and publish. But they charge no subscription fees - they make all their articles available free online. To cover costs, they instead charge researchers publication fees around $2,000. (Reviewers not on payroll decide which papers to accept to spare journals the temptation of accepting every paper and raking in the dough.)

Unlike traditional journals, which claim exclusive copyright to the paper for publishing it, open access (OA) journals are free of almost all copyright restrictions.

If universities source the funding for research, and its researchers perform both the research and peer review, why don't they all switch to OA journals? There have been some notable successes in the form of the Public Library of Science'swell-regarded open access journals. However, current scientific culture makes it hard to switch.

A history of publication in prestigious journals is a prerequisite to every step on the career ladder of a scientist. Every paper submitted to a new, unproven OA journal is one that could have been published in heavyweights like *Science* or*Nature*. And even if a tenured or idealistic professor is willing to sacrifice in the name of science, what about their PhD students and co-authors for whom publication in a prestigious journal could mean everything?

One game changer would be governments mandating that publicly financed research be made publicly available. Every year the United States government provides over $60 billion in public grants for scientific research. In 2008, Congress mandated (over furious opposition from private publishers) that all research funded through the National Institute of Health, which accounts for 50% of government funding of science, be made publicly available within a year. Extending this requirement to all other research financed by the government would go a long way for OA publishing. This is true of similar efforts by the British and Canadian governments, which are in the midst of such steps.

Disrupting Science

> "The process of scientific discovery – how we do science – will change more over the next 20 years than in the past 300 years."

~ Michael Nielsen

The current model of publicly funding research and publishing it in academic journals was developed during the days of Isaac Newton in response to 17th century problems.

Beginning in the 1960s, private companies began to buy up and unduly profit off the copyrights they enjoyed as the publishers of new scientific knowledge. This has caused a panic among cash-strapped university libraries. But the bigger problem may be that scientists have not fully utilized the Internet to share, collaborate, and invent new ways of doing science.

The impact of this failure is "impossible to measure or put an upper bound on," Toni told us. "We don't know what could have been created or solved if knowledge wasn't paywalled. What if Tim Berners-Lee had put the world wide web behind a paywall. Or patented it?"

Advocates of open science present a strong case that the idolization of publishing articles in journals has resulted in too much secrecy, too many false positives, and a slowdown in the rate at which scientific discoveries are made. Only by changing the culture and incentives among scientists can a system of openness and collaboration be fostered.

The Internet was created to help scientists share their research. It seems overdue that scientists take full advantage of its original purpose.