

*Future of Publishing***Transformative choices towards a sustainable academic publishing system****Mohsen Kayal, Jane Ballard, and Ehsan Kayal***Mohsen Kayal (mohsen.kayal@ird.fr), ENTROPIE, IRD, CNRS, IFREMER, Université de la Nouvelle-Calédonie, Université de la Réunion, Nouméa, New Caledonia**Jane Ballard, University of Michigan, Ann Arbor, Michigan, USA**Ehsan Kayal, Normandie Université, UNICAEN, BOREA, Caen, France***Abstract**

Communicating new scientific discoveries is key to human progress. Yet, this endeavor has been increasingly hindered by monetary restrictions that restrain scientists from publishing their findings and accessing other scientists' reports. This process is further exacerbated by a large portion of publishing media owned by private companies that, in contrast with journals from scientific societies, do not reinject academic publishing benefits into the scientific community. As the academic world is not exempt from economic crises and funding restrictions, new alternatives are necessary to support a fair and economically sustainable publishing system for scientists and society as a whole. After summarizing major shortcomings of academic publishing today, we present several solutions that span the levels of the individual scientist, the scientific community, and the publisher to initiate a transformative change towards more sustainable scientific publishing. By providing a voice to the many scientists who are fundamental protagonists, yet often powerless witnesses, of the academic publishing system, as well as a roadmap for implementing solutions, we hope this initiative will go beyond sparking increased awareness and promote a shift towards more sustainable scientific publishing practices.

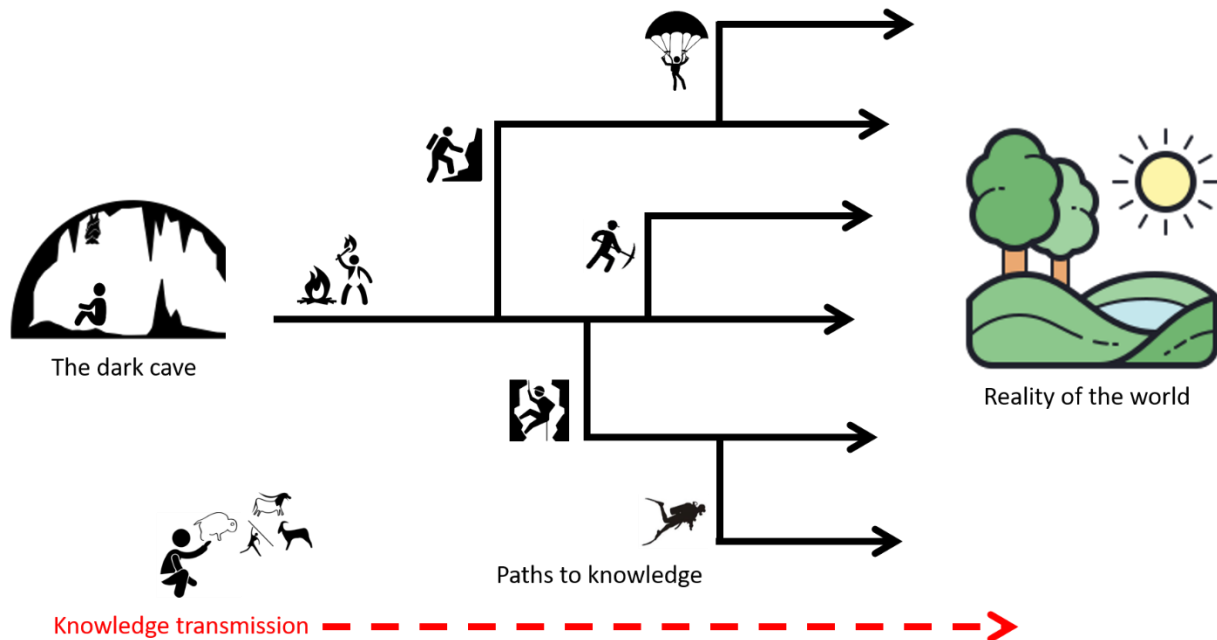
*Key Words*

Scientific knowledge, Publication economics, Open access, Intellectual property rights, Copyright, Sustainability, Transformative change.

