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# DIAMOND OPEN ACCESS WITH PREREGISTRATION: A NEW PUBLISHING MODEL FOR PALAEONTOLOGY

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# ABSTRACT

The current academic publishing model is systemically unfit for purpose. The academic publishing ecosystem is dominated by a few large for-profit publishing houses which, at every stage of the publication process, transform academic work and public resources into private profit. Although extracting substantial profits, these publishing houses themselves add little value to the final published work, impose policies that strip copyright from authors and institutions, and bake in opaque and sometimes discriminatory gatekeeping to the publication process. Systemic problems in academic publishing have for decades been suggested to hinder access to academic research, suppress original thought, bias the publishing process against people with protected characteristics, and simultaneously provoke unnecessary changes to articles whilst failing to improve the quality of flawed work. The diamond open access (DOA) journal model addresses many of these issues, particularly financial accessibility and authors' retention of copyright. Some publishers, such as the geoscience-specialist Copernicus Publications, have developed protocols to increase transparency and efficacy in review processes, and others have made recent moves towards including preregistration of research protocols with the aim of bolstering the rigour of the academic process. However, publishing options that offer all these facilities are few and far between. In palaeontology there is a notable paucity of transparent open science publications, with only a handful of discipline-specific options for DOA publishing. Here, we present a new publishing model that builds in financial accessibility, transparency, and accountability from the ground up. This model is broadly applicable across academic publishing, including to academic palaeontology. The new model incorporates community-driven DOA publishing procedures, a broad-access and transparent peer review system, research protocol preregistration, and a systematic but flexible approach to publishing work at various stages throughout the research process. We aim to demonstrate the potential of a more flexible, more transparent, more equitable academic publishing model, and declare our intention to establish a new palaeontology journal rooted in these principles.


**KEY WORDS** academic publishing; diamond open access; research preregistration; peer review systems; palaeontology

# INTRODUCTION

The collective corpus of academic literature is, in theory, an approximation of all robustly assessed knowledge recorded by societies with a tradition of the written transfer of knowledge. The state of the academic publishing system therefore determines the accessibility of conducted research and influences the direction of current and future research. The current academic publishing system is dominated by a small number of for-profit publishers that levy substantial resources from the academic sector in Article Processing Charges (APCs; Khoo 2019; Grossmann & Brembs 2021) whilst inadequately compensating academics for the editorial and review work on which the publishers rely (de Knecht 2019). Traditional publishing processes rely on opaque editorial and review processes that rest power in the hands of a few, fostering a system in which conscious and unconscious biases negatively impact people with marginalised identities (e.g., Wennerås & Wold 1997; Williams 2020; Kern-Goldberger et al. 2022; Liu et al. 2023). Pressure on researchers to publish high volumes of high impact papers has a negative impact on research ethics (Raja & Dunne 2022) and increases the volume of work submitted for publication (Lajtha & Baveye 2010), which in turn increases pressure on under-resources editors and reviews and increases the time taken to get work published. Moreover, the pressure to publish exciting papers in high impact journals disincentives confirmatory research and the publication of null and negative results (e.g., Baker 2016; Mehta 2019). We think academic publishing needs to step back and consider a new model for publishing academic research that is centred on ethical propriety, transparency, accountability, and accessibility. Here, we outline some of the key issues we see in the academic publishing landscape and then describe a new publishing model, tackling most of these concerns, that we intend to develop for the field of palaeontology.

## FINANCIAL GATEKEEPING

It is increasingly evident that the major publishing houses are making extraordinary profits from academic publishing (e.g., Khoo 2019; Björk 2021; Editorial 2022; Magee 2023) and that this has recently been further driven by exorbitant APCs that overstate the actual costs of processing articles (e.g., Farquharson & Wadsworth 2018; Khoo 2019; Siler & Frenken 2020; Björk 2021; Grossmann & Brembs 2021; Rowe et al. 2022). RELX, the parent company of Elsevier, noted in the press release[1] accompanying their 2022 financial report that in their

Scientific, Technical & Medical division's "Primary Research academic & government segments", which includes academic publishing, "growth was driven by higher volumes of articles submitted and published, with pay-to-publish open access articles growing particularly strongly" (RELX 2023). The adjusted operating profit margin of RELX's Scientific, Technical & Medical division was 37.8%, valued at £1.1bn (Magee 2023). In 2021, Springer Nature had an adjusted operating profit margin of 27.6%, valued at £387m, and waived fees for publications totalling just £16m, or 4% of the company's adjusted operating profits (Editorial 2022). John Wiley & Sons' Annual Report 2022[2] shows an operating income of $288m, with a 35.1% adjusted EBITDA (earnings before interest, taxes, depreciation, and amortisation) margin from the Research Publishing & Platforms Segment (John Wiley & Sons 2022 pp. 5, 32).

