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Open Access and Scientific Knowledge: Between the Public Interest and the Business Model. A Literature Review

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Abstract

The discussion on what open access can give to science has become polarized in recent years. On the one hand, the first decade of the new millennium brought us an enthusiasm that one can consider as quite comprehensive in the scientific community, regarding the great potential of open access in the dissemination of knowledge, its sharing and the mechanisms of citizen participation in the scientific process. On the other hand, the last few years have brought us a new debate that addresses and criticizes the derivation of open access to a new business model. By supporting this article with an extensive review of the literature on a topic that is still residual in studies that intersect the areas of science communication and the field of the economics of science, we propose to summarize the main reasons evoked by a side and the other. Among the positive points, we highlight the potential of open access in the dissemination of knowledge, the increased visibility of this knowledge, the involvement of society and professionals in the scientific process through civic participation logics, greater efficiency and interaction with benefits for the research projects themselves, the retention of publication rights by the authors, the redistribution of resources, and the greater transparency of a more scrutinizing model. Among the negative points, we can essentially highlight the inability to combat a kind of parallel science economy, which takes advantage of open access and the logic of academic overproduction, to establish the so-called "article processing charges" with little transparency and with publication rates often in excess of several thousand euros, which violate the principles of open science and generate inequalities in opportunities within the scientific community itself.

Keywords
open access, scientific knowledge, public interest, business model

Acesso Aberto e Conhecimento Científico: Entre a *Res Publica* e o Modelo de Negócio. Uma Revisão da Literatura

Resumo

A discussão sobre aquilo que o acesso aberto pode dar à ciência polarizou-se nos últimos anos. Se, por um lado, a primeira década do novo milénio nos trouxe um entusiasmo que poderemos considerar como bastante abrangente na comunidade científica, relativamente às

grandes potencialidades de abertura do conhecimento, da sua comunicação e partilha, e dos mecanismos de participação cidadã no processo científico, os últimos anos trouxeram-nos um novo debate que aborda a derivação do acesso aberto para um novo modelo de negócio. Ao sustentarmos o presente artigo numa extensa revisão da literatura de um tema que é, ainda hoje, residual nos estudos que intersectam as áreas da comunicação de ciência e da economia da ciência, propusemo-nos sintetizar as principais razões evocadas de um lado e do outro. Entre os pontos positivos destacados na relação entre acesso aberto e conhecimento científico, destacam-se o potencial difusor do acesso aberto na disseminação de conhecimento, o aumento da visibilidade desse conhecimento produzido, o envolvimento da sociedade e dos profissionais no processo científico, através de lógicas de participação cívica e interpares, a maior eficiência e interação com benefícios para os próprios projetos de investigação, a retenção dos direitos de publicação pelos autores, a redistribuição de recursos, e a maior transparência de um modelo de natureza mais escrutinadora. Entre os pontos negativos, destaca-se essencialmente a incapacidade de combater uma espécie de economia da ciência paralela que tira proveito do acesso aberto e das lógicas de sofreguidão da produção académica para instituir as designadas *article processing charges*, pouco transparentes e com valores e taxas de publicação muitas vezes superiores aos vários milhares de euros, que atentam contra os princípios da ciência aberta e que são geradoras de desigualdades de oportunidades dentro da própria comunidade científica.

Palavras-chave
acesso aberto, conhecimento científico, interesse público, modelo de negócio

Introduction

The most enthusiastic vision of the internet as a technological artefact positions it as a panacea for the problems of a closed world (Hindman, 2018; Quintanilha, 2019b), in the sense that its primary goal is said to entail doing away with the hierarchies of both the communicational process and the exchanges of information that occur in a disparate and asymmetrical fashion in the closed, monopolistic and hierarchical environments that predated the ubiquitous internet ecosystem (Quintanilha, 2019b).

Even if some authors (e.g., Hindman, 2018) believe this generalised perception of the elimination of hierarchies in the communicational process and information exchanges could lead to a partly wayward understanding of the internet's positive potential and what it has to offer, in which it is normally the decentralised and horizontal peer production and participation markets that take the lead, several others place themselves on a more techno-determinist level and enthusiastically celebrate what they describe as a magical fair of full competition.