**Knowledge, a valuable common for humanity**

Since the dawn of humanity, knowledge has been a most precious and path-determining asset of mankind. From ancient craftsmanship of tools, mastering fire, and the invention of the wheel to designing the most complex technologies yet to be created or the cutting-edge fields yet to be explored, scientific knowledge is the building block of human development. Knowledge is also a peculiar wealth in many aspects. It is non-perishable (once acquired, it remains), non-exhaustible (there is always more to learn, with each additional knowledge bringing more potential knowledge<sup>1</sup>), multiplicative (the sum of two pieces of knowledge is often greater than their singular values), and finally non-subtractive (knowledge donations do not create a loss for donors) and as such

<sup>1</sup> Knowledge has this fractal characteristic that the deeper we learn about things, the more we open new space to explore (Figure 1). Knowledge therefore appears as expansible and non-exhaustible, at least at the scale of human history and as far into the future as our generations can conceive.



**Figure 1.** Paths of knowledge acquisition with reference to Plato’s Allegory of the Cave. Men are initially locked in a dark cave (left) away from the light of knowledge. Knowledge acquisitions (e.g. the discovery of fire) through generations open new paths (center) towards the reality of the world (right), each path opening possibilities for deeper levels of knowledge acquisition. Knowledge transmission (red) is key to progressing through these often arduous and interdependent acquisitions.

highly sharable (Aberkane 2016). As a consequence, knowledge has a relatively small value when locked in a box, with its powers truly unleashed when widely shared (Figure 1). This is when knowledge becomes a common, a tool at the disposition of all, with knowledge dissemination as a natural end-goal in the process of knowledge production, and scientists as major protagonists in this endeavor. However, as with other valuable commons, access to knowledge is vulnerable to unsustainable exclusion and needs to be regulated to guaranty equity and sustainability, away from the “tragedy of the public knowledge commons” (Hardin 1968, David 2000). In the present manuscript, we highlight several shortcomings of scientific publishing hindering knowledge dissemination and potential solutions.

### Today’s academic publishing system

Academic publishing is the predominant medium scientists use to describe and communicate their findings. It is also the main metric by which scientists are evaluated throughout their career, particularly when it comes to accessing jobs and grants, with frequency of publications and journal prestige as a gauge of scientific achievements. In today’s process of academic publishing, scientists provide valuable<sup>2</sup> scientific findings to journals for free, often even giving away author copyrights, which then sell this knowledge to the public and other scientists (Liedes 1997, Odlyzko 1997, Bachrach 1998, Walker 1998, Smith 2006, Van Noorden 2013, Buranyi 2017). Indeed, most journals charge fees to both the authors for

<sup>2</sup> Scientific findings rely on replicated and technical work which often necessitate time and costly resources.