Academic research is largely publicly or charitably funded (e.g., National Science Board 2021); researchers are not remunerated by publishers for the manuscripts they publish; researchers review manuscripts for no financial compensation, in the name of service to the community; researchers take on editorial roles that include managing journal operations either for no compensation or for minimal compensation that does not match the time commitment required (de Knecht 2019). Moreover, researchers or their institutions pay to publish open access (OA) articles, and individuals and academic institutions pay to access published non-OA articles. The profits of large players in the academic publishing system are subsidised by public and charitable funding in the production, publication, and reading of research articles. This situation directly led to the mass-resignation[3] of the editorial board of Elsevier journal *Neuroimage* in April 2023 (Fazackerley 2023).

This model of high profit-generating publishing represents something more repressive than simply the diversion of resources that could otherwise be used to fund further academic research. Submitting articles for publication and accessing published articles to read are bottlenecks where financial gatekeeping becomes a crucial factor in equitable access to academic research production and consumption (e.g., Farquharson & Wadsworth 2018; Björk 2021; Khanna et al. 2022; Raja et al. 2022). In response to the profits generated through academic publishing, the 2003 Berlin Declaration on Open Access to Knowledge in the Sciences and Humanities led to the Plan S initiative, which requires state-funded research to be published solely open access to ensure accessibility to all, including the non-academics whose taxes partially or wholly facilitate the research (cOAlition S accessed 22 May 2023). However, it is debatable whether the letter and spirit of Plan S has been widely accepted by for-profit publishers, in particular regarding Plan S principle 1 that authors or their institutions retain copyright of their work. Moreover, Plan S principles 4 and 5 explicitly continue the practice of funnelling of research funds into for-profit publication models, with funding bodies agreeing to pay the APCs required by journals—which can be many thousands of pounds—as long as the APCs are "commensurate with the publication services delivered and the structure of such fees [is] transparent" (cOAlition S accessed 22 May 2023). Plan S is a positive step in transforming the academic publishing landscape, but it still leaves a lot of room for improvement in the financial accessibility of academic publishing.

The diamond open access (DOA) publishing model addresses financial accessibility concerns by ensuring publication is free for authors and access is free for readers, with costs being met by donations. DOA publication maintains the confidence of academic rigour resulting from the review process (but see below) and often, though not always (e.g., *Palaeontologia Electronica* accessed 5 May 2023), ensures that authors retain copyright of their work, typically under a CC-BY licence (e.g., Farquharson & Wadsworth 2018 p. v). DOA publications have existed in the geosciences for decades (e.g., *Acta Palaeontologica Polonica, Carnets Geol., Earth Science Malaysia, Geologica Belgica, Journal of the Geological Survey of Brazil, Lethaia, Palaeontologia Electronica, Rivista Italiana di Plaeontologia e Stratigrafia, Scientific Drilling*, and more; see Thomas et al. 2023 p. 4), and there are at least 58 DOA titles that publish work with some palaeontological aspect, 15 of which are palaeontology-specialist journals and which are predominantly published by societies or universities (data in Tennant & Lomax 2019). The launch of *Volcanica* in 2018 (Farquharson & Wadsworth 2018) sparked a new generation of community-driven earth science journals, including *Geomorphica, Sedimentologika, Seismica*, and *Tektonica* (Fernández-Blanco 2021; Rowe et al. 2022; Thomas et al. 2023), that have community support, DOA, and author ownership as cornerstones of their publication model.

