

# The war to free science

How librarians, pirates, and funders are liberating the world's academic research from paywalls.

By Brian Resnick and Julia Belluz | Updated Jul 10, 2019, 3:58pm EDT

*Illustrations by Javier Zarracina*



The **27,500 scientists** who work for the University of California generate **10 percent** of all the academic research papers published in the United States.

Their university recently put them in a strange position: Starting July 10, these scientists will not be able to directly access much of the world's published research they're not involved in.

That's because in **February**, the UC system — one of the country's largest academic institutions, encompassing Berkeley, Los Angeles, Davis, and several other campuses — dropped its nearly **\$11 million annual subscription** to Elsevier, the world's largest publisher of academic journals.

On the face of it, this seemed like an odd move. Why cut off students and researchers from academic research?

In fact, it was a principled stance that may herald a revolution in the way science is shared

around the world.

The University of California decided it doesn't want scientific knowledge locked behind paywalls, and thinks the cost of academic publishing has gotten out of control.

Elsevier **owns** around 3,000 academic journals, and its articles account for **some 18 percent** of all the world's research output. "They're a monopolist, and they act like a monopolist," says **Jeffrey MacKie-Mason**, head of the campus libraries at UC Berkeley and co-chair of the team that negotiated with the publisher. Elsevier makes huge profits **on its journals**, generating billions of dollars a year for its parent company RELX.

This is a story about more than subscription fees. It's about how a private industry has come to dominate the institutions of science, and how librarians, academics, and even pirates are trying to regain control.

The University of California is not the only institution fighting back. "There are thousands of Davids in this story," says the head of campus libraries at the University of California Davis MacKenzie Smith, who, like other librarians around the world, has been pushing for more open access to science. "But only a few big Goliaths."

Will the Davids prevail?

## **The academic publishing industry, explained**

Imagine your tax dollars have gone to build a new road in your neighborhood.

Now imagine that the company overseeing the road work charged its workers a fee rather than paying them a salary.

The overseers in charge of making sure the road was up to standard also weren't paid. And if you, the taxpayer, want to access the road today, you need to buy a seven-figure annual subscription or pay high fees for one-off trips.

We're not talking about roads — this is the state of scientific research, and how it's distributed today through academic publishing.

Indeed, the industry built to publish and disseminate scientific articles — companies such as Elsevier and Springer Nature — has managed to become incredibly profitable by getting a lot of taxpayer-funded, highly skilled labor for free and affixing a premium price tag to its goods.

Academics are not paid for their article contributions to journals. They **often have to pay fees** to submit articles to journals and to publish. Peer reviewers, the overseers tasked with making sure the science published in the journals is up to standard, typically aren't paid either.

And there's more: Academic institutions have to purchase exorbitant subscriptions priced at hundreds of thousands of dollars each year so they can download and read their own and other scientists' work from beyond the paywall. The same goes for members of the public who want to access the science they've funded with their tax dollars. A single research paper in *Science* can set you back **\$30**. Elsevier's journals can cost, individually, thousands of dollars **a year for a subscription**.

Publishers and journal editors say there are steep costs associated with digital publishing, and that they add value at every step: They oversee and manage peer reviewers and editors, act as quality gatekeepers, and publish an ever-larger number of articles each year.

We spoke with executives at both Elsevier and Springer Nature, and they maintain their companies still provide a lot of value in ensuring the quality of academic research. It's true these companies are not **predatory journals**, businesses that will publish just about any paper — without any scientific vetting — for a fee.

In 2018, **Elsevier's revenue grew by 2 percent**, to a total of \$3.2 billion. Gemma Hersh, a senior vice president for global policy at Elsevier, says the company's net profit margin was 19 percent (more than double the net profit of **Netflix**).

But critics, including open access crusaders, think the business model is due for a change. "I think we're nearing the tipping point, and the industry is going to change, just like the industry for recorded music has changed, the industry for movies has changed," MacKie-Mason says. "[The publishers] know it's going to happen. They just want to protect their profits and their business model as long as they can."

It's a business model as convoluted as the road you paid for but can't use. And it grows more expensive for universities every year.

Now the status quo is slowly shifting. There is a small army of people who aren't putting up with the gouging any longer.

This disparate band of revolutionaries is waging war on the scientific publishing industrial complex on three fronts:

- Librarians and science funders are playing hardball to negotiate lower subscription fees to scientific journals.
- Scientists, increasingly, are realizing they don't need paywalled academic journals to act as gatekeepers anymore. They're finding clever workarounds, making the services that journals provide free.
- Open access crusaders, including science pirates, have created alternatives that free up journal articles and pressure publishers to expand access.