This is the view of those who define the power of the internet as a form of techno-social system per se, with the ability to exponentially amplify and consolidate important social, participative and deliberative movements (Castells, 2012; Dahlberg, 2007), but it is also the perspective of those who see the internet and information technologies as the last opportunity to respond to four fundamental problems faced by a science that is secretive, closed-access, traditionalist, and in a certain sense obsolete: the problems of distrust in science, the democratic deficit in science, the slowdown in productivity growth, and replications (Mirowski, 2018).

The ubiquity of technology and the internet thus led to a dramatic change in the ecosystem of available information, and one of the largest changes took place in the scientific context (Skarlatidou et al., 2019), with the appearance of the open access model as one of the most emblematic events of that transformation in access to science. A model which Castells (2004) quickly reckoned to be a true social movement that was flowering within the scientific community. A fruit of a new communicational context which, following the Berlin Declaration on Open Access to Knowledge in the Sciences and Humanities of 22 October 2003, meant that the dissemination of scientific knowledge would involve making it available on a large scale, based on principles of democratised access, and taking advantage of the information technologies and network architectures with the capacity to promote collaborative research (Quintanilha, 2019a).

However, almost 2 decades after the Berlin Declaration, the reconfiguration of the discussion about open access in the dissemination, communication and sharing of scientific knowledge requires us to brave an incursion into the dialectic that is currently flourishing at the intersection between science communication and the economics of science. A discursive dialectic in which the defence of open access as a *res publica* is meeting significant opposition from a vision that sees open access as a paradoxical business model.

The opening question in this essay is thus: what does the available literature tell us about: (a) the primary advantages which the open access model offers for the spread, communication and sharing of scientific knowledge; and (b) the main derivations of a model that is increasingly oriented towards business and the mercantilisation of scientific knowledge?

In seeking to situate and respond to these two questions, we also want to contribute to the communication field — namely science communication — itself, in the sense that open access is not only, by definition, a movement which argues that all information of an academic nature (such as scientific publications and other data) should be free of charge and open to everyone, but is also inherently consolidating itself into a movement that is strongly oriented towards the communication of everything that fits within the sphere of academic production.

Literature Review

Open Access as *Res Publica*

The movement in favour of open access to science has grown in parallel with a new wave of enthusiasm associated with that which the internet could give to humanity. The vision of open access as a public service model originated in that prerequisite, and has been imbued with the spirit of freedom and the desire to both provide and guarantee the common good, using the resources made available by the new communicational environments underpinned by network architectures.

On the subject of the expectations of the scientific community, we should begin by mentioning two documents that are important to the open access movement: the

Budapest Open Access Initiative, and the Berlin Declaration on Open Access to Knowledge in the Sciences and Humanities. Together with an unprecedented idea of a "public good", the former brought with it the open access function as a tool for democratising science with the goal of overcoming information inequality in the scientific community: extinguishing barriers to access to knowledge would tend to speed up research, enrich education, and empower knowledge-sharing in a more egalitarian way, establishing the bases for uniting humanity around a common intellectual principle of searching for knowledge that belongs to and is for everyone (Trishchenko, 2019). The Berlin Declaration expanded that principle by promoting the internet as a functional instrument or a new infrastructure with the ability to serve as a basis for global scientific knowledge (Berlin Declaration on Open Access to Knowledge in the Sciences and Humanities, 2003).

Proponents of the idealism associated with the possible role that open access might play in the transformation of the scientific communication system sought to promote the development of solutions to specific problems generated by the traditional scientific publication system, including distrust, the oligopolistic position of the publishers, and a rigid hierarchical system supported by the international scientometric databases (Mirowski, 2018). As a result, the means replaced the end and academic "journals become the gatekeepers of academic power" (Whitworth & Friedman, 2009, Section The Role of Research). The internet created the conditions needed for it to be possible to overcome the problems that had accumulated within the system for nearly a century, in the search for a way to sustain a new science communication system which could become an open ecosystem outside the pure business spectrum that characterised the large corporations and scientific publishing houses. In this regard, Whitworth and Friedman (2009) observed that paradoxically, while academia can be successful in business, it will always be those commercial goals that make academia itself fail. Paraphrasing those authors, when an academic system turns into a business system, it loses both its academic value and its business value, and when the business goals are ranked higher than the academic goals, both tend to fail.