publication of, and to the readers for access to, scientific content, with some allowing higher publication fees to offset the access fee (a.k.a. open access; Smith 2006, Minet 2017, Zhang 2019) and vice versa. These publishers depend on continued input of scientific research that is funded largely by government agencies, and rely heavily on the scientific community for the skilled<sup>3</sup> and uncompensated<sup>4</sup> tasks of manuscript selection and evaluation (i.e. editorship and peer review), on a volunteer basis (Odlyzko 1997, Smith 2006, Aarssen and Lortie 2010, Van Noorden 2013, Schmitt 2014, Buranyi 2017, Huang and Huang 2018, Zhang 2019). This system of scientific publishing is not new, and was historically initiated by non-for-profit scientific societies with very small monetary power as a way to strengthen scientific endeavors. However, the academic publishing industry was quickly overtaken by for-profit companies, which prospered on this highly profitable business model thanks to decades of growing public investments in science and globalization of scientific literature (Odlyzko 1997, Walker 1998, Smith 2006, Van Noorden 2013, Schmitt 2014, Larivière et al. 2015, Buranyi 2017, Copiello 2018, Fire and Guestrin 2019). This ongoing success-story of the publishing business contrasts with the drastic decrease in funding and job opportunities experienced by the scientific community in the current era of austerity, precipitating many scientists into precariousness while being increasingly solicited for free contributions to an ever-expanding publishing industry (Aarssen and Lortie 2010, Schmitt 2014, McDonnell 2016, Herschberg et al. 2018, Ålund et al. 2020, RogueESSR). Ironically, the rising competition among scientists resulting from funding scarcity has only exacerbated reliance on existing metrics of research excellency, predominantly based on the number of publications in, and editorship for, a handful of high-profile and often privately-owned, costly journals (Smith 2006, Aarssen and Lortie 2010, Heyman et al. 2016, Magistretti 2016, Buranyi 2017, Minet 2017), further draining scarce scientific resources into the cycle of publication and access fees. Here we provide a voice to the many scientists who are the fundamental protagonists yet often powerless witnesses of the academic publishing system, and identify initiatives for actors throughout the academic publishing process (Figure 2) for stepping away from the current model toward more sustainable practices.

Scientific activities rely heavily on funding allocated to individual scientists, research programs, and official institutions, in big part in response to publicly-funded

calls for scientific investigation (Huang and Huang 2018). Yet, paradoxically, the dissemination of scientific findings predominantly lays in the hands of a few for-profit publishing groups that largely benefit from the commercial exploitation of the knowledge produced by these publicly-funded endeavors (Smith 2006, Schmitt 2014, Larivière et al. 2015, Buranyi 2017, Minet 2017, NewScientist 2018, Zhang 2019). The generalization of open-access publication of scientific findings funded by public grants (Government of the Netherlands 2016, Minet 2017, Else 2018, OuvrirLaScience 2018), while a great initiative in itself, is in many ways amplifying scientific expenditure in publishing fees, further wasting scarce public funds to lucrative journals (Van Noorden 2013, Schmitt 2014, Wingfield and Millar 2019, Grossmann and Brembs 2019). Neither ethical nor sustainable (Smith 2006), the conflictual scientific publishing system has generated intense debates within many academic institutions and scientific circles, with some recent, strong initiatives withdrawing subscriptions to major publishing groups (Smith 2006, Larivière et al. 2015, Buranyi 2017, Minet 2017, Else 2018, Zhang 2019, The Cost of Knowledge). However, these initiatives have so far had limited impacts on the publishing system with no significant shift to a sustainable alternative (Heyman et al. 2016).