## REVIEW PROCESSES

The peer review process is important: it shapes what academic research is published and, therefore, what future research is funded and conducted, and it fundamentally impacts researchers' career trajectories. The traditional academic peer review model is for a handling editor to make an initial decision on whether to reject a manuscript or send it for solicited single-blind review by two or three subject experts, who then write an unpublished critique of the article and provide a recommendation to the editor of whether or not the article should be published. The peer review process is a cornerstone of the concept of academic rigour, as multiple specialists must

agree that submitted work meets subject-specific professional standards and advances human understanding. However, the traditional peer review process in practice is not the bastion of academic rigour claimed in theory, and problems rooted in both the process itself and in human interactions are increasingly being identified. These problems are outlined briefly here, and are well documented elsewhere (e.g., Wennerås & Wold 1997; Smith 1999, 2006; Tregenza 2002; Bornmann et al. 2007; Hauser & Fehr 2007; Budden et al. 2008; Newton 2010; Helmer et al. 2017; Williams 2020; Niriella et al. 2021; Berhe et al. 2022; Schiffbaenker et al. 2022; Heidt 2023; Liu et al. 2023).

Traditional, single-blind, peer review structures have been described as "suppress[ing] original thought" and "coerc[ing] authors into unnecessary revisions" (Newton 2010 and references therein), as well as being a "slow, expensive, profligate [waste] of academic time, highly subjective, prone to bias, easily abused, poor at detecting gross defects, and almost useless for detecting fraud" (Smith 1999). More recent studies, reinforced by widespread anecdotal evidence, have found that this traditional peer review model in publication and grant reviewing negatively impacts researchers with protected characteristics and from marginalised backgrounds (e.g., Roberts et al. 2020; Niriella et al. 2021; Kern-Goldberger et al. 2022; Schiffbaenker et al. 2022; Liu et al. 2023).

Systemic biases against researchers from marginalised backgrounds manifest as fewer successful grant and publication outcomes for those researchers as well as personally harmful comments from reviewers towards those researchers (Wennerås & Wold 1997; Tregenza 2002; Bornmann et al. 2007; Budden et al. 2008; Pierson 2014; Berhe et al. 2022; Schiffbaenker et al. 2022; Liu et al. 2023). Women researchers frequently report receiving misogynistic and sexist comments in peer review reports (e.g., Pierson 2014; Cochran 2016; Roberts et al. 2020), and researchers of colour and from countries in the Global South report receiving xenophobic and racist comments in peer review reports (e.g., Williams 2020; Niriella et al. 2021). Gender bias in reviewing science is evident from, depressingly if predictably, early in an academic's educational pathway (Knobloch-Westerwick et al. 2013), and the same can be reasonably assumed for other biases. Moreover, nepotism, which intrinsically advantages the majority group and disadvantages people from marginalised or minority groups, is an acknowledged factor in peer review outcomes (Wennerås & Wold 1997; Pierson 2014; Cochran 2016).

These problems are not simple to fix, and it is hard to envisage a process that can fully replace the review of work by subject-specific colleagues who understand how it should be done and why it matters. However, a number of adaptations have been proposed and implemented to tackle some of the issues arising from the traditional single-blind peer review process. These include tangible incentives for peer review, such as financial compensation or reduced APCs for future papers, though these could easily be taken advantage of by ethical bad actors (Patterson 2007), and APCs cease to matter under a DOA model. Systems such as a 'reviewer metric', where editors briefly score reviews, are relatively simple to enact and may provide an incentive to improve the quality of peer reviews (Hauser & Fehr 2007), though this would add work to already overburdened editors and is also vulnerable to gaming by bad actors. Ideas for directly modifying the peer review process include mechanisms to streamline reviews, such as employing structured templates and potentially in the near-future AI-assistance (Hauser & Fehr 2007; Newton 2010), which may help address the substantial growth in submission volume (Checco et al. 2021).

More fundamental changes proposed for peer review centre on redistributing anonymity in and/or opening up the process, by making reviews double-blind, publishing (signed) reviews, and including public peer review. Double-blinding the peer review process is appealing because it can protect authors from conscious and unconscious bias and reviewers from any backlash following a justified negative review. Intuitively, it may be hard to truly hide the identities of authors or reviewers, particularly in a small specialist field, but there is some evidence that this does not happen despite the ease of accidentally including information in a manuscript that could unblind it (Katz et al. 2002; Budden et al. 2008). Moreover, there is some evidence that double-blinding peer review can counteract the impact of gender bias (e.g., Budden et al. 2008; Kern-Goldberger et al. 2022). An alternative approach to double-blinding is increasing the transparency of the review process so that it is fully unblinded and publicly visible. Copernicus Publications pioneered an Interactive Public Peer Review™ system in the early 2000s (Töpfer accessed 21 April 2023), and many journals now include the option for review exchanges to be published with the final manuscript. The public nature of reviews under a fully transparent process means reviewers and their reviews can be directly assessed by the academic community for quality, usefulness, and potential biases. Further transparency of reviews could also act as an incentive if reviews themselves are made citable, giving further recognition to academic ideas and work traditionally done behind the scenes (Patterson 2007).