If they succeed, the cloistered, paywalled way that science has been disseminated for the past century could undergo a massive transformation. The walls, in other words, could fall.

If paywalls fall, the impact would reverberate globally. When science is locked behind paywalls, it means cancer patients can't easily access and read the research on their conditions (even though research is often taxpayer-funded). When scholars can't read the latest research, "that hinders the research they can do, and slows down the progress of humanity," MacKie-Mason says.

But there's a big thing getting in the way of a revolution: prestige-obsessed scientists who continue to publish in closed-access journals. They're like the road workers who keep paying fees to build infrastructure they can't freely access. Until that changes, the walls will remain firmly intact.

## How academic journals became so unaffordable

Scientific journals, published mainly by small scientific societies, sprouted up alongside the printing industry in the 17th century as a way to disseminate science and information about scientific meetings.

The first scientific journals, the *Journal des sçavans* and the *Philosophical Transactions of the Royal Society of London*, were distributed via mail. Like all pre-internet publishing models, early journals sold subscriptions. It wasn't the hugely profitable industry it is today.

After World War II, the business changed dramatically. The journals — which were mostly based in Europe — focused on selling subscriptions internationally, targeting American universities flush with Cold-War era research funding. “They realized you can charge a library a lot more than an individual scholar,” says **Aileen Fyfe**, a historian specializing in academic publishing at the University of St. Andrews.

As more and more journals popped up, publishing companies began consolidating. In the 1950s, major publishers started to purchase journals, transforming a once diffuse business into what's been called an **oligopoly**: a market controlled by a tiny number of producers.

By the early 1970s, just five companies — Reed-Elsevier, Wiley-Blackwell, Springer, and Taylor & Francis — published one-fifth of all natural and medical scientific articles, according to an analysis in *PLOS One*. By 2013, their share rose to 53 percent.

No single publisher embodies the consolidation, and the increase of costs, more than Elsevier, the biggest and most powerful scientific publisher in the world. The Dutch company

now publishes nearly **half a million articles** in its 3,000 journals, including the influential *Cell*, *Current Biology*, and *The Lancet*.

And the consolidation, the lack of competition, means publishers can get away with charging very high prices.

When the internet arrived, electronic PDFs became the main medium through which articles were disseminated. At that point, “librarians were optimistic this was going to be the solution; at last, journals are going to become much, much cheaper,” Fyfe says.

But instead of adopting a new business and pricing model to match the new means of no-cost dissemination, consolidation gave academic publishers the freedom to raise prices. Starting in the late 1990s, publishers increasingly pushed sales of **their subscriptions into** large bundled deals. In this model, universities pay a hefty price to get a huge subset of a publisher’s journals, instead of purchasing individual titles.

The publishers argue the new mode of digital delivery has come with an array of additional costs. “We’re continuing to invest significantly in digital infrastructure, which has a lot of fixed costs that repeat each year. We’re employing thousands of technologists,” said Elsevier’s Gemma Hersh. “So it’s not the case that digital is cheaper.”

The publishers also say that the volume of articles they publish every year increases costs, and that libraries ought to be funded to pay for them. “The libraries are treated by the senior academics at these institutions as a fixed cost; they’re not a fixed cost,” says Steven Inchcoombe, the chief publishing officer at Springer Nature, which publishes the prestigious

*Nature* family of journals.

In a July 10 **statement**, Hersh said of Elsevier's battle with the UC system "this stalemate was avoidable" and that the company hopes "we can find a pragmatic way forward if there is will and engagement from both sides."

The librarians beg to differ. For universities, the most frustrating development is that cost of access keeps rising at a very steep rate.