### **Towards a sustainable publishing model**

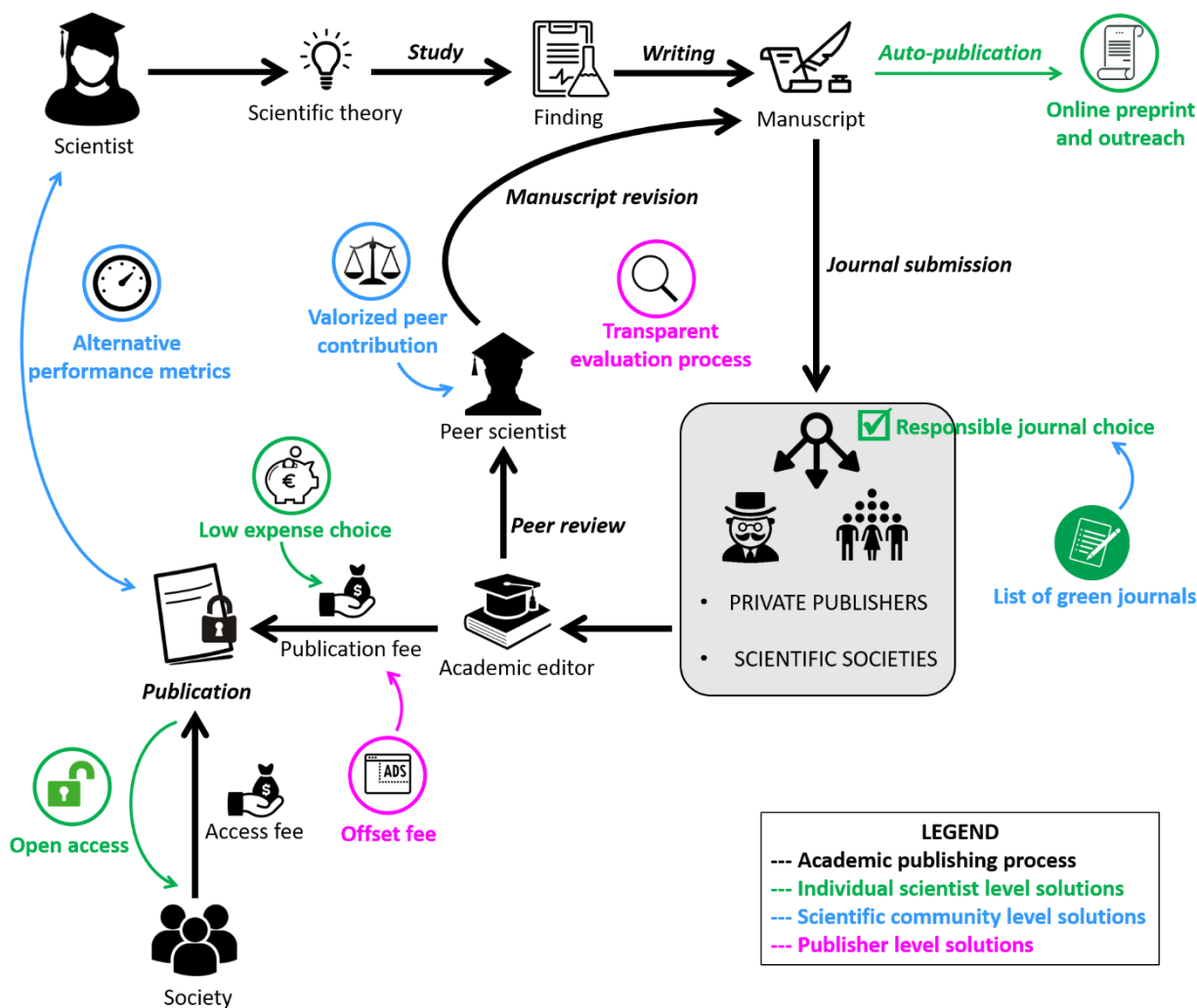
When the system is drifting astray, individual and community choices can be a driving force towards a better pathway. Most scientists are already aware of the above-mentioned aberrations in the scientific publishing system. However, pushed by the inertia of the ongoing model and without a clear vision for alternatives, it is the path of least resistance to keep fueling conventional publishing practices as authors, reviewers, and editors (Whitfield 2012, Heyman et al. 2016), despite this being a clear deviation from the fundamental commitments of the scientific communities for a better society (Odlyzko 1997, Bachrach et al. 1998, Walker 1998). Below we provide cues for an emancipation from the all-for-profit publishing system, and toward a community-driven, circular, and more virtuous publishing model.

*At the level of individual scientists*, academics can avoid publishing in and evaluating for journals with unsustainable practices as prescribed by several previous initiatives, including The Cost of Knowledge initiated in 2012 (Whitfield 2012). Fortunately, many non-for-profit journals run by scientific societies provide equivalent

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<sup>3</sup> Scientific publications undergo meticulous evaluations by peer scientists acting as journal reviewers and editors, in charge of evaluating the adequacy of the design, execution, and interpretation of the study (Warne 2015, Riley and Jones 2016).