## ACCOUNTABILITY & TRANSPARENCY

The DOA publishing model addresses the prohibitive costs of publishing and/or accessing academic work, and increasing the balance of transparency in the review process

can improve the quality of reviews and reduce some of the negative impacts of bias, discrimination, and nepotism. Publishing peer reviews, in particular, can improve the accountability of those engaged in the review process. However, creating ever-increasing numbers of DOA journals with more transparent review processes is not a panacea for the academic publishing system. Traditional and DOA publication models do not ensure transparency of the academic process or accountability and recognition for particular aspects of academic work.

Authorship order is often used, including in palaeontology, as an indicator of authors' roles in a study. The first and corresponding author(s) usually did most of the work, including writing the manuscript, and the last author usually provided senior supervision of the project. But these conventions are not always followed and authorship order can be subject to academic political pressures that arise from inherent power imbalances in the system. Author contributions statements are increasingly used to address this concern, and many academic journals have adopted the CRediT (Contributor Roles Taxonomy) statement model, which aims to unambiguously credit authors for their roles in a particular study (Allen et al. 2014, 2019; Brand et al. 2015). However, author contribution statements are often written after-the-fact and remain subject to academic political pressures on the path to manuscript publication. Moreover, the typical placement of an author contribution statement at the end of a paper minimises the visibility, significance, and clarity of the statement. In laying the groundwork for a contributor roles taxonomy, Allen et al. (2014) wrote that "What we cannot tell easily by reading a paper is who did what." Author and CRediT statements offer a substantial improvement in facilitating transparency of the academic process, but they remain vulnerable to political influence and unethical behaviour, and often lack in influence.

Beyond obscuring 'who has done what', most established publication models also obscure the order of research work, that is, 'what was done when'. By only fully writing up a study after the fact it is easy to, intentionally or unintentionally, muddle the order of the actual research process that was followed. This includes misrepresenting the order of intellectual developments, whether data collected for hypothesis generation were subsequently used in hypothesis testing (Nosek et al. 2018), and when and why certain statistical tests were deemed appropriate, which can lead to widespread academic p-hacking (Head et al. 2015). Preregistering detailed research plans is one means to mitigate this lack of transparency in the research process (Nosek et al. 2018). To meet international standards, clinical trials are required to preregister their intended aims, hypotheses, and methods (ICMJE accessed 16 May 2023; World Health Organisation accessed 26 April 2023). However, preregistration is not routinely built into journal publication models in other disciplines. While separate repositories ("registries") are commonly used instead (Nosek et al. 2018), and protocols are publicly available via registries, these publications are typically only reviewed by an ethics committee and there is no requirement that they be subject to full or transparent peer review. Recently, some journals, such as *PLoS ONE* and *PLoS Biology*, have incorporated reviewed preregistration within their publication processes (e.g., Heber 2020; Pariente & other Editors 2022; Center for Open Science accessed 16 May 2023), though take-up outside of clinical and social sciences has been limited.

Opacity in the academic research and publishing systems can serve to mask unethical behaviours in research. These behaviours include those outlined above, exerting pressure to gain undue credit for work, biases in the performance and review of research, as well as breaches of good practice ethical codes (e.g., the Nagoya and Cartagena protocols; Convention on Biological Diversity 2023a, b) or even breaches of legislation (e.g., Cisneros et al. 2022). Medical, zoological, and social science publications typically require an ethics statement affirming that the research has been performed following current best practice codes, sometimes supported by formal approval from an appropriate ethics committee. Opening up the academic research and review processes to wider scrutiny can help spot, and correct, poor ethical practice prior to publication, and positively transform academic ethical practice, particularly that of extractive disciplines including the geosciences (e.g., Haelewaters et al. 2021; Cisneros et al. 2022; Dunne et al. 2022; Raja & Dunne 2022).

## A PARADIGM SHIFT IS NEEDED

We argue for a paradigm shift to holistically address systemic problems with the academic publishing landscape, including financial gatekeeping and a lack of transparency in academic and publishing processes. Here we propose a broadly applicable publication model that offers transparency and accountability throughout the academic and publishing processes and which we intend to use as the basis for a new-wave journal in palaeontology. None of the individual components of this model are truly new – examples of each aspect can be found scattered throughout the academic publishing environment. However, we believe that this is the first time a journal has been suggested to be established with this ethos and process from its foundation.