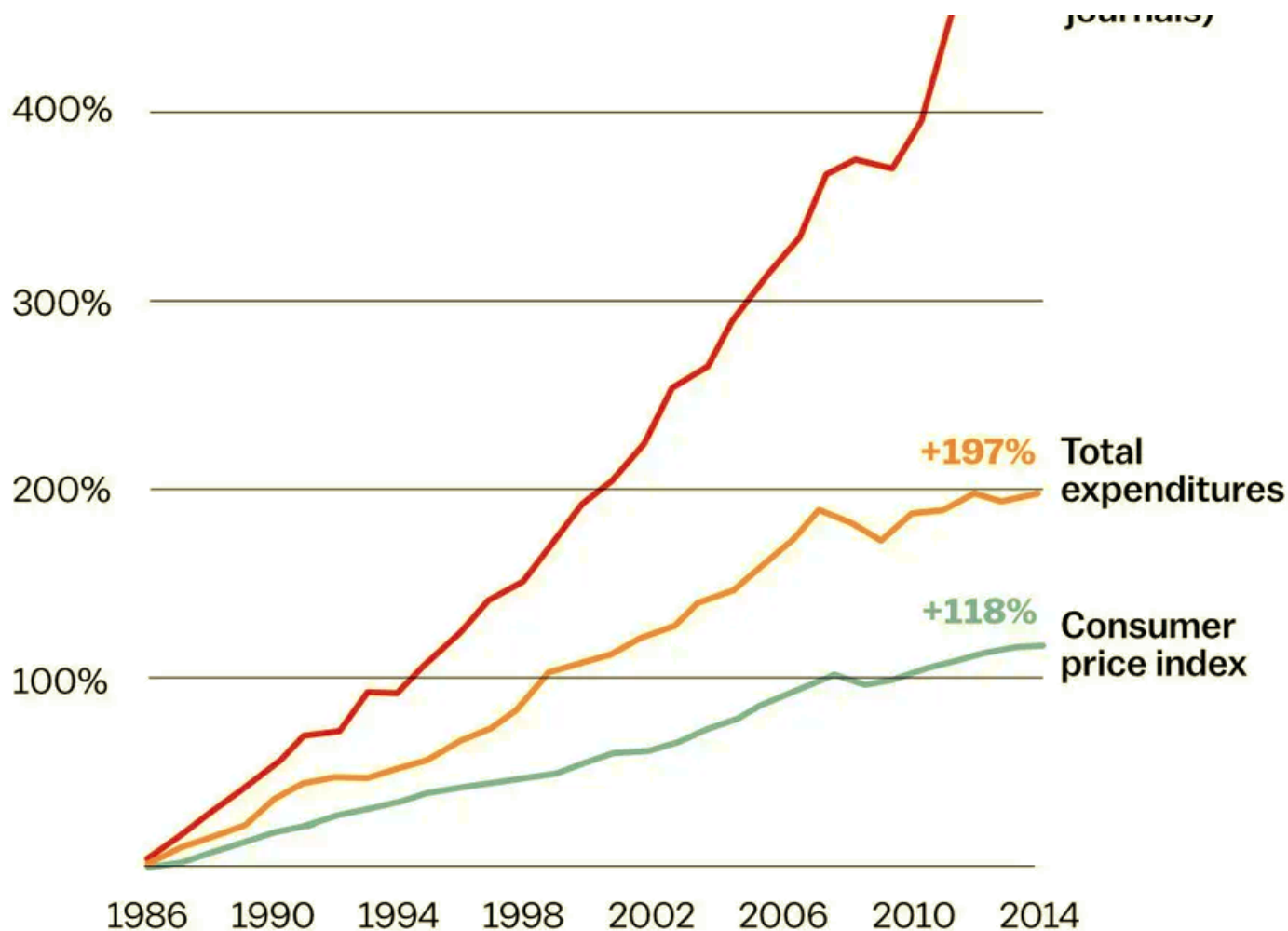
Take a look at this graph from the Association of Research Libraries. It shows the percent change in spending at university libraries. The category "ongoing resources expenditures" includes spending on academic journals, and it rose 521 percent between 1986 and 2014. Over that time, the consumer price index — the average increase of costs of common household goods — rose 118 percent.

## Spending on journals (and other reoccurring materials) has greatly outpaced inflation

Percent change in spending in university libraries







Source: Association of Research Libraries



## Librarians at the breaking point

The University of Virginia **has** a website where you can see how much money its library is spending on journals. From 2016 to 2018, the costs for Elsevier journals increased by \$118,000 for the university, from \$1.716 million a year to \$1.834 million.

The data shows that the university is also spending a lot of money for journals that no one who uses their library system reads. In 2018, the university paid Springer Nature \$672,000 for nearly 4,000 journals — 1,400 of which no one ever accessed. No one at UVA read the *Moscow University Chemistry Bulletin*, or *Lithology and Mineral Resources*, for example.

Why are universities paying for journals that no one reads? “It’s a lot like the cable bundle — they tell you you’re getting 250 channels, but if you look inside your heart, you know all you want is ESPN and AMC,” says **Brandon Butler**, director of information policy at the University of Virginia Library. An individual journal subscription can cost a university thousands of dollars. “UVA is absolutely considering cutting these bundles,” he says. “It’s quite likely we will, unless the price and other terms change radically.”