<sup>4</sup> The only benefits for such free-of-charge contributions happens when a scientist integrates into the editorial board of a high-profile journal, which can facilitate publishing in that journal and bring some notoriety among peers in the field (Walker 1998, Copiello 2018).



**Figure 2** The current academic publishing process (black arrow path) and key solutions for improvements at the individual scientist (green), scientific community (blue), and publisher (purple) levels.

levels of editing and review-management services to privately owned journals, usually at a much lower price. As a general rule, given the relatively low costs of archiving and distributing articles in electronic formats, with printing and mailing rapidly vanishing (Odlyzko 1997, Walker 1998), working with journals that charge minimal publication fees can encourage transition to a new economic model. Lower expenditure in publication fees can further put pressure on pricing in the publishing market, making scientific publishing more affordable to those with limited resources (Wingfield and Millar 2019). In addition, a large spectrum of new alternatives has emerged, from community driven media with established ethical publishing strategies (e.g. Peer Community in, SCOAP3, Zenodo) to author-led, open

peer-reviewing practices (Aarssen and Lortie 2010, F1000Research, Ideas in Ecology and Evolution, Peerage of Science). These, along with existing public disobedience initiatives for free universal access to scientific literature (Sci-Hub), can be more broadly embraced as a means to further scientific contributions to society.

Scientists can also communicate their engagement for a better academic publishing system by inquiring on equitable practices when invited to review articles or to stand on the editorial board by a journal. Stronger engagement demands can include some degree of compensation for each contribution (Warne 2015, Riley and Jones 2016, Copiello 2018), for example a discounted rate for publishing future articles as

established by the PeerJ community (PeerJ) or, similar to practices found in other evaluations requiring scientific expertise (e.g. assessments of Ph.D. dissertations and research proposals), a monetary compensation as prescribed in ScienceMatters (ScienceMatters) and Ideas in Ecology and Evolution (Ideas in Ecology and Evolution). Such monetary compensations can be relinquished, donated to an external cause (e.g. via non-governmental organizations), or reinjected into scientific activities (research, hiring, etc.) at the will of the researcher. Compensation systems shifting away from monetization can consist of including reviewers with significant inputs to the author list of articles (Aarssen and Lortie 2010) or, as in the case of the present article, provide an opportunity for reviewers to integrate the debated research within the publication process (see reviewer response commentary associated with this publication). Making one's published articles available online (using preprint servers and personal or institutional web pages) and communicating scientific findings directly to the end-users or via other media that are freely accessible to the public (blog posts, photos and videos on various online platforms, and so-called "social media" supported by peer scrutiny) can also help bypass the monopoly of academic publishers. Similarly, when looking for a paper locked under a paywall, contacting the authors directly rather than using the payment process will save precious research money while strengthening interactions among scientists. Fortunately, most, if not all authors gladly share their publications for free when contacted directly. Yet, despite these above-mentioned alternatives, academic publishing, reviewing, and editing remain intrinsic tasks of scientists, and deciphering the publishing standards of each medium available on the market stands as an overwhelmingly challenging barrier for individual scientists. Therefore, scientist-level choices need to be backed up with community-level initiatives and engagement from the publishing industry.

*At the level of the scientific community*, creating an ethical label to orient authors on publisher practices, similar to the organic and fair-trade labels used in agriculture, can help scientists navigate through the various options and promote positive choices. Institutionalizing the practice of alternative methods, including funding and institutional requirements for open-access publications in 'fair'-labelled journals, and using research libraries and institutions to host open-access publications online (Walker 1998, Horizon Pleins Textes), will also move the needle. Sparse examples of such initiatives already exist, such as the U.S. government requiring research carried out by public employees to be published in the public domain without copyright transfer to a third party (Bachrach et al. 1998), and the European Commission launching an online platform to host publications resulting from its Horizon 2020 funding program as fully subsidized, open-access,

