

PREPARING THE FINAL NAILS TO SEAL THE COFFIN OF GENUINE SCIENCE¹

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Science is meant to be shared and discussed, not sold. However, over the past two decades, the phrase "publish or perish" has led significantly to the decline of genuine scientific inquiry. Today's science is often more about profit than sharing knowledge. Neuropsychologist Bernhard Sabel, using a fake-paper detector developed by him, was "stunned" to discover that after screening approximately 5000 papers, up to 34 % of neuroscience articles published in 2020 were either fabricated or plagiarized. In medicine, the rate was 25 %. Currently, more than 11,000 scientific journals operate based on a pay-to-publish open access model (excluding the so-called "predatory journals"), contributing to an industry valued at approximately \$20 billion USD. Alongside the annual publication of over 7 million papers (estimated for 2023), concerns are mounting about flawed, incorrect, or fabricated data. The recent introduction of tools like ChatGPT has further elevated ethical concerns related to irregularities, errors, falsification in published papers to a new level. This work aims to highlight the major concerns regarding how the policies of many pay-to-publish journals harm the integrity of real science. The insights presented are based on the author's personal experiences and observations over 15 years as a referee for numerous journals. Meanwhile, the metric of "number of published papers per year" and "profit margins" seem to be the only "valuable" aspects of modern "science".

Keywords: pay-to-publish; publishing scams; ChatGPT; "paper mills"; junk science

ПОДГОТВЕНИ СЕ ПОСЛЕДНИТЕ КЛИНЦИ ЗА ЗАПЕЧАТУВАЊЕ НА КОВЧЕГОТ НА ВИСТИНСКАТА НАУКА

Примарната намена на науката е споделување на знаење и дискусија за научната мисла, а не продажба на знаење. Меѓутоа, во последните две децении фразата „објави или исчезни“ значително придонесе за процесот на ерозија на вистинската наука. Неоспорен факт е дека во фокусот на денешната наука многу повеќе е профитот и профитните маржи, отколку споделувањето на знаење. Невропсихологот Бернхард Сабел, користејќи детектор за лажни трудови што самиот го развил, останал „запрепастен“ кога открил дека по анализа на приближно 5000 трудови дури 34 % од трудовите од областа на невронауката објавени во 2020 година биле или измислени или биле плагијати. Во медицината тој процент изнесувал околу 25 %. Во овој момент повеќе од 11000 научни списанија функционираат врз основа на моделот за отворен пристап наречен „плати за да публикуваш“ (без да се вклучат во оваа бројка т.н. „предаторски списанија“), што придонесува за индустрија вредна приближно 20 милијарди американски долари. Доколку се знае дека околу 7 милиони трудови се публикуваат на годишно ниво (процентот е за 2023 година), тогаш огромна е загриженоста за јавна достапност на голем број фабрикувани, неточни или измислени податоци што се презентираат во научните трудови. Покрај тоа, неодамнешното воведување на алатки како што е ChatGPT дополнително ја зголеми загриженоста поврзана со суштински грешки и фалсификување на резултатите во објавените научни трудови. Овој труд има за цел да ги нагласи некои од главните проблеми поврзани со политиките на многу списанија што функционираат по моделот „плати за да публикуваш“, стратегиите кои доведуваат

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до ерозија на интегритетот на вистинската наука. Презентираните податоци во овој труд се базираат на личните искуства и набљудувања на авторот во последните 15 години, период во кој авторот бил рецензент на трудови за голем број научни списанија. Истовремено, останува впечатокот дека единствените „вредни“ аспекти во денешната „модерна наука“ се „бројот на објавени трудови на годишно ниво“ и „профитните маржи“.

Клучни зборови: „плати за да публикуваш“; измами во публикувањето; ChatGPT; „фабрики за научни трудови“; лажна наука

INTRODUCTION

For a long time, scientific achievements have been closely evaluated based on the number and quality of a scientist's published papers. Attaining a scientific degree, securing a university professorship, obtaining a research grant, advancing in a scientific career, or being awarded a scientific project are all endeavors closely tied to the quality of one's research. This quality is most commonly assessed through the number and impact of research papers published by the applicants within a defined period of time.

When I began publishing research papers in my field (electrochemistry) about a quarter of a century ago, I vividly recall how challenging and time-consuming it was to get a paper accepted for publication. Limited internet access at the time compounded these difficulties, and the review policies of most of the existing journals were stringent and dependable. In other words, it was nearly impossible for junk or scam work to be published in well-established journals in chemistry or electrochemistry. For us young scientists, engaging in discussions with reviewers and learning from their remarks and comments was genuinely gratifying. The acceptance of a paper elicited profound feelings of accomplishment and motivation, reinforcing our commitment to further scientific pursuits and affirming the value of our contributions. Under those circumstances, the work we were engaged in embodied the essence of genuine science, as it was meant to be.