However, in the last 2 decades, the dream of open access has taken on some quite formalised outlines that are accepted not just by academics, but also by the publishing community. The OpenAIRE (n.d.) report, for example, designed a fair open access model based on the following principles:

1. Academic journals must be owned by their editorial boards.
2. Copyright to an article must be held by its author(s), based on a CC-BY licence.
3. All articles must be published in open access.
4. Article processing charges (APCs) must be low (max. €1,000), transparent, justified, and proportionate in relation to the work done by editorial boards.
5. No author may be responsible for paying APCs, and library consortia, such as the Open Library of the Humanities, must be the ones to ensure the funding for these necessary expenses.

Although the seminal approach at the heart of these principles is very practical, the following set of guiding values do stand out: control over the dissemination of scientific knowledge must return to the scientific community; authors must be recognised to be

entitled to the results of their work; information must be open and available to all those with access to the internet; publishers play a public-service role, and must thus decline to be the owners of all knowledge.

Specialists divide the positive aspects of the impact that open access has on the scientific community into various categories, in which one can place both all the main advantages of the transition to a new model, and the impact on the democratisation of the scientific process (Trishchenko, 2019). Among the main positive effects, it is possible to highlight the spread of information and the increase in its visibility, the involvement of society and professionals in the scientific process, efficiency and interaction, the fact that authors retain rights, and the redistribution of resources. It is in accordance with these categories that open access is seen as a public service.

One of the most obvious benefits of open access is the speed with which a reader can gain access to an article, be it via deposited preprints, or by resorting to new open access platforms containing peer-reviewed articles once they are published. For example, in most cases, an article submitted for publication on a platform through Open Research Central will become available 1 week after its submission.

Another important benefit is that articles become more visible. Since the beginning of the 2000s, researchers have become interested in the way in which open access tends to affect how citations are counted. Over the course of 2 decades, many studies have been conducted for various scientific disciplines, and the majority of them have been dependent on the hypothesis that open access has a positive effect on citation dynamics, despite the fact that the data collected in this respect differ significantly from one scientific field to another (Antelman, 2004, 2017; Donovan et al., 2015; Hajjem et al., 2006; Harnad & Brody, 2004; Kousha & Abdoli, 2010; Makeenko & Trishchenko, 2018; McCabe & Snyder, 2015; Norris et al., 2008; Schultz, 2017; Wohlrabe & Birkmeier, 2014; Xu et al., 2011; Zhang, 2006).

One of the most wide-reaching studies on this topic is based on a sample of tens of millions of articles and suggests that, on average, open access articles receive 30% more citations (Piwowar et al., 2017). The situation with regard to monographs appears to be similar (Snijder, 2016).

Several studies are also devoted to the question of how open access positively affects the dissemination and impact of research results.

As Chang (2006) observes, open access publication allows results to spread more widely and permits greater advances in science. An article published in *Nature Communications* illustrates how open access articles are viewed 3.26 more times than articles consulted under subscription, and their citation rates on social media are 1.37 times higher (Wang et al., 2015). The American Psychological Society's academic journals presented similar results: during the first year, articles that were available free of charge were read in full 2.19 times more often than those available by subscription, and PDF versions were downloaded 61% more frequently (Davis, 2010).

By constituting itself in accordance with the principles that guide any public service, open access also enables researchers to choose between a wide variety of relevant articles and not just from the limited collection to which organisations like universities have access. This means citations are potentially distributed more fairly, inasmuch as recognition is mainly achieved by the quality of the articles themselves, regardless of the classification of the academic journals in which they appear.

Moreover, open access greatly simplifies the process of searching for relevant scientific contents, given that huge investments in the development of specific search-support functionalities mean that search mechanisms such as Google Scholar are much more efficient for research purposes than academic instruments specialising in that kind of search. Those mechanisms can effectively index the content that is openly consultable, but simultaneously ensure access to everything that is open on the internet, thereby offering scientists a much greater variety of sources. For example, Google Scholar exceeds Web of Science and Scopus in coverage, at least in the social and human sciences (Martín-Martín et al., 2018). The main language of both scientometric databases is English, which seriously diminishes their ability to cover regional literature, and negatively influences the criterion of plurality, although in many countries, including Russia, Japan and China, the scientific community mostly uses their native language to exchange scientific information (Obuhova et al., 2011). At the same time, it is extremely hard for non-English sources to gain entry to international scientometric databases, and this creates a serious shortfall in both information and visibility among scientists from a variety of countries.