and open peer-reviewed articles (Open Research Europe). Further broadening such practices will highly benefit scientific publishing. Similarly, the academic community can be the intermediary between individual scientists and academic publishers in defining a reference compensation system for editing and reviewing contributions (Warne 2015, Riley and Jones 2016, Copiello 2018). The broadening of such a compensation system shall facilitate transition to a self-sustaining, fair, and economically circular publication system (Aarssen and Lortie 2010). In addition to reorienting part of the revenues to support the scientific community, the reviewer compensation system and the disclosure of reviewer identities and comments are promising incentives for promoting both better manuscript preparation by authors and more constructive evaluation by reviewers (Aarssen and Lortie 2010). Finally, finding new ways beyond journal prestige to assess scientific contributions and promote scientific rigor will help the community emancipate from the supremacy of established conventional journals (Odlyzko 1997, Aarssen and Lortie 2010, Whitfield 2012, Van Noorden 2013, Magistretti 2016, Else 2018). This includes an increased recognition of existing and emerging tools, such as using manuscript views and citation indices as metrics of article influence as prescribed by the PLOS initiative (Public Library of Science), and open community discussions and validations to measure article integrity as implemented by multiple publishing platforms (Aarssen and Lortie 2010, F1000Research, Peerage of Science, WikiLetters). Establishing an ethical impact factor (eIF index) restricted to journals with sustainable practices could provide additional help in emancipating scientific evaluations from the grip of unfair and often predatory journals (Beall 2012).

*At the publisher level*, endorsements of emerging initiatives and constructive alternatives through engagements dedicated to streamlining the publication process can support transparency and fairness. This includes a general paradigm shift in relation to copyrights, a central component of the conventional publishing industry (Bachrach et al. 1998, Walker 1998, Creative Commons). Copyrights were established to protect authors in their capacity to control the reproduction and dissemination of their work, not to be used for publishers to take possession over authors' rights (David 2000, Joyce et al. 2016). A logical alternative for journals to own copyrights would be for publishers to provide major contributions, such as funding or added value services, to the research effort whose findings are to be sold, as it happens in the production of other goods and services in the private sector. Generalizing the use of non-exclusive and royalty-free publisher licences, an already viable and ongoing system since 2003 (Public Library of Science), will allow authors to reproduce and distribute their findings independently, and encourage the



**Figure 3.** Example of market transparency where the price of the product (apples) is displayed along with the prices paid to the producer and intermediate distributor. Picture from a grocery store in New Caledonia where this transparency measure, along with several market regulation decrees, has been implemented by the agricultural sector since 2014.

publishers that actually provide additional contributions to the work performed by authors, such as improved content, complementary media design, or outreach support (Odlyzko 1997, Bachrach et al. 1998). Various journals already embrace open and author-led reviewing processes as ways to save the present demise of the scientific reviewing system (Aarssen and Lortie 1998, Peerage of Science), with several of them also publishing reviewer names and/or comments alongside research articles (Warne 2015, Eisen 2019, F1000Research, Ideas in Ecology and Evolution). This practice could further be expanded to publishing reviewers' bio- and bibliographies with articles as ways to increase recognition of expert contributions (Riley and Jones 2016). Another way to promote contributions could be for publishers using sustainable practices to state transparently their business model (e.g. % fees affiliated to the publication process versus profit margins, Grossmann and Brembs 2019) when inviting researchers to participate in reviewing or editing tasks (Figure 3). Besides, alleviating publication fees can help make larger portions of funding available for research *per se*, which will constitute non-negligible support to the overall academic community. Recently, many journals with increasingly lower publication fees have emerged. In fact, scientific journals

could publish high quality research for free if publication costs are covered by sponsoring and advertising, a system largely in use in diverse media, search engines, and mobile-app industries. From universities and laboratories to manufacturers and providers of scientific equipment, many academic institutions and research societies already use broad advertising, a portion of which can be displayed in specialized scientific publishing media. Advertisement-funded journals could constitute a win-win for profitable businesses that want to advertise products to potential and/or targeted clientele, while reducing burden on scientists in search of publishing at lower costs.

