Open Access – A never-ending transition?

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1. Introduction

In recent years, Open Access (OA) has obtained growing attention from the public. From academics to active citizenship, having access to the results of science is a matter of great importance for many different reasons. For instance, research is, in the majority of the cases, publicly funded, and for this reason, its results should be in the public domain. The production of scientists would undoubtedly benefit from the broader view of the scientific landscape they would have. Funders may see either the profits or the impact of their expenditures and decide where to orientate future investments.

Moreover, the results of previous investigations show that OA publications receive more citations than those behind a paywall (cf. Gargouri *et al.*, 2010; Piwowar *et al.*, 2018), favoring academics in research assessment exercises based on such metrics as citation counts.

As we will see in the following paragraphs, much has been done and achieved. Over the years, technology has been fundamental for the creation of tools to support the widespread of OA (e.g., archives, repositories, databases, etc.). Different marketing strategies have been proposed, creating a new scenario in the publishing business, where native OA journals appeared and kept growing in numbers and size. The APCs system is now a consolidated reality; academic institutions and commercial publishers subscribed to a growing number of transformative agreements.

Likewise, an increasing number of academic and governmental institutions, as well as both public and private funders have issued policies, either mandatory or not, concerning the right of public dissemination, exploitation, and reproduction of scientific products and results.

In such a scenario, the marketing license regulating authorship and intellectual property rights becomes of fundamental importance. Thanks to the OA movement, nowadays, authors may safeguard their production via CC-BY licenses, which guarantee recognition to creators and favor reproducibility at the same time.

Nevertheless, OA is still struggling for its complete realization. Despite the mandates, much of the scientific production remains behind a paywall. Besides, major commercial publishers firmly maintain their oligopoly as well as the largest share of the licensing market, twisting the perspective on OA at their profit. Indeed, the emerging business models and even the most advanced technology solutions do not represent a threat to such *an in-elastic* market.

To favor the transition towards OA, trans-national initiatives as PlanS[1] and Amelica[2] were presented at the end of 2018. They share the common goal of turning OA into a concrete reality, starting, however, from different historical and cultural backgrounds.

In our work, we will go through the history of OA, from its first definition to the earliest initiatives until the current situation. We will trace a timeline that starts in the 1970s and highlights OA's most famous landmarks. Our focus will be on the evolution of scholarly communication. We will show how the editorial landscape and the publishing market has been changing over the years due to significant transformations in academia, economic conditions, and technology development. We will concentrate on the current scenario, in which even though a large number of solutions are available, it seems quite impossible to reach the complete transition to OA. Therefore, we will try to outline possible ways to accelerate the process. More than forty years after the first "open project" (Project

[1] https://www.coalition-s.org
[2] http://www.amelica.org/en/

Gutenberg 1971)[3] the time has now come to take a clear stand to obtain the complete realization of Open Access.

2. The origins of Open Access

2.1. Open Access: an ancient idea

The term *Open Access* as conceived nowadays dates back in 2002, when the Budapest Open Access Initiative (BOAI)[4] articulated its first public definition, extending the concept to all disciplines and all countries.

However, as we will show in the following sub-paragraph, several initiatives took their first steps years before, tracing back the first technological applications in favor of OA at the beginning of the 1970s.

Nevertheless, the idea of open access to knowledge goes far beyond that date. If we place the scholars at the center of our investigation, we can argue that it originates in the antiquity, when they gathered in - mostly oral - groups and communities to debate about different topics. It is the time when the first "research questions" were posed; the hypotheses expressed to answer them represent the essential function of research.

As far as the circulation of ideas is concerned, later individuals were able to connect across space with the establishment of various postal systems. The real revolution came after the invention of printing when group- and networked-dissemination of knowledge became much more accessible.

Indeed, if we consider scholarly communication as a mean offered to researchers to participate in a global, distributed system of knowledge, then we understand the metaphor of the "world brain" proposed by H.G. Wells in 1938. In his vision, the knowledge generated around the world should be accessible to any citizen without restrictions; in this sense, the connection between humans is "*as inevitable as anything can be in human affairs*" (Wells 1938). At the time when the speed of telecommunications was increasing very fast, Wells sketches the image of a world becoming a connected community. His "prophecy" has been maintained: we currently live in an incredibly connected world, thanks to the Internet and mobile technologies.

In our opinion, his idea fits entirely with the nature of scholarly communication, considered as any form of exchange that contributes to knowledge development through critical discussions. Wells' *world brain* represents a shared, open system that can be freely accessed by either scholars or citizens. In this perspective, it embodies the interconnected nature of scientific research and represents the multiple forms of creation and dissemination of knowledge, from informal exchanges to scientific publications.

Furthermore, when Wells sustains: "*the world has to pull its mind together, and this is the beginning of its effort*" (Wells 1938), he identifies in a single sentence the nature of "Open Knowledge," the intrinsic setbacks, and the significant efforts behind its complete realization.

2.2. A timeline for Open Access in the contemporary era

As said before, while the BOAI represents the first formalization of the concept of Open Access, different initiatives took place well before the year 2002. For instance, the first online digital library was launched in 1971, named "Project Gutenberg."[5] From the end of the 1980s, the resources available have been continuously increasing, as summarized in the timeline below.

[3] https://www.britannica.com/topic/Project-Gutenberg
[4] https://www.budapestopenaccessinitiative.org/read
[5] https://www.gutenberg.org/wiki/Gutenberg:The_History_and_Philosophy_of_Project_Gutenberg_by_Michael_Hart

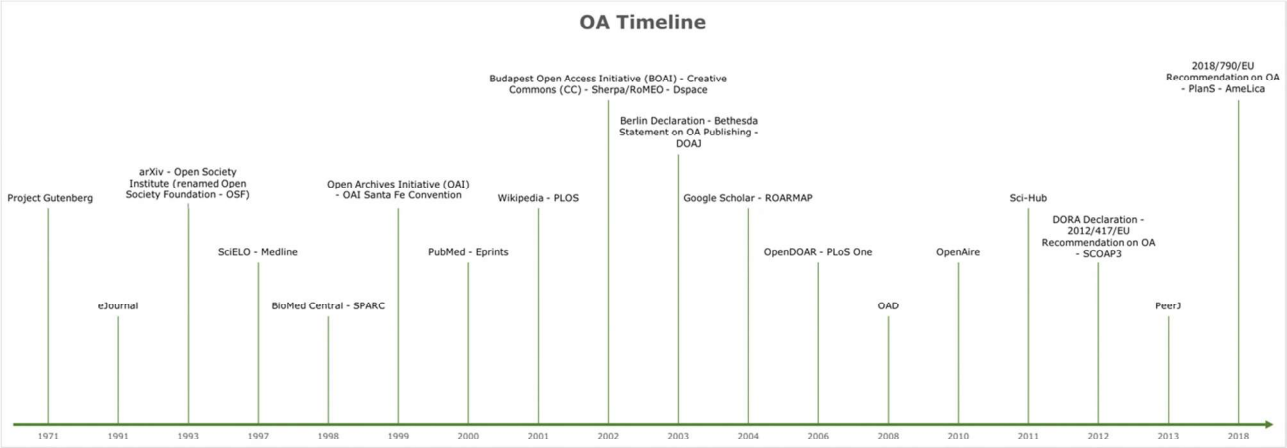

Figure 1: main initiatives in the OA landscape

In the diagram, we focused on the most common initiatives for the wider audience. It shows clearly that from the end of the 20th-century, technology advancements served as a primary mean for the widespread of OA. For instance, the first eJournal was created in 1991, opening the way to the first open, online commercial publisher, i.e., BioMed Central. The "opening act" of arXiv dates 1993, establishing the habit of using preprints among communities of scientists (especially physicists) as fully-fledged scientific material. Over the years, open tools have become of fundamental importance for everyday practice in research, both for granting wider dissemination and exploitation of results as for having resources always available, especially in contexts where funds have been constantly cut.

In this light, we decided to include in our representation the launch of SciHub (2011)[6], the website that provides free access to millions of research papers and books, without regard to copyright, by bypassing publishers' paywalls in various ways[7]. The widespread use of this tool represents the urgent need to institutionalize OA at the lowest costs for researchers and research institutions, to rationalize expenditures for the exploitation of research materials that have to be made available on a broader scale.