Additionally, open access allows more people to be involved in the scientific process, including scientists from organisations that do not enjoy the conditions — namely financial ones — to register with or even try more expensive academic journals, which generally possess high impact factors. Students are another group who more frequently find it difficult to consult information — a problem that open access helps overcome (Pisoschi & Pisoschi, 2016). In other words, more people with different levels of experience create the basis for more effective participative collaboration, discoveries and innovations (Pöyhönen, 2017).

In short, the scientific community is not the only beneficiary of open access. Professionals and civil science representatives also gain access to participation in the scientific process, and this, in turn, helps science enrich itself with different perspectives and instruments, forge closer bonds with society, and thus overcome the crisis of trust in scientists and science (Papadopoulos, 2014).

This citizen science thus makes a significant contribution to scientific development by restoring the public's trust in science, reorienting science in such a way as to deal with the complexity of the most pressing problems, such as environmental issues, and installing democratic governance within science itself (Bäckstrand, 2003). What is more, this citizen — or civic — science ties science's vast potential to the civic capacities of different communities, in ways that revitalise the democratic purposes of science in terms of the public good (Garlick & Levine, 2017).

Open access also increases the chances that an article will be cited on Wikipedia by 47% (Teplitskiy et al., 2017) — a Wikipedia that often becomes the "point of entry" to a given topic (Scaffidi et al., 2017).

At the end of the day, the tendency for science to open up to society goes far beyond simply allowing someone to get to know the results of scientific research. As such, open access defines a much more significant tendency — the reorientation of the scientific community and its closed interests and values towards the interests and values of the whole of society, which results in a kind of ethical transposition of science itself, which truly places itself in the service of society (Brüggemann et al., 2020).

The results of adopting open access as a publication model also include the development of a new type of entrepreneurial publishing — open access academic mega-journals that increase efficiency and interaction. These mega-journals offer more opportunities for interdisciplinary research, but one of this model's great achievements is its ability to allow the publication of articles that may seem quite useless to the editor/publisher of a typical academic journal, but are of significant importance to the scientific community. Additionally, academic mega-journals introduced a new procedural quality verification model — the so-called "peer review", which is tendentially blind. The reviewer, who also tends not to know who wrote the article they are reviewing, only considers the work's scientific validity and the exactitude of its methodology, in a process which, according to Erfanmanesh (2019), contributes to the publication of contents that offer genuine methodological/scientific guarantees. The blind peer review is joined by one of the most innovative approaches, which consists of an open peer review — a process that is fundamentally opposite to the blind peer review, which is accepted almost without any controversy in the scientific community and is deemed the guarantor of the objectivity and impartiality of assessments/reviews. Open peer reviews can take many different shapes (Ross-Hellauer, 2017), but in any case help provide readers with more information than that disclosed by traditional peer review procedures. The advantages of an open peer review are linked to the fact that neither editors/publishers nor reviewers can prevent the author from publishing an article that is a work-in-progress, which means that every work becomes available. An open peer review also ensures that any citizen has the opportunity to witness or even take part in a scientific discussion, and is also a good opportunity for students and untrained readers to familiarise themselves with new material in an embryonic phase of their own projects. This model's value added thus involves both broader access to scientific results, and the democratisation of the process of discussing and publishing results (Velasquez, 2016).

Another way of expanding access by developing open access entails giving access to data, which is essential in many scientific fields (mainly the life sciences), even though some authors believe that open data access may augment problems linked to privacy issues — "privacy and open science are on a collision course" (Dennis et al., 2019, p. 1845).