*Revolutionizing the academic publishing system* inevitably involves several challenges in preserving publishing sustainability and scientific rigor. Many such barriers can be alleviated by changing incentives through steps taken at the individual, community, and publisher levels (Figure 2). In the present era of transition where old and new academic publishing models coexist, positive initiatives and institutionalized support can promote shifting to a new publishing system that is in line with the scientific commitments for accessible knowledge for the society as a whole. At the end of the road, academic publishers, scientific institutions, and individual scientists all need a durably operating publication system. Engaging collaborative initiatives among these protagonists is key to sparking the transformative change needed to achieve sustainable publishing practices. Global responses to recent pandemics have shown that open science is possible, profitable, and necessary (Wellcome 2016, 2020, International Coalition of Library Consortia 2020). Facing the social and environmental challenges of the 21<sup>st</sup> century (Ripple et al. 2017, Kayal et al. 2019), the time has come to make such values a standard, rather than an exception, in the academic system.

## Referees

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## Response to referee

We agree with Brun (2021) that individual scientists’ behaviors contribute in big part to supporting the present academic publishing system, and that changes to a better system require shifting paradigm in personal and community targets. In this regard, Latour’s (2003) comparison of researchers as capitalists investing in publications is judicious, although the general analogy of considering professional contributions as trust and reputation investments could easily be extended to performance metrics of any (or many) professions. Isn’t it the case with a politician making or holding electoral promises, a medical practitioner treating a patient, a mechanic fixing a car, or an athlete achieving a new record? A central question is, how to incentivize researchers in their publication strategies to prioritize community achievements alongside individual carrier paths? As in other individual decision making (e.g. ethical consumption, Gregory-Smith et al. 2013), researchers’ behaviors are expectedly dynamic, evolving in time and with moods and circumstances, and spread across both ends of the spectrum: ranging from “savage capitalists” ceaselessly publishing to climb up the carrier ladder (Latour 2003), to more generously contributing personal capital and collaborating for better community outcomes. As argued in our article, shifting scientist leitmotivs towards profitable, common goals relies on improving the level of awareness on journal shortcomings and alternative solutions, and, as also highlighted in Brun (2021), reducing the attractiveness of reputed conventional journals (see also Rose-Wiles 2011, Walter and Mullins 2019). These changes necessitate transformative evolvments at all three levels of individual scientists, scientific communities, and publishers (Figure 2).

When it comes to sharing scientific knowledge, major limitations of today’s publication system do not merely relate to the fact that scientists give away their findings for free. It is rather that the dissemination of these findings is largely controlled and hindered by third parties not contributing to the research production process or added value of manuscripts yet selling articles to the public domain at a high price (see also Alizon 2018, Walter and Mullins 2019). Further, the public is paying twice the price, once by funding scientific research through taxpayer money, twice by having to pay for accessing the research findings. Because researchers produce, improve, and make scientific literature available to society as part of their work, it is as if knowledge and societal wealth has been high-jacked by private companies, the publishing middle-men. While such middle-men positions can exist in a diverse economy, minimizing resource leaching intermediates will produce shorter circuit supply chains, lower prices, and higher market transparency in a resource limited economy.



Fortunately, there is growing awareness of the scientific publishing issues, with emerging alternatives and ways to promote positive publication decisions. For example, launched during the process of this revision mid-2021, the DAFNEE database (DAFNEE) provides a classification of scientific journals in the fields of ecology and evolution by publishing practices. Besides summarizing practical information about journals (owning institution, business model, pricing, impact, etc.), the online platform also displays a useful graphing tool to visualize an author's position in terms of ethical publishing practices based on its publication record. While there is still a long way to go for achieving sustainable scientific publishing mechanisms, such initiatives contribute to raising awareness, encouraging positive choices, and triggering significant change.

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