Shortly afterward, the advent of so-called "open access publishing" (also known as "pay-to-publish") dramatically transformed the landscape, evolving from normalcy to almost a disaster in many scientific fields. A few decades ago, the notion of profiting heavily from scientific work would have seemed absurd. For much of the 20th century, the dissemination of knowledge was largely free and open, particularly among scientists. This tradition continued until the last decade of the 20th century. During this period, the accomplice (currently imprisoned) of an infamous U.S. oligarch (who was arrested and charged of child

trafficking and sex offenses against minors, who died by suicide in federal prison in 2019), began capitalizing on the publication of scientific works, promoting the concept of "paid science available for everyone". Since then, the industry of publishing scientific papers for profit has experienced exponential growth, prioritizing profit margins over the integrity of scientific research.

In this work, I aim to highlight just some of the significant dangers and challenges posed by the open access publishing model and its impact on genuine science that many of us have witnessed over the past 10–15 years. While I will refrain from naming specific journals, publishing houses, or individuals, I will provide examples and data to illustrate how nowadays a large portion of real science has increasingly devolved into junk.

DISCUSSION

Eleven years ago, John Bohannon, a former contributing correspondent of the journal *Science*, conducted an experiment to evaluate the reliability of the peer review process in over 300 open access (pay-to-publish) scientific journals. Many of these journals were considered reputable and were included on the so-called "green list" (trustworthy academic journals).¹ Using a fictitious name and a nonexistent institutional affiliation, Bohannon's goal was to create a seemingly credible, but fundamentally flawed, scientific paper. The errors in the paper were so obvious and significant that any competent peer reviewer should have readily identified it as unpublishable.

Bohannon submitted nearly similar hoax-papers with identical scientific content to 304 open access journals with a "pay-to-publish" model. Of these, 167 were listed in the Directory of Open Access Journals (DOAJ), 121 were on Beall's list, and 16 appeared on both lists. The results from his hoax experiment were shocking: 157 journals accepted the flawed paper, 29 journals appeared to no longer exist, and only 98 journals rejected the work. Notably, many of the journals that accepted the flawed paper belonged to reputable publishing houses.

This experiment highlighted the extent of the problem in the peer review process of many open access journals, far exceeding Bohannon's expectations. His work demonstrated a troubling reality: the integrity of scientific publishing faces considerable challenges, particularly in the pay-to-publish model.

Open access publishing (OAP) has significantly impacted scholarly communication over the past two decades. Since the start of the 21st century, a new publishing model emerged, founded on the principle of providing free, unrestricted access to research outputs for readers. This goal is achieved through two primary strategies: (a) Diamond and Platinum OAP, which publish articles without any processing charges to authors, and making them freely available to readers without any restrictions; and (b) Gold OAP, where journal publishers make articles immediately available for free on their online platform. To maintain their operations, publishers of Gold OA journal typically require authors to cover the costs of publication, which can exceed \$3,000 USD, with some prominent publishers charging upwards of \$12,000 USD. Under this model, authors retain the rights to their publications rather than transferring them to the publishing house.

In recent work by Van Noorden,² it has been highlighted that tens of thousands of bogus research papers are being published in journals, contributing to an escalating international scandal. This surge in sham science is severely compromising medical and biomedical research while jeopardizing promising academic research in laboratories and universities worldwide. Last year, for the first time, the annual number of papers retracted by research journals exceeded 10,000. However, many experts believe that this figure represents less than 5 % of the entire scientific fraud occurring globally.

A recent study by Sabel et al.³ revealed that one in five articles published in biomedical journals might contain fabricated data produced by unauthorized "paper mills", which are platforms/agencies paid to create fraudulent scientific submissions. These problematic papers are often identified through "red flag" warning sign. Globally, there are approximately 22,000 scientific journals with an impact factor.⁴ Of these, only about 1,000 are considered diamond or platinum open access journals, while more than 11,000 journals fall under the gold OAP model.

As highlighted in many published articles, primarily those authored by beneficiaries of OAP houses, gold open access journals offer several

major benefits. These include the immediate availability of articles for free on the web, a typically smooth and fast reviewing process (with reviewers often proposed by the authors), a short time between article acceptance and online posting, and a high acceptance rate. Everything seems ideal, except for some important issues that many authors or reviewers have encountered in these journals.

To date, I have reviewed more than 90 papers submitted to more than 30 open access journals and have published 5 papers in such journals. What surprised me most during the review process was the editorial insistence that I complete my review within 10 days. If I failed to submit my review on time, I received daily reminders from the editors. In many cases, just a few days after agreeing to review, I would receive an e-mail stating "Revision no longer needed".

In my experience reviewing for these journals, I was most astonished to see papers containing data that was completely wrong, illogical, or even fabricated. In such cases, I recommended rejecting the papers. However, in more than 80% of those cases, the editorial response to the authors was simply, "Please correct the remarks of the referees and resubmit the corrected version of your manuscript for further consideration". These papers were eventually accepted without a second review.

Despite my clear negative reviews, I saw many low-quality papers published. This led me to discontinue reviewing for those journals. The policy of prioritizing higher profit margins by accepting as many papers as possible drives many genuine reviewers to quit. The processing charges for over 70% of gold OAP journals exceed \$2,500 USD. For example, in June 2024, a single pay-to-publish journal published 120 papers in one day, earning over \$360,000 USD in just 24 hours! In 2023, more than 2,000,000 papers were published in pay-to-publish journals, illustrating how profitable this business is. Research indicates that the pay-to-publish industry is valued at over \$20 billion USD as of 2023.