For the sake of brevity, we did not include the vast number of policies issued during the years. It is undoubtedly true that governments, funders, and academic institutions played a fundamental role in the advancement of OA in the last twenty years. They helped to institutionalize the concept, supporting strategies that offered not only to academics but also to the citizenship a view on the results of what has been paid mainly with public funds.

As we can understand from figure 1, the years 2002-2003 may be considered as a sort of turning point in the OA scenario. From BOAI to the Berlin Declaration[8] and the Bethesda Statement on OA Publishing[9], we pass through the releases of fundamental tools as CC licenses[10], Sherpa/RoMEO[11], DSpace[12], and DOAJ[13], until the San Francisco Declaration on Research Assessment (DORA)[14] and the first EU Recommendation on OA (2012/417/EU) ten years after.

The year 2018 also represents an essential step in this context, as for the publication of the second EU Recommendation on OA (2018/790/EU) and the launch of PlanS and Amelica. These two initiatives, although conceived in two completely different contexts, share the

[6] https://en.wikipedia.org/wiki/Sci-Hub
[7] https://en.wikipedia.org/wiki/Sci-Hub
[8] https://openaccess.mpg.de/Berlin-Declaration
[9] http://legacy.earlham.edu/~peters/fos/bethesda.htm
[10] https://creativecommons.org/
[11] http://www.sherpa.ac.uk/romeo/index.php
[12] https://duraspace.org/dspace/
[13] https://doaj.org/
[14] https://sfdora.org/read/

common goal of transforming Open Access into a concrete reality. We will describe them more in detail in a dedicated paragraph.
In the following sections, we will concentrate mainly on the development of scholarly publishing and the evolution of the editorial market. We will try to understand why, despite the significant accomplishments of the OA movement, its comprehensive realization has not been achieved yet.

3. Scholarly communication through time

The invention of printing (1454) represents the starting point of the modern dissemination of information. Between the end of the 16th and the beginning of the 17th century, scholars exploited this powerful tool to circulate the results and findings of experimental science. In this context, the first scientific journals, the *Journal des Sçavans*, and the *Philosophical Transactions* saw the light in the same year (1665) in France and UK, respectively (Santoro 2004). Especially in the Anglo-American framework, due to the establishment of learned societies, from the 1790s, an increasing number of periodicals were proposed to a growing reading public (Fyfe *et al.* 2017).
At the same time, the issue of intellectual property started to rise. However, it is during the 19th century that its importance grew significantly. Until that moment, the communities of scholars were mainly represented by independently wealthy, cultivated men, whose scholarly duties often ran parallel with their primary profession. In these years, major educational reforms led to the transformation of the "scholar" into an "academic," due mainly to the establishment of professional academic communities employed in universities. In such a way, doing research evolved into an actual job, which had to suit specific disciplinary standards. As a consequence, the list of publications became the method for demonstrating the knowledge of a particular field. For the administration of the universities, the number of published material became one of the fundamental tools to judge candidates for a potential academic position (Fyfe *et al.* 2017).
Publications counted not only in their number but also in their quality. In this changing landscape, the communication between peers shifted from direct- to mediated-communication. In the beginning, the outcomes of a scientific investigation were disseminated only after the revision of the journal's editor. Though, with the increase of the production and its more thorough specialization, only the articles that underwent the review of fellow experts would go to print (Greco 1999). It is the beginning of the peer-review mechanism as we know today.
There are no major changes since then. As in the 19th century, the review of the work of a peer is unprofitable for researchers, as it is part of their academic routine. Conversely, the evolution of the market is quite significant. Even though it is not before the 1940s that publishers start to make real profits with scientific publications, the transformations in academia and the professionalization of the scholars undoubtedly affect the mechanism of supply and demand.
Another significant variation regards the "key functions of scholarly communication" as described by Henry Oldenburg and Robert Boyle in the *Philosophical Transactions* (1665). They had identified four primary purposes of scholarly publishing: registration (attribution), certification (peer review), dissemination (distribution, access), preservation (scholarly memory and permanent archiving). The process itself has remained remarkably stable. However, a few decades later, an additional function emerged, i.e., evaluation (Guédon 2019). The significance of this factor has been growing exponentially over the years until reaching the importance that today affects not only scientific publishing but research in general.
During the 20th century, and mostly from the 1940s, research institutions have undergone substantial changes. Many universities have been turning more into large enterprises whose administrations adopt managing techniques similar to different areas of business (Fyfe *et al.* 2017). In such a competitive environment, "excellence" rises as a crucial parameter not only

for scientists, but also for research institutions, funders, and in national and trans-national research strategies.

In this landscape, the business of scientific publishing has undergone considerable transformations. As we will see more in detail in the following paragraph, after the end of World War II, the revenues in this industry have increased exponentially, transforming it into a very profitable market.

4. The business of academic publishing

As mentioned before, from the end of the 17th century until 1945, academic publishing could not be considered as an actual profitable business: the publication of scientific journals was primarily part of the core activities of learned societies. The topics covered were quite broad, mainly coinciding with the societies' areas of interest. Individual subscriptions to receive copies of the paper journal were not very expensive and mostly included in the societies' membership fee (Björk, 2017).

It is after the second post-war era that the profit margins of commercial publishers exponentially grow. From the 1940s to the 1980s, state funding to R&D increased. The number of academic and research institutions multiplied, together with the number of people employed in this area. Research became an international business, owing to the increasing interconnection of the scientific communities at a trans-national level. Therefore, scientists received their academic credit among significantly larger groups of peers, reinforcing the trend of considering "excellence" as one of the principal parameters to obtain career's recognition. This criterion is firstly measured counting publications' number.

Researchers represent the suppliers and the primary recipients of scientific publishers at the same time, leading to an escalation in demand for publishing outlets. Journals became more and more discipline-oriented, and their number inflated (Fyfe *et al.* 2017; Björk 2017).

In such a context, commercial, scientific publishers increased their market share. The two basic strategies were: waive authors publication costs per page, as charged by society journals; regularly launch periodicals that cover niche areas of research, responding to the market demand (Björk, 2017). Hence, it is not difficult to imagine why between 1950 and 1980 the number of journals published worldwide went from 10,000 to 62,000 (Meadows 2000), while in 2002 53% of the trebled number of the monographs published in the UK since 1950 covered academic or professional topics (Thompson 2005; Fyfe *et al.* 2017).

As far as academic libraries concern, the investments in research coincided with substantial funding for their core functions, such as acquisitions and subscriptions. The expenditures dedicated to published material considerably increased, giving leeway to librarians as to the purchasing of titles and the types of contracts to subscribe with publishers.

In this booming market, the number of scientific papers circulating grew steadily. Therefore, it became necessary to elaborate on different standards for the evaluation of the "excellence" in research. As a consequence, in the 1970s, databases (e.g., the Science Citation Index) converted into a fundamental tool to count not only the number of articles circulating but also the number of citations they received.

However, at the beginning of the 1980s, the situation dramatically changed, leading to what is known as "serials crisis". Due to severe contractions in government funding to research, libraries were not able to feed the business of academic publishing as in the past decades. Maintaining high numbers as well as high quality in acquisitions became a challenge, forcing librarians to "go for convenience" (Chan 2018).

On the other side, researchers started to look for grants in more and more competing contexts. The "impact" of research grew in importance, and adopting strategies for its evaluation turned out to be of considerable importance. Indeed, despite the cuts in funding, scientific production kept rising. As a result, quantitative measurements of scientific excellence like journals' Impact Factor, H-index, citation counts appeared. They are currently considered as universal standards for research assessment, profoundly affecting the nature

of research itself (Neylon 2019). By the end of the 1960s, publishers represented a "necessary partner in the advancement of science" (Buranyi 2017).

This situation left room to major commercial publishers for establishing what is now commonly considered as their oligopoly. Their revenues have incremented continuously since then, due mainly to the commercial system they actively contributed to establishing. In such a structure, scientists create their work, supported mainly by public funds, and hand it to publishers for free. Publishing houses pay editors to evaluate if the work is ready to be disseminated and to check its grammar and spelling. It is quite evident that the editorial burden (i.e., the peer-review) is carried primarily by scientists voluntarily, respecting a long-term tradition (see §3). At this point, publishers are ready to sell back the outcome to the same institutions that contributed to its production and exploited by the same audience involved in its preparation.