As the University of North Carolina Chapel Hill librarian, **Elaine Westbrook** is facing what she and so many other academic librarians call the “serials crisis”: “If we buy the exact same journals every year, I have to pay at least \$500,000 more just for inflation,” she says. “I can’t afford it.”

In her ongoing negotiations with Elsevier, Westbrook is considering “the nuclear option,” as she puts it. That is, canceling the subscription that gives UNC Chapel Hill students and faculty access to thousands of Elsevier journals.

“It felt very much in 2017 the librarians felt beaten by the system and they couldn’t afford it,” says David Stuart, the researcher behind a **yearly survey** on the academic publishing industry. “Whereas in 2018, you could feel there was a bit more strength and power emerging, and they had the ability to push back on the publishers a bit.”

## **Science funders increasingly are calling for open access**

It’s not only librarians waking up to the fact that the costs of accessing science are unsustainable — so are science funders. A lot of the money that fuels this system comes from government grants. In the US, taxpayers spend **\$140 billion every year** supporting research, a huge percentage of which they cannot access for free. When scientists do want to make their work open access (meaning published without a paywall), they’re charged an extra fee for that as well.

This year, a **consortium of public research institutions in Norway** canceled its Elsevier contract, a move that followed a research consortium in **Hungary** breaking ties with the Dutch giant. In **Germany**, nearly 700 libraries and research institutes made a deal with the publisher Wiley: For about 25 million euros, they’re paying to access journal content — but also demanding the work of their researchers, published in Wiley journals, be made open access for all at no additional cost.

These institutions and funders are also banding together **as part of Coalition S**: The agreement says all scientific publications that have sprung from publicly funded research grants must be published on open access journals or platforms by 2020.

“The ambition is if the University of California does this deal, Germany does this deal — we eventually get to the point where [all science is] open access. The libraries are no longer paying to subscribe, they’re paying to publish,” said Robert Kiley, the head of open research at the UK’s Wellcome Trust.

But open access doesn’t necessarily mean cheap. Currently, publishers typically charge academics to publish that way too. If you want your article to be open access in an Elsevier journal, you could **pay** anywhere from \$500 — the fee to publish in *Chemical Data Collections* — up to \$5,000, the fee to publish in *European Urology*.

“Open access is absolutely in the best interest of the research process,” Inchcoombe, the chief publishing officer at Springer Nature, says. “If you can pay once and then it’s free for everybody, you eliminate a lot of the friction from the system of access and entitlement.” He hopes publishing will transition, over time, to open access.

But he stresses that open access won’t change “the fact that if you do more research, and you want to communicate it to more people, then there is a cost of doing that that rises with volume.”

Put another way: Publishers are still going to get paid. Open access just means the paychecks come at the front end.

This brings us to another band of revolutionaries in the fight against the status quo: the scientists who want to find ways to circumvent the behemoth publishers.

## Some scientists are saying no to the big publishers and spinning off open access journals of their own

The structure of academic publishing isn't just a pain for librarians and funders; it's a bad deal for academics too. Basically, scientists trade in their hard work, their results for their toils in the lab, for free, to a private industry that makes tons of money off their work, in return for prestige.

Some researchers have been waking up to this and spinning off freely accessible journals of their own. One of those scholars is a University of Cambridge mathematician named **Timothy Gowers**. In 2012, he wrote **a post** bemoaning the exorbitant prices that journals charge for access to research and vowed to stop sending his papers to any journal from **Elsevier**.

To his surprise, the post went viral — and spurred a boycott of Elsevier by researchers around the world. **Within days**, hundreds of researchers left comments commiserating with Gowers, a winner of the prestigious Fields Medal. Encouraged by that response, in 2016, Gowers launched a new online mathematics journal called ***Discrete Analysis***. The nonprofit venture is owned and published by a team of scholars. With no publisher middlemen, access is completely free for all.

University of Montreal professor and open access researcher **Vincent Larivière** has helped take the Elsevier boycott another step further. In January 2019, the entire editorial board of the Elsevier-owned *Journal of Informetrics* (including Larivière) **resigned**, and moved to MIT Press to start another open access journal, ***Quantitative Science Studies***.

Again, the move was a principled one. “There’s a universalistic aspect to science, where you want it to be available to everyone,” Larivière said.

