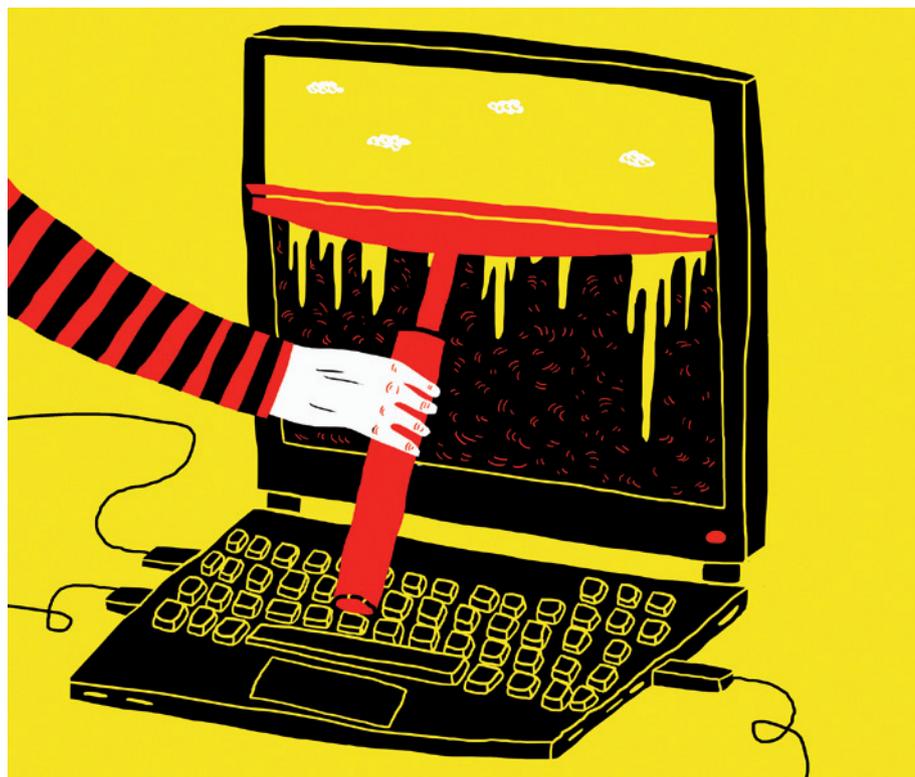


# CAREERS

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## RETRACTIONS

# A clean slate

*Mistakes are part of science. But setting the record straight promptly and clearly can help to avoid a career blot.*

BY VIRGINIA GEWIN

After 18 months of complex testing and retesting, Pamela Ronald became certain that she needed to retract two high-profile papers on disease resistance in rice<sup>1,2</sup>. The hardest part, says Ronald, a crop scientist at the University of California, Davis, was staying calm — she worried about the implications for current and past lab members and about others spending time replicating potentially faulty work.

The papers had claimed to identify a bacterial protein that could activate an immune response in rice plants with a specific receptor. But when new members of her team were unable to reproduce the results, alarm bells started ringing.

Shaken, they decided that the first step was to genotype all the laboratory strains in their collection. Eventually they caught a labelling error: two of the 12 strains thought to lack the protein in question actually lacked a different protein. And the careful backtracking unearthed yet another error: the test, which they had used to verify that this protein could trigger resistance, turned out to be faulty. Despite her distress, throughout the ordeal Ronald was straightforward with journal editors and her colleagues about the likelihood of retractions. She knew that her scientific reputation depended on complete transparency about possible errors. “You just have to set aside emotions and let the scientific process pull you through,” she says.

Worldwide, retractions are on the rise: last

year alone, scientific journals retracted roughly 500 papers (of more than 1 million published), compared with fewer than 50 per year in the early 2000s (see *Nature* 478, 26–28; 2011).