# A NEW MODEL

## ETHOS

The principles of our proposed DOA publishing model are to enshrine ethical good behaviour, transparency and accountability throughout the publishing process, and to promote these aspects during the broader scientific process. We consider several strands of ethical behaviour in developing this model, spanning the entire research and publication process. We provide examples of these ethical considerations that chime with our own disciplines, palaeobiology and the geosciences, though we consider the general ethical principles to be broadly applicable across academic disciplines, and we explicitly borrow best practice from other disciplines where useful.

### ETHICAL BEST PRACTICE

It is common practice in medical, zoological, and social science publications to require authors to confirm that their research has been conducted in accordance with current ethical best practice (see above). There are numerous discipline-specific best practice ethical codes, including the Nagoya and Cartagena protocols (Convention on Biological Diversity 2023a, b) in the biological sciences, the "Ethical standards and procedures for research with human beings" set by the World Health Organisation (World Health Organisation 26 April 2023), as well as national medical councils' and institutes' own clinical research standards. In what can be broadly termed 'extractive sciences', to which field work-heavy subjects like palaeontology and geosciences belong, there is the Global Code of Conduct for Research in Resource-Poor Settings[4] (TRUST accessed 26 April 2023), which provides a framework for working ethically across intra-national and international resource boundaries. The TRUST Global Code of Conduct has been adopted by several universities, the Nature Portfolio journals, and the European Research Council as part of their ethics procedures.

As well as having established ethical codes, it is equally important to have procedures in place to ensure they are followed. Ethics statements are not typically required for palaeontological or geoscience studies, other than in the field of experimental taphonomy with animal subjects. This does not mean that these fields are devoid of ethical considerations. Parachute or helicopter research has been common practice for decades (e.g., Haelewaters et al. 2021), including in palaeontology (Raja et al. 2022), and the illegal, or at least not legally documented, removal of fossil materials from low- and middle-income countries to institutions in high-income countries remains commonplace (e.g., Cisneros et al. 2022; Dunne et al. 2022). Journals have an important role to play in maintaining ethical good practice in academic research, and should both require and reinforce adherence to ethics statements in published papers through careful editorial training and working.

### TRANSPARENCY IN ACADEMIC RESEARCH

Transparency is important in the research process, from formulation of research ideas, to providing primary data in an accessible format, to documenting clearly the methods used to obtain a particular result. Transparency is the foundation of reproducibility and is important in the robust formulation and testing of hypotheses. Following a traditional academic publishing model, a study is only written up and made publicly available after the fact. This makes it easy to accidentally or deliberately confuse important parts of the process, such as the order of intellectual developments, whether data were gathered with the intention of hypothesis generation or hypothesis testing, or selectively reporting which statistical tests were performed (Head et al. 2015; Nosek et al. 2018). Time-stamped transparency of hypothesis generation, methodological decision making, data collection, and hypothesis testing bolsters the rigour of academic research and this can be achieved with a more flexible publication structure that fully integrates preregistration (e.g., Nosek et al. 2018).

### RECOGNITION OF AUTHORS FOR THEIR WORK

Formal recognition of author contributions to a paper have become increasingly common across the academic publishing landscape. As outlined above, however, author contributions and CRediT statements are imperfect mechanisms for proper attribution of academic work. Taxonomic research has long had a mechanism for recognising subsets of authors on a paper for their contributions in defining specific taxonomic names that the other authors of the paper were not responsible for. However, this method is not universally applicable to other disciplines. In addition to methods such as CRediT statements, journals should develop approaches for charting author contributions that better recognise contributions made to each stage of an academic study.

### TRANSPARENCY IN THE REVIEW PROCESS

The bigotry of 'Reviewer 2' should not be a joke. That sentence started as placeholder text, but it nicely encapsulates the driving sentiment behind this principle. The caricature of 'Reviewer 2' as bigoted, rude, and unhelpful to the point of deliberate obstruction does have some foundation in reality. That reviewers are sometimes allowed to employ strawman arguments and ad hominem attacks on authors as reasons to reject or substantially revise a manuscript are facilitated by

opaque peer review processes. Employing a fully transparent review process, with reviews and author responses signed and published alongside the final article, encourages professional and constructive reviews and responses. This must be enforced by adherence to author, editor, and reviewer codes of conduct.