The significant benefits of data-sharing include the ability to reuse data for other research — in other disciplines, for example — which helps save a substantial amount of research time and make the research process more transparent (Patel, 2016). Moreover,

with Creative Commons licences, on condition that they cite their sources, authors can use text charts, tables and other material taken from open access academic journals, thereby also contributing to a more efficient use of projects' funding and time. The fact is that statistics on the reuse of datasets indicate that they are in high demand in the scientific community. Conservative estimates suggest at least 20% of datasets are reused within 5 to 10 years after publication (Piwowar & Vision, 2013).

In addition, authors are sometimes afraid to publish their article in open access because they think that transferring rights to such a large extent increases the risk of plagiarism. However, the reality appears to be exactly the opposite. Open licences subject the use of works to certain rules. The danger of someone improperly using a text published in open access is much smaller, because the search mechanisms will index the article that was published first along with its author's name (Trishchenko, 2019). What is more, with an open licence, the author only transmits non-exclusive rights to an undefined circle of people and continues to own the material — something that is generally impossible under the traditional approach, when all the exclusive rights belong to the publisher.

The use of open licences thus creates a unique situation for the scientific community, with no obstacles to the subsequent use of the information. Although this aspect is often undervalued, the advances in artificial intelligence technologies mean the questions of authors' rights become especially relevant.

Moreover, the change in the legal status of scientific works also helps prevent traditional publishers from acquiring exclusive rights and continuing to maintain any form of monopoly.

At the same time, the results of a study on the impact factor's influence on the citation count of articles published in open access academic journals suggest that the community's response to publication in them is less dependent on that factor than it is in the case of subscription-based publications (Chua et al., 2017). Open access thus democratises the market for scientific significance, and reduces dependence on the traditional indicators and measurers of scientific results — the so-called "dictatorship" or "tyranny of metrics and quartiles" (Muller, 2018). A dictatorship of metrics (Muller, 2018) that was addressed among others by Eugene Garfield (2006) — the father of the term "impact factor" (Garfield, 1955) — who, at the beginning of the century and with regard to the question of scientific significance via dependency on scientific measurers, coined the neologism "scientometry" in order to define the moment of scientific production.

In short, the expansion of the open access model over time tends to contribute to the appearance of new elements in science communication that will ensure the assessment of all scientific contributions, including the content on platforms and in periodicals which, for one reason or another, do not fulfil the criteria employed by the international scientometry of databases, but do publish high-quality content.

The fact is that various attempts have already been made to change the current situation. One of the most prominent initiatives in this area was the San Francisco Declaration on Research Assessment (2012), which proclaims we should reject the principle of using

metrics (such as the impact factor) to assess the research quality per se as well as their importance in deciding how to allocate grants for projects, hiring researchers, and so on.

The declaration was signed by various organisations, including PLOS, eLife, PeerJ, and the European Association of Science Editors. However, the initiative has been the object of much criticism due to contradictions in the document, imprecise terminology, and other reasons (Kiermer, 2016). This is why some people think that the use of alternative metrics could be a significant step towards the openness of science (San Francisco Declaration on Research Assessment, 2012). The manifesto signed by the group of scientists behind the San Francisco initiative includes a statement that alternative metrics can become a peer review tool, collecting information on both the discussion presented in the article and its references, and taking the context into consideration. This method would significantly speed up the process of checking the results of scientific activities and would promote the development of new platforms for science — something that will only be possible when scientific knowledge really opens up.

Open Access as a Business Model

As explained earlier, open access made an unrivalled contribution to the impetus towards the democratisation of produced knowledge, be it scientific, intellectual, or performative in nature. It also seems evident to us that the opening up of the channels for the dissemination, communication and sharing of knowledge, on the basis of horizontal and decentralised peer collaboration philosophies, means that new opportunities are beginning to present themselves in the fight against the duplication of knowledge, to the extent that the latter is being more quickly exposed to a model that is openly reflexive and, in a certain sense, refractory.

Having said that, the voraciousness of the production of knowledge, which seeks to offer a response to the principles of academic reward (Quintanilha, 2019a), enhances the so-called "episodes of deregulation and loss of control" associated with mass, almost industrialised production, in which both researchers and research centres desperately try to respond to the dictatorships of scientific metrics (Muller, 2018) by producing outputs in a manner that can sometimes be totally hectic and primarily aims to achieve quick visibility and recognition. Yeoh et al. (2017) called it the challenge of the greed of academic production, which drives the so-called saturated markets, where the demand for shorter submission/publication times (Beall, 2012) not only incentivises the appearance of predatory journals whose sole objective is to (quickly) publish the largest possible number of articles in exchange for a given APC — something that has an important impact on scientific culture and agency themselves — but also makes a considerable number of editorial teams feel that, in the light of the demand for publication slots, it is possible to take financial advantage of an activity which should in principle be oriented not just towards the principle of the democratisation of access to knowledge, but also towards the democratisation of publication itself.