One study<sup>3</sup> — in the life sciences — suggests that misconduct, such as plagiarism or falsified data, has been to blame for two-thirds of retractions (see *Nature* 490, 21; 2012). And behavioural ecologist Daniele Fanelli of the University of Montreal in Canada, who studies the issue, says that at least one-quarter are the result of unfortunate mistakes. The rise in retractions could be because scientists are making more errors, but it could also indicate a growing culture of coming clean on errors. And that, Fanelli says, is a positive trend. “We really need to think more about how to reward retractions that are correcting mistakes — find a way to make them a badge of honour instead of a badge of shame,” he says.

Scientists often treat retractions as dirty secrets. The muted discourse means that the process is often much more confusing, frustrating and embarrassing for researchers, journal editors and universities than it needs to be. Many struggle with the best way to correct the record and with how to salvage viable data. Yet if a retraction is the result of an accident or honest error, it should not be a blot on an otherwise respectable publication record. Scientists and journal editors who have retracted papers say that the process can be handled productively, whether the errors are from contamination, a cell-line mix-up or statistical analyses gone awry. Above all, they say, transparency is key.

## SENSING A PROBLEM

A decade ago, retractions were far from transparent. “It was not unusual to see ‘Paper is retracted’ [in the journal] and nothing else,” says Ferric Fang, a microbiologist at the University of Washington in Seattle who also studies retractions. In 2009, realizing that journals lacked policies, the UK-based non-profit organization COPE (Committee on Publication Ethics) published guidelines on how best to correct the scientific record. COPE expects its more than 9,000 journal members to follow the guidelines, which recommend that retraction statements link to the retracted article, be freely available and state who is retracting the article, among other criteria. But perhaps most importantly, says former COPE chair Liz Wager, a retraction notice should include the reason that the retraction was made to clearly distinguish misconduct from honest error. “The retraction has to be complete and ▶

► honest, and clearly articulate what things are wrong,” says Inder Verma, a molecular biologist at the Salk Institute for Biological Studies in La Jolla, California, and editor-in-chief of *Proceedings of the National Academy of Sciences*.

**RETRACTION BREAKDOWN**

There are several ways to amend a published paper (see ‘Retraction guide’). A retraction is reserved for the most severe problems, ones that unravel a paper’s conclusions. It is hard to retract a paper and later republish the valid parts, says Arturo Casadevall, editor-in-chief of *mBio* and a microbiologist at the Albert Einstein College of Medicine in Bronx, New York. “Many journals won’t allow that.”

For less serious issues, there are two other options. For the least egregious errors — a mislabelled figure, for example — a correction often suffices. Alternatively, the paper can be partially retracted if the erroneous findings do not invalidate the article’s stated conclusions. (COPE discourages partial retractions, however, saying that they “make it difficult for readers to determine the status of the article and which parts may be relied upon”.)

Once alerted to a potential problem, the first step is to identify whether an error has actually occurred and, if so, how. The authors and journal editors then need to decide on the appropriate response. As soon as Ronald realized something was amiss with her original work, she contacted the editors of the journals that had published the papers. “Part of you wants to retract it immediately,” she says. But she knew that she needed to ascertain the facts first.

Her team worked out all the experiments that would be needed to determine the problem. “Everyone had slightly different concerns, but we all wanted to get it right,” she says. Finding the error became all-consuming; other projects languished.

And Ronald went a step further. Once she was sure that there was a problem, she contacted colleagues to highlight the issue and gave a public seminar to inform the international community. “I was alarmed that others were trying to build on this work when we couldn’t, and I didn’t want to waste anyone’s time,” she says. Her efforts won her praise both from her colleagues and from the *Retraction Watch* blog, which reports on scientific retractions and misconduct cases.

In a post about Ronald’s case, *Retraction Watch* co-founder Ivan Oransky said that the blog likes “being able to point out when researchers stand up and do the right thing, even at personal cost”.

Deciding whether to issue a full-blown retraction is difficult. Reputations are on the line, and authors may not necessarily agree on how best to amend the mistake. It can take a lot of negotiating with journal editors and colleagues.

