BERNARD RENTIER

OPEN SCIENCE, THE CHALLENGE OF TRANSPARENCY

Preface by Philippe Busquin

ACADÉMIE ROYALE DE BELGIQUE
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To Alma Swan, my friendly mentor
in Open Access activism.

Preface

Writing the preface to this book published in *L'Académie en Poche* and jointly, for the first time, in a free open access electronic version, is a pleasure and an honour.

Bernard Rentier, beyond his academic qualities and his rectoral responsibilities at the University of Liège, is a tireless and committed activist who shares with us his fight for Open Science. In this respect, it is entirely in line with the approach advocated by the European Commission and which Carlos Moedas, the current European Commissioner for Research, has also made his main focus.

The 2016 European Union Report on Science, Research and Innovation is subtitled: "Contribution to Open Innovation, Open Science and Open to the World Agenda", indicating the EU's commitment to developing high quality science and positioning itself as a global leader in Open

Science. As Moedas summarises it: "*Share faster and innovate faster*".

However, open innovation is only one element in relation to the profound impact of this major development on science, research, researchers and Science's relationship with Society.

The author describes clearly the evolution of scientific communication since 1665 and the first issue of the Philosophical Transactions of the Royal Society of London, cradle of modern science with Bacon, until today when it became a profitable and flourishing business for publishers, who have built huge consortia, whose profits have become unreasonable and whose "impact factor" constitutes a bias with negative consequences for researchers and for the guarantee of research quality.

He explains how the international Open Access movement was organised during the 2000's and has become essential today. Bernard Rentier started this fight for openness before becoming the rector of ULiège, Science being in his mind a public good, a conception that I share: "*The Internet today opens up a fast and universal means of communication. It may give the researcher full control of his/her publication provided that he/she so wishes or is authorised to do so.*"

As Rector of the University of Liège and, at the international level, co-founder and chairman of the now extinct "EOS" (Enabling Open

Scholarship), he was a precursor to Open Access as later defined by the European Commission (2010): he shaped a model that provides free access, use and reuse to readers on the Internet, mandating ULiège researchers to deposit their scientific articles in the University's electronic archive (ORBi) and by linking this deposit to evaluation procedures. Since then, ULiège is cited as an example by the EU's DG Research for providing an illustration of its political will to develop Open Science.

It is urgent that governments and international institutions support such an opening. It is now the case with the European Commission's H2020 programme (the blunder reported on the Open Science Monitor is of great concern to me), but also in Switzerland and in the Wallonia-Brussels Federation (the 2018 decree to which Bernard Rentier contributed actively).

The book describes well the variants of open access as well as the obstacles, reticences (the cartwheel manufacturers!) and the economic stakes of the current evolution. This leads to other topical issues: scientific integrity, the evaluation of researchers and the principles of citizen science.

The European Research Area also aims to develop the relationship between Science and Society and how could we not share Bernard Rentier's fine conclusion: "*We must therefore*

acquire and communicate the wisdom to build the new science by avoiding all the traps set on its path. We must find the strength to resist the tyranny of big money and the sirens or even the pressures of its supporters. And we may find the beauty of a scientific world of cooperation, sharing and exchange."

Philippe Busquin,
Former European Commissioner for Research
Associate Member of the Royal Academy of Belgium.
July 15, 2018

Foreword

This book is an attempt to cover a set of notions that characterise the concept of Open Science. As it stems from a bottom-up movement for the liberation of scientific publications, known as "Open Access", the latter is given a large space here, the place of honour for the icebreaker.

In addition, dealing with Open Access to knowledge, it is only natural that I wanted to refer only to works available freely on line, which I provide as a link so that the reader can find them immediately as a full text without having to go to a university library or search through newspaper archives when I refer to press articles.

Finally, it was only natural that I absolutely wanted this book to be available online for free from the outset, even though it is not strictly speaking the presentation of research results. Given the subject, the opposite would have been somewhat paradoxical. Apart from the fact that it is free of charge, one advantage pleads in favour

of digital publishing and it is quickly obvious to the reader: the link to the references.

I would like to thank Didier Viviers, 'Secrétaire Perpétuel' of the Royal Academy of Belgium, for the trust he has placed in my approach as well as the editorial team for the extra work they have agreed to do. I hope that the release of this e-book will prompt the reader to explore other publications by the Academy and enrich the showcase of its great collection.

I also wish to acknowledge the support of Paul Thirion, Chief Librarian of ULiège, a tireless companion on the road to Open Access, who has encouraged me throughout the past decade of constant effort, not only to defend the concepts of openness and transparency in research, but also to develop pioneering tools.

Foreword of the English edition

This book is the English translation of "*Science ouverte, le défi de la transparence*" published in December 2018, both in printed and electronic forms simultaneously.

As the subject is timely and constantly evolving, some modifications have been made in accordance with new events. In this matter, even in a few weeks, things move quickly. Hence, the English version is slightly different from the French original.

My intention is to update both the French and English digital texts on a regular basis, with dated versions, to reflect the evolutions of the subject.

CHAPTER 1

Towards a new way of transmitting knowledge

> "Parce que l'homme est un être social qui tire l'essentiel de sa force du groupe auquel il appartient, l'échange tient dans son existence une place primordiale. […] Sans la communication, le savoir ne serait rien."
> (*Because humans are social beings who derive most of their strength from the group to which they belong, exchange holds a primordial place in their lives. […] Without communication, knowledge would be nothing.*)
> Jean-Paul Pigasse, 1981

THE ORIGINS

Before 1665, researchers communicated their discoveries and inventions by sending letters to each other, which necessarily meant that they knew each

other. As a result, their network was hardly likely to expand. They could also exchange information in meetings and seminars. Or spread their knowledge by accumulating it in books. There was no way to disseminate research results widely in fragmentary increments, although it was known then that the progress of Science was essentially based on the sharing and accumulation of very partial elements, as Bernard de Chartres' metaphor (often attributed to Isaac Newton) puts it: "We are dwarves hoisted on the shoulders of giants."

In 1665 the first issue of the Philosophical Transactions of the Royal Society of London was published. Still in operation today, the journal claims authorship of the concepts of 'scientific priority' and 'peer review' as well as the creation of archives. It was in the air: the Journal des Sçavants was born the same year in Paris and announced its objective: "*to publish a weekly journal, to let it be known what is happening again in the Republic of Letters*".

Two centuries after the invention of printing, these initiatives represent a major step in the evolution of knowledge transmission. By allowing the publication of reports of experiences or specific technical advances, they have initiated a much faster and more fruitful process, giving the possibility to science to be developed in small steps, by the individual and almost anecdotal contribution of bricks to build the edifice.

This modus operandi has ruled science until today, allowing the reproduction of observations and the construction of new theories and demonstrations. Originally, it is learned societies that handled the publishing: editing, printing and distributing. Subsequently, with few exceptions, these societies started using specialised subcontractors to print, bind and distribute, often retaining only the editing, i.e. selecting the articles, organising the reviewing by peers and taking the final decision to publish.

Hence private publishing houses appeared, taking charge of the technical stages and thriving to the point of increasingly taking on the publishing mission itself. They called on the contribution of skilled researchers whose expertise was generally recognised by their peers (or selected as such by the publisher) and who became responsible for the revision, quality,

validity, ethics and the final decision to publish or not. They used even more specialised experts as reviewers to read the manuscripts extensively and to give their opinion on the quality of the publication, possible corrections, often pointing at the need for rewriting, or even for additional experiments or observations.

These two missions (editing and reviewing) were carried out by scientists considered suitable and supposedly neutral. This immediately raises the objection of the conflict of interest: when one is strongly involved in a research subject, can one remain neutral towards a potential competitor while having the power to slow down or recommend the rejection of a publication? Or while having the temptation, even subconsciously, to be tempted to find inspiration in these results?

Editors are most often paid — or at least rewarded in some way — for their work[1], while the reviewers are very generally not. The publisher makes the final decision based — or not — on the opinion of the reviewers and the editor, and more often than not, he/she justifies his/her decision based on their opinion or recommendation. In this whole process, the

[1] This remuneration or reward often makes them unconditional allies of their publishing houses and opponents of open access. Publishers use this resistance to demonstrate that the scientific community is not homogeneous in its rejection of the system… Faced with the abuses they faced, some of them nevertheless resigned from these charges with a resounding resignation.

author knows only the publisher. He/she is often informed of the identity of the editor, but the reviewer almost always remains anonymous.

In the 20th century, the growth of research and the resources allocated to it transformed scientific publishing into a flourishing business for publishers who grew through acquisitions and formed huge multinational consortia with sales in the billions of dollars and profit margins that could reach or exceed 40%. These profits are all the more unacceptable as they are made up essentially of public funding.

By taking the best care of the quality of their work, some publishing houses have quickly enjoyed growing prestige, linked to the judicious selection of the articles they publish. This prestige quickly found itself at the heart of all the problems of scientific publication, reaching their peak at the dawn of the 21st century. Thus, scientific production was quickly swept away in a vicious spiral centered on the interests of publishing houses, which can be summarised in 6 points:

1. Publishing with a prestigious publisher has become a source of pride, which is a very powerful motivator for the researcher because it impresses any evaluator responsible for judging the quality of his/her work. For such an honour, the researcher goes so far as to agree to waive his/her legitimate copyright.

2. The limitation imposed by printing and distributing has made the profession increasingly competitive and has therefore contributed to increasing the publishers' prestige and, consequently, their prices.

3. The cost of the journal has thus increased to the point of making the business extremely lucrative. The escalation of profits has allowed large publishing houses to carry out large-scale buy-outs that have led to the near extinction of smaller houses and created huge, outrageously profitable and powerful multinationals capable of buying public or non-for-profit initiatives as well as many start-ups that are innovative in scientific publishing.

4. The resources generated by this trade have enabled the major publishers to gradually control the entire market and its tags. Among the acquisitions made in 1992 by Thomson-Reuter was the independent Institute for Scientific Information (ISI) founded by Eugene Garfield in 1960[2], which had developed the annual calculation of a journal impact index, proportional to the average number of citations of articles published in the previous two years. In the meantime, this so-called "impact factor" (IF), conceived as an honest measurement of the impact of the

[2] Now Thomson-ISI, it was subsequently sold to Onex Corporation and Baring Private Equity Asia and now operates under the name Clarivate Analytics.

journal[3], has become, out of laziness on the part of the evaluators, a quick criterion almost universally used to evaluate an isolated article published in a journal (abusive in 86% of cases), as demonstrated for Nature magazine in 2015, but also verifiable for all newspapers with high IF, this effect being particularly marked for journals covering a very broad spectrum). Moreover, within the academic community, this scientifically unacceptable practice has spread very effectively to the point of being used for the evaluation of researchers themselves, which constitutes an even more abusive extension and an unforgivable scientific heresy. The acquisition of the tool to measure the prestige of scientific journals by a publisher is a glaring conflict of interest — much as if McDonald's was buying out the World Health Organisation… — This is all the more so as a highly questionable notion of "citable article" has recently appeared in the IF measure, making it possible to eliminate from the calculation a category of articles that are by nature rarely cited. Such abuses have been officially banned by the many research or funding institutions that have signed the San Francisco Declaration on Research Assessment (DORA) since 2012. This statement affirms the need to improve the way research results are evaluated.

3 Provided that the quotation is given a value indicative of that of the quoted article, which remains debatable.

It is a global initiative covering all disciplines and stakeholders, donors, publishers, professional societies, institutions and researchers. It must be noted that, despite this display of good resolutions, in practice and despite its scientifically heretical nature, the IF remains today the most widely used means of evaluating a researcher because it cultivates the illusion of objectivity, but above all because it minimises the evaluator's effort. It is time to denounce its use in the evaluation of a researcher as a breach of ethics.

5. The unfortunate practice of encouraging researchers to publish a lot (by adding the number of articles published but also by taking into consideration the arithmetic sum of the values of the impact factors corresponding to each article, an incredible intellectual aberration!) causes an overproduction of publications. This multiplication leads to a decrease in the average quality of the articles, many retractions (the retraction factor turns out to be directly proportional to the impact factor) and a significant decrease in the readership of each article. In 2012, it was estimated that 1.8 million articles were published annually in about 28,000 journals. Who reads these newspapers? Few people: half of the academic articles would be read only by their authors and newspaper publishers. Who buys all these newspapers? No university in the

world can do that. Harvard itself claims that they cannot afford them all.

6. Finally, to ensure the consistency or even the growth of their revenues, scientific publishers have developed the habit of requiring authors to completely abandon not only their remuneration rights, but also their exploitation rights, which ensures the moral (and legal) imprisonment of the researcher when his/her publication is accepted.

As you have understood, the researcher plays almost all the roles:
— as an author, he/she carries out the research and writes the article to disseminate the results, receives a salary or scholarship from his/her university or research centre or foundation but does not receive any money from the publisher. In some circumstances, he/she (or his/her institution or funder) even pays to publish (which amounts to self-editing…);
— as an expert reviser, he/she is a volunteer, generally anonymous. He/she does not receive any money from the publisher;
— as a reader, he/she (or their institution) pays to get access to the articles.