In 1990, while libraries and consortia were struggling to renew increasingly expensive subscriptions, Ann Okerson[15] launched an appeal to the scientific community to subvert the system. She invited authors and institutions to claim intellectual property rights on their products and advertised the introduction of modern technologies for dissemination. In particular, she referred to the emerging Internet technology and the expansion of digital archives: the combination of the two would represent a significant step towards the evolution from the publishers' dominant position. In the same year, Stevan Harnad launched *Psycoloquy*, one of the first online, peer-reviewed journal (Santoro 2004).

As illustrated in figure 1, from that moment onwards, a growing number of initiatives were set mainly in universities and research centers. This situation highlights the profound need of the scientific community to find alternative solutions for scholarly dissemination.

However, publishers did not remain silent. From the mid-1990s, the affirmation of the World Wide Web revolutionized many industries, including scientific publishing. Due to the revenues obtained with the business of subscriptions, commercial publishers were able to set up the first commercial online solutions. Companies such as Elsevier proposed services to both libraries and researchers that could not be offered by public-funded laboratories.

First, they developed web-based platforms to publish electronic versions of the work and manage the peer-review process at the same time. Second, taking vantage of the transition to the online versions of paper journals, they were able to implement different business strategies and solutions for customers. These circumstances led to the affirmation of the "Big deals" between publishers and individual universities or consortia (Björk 2017). These contracts aimed at helping libraries' savings, allowing the cancellation of subscriptions to paper journals in favor of the acquisition of packages of digital resources.

Frazier (2001) explains that a "Big deal" is: "*an online aggregation of journals that publishers offer as a one-price, one size fits all package. In the Big Deal, libraries agree to buy electronic access to all of a commercial publisher's journals for a price based on current payments to that publisher, plus some increment. Under the terms of the contract, annual price increases are capped for a number of years*."

Initially, this appeared to be a win-win situation for both publishers and libraries, who were able to offer to their researchers and students a vast number of titles. However, Frazier again highlights that: "the content is […] "bundled" so that individual journal subscriptions can no longer be canceled in their electronic format." Hence, he invites research institutions not to sign any contract of this kind, as well as any comprehensive licensing agreement (Frazier 2001).

Technically speaking, due to the lack of statistics to rely upon pricing, publishing houses usually offered a deal covering several times more titles than before, for a slight mark-up compared to what they had paid earlier (Edlin, Rubinfeld 2004). After signing the first of such contracts, universities established a compelling lock-in situation: publishers were given

[15] https://en.wikipedia.org/wiki/Ann_Shumelda_Okerson

leeway to keep rising prices every year, not only exceeding inflation but also the growth in library budgets. Furthermore, they implemented the strategy of unbundling articles for pay-per-view. It has not become prevalent, though: instead of looking for funds to pay for reading electronic resources, scientists preferred to rely on those already included in the contract subscribed by their central libraries.

Quoting Stephen Buranyi's article for *The Guardian* (2017): "*What other industry receives its raw materials from its customers, gets those same customers to carry out the quality control of those materials, and then sells the same materials back to the customers at a vastly inflated price*?"

5. Open Access in practice

5.1 Support strategies and tools

As is well known, OA represents a sub-sector of the broader concept of Open Science (OS), a paradigm encompassing numerous aspects and implying a profound cultural change. The European Commission has made a precise choice to sustain Open Science, realizing the European Open Science Cloud[16], a shared infrastructure to support various innovative services for the scientific community and citizenship. The theoretical principles are stated in the EOSC Declaration[17], while the EOSC Roadmap[18] offers operational indications.

The project *Accelerate Open Science*[19] has recently given the following definition of OS:

> *'Open Science' stands for the transition to a new, more open, and participatory way of conducting, publishing, and evaluating scholarly research. Central to this concept is the goal of increasing cooperation and transparency in all research stages. This is achieved, among other ways, by sharing research data, publications, tools, and results as early and open as possible.*
>
> *Open Science leads to more robust scientific results, to more efficient research and (faster) access to scientific results for everyone. This results in turn in greater societal and economic impact.*

In the framework of OS, together with Open Data (OD), OA firmly supports the view of research as a public good. The actions taken by the European Commission in recent years have much sustained the spread and affirmation of such concept among the different actors of scholarly communication.

The EC Communication 2012/401 officially structured the prominence of OA for faster scientific progress in fostering the profits of public investments. The EC Recommendation 2012/417 clearly states: "[…] there should be open access to publications resulting from publicly-funded research as soon as possible, preferably immediately and in any case no later than 6 months after the date of publication, and 12 months for social sciences and humanities". FP7 first and Horizon2020 later granted financial support by the EC to achieve the goals of OA.

The European regulatory framework, as well as the long list of documents and recommendations concerning best practices in OA, are very well detailed.

[16] https://ec.europa.eu/research/openscience/index.cfm?pg=open-science-cloud.
[17] https://ec.europa.eu/research/openscience/pdf/eosc_declaration.pdf.
[18] https://ec.europa.eu/research/openscience/pdf/eosc_strategic_implementation_roadmap_short.pdf.
[19] Cf. https://www.accelerateopenscience.nl/what-is-open-science/.

Here below, we report a list of the essential documents[20]:

- **2018** C/2018/2375 Raccomandazione (UE) 2018/790.
- **2017** Guidelines to the rules on Open Access to scientific publications and Open Access to research data in Horizon 2020.
- **2015** Towards a modern, more European copyright framework. Communication from the Commission to the European Parliament etc. (COM 2015/626).
- **2013** Launch of Horizon 2020 and related Open Access policies (followed by an upgrade in 2017).
- **2012** FAQs on Open Access to publications and data in Horizon 2020.
- **2011** Main references to open Access in the European Commission's proposals for Horizon 2020; report entitled National open access and preservation policies in Europe.
- **2010** Europe 2020 Flagship Initiative and EU publication Policy proposals for developing world-class research and innovation space in Europe 2030: second report of the European Research Area Board, 2010
- **2008** European Commission and Unesco - Open Access handbook. Opportunities and challenges.
- **2007** Communication from the Commission to the European Parliament etc. on scientific information in the digital age: access, dissemination, and preservation.

For further information, we suggest consulting the web of the European Commission at the section dedicated to Open Access[21].
On the side of OA everyday practice universities, research institutions, projects, libraries, associations, and foundations have operated for the establishment of suitable environments and to provide necessary information for the dissemination of the OA best practices. In this light, a vast number of tools and guidelines have been developed to support authors in open access publishing.
For instance, with the purpose of providing them with an instrument for rapid consultation of OA policies applied by publishers and journals, the Sherpa-Romeo service was implemented. Sherpa is supported and maintained by a British research consortium and currently represents a fundamental instrument that synthesizes publishers' policies for self-archiving.
The fact that publishers often impose an embargo for the deposit of the OA version of a publication, may lead to significant delays with funders' mandates. For this reason, addenda to publishing contracts and specific licenses as Creative Commons are now available.
A practical example of authors' addenda is the models supplied by SPARC - Scholarly Publishing and Academic Resources Coalition[22] or the H2020 model of publishing agreement for the authors participating in actions financed by EU publishing in non-OA journals.
With the application of a CC license, the author grants to the publishers and the readers some rights for the re-use of the scientific and educational material, e.g., public reproduction of the document or creation of derivative works.
Other fundamental instruments are Sherpa/Juliet[23] and Sherpa/Fact[24]: they guide authors about the compliance of publishers' policies to funders' mandates. Depending on these search results, authors may choose to follow the Green or the Gold Road.
Examples of directories to obtain information about OA monographs, journals, and archives are: DOAJ, DOAB[25], OpenDOAR[26], ROARMAP, CORE[27], Base Bielefeld[28], Open Access Button[29], OAD[30], ROAD[31].

[20] Cf. http://cde-genova.unige.it/openaccess
[21] https://ec.europa.eu/research/openscience/index.cfm?pg=openaccess
[22] https://sparcopen.org/
[23] https://v2.sherpa.ac.uk/juliet/
[24] https://sherpa.ac.uk/fact/
[25] https://www.doabooks.org/
[26] http://www.opendoar.org/

Furthermore, infrastructures like OpenAIRE, projects like Foster, or institutions as TU Delft promotes webinars, tutorials, and (open) courses to examine OA issues more in-depth.
Finally, an exhaustive overview of the tools available to practice Open Science is given by the famous Rainbow of OpenScience Practices by Bianca Kramer and Jeroen Bosman[32].
To sum up, after almost twenty years from the Budapest Open Access Initiative (BOAI), OA today is a global issue involving at the same time and in the same way the protagonists of academic dissemination, who developed essential tools to make Open Access in practice.
In the following paragraph we report some data, which show how much OA spread in the scientific community.