That was the experience of Daniel St Johnston, a developmental biologist and director of the Gurdon Institute at the University of Cambridge, UK. He and his colleagues had published two papers<sup>4,5</sup> describing a pathway that they thought was essential for the epithelial cells surrounding a developing egg to maintain their polarity, or orientation, under starvation conditions. However, they later discovered that they had damaged some of the cells when they had dissected the tiny ovaries of the starved fruit flies, resulting in ‘false clones’ that mimicked the appearance of the cells of interest, but that did not have the same mutations.

St Johnston first wrote a new paper highlighting the existence of false clones. Once that paper was accepted in *Biology Open*<sup>6</sup>, he sent the manuscript to the two journals that had published the original incorrect papers, *Journal of Cell Biology* and *Developmental Cell*, in a bid to find the best way to link the new findings to the original papers. The journal editors advised him to retract the original papers because the main conclusions were no longer valid. Then things got complicated.

One author was not happy about the prospect of losing the data that remained sound from the scientific record. But to retract the papers, all authors had to approve. The researchers and journal editors discussed various options, including a partial retraction, but couldn’t reach an agreement. To break the deadlock,

St Johnston arranged for the valid data to be published alongside the false-clone findings in *Biology Open*<sup>7</sup>, and the retractions went ahead. St Johnston says that he had to figure out the best course as he went along: “There’s no obvious mechanism in place to handle the useful, valid content of a retracted paper.” He adds that, so far, he has not experienced any career backlash.

**SURMOUNTING STIGMA**

The data support what many journal editors advise — that the best way to overcome the stigma associated with a retraction is to come clean with a detailed account of mistakes. A study published last November<sup>8</sup> found that authors who self-report mistakes and retract papers accordingly will not lose out on citations to their previous, legitimate research. However, authors who fail to self-report the need for a retraction lose up to 12.5% of citations per year per paper, five years after the retraction, compared with non-retracted papers with similar citation patterns. “Being transparent preserves your reputation as someone honestly seeking truth,” says study author Benjamin Jones, a higher-education researcher at Northwestern University in Evanston, Illinois.

In fact, a clear retraction may end up being worthy of a citation itself. For example, a 2006 retraction<sup>9</sup> detailed an author dispute over whether original findings of ferromagnetic behaviour found in a carbon-60 atom remained valid in the face of new measures. “I’ve found examples of retracted papers that continue to be cited because the retraction is clear, suggesting that people in the field are more discerning than they’ve been given credit for,” says Fang.

In St Johnston’s experience, the more common case is that scientists bury the error — which, he says, harms the scientific community by squandering everyone’s time and resources. “I personally didn’t want to do that because my reputation is my trademark,” he says. “If I own up to my mistakes, people know that if I get it wrong, I will tell them.”

St Johnston knew that retracting the paper was the right thing to do, but he says that if he had been at an earlier, more precarious stage of his career, he might have thought twice. And he did have serious concerns about the impact it would have on his junior co-authors. “Most of the scientific community doesn’t bother



*“The greatest currency we have as scientists is respect.”*

Arturo Casadevall

**RETRACTION GUIDE**

Publishers have a range of options for amending the scientific record, depending on the circumstances.

Action	Example	Paper conclusions affected	Issued by
Correction (erratum)	Typographical errors Mislabelled figures Author/contributor list incorrect	No	Paper author (ideally)
Expression of concern	Investigation suggests that data are not reliable Suspicion of misconduct	Unsure	Editor
Partial retraction	Figure or table based on corrupt data Some data inappropriately analysed	Yes, but not overall finding	Author or editor
Retraction	Clear evidence of misconduct Error invalidates work	Yes	Author or editor

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distinguishing between an error and something more sinister,” he says.

Indeed, some data suggest that early-career researchers are right to be concerned. Jones has compared how the citation records of eminent and less-well-established authors are affected after a retraction<sup>10</sup>. “If you are highly established, we see little effect if you are one of the authors on a retracted paper. If you are not well established, you will see a negative effect,” he says.

As a then-assistant professor, Geoffrey Chang had such concerns when he was alerted to a problem with his work, and threw himself into discovering the error. A crystallographer at the University of California, San Diego, he had had a string of successes in the form of awards, grants and high-profile papers starting in 2001, when he was in his late 20s.