Even in the absence of starting open access journals, though, some scientists have been taking quieter, but equally principled, stands. One **paleontologist** took his name off a paper because his co-authors wouldn’t publish in an open access journal.

One key reason scientists, librarians, and funders can fight back is because other crusaders have made research more accessible. Enter the pirates.

## **Pirating and preprints are also pressuring the publishing industry to increase access**

Over the past decade, it’s been getting easier and easier to circumvent the paywalls and find free research online. One big reason: pirates, including Kazakh neuroscientist Alexandra Elbakyan. Her (illegal) website Sci-Hub sees more than 500,000 visitors daily, and hosts more than **50 million** academic papers.

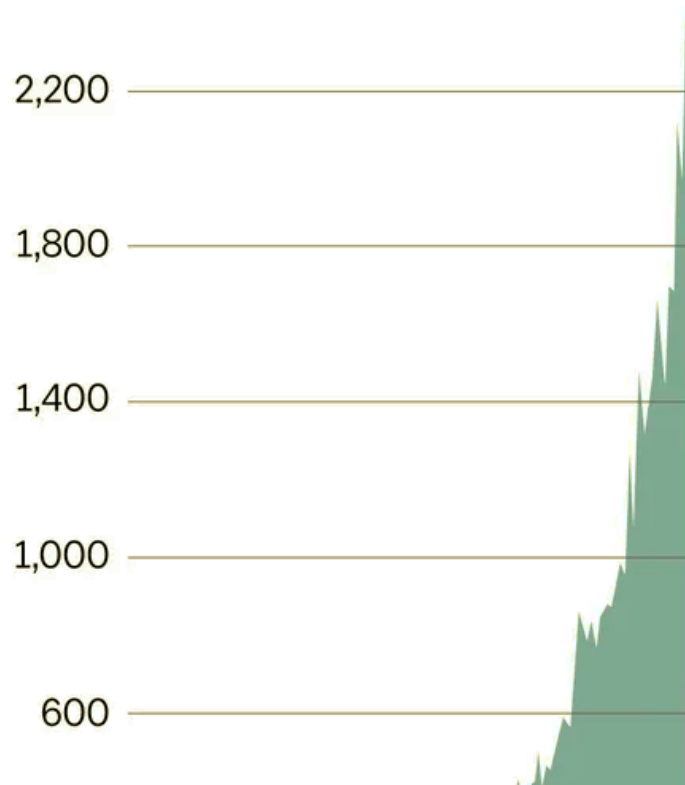
But Sci-Hub is just one tool to get around paywalls. Scientists are also **increasingly** publishing prepublication versions of their studies (often called preprints). These study drafts are free to access.

The problem is that often, these studies have not yet been peer-reviewed. But **advocates of preprints** say they’re a net benefit to science: They allow for the public discussion of papers before they’re set in a finalized form — a type of peer review. And there are more preprints

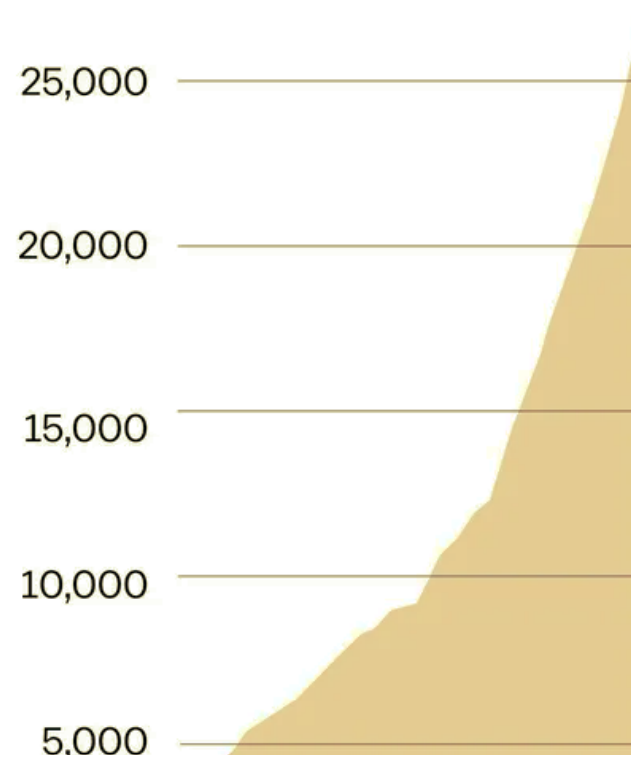
than ever before. (Some of the preprint servers are **owned** by the big publishers too.)

