News in focus

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Retractions are skyrocketing as publishers work to remove sham articles from the literature.

MORE THAN 10,000 RESEARCH PAPERS WERE RETRACTED IN 2023 — A NEW RECORD

The number of articles being retracted rose sharply this year. Integrity experts say that this is only the tip of the iceberg.

By Richard Van Noorden

The number of retractions issued for research articles in 2023 has passed 10,000 — smashing annual records — as publishers struggle to clean up a slew of sham papers and peer-review fraud. Among large research-producing nations, Saudi Arabia, Pakistan, Russia and China have the highest retraction rates over the past two decades, a *Nature* analysis has found.

The bulk of 2023's retractions were from journals owned by Hindawi, a London-based subsidiary of the publisher Wiley (see 'A bumper year for retractions'). So far this year, Hindawi journals have pulled more than 8,000 articles, citing factors such as "concerns that the peer review process has been compromised" and "systematic manipulation of the publication and peer-review process", after investigations prompted by internal editors and research-integrity sleuths who raised questions about incoherent text and irrelevant references in thousands of papers.

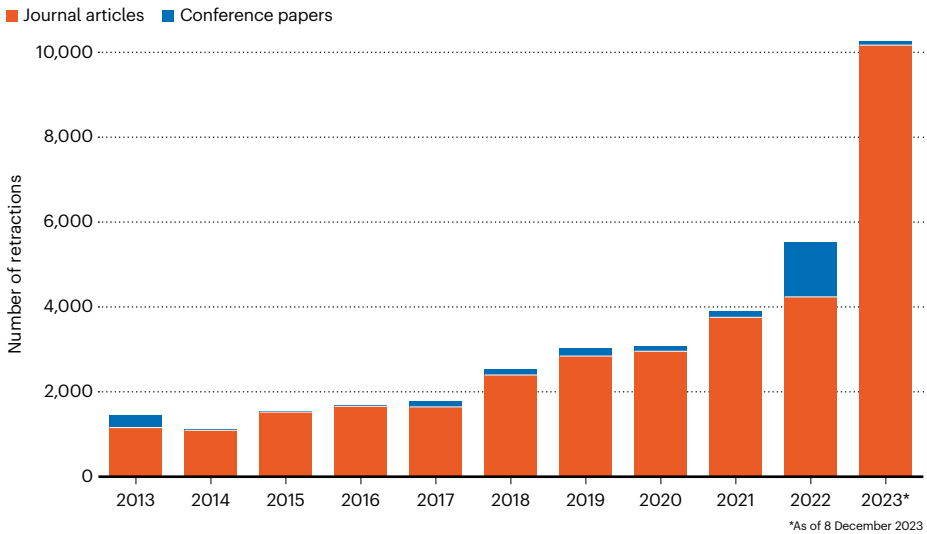
Most of the Hindawi retractions are from special issues: collections of articles that are often overseen by guest editors and that have become notorious for being exploited by scammers to rapidly publish low-quality or sham papers.

Counting the costs

On 6 December, Wiley announced on an earnings call that it would stop using the Hindawi brand name altogether, having previously shuttered four Hindawi titles and, towards the end of 2022, temporarily paused the publication of special issues. Wiley will fold existing titles back into its own brand. As a result of the problems, said Matthew Kissner, Wiley's interim chief executive, the publisher

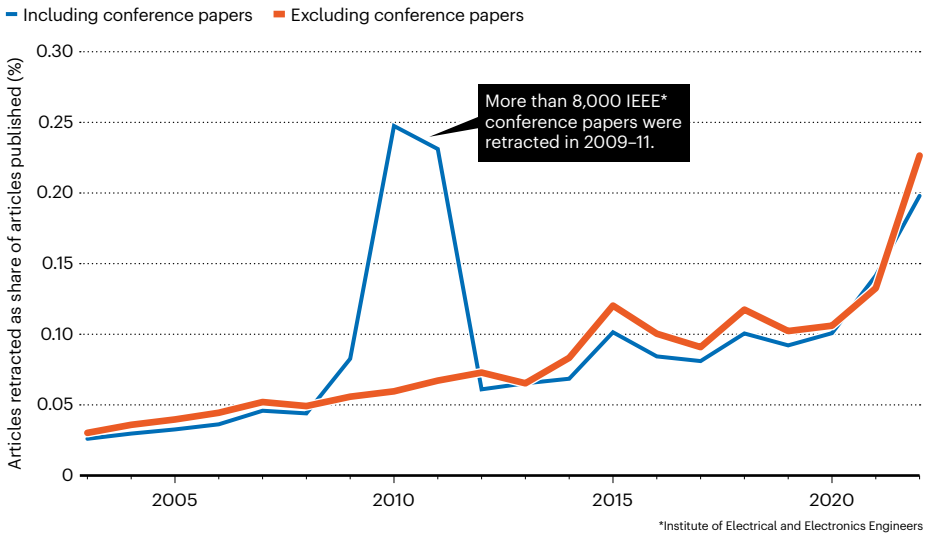
A BUMPER YEAR FOR RETRACTIONS

Retraction notices in 2023 have passed 10,000, largely because of more than 8,000 retractions by Hindawi.