In summary, the most visible effects of outsourcing the publication process have been multiple: 1) the compulsory abandonment by authors of their legitimate rights to reuse their

own work; 2) the spectacular inflation of subscription fees (400% over two decades), a much faster rate than that of consumer prices, due to an almost monopolistic situation known as "oligopolistic"; 3) the unreasonable multiplication of publications, including unnecessary duplications and repetitions, article splits, plagiarisms, not to mention various falsifications and frauds.

A TENACIOUS TRADITION

The era of printed paper has imposed a format on scientific communication. The advent of photography, capable of transmitting much more precise information than text in many cases, has enabled a development whose challenge was quickly met. Despite its essential nature as a research tool integrated into observation or experimentation, cinematography has completely failed, remaining confined to accompanying oral presentations or through fixed views representative of the recorded movement. This failure has been — and still is — also that of the video, of course, with some exceptions. Such conservatism is surprising, since the moving image has become a popular communication tool par excellence. It reveals the industry's hold on the scientific community, whose legendary creativity requires both audacity and innovation.

It must be said that the most advanced techniques are used daily by researchers in their research work but, when it comes to reporting the results and conclusions drawn from them, they stopped in the 20th century, facing the straitjacket of traditional publishing.

THE THIRD TURNING POINT

After the invention of printing in the 15th century and of the scientific journal two centuries later, we have now entered the era of computers and their applications with, in the field of communication, the Worldwide Web, born at the end of the 20th century. Each of these inventions was a major turning point for the dissemination of science. We should probably not be too impatient to take advantage of this latest development.

However, since each of them significantly accelerates the collectivisation of knowledge, we can still be surprised at the lack of responsiveness of the research world compared to the rapid evolution of social networks, to take just one example, which is of course not chosen at random.

Indeed, these new means of interaction make it possible for everyone to use ultra-efficient, fast and effective techniques that make it possible to

communicate. Their slowness to establish themselves in the world of research is, according to academic circles, a reflection of a firm desire to resist any hollow, useless and often perverse, sometimes fraudulent, communication. It is supposed to be preserved to build a solid wall between the ancestral system initiated 350 years ago and the chatter or uncontrolled manipulation that is flourishing abundantly today.

Obviously this fails to take into account, on the one hand, the invasiveness of these new tools, particularly with regard to the generation that will soon take control and, on the other hand, the fact that it is definitely possible to exercise a rigorous surveilance, accepted by the community, of the credibility, reproducibility[4] and reliability of research in a modernised system, thus ensuring its validation.

4 When we say "reproducibility of research", we do not mean "repeating experiments already carried out", which is only rarely useful, except in some applied areas. Rather, it refers to the possibility of relying sufficiently on the methods used as described. A researcher must afford to rely on the publication of a peer to make progress. It is clear that a reviewer is never asked to verify the reproducibility of a research by reproducing it him/herself!

Today, the advent of digital technology at all levels of research and publication makes it easier to build a «verifiable science» by putting underlying data and processing procedures online.

In this regard, it is important to remember that publication remains, probably wrongly, one of the few - if not the only - bases for recognising the researcher's merits. Moreover, the strict control of the validity of a research project, the famous peer review, an unshakeable pillar of the scientific process, does not escape the criticism, more and more frequent, of its objectivity. We will come back to this later.

CONCLUSION: AN OBSOLETE PRACTICE

Even if the online publication frees up from paper printing, at least partially, the scientific article remains constructed as it has been for more than three centuries, with rare exceptions: formatted text and images. Surprisingly, the remarkable inventive capacity of researchers to develop and use increasingly sophisticated techniques in their own research is largely lost when it comes to reporting, making known and sharing.

It is obvious that the next step, in terms of the design of the scientific article, must move it as

quickly as possible towards a form that exploits the potential of digital technology, not only in the way information is transmitted but also and above all in the way the message is constructed, its form and its didactic quality.

CHAPTER 2

Towards a true sharing of knowledge

> *"As knowledge is a public good that must be accessible to all, there should be no exclusion in a knowledge society. But knowledge sharing cannot be reduced to a partition of knowledge or the exchange of a scarce resource that nations, societies and individuals compete for. Knowledge sharing is a growth multiplier."*
>
> (Koïchiro Matsuura, 2006)

SCIENCE AS A COMMON GOOD?

There is now a widespread view that the right to knowledge must be given the status of a fundamental human right as an integral part of the right to education.

Indeed, the rise of obscurantism, which is usually attributed to regimes of strict religious observance and whose progression can be seen with the advent, on 20 January 2017, of scientific negativism to the power of the greatest Western power, must challenge us to the highest degree.

However, we are still far from a recognition of knowledge as a public good, particularly in the scientific field, where knowledge is produced by research, disseminated through publications which, as their name suggests, are intended to make it public, but which, in most cases, are accessible only against payment.

Defining what constitutes a common good or possibly a public good may lead us into endless discussions. Indeed, the angle under which this question is considered varies according to each interlocutor and, moreover, according to the country where one is located. The definitions of these concepts are multiple and varied. I will therefore choose here the one that seems to me to be the most satisfactory for the logic and understanding of the subject.

The most immediate approach is to consider two simple criteria: is a property exclusive or not? Is it competitive or not? By exclusive, we mean that if it belongs to someone or a group of people, it cannot belong to anyone else, even if the owner can leave its enjoyment to others on the basis of a lease. By competitive, let us unders-

tand that the good exists in such a quantity that any possible sharing meets a limit beyond which no one can also use it. We can then consider the following classification table, where an exclusive and competitive good is private, where an exclusive and non-competitive good is priced, where a non-exclusive and competitive good is common and where a non-exclusive and non-competitive good is public:

Table 1 *— Characteristics of the goods*

	EXCLUSIVE	NON-EXCLUSIVE
Competitive	*Private*	*Common*
Non-competitive	*Priced*	*Public*

The standard example of *private good* is private property, exclusive since it belongs to an owner and competitive since, initially and in principle, anyone can acquire it. The responsibility for the management of the property rests with the legitimate owner (individual, organisation, company…).

On the other hand, roads are generally a *public good*, they are not competitive (up to a certain point of congestion, where they become a common good!). This section also includes air quality, climate, biodiversity and… the World-wide Web with, in its wake, cooperative initia-

tives such as Wikipedia. The responsibility for a public good is collective and must be recognised and assumed by all users. They are frequently represented by constituents (political or associative).

In the category of *priced goods*, there is the toll-road or encrypted television, the responsibility of which lies with the exclusive owner.

Finally, community gardening plots or orchards are considered as *common goods*, for which the responsibility rests with the community that uses them, according to terms and conditions defined by the community itself.

Register at Stanford University, for example, and you will quickly understand that you are in the «private good» box, exclusive and competitive. Try to read a scientific article published by a publisher who will only provide it for a fee and you will quickly understand that the knowledge it contains and which is possibly essential to you is confined in the «priced good» — exclusive and non-competitive — box.

If we are to try to classify knowledge among these four definitions, it is obviously as a *public good* that we should do so (and not, as we often hear, as a common good, since it is not — and should not be — in any way competitive). In this line, Wikipedia's approach, from which the worst

could a priori be expected and which on the contrary proves rather convincing, foreshadows the idealised path of free access to knowledge, on which we pay neither to publish nor to read. Indeed, if everyone can find imperfections in it — especially in their own field of competence (but not much more so than when they are asked as peers reviewer!) — we can affirm that its evolution is rather reassuring. These findings should also make us think about the supposedly unavoidable nature of peer review, but this is another debate that we will discuss later.

Unfortunately, even today, science, knowledge, the fruits of public research and even education and training are, to varying degrees and with varying obstacles, still far from being assimilated to public goods.

For the buyer, paying to read is first and foremost, let's be pragmatic, paying to determine if the content is of interest to him/her. In most cases, the answer will be no. For many researchers, in the vast diversity of their professional status, such a probe approach becomes quickly excessively expensive when this quest involves a large number of articles. It then only discourages the reader who spontaneously falls back on the articles that he/she can most easily find, those

that are displayed in their entirety on his/her computer screen or tablet.

The practical and often observed result is twofold:

1. As the article is hidden behind an opaque toll gate, the researcher neglects to examine its content even though this article may have proved to be the most interesting, the most appropriate for his purpose and perhaps even the one that should benefit from the precedence recognition. The researcher then relies only on articles available online. In a system locked by the publisher, if the reasoning is followed through, the available article is likely to be less legitimately cited than the unavailable article, which is not acceptable in all fairness. Therefore, it is important to ensure that all items are available immediately and unimpeded. And we must also ensure that publishers do not manage to lock the system and that, if they do, the system itself dies bloodless. Legitimate pressure from the research community for absolute freedom of communication will always prevail. We would be wise to know it and to be well prepared for it.

2. A researcher who complies with all the requirements of publication in a reputable journal as required by his/her hierarchy will have his article much less read and later than those which are immediately available. Through a kind of natural selection, the effect will be detrimental

to the advancement of knowledge and will harm the best researchers.

Therefore, it must be ensured that the opening is immediate in all cases. We will see that there are several ways to do this, the most interesting in many respects being, on the one hand, the preprint, a version submitted or to be submitted by the author(s) for review prior to any peer review process and, on the other hand, open and free publication on a public and inexpensive platform.

Many in the scientific research community today believe that the necessary elements are in place to move scientific knowledge from the «priced good» to the «public good» box. The main argument is that research is carried out with public funds and that, therefore, its results should be available to all without barriers.

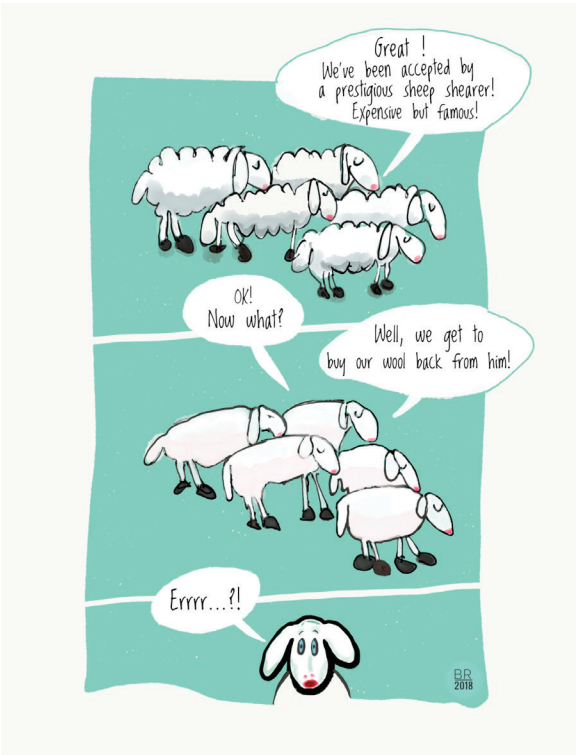
The second argument is linked to the very nature of the scientific community's investment where the researcher designs the research, prepares for it, submits it to a funding body, conducts it, writes a publication that he submits free of charge to a publisher to whom he abandons the exploitation rights and any remuneration and then buys the final product from it. He has often also done the work of proofreading and

evaluating the work of colleagues, on a voluntary basis for the benefit of the publisher.

The scientific community therefore does all the work, with the exception of hunting for expert reviewers, printing and distributing. It is understandable that, since the technical means of dissemination have become what they are, the scientific community is getting emotional and contemplating the prospect of ensuring the entire process once again. As for his/her willingness to take action, that's another story…

Finally, a third argument lies in the incongruence, today, of seeing the researcher transfer to the publisher all his fundamental rights as an author on his text, figures, codes and data and of not being able to reuse them him/herself in any form whatsoever for the legal duration of copyright, generally 70 years. This is a leonine condition unilaterally imposed by the publisher as an absolute prerequisite for publication.

This system, which, from a psychological point of view, is similar to the one that prevails quite widely in the field of artistic production, is based on the prestige of the publisher. If the evaluators did not reflect this prestige on the author, he/she could be freed from this enslavement…



EVERYTHING COMES AT A PRICE

Let's be clear: all work deserves remuneration and if work is requested by researchers from a third party to make the results of their research public, it is obvious that this work must be paid. But it also goes without saying that this must be done

in proportion to the work done. To claim that everything is free in the process of disseminating knowledge is obviously an aberration, unless no work is asked of anyone other than the researcher him/herself, who may consider that his/her salary is sufficient and who, since the existence of the Web, may deposit his/her work free of charge online, in full view of all.

However, if he/she wishes to have his/her publication validated by reliable and experienced peers and to increase the visibility of his/her production, he/she will generally be dependent on other stakeholders who could monetise their contribution. This is where, from the "public good" box, we go to the "priced good" box and even, if the intervener reserves the right to refuse publication, or exaggerates the cost, in the "private good" box.

There is nothing shocking about this approach as long as it is mutually agreed to with full knowledge of the facts. What is striking is the drift of the interveners who, taking advantage of an oligopoly linked to prestige (built successfully over time and which cannot be denied), keep practicing regular and disproportionate tariff increases that they justify by the competitive nature of their services. It is largely such drifts, often exorbitant, confronted with the current technical ease of doing a significant part of the work oneself, that were at the origin of the

growing Open Access (OA) movement around the world, as we will see.

> Today, the Web offers a fast and universal means of communication. It can give the researcher full control over his/her publication. Provided he/she wants to. Or is allowed to want to...