5.2 A bit of data

According to a recent study (Piwowar 2019) at the present we have:

- 31% of all journal articles are available as OA
- 52% of article views are to OA articles

They can be considered as the results of the actions taken after the BOAI, and as a consequence of the formal definition of OA. In 2002, authors had only two strategies available to contribute to OA, i.e., the Green and Gold Roads. However, the so-called Red or Hybrid Road appeared in the market immediately afterward.
The Green Road concerns the self-archiving of the pre-print or the post-print in an institutional or disciplinary repository, or on the author's website. Indeed, publishers impose an embargo period to the public access of the deposited documents in the majority of the cases.
Following the Gold or the Red Road, authors retain the copyright of their work, as specific licenses (e.g., Creative Commons Licenses) regulate the use and the re-use of the scientific production. Moreover, they publish their articles in peer-reviewed journals upon payment of an Article Processing Charge (APC). The difference between Gold and Red is that the so-called Red journals, or hybrid journals, are already covered by a subscription paid by the authors' institutions.
The offer has expanded to this day with the addition of the following models:

- **Bronze Open Access**: the article is published and available free of charge on the publisher's website, but no license for re-use is specified. Examples of this type are articles published for promotional purposes or under a Delayed Open Access regime, or Gold Open Access articles where the publisher does not make explicit reference to re-use licenses.
- **Diamond Open Access**: seen as a form of Gold Open Access, they share high-quality peer review and editing processes, but the Diamond model requires no article processing fees. Diamond OA is mainly supported in the academic environment and seeks to make the production, dissemination, and consumption of knowledge as free as possible.
- **Black Open Access**: this is the definition given by Björk (2017b) to the methods of publication of the so-called "academic social media" such as ResearchGate and Academia.edu as well as the pirate website Sci-Hub. These are channels that illegally offer copies of published articles without subscriptions, payments, and bureaucracy.

We can say that the Bronze category shares both Gold and Hybrid attributes. On the one hand, OA Bronze is available on publishers' websites. On the other, Bronze articles do not appear in OA journals and, unlike Hybrid, do not contain license information. For this reason,

[27] https://core.ac.uk/
[28] https://www.base-search.net/
[29] https://openaccessbutton.org/
[30] http://oad.simmons.edu/oadwiki/Main_Page
[31] http://road.issn.org/
[32] https://zenodo.org/record/1147025#.XfSibdZKjR0

no use is allowed for them other than reading. Likewise, the publisher retains the right to give free access to the content permanently or only temporarily.

Another study shows that Green OA represents a relatively small percentage of the samples used. The most prevalent subtype in all samples is OA Bronze, although many Bronze articles are not recent, thus being classifiable as Delayed OA from toll-access publishers (Piwowar 2018).

The same study examines the citation impact of OA publications and concludes that open articles receive 18% more citations than closed articles.

John Tennant and other authors provide a very detailed bibliography on the scientific literature dealing with the relationship between the number of citations and open access. It argues that OA is related to the increase in the number of citations, as shown in the next graph. However, the results are still quite variable depending on the disciplinary field (Tennant 2016).

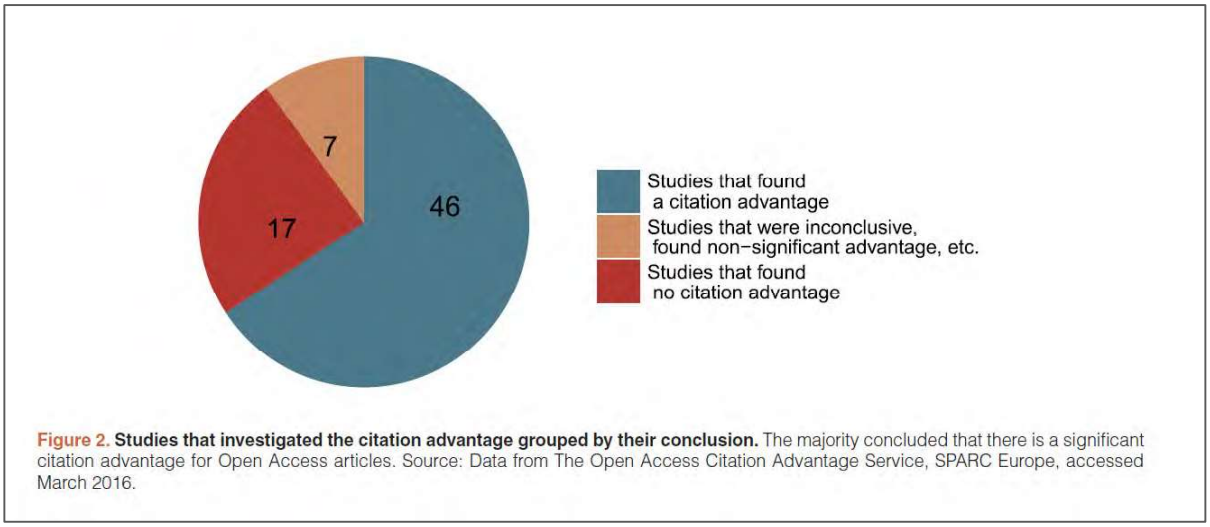

Figure 2. Studies that investigated the citation advantage grouped by their conclusion. The majority concluded that there is a significant citation advantage for Open Access articles. Source: Data from The Open Access Citation Advantage Service, SPARC Europe, accessed March 2016.

Figure 2: The academic, economic and societal impacts of Open Access: an evidence-based review (John Tennant et al. 2016)

In their work, Tennant and his co-authors analyze the impact of OA from different perspectives: academic, economic, and social. As far as the first is concerned, in their opinion, the most significant impact of OA is about:

- the increased documented impact of scientific articles as a result of availability and re-use;
- the possibility for researchers to have access to a large amount of scientific literature and to use automated tools to extract it, legally and without restrictions.

From an economic point of view, the authors argue that access to more research results certainly benefits private industrial sectors, with effects that go beyond financing. Indeed, adequate licensing and accessibility can give great benefits in terms of financial results. With access to scientific articles, entrepreneurs and small businesses can accelerate innovation and discovery by stimulating regional activities and global economies in the public interest.

From a social point of view, it is undoubtedly irrefutable that open access to scientific literature benefits not only academics but also other sectors of society. Access to knowledge has been defined as a human rights issue, making specific reference to Article 27 of the United Nations Declaration of Human Rights[33].

As we all know, one of the most innovative aspects of Open Science is the dimension of citizen science. Projects such as Galaxy Zoo, Zooniverse, Old Weather, Fold It, Whale FM, Bat

[33] https://www.un.org/en/universal-declaration-human-rights/

Detective, and Project Discovery are all initiatives in which citizens engage publicly and openly in active research.

The benefits of implementing OA models seem to have been taken up by many organizations if we consider the increase in the number of OA policies and repositories on a global basis. As of October 15, 2019, OpenDOAR reports the existence of 4,367 repositories with the distribution shown in the charts.

