

The crisis in scientific integrity and its implications

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Introduction

Science, as a collective endeavor of humanity, has gradually been built upon epistemological, ethical, and normative foundations to ensure the credibility and consistency of its findings.¹ The scientific ethos, as proposed by sociologist Robert Merton (1974), refers to the set of values and norms that guide scientific conduct and safeguard its integrity. Among these values are universalism (scientific knowledge should be assessed objectively, regardless of its origin), disinterestedness (scientists should prioritize the advancement of knowledge over personal or commercial interests), communalism (the open sharing of results and methods, ensuring accessibility and verification by the broader scientific community), and organized skepticism (continuous critical evaluation and systematic scrutiny of presented evidence and theories).¹

These principles ought to, or at least should, govern scientific practices and establish ethical and methodological standards for the production and validation of knowledge. However, despite ostensibly adhering to these ideals, contemporary scientific production system faces structural challenges that undermine research integrity and the ability to generate reliable knowledge.²

The 2024 retraction of 34 articles authored by a Brazilian researcher in the journal *Science of the Total*

*Environment (STOTEN)*³ exposed alarming weaknesses in the scientific publishing system, drawing attention to critical gaps in both editorial and peer-review processes. Allegations, including the use of fabricated information, such as falsified reviewer emails, undermine not only the credibility of the individual researcher, but also reveal a structural vulnerability within contemporary science.

The “crisis of scientific integrity” is not an isolated phenomenon. In recent years, the number of retracted scientific articles has significantly increased, exposing systemic flaws in the scrutiny of academic output. By the first week of December 2023, 10,000 articles were retracted,⁴ with over 450 articles on COVID-19 alone retracted by the end of 2024.⁵ To put this issue into perspective, while the retraction of 34 articles represents a striking milestone for Brazilian researchers, the record belongs to anesthesiologist Joachim Boldt, the first author to have over 200 articles retracted, accounting for nearly half of the 400 publications.⁶

An unsustainable peer-review system

Historically, the submission of manuscripts to other scientists capable of evaluating methodological rigor, originality, and relevance was established as a quality filter before an article was published. This process was intended to operationalize organized skepticism, allowing a subset of the scientific community to assess a study before it reaches the public.⁷



Over time, however, peer review has increasingly been perceived as a bureaucratic ritual that grants an immutable “seal of approval,” signifying that an article has been reviewed and published in journal “x”. However, this pursuit of a quality stamp contrasts sharply with the complexities of the system: the exponential growth in the number of journals and articles, the lack of incentives for peer reviewers (who work on a voluntary basis), and mounting pressure on researchers. These factors collectively expose vulnerabilities within the model, rendering the peer review system more susceptible to failures.⁸

Journal reviewers bear greater responsibility than often acknowledged. The vast majority serve on a voluntary basis, adding yet another duty to their already extensive workload. This increasing burden becomes unsustainable in the long run, thereby compromising the quality of the review process. As Bertrand Russell⁹ aptly stated: *“It is obvious that a system that demands exceptional qualities from human beings will succeed only exceptionally.”*

In a high-pressure environment, the fate of a manuscript is often determined by two or three overburdened reviewers without broader scrutiny from the scientific community; when such scrutiny occurs, it is often too late. Systemic loopholes further exacerbate the situation, such as the common practice of author-suggested reviewers, which, in a recent Brazilian case, enabled the use of fraudulent email accounts. The editorial board’s failure to conduct more rigorous verification revealed another critical vulnerability: the lack of systematic audits and robust authentication mechanisms in scientific editorial processes.¹¹

Productivity, dilution of rigor, and impact on the scientific ecosystem

The excessive focus on quantitative metrics such as the impact factor and h-index creates incentives that deviate from scientific integrity. Researchers pressured to publish or perish often prioritize the quantity of publications over quality, fueling the proliferation of predatory journals. In exchange for payment, these journals publish virtually any material, disregard scientific and ethical protocols, and ultimately compromise the credibility of science.¹²