## EQUITABLE DISTRIBUTION OF RESEARCH

Most academic research is to some degree the beneficiary of public funding (e.g., National Science Board, National Science Foundation 2021), and we contend that the results of publicly funded research should be available to those who have already paid for it, that is, the public. However, most academic publishing remains for-profit and dominated by major publishing houses. Non-DOA publication erects barriers to authors who have to pay (often more public money) to publish, and/or to readers who have to pay to access published work. DOA publication circumvents this by using small amounts of additional funding (much less than an institutional subscription to a for-profit publishing house) to set up and maintain an online archive of author-generated and editor- and reviewer-augmented publications, providing more equitable distribution of research within academia and the public sphere.

# PUBLISHING MODEL STRUCTURE

The new publishing model we propose envisages three main types of publication:

**1)** *Hypotheticals* – short opinion pieces outlining an idea or hypothesis; broadly equivalent to the introduction and aims of a traditional research article. *Hypotheticals* represent early-stage thought experiments, testing the water with new ideas, and, at their most constructive, open calls for collaborations.

**2)** *Preregistered research protocols* – plans for work to be done. The plans should include detailed aims, objectives, and any hypotheses to be tested, as well as data collection and analysis strategies. Preregistration of research protocols is common practice in clinical and social sciences (e.g., Nosek et al. 2018; ICMJE accessed 16 May 2023), though take-up in other disciplines, including palaeontology, has been limited. We propose to encourage preregistration as the norm in academic publishing, with *Preregistered research protocols* reviewed and published on acceptance. Such publications can be differentiated between preregistered research articles which anticipate a follow-up full *Research article*, and those which are primarily focused on publishing protocols that present methodological developments.

**3)** *Research articles* – full research articles with, broadly, introduction, methods, results, and discussion sections. A *Research article* can be submitted as a standalone paper, or comprise related *Hypothetical* (introduction, aims, hypotheses), *Preregistered research protocols* (materials, methods), and a follow-up results and discussion article.

Publications submitted under any of these categories will be made available as online preprints following initial quality assurance and confirmation that they are within scope of the journal by a handling editor. Initial preprint publication allows all article types to undergo open peer review from the academic community. As in the Copernicus model (Töpfer accessed 21 April 2023), the journal or its parent body hosts a preprint that is assigned a DOI, and separate but related (versioned) DOIs are then issued for an accepted manuscript.

These three publication types are ontogenetically coherent and reflect the main components of scientific inquiry. In principle, a researcher could write a *Hypothetical* piece, outlining a knowledge gap and proposing hypotheses to evaluate. They could choose to follow this up with a *Preregistration research protocol* describing in detail the protocol they will follow to test their hypotheses. Finally, the researcher could publish a full *Research article* comprising links to their