Who benefits from this industry? Reviewers receive no compensation for their efforts, yet they are a decisive segment in the process of publication. While journals do incur costs for maintaining their online platforms and for some technical editing, these expenses are typically less than \$200 per article, meaning the profit margins for these journals often exceed 80 %. Additionally, many gold open access journals that operate on a pay-to-publish model do not even offer language editing services. In our experience with such journals, not a single letter was changed in the proofs we re-

ceived, despite our non-native English-speaking background.

Many bad practices have been reported in recent years by fully OAP journals that charge authors,⁵ and nothing seems to stop this business from growing. Ethical issues are largely ignored, the quality of work is neglected, reviewers' time and efforts are disregarded, and the potential damage to global research from the "scientific results" published in many substandard papers is overlooked. It has already become "normal" to read "scientific" papers in OAP journals claiming absurdities such as the vibration of a single DNA molecule can generate energy equivalent to that of a nuclear power plant, or that a black hole at the Earth's center can cure psoriasis, or that DNA taken from a chicken egg can revive a dead human brain. Many pranksters have published scam papers in OAP journals to expose their unreliability, yet the business continues smoothly. Many gold OAP journals lack a proper review process, with papers often accepted within just a few days!

The advent of artificial intelligence (AI), exemplified by tools like ChatGPT, marks the beginning of a new era that raises concerns about the integrity of scientific research. ChatGPT now assists not only with linguistic challenges but also enables the creation of "scientific papers" that lack original research or valid results. Alarmingly, it has become a practice for many highly reputed scientific journals with substantial impact factors to exhibit no editorial oversight, with reviewers failing to engage critically, and neither proofreading nor language editing being conducted!

In the current race for rapid publication and financial gain, we are witnessing the fast publication of articles entirely generated by AI. These papers often include glaring issues, such as unedited text from ChatGPT's initially friendly responses to the customers (read authors), which have been published verbatim in prominent journals, some of them with impact factors exceeding 5.9, journals with a legacy of over 50 years. Another notable example is the recent publication, a so-called "Rocco S. rat", an AI-generated paper having content of absurd scientific merit. This published "scientific paper," featuring a "scientific" image of a rat with exaggerated external genitalia, "shocked" the scientific community. While it serves as a cautionary example, it also underscores the significant risks associated with the misuse of AI in academic research and publishing.

Tragically, most government funding and scientific institutions require that papers from the projects they support be published exclusively in

OAP journals. At the same time, it is equally problematic for many traditional publishing houses to impose unrealistic subscription fees for accessing their journals, a practice that was common among traditional publishers up until the year 2000.

When it comes to fraudulent work, it is well known that some of the biggest scams have been published in some of the top ten most reputable scientific journals, often from publishing houses with long-standing traditions. Therefore, when it comes to profit margins, there is little difference between traditional publishers and gold open access publishers. This situation leaves many ordinary scientists, who have limited funds for their research, questioning how they can continue their scientific pursuits and which scientific publications they can trust.

After my experiences over the past ten years, I have decided to no longer act as a reviewer for many gold pay-to-publish journals. Many colleagues in my field have made the same decision. While this decision may not significantly impact the direction of science, it is a small step toward avoiding participation in the destruction of the science we once knew.

CONCLUSIONS

In the conclusion of this work, I would like to pose some relevant questions and highlight some points. How can we address the challenges posed by major publishers in this "open era"? How can we identify credible science? Where can we publish at reasonable costs or without fees? How can journals find reliable reviewers? Is it worth publishing in every pay-to-publish journal, or are the diamond open access journals a credible alternative?

Diamond and platinum open access journals offer one solution for this situation, although they have limited resources and typically publish only 20 to 100 papers per year. Remarkably, most diamond open access journals (mainly funded by the governments of smaller countries) provide free language editing, which is not the case for the majority of pay-to-publish OAP journals. Although diamond open access journals charge no publication fees to authors, many scientists avoid publishing in these journals due to their more rigorous review process and low acceptance rates. However, these characteristics should be seen as advantages, both for the journals and for genuine scientists.

Based on trends observed over the last 10–15 years, it is likely that the integrity of science

will continue to erode unless a model with real publication fees is introduced, one in which reviewers are also compensated, even symbolically, for their efforts.⁶ Without such a system, the peer review process risks becoming an even greater scam than the infamous "paper mills".⁷

While preparing this manuscript, I discussed some of my findings with a fellow compatriot, a renowned expert in electrochemistry from Macedonia. He remarked, "I have a feeling that nowadays, everyone publishes, but no one reads", a sentiment with which I fully agree. His observation aptly captures a broader issue within the scientific community and could serve as a fitting title for a future work examining the erosion of science. An immediate overhaul of the entire publishing system is urgently needed. Unfortunately, it appears that the final nails have already been driven into the coffin of genuine science, as millions of fraudulent papers have inundated scientific journals.

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