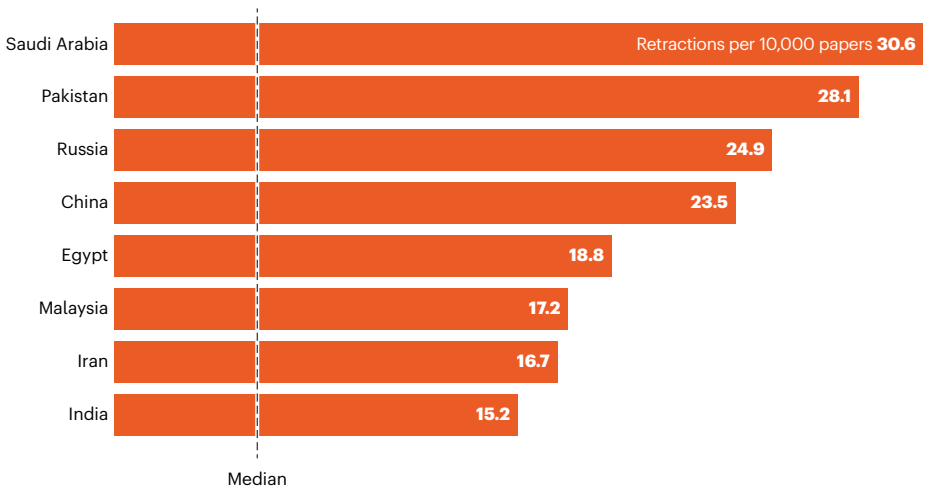
RISING RETRACTION RATES

The ratio of retracted papers to articles published has risen to above 0.2%.



COUNTRIES WITH HIGHEST RETRACTION RATES

Saudi Arabia, Pakistan, Russia and China have the highest retraction rates among countries with >100,000 papers* published over the past two decades.



*Total number of research papers according to Scopus: articles and reviews. Analysis excludes conference papers (and their retractions)

expects to lose out on between US$35 million and $40 million in revenue this fiscal year.

A Wiley spokesperson said that the publisher anticipated further retractions, but that the company takes the view that "special issues continue to play a valuable role in serving the research community". The spokesperson added that Wiley had put in place more rigorous processes to confirm the identity of guest editors and oversee manuscripts, removed 'hundreds' of bad actors – some of whom had held guest-editor roles – from its systems, and scaled up its research-integrity team. It is also "pursuing legal means" to share data about the bad actors with other publishers.

Hindawi's retracted papers might have been mostly sham articles, but they were still collectively cited more than 35,000 times, says Guillaume Cabanac, a computer scientist at the University of Toulouse in France who tracks problems in papers, including 'tortured phrases' – strange wording choices used to evade plagiarism detectors – and signs of undisclosed use of artificial intelligence.

Retractions are rising at a rate that outstrips the growth of scientific papers (see 'Rising retraction rates'), and this year's deluge means that the total number of retractions issued so far has passed 50,000. Although previous analyses have shown that most retractions are due to misconduct, this is not always the case: some are led by authors who discover honest errors in their work.

The world's largest database to track retractions, collated by the media organization Retraction Watch, does not yet include all of 2023's withdrawn papers. To analyse trends, *Nature* combined the roughly 45,000 retractions detailed in that data set – which in September was acquired for public distribution by Crossref, a non-profit organization that indexes publishing data – with another 5,000 retractions from Hindawi and other publishers, with the aid of the Dimensions database.

Rising rates

Nature's analysis suggests that the retraction rate – the proportion of papers published in any given year that go on to be retracted – has more than trebled over the past decade. In 2022, it exceeded 0.2%.

Among countries that have published more than 100,000 articles in the past two decades, *Nature*'s analysis suggests that Saudi Arabia has the highest retraction rate, of 30 per 10,000 articles, excluding retractions based on conference papers. (This analysis counts an article for a country if at least one co-author has an affiliation in that country.) If conference papers are included, withdrawals from the Institute of Electrical and Electronics Engineers (IEEE) in New York City put China in the lead, with a retraction rate above 30 per 10,000 articles (see 'Countries with highest retraction rates').