This vast and growing movement whose emergence and evolution I will describe below, does not reject payment for services rendered. He only pleads in favour of a fair proportionality between the work done and the price charged. It remains high for the publishing, production, delivery, distribution and sale of books such as books. It is becoming increasingly unjustified for articles whose purpose is to communicate very quickly partial elements of an often much broader research and for which the printed version is no longer essential since the availability of the Web.

It goes without saying that there is a danger of ephemeral conservation of these documents, but current techniques and their future evolution make it possible to be reassured on this point. There is nothing to prevent anxious people from keeping printed copies of their work.

Finally, this current ease of posting on the Web frightens many people, on the pretext that

such a practice would make the security of peer review disappear. This means forgetting that organising this revision is not the prerogative of the publisher but of the academic editor and that the revisers are also researchers.

SCIENCE AS A PUBLIC GOOD?

Proclaiming the public nature of science has become as trivial as it is controversial. Many people are calling for more research and more funding for it, considering that science is not only economically but also morally indispensable. At the same time, its detractors are questioning the type of science we want or blaming techno-science for the environmental and health damage produced by its deployment. The difficulty is that science is not only public, it is also private, and the confrontation (and sometimes collusion?) between universities, governments and the business world is an ancient, profound and sometimes blurred phenomenon. Although transparency is definitely a challenge, it is now essential.

CONCLUSION: ACCESS TO KNOWLEDGE IS DEFINITELY A FUNDAMENTAL RIGHT

As I mentioned earlier, access to knowledge should obtain the status of a fundamental human

right as an integral part of the right to education. Yet, we are still far from a recognition of knowledge as a public good, particularly in the scientific field, where knowledge is produced by research, disseminated through publications which, as their name suggests, are intended to make it public, but which, in most cases, are still only accessible against payment.

CHAPTER 3

Towards free access to publications

> "*Open access to scientific information is a cornerstone of a modern Open Science system. [… The] revised Recommendation provides very powerful guidance to the Member States so that they can reach their goal of transition to immediate open access as the default by 2020.*"
>
> (Carlos Moedas, 2018)

THE EPIC OF OPEN ACCESS

The means now exist to meet the conditions of universal openness, with what is called Open Access (OA), meaning "open access to scientific information resulting from research". In 2010, the European Commission defined open access as "a

model that provides free access, use and reuse to readers on the Internet".

> A public good is, by definition, universally accessible, non-competitive and non-exclusive, which implies free access and the absence of any technical barriers.

Born in the mid-1990s, the international open access movement was organised during the 2000's and became practically unavoidable during the 2010 decade. Even large publisher consortia must admit that the trend has become irreversible.

The first logic proposed was to completely overturn the system by making it independent of the constraints set unilaterally by publishers. This is the path launched by Paul Ginsparg who, in 1991, created arXiv a repository of electronic pre-publications of scientific articles. ArXiv was rapidly adopted mainly by physicists, mathematicians, astrophysicists and computer scientists. It is freely accessible on the Web. Actively supported by Cornell University since 2010, built on the principle of "free publication and free reading", it is the gold standard of Open Access, the "Gold Route" now called Gold OA.

Pre-publication allows for a very open discussion with peers and, surprisingly, does not

prevent the subsequent publication of an improved — or even significantly modified — version of the article through this pre-broadcast in a traditional circuit newspaper. Neither arXiv nor its users have ever been bothered by publishers and, to my knowledge, pre-publication has never justified the refusal of subsequent publication in an established journal.

As this elegant solution did not immediately resonate in other fields of science, Stevan Harnad launched a provocative concept in 1994 in a short founding article entitled "A Subversive Proposal". He also suggested a name: the "Green Route to Open Access", evoking a less radically direct but more enchanting path…

In this Green OA model, authors submit their articles in the traditional way to a publisher, through all the usual stages (peer review, modifications and additions requested, signature of contract, acceptance of conditions, waiver of copyright, possible embargo period, etc.) and in parallel, as soon as their manuscripts are accepted, they simply deposit them in extenso in the digital archive of (or recommended by) their institution. Harnad was of course aware that this approach could not immediately change the traditional scientific publishing system, but he hoped that, as the movement grew, it could eventually undermine the foundations of the system and turn it upside down in the long run.

Indeed, this approach somewhat alleviates the difficulty by affecting only at the margin the profits of publishers, at least initially, thus avoiding a head-on clash. In the long run, it is expected to undermine the traditional mode of publication by invalidating the business model of scientific publishers. The main targets are the "majors", the five giants of scientific publishing (Elsevier, Springer, Wiley, Kluwer and Thomson-Reuters) who now share among themselvesr not only two thirds of the production but also about 95% of the university documentation budgets. To simplify my point, and to make a clear distinction between the five large multinationals in publishing and the smaller, less guilty companies, I will now refer to these five by calling them the "shark-publishers".

It goes without saying that such a defence policy can only irritate — to say the least — "reasonable" publishers, whose shoulders are less robust and whose profit margins are much more decent. Unfortunately, the defence mechanisms that researchers are developing against sharks kill harmless and useful fish first.

It is the ultra-capitalist globalised mechanism of scientific publishing that should be held responsible for collateral damage, not universities and the world of research. Researchers and dignified publishers are jointly the victims, one can only regret it.

The following anecdote is just one of many episodes in the Open Access epic and illustrates the ongoing trench warfare between shark-publishers and the research community. The quotation at the beginning of this chapter, which dates from January 2012, expressly refers to a bill tabled in the US House of Representatives in December 2011: "Prohibits a federal agency from adopting, maintaining, continuing, or otherwise engaging in any policy, program, or other activity that: (1) causes, permits, or authorises network dissemination of any private-sector research work without the prior consent of the publisher; or (2) requires that any actual or prospective author, or the author's employer, assent to such network dissemination." You have certainly understood with dismay that this is about halting the remarkable pioneering initiatives of the U.S. National Institutes of Health that were meant to promote open access to the research they are funding.

WHAT EXACTLY IS OPEN ACCESS: OPEN OR LIBRE?

What is it and what are its outlines? A perfect answer can be found in the preface by Marin Dacos to the French edition of Peter Suber's excellent book "Open Access" (which is an absolute reference in my opinion, though clearly marked by the American academic ecosystem). I quote (and take the liberty to translate) Dacos:

> "The term 'open' means open, not free. It therefore implies that the text of an article in Open Access is open for reading, without legal, technical or commercial barriers. But it says nothing about the possibilities of reusing the document. Therefore, stricto sensu, Open Access removes barriers to access and maintains all copyright protections on texts, which means that they may only be reproduced or modified after explicit authorisation, as part of a contract of assignment of rights. The main exception to this protection is the right of short quotation, which allows readers to quote the work as long as the excerpt quoted is brief […]. Open access goes much further: it grants additional rights to the reader, i.e. liberties. Among them, the right to share, and therefore to publicise, is the most important. Some versions of open access even grant a right to modify the original work, but this is rarely discussed in the context of academic publication, for obvious reasons of documentary integrity. It is important to return here to the fundamental freedom of having the right

> to share/re-disseminate the document. This freedom means that everyone has the right to republish the work, for example on a website, in a printed anthology or on a mailing list… It therefore means that it is permissible to quote lengthy excerpts from a work, or even the entire work, in any other work, without having to ask for permission. The condition for all these reuses is, of course, to acknowledge his authorship."

Dacos then decides in favour of two simple terms: "Accès Ouvert" will be the French translation of Open Access, i. e. allowing reading, and "Accès Libre" will be that of Open Open Access, i. e. allowing reading and reuse in any form whatsoever. The nuance may seem subtle, but it is important, as the technical conditions are very different. The authors can define exactly what they want for their online manuscript if they protect it using appropriate licenses (see Appendix 2).

MORE THAN A TECHNIQUE, OPEN ACCESS IS A CAUSE

As we can understand, the cause of Open Access is essential, not so much because it could eventually relieve universities of the unreasonable financial burden imposed on them by companies in a position of virtual monopoly, but because it

will make it possible for researchers whose institutions cannot afford to obtain the literature necessary for their research and confiscated outrageously and because it will provide free access to it.

"What is publicly funded must be accessible publicly and unfettered by anyone on our planet." One might think that this principle applies within a nation and that each of them is limited to promoting the "each for oneself". "British public research must benefit British economy", did I hear a while ago. And it could be claimed in any developed country. Fortunately, this is not the case: the great tradition of fundamental and disinterested research is that Science should be global and should be shared with the entire World.

> When this action takes on a truly global dimension is when generous sharing replaces paid exchange and becomes the best guarantee for the education of peoples, the fight against dogmas, prejudice and empirical beliefs, when it builds the prevention of the fanaticism and extremism with which our Earth is infected.

This openness to scientific publications has already proved its effectiveness on a large scale, as demonstrated by the initiatives of the Human

Genome Project (HGP) or the Global Fight against Malaria.

IGNORANCE AND WASTE

Finally, there is now a huge gap in the communication of scientific information: it is almost never possible for researchers to share negative results or experimental failures. No publisher agrees to publish them even though it is imperative that they be known. Indeed, for the researchers, they sometimes represent a considerable amount of work that will not be taken into account when they are subjected to an evaluation. But above all, the lack of knowledge of this work allows other researchers to pursue the same dead-end paths, multiplying the wastage of forces and resources. Interaction between researchers must therefore include all research achievements, whether glorious or not.

> Only public platforms will be able to publish negative results and it will be necessary to ensure that they do so effectively.

THE USURPATORS: A DANGEROUS INVERSION OF THE MODEL

The imperative of excessive profit remains an immutable commercial principle. Faced with a foreseeable reduction in subscription profits, publishers have chosen to reverse the principle and demand payment no longer for reading, but for publishing. These fees are called **article processing charges (APCs)**. Building on their prestige, they convince researchers to publish in their journals, thus consolidating their oligopoly on high-end scientific publishing. Worse still, they offer so-called hybrid formulas, which allow them to continue printing and selling their journals while offering authors to pay APCs for immediate online publication of their articles, thus winning on both sides, a system which has been dubbed "double-dipping" by the research community.

It did not take long before the same price escalation for APCs as that seen for journal subscriptions over the past three decades occurred. In some cases, the increase can even reach 30% from one year to the next! And of course the people in charge are blaming Open Access itself rather than its perverted side effects.

> Today, the struggle consists no longer so much in giving free and immediate access to knowledge — even in the least favoured countries — but rather in preventing that only wealthy researchers can express themselves. This would be appalling and discriminatory development which, after having restored sight to a majority of the scientific community, deprives it of its voice.

And the danger is spreading to many research funding agencies and even to some governments, who believe they are solving the problem but aggravate it by offering to cover the payment of APCs and including them in research grants, as if this were the solution when it is only a reversal of the process. The balance sheet is, at a minimum, a status quo of the financial flow substracted from public research that ends up in private funds.

Let's be clear: sharks cannot be blamed for being voracious, it is in their nature, just as a lion can be asked to become a vegetarian. So let's let the businessmen do their job. But let us ask ourselves if, on the side of universities, funding agencies and governments, we really have to comply with these extreme conditions. Let's ask ourselves if we can continue to waste public money by spending excessive amounts where, if

not to flatter the ego of the researcher or to satisfy the requirements of his evaluators and hierarchy, it would be very easy to develop another system for the dissemination of knowledge.

And beyond financial considerations, let us ask ourselves about access to scientific information for millions of people who today have free access only to what circulates on the Web, many of whom do not offer the slightest guarantee of quality, honesty and intellectual rigour.

INITIATIVES TOWARDS INDEPENDANCE

The only way to counter this unbearable drift is undoubtedly to create public and free electronic publication platforms, in short a return to the authentic Golden Route. Nothing complicated, nothing new, such initiatives exist today. Alongside arXiv, we have recently seen the emergence of new pub lication platforms such as BioRxiv in biology in 2013, ChemRxiv in chemistry and SocArXiv in sociology in 2016, EarthArXiv and ESSOAR in geosciences in 2018, AgriXiv in agriculture, EngrXiv in engineering, MarXiv in oceanology and marine climatology, NutriXiv in nutritional sciences, PaleorXiv in paleontology, PsyArXiv in psychology, LawArXiv in law, SportRXiv in sports science and LIS Scholarship Archive in library and information science. And

let us add Frenxiv and Arabixiv for all subjects in French or Arabic, respectively. We really can't pretend we're short of resources…

It remains for the scientific community worldwide to adhere to it and to ban the criteria for evaluating research and researchers based solely on the prestige of publishers. It is also necessary to ensure that these collective and generous initiatives do not suffer the fate of their predecessors like Mendeley (acquired by Elsevier in 2013), SSRN (acquired by Elsevier in 2016), or Science Metrix acquired by Elsevier in 2019). It is a real cultural revolution that will, alas, still take time to impose its common sense, but it is absolutely critical.

The question today is: will rigidity, anachronism and financial greed kill scientific communication in an era of global hyper-communication?

Today, everyone communicates, and increasingly, through social networks, blogs and websites. The new generations are literally immersed in the new means of communication. Whether we wish it or try to avoid it, these means will inevitably be used in the context of communication of science in general and research results in particular. It is useless to resist a fundamental movement of this magnitude, it

must be organised rather than be allowed to settle in an uncontrolled way.