It is in this sense that one can talk about a derivation from the historically enthusiastic debate associated with open access and what it can do for science and knowledge, to a more polarised one in which, in addition to the positive points, participants are also starting to discuss the model's major negative implications. We are talking about a growing tendency to take economic advantage of the model, based on the capture and dilution of its social function (*res publica*), which is gradually succumbing to the market exchanges where knowledge, produced and disseminated through open access mechanisms, is mercantilised, often in the form of pseudo-sciences and pseudo-knowledge, in the so-called "predatory journals" (which constitute quite a complex topic in their own right).

As Whitworth and Friedman (2009) point out, there is an accumulation of problems within the science communication system that often have their roots in a commercialisation domain that rarely ensures a good service either to the scientific community, or to society as a whole.

Quintanilha (2019a) develops a typology of challenges imposed on the open science model and discusses the challenges of the (dis)accreditation of produced knowledge, the informality of assessment and validation structures, the commodification/mercantilisation of knowledge, and the predation of the open access model. He emphasises that instead of becoming truly free and free of charge, produced knowledge has once again come to be seen as merchandise, as it is in the structures of the traditional scientific dissemination models, in a tendency that once again retrieves the scientific reification mechanisms in which knowledge is above all seen as a thing that is saleable or capable of generating income in some form — a commodity like any other.

For Quintanilha (2019a), this mercantilisation is clearly present throughout the process of producing and disseminating articles in a myriad of academic journals which, in an initial phase, upheld the ideal of open science, lay outside the power of the A-lists and the four largest publishers (Sage, Elsevier, Willey, and Routledge) and began working in accordance with the essence of the open science model. However, they have since branched into a model underlain by APCs that are antagonistic to the once celebrated democratisation and procedural facilitation of forms of publication. The author concludes by saying that:

> the extent of the more-or-less premeditated monetisation strategies is thus once again transforming the scientific panorama, contributing to the biasing of an academic system which, since the beginning of the millennium and as imagined by its participants, had seemed to want to move towards the openness and democratisation of scientific knowledge. (Quintanilha, 2019a, p. 207)

Only 50 of the first 500 academic journals in the 2019 Scimago/Scopus ranking (which was only published in the second half of 2020; SCImago, n.d.) can be characterised as open access. Of those 50 open access journals, which could be said to comply with the two main principles of open science (democratisation of the publication of knowledge, without barriers, and democratisation of access to that knowledge), only 11

stipulate that publication is free; the guidelines of seven are unclear as to whether or not payment for publication is obligatory; while 37 (74%) establish APC fees, which can range from $600 to $5,000 per article, all of which must be fully covered by the authors.

Most of these academic reviews are situated within the spectrum of the natural sciences — the so-called "hard sciences". However, analysis of the first 50 open access academic journals in the social sciences shows that a similar majority also opt to apply APCs.

Outside the spectrum of journals indexed on the Scimago Journal and Country Rank, one of the most instructive cases is that of the large MDPI group which, with its 259 thematic academic journals, publishing in open access, but imposing APCs amounting to hundreds of Swiss francs. The group's activity was allegedly investigated by specialists who look at the quality of academic journals, with the result that it was included on Beall's list[1], in a process that included a legal action in which MDPI explained its position and demanded to be taken off the list of journals classified as predatory (MDPI, 2017).

In summary, one can ask the following questions: what types of service can justify a publication fee of $1,000, $2,000, $3,000, $4,000 or $5,000 per article? What are these services, how are they calculated and justified, and how are they presented in the guidelines of journals of an academic nature? Why do their amounts vary so much from one journal to another, and what influence does a journal's metric or classification (quartiles) have when it comes to setting those amounts?