The analysis shows that around one-quarter of the total number of retractions are conference papers — and the bulk of those comprise withdrawals by the IEEE, which has pulled more than 10,000 such papers in the past two decades. The IEEE was the publisher with the highest number of retractions. It does not record when it retracts papers, but most of those removed were published between 2010 and 2011.

Preventive measures

Monika Stickel, director of corporate communications at the IEEE, says that the institute thinks its preventive measures and efforts identify almost all submitted papers that do not meet the organization's standards.

However, Cabanac and Kendra Albert, a technology lawyer at Harvard Law School in Cambridge, Massachusetts, have found issues, including tortured phrases, citation fraud and plagiarism, in hundreds of IEEE papers published in the past few years, Retraction Watch reported earlier this year. Stickel says that the IEEE has evaluated those papers and found fewer than 60 that didn't conform to its publication standards, with 39 retracted so far.

The 50,000 or so retractions recorded around the world thus far are only the tip of the iceberg of work that should be retracted, integrity sleuths say. The number of articles produced by 'paper mills' — businesses that sell bogus work and authorships to scientists — is estimated to be in the hundreds of thousands alone, quite apart from genuine papers that might be scientifically flawed. "Paper-mill products are a problem even if no one reads them, because they get aggregated with others into review articles and laundered into the mainstream literature," says David Bimler, a New Zealand-based research-integrity sleuth also known by the pseudonym Smut Clyde.

"Paper-mill products are a problem even if no one reads them."

'BIOCOMPUTER' COMBINES BRAIN TISSUE WITH SILICON HARDWARE

A system that integrates brain cells into a hybrid machine can recognize voices.

By Lilly Tozer

Researchers have built a hybrid biocomputer — combining laboratory-grown human brain tissue with conventional electronic circuits — that can complete tasks such as voice recognition.

The technology, described on 11 December in *Nature Electronics*, could one day be integrated into artificial intelligence (AI) systems, or form the basis of improved models of the brain in neuroscience research.

The researchers call the system Brainoware (H. Cai *et al. Nature Electron.* https://doi.org/k8vz; 2023). It uses brain organoids — bundles of tissue-mimicking human cells that are used in research to model organs. Organoids are made from stem cells capable of specializing into different types of cell. In this case, they were morphed into neurons, akin to those found in human brains.

The research aims to build "a bridge between AI and organoids", says study co-author Feng Guo, a bioengineer at the University of Indiana Bloomington. Some AI systems rely on a web of interconnected nodes, known as a neural network, in a similar way to how the brain functions. "We wanted to ask the question of whether we can leverage the biological neural network within the brain organoid for computing," Guo says.

STEVE GSCHMEISSNER/SPL

Part of a brain organoid.

Harnessing brainpower

To make Brainoware, researchers placed a single organoid onto a plate containing thousands of electrodes, to connect the brain tissue to electric circuits. They then converted the input information into a pattern of electric pulses, and delivered it to the organoid. The tissue's response was picked up by a sensor and decoded using a machine-learning algorithm.

To test Brainoware's capabilities, the team used the technique for voice recognition by training the system on 240 recordings of 8 people speaking. The organoid generated a different pattern of neural activity in response to each voice. The AI learnt to interpret these responses to identify the speaker, with an accuracy of 78%.

Although more research is needed, the study confirms some key theoretical ideas that could eventually make a biological computer possible, says Lena Smirnova, a developmental neuroscientist at Johns Hopkins University in Baltimore, Maryland. Previous experiments have shown only 2D cultures of neuron cells to be able to perform similar computational tasks; this is the first time it has been shown in a 3D brain organoid.

Better brain model

Combining organoids and circuits could allow researchers to leverage the speed and energy efficiency of human brains for energy-intensive AI, says Guo.

The technology could also be used to study the brain, says Arti Ahluwalia, a biomedical engineer at the University of Pisa in Italy, because brain organoids can replicate the architecture and function of a working brain in ways that simple cell cultures cannot. There is potential to use Brainoware to model and study neurological disorders, such as Alzheimer's disease. It could also be used to test the effects and toxicities of different treatments. "That's where the promise is; using these to one day hopefully replace animal models of the brain," says Ahluwalia.

But using living cells for computing is not without its problems. One big issue is how to keep the organoids alive. The cells must be grown and maintained in incubators, something that will be harder the bigger the organoids get. And more complex tasks will demand larger 'brains', says Smirnova.

To build on Brainoware's capabilities, Guo says that the next steps include investigating whether and how brain organoids can be adapted to complete more complex tasks, and engineering them to be more stable and reliable than they are now. This will be crucial if they are to be incorporated into the silicon microchips that are currently used in AI computing, he says.