BUT WHERE ARE THE OBSTACLES?

The first obstacle is rigidity. Conservatism in the style and format of the scientific publication as well as in its immutability and finality is considered by many to be a guarantee of its quality. However, it no longer corresponds at all to the broadcasting technologies used by the majority of young people who are nowadays called "digital natives". All over the world, researchers' evaluation methods are too often based on criteria that are certainly practical but unjustifiable. This gap between a secure tradition and available resources is increasing day by day and new forums for discussion of science are emerging. It is imperative that some form of regulation is put in place and ensures quality control. However, as always, technology will be right.

The second obstacle is the greed of the major publishing houses, which have now become international financial companies. The financial implications are now so significant that no further steps can be expected from them if it reduces their profit margin. These companies contribute to maintaining rigidity by masking it under the guise of a qualitative added value

and a rigorous selection. In addition, they flatter the ego of researchers by using them as experts and striving to maintain a high impact factor for their journals to maintain their prevalence in the judgment that informs academic decisions.

The third obstacle is the researchers' own ignorance of the functioning of the system. By being badly swindled in this way, they become largely unconscious victims of their misfortune. Why? Because they have no idea of the costs of documentation, never being personally confronted with it (unless they get involved in the management of their library). They generally expect their institution to provide them with all the scientific documentation they need, in addition to basic equipment and financial, human and administrative resources. Costs are of little importance to them, since they rarely realise that they are competing with the other resources they claim.

> Publishers benefit enormously from the internal structural silos of research institutions that relieve the researchers of some of their financial concerns.

The researchers themselves thus contribute to the perpetuation of the system through their thirst for prestige. Publishing in a prestigious newspaper remains their number one objective.

In their defense, it is not necessarily a reflection of their narcissism - even if it can be! - but above all, it is a desire to comply with the requirements of the evaluators responsible for assessing their merits.

The fourth obstacle is the hierarchy of the academic world, evaluation processes, peer reviewers and various juries.

Indeed, in a utopian — but almost universally widespread —claim to quantify quality, evaluators of all kinds, whether in universities or within research funding bodies, use staggering shortcuts to represent the value of a researcher, research team, department or university by a single number. Characterisation by a simple number also makes it possible to rank them, a total illusion of objectivity that human beings are extremely fond of, especially when they have to make a choice. Even if no one is fooled anymore, everyone pretends to believe it and no one takes the risk of giving up the criterion.

This is true, both to choose a university based on its ranking, and to buy a record based on its place in a hit parade or a book based on its classification in a list of best sellers, although the comparison is misleading because in the latter two cases, the criteria for establishing the ranking have at least the merit of being objective (if not significant).

Measuring the quality of a researcher and his/her impact on Science by measuring the impact of the journals in which he/she publishes is a practice — I should say dodging because it avoids substantive examination, which is much more time- and energy-consuming, as well as more demanding in terms of competence and expertise — which maintains, even encourages, overproduction and consequently the decline in the quality of scientific publications on average. Little read, publications are often used only to add lines to the author's curriculum vitae rather than to effectively disseminate knowledge. To remain competitive, since this is the norm, researchers must comply with known and announced requirements. Currently, to put it simply, it is better to publish many mediocre articles than few excellent ones.

> Researchers are victims of the epidemic of rankings and numerical evaluations at any time during their careers and their behaviour will therefore be entirely devoted to trying to move up in these rankings.

And in saying this, I use one of the most common terms in the field of evaluation and the least well defined: the sacrosanct excellence. Everyone talks about it and thinks they can imagine it, yet everyone has a different vision.

The researchers strive to achieve a form of excellence that they believe is taken into account by the evaluators they encounters along the way and, in general, have quickly understood that the rapid, even expeditious, measurement of excellence is the famous impact factor or its substitutes (h-index, etc.).

The fifth obstacle is with academic authorities, rectors, presidents, vice-chancellors, etc. In principle, they should be sensitive to several key elements:

1. The need, for the proper management of their institution, to know its scientific production and therefore to have a complete inventory of it. As much as is unthinkable that a business owner should ignore the quantity and especially the quality of the products that are produced there, it is also true for a university executive (even if the university is not a company like any other).
2. The need to be able to refer to fairer and more justified criteria in order to improve decision-making processes regarding researchers' careers and the various incentives to grant researchers at any level.
3. The need, for the proper management of the institution's documentary acquisitions, both in teaching and research, to better know and understand the needs of researchers and teachers

and to adapt institutional policy to the realities on the ground.

However, this is still not the case in many academic and research institutions. If almost all of them have acquired, during the last ten years, an electronic archive, it is far from containing all the in-house production… A European study in 2015 lead by Alma Swan showed how few universities applied a real obligation to archive linked to evaluation processes (see page 27 of the study's report).

The sixth obstacle is the fantasy of illegality, some researchers fearing not only the judgment of evaluators but also the vindictiveness of publishers. They believe that they are putting themselves in danger by depositing their manuscripts in their institution's archive or that they will be blacklisted by publishers. It is important to reassure them, but it is equally important to ensure that they do respect their commitments and, in particular, the embargo periods that they have accepted by contract. Compliance with this deadline does not interfere in any way with the filing as it can take place as soon as the manuscript is accepted for publication and remain temporarily accessible on individual request.

It would of course be simpler if they did not sign anything of the kind and if they even boycotted publishers who require these embar-

goes. It would also be good if they avoided publishing, even in OA, with a publisher who requires an APC to publish. "Green" OA does not have these requirements, the researcher has nothing to fear on this side, nor do universities. But both of them are never as reassured as if their national government (in Belgium, the Community government is responsible) covers them by authorising or, even better, by releasing any personal liability on the part of the most fearful, by ordering the deposit of the latest "author" version of their publication in an electronic archive, and its opening as soon as they can.

CHARACTERISTICS OF THE SEVERAL VARIATIONS ON THE THEME OF OPEN ACCESS

The Open Access landscape has become very complex, with a range of colours that fortunately almost no one has adopted (after gold and green, we have seen platinum, diamond, etc.). In an attempt to clarify the situation and with only the main variations that are actually being used, Appendix 1 analyses the characteristics, pros and cons of each formula. A rating assigns a subjective score to each of the variants based on their comparative strengths and weaknesses.

IN PRACTICE, WHAT CAN WE DO?

Researchers cannot be expected to lead the fight for the openness of Science at the risk of jeopardising their own careers. It is at the level of institutional leaders that the will must be firmly stated, based on a good understanding and on the common interest. Personally, this is what I wanted to do when, for almost a decade, I was at the helm of an academic institution, imposing a top-down obligation to deposit scientific articles from researchers at my university in the institution's electronic archive, at the risk of being considered a despot imposing additional tasks on its researchers.

This is how I was perceived outside the institution, but very quickly, the Liège academics readily acknowledged that this order from above was accompanied by a very active campaign of conviction and persuasion, with significant personal commitment and a lot of proselytism. Giving it an easy-to-remember and iconic name ("ORBi" for Open Repository and Bibliography) has facilitated its adoption by all. It should also be noted that the team responsible for the development of ORBi's IT system and management has given itself to this task without counting and with an unusual enthusiasm, creating from the outset an extremely efficient and user-friendly tool. Finally, the researchers themselves

acknowledge that they have become aware of the benefits they have gained from the new mechanism, in terms of speed and visibility, as evidenced by the quotes and increased interaction with their colleagues around the world.

> What's the trick? Introduce in the internal regulations that only publications that are in the open archive are considered for any request for funding, appointment or promotion.

Our university has equipped itself with a real dashboard of its scientific production, information that it had never had before, to the point of, until then, underestimating the academic production of its researchers by a factor of three. It has also won the complete collection of the works of its researchers in full text and a leading world reputation as the best institutional archive in the world, with 87% of its production preserved in 2015 (a proportion that has exceeded 90% since then), while the European average has reached a ceiling of 17% when filing is simply mandatory but non-compliance with the obligation remains without consequence, and only 7% on average if filing is left to the researcher's discretion, as demonstrated by a study funded by the European Commission.

Europe has tested the model in its 7th Framework Programme and fully implemented it in the 8th (Horizon 2020). In Belgium, the Wallonia-Brussels Federation adopted a decree in 2018 imposing the Liège model on all its universities and higher education institutions, and in September 2018 the Belgian Federal State made amendments to the Code of Economic Law (art. 29 page 68691) offering legal protection to those who allow immediate access to their data and research results.

The ultimate target to convince is researchers, of course. Convincing library managers is generally a done deal, even if it means more work and adaptation to new responsibilities and skills. Convincing university leaders is (still) too slow. Convincing governments is on the way.

But it is also, and above all, at the level of evaluators that change must take place, in good coordination with managers. And what makes it difficult is that these evaluators are found at all levels, whenever a qualitative judgment must be made about a person or a research project, at the local, regional, national or international level. There is still a long way to go to rid these researchers of all their prejudices and of their feeling of absolute freedom (because of their anonymity!) when they have to make judgments about other researchers. Especially those with whom the system puts them in competition…

Sound reference advice for research institutions has been carefully developed on the basis of PASTEUR4OA's comparative study in European universities and is now readily available online.

TO THE BARRICADES!

Today, it is essential for researchers to take back control of their work, their creation, and therefore their 'raison d'être' and their passion. The means to achieve this have now emerged they have established themselves and everyone has learned to use them. These means are computers, the Internet and digital literacy. On closer look, these tools give the researcher all the necessary skills to dispense with intermediaries.

While this requires a reorganisation of the production flow, a model similar to that of communications at congresses could prevail and bring us back to the historical sources of knowledge exchange, without confiscation by any in-between in the process.

Let's be objective, there are dangers:

— The spontaneous emergence of anarchic discussion forums and a multitude of initiatives to create publication platforms that run the risk of losing the interoperability essential for readability and exchange.

— An inversion of the payment paradigm (from pay-to-read to pay-to-write) to allow the perpetuation of excessive expenses by research organisations, to meet the requirements of shark-publishers who want no decrease in their profits, regardless of actual costs.

— The proliferation of parasitic or fake publishers in a so-called "Gold" system but without added value. These are generally called "predatory" but this name does not differentiate them from those who may provide quality work but over-priced (that is why I prefer "parasites"). They solicit researchers to attract them to pseudo-journals with impressive names, promising a peer review that will never take place, taking the money to publish, or even, in the worst cases, not to publish at all!

How can I detect «parasitic» or «predatory» journals?
— They charge high fees for the publication of articles without peer review and/or editorial supervision.
— They overwhelm researchers with mass spam to encourage them to publish or sit on editorial boards.
— They only notify authors after acceptance of the amounts to be paid.
— They quickly accept poor quality items, even hoaxes.
— They register academics as members of editorial boards without their knowledge, without their permission and sometimes even do not agree to remove names that are being misused.
— They indicate false names of scientists as members of editorial boards or as authors.
— They mimic the style and language of promotional materials and websites of legitimate and established magazines. They can often be detected by the poor quality of English while a reputable commercial publisher can afford a good translator.
— They fraudulently use or invent ISSNs.
— They give false information about their company's registered office.
— They attribute to themselves imaginary impact factors.
— They publish articles without the final consent of the authors and then refuse to retract them. The author must then take legal action to win the case, as publication in such a journal may harm the authors and, above all, prevent them from republishing elsewhere.

— The loss of quality benchmarks if researchers do not ensure their preservation, at the cost of a dedication to the public interest far from the competitive principles that prevail in today's research community.

— The implementation by shark-publishers of new tools the need for which they are trying to convince researchers in various fields. Technological revolutions have always brought advantages to some by reserving for others solid disadvantages, mostly financial, such as the collapse of their incomes, or even the disappearance of their profession. Let us remember the fate of the scribes or the carriage makers.

The Internet revolution is no exception to this rule, ask music record producers, film producers, print media, mobile phone manufacturers before the smartphone… Only those who are inventive, innovative and capable of reconversion can survive. This is what we can expect from publishers. The most astute have understood this (even though they continue to take advantage of the providential manna that has made their fortune and as long as it does not precipitate their loss). And that doesn't stop them from thinking we're stupid…

In this regard, at Elsevier, several very clever avenues are emerging, explored by new internal creations or external acquisitions: exploration

and exploitation of bibliographic data (Scopus), research practices (Mendeley), storage and management of research data (Figshare, Data Dryad, Mendeley), laboratory notebooks (Hivebench), automated publication systems (Evise), open archives (Bepress, Digital Commons), scientific metrics and research analyses (PURE, Scival). In addition, they have created their own performance indicators, the "Snowball Metrics", capable of using all the data generated by previous initiatives and they intend to impose them as standards by lobbying government authorities, particularly the European ones. Immediately very efficient, these tools, combined with effective marketing to researchers, will certainly appear very attractive to them…

The current criteria for evaluating research and researchers are deeply out of step with the reality while cooperative rather than competitive values should be expected of researchers today. In addition, these criteria encourage publication engineering that is extremely pernicious for the progress of Science. They risk leading to the sclerosis of an undeniably obsolete system if initiatives are not taken quickly. It is necessary to create incentives disconnected from proxy metrics but highlighting the real merits of the researcher as a contributor to the public interest. An example of such a new method will be discussed below.