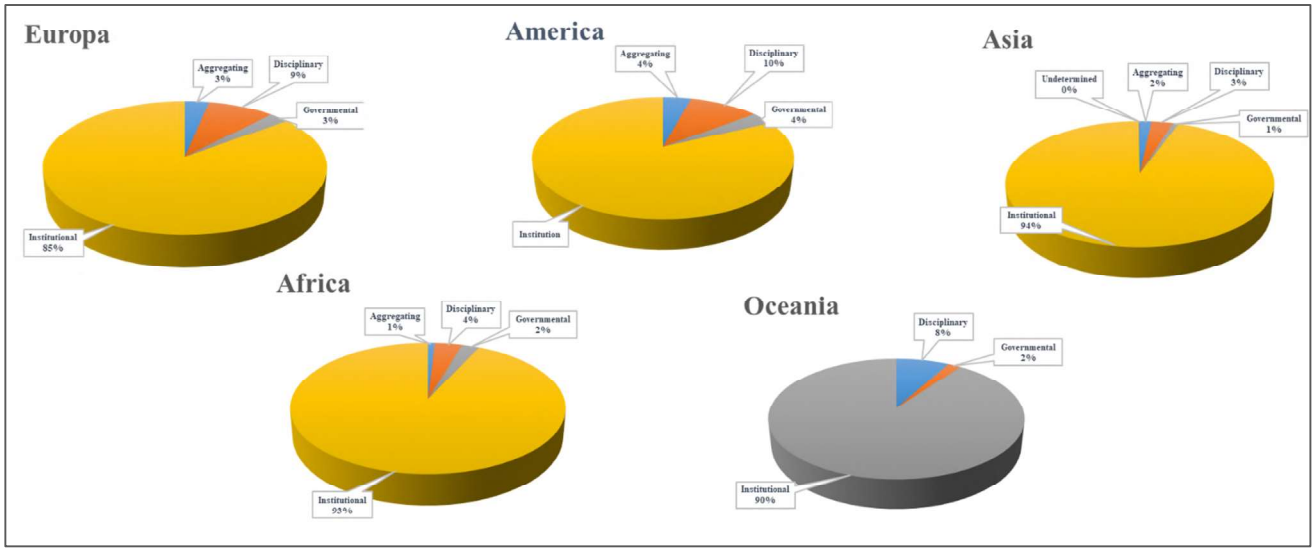

Figure 3: Distribution of repositories worldwide

The distribution of repositories in the different regions of the world varies significantly. Their majority locates in Europe and the US.

In almost every country analyzed, the most significant number of repositories is institutional, with percentages that slightly vary between 82% and 94%. The others are aggregative, disciplinary, and governmental repositories. The exception is Oceania, with no aggregative repository.

An in-depth analysis of the contents of OpenDOAR is outside of this study. However, it is quite evident the growth in the number of repositories over the years, as graphically explained below: from 2005 to 2019, we estimated annual growth of 32.38%.

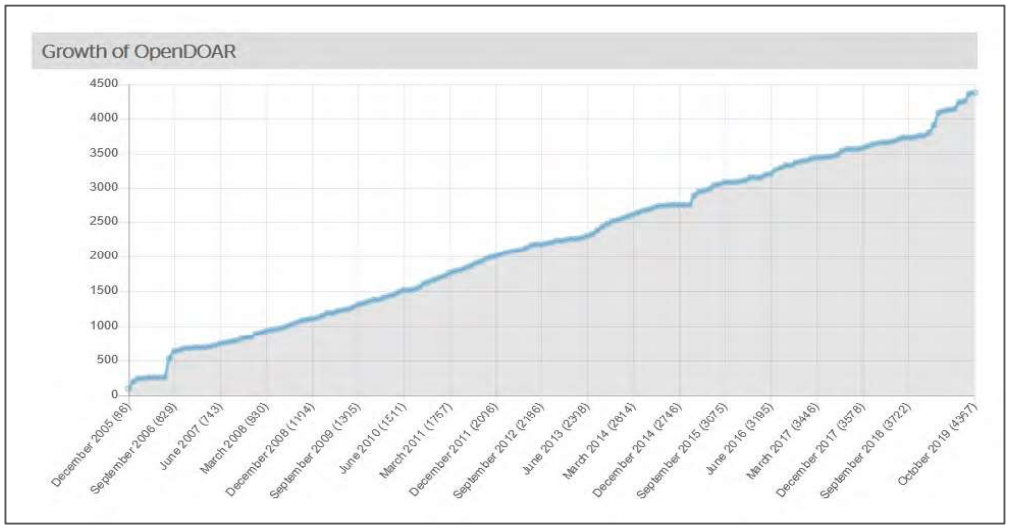

Figure 4: Growth of repositories in OpenDOAR (2005-2019)

The following graph shows the presence of more than 750 OA policies and mandates, registered in ROARMAP by a series of research institutions and subdivisions around the world, the majority of them being geographically distributed as highlighted above, i.e., in Europe and USA.

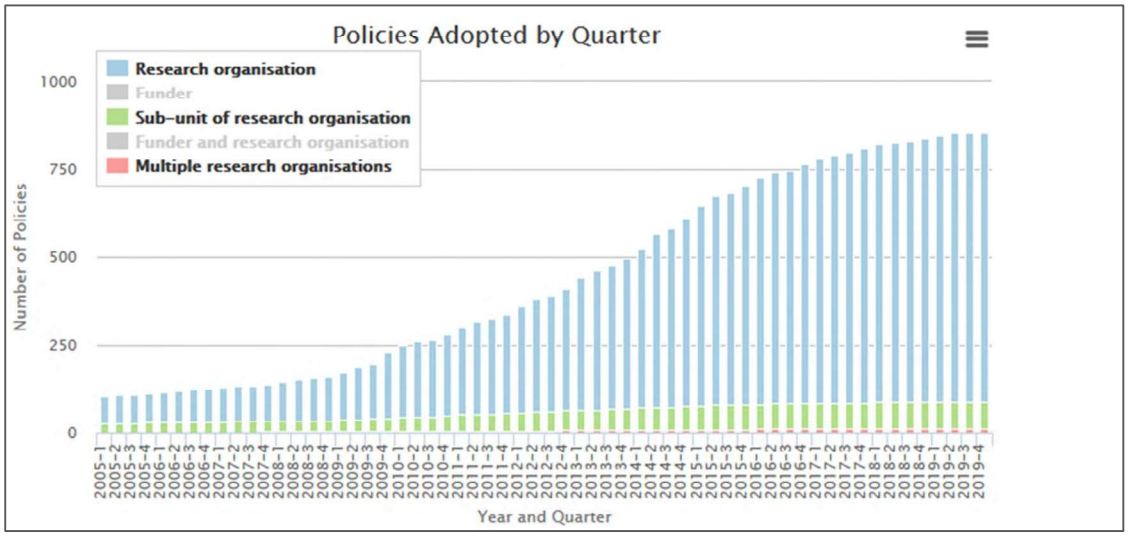

Figure 5: Number of policies in OpenDOAR 2005-2019

We estimated annual growth in the number of policies recorded by ROARMAP between 2005 and 2019 at around 15.62%.

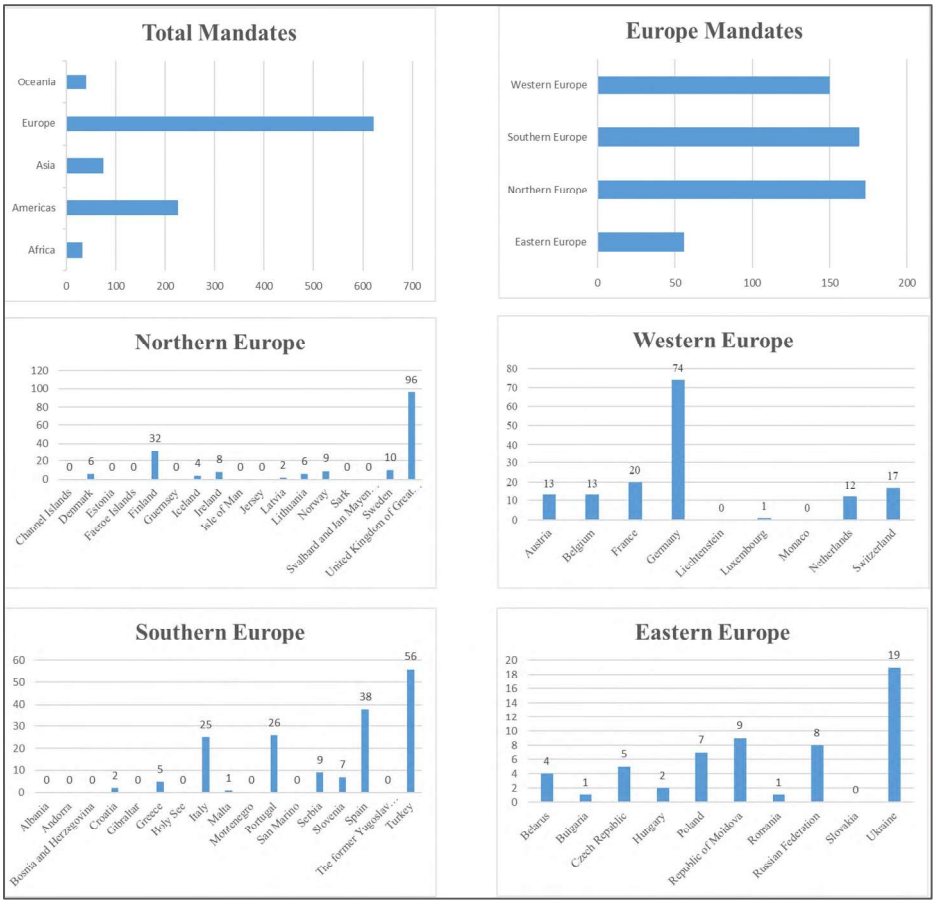

Figure 6: Distribution of policies in Europe

As far as the distribution of OA policies in Europe is concerned, the graphs above report quite noticeable results. While northern and southern Europe present the highest total number, they concentrate on fewer countries. A similar situation is also registered in western Europe, while in the East, the situation appears to be more consistent, except for Ukraine.