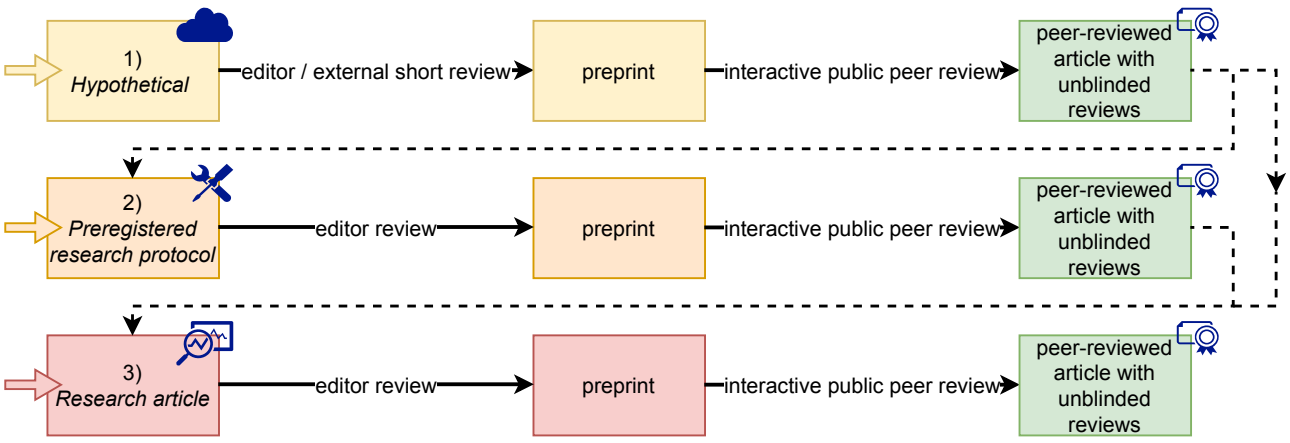


**Figure 1.** Structure of the new academic publishing model. Dashed lines represent optional pathways.

first two articles alongside the results and a discussion of their findings (see Example Box). Each article would receive a DOI, and these DOIs are linked together to show the development of a project. There are strong merits to formally documenting the evolution of a research project, including transparency of the academic process, enhanced academic rigour, and protection of intellectual property (e.g., Nosek et al. 2018; Center for Open Science accessed 16 May 2023), but authors would not be required to submit individual stages of a project separately and could instead opt to publish two or more stages together. We view each of these article types as important components of the scientific process that authors progress through in normal practice, in a more or less formal manner, and we see this publication structure as being designed to support and rigorously demonstrate that process.

## PEER REVIEW STRUCTURE

In this new publishing model, we propose a novel process that combines double-blinding with public and solicited peer review, and ends with all reviews unblinded and published. The combined interactive public and solicited peer review model used by a range of journals, particularly those in the Copernicus and Frontiers groups (Frontiers accessed 21 April 2023; Töpfer accessed 21 April 2023), opens up the review process to accommodate more voices from the community alongside promoting transparency and accountability. Typically, this model remains unblinded or single-blinded—the reviewers usually know the identities of the authors—leaving the system open to (un)conscious bias. This can be tackled by double-blinding the review process (e.g., Budden et al. 2008; Kern-Goldberger et al. 2022). Including a final step of unblinding and publishing reviews should, we hope, encourage reviewers and authors to have a scientifically rigorous discussion in a considerate and professional manner.

We envisage the review processes to follow the flowchart in Figure 2. Submitted manuscripts will be anonymised and posted as preprints that are available for public scientific discussion with short-format comments and, simultaneously, two to three invited peer reviews will be solicited from subject experts by the handling editor. All peer review comments, public and solicited, will be anonymised to authors and reviewers during the review process, but signed and published alongside the article preprint (if rejected for publication) or postprint (if accepted for publication). Peer reviews will also be streamlined by provision of review templates relating to the specific requirements of each of the publication categories.

To ensure a balance of workload between authors and reviewers, particularly in the current climate of increasing numbers of submitted articles (Lajtha & Baveye 2010), we would ask that the corresponding authors of any accepted manuscript agree to review two manuscripts, if requested and within their expertise, over the following two years. Published reviews could be linked to authors using the ORCiD system to help emphasise and quantify the crucial contributions that reviewers make to the publishing process, including so that this can be used as evidence of academic community labour (e.g., in the context of performance reviews).

## PUBLISHING MODEL ADVANTAGES

Building a DOA journal with preregistration, flexibility, and transparent public peer review integrated into its foundations ensures accessibility to authors and readers alike. The publishing model proposed here facilitates the efficient, flexible, and accessible sharing of new ideas, workflows, data, and interpretations in an intellectually rigorous framework that