In any case, it is up to the academic community to be aware of all these issues. To do this, they must lift her nose off the handlebars, stop rushing headdown and take time to think.

> The main characteristic of humanity is also its great weakness: to base its judgments on prestige or to let them be strongly influenced by it. It would not matter if prestige was not so manipulable and if it was not essentially a measure of the ability to appear.

CONCLUSION: AN UNEQUAL ARM WRESTLING MATCH

In the Open Access revolution, moral reason is clearly on the side of Science. It is opposed to the practices of corporate executives who, as good managers, are more interested in building the capital of their shareholders than in advancing knowledge, although this should be at the heart of their profession as publishers. It must be recognised that their determination to preserve the system is stronger than that of the majority of researchers to make it move forward… Indeed, researchers are rarely aware of the financial arm wrestling that publishers put universities through. Instead, they let themselves be lulled by the soft music of impact factors and other pseudo-scientific aberrations of a certain form

of scientometry, lazy and expeditious, which is, it must be said, the shame of our evaluation system. Without a thorough reform of the bases and methods of evaluation, which would restore its scientific rigour and fundamental honesty, I have the greatest fears about the evolution of global scholarly research.

CHAPTER 4

Towards a more transparent Science

> "*Science that isn't transparent isn't Science.*"
>
> (Chambers & Nosek, 2015)

OPEN SCIENCE

As defined in the European Commission's writings, Open Science consists of "*a new approach to scientific development, based on cooperative work and the distribution of information through networks using advanced technologies and collaborative tools. It aims to facilitate the acquisition of collective knowledge and to encourage the emergence of solutions based on openness and sharing.*"

The idea of an Open Science, like that of an Open Access to knowledge that was the precursor to it and is now part of it, is increasingly being discussed. It reflects a significant change

in mentality, not only in the world of research, but in society in general. The widespread belief that access to knowledge is fundamentally good for society is the very basis of our model of democratic education, which is supposed to distribute knowledge equitably and encourage everyone to participate in its acquisition and dissemination. However, despite the availability of high-performance tools, access to knowledge rigorously validated by recognised — and not self-proclaimed — experts is still severely hampered. The main objective of the Open Science movement is to remove these barriers.

What is certain is that it has now become essential to recognise and value researchers' full commitment to Open Science, and to make it clear how this goodwill will be rewarded in the various evaluations they will have to undergo more and more frequently.

Beyond open access to scientific articles which was the first milestone of openness, the movement also encourages the use of open systems in all scientific research processes: sharing raw data, maintaining an "open laboratory notebook", using open source software. Open Science aims to broaden the scope and freedom of use of research results, by facilita-

ting the transfer of information, reducing its costs and, ultimately, preventing exclusion. This is why the principle of Open Science is similar to that of Open Educational Resources and Open Education Policies. Open Science is supported by the United Nations, the European Commission and the European Research Council; more and more scientific institutions and research funding bodies are promoting this model and imposing its rules.

OPEN CITATIONS

In addition to initiatives to open up publications, a movement has developed calling for free access to quotations located in published articles but accessible only by purchase. Some of these publications may be relatively old and difficult to find, subject to complex licenses, and generally not computer-readable.

Citations are, however, the very important links that provide access to scientific and cultural knowledge and conceptualise the work of other researchers. They specify its origin, they acknowledge the authorship of the ideas and data acquired and they provide an indication of how the facts were discovered, thus a historical thread of the links of Science. They make it possible to reconstruct the intellectual path of

research and its correlates, to allocate and credit scientific contributions and to evaluate research and its impacts on the progress of knowledge and society. In short, the citations outline the essential paths for the discovery, dissemination and evaluation of the most advanced knowledge.

> With the increasing number of scholarly publications, citations, in a digital context, allow researchers and the public to keep abreast of developments in their field of interest. To do this, it is essential to have unimpeded access to bibliographic data and citations in a form that is computer-readable.

In this context, the Initiative for Open Citations (I4OC) brings together researchers and publishers to promote the availability of structured (expressed in compatible, machine-readable and programmable formats), separable (searchable and analysable without the use of bibliographic sources, journal articles and books) and open (freely accessible and reusable) citation data.

OPEN DATA

In the digital age, "data" is the very foundation of many discoveries and can be found in various

forms in all fields of knowledge, from the material sciences to the life sciences and the various humanities. Like research results, the underlying data must be freely accessible. They play an essential role in our ability to predict and overcome natural disasters, to understand human biology and to develop technological advances.

Despite these obvious facts, which are well known and proclaimed by all, research data today remain largely fragmented, isolated on millions of personal computers, blocked by complex and varied technical, legal and financial restrictions.

Like information held by public services and currently subject to an increasingly pressing need for universal and free access, open availability of research data is being urged by advocates of Open Science, and in particular by the European Commission (see the EU Open Data Portal), to make them available without barriers, neither technical nor financial. Proclaimed loud and clear by the Hague Declaration (2015), data openness aims to promote access to facts, observations and ideas for research and knowledge dissemination in the digital age. By removing barriers, analysis of the wealth of data generated by research encourages the development of responses to major challenges facing our socie-

ties, such as climate change, the exhaustion of natural resources and globalisation.

The amount of scientific data produced is growing exponentially each year, but infrastructure, policies and practices are still lacking to effectively exploit this vital resource. While some major projects — such as the Human Genome Project or the Large Hadron Collider — make their data accessible, too often the data are not shared beyond the operators of the project. The Worldwide Web (WWW) was originally designed to facilitate military communications, but it was quickly adopted and refined by researchers to share data. However, data sharing has not yet become the norm in research.

What is open data? It is information, of all types and not just digital, available free of charge on the Internet and allowing any user to download, copy, analyse, reprocess, transmit without financial, legal or technical obstacles other than that concerning access to the Internet itself.

Open data generally applies to a range of non-textual documents, including data sets, statistics, transcripts, survey results and metadata associated with these objects. This is the factual information necessary for the reproduction and verification of research results. The so-called "Open Data" policies generally include the idea that the extraction, manipulation and meta-analysis of the machine's data can be authorised.

It is very clear that, in the process of moving towards open access to research data, resistance is no longer to be expected from the major publishers but from the researchers themselves. In the absence of an extremely clear and credible signal that, if the researchers are playing the game of opening up the data they have accumulated, they will be recognised, appreciated and rewarded in some but significant way, it will be very difficult for them to spontaneously engage in this endeavour. Again, overcoming the individualistic tendency to the advantage of the collectivity will require a considerable, well-coordinated and simultaneous effort. One immediately perceives the extent of the difficulty of such an implementation.

OPEN SOURCE SOFTWARE

A free or Open Source software is a computer program whose original code is distributed through a license that enables everyone to read it, modify it or even redistribute it. Developed according to an open and collaborative principle, free software is designed with the contributions of members of a large community. A core group of high-level contributors and often specialised service companies ensures the control, coherence and quality of new programs.

An "Open Source" label was created during a working session in Palo Alto in 1998, shortly after the announcement of the publication of Netscape's source code. It reflects the awareness of the need to promote an open development process at the time.

In an Open Science context, and in particular when it is essential to be able to verify and reproduce research results, it goes without saying that the principle cannot be respected if, at any stage in the research process, a closed-source software whose intimate functioning cannot be known and understood is used.

> The recommendation of Open Science is therefore not to use, unless there is a duly justified exception, «proprietary» software whose code is not accessible to the user.

There are already many examples of the undeniable contribution of free software to the development of research, a necessity that is also integrated into European policy.

OPEN PEER REVIEW

Traditional peer review is based on the use of skills to control the scientific validity and qua-

lity of a scientific article or book. The process is usually confidential and protects the auditor's anonymity.

Since the early days of scholarly publication, pre-publication scientific review has been carried out by peers whose advice was deemed relevant. The selection of peers was initially organised by learned societies who assumed responsibility for publishing. Peers were invited to carry out editorial work and quality control on a voluntary basis. When these tasks were outsourced to private publishers, these have perpetuated the process. In order to avoid personal conflicts, the review was conducted anonymously in most instances, but its fairness was often challenged due to numerous biases. The process itself has been accused of inefficiency, hypocrisy, partiality and permissiveness to abuses….

However, even if to date informed revision remains an immovable pillar of scientific communication, its subjective character, to which all the denounced deficiencies are associated, cannot be denied, and it is becoming urgent to question its limits and the means of making it more equitable. A first adaptation consists in abolishing anonymity, thus placing the reviewers in front of their responsibilities and making them fully assume their conflicts of interest. On the other hand, it would be advisable to give credit to the reviewers. They would still be

volunteers but would be acknowledged for the work they have done, which is generally heavy if carried out with great care. At present, such identification is impracticable and this makes some of them loose the motivation to perform this task with all the rigour necessary to insure that the review process itself is indisputable and helpful.

The move towards transparency in scholarly publishing has recently prompted a number of journals to embrace a more open model such as the one used, for example, by the Royal Society in London. Reviewers are encouraged to disclose their identity by signing their reports, although they are not obliged to do so. The transparency of the editorial process is ensured by an open publication of those reports, of the revised decision letter and of the author's responses, joint to the published articles. In this way, the reader can better evaluate the publication and even participate personally in the process over the long-term, allowing the article to continue to live and even to evolve after the initial publication (this is referred to as "liquid publication"). The reviewers' reports are made public under an open access license from Creative Commons, CC-BY.

The work of the reviewers, on a voluntary basis, can thus be somehow rewarded and it can be officially listed with the author's other writings, in a separate rubric. This was not possible until now and the volunteer reviewer

was only given the hidden pride of being picked by the publisher or perhaps sometimes the satisfaction of more suspect motives.

> The abolition of anonymity makes it possible to restore a real dialogue between the parties involved in the publication process and ensures transparency that is in keeping with the spirit of Open Science. It eliminates a highly contentious source of abuses due to competition between researchers or research teams, hostility between rivals or, on the contrary, patronage. It is obvious that it requires the reviewer's willingness to express his/her opinion publicly and to offer a sound and rigorous argumentation.

Having been maintained as an almost absolute rule, the anonymity and confidentiality of reviews have indeed become a plague of the current publication system, leading to many challenges that tarnish nowadays the peer review process although its original intent was praiseworthy. Their discontinuation would undoubtedly open up new and exciting perspectives.

CITIZEN SCIENCE

The principle of Citizen Science is based on the participation of the public in research, with two

main objectives. The first is to ensure that by involving people who are interested and often passionate, in collaborative projects and by involving them in a disciplined scientific approach, we contribute to combating the growing popular and populist trends that challenge the validity of Science and its foundations. While not everyone can be involved in Citizen Science, it is a broadening support of Open Science. The second reason for developing this new approach is the almost free availability of the Internet, which makes scientific communication accessible to all, not only through open access to scientific publications, but through the ease of interaction and communication that it allows and will continue to develop at a rapid pace. The rise of artificial intelligence also contributes to Citizen Science by offering participants the opportunity to contribute to the development of tools for recognising and identifying complex objects (plants, animals, celestial bodies, etc.).

Citizen Science projects involve non-professionals involved in crowdsourcing, data collection and analysis. The idea is to break down the gigantic and tedious tasks into understandable components that everyone, with a little specific training, can perform.

Some sectors for which information gathering is crucial, now benefit from Citizen Science.

This is the case of astronomy (Zooniverse) and ornithology (eBird) quite clearly, but we are now seeing the development of this practice in several other disciplines, such as cartography (Missing Maps: Hosting a mapathon).

Large programmes have been launched through the creation of websites, offering enthusiasts a variety of collective projects on attractive themes such as understanding the formation of galaxies, ranking tropical cyclones, collecting and analysing cancer data. The research fields involved range from space to climate, from human sciences to field biology. Everyone can potentially contribute to these areas of research by producing, classifying and sharing images or observations. It goes without saying that a rigorous and professional scientific framework must help coordinate these citizen actions.

Nevertheless, we must remain vigilant and avoid believing that Citizen Science is in the process of replacing Science. It is only an extension of it, but it is hoped that it will usefully complement it and also contribute to improving its image in the public.

OPEN EDUCATION

Although Open Education is not, strictly speaking, part of Open Science, we are finding this same spirit of transparency and free education in the world of education. Free access to studies and the costs it implies is an old notion that remained utopian for a long time. It was enshrined in an international convention in New York in 1963 before falling back into oblivion, punctuated periodically by the awakening of expectations. The student movement of 1968-69 restored the concept, but it is true that, like Open Science, Open Education, as a public good and a fundamental human right, requires significant public investment and few countries have made sacrifices in this regard. Today, as in the case of Open Science, free access to school information has become a possibility with the Internet. This still requires a change in mentalities in the teaching staff but also the guarantee of Internet access for all schoolchildren and students. Such progress, while almost achieved, is not yet completely inclusive.

Open Education requires Open Educational Resources (OER) that are barrier-free and legally authorised for open use. This authorisation is granted through the use of an open license (e. g. Creative Commons) allowing anyone to use, adapt and share the resource freely, at any time

and at any place. Open permissions are generally defined in terms of the "5 Rs": users are free to retain, reuse, revise, remix and redistribute these educational documents. The link with the practices and resources of Open Science is therefore obvious.