These figures provide consistent background for major transformations in the contemporary editorial scenery, as we will describe in the following paragraph.

6. The changes in editorial landscape

As we saw before, after more than three hundred years from the publication of the first scientific journal, the editorial system has not changed, its core still relying on the work done voluntarily by fellow scientists. The outcomes appear on journals whose subscriptions are paid by research institutions. It raised two fundamental issues:

- publications are behind paywalls: only those who can afford to pay the reading fee may access the contents;
- institutions pay the same work three times: researchers' salaries, research funding, and journals' subscriptions.

A situation like this causes great harm not only to scientists but also to citizenship. A widespread opinion sustains that public access to research results is not necessary as they are not understandable by non-specialists. We firmly believe, on the contrary, that everybody should have the possibility to freely access scientific contents, especially those of significant concern for the population worldwide (e.g., healthcare and climate change) (Tennant 2019).

In the contemporary world, the majority of scholarly communication goes online; therefore, costs like printing, shipping should not be charged as before. However, prices imposed by publishers have not dropped down (Borrelli 2019). In order to better afford the costs of Big Deals, academic and research institutions have gathered in consortia. However, this strategy has not turned out to be a win-win situation for institutions as well as for publishers.

As mentioned previously, a provocative, illegal reaction was the foundation of Sci-Hub in 2011 by Alexandra Elbakyan. She has been recently sentenced by an American court of Justice after suited by major editorial brands like Elsevier. Even though we cannot defend Elbakyan's misconduct, such a condition brings to some observations. On the one hand, a scientist whose aim was making science accessible by everyone, especially in economically disadvantaged countries, was condemned. On the other, academic and research institutions pay millions every year to keep science behind a paywall (Tavecchio 2017).

The results of a survey conducted by the European University Association (EUA) over 31 consortia in 30 European countries show that every year, institutions spend at least 1,025 billion euros for electronic resources (e.g., journals, databases, e-books...). Between 2017 and 2018, consortia spent 726 billion for Big Deals, 475 of them paid to the five major publishers (Elsevier, Springer Nature, Taylor & Francis, Wiley, and the American Chemical Society) (EUA 2019).

The study took into account the annual price increase and the resulting negative effect of the rising costs on the institutions, which try to guarantee access to scientific content when funding to research is steadily reducing.

The advent of Open Access brought to light a different business model based on Article Processing Charges (APC), i.e., the costs to support the dissemination of an article in Open Access.

There are three models of APC, with three different financial impacts[34]:

- APC for native Open Access publishers (e.g., PLoS, BioMedCentral...) that have no other source of income.
- APC for traditional publishers that offer optional Open Access to publications. In this case, the journal remains upon subscription, but the individual article becomes Open Access by the payment of a fee.
- APC for fully Open Access journals from traditional publishers.

The second model brings editorial brands profits from both subscriptions and APCs, leading to the so-called *double-dipping*, another *bizarre* mechanism that once again increases the costs of the institutions for the work of their researchers.

[34] cf. Elena Giglia, https://www.oa.unito.it/new/article-processing-charges/

On the other side, APCs for Gold OA may be quite expensive, especially if authors choose to publish in journals with high Impact Factors, as necessary to succeed in research assessment exercises.

Increasing spending induced the arrangement of different deals, the so-called "transformative agreements." A transformative agreement is a contract negotiated between institutions and publishers whose purpose is to move from the current business model based on subscriptions to one that bears the costs of OA. The assumption is based on the evidence that the amount currently paid for journals' subscriptions is mostly sufficient to sustain OA publishing. Besides, copyright remains to the authors; transparency of costs and contractual terms are essential.

The most common models of transformative contracts include *formulas* such as:

- *Read & Publish*: in the same contract, institutions pay for both reading and publishing.
- *Publish & Read*: institutions pay only to publish; reading costs are already covered.
- Inclusion of the entire (or part of) publisher's OA and non-OA portfolio.
- Inclusion of all (or part of) the OA publications of an institution[35].

A practical example is the agreement reached in 2018 between Wiley and Projekt Deal[36], a consortium of 700 German research institutions. Other instances may be the "Springer Compact" models (Read & Publish), subscribed with the publisher by countries such as Austria, Germany, Sweden, Hungary, Poland, The Netherlands, and United Kingdom.

Approximately 50% of all articles published in peer-reviewed OA journals are published upon APC payment. This mechanism of “pay-to-publish” has raised several “moral” reactions as it can only generate a conflict of interest. This can be resolved if editorial decisions on the quality of the publication remain separate from the commercial aspects (Tennant 2016).

Numerous initiatives nowadays promote sustainable OA and facilitate informed negotiations with publishers. Among them, OpenAPC[37] aggregates data from various research entities, creating datasets that facilitate an overview of the fees paid for OA. All data collected are provided voluntarily by the participants; data transfer may vary among countries, but each data provider agrees on the principles of Open Knowledge.

The following table shows data from OpenAPC listed by the publisher as of November 2019.

Publishers (489 entries)	Sum	Number of Articles	Mean Value	Standard Deviation	Percentage
Elsevier BV	€34.572.109	12579	€2.748	€1.094	20.12%
Springer Nature	€28.220.357	14475	€1.950	€924	16.42%
Wiley-Blackwell	€16.676.961	7159	€2.330	€767	9.71%
Public Library of Science (PLoS)	€12.633.071	8765	€1.441	€411	7.35%
Frontiers Media SA	€9.931.876	6083	€1.633	€557	5.78%
Oxford University Press (OUP)	€7.389.019	3075	€2.403	€760	4.30%
Springer Science + Business Media	€5.588.097	3733	€1.497	€505	3.25%
American Chemical Society (ACS)	€5.575.937	2133	€2.614	€1.057	3.25%
MDPI AG	€4.118.463	3612	€1.140	€439	2.40%
BMJ	€3.871.729	1801	€2.150	€704	2.25%
Copernicus GmbH	€3.382.865	2426	€1.394	€606	1.97%
Informa UK Limited	€3.232.511	2388	€1.354	€828	1.88%
IOP Publishing	€3.196.756	2054	€1.556	€675	1.86%
Ovid Technologies (Wolters Kluwer Health)	€2.360.543	777	€3.038	€1.327	1.37%
		view small values			
Total	**€171.828.193**	**87916**	**€1.954**	**€984**	**100%**

Table 1: articles’ number and amount paid by publisher for APCs (data from OpenAPC – November 2019)

[35] Silvana Mangiaracina. *Dai Big Deals ai contratti trasformativi*, https://www.slideshare.net/BiblioBoCNR/dai-big-deal-ai-trasformative-agreements-unanalisi-del-cnr

[36] https://www.projekt-deal.de/wiley-contract/

[37] https://www.intact-project.org/openapc/

OpenAPC does not substitute national or international reports and collected data only from countries with significant financial resources. However, with its complete transparency, it has gradually become a fundamental source of information to obtain a more profound knowledge of transformative mechanisms.

7. A slow and difficult transition

7.1 International initiatives

Unless the favorable results, we are still talking about a *transition towards OA*. At the end of 2018, cOAlition S[38] launched Plan S to accelerate the complete and immediate open access to research publications.

In the first version of the project, the results of publicly funded scientific publications should be published in OA journals or platforms by 2020, without any additional financial burden on the authors.

The guidelines on the actuation of Plan S were published on November 27, 2018, and were left open to the general audience until February 8, 2019.

The publication of Plan S raised a debate with contrastive opinions, opening an extensive international consultation on OA policies. Thanks to the contributions received and the debate between the participating institutions, at the end of May 2019, cOAlition S published updated principles and guidelines for the program's implementation.