The strategy of the journals that operate an open access model and charge their authors the so-called APCs primarily entails getting the idea across that maintaining and operating an open access journal has costs, and that these should be borne by the authors who decide to publish in the journal.

Example 1:

> Article Publishing Charge
>
> As an open access journal with no subscription charges, a fee (Article Publishing Charge, APC) is payable by the author or research funder to cover the costs associated with publication. This ensures your article will be immediately and permanently free to access by everyone. The Article Publishing Charge for this journal is USD 1390, excluding taxes. (Elsevier, n.d., Section Article Publishing Charge)

Example 2: "open access publishing is not without costs. *Genome Biology* therefore levies an article-processing charge of £3380/€4040/$4990 for each article accepted for publication. Short Reports have an article-processing charge of £2,540/€3,035/$3,745 for each accepted article" (BMC, n.d., para. 1).

[1] Over the years, Beall's list (https://beallslist.net/), which was compiled by Jeffrey Beall, positioned itself as a reference list for looking up potentially predatory journals. Although with the passage of time this list has been complemented by other equally exhaustive ones, such as Cabell's blacklist (https://www2.cabells.com/), Beall's list is still seen as a key work in the search to identify predatory journals.

Example 3:

> article processing charges (APC)
>
> Through the end of 2019, *Transgender Health* is a fully open access journal. (Beginning January 1, 2020, it will become a hybrid subscription-based model, with Open Access options.) The cost of maintaining and publishing the journal through 2019 are covered by Article Processing Charges (APC). (Mary Ann Liebert, n.d.)

In contrast, journals that pursue a double open access policy — that is, both open publication and open access to produced knowledge — tend to underline the idea that it is feasible to keep an academic journal free of charge to authors, strictly with the purpose of contributing to the advance of science and the democratisation of knowledge.

Example 4:

> this "Open Access" enables authors to obtain the maximum possible exposure for their work. The web makes the free dissemination of research feasible, and the free availability of sophisticated editorial software makes the cost of operating a peer-reviewed journal minimal. Open Access to research is thus socially efficient. (Econometric Society, n.d., para. 1)

Example 5: "we ensure open access so that everyone can consult the important new research in chemistry. We pay all article processing costs (APCs) so that there are no barriers to publishing and sharing any work" (Royal Society of Chemistry, n.d.).

Example 6:

> starting January 1, 2020, all items published in LLT are under an Attribution-NonCommercial-NoDerivs Creative Commons license, or CC-BY-NC-ND, which permits users to download and share the original work. Authors are not charged article processing charges (APC) for submitting articles or for publication of their accepted articles. (National Foreign Language Resource Center, n.d., Section Permissions)

It should also be noted that some journals adopt a hybrid strategy when they institute APCs, but also take care to ensure that those charges are reduced or waived for authors who are unable to cover the costs associated with the open access publication of an article.

Example 7:

> *Cultural Anthropology* does not use article processing charges (APCs) to support the cost of publication. Members of the Society for Cultural Anthropology (SCA) support the journal through their membership dues. Authors who are members of the American Anthropological Association (AAA), but not of the SCA, must join the SCA before their manuscripts will be reviewed.

> Authors who are not members of the AAA may pay a submission fee of $25 in lieu of becoming a member of the AAA and SCA. Authors can pay the fee with a credit card (MasterCard, Visa, or American Express) using the AAA's secure payment system; select the option "Manuscript Processing Fee - SCA Nonmember." The editorial office will be notified once the charge has been paid and will proceed with the review of your manuscript. (Society for Cultural Anthropology, n.d., ASection rticle Processing and Submission Charges)

Example 8:

> the Carnegie Corporation of New York grant has sponsored open access APCs for *R&P* authors from January 2016 to May 2018. Any articles published in the journal will continue to benefit from the current APC waiver as a result of this sponsorship. In future, an APC will be set at a level appropriate to the discipline, with an appropriate waiver and discount policy available for those authors who do not have the means to cover the APC. (Sage Publishing, n.d., Section 2. Article Processing Charges)

In short, bearing in mind all the characteristics that surround an academic reward process focused on the hyperproduction of articles, open access creates clear opportunities for academic journals to revise their publication criteria, bringing in new ways of revenue generation through more-or-less vague criteria that are unable to justify the amounts in question.