CONCLUSION: OPEN SCIENCE, A BROAD CONCEPT

Well beyond open access, Open Science extends over a very wide field. It takes into account, in an effort to renew and modernise, all the issues of research and its consequences, such as the opening and management of research data, the openness and interoperability of software, the transparency of evaluations, the encouragement of citizen participation in research and freedom of access to teaching subjects. It is a huge project, its scale frightens many people and it is true that a necessary synchronisation of all these ambitions is a serious challenge. It should also be added that, in this context too, a profound reform of the foundations of evaluation is required, without which it will be impossible to find a significant motivation among researchers.

CHAPTER 5

Towards a more ethical research

> "*Ethics is knowing the difference between what you have a right to do and what is right to do.*"
> (Potter Stewart)

STRICT PRINCIPLES

Ethics is an integral part of research. Only if ethics is respected can "excellence" be achieved and recognised. The ethical conduct of research involves the application to scientific research in all fields — without exception — of fundamental ethical principles and legislation. It excludes fabrication, falsification, plagiarism or any other misconduct in research.

In the European Community, all activities carried out under the Horizon 2020 framework programme must comply with relevant national,

European and international ethical principles and legislation, such as the Charter of Fundamental Rights of the European Union and the European Convention on Human Rights. They must refrain from practising ethics dumping, which consists in carrying out outside Europe experiments that are illegal within the Community.

There are many codes and charters regulating research ethics today. Some principles are found everywhere, others have emerged with the rise of Open Science. Here is a summary, based on the book (unfortunately in closed access!) by Shamoo & Resnik[1]:

1. ***Honesty***: in all scientific communications, honestly report data, results, methods and procedures, and publication status. Do not fabricate, falsify or distort the data. Do not mislead colleagues, research sponsors nor the public.

2. ***Objectivity***: Avoid bias in experimental design, data analysis, data interpretation, peer review, staff decisions, grant writing, expert testimony and other aspects of the research. Avoid prejudices. Disclose any personal or financial interests that may have an influence on the research.

[1] Shamoo A.E., Resnik D.B., *Responsible Conduct of Research*, 3e éd., Oxford University Press, 2015.

3. ***Integrity***: keep promises and agreements; act with sincerity; aim for coherence of thought and action.

4. ***Caution***: Avoid careless mistakes, imprudent errors and negligence. Carefully and critically review your own work and the work of peers. Maintain good records of research activities, data collection, research design and correspondence with agencies or journals.

5. ***Openness***: share data, results, ideas, tools, resources. Remain attentive and open to criticism and new ideas.

6. ***Respect for intellectual property***: honour patents, copyrights and any other form of intellectual property. Do not use unpublished data, methods or results without permission. Provide appropriate recognition or credit for all research contributions. Never plagiarise.

7. ***Confidentiality***: Protect confidential communications, such as documents or grants submitted for publication, personnel files, trade or military secrets and patient files.

8. ***Responsible publishing***: publish for the purpose of advancing research and scholarship, not just to advance your own career. Avoid unnecessary and redundant publications that exist only to add to the number.

9. ***Responsible mentoring***: educate, advise and support students and novices. Promote their

working conditions and allow them to make their own decisions.

*10. **Respect for colleagues***: be considerate of your colleagues and ensure that you treat them fairly.

*11. **Social responsibility***: strive to promote the social good and to prevent or mitigate social harm through research and public education.

*12. **Non-discrimination***: avoid any discrimination against colleagues or students on the basis of gender, race, ethnicity or any other factor unrelated to scientific competence and integrity.

*13. **Competence***: maintain and improve one's own professional skills and expertise through education and lifelong learning; take measures to promote competence in Science.

*14. **Legality***: learn and respect the laws and institutional and governmental policies in force.

*15. **Protection of human subjects***: when conducting research on humans, minimise the dangers and risks to the subjects and maximise their benefits, respect human dignity, privacy and autonomy, take special precautions with vulnerable populations and seek to distribute fairly the advantages and disadvantages of research.

*16. **Animal care***: respect and treat animals appropriately when they are used in research. Do not conduct unnecessary or poorly designed

animal experiments. Submit to and respect the decisions of ethics committees.

CHAPTER 6

Towards a fairer assessment

> *"Self-esteem is an erroneous appraisement"*
>
> (Ambrose Bierce, *The Devil's Dictionary*, 1911)

THE INCENTIVES

To recognise first and then encourage activities that are consistent with the principles of Open Science, it is necessary to go beyond this and place oneself in the general context of the evaluation of researchers. For example, their merits should be examined according to their background and not according to a single standard applied to all, such as the number of their publications or their cumulative impact factors… Similarly, when a research project requires the intervention of two or more researchers, it is necessary to

determine the actual role played in the team by the researcher being evaluated and to take into account his/her contribution as a leader, technical expert, convener of the various forces, etc. It is generally accepted that the international mobility of researchers is an asset for research in general: this mobility must therefore be taken into account in a positive way. Finally, researchers who, for whatever reason, devote part of their careers to industry must be able to receive recognition and not a penalty.

It is therefore clear that an incentive-based and generally positive policy for the advancement of their careers and the evaluation of the research grants they apply for requires a multidimensional approach. It must take into account a set of assessment criteria adapted to researchers from all sectors, in all scientific fields and at all career stages, including for their participation in Open Science activities.

Under no circumstances can the evaluation of a researcher be reduced to a mere number. His/her merits and achievements depend on a complex set of variables that cannot be condensed to such an extent.

THE MULTI-CRITERIA EVALUATION

The "Working Group on Rewards under Open Science", convened by the European Community's DG Research and Innovation, published a report in July 2017 proposing a career evaluation matrix in a context of Open Science (the Open Science Career Assessment Matrix, OS-CAM).

This is a more comprehensive approach to the assessment of researchers that takes into account service and leadership, the impact of research and contribution to teaching, all of which are emerging in work descriptions and as criteria for promotion. The matrix illustrates how these more general aspects could be taken into account in the context of recognising researchers' contributions to Open Science.

***Table 2** — Example of a list of criteria that can be considered for the evaluation of a researcher*

ACTIVITIES	CRITERIA
RESEARCH OUTPUT	
Research activity	Pushing forward the boundaries of Open Science as a research topic
Publications	Publishing in open access journals Self-archiving in open access repositories
Datasets ans research results	Using the FAIR data principles Adopting quality standards in open data management and open datasets Making use of open data from other researchers
Open Source	Using open source software and other open tools Developing new software and tools that are open to other users
Funding	Securing funding for Open Science activities
RESEARCH PROCESS	
Collaboration and Interdisciplinarity	Widening participation in research through open collaborative projects Engaging in team Science through diverse cross-disciplinary teams

Research integrity	Being aware of the ethical and legal issues relating to data sharing, confidentiality, attribution and environmental impact of Open Science activities Fully recognizing the contribution of others in research projects, including collaborators, co-authors, citizens, open data providers
Risk management	Taking account of the risks involved in Open Science
Stakeholder engagement & citizen Science	Actively engaging society and research users in the research process. Sharing provisional research results with stakeholders through open platforms (e.g. Arxiv, Figshare) Involving stakeholders in peer review processes
SERVICE AND LEADERSHIP	
Leadership	Developing a vision and strategy on how to integrate OS practices in the normal practice of doing research Driving policy and practice in Open Science
Academic standing	Developing an international or national profile for Open Science activities Contributing as editor or advisor for Open Science journals or bodies
Peer review	Contributing to open peer review processes Examining or assessing open research

Networking	Participating in national and international networks relating to Open Science
RESEARCH IMPACT	
Communication & dissemination	Participating in public engagement activities Sharing research results through non-academic dissemination channels Translating research into a language suitable for public understanding
Societal impact	Evidence of use of research by societal groups Recognition from societal groups or for societal activities
Intellectual property (patents, licenses)	Being knowledgeable on the legal and ethical issues relating to IPR Transferring IP to the wider economy
Knowledge exchange	Engaging in open innovation with partners beyond academia
TEACHING & SUPERVISION	
Teaching	Training other researchers in Open Science principles and methods Developing curricula and programs in Open Science methods, including Open Science data management Raising awareness and understanding in Open Science in undergraduate and masters' programs
Mentoring	Mentoring and encouraging others in developing their Open Science capabilities

Supervision	Supporting early stage researchers to adopt an Open Science approach
PROFESSIONAL EXPERIENCE	
Continuing professional development	Investing in own professional development to build Open Science capabilities
Project management	Successfully delivering Open Science projects involvingdiverse research teamsS
Personal qualities	Demonstrating the personal qualities to engage society and research users with Open Science Showing the flexibility and perseverance to respond to the challenges of conducting Open Science

Neither the number of criteria, nor their nature, nor the explanation given here are definitive. They should certainly not be imposed as such. There may be too many and others may be missing. A bias in favour of Open Science is obvious. It goes without saying that, in the context of an evaluation, evaluators may decide to use other indicators. But what matters here is to highlight the fact that a serious evaluation of a researcher's merits throughout his/her career must be based on a multifactorial analysis.

In order to take into account differences in the researchers' career progress, at least four categories defined by the European Commission in this respect should be considered: R1 or First Stage Researcher, R2 or Recognised Researcher, R3 or Established Researcher and R4 or Leader Researcher. Everyone will understand that the same criterion cannot be equivalent depending on whether you are evaluating a junior or an experienced researcher. Each box should be assigned a value representative of the importance to be given to it. This is represented here by a rating ranging from + to ++++ (the absence of a rating means that the criterion is not relevant).

Table 3 *— The OS-CAM (Open Science Career Assessment Matrix), example of a distribution of the weight to be given to different criteria for the evaluation of a researcher, organised in a matrix format according to his/her seniority in the career.*

ACTIVITIES	R1	R2	R3	R4
Research output				
Research activity	+	++	+++	++++
Publications	+	++	+++	++++
Datasets & research results	+	++	+++	++++
Open Source	+	++	+++	++++
Funding		+	+++	++++
Research process				
Stakeholder engagement/citizen Science	+	+++	+++	+++
Research integrity	+	++++	++++	++++
Risk management	+	+	+++	+++
Collaboration and Interdisciplinarity	++	++	++	++
Service and leadership				
Leadership		+	+++	++++
Academic standing		++	++++	++++
Peer reviewing		++	++++	++++
Networking	+	+++	++++	++++

Impact				
Communication & dissemination		++	++++	++++
Societal impact		++	++++	++++
Intellectual property		++	++	+++
Knowledge exchange	+	+++	++++	++++
Teaching & supervision				
Teaching		++	++++	++++
Mentoring		+++	++++	++++
Supervising		++++	++++	++++
Professional experience				
Continuing professional development	+	++	+++	+++
Project management		++	++++	++++
Personal qualities	+++	++++	++++	++++

Again, this is just one example among many possibilities. In each evaluation committee, members may decide on the relative weight they wish to give to each criterion, provided that it is agreed between them. For each person assessed, a single column is therefore required.

As I was personally part of the working group, I took the liberty of going further in the development of this grid, which was incomplete

in that it did not take into account the differences between fields of activity. Indeed, these are so wide in scope that a third dimension must be given to the exercise.

For this reason, the matrix, as just described, must be multiplied by as many formats as there are sufficiently homogeneous areas of research in which individuals may be assessed.

> The difficulty of any radical revision of the evaluation method is that, if it does not take place simultaneously at all levels and on a global scale, some universities, countries, continents, will disadvantage their own researchers by anticipating the change... International coordination and synchronisation are therefore absolutely necessary, which renders the task very complex.

Table 4 *— The OS-CAC (Open Science Career Assessment Cube), in which the matrix to be used varies according to the research area concerned. The weight of the criterion is established here on a scale of 0 to 4 pluses as an example. It must always be established by the evaluators collectively, according to their preferences.*

Humanities	R1	R2	R3	R4		
Social Sciences	R1	R2	R3	R4		
Life Sciences	R1	R2	R3	R4		++++
Earth & Material Sciences	R1	R2	R3	R4	++++	++++
Research output					++++	++++	+++
Research activity	+	++	+++	++++	++++	++++	+++
Publications	+	++	+++	++++	++++	+++	++++
Datasets & research results	+	++	+++	++++	++++	++++	
Open source	+	++	+++	++++	++++		+++
Funding		+	+++	++++		+++	++++
Research process					+++	++++	+++
Stakeholder eng./Citizen science	++	+++	+++	+++	++++	+++	+++
Research integrity	+++	++++	++++	++++	+++	+++	
Risk management		+	+++	+++	+++		++++
Collaboration & interdisciplinarity	++	++	+++	+++		++++	++++
Service & leadership					++++	++++	++++
Leadership		+	+++	++++	++++	++++	++++
Academic standing		++	++++	++++	++++	++++	
Peer reviewing		++	++++	++++	++++		++++
Networking	+	+++	++++	++++		++++	++++
Research impact					++++	++++	+++
Communication & dissemination	+	++	++++	++++	++++	++++	++++
Societal impact	+	++	++++	+++	++++	++++	
Intellectual property	+	++	+++	++++	++++		++++
Knowledge exchange	+	+++	++++	++++		++++	++++
Teaching & supervision					++++	++++	++++
Teaching	+	++	+++	++++	++++	++++	
Mentoring		+++	++++	++++	++++		++++
Supervising		++++	++++	++++		+++	+++
Professional experience					+++	++++	++++
Continuing professional development	++	++	+++	+++	++++	++++	
Project management		++	++++	++++	++++		
Personal qualities	+++	++++	++++	++++			

CHAPTER 7

Tomorrow, the Research…

> "*On the pretext that their future lies ahead of them, men live on a day-to-day basis.*"
>
> (Tristan Bernard)

A FORWARD-LOOKING VISION

Risking a prediction of how research will evolve in the coming years, given the many initiatives that propose to change its course, promises to be a terribly uncertain challenge. It is obvious that a formidable arm wrestling match will, even under a policed appearance, oppose the supporters of Open Science and many critics, for very different reasons: publishers concerning open access, researchers themselves about open data, part of the research community for open peer review, etc. Only a global philosophy embracing all the ini-

tiatives must prevail if it is not to be sequestered under all kinds of reasons, the most revolting of which being profit, particularly when it is less and less justified and reaches obscene proportions.