The revised Plan-S maintains its fundamental principles:

- scientific communication must be accessible;
- Open Access should be immediate;
- Creative Commons Attribution CC BY is the tool to implement full Open Access;
- funders undertake to support Open Access fees at a reasonable level;
- funders will not support publication in hybrid journals unless they are part of a Transformative agreement with a clearly defined endpoint;

with some significant modifications:

- the outcomes of publicly funded scientific projects should be available OA by 2021;
- it will support transformative agreements until 2024;
- it will promote multiple transition models;
- it will provide greater clarity on the various routes to comply with Plan-S;
- it will place greater emphasis on changing the system of evaluation and rewarding academic production;
- the importance of transparency in OA publication fees (APCs) is stressed;
- the technical requirements for the OA repositories have been revised and simplified.

At the same time, in Latin America, another project called AmeliCA started. These are the ten principles as appear on its official website:

- Scientific knowledge generated with public funds is a common good, and access to it is a universal right.
- The open academy-owned non-profit non-subordinate sustainable and with responsible metrics publishing model ought to be strengthened.
- Open Access has neither future nor meaning unless research assessment systems evolve.
- Open Access consolidation demands the transition to digital scientific communication.
- Financial investment in Open Access ought to be in line with its benefit for society.
- Open Access sustainability using cooperative work schemes and a horizontal distribution to cover costs.

[38] https://www.coalition-s.org/about/

- The diversity of scientific journals is necessary; hence the pressure to homogenize them ought to be stopped.
- Journals ought to allow authors to retain their copyright and remove their embargo policies.
- Science's social impact is the foundation of the existence of OA.
- The various dynamics to generate and circulate knowledge per field ought to be respected, especially as regards Social Sciences and Humanities.

Both the initiatives, together with others as the ***African Open Science Platform***, ***OA2020***, **and *SciELO*,** have the same global aspiration and stem from the need to accelerate an excessively slow and ineffective transition to Open Access.
As reported by cOAlition S, their common objectives are:

- scientific knowledge is a global public good. When generated by public funds, free access to it is a universal right;
- providing universal, unrestricted, and immediate Open Access to scholarly information, including use and re-use by humans and machines, is the ultimate objective;
- this common goal can be achieved through a variety of approaches, looking for alignment within their approaches and ways to co-operate;
- they both promote an active dialogue with all stakeholders (e.g., researchers, funders, universities, libraries, publishers, learned societies, governments, and citizens), referring to the diversity of the global scholarly community.

By coincidence, Plan S and AmeliCA have a similar structure and are both based on ten principles, so they are often associated and compared. However, their different historical and cultural backgrounds led them to distinct, often opposed, strategies.
Plan S generates in a context where the use of scientific contents is entrusted to commercial systems, based on the relationship between publishers and institutions.
Because of its history and culture, AmeliCA "*leads its efforts towards a non-profit publishing model to preserve the scientific and open nature of scientific communication (also known as "diamond open access").*" Indeed, scholarly communication in Latin America refers to a non-commercial structure in which scientific publications belong to the academic institutions and not to major publishers.
As a result, on the one side, Plan S appears to be strongly oriented to regulate agreements and to establish a limit to the costs that institutions have to pay. On the other, AmeliCA aims to build multi-institutional platforms led by the same scientific community to consolidate a collaborative, sustainable, and non-commercial Open Access.
Accordingly, we are facing two profoundly different understandings of Open Access. In the Global South, the access to the scientific production has been historically more challenging, due to the high costs either for reading or for publishing in high impact journals (Chan, Kirsop, Arunachalam, 2011). In Latin America, earlier than BOAI, state budgets have always been a primary element in the dissemination of scientific knowledge, as institutional funds usually cover OA without any fee for authors and readers.
On the other hand, the current version of Plan S appears to be closed tight to the publishing market and, therefore, to the same structure that OA principles firmly disapprove. For this reason, the supporters of AmeliCA sustains that this model would not be exportable outside Europe.
Moreover, while the nature of Plan is indicative/normative, AmeliCA proposes concrete actions and projects to solve the problems related to the diffusion of science.
Both initiatives criticize current research evaluation systems, almost exclusively based on indicators such as the impact factor and express their commitment to the application of the principles promoted by the DORA Declaration. Nevertheless, AmeliCA has also set up a

multidisciplinary working group of experts from various countries to generate more relevant and equitable metrics for researchers, science and Open Access.
Regarding institutional repositories and OA platforms, although Plan S recognizes their role in long-term archiving and their potential for the promotion of new editorial systems, it does not acknowledge their practical value for global access to scientific production.
However, COAR[39] and cOAlition S in their joint statement argue that: "*repositories offer a low-cost, high-value option for providing Open Access and are also a mechanism for introducing innovation in scholarly communication, acting as vehicles for developing new dissemination models and providing access to a wide range of scholarly content.*"

On June 2019, at the end of the XI Joint Steering Committee Meeting of the Bilateral Agreement on Science and Technology between the European Union and Argentina, a joint declaration reported about Argentina's accession to Plan S, and, at the same time, the intention to bring the issue to the discussion of the whole of Latin America and the Caribbean countries.
Finally, we can reasonably argue that the debate is still very open as the guidelines of Plan S do not address essential issues for Latin Americans. In addition, Plan S "*…will influence the publishing ecosystem worldwide, [but] its design has ignored more than 20 years of agenda on Open Access from the Global South and the paradigm of a contrasting scholarly publishing landscape in Latin America*." (Debat, Babini 2019).

7.2 What went wrong?

Since we are still talking about a *transition towards full OA*, we must argue that something went wrong during these years, and identify some possible reasons.
One is the lack of researchers' awareness. Many of them still think of Open Access as something that is not of their concern. Researchers are almost wholly unaware of the costs sustained by the institutions for subscriptions, even though we are talking about public money that ends up in the pockets of the publishers. Besides, a large number of them are unaware of neither the principles nor the practices of OA. Furthermore, it favors the persistence of some mistaken beliefs. The famous *Six false myths* by Peter Suber (Suber, 2013) are still in force in some scientific communities.
Between these false myths, we find the widespread belief that it is necessary to publish in OA journals to make Open Access. As we have seen in the previous sections, BOAI immediately provided the strategies to practice OA, and, since the beginning, there are two complementary models to achieve the goal: the Green and the Gold road. Almost every OA policy in the universities or the funding agency requires storage in OA archives and repositories, and repositories for self-archiving are a concrete reality that researchers can exploit.
Many researchers believe that it is necessary to pay APCs to publish in peer-reviewed OA journals. However, the majority of them do not require any publishing fee, as demonstrated by data in DOAJ (December 2019): OA journals utterly free of charge are over 10,000 against about 3,000 that require payment.
Similarly, several authors are not aware that most of the publishers allow the green road. Authors then are free to publish in the best journal of their field and deposit the allowed version in an institutional or disciplinary repository. Furthermore, as we have already pointed out, there are various tools for knowing publishers' policies and others that allow the authors to request amendments to the publication contracts.
Another misbelief is that open access journals are low in quality. Scientists should always remember that the quality of a scientific journal is in its contents, authors, and reviewers, and not by its publisher's business model or access policy. However, the so-called predatory publishers have contributed a lot to the persistence of this false principle.

[39] COAR – Confederation of Open Access Repositories, https://www.coalition-s.org/coar-supporting-repositories/

As a matter of fact, in the OA panorama, there have been less severe publishers who are riding the OA phenomenon to take advantage of the *pay-to-publish* system and cash the APCs in exchange for publication in low-quality journals without peer-review. They are very often publishers who falsely state that their journals are indexed in databases such as WoS or Scopus with high Impact factors or other indicators of prestige used in research evaluation systems. Unfortunately, the problem of predatory publishers has had a very negative impact on the OA movement, and many authors, especially the youngest and most inexperienced ones, have fallen in the network of predators. However, now several methods can help authors to avoid predatory publishers: from the Beall's List to modern tools such as *Think, Check, Submit,* which provides checklists to help researchers in identifying reliable journals and "real" OA publishers.

Finally, some scientific communities argue that the obligation to publish in Open Access may violate academic freedom. This conviction partly leads to the issue of the distinction between Green and Gold road. On the one side, Gold OA indeed implies publication in specific journals. Nevertheless, on the other, Green OA in no way limits the freedom of researchers to publish in the journals of their choice. Probably this is the main reason why almost all OA policies issued by universities and research institutions support the Green road.

