Open Access and the divide between "mainstream" and "peripheral" science[1]

Jean-Claude Guédon
Université de Montréal

1 Introduction: scientific "fields" and scientific forms of power

The discussions that have accompanied the development of Open Access have involved many different, actors, each with a particular point of view. As a result, the ensuing debates have been marked by the complex criss-crossing of various forms of discourse that often fly past each other without meeting. A fair degree of opacity has resulted from this situation, with the consequence that some of the concerns that should have been placed at the heart of the Open Access strategies have largely been neglected. For example, the stratified, competitive nature of science is largely admitted by most, but its evolution into what increasingly appears as an oligarchic power structure is less present in discussions and left unquestioned. Clearly, the structure of scientific power is affected by Open Access, and, as result, that structure should be kept in mind while framing strategies aimed at fostering Open Access. It is difficult to imagine, except rhetorically, how advocating for Open Access can be divorced from working for a different structuring of power in science. This issue is particularly important for developing and emerging countries.

A theoretical detour will help set up the issue of power in science more sharply. Since the 1970's, Pierre Bourdieu, the well-known French sociologist, has argued that all cultural and intellectual activities should be analyzed in specific terms. The quest for success in literature may structurally be analyzed in terms that are structurally similar to those used to approach science, but the particulars are altogether different. Authority in science is different from authority in literature even though it may be acquired in similar ways in both cases: for example, the cornering of a prestigious institutional role, the control of a well-known scholarly journal, the ability to influence the selection of research grants or the promotion of colleagues may be at work in either case, but the institutions and the journals will differ, the research grants will be adjudicated by entirely separate juries when they are not divided up between different agencies. Finally, the criteria affecting tenure and promotion will vary greatly between science and literature. Publishing fiction, for example, will not help in the sciences, for obvious reasons, but it will be examined more positively in a literature department. Publishing a monograph is the highest form of publication a professor of humanities can produce. In the sciences, on the other hand, articles dominate and books play a secondary role because they do not incorporate cutting edge research.

Bourdieu names these complex activities "