This goes against the wishes expressed during the initial discussions about the need to democratise knowledge in both production and dissemination — fundamental pillars of the idea of open access to science.

Russell (2019) argues that the essential roots of the transformation of open access into a business model lie in the fact that initiatives intended to promote open access to scientific knowledge have been epiphenomena that have been both dispersed and with too much time between each one. This has led to a lack of general awareness among researchers and other authors about the long-term sustainability of the open model, thereby favouring the appearance of parallel business models like the one sustained by APCs, which are quite opaque, take unfair advantage of authors, and unable to offer grounds for the exorbitant amounts charged.

Russel (2019) goes on to say that there is still a significant lack of knowledge about what open access actually is, or what it means within the research community, particularly in the social and human sciences. Even among the fringes of researchers where that knowledge is more substantial, authors face a dilemma derived from the fierce drive to publish, in which the tyranny exercised by metrics (Muller, 2018) means that closed access journals, which normally belong or are attached to large publishing groups, are the ones that attain the best rankings and have the most impact on the research resource allocation process: should they publish in a totally open journal, or in a closed one to

which access is dependent on subscriptions and payments, but enjoys a high degree of recognition in the academic world? In a study by Schroter and Tite (2006) involving 468 researchers who were authors of articles, only 10% reported that they had submitted works to an academic journal that imposed APCs at the time.

Moreover, the question of APCs as a business model — not exclusive to, but more frequent in academic journals that are open access — generates problems with regard to the transparency of prices and the redistribution of resources. According to some (Siler et al., 2018), the transition to open access can be a cruel joke for developing countries, whose researchers will have access to all the scientific literature, but will be excluded from the international scientific communication process, inasmuch as they are unable to pay the so-called APCs required to publish in the leading periodicals (the same problem was also stated in the Open AIRE, n.d., report mentioned above).

The results of this study on publication preferences with regard to open access academic journals confirmed that authors from universities with a low classification are more likely to publish in academic journals to which access is closed (subject to payment) but are free of charge for the authors of articles, thereby opting not to choose open access journals that require authors to pay APCs, which exceed €1,000 per publication in the great majority of cases (Siler et al., 2018).

Conclusions

In this article we sought to look at the state of the art concerning the subject of open access and scientific knowledge. We found that the discussion about the benefits and obstacles derived from the open access model has become polarised in recent years. The first phase of the discussion as to what open access can bring to scientific knowledge, which started at the beginning of the millennium, was positive and marked by an enthusiastic tone in relation to what the model can give to science, namely: greater civic participation and the resulting scrutiny, in pursuit of a common good linked to the desire to place science in the service of society, opening up scientific knowledge and combating the centralised, hermetic and rigid structures of the more traditional publication model controlled by editorial oligopolies.

Among its most feted characteristics, we observed arguments for the democratisation and dissemination of knowledge, the transparency of produced knowledge, the increase in the visibility of the scientific product, the greater efficiency and redistribution of resources associated with both the scientific process and scientific agency. These tend to be the aspects celebrated the most by authors who look at the topic and at how this open access can be brought close to a *res publica*.

However, the lack of regulatory stimuli and the sparse, unstructured debate on the parallel/shadow structures that have come to feed off that same open access model made it impossible to stem the dangers of a parallel science economy. Suffocated by deadlines and driven to present constant results (articles, book chapters, etc.), researchers started competing within an academic reward model built on the hyperproduction

of articles, in which the race to publish in journals of an academic nature in order to formalise and legitimise produced knowledge leads many editorial teams at many journals sustained by open access to choose to take maximum economic advantage of a saturated market. It is in this work-saturated environment that open access began to act, at least in part, leading stakeholders to seize the business opportunity and narrow the principles that govern the open science model, instituting high publication fees that are unsustainable for authors and researchers stuck in a loop in which they must publish as fast as possible.

More than contributing to a meta-analysis of what is being or has been written about the main pros and cons of the open science model, this article's primary goal is to launch the bases for a broader discussion that ought to underpin a more solid regulatory framework, which, for example, would make it mandatory for the policy governing publication prices to become more transparent and properly justified.

Translation: Richard Rogers

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