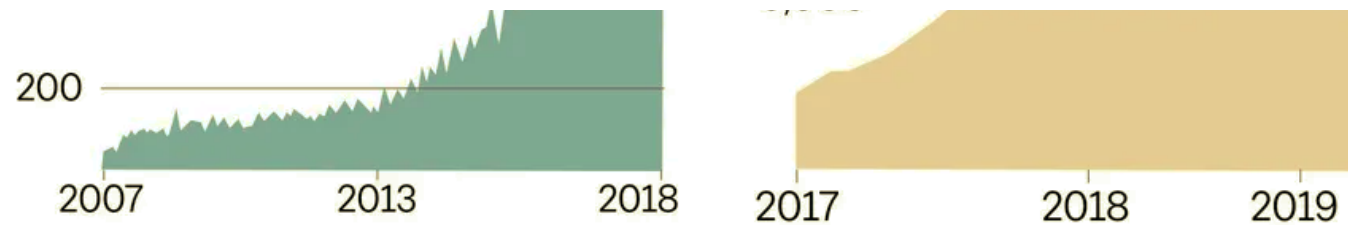
## Preprints over time

**Biology preprints at PrePubmed**



**Preprints hosted by Open Science Framework**





Sources: Center for Open Science, Asapbio.com

**Vox**

To find these preprints, all it takes is a single click: **Unpaywall**, a browser extension, helps users find the preprints associated with paywalled journal articles.

These mounting pressures on the academic publishing industry aren't so different from the pressures on the music industry in the late '90s. If you recall, in the late '90s, music pirating was suddenly everywhere. You could log in to Napster and Limewire and illegally download any song you wanted for free.

"Piracy seems to come in when there's a market failure," UVA's Butler says, "and people aren't getting what they need at a price that makes sense for them."

But as Larivière points out, Sci-Hub isn't a long-term solution, and eventually, it may not even be needed: "Once there's no paywalls, there's no Sci-Hub anymore."

**What's standing in the way of a full-on revolution? The**



## **culture of science.**

For now, the paywalls mostly stand. Elsevier's profits have actually increased in recent years. And as Elsevier's Hersh told us, while the volume of open access research published by the company has been growing, so has the volume of paywalled papers.

Even with the growing pressure from the open science crusaders, the publishers remain in an extremely strong and nimble position. More and more, Elsevier's business is not in the publication of journal articles, but in data-mining its enormous library. That means it's using analytics to report on research trends, recommend articles scientists ought to be reading, and suggest co-authors to collaborate with based on shared interests.

Even if the publishers lose ground on selling subscriptions, they'll still offer a profitable service based on control of the content. Still, it's not hard to imagine a future where more and more institutions of science simply ignore, or circumvent, the major publishers.

The growing popularity of preprints is giving them one avenue to escape. One could imagine a system where researchers upload their drafts to preprint servers and then other academics choose to peer-review the articles. After peer review and revision, that preprint paper could be given a stamp of approval and added to a digital journal. This system is called an overlay journal (in that the editing and journal gatekeeping is overlain on top of preprints), **and it already exists to a small extent.** (Gowers's *Discrete Analysis* is an overlay journal.)

So it's not technology or innovation holding science back from a revolution. "The biggest elephant in the room is how researchers are rewarded for the work they do," said **Theodora**

**Bloom**, the executive editor at *BMJ*.

At the moment, researchers' careers — the grants they're given, the promotions they attain — rise or fall based on the number of publications they have in high-profile (or high-impact) journals.

"If an academic has a paper in *Nature* or *Science*, that's seen as their passport to their next grant or promotion," said Bloom.

As long as those incentives exist, and scientists continue to accept that status quo, open access journals won't be able to compete. In fact, many **academics still don't publish in open access journals**. One big reason: Some feel they're less prestigious and **lower quality**, and that they push the publishing costs on the scientists.

"I'm also waiting to see change within academic culture," says Fyfe, the historian. "Until we have enough academics who are willing to do something different, then I don't see a big change happening."

So for now, the revolution is just beginning. "Everyone agrees, in some way, the future is open access," UVA's Butler says. "Now the question is, in that future, how much control do the big publishers retain over every step in the scientific process? They've been working for over a decade to ensure the answer is the most possible control."

Academic publishing isn't a hot-button political topic. But it could be. "If citizens really cared, they could talk to their representatives and senators and tell them open access matters,"