Extreme cases, such as that of entomologist Matan Shelomi, who submitted a fabricated paper claiming that the consumption of Pokémon Zubat triggered a COVID-19 outbreak, starkly illustrate the complete lack of scrutiny in predatory journals.¹³ This satirical experiment underscored the dangers of disinformation and the absence of quality control, undermining the credibility of the scientific publishing system. Such failures have far-reaching consequences, affecting systematic reviews, evidence

synthesis, clinical decision making, public health policies, and societal trust in science.^{12,13}

The problem extends beyond methodology, as it is fundamentally cultural. In an environment where productivity is valued over intrinsic quality, even reviewers - including those evaluating master’s and doctoral theses - feel pressured to meet deadlines and maintain good relationships with their peers. This dynamic often results in the approval of mediocre or methodologically flawed research. Consequently, peer review cannot be upheld as an absolute quality filter, and must be restructured and supplemented with more transparent and democratic mechanisms of scientific scrutiny.¹¹

When peer review fails, an inadequately published article can cause irreparable damage even after retraction. The fraudulent study by Andrew Wakefield, which falsely linked vaccines to autism, left behind a pseudoscientific legacy that continues to fuel anti-vaccine movements and distort the scientific landscape.¹⁴ A similar case is the now retracted “pioneering” study on hydroxychloroquine as a COVID-19 treatment, led by Didier Raoult.¹⁵ These iconic examples illustrate that the impact of scientific misinformation - especially when it originates within a “scientific cradle” - is rarely fully reversed.

The consequences of such retractions extend beyond the articles themselves, undermining trust in the scientific system. By publicly exposing major publishers’ failures to prevent unethical practices, retractions contribute to the erosion of societal confidence in science, particularly in an era of rampant misinformation. Moreover, honest co-authors and collaborators who had no direct involvement in misconduct may also see their reputations tarnished. Cases such as the suspension of Science of the Total Environment (STOTEN) from the Science Citation Index Expanded highlight the alarming reality of “industrial-scale article production” (paper mills) and the relentless pressure for academic productivity.¹⁶

Another cultural flaw that exacerbates this crisis is the lack of emphasis on reproducibility. Robust science requires independent researchers to replicate findings across diverse contexts. However, reproducibility studies are undervalued.¹⁷ In the same vein, well-founded critiques of published articles are often marginalized, as if critical evaluation of peer-reviewed literature were of lesser importance. Even more concerning, researchers dedicated to scrutinizing published evidence are frequently dismissed as “jealous” or “idle,” as though only innovation - often uncritical and lacking reproducibility - were the true engine of scientific progress.

However, this perspective is flawed. Well-founded criticism is an essential component of scientific progress, serving to correct errors and reinforce the reliability of evidence. Researchers who identify inconsistencies

and expose fraud play a crucial role in maintaining the integrity of the scientific ecosystem, helping detect problematic research and guiding retractions when necessary. Initiatives such as *PubPeer* and the *Retraction Watch* demonstrate the importance of an engaged scientific community dedicated to the systematic critique of published evidence.¹⁸ Furthermore, the implementation of institutional policies and funding agency guidelines aligned with frameworks such as the San Francisco Declaration on Research Assessment (DORA) could help shift the focus away from sheer publication volume toward intrinsic quality, methodological rigor, and real scientific impact.¹⁹

Final considerations

The increasing number of article retractions reflects both the proliferation of paper mills and growing vigilance of the scientific community. While the crisis of integrity is concerning, ongoing efforts to identify and address misconduct demonstrate that the system has capacity for reform. Several initiatives can strengthen this movement, including greater transparency in editorial processes, the recognition of critical evaluation and reproducibility, and robust post-publication review mechanisms that distinguish between correctable errors and outright fraud. Additionally, ethical education and efforts to combat unethical practices are crucial for mitigating the pressure to publish at any cost.

Despite these challenges, this crisis does not invalidate science. On the contrary, its strength lies in its ability to self-correct and evolve. The existence of retractions is evidence of scientific self-regulation, even if imperfect. Science is reinforced when it embraces critiques and continuously adjusts. The true challenge, therefore, is to reaffirm science as a transparent and rigorous process that is essential for maintaining its credibility in the face of denialism and misinformation.

Author's contribution

The authors performed the conception of the article and declared no conflicts of interest.

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