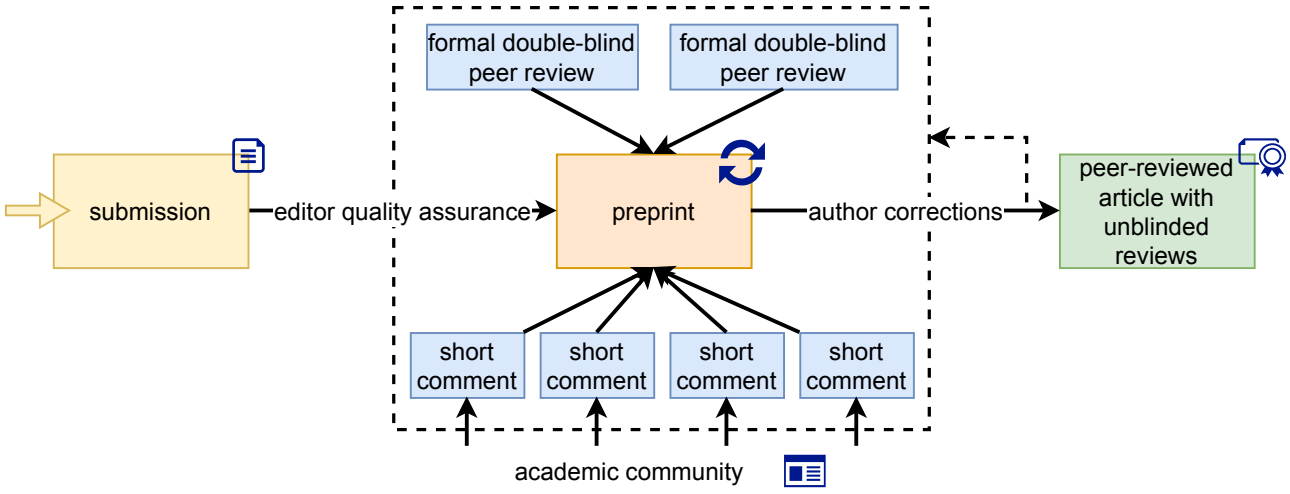


**Figure 2.** Flowchart of the Interactive Public Peer Review™ process developed by Copernicus Publications (adapted from Töpfer accessed 21 April 2023).

safeguards authors' intellectual property.

Publishing hypothesis creation, planned methodology, and hypothesis testing independently allows authors to share their ongoing work publicly, as-and-when they are ready to do so. This may reduce the pressures to rush to and through the hypothesis testing phase of a project in order to 'get the work out'. The flexibility of this framework allows authors to decide which aspects of their work justify independent publication, whilst still allowing them to be linked together as part of a larger project. Clearly separating the different stages of scientific enquiry with distinct timestamps on hypothesis generation, methodological development, hypothesis testing, and post hoc testing enhances the intellectual rigour of a study. This helps, at the level of a journal, to reinforce the intellectual rigour of the whole academic research process.

Alongside flexibility for authors in sharing ongoing work, this framework can also be used to accurately and transparently record the contributions of different authors to each component of a study. This provides authors enhanced intellectual property safeguards, by preregistering research plans and protocols, and builds in opportunities for developing new collaborations. Efficient and independent publication of new ideas, methodologies, and data allow researchers to clarify all aspects of work they have done, providing authors with credit for their ideas and input at different stages of academic research. Furthermore, publication of distinct aspects of the research process can also provide a forum for soliciting collaborations from across the academic community, beyond one's own network, by putting out an open call through a *Hypothetical*.

# NEXT STEPS

The diamond open access with preregistration publishing model described here tackles many of the problems of the traditional academic publishing process. At its core are principles of transparency, accessibility, flexibility, efficiency, and ethical good behaviour. Driving change in the academic publishing environment requires concerted effort from a diverse range of perspectives across the academic community. We intend to further develop this model as the basis of a new palaeontological journal and we warmly welcome contact from any and all parties interested in helping in this endeavour.

# AUTHOR CONTRIBUTIONS

HBD and TWWH contributed equally to all aspects of this work, including Conceptualisation, Writing – Original Draft, Writing – Review & Editing, and Visualisation. The authors share first and corresponding authorship, and are listed in alphabetical order.

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# CONFLICTS OF INTEREST

The authors declare no conflicts of interest.

## EXAMPLE BOX: FLEXIBILITY OF THE NEW MODEL

**Example 1.** An author team has examined a wealth of published observations on animal behaviour. The team devise a hypothesis to explain these observations, and want to share their idea with the scientific community before embarking on the time-consuming data collection and analysis; they therefore publish a *Hypothetical* (1). The *Hypothetical* is well-received, and the team wish to test their hypothesis; they update their article record with a *Preregistration research protocol* (2) detailing the methodology they will follow to test their hypothesis, establishing their intentions, and calling for collaborators. The team then carry out data collection and analysis, test their hypothesis, and publish a *Research article* (3) that builds on their previous two publications.

**Example 2.** An existing hypothesis on taphonomic processes in fossil preservation exists in the literature as part of previous research. An author team wishes to test this hypothesis through taphonomic experiments; they publish a *Preregistration research protocol* (2) detailing their planned experimental methodology. The team then carry out their experiments, test the existing hypothesis, and publish a *Research article* (3).

**Example 3.** An author team opportunistically devises a hypothesis on sexual selection in the fossil record while focusing on other work; they publish this as a *Hypothetical* (1). However, they do not wish to pursue this work further; they do not publish any additional articles, but the hypothesis now exists in the literature for others to test.

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