> It is imperative that in the future, articles written by researchers and peer-reviewed by their peers cease to be commercial merchandise but be fully considered as common knowledge, i.e. a public good to be shared free and unhindered with anyone who so wishes and a precious heritage to be preserved for future generations.

Technological advances in communication are already allowing such a paradigm shift that it is necessary to overcome the resistance of publishing houses that are reluctant to change their operating mode and their relationship with the world of research - from which they depend, in principle. It will also be necessary to overcome the reluctance of the research community by making it accept the modernisation of this aspect of its mission. It is also time for the research community to use the Web resource that was, after all, invented by researchers to communicate with each other more systematically, wisely and effectively!

In a visionary article, the French researcher Marie Farge offers some groundbreaking ideas:

— Researchers should be the owners of the journals they create, for which they produce content and for which they review articles.

— Publication platforms should be set up by public authorities or with their support. They should be 1) public, 2) open and 3) free (for free access to information and data and through the use of free software).

— In order to improve the reproducibility of published results, articles should be reviewed in a transparent manner by peers who take open responsibility and receive recognition.

— And in the waiting, the "green" open access model should ensure a smooth transition to open access for all scholarly publications.

I share this vision. Some people find it too utopian because it is not simply a question of making use of technical innovations that are easy to master and that are used in all fields. It is about overcoming the robust barrier of profit and changing attitudes towards the appraisal of the true value of a research or of a researcher rather than using an approximation based on prestige indicators. And that goal is very ambitious.

THE STRUGGLE GOES ON

National university consortia in Germany, France and Sweden have started in 2018 a form of resis-

tance by refusing the "big deals" that publishers Elsevier and Springer want to impose on them. They have discontinued negotiations, at the risk of seeing the supply of scientific journals from these companies interrupted. And that's what happened. The University of Lorraine, for its part, has decided to use the money saved by the blocking of French subscription at Springer to invest in open access publishing initiatives. This decision undeniably has the smell of permanence…

In parallel with these developments, becoming aware of their active participation in the abuses of the system, some members of editorial boards have decided to resign from their (sometimes lucrative) mission. We must salute their courageous act. Some editorial boards have even resigned all together and decided to create a new journal, a move that has been ironically dubbed "Elsexit" since in most cases, these boards have been leaving the publisher Elsevier. This is the case with *Lingua* (Elsevier) whose editors left massively and launched *Glossa* (Ubiquity Press) in 2016 and with *The Journal of Informetrics* (Elsevier) whose editors launched *Quantitative Science Studies* (the International Society for Scientometrics and Informetrics, ISSI) on January 9, 2019. However, the movement appears larger as the reputation of *the Journal of Algebraic Combinatorics* (Springer) is announced to be transferred, along with most

of its editorial board, to *Algebraic Combinatorics* (The Mersenne Centre for Open Scientific Publishing).

AND WHAT ABOUT EUROPE?

We can welcome the European Commission's proactive stance in favour of Open Science and there is no shortage of statements to that effect. However, we must be concerned about the formidable power of the lobbies of the major scholarly publishers, which are winning on some points:

— their about-face to adopt Open Access and claim to defend it after having fought it fiercely, a change of attitude adopted as soon as they understood the profit they could continue to make by charging to publish while continuing to sell subscriptions;

— Europe's missteps, giving in too easily to lobbying pressure. We are learning that they are handing over the market for the implementation of the Open Science Monitor, the European tool for monitoring the progress of Open Science in their member countries. If confirmed, this is a flagrant and, to be frank, unacceptable new conflict of interest.

A LIGHT AT THE END OF THE TUNNEL? PLAN S

On September 4, 2018, Science Europe, structuring the "*cOAlition S*", a group of research funding agencies from eleven countries, announced the launch of a new strategic plan to end the procrastination around Open Access and its equitable implementation. The aim is to speed up the transition to full and immediate Open Access. The initiative is based on "Plan S" which calls for the implementation of the necessary measures to achieve its fundamental principle: "*As of January 1, 2020, scientific publications resulting from research funded by public grants from participating national and European research councils and funding bodies must be published in journals or on open access platforms in accordance with the legislation*".

Beware that Plan S is not a legislative act. It is a pledge the signatories of Plan S want to implement in a coordinated way. Research funders from all over the world, public and private, are invited to join them.

The ten commendments of Plan S are as follows:

1. After January 1st, 2020, publications of the of research results funded by public grants from national and European research councils and funding bodies shall be published in journals or on compliant open access platforms.

2. The authors retain the copyright to their publication without any restriction. All publications must be published under an open license, preferably the Creative Commons Attribution Licence CC BY. In all cases, the requested licence must meet the requirements set out in the Berlin Declaration.

3. Donors will jointly ensure the establishment of strong criteria and requirements for the services that high-quality, compliant journals and open access platforms must provide.

4. If there are no high-quality Open Access journals or platforms yet, donors will provide, in a coordinated manner, incentives to establish and support them where appropriate; support will also be provided for Open Access infrastructure where necessary.

5. Where applicable, the costs of publishing open access are covered by donors or universities, not by individual researchers; it is recognised that all scientists should be able to publish their work in open access even if their institutions have limited resources.

6. When open access publication fees are applied, their funding is standardised and capped (across Europe).

7. Donors will ask universities, research organisations and libraries to align their policies and strategies, particularly to ensure trans-

parency. Donors will monitor compliance and sanction non-compliance.

8. The above principles apply to all types of scholarly publications, but it is understood that the deadline for achieving open access for monographs and books may be longer than January 1, 2020.

9. The importance of open archives and repositories for hosting research results is recognised because of their long-term archiving function and their potential for editorial innovation.

10. The 'hybrid' publication model does not comply with the above principles."

Immediately benefiting from the full support of the European Commission, Plan S is full of good intentions and certainly represents the boldest and most proactive official step forward in the Open Access (OA) saga to date. For the most part, the principles correspond to the wishes of all OA supporters.

However, there are still serious concerns about its implementation within a very short time frame and about the partnerships that this entails, particularly because of the involvement of shark-publishers who can be seen participating in the ongoing reflection…

— Plan S is supposed to be enforced in such a short time that there is little hope that most jour-

nals that do not require APCs (article processing charges) will move to the desired model. They will therefore be banned for the benefit of "unfair gold" publications.

— There are not so many public funding organizations after all. In some countries, there is only one or very few. And even fewer — or sometimes no — not-for-profit private funders. In Europe, alternative resources come from the European Community. Researchers may therefore be restricted to depend upon *cOAlition S* members. In such a case, they will have to follow the requirements of the plan when choosing their publisher. This effectively limits their choice, and it worries many people.

— Regardless of the publication scheme, the authors are required to place their text under a CC-BY licence (hopefully without the ND or NC suffixes). This will inevitably repel researchers as an additional administrative constraint or even — wrongly, I believe — a deprivation of their academic freedom.

— Plan S does not solve the problem of "predatory" or "parasitic" publishers. Rather, it would have the effect of encouraging them and it may even be profitable for them if no safeguards are provided.

— It is highly unlikely that publishers who will be asked to concede more rights to authors (no embargo, licence, etc.) would agree to signi-

ficantly reduce their APCs and even to avoid increasing them to counter the loss.

— Plan S does not take into account the differences in the way Science is conducted in the various fields of research. Publication practices are highly variable and the plan finds its best justification in the material and life sciences, although less, if at all, in the human and social sciences. Particular attention must be paid to these pitfalls when implementing the plan.

— Plan S does not clarify the future of learned societies that live from subscriptions to their editions, and whose price is usually very reasonable and not worth a fight.

— Plan S applies to the various partners in scientific research in Europe but it runs the risk of placing European research at a disadvantage compared to research of other continents that do not adopt these new rules. Consultation is therefore essential beforehand, otherwise our researchers will rebel against any constraint that they may feel dangerous for their international positioning and such consultation, which will take time. This is all the more serious as it could mean excluding these European researchers from publications by international research teams…

— There is serious concern about principle number 5 of Plan S. Indeed, by considering the assumption of publication costs by funding agencies — an excellent initiative — the plan

paves the way for a price increase as requested by shark-publishers. It encourages the latter to switch to an open access formula where the author pays to publish and the author will be in favour of it as long as his/her funder covers the cost. A quick calculation shows that if a research department of respectable size publishes about a hundred articles per year, and each article would cost between €2,000 and €5,000, based on the current norm for shark-publishers (who can afford a financial loss neither in the transition nor afterwards), we are heading towards an expense of half a million Euros for this single group. Therefore one understands immediately that the system goes head-on into the wall… While principle #6 provides some comfort by stating that costs will be capped and controlled, it is questionable how such control can be exercised. The future will tell us, but without a truly effective solution, the system will not be viable.

In conclusion, I strongly support the concept of Plan S but it still needs several important changes and clarifications[1].

In particular, what is missing from Plan S is an infrastructure component. If the plan provi-

[1] New elements have been published by cOAlition S since the French edition of this book was released, answering some of our questions. However, there are still uncertainties on crucial points still to be resolved. A discussion on these questionings is available here.

ded for limiting its funding to researchers whose institutions are in order with the infrastructure (yet to be clearly defined by the technicians) necessary for a smooth and effective application of the various aspects of Open Science. By setting the conditions for accreditation, funders would give an incentive to institutions that could find the financial means to do so in the savings they would make by abandoning journal subscriptions. We owe this reasoning to a German researcher, Björn Brembs, whose project has been called *Plan I* (for infrastructure).

The following analysis has been published on my blog on January 6, 2019.

A new difficulty arises. Among those who are ready (i.e. who offer immediate distribution and free reading via the Web), two categories exist:

A. Platforms that are available to authors for free or almost;
B. Fee-based publication platforms. Among these, one can distinguish several, very different options:

B(1) Publication is made in a "traditional" subscription journal and deposited immediately when accepted in an open access repository (Green OA). The cost is for subscribers (usually universities, sometimes individuals) on the

reader's side, not on the author's side. There is a very light cost for universities to manage the repository.

B(2) "Hybrid" editions, generally offered today by the same traditional publishers, who continue to sell subscriptions but at the same time charge for immediate online publishing. The cost is both on the author's side and on the reader's side (double dipping).

B(3a) Innovative platforms using new forms of reviewing (identified, open, etc.). The cost is on the author's side.

B(3b) Platforms of traditional publishers that distribute articles without paper publication in parallel (i.e. not hybrid) but reproducing the traditional scheme of traditional scientific publishing, in particular peer review. The cost is on the author's side.

B(4) "Predatory" publishers who put manuscripts online for money without any real guarantee of quality. The cost is on the author's side, the reader reads for free when the scam doesn't go so far as not to publish anything…

Here are a few personal comments about each of these options:

B(1): At first, cOAlition S members were not considering Green OA as compliant, but there have been adjustments along the way since

September 2018 and it appears that this would be acceptable. They will, "under specified conditions, accept deposit of scholarly articles in Open Access repositories". It would be nice to know what these "specified conditions" are. What is sure is that embargoes are banned. Although we have been denouncing them from the onset, they have been a compromise that has allowed Green OA to be tolerated by the most demanding publishers up to now. In the short or middle-term, forbidding embargoes might kill Green OA. There is an additional difficulty with Plan S and Green OA: the technical requirements imposed upon the repository management teams will be difficult to meet in such a short notice. Exhausting but not impossible.

B(2): cOAlition S members clearly ruled out the hybrid model at first. However, in the implementation document of November 26, they announced that they will tolerate "in a transition period, publishing Open Access in subscription journals ('hybrid Open Access') under transformative agreements as means to achieve compliance with Plan S.". The transformative agreement must be signed with cOAlition Sand must "have a clear and time-specified commitment to a full Open Access transition". Yet this blurs the project somewhat by leaving some loose ends…

B(3a & 3b): cOAlition S clearly favours these open platform models from the outset, while also supporting model A. It should be noted that B(3b) risks perpetuating the cult of the impact factor and the illegitimate transfer of prestige from publisher to author.

B(4): One can hope that researchers will be wise enough to avoid becoming preys by all means. However the pressure to publish directly in OA may lure many of them into an extremely fast but insecure publication. In any case, predatory publishers will be banned. It is an excellent thing except for the fact that beside the obvious or documented predators there is a grey zone where it is difficult to decide whether or not a publisher is predatory, particularly for newcomers for whom there is still a lack of evidence.