When colleagues called his findings into question, Chang pored over his home-made computer program and eventually discovered that he had transposed two data columns. He retracted five papers, and republished the corrected molecular structures in two papers roughly a year after pinpointing the problem. The thorough, transparent reanalysis of the data, he says, corrected the scientific record, which helped to maintain his academic standing. “It was seven years ago,” he says, “and it’s still very much a part of me. But it made us a stronger, more careful lab.” Chang has since secured major grants, including grants from the US National Institutes of Health.

Cases such as Chang’s illustrate that retracted papers need not doom a career, even a fledgling one. But navigating the process requires a willingness to deal with policies and distinctions that are not always clear-cut. “The greatest currency we have as scientists is respect — that colleagues respect us and our work,” says Casadevall. “A retraction is survivable — if it’s tackled honestly and transparently.” ■

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## COLUMN

# Strapped students

Graduate students face myriad financial challenges — some more obvious than others, says **Susie Crowe**.

Postgraduate education is a minefield of financial pitfalls — from tuition fees and loans to long stretches without contributing to savings. And yet many graduate students neglect to plan their finances accordingly.

The difference between starting a retirement plan in your early 20s versus your early 30s is in the hundreds of thousands of dollars. This realization hit me like a ton of bricks when I attended a seminar at my husband’s workplace. At 28, I had long missed my opportunity to take full advantage of compound interest. Like many graduate students, I had spent my early 20s focusing on day-to-day financial challenges rather than on the big picture.

There are smaller, often overlooked financial traps. They include interest charges from living off credit cards; fees for late tuition payments; library fines; parking expenses; and unintentionally paying for your own research because you have lost receipts for fieldwork or laboratory expenses (see *Nature* **501**, 579–581; 2013). These seem trivial and short term compared with larger concerns, but they can mean the difference between comfortably paying your bills and barely scraping by.

Many expenses can be avoided or mitigated if you stay organized and remain on top of your finances. But in some cases, this is not so simple.

The money I am paid comes from so many sources it makes my head spin. Most students hope that income from teaching-assistant and research-assistant posts, external awards, internal scholarships, one-time entrance scholarships, tuition waivers and reimbursements will outweigh tuition and other fees, research costs, administrative charges, union dues and ‘clawbacks’ (funds that must be returned to a university administration owing to accounting errors). It can be tough for even the most financially savvy graduate student to keep a handle on things.

These days, my biggest worry is that my degree will drag on for longer than my current funding — a fate I have witnessed often enough to make every thesis setback seem like an ominous premonition. Sinking thousands

of dollars into tuition for extra semesters is probably not a scenario envisioned by eager new students, but it is one of the more serious financial risks they can incur.

Given this bleak picture, what is a financially conscious student to do? The tired cliché of the impoverished graduate student is trotted out like a comforting inside joke, but it does not have to be the case. It is possible to make it through postgraduate education in decent financial shape.

Getting a head start in research was more important to my financial solvency than I initially appreciated. I got a job as a field assistant for an ornithology project early in my undergraduate studies, which gave me the skills to think up my own thesis project and led to a first-author publication in *Animal Behaviour*. This project gave my CV the boost it needed to get me a competitive national scholarship.

I try to be frugal and forward-thinking. It is important to be mindful of how tax laws apply to you — for example, in Canada, full-time students do not pay taxes on scholarships, but part-time students

do. Choose a retirement plan early, and pay into it whatever you can. With compound interest, even the smallest efforts can yield big returns.

‘Work hard and work smart’ is a useful mantra. Efficiency buys time that can be spent on side jobs or business ventures to provide supplemental sources of income and a back-up plan if things go wrong. Students who stay focused and graduate quickly will avoid sinking money into extra tuition.

Be realistic. For prospective students put off by the financial difficulties that they may need to endure, I suggest thinking critically about whether a PhD will benefit you. Do the intellectual and career benefits seem worth the struggle? The hard truth is that if a prospective student has trouble defining what makes a PhD ‘worth it’ in the long run, then perhaps it is not. ■

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