Furthermore, are researchers currently free to publish not only **what** they want but also **where** they want? In our opinion, the answer is no, because they have to publish in high Impact Factors journals for a positive evaluation.

The importance of the Impact Factor in research evaluation systems is still very dominant, despite the success of initiatives such as the DORA declaration or the Leiden Manifesto and the criticisms expressed by numerous authors (Wouters 2019). Some argue that the IF provides a poor representation of real trends, while others explicitly talk about manipulation by unscrupulous publishers and even fraud, referring to the emergence of a craft industry of questionable journals that make use of falsified impact factors (Pudovkin 2018).

The selection of journals based on bibliometric indicators has become a driving force behind the research activities themselves. It discourages publication in journals that are not included in the citation indices and reflects research planning, performance, and communication. As long as the assessment is based on the number of citations received and the prestige of the journals, it will be difficult to change the model of scientific communication.

The publication of Plan S has raised an open debate, which in many cases highlights a lack of knowledge of the same principles of Open Access, confirming the persistence of the false myths as well as a general low degree of awareness about the topic.

For instance, the fear that OA is opposed to peer-review emerged in some criticisms addressed to Plan S. Nonetheless, the importance of peer-review is also reaffirmed by Plan S itself. Open access, or rather Open Science, does not discredit peer-review but supports the need to expand the means of evaluation. We speak in this sense of *Open peer-review* as the opening of a process traditionally closed would make the practice completely transparent.

Other misinterpretations would expect a total ban of hybrid journals from the editorial panorama after the entry into force of Plan S. Alternatively, the initiative would divide somehow the scientific community, causing damage to the circulation of knowledge. Last but not least, it would lead to an exorbitant increase in publications costs, so that scientists would be forced to publish their work exclusively in Open Access.

Another obstacle concerns the practice of Green Open Access. Although the growth in the number of OA repositories and policies, the publication in institutional or disciplinary repositories is still lacking. In 2016, John Tennant said that this situation might have three potential explanations:

- *authors are unsure whether they have the legal right to practice self-archiving;*
- *authors are concerned that the request for self-archiving may jeopardize the acceptance of their article for publication;*

- *authors believe that self-archiving could involve much work.*

The first point highlights the issue of the embargo imposed by the publishers on the unrestricted access to post-print. As is well known, the EU regulation establishes that research products published with the support of EU financing should follow the indications provided in the Commission Recommendation (EU) 2018/790 (April 25, 2018), which substitutes those published on July 12, 2012. It confirms that the research products should be deposited in an online repository granting open and free access as soon as possible or within six months (STM) or 12 months (SSH) from the publication date at the latest. Research products whose purposes are bound to copyright, economic exploitation, and marketing are not involved (e.g., patents).
Very often, the embargo period established by the commercial publishers does not coincide with the European rules. In these cases, the only choice available to an author is to opt for Gold OA directly.
A possible solution may be the acknowledge of different status to the preprint, as demonstrated by a recent analysis that focuses on its potentially transformative role in the academic communication landscape (Chiarelli 2019). The community of Physicists has been sharing preprints for over 60 years. In the beginning, paper copies circulated via postal service. Even though the emergence of arXiv and the Web after 1991 redesigned the distribution system, and a wide range of platforms are now available for archiving preprints, the dissemination of preprints is not the same within all communities. The reluctance to the use of preprints is mainly due to the absence of peer review and the fear that a deposited preprint may not be accepted and published.
At the same time, preprints do not entirely integrate into the publication workflow. Although technology is perfectly capable of supporting versioning systems, the deposit of a preprint is disconnected from the subsequent processing of the work, resulting in overlapping information and identification problems.
Therefore, we can argue that today the different scientific communities would not consider enhancement in the status of preprints as a priority. However, *a growing number of research funders are starting to acknowledge and accept preprints as suitable for inclusion in grant applications*, and we recognize the role that preprints can play in the evaluation of researchers (Chiarelli 2019b).
Soon, the possible role of preprints may bring very significant changes in the publishing landscape, shifting the focus from the publisher to the author and, most of all, towards the scientific outcomes.

8. Conclusions

It seems to have everything we need. We have the support of the European Commission, models, tools, laws, policies, recommendations, and repositories. However, universal or partial access to about 70% of articles is not yet directly possible unless the author's institution pays a subscription, or has enough money to pay per article.
The aforementioned Piwowar's study estimates that in 2025 (given existing trends):

- 44% of all journal articles will be available as OA
- 70% of article views will be to OA articles

The results achieved by the movement in almost 20 years are significant, even though there are still obstacles to overcome. The most significant limit probably is that Open Access requires a significant cultural change, especially on the researchers' side. At the moment, there is a general lack of knowledge, and it will be necessary to make them aware of the benefits offered by OA. The institutions should identify the best practices to involve all researchers in all phases of the transition, for example providing institutional incentives and awards if they publish in Open Access journals or repositories. At the same time, institutions should provide researchers and all support staff adequate training. Moreover, the

institutions should promote the development of open e-publishing systems and repositories and also plan the building of new skills in copyright and data protection, platform management, research data management.

Another critical barrier is the current system for research evaluation and career advancement, which gives more importance to *where to publish* instead of *what to publish*. In research evaluation, quantitative metrics (e.g., number of publications, the impact of journals) should not replace a meaningful and qualitative assessment of an individual's work. With the move towards an open editorial system, research evaluation processes could, for example, include incentives for open access publication as well as rewarding the quality of the article itself, regardless of the impact factor of the journal chosen. Besides, activities such as review, evaluation, care, and management of research data, as well as data sharing and the development of open resources, should be explicitly recognized in the framework of researcher evaluation.

The editorial landscape has changed a lot in recent years. The increase of OA has required careful negotiations between several stakeholders (e.g., librarians, financiers, academics). Many countries have already adopted strategies to transform the economic model of scientific publications. The Netherlands, Germany, Sweden, and Norway defined transformative agreements whose rates are based on the number of OA articles published. The University of California and the Max Planck Society canceled its contracts with Elsevier.

However, at the moment, the APC market and the transformative agreements do not seem to produce the expected results, from a strictly economic point of view. On the contrary, with the growth of OA, the most prominent publishers have seen the phenomenon as a further business opportunity. They are generating additional profits through the APC mechanism, while institutions are incurring additional expenses in addition to the Big Deals.

So, while OA has the great merit to have defined the concept of scientific research as **a public good** and to have introduced the idea of change, it has not been able, until now, to significantly contrast the great publishing oligopolies.

In order to contrast the great publishing oligopolies, institutions should:

- follow the "gold" and the "green" roads as both of them present considerable advantages;
- avoid hybrid models and any other model that charges additional costs;
- ensure that publishers respect the embargo periods established at national and EU level;
- ensure greater transparency on contracts and costs in the scientific publishing market by acquiring the necessary knowledge on the costs incurred for APCs and subscriptions at regional, national and European level;
- seek more cost-effective solutions by taking control of the total cost of publication;
- acquire a higher bargaining power in negotiations with publishers;
- secure the support of governments and funders.

Plan S has undoubtedly triggered a kind of revolution in the circuit of scientific communication. Nevertheless, we still need to understand if Plan S represents a turning point. Does it work at trans-national level? Will transformative agreements save the libraries' finances, or they will be the "New Big Deals"? According to some authors, *every time we sign one of these so-called transformative contracts, which often contain multi-year lock-ins, we lose the opportunity to create something more just, sustainable, efficient, and effective* (Tennant, 2019).

On the other hand, the primary duties of institutions like the European Commission will be to give concrete indications to remove the obstacles currently posed to Open Access. With the new framework project, Horizon Europe, the EU will have the opportunity to determine different conditions for the practice of OA. We hope that the experience of FP7 and Horizon2020 has helped to understand how to overcome obstacles as the embargo periods by re-evaluating, for example, the role of preprint in the dissemination of research results.

In the course of this study, we had the opportunity to understand that OA increases the knowledge and contributes to its transfer, creates positive spin-offs in the economy, and allows interdisciplinary approaches on issues of great importance for society. Only with the collaboration of all actors and a significant change in mentality, we would obtain an effective revolution in the scholarly communication.

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