This leaves the researchers with 4 options: **A**, **B(1)** conditionally, **B(2)** transiently and **B(3a or 3b)**.

But with all this, Plan S can be sustainable only if:

- *cOAlition S* gathers enough signatories to weigh significantly on the scholarly publishing landscape. So far, according to a US source, "the first 15 funders to back Plan S would account only for 3.5% of the global research articles in 2017".

Pressure on the global system needs much more adhesion than that.

- *cOAlition S* ensures that none of its members fails to take back the compliance label from publishers who practice excessive increases in their APCs, above the "cap" announced by Plan S, the level of the cap being still unspecified. Will it be unified? Or will it vary according to still unknown criteria such as impact, prestige and the like? The wish of Open Access advocates is that the cost of publication should be low enough to cease being an element of discrimination based on financial capacity.
- *cOAlition S* members adjust their evaluation criteria to the new norms and make sure there is a real consistency between their requirements for granting and those for post-evaluation. In this respect, a strong commitment to the principles of the DORA ("cOAlition S members intend to sign DORA and implement those requirements in their policies") and of the Leyden Manifesto is indispensable.

WHAT CAN BE DONE NOW?

If, in all modesty, a set of recommendations can be proposed, some major avenues can be highlighted:

1. regain control of the entire editorial process

• Researchers can no longer delegate the communication of their scientific production free of charge to profit-driven subcontractors. They must recover the mode of expression they should never have abandoned and assume exclusive responsibility for it.

• The authorities of universities and public research institutions must actively support them in this process. They must offer them the opportunity to free themselves from unjustified constraints and to preserve their rights over their work, including the right of reuse.

• It will often even be necessary to exert a certain amount of pressure on researchers to make them abandon their pillar of reference: the prestige of journals.

2. Get official support to ensure efficient dissemination.

• Public authorities and funding organisations, which are major sources of resources for research, must also ensure its proper dissemination, in all fairness. They must change the paradigm of scientific publishing (as Plan S effectively stipulates) and provide the researchers they fund with electronic publication platforms

that are free or very inexpensive (i.e. covering the actual cost) for research articles and reports.

• They must also issue laws and decrees protecting researchers against the ukases of some publishers by granting hierarchical superiority to the preservation of the researcher's rights over commercial interests. The circulation of scientific information must be immune to any commercial constraints.

3. Use rigorous and relevant criteria for the assessment of research and researchers

• Since protocols for evaluating research and researchers have a deleterious effect on the quality of published Science, it is essential that evaluation bodies stop relying on criteria such as the prestige of the publisher, which in most cases is an indirect, abusive and misleading mirror of the quality of the researcher.

• Another criterion to be avoided for its perverse effect is the number of publications. In both cases, in addition to the deceptive character of the criterion, these are numerical values that offer an easy way of ranking, but they only provide an illusion of objectivity. Even worse, they contribute to useless over-publishing.

• Any evaluation should henceforth be based on multiple criteria reflecting the qualities and skills expected from a good researcher.

4. Unveil the entire research process.

- Finally, all citizens must promote and encourage the utmost transparency regarding the research they contribute to in part.
- They may claim access to it and must reject elitist (as to their ability to understand) or financial (as to the remuneration of intermediaries who have become almost useless) pretexts that are hindering their route.
- They must require that the data underlying the results made publicly available be verifiable and reusable (not necessarily by them, but they must defend the principle of it).
- Everyone must be able to obtain as much useful information as possible from public research and must be able to access, without encountering a toll gate, the original document to which, for instance, a press article refers by mentioning: "a study shows…".

CONCLUSION: A NOBLE PURPOSE

As researchers, it is up to all of us to take responsibility for future generations. Our mentalities must adapt to a much more collaborative minset for communication and data sharing as well as for the way research and researchers are being evaluated.

The «Movement for the Liberation of Science», as I like to refer to it, is not a mental view of a distant future, but a very contemporary struggle whose stakes are among the most important in the world: to empower all peoples to emerge from obscurantism that generates only injustice and hatred, terror and devastation.

We must therefore acquire and communicate the wisdom to build the new Science by avoiding all the traps set on its path. We must find the strength to resist the tyranny of big money and the sirens or even the pressures of its supporters. And we may find the beauty of a scientific world of cooperation, sharing and exchange.

Appendix 1

Comparison of the different publication variants

Color code: from strongly discouraged (brown) to discouraged (red) to mediocre (purple) to slightly positive (yellow) to recommended (green) to strongly encouraged (turquoise).

CLASSIC PUBLICATION

Principle: commercial publication on paper (recently electronic). Pay to read and sometimes to publish.

Supported by: many countries, often through negotiations on the "Big Deals".

☑☑☐☐☐ *Cost:* Subscription usually paid by the Research Institution. Unrestricted scope for cost increase.

☑☐☐☐☐ *Readership:* Restricted to researchers whose institutions pay for the subscription to the journal.

☐☐☐☐☐ *Advantages:* none anymore today.

☐☐☐☐☐ *Disadvantages:* slow, inefficient, poorly read, expensive and, moreover, obsolete in the digital age.

☑☐☐☐☐ *Effect on evaluation:* favours the prestige criterion

GREEN OPEN ACCESS

Principle: classic publication, simultaneous deposit of the revised manuscript in a public electronic archive, free for reading and reuse, either immediately or after the embargo period.

Supported by: European Community, Switzerland, Wallonia-Brussels Federation of Belgium.

☑☑☑☐☐ *Cost:* subscription generally paid by the Research Institution but with the prospect of abandoning subscriptions in the long run if everyone joins.

☑☑☑☑☑ *Readership:* universal

☑☑☑☑☐ *Advantages:* fast, efficient. The submitted manuscript provides a useful inventory for institutional management.

☑☑☑☐☐ *Disadvantages:* no cost reduction in the short term. Useful as a transition, self-destructive in the mid to long term.

☑☑☐☐☐ *Effect on evaluation:* likely to remain prestige-oriented but offers evaluators better access to content if they so wish

"GOLD" OPEN ACCESS (THE ORIGINAL, OFTEN CALLED "DIAMOND")

Principle: free electronic publication, immediately free for reading and reuse.

Supported by: Initiative of local or disciplinary sector that develop pre-publication or publication platforms at cost price.

☑☑☑☑☑ *Cost:* none.

☑☑☑☑☑ *Readership:* universal.

☑☑☑☑☑ *Advantages:* fast, efficient, liberates the researcher from any external manipulation.

☑☑☐☐☐ *Disadvantages:* requires researchers to take charge of the entire publication process; requires universal acceptance of open peer review.

☑☑☑☑☐ *Effect on evaluation:* content-oriented.

OPEN ACCESS WRONGLY BUT WIDELY REFERED TO AS "GOLD" (IN FACT, FOR PROFIT)

Principle: chargeable electronic publication for immediate free use for reading and reuse.

Supported by: many governments and research funding agencies that support APCs.

☐☐☐☐☐ *Cost:* APCs paid by the author, the Institution or the funding agency. Unrestricted scope for cost increase.

☑☑☑☑☑ *Readership:* universal.

☑☑☑☑☐ *Advantages:* rapid, efficient.

☐☐☐☐☐ *Disadvantages:* subject to inflation. Limits the opportunity to publish to wealthy researchers, institutions and countries. Strengthens the dominant position of the 'shark-publishers'.

☑☐☐☐☐ *Effect on evaluation:* favours the prestige criterion.

HYBRID ACCESS

Principle: commercial publication in print and, at the author's request, electronic. Pay to read and sometimes to publish. Pay for an immediate upload.

Supported by: several governments and research funding agencies that support APCs. Subscription often paid by the Institution in addition.

☐☐☐☐☐ *Cost:* APCs paid by the author, the Institution or the funding agency. Unrestricted scope for cost increase.

☑☑☑☑☑ *Readership:* universal.

☑☑☑☑☑ *Advantages:* fast, efficient, tailor-made.

☐☐☐☐☐ *Disadvantages:* double dipping (APCs and subscriptions).

☑☐☐☐☐ *Effect on evaluation:* likely to favour the prestige criterion.

Appendix 2

What is a Creative Commons license?

"Copyright licenses and Creative Commons (CC) tools provide a balance within the traditional "all rights reserved" framework created by copyright laws."

Within this introduction, CC managers define the very valuable role of the copyright protection tools they have developed. These offer a wide range of authoritative possibilities today, allowing authors to clearly announce, as early as the pre-print stage or for their manuscript if they make it freely accessible, the conditions they grant to users.

Although CCs are very often mentioned (several times in this book), few know exactly the subtleties of their use. The following table outlines the principles of the different variants, the coverage they provide, known examples and possible recommendations.

Table 5 *— Panel of Creative Commons licences*

TYPE OF LICENCE	SIGNIFICANCE	COVERAGE OF THE LICENCE	PRACTICAL CONSEQUENCES, COMMENTS	USAGE AND RECOMMENDATIONS
CC BY	Attribution	Reuse permitted, all or in part, without constraint except for the author's credit	• Attribution to the author. • Inclusion of a link to the original	• Recommended by the NIH in the USA and, in general, for maximal diffusion and use of works luceced under CC • In line with the basic principle of Open Access
CC BY-ND	No derivatives	Prohibits sharing adaptations of content	• Attribution to the author. • Prohibits translation in another language, creation of an annotated copy, adaptation of a graph or drawing in another article	

CC BY-SA	Share alike	Requires adaptations of the content for a diffusion under the same licence	• Attribution to the author. • Any figure from the original article and modified can only be re-published under the same licence as the original	Used by Wikipedia and Wikimedia Commons
No licence (CC 0)	All rights reserved	Total prohibition of reuse, in all or in part, under any form	Prohibits any form of reuse, even of a figure for a lecture. However, in many countries, using short parts of the work in the frame of teaching and basic research	

— Any modification, in the context of an authorised reproduction must be clearly signaled.

— Constraints of the chosen licence may be softened at will by the author on an individual basis i.e. towards a public or private interlocutor.

— Basic rules in terms of scientific ethics, citations and plagiarism remain in application, even in CC 0.

Appendix 3

Myths and realities of the mandatory Green Open Access

All sorts of statements are circulating concening Open Access. It is important to clarify things. The next table provides rectifications of widespread beliefs that are false but quite hard to uproot…

***Table 6** — Myths and realities of Green OA*

MYTHS	REALITY
1. Mandatory Green OA increases the (already heavy) administrative burden of the researchers, imposing on them an additional chore.	**False.** The burden is only heavy the first time, if you are the author of many publications, otherwise a few minutes are enough and you do not publish an article every week... And the researcher is relieved of the tedious task of maintaining his/her publication list and archiving it in a safe place. Besides, an article that has taken months or even years to prepare is well worth a few minutes of recording in a searchable archive that increases its readership.

2. Mandatory Green OA is a tool designed to evaluate researchers, allowing to compare their merits and draw conclusions that could be detrimental to their carreer progression.	**True in part**, although is not its primary function. But in this role, the institutional archive provides more accuracy to evaluators with regard to the inventory of the appraisee's publications. If the principle of evaluation remains unavoidable, it is preferable to use reliable tools.
3. Mandatory Green OA reduces academic freedom. 3. Mandatory Green OA reduces academic freedom.	**False.** Academic freedom is fully respected, with the author being able to publish wherever he/she wishes. The constraint is purely administrative. Academic freedom concerns only freedom of thought and expression in education, the freedom to decide what research should be done and the freedom to choose where to publish it. The act of depositing comes later, after having made these free choices, and does not influence any of them.
4. Mandatory Green OA violates the copyright laws.	**False.** No copyright is infringed if the procedure is respected by the author (respect of embargo if any). In Belgium, the recently amended Federal Copyright Act protects the applicant. Do not confuse green AO and clandestine AO (SciHub for example).
5. Mandatory Green OA bypasses peer review and it could lead to a decrease in the quality of publications.	**False.** In Green OA, the institutional archive must specify the status of the article (peer-reviewed or not), eliminating any confusion in this regard.

6. Mandatory Green OA is an obstacle to the financial return of intellectual property.	**False.** The decision to keep research results closed occurs before the decision to publish and before any consequent commercial exploitation. The same principle applies to the publication of a patent.
7. Mandatory Green OA deprives researchers of their royalties.	**False.** The Green RFP applies to all publications, including those for which all potential revenues go to the publisher. Authors publish these articles for the dissemination of knowledge and/or for the prestige, but not for money. Exceptions to the mandate include books and book chapters. The right to royalties for books written with public support is rarely mentioned, but it is an interesting issue that must be resolved within each institution.
8. Green OA puts researchers at risk of losing their work due to a computer failure.	**False.** In the green OA process, the article is still printed and archived by the publisher. The fear is more relevant for Gold OA for which no printed archive can be guaranteed and where it resides within the author's discretion. However, depositing and harvesting can be carried out at several sites, which greatly reduces the possibility of total loss.

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Selected personal bibliography:

B. Rentier's full list of publications can be found at the following link: http://urlz.fr/81OQ

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A new way of conceiving scientific research, Open Science, was born with the computer revolution. In the wake of Open Access (free public access to the results of publicly funded research), it accompanies the great ideal of transparency that is now invading all spheres of life in society. This book describes its origins, perspectives and objectives. It also reveals the obstacles and barriers due to private profit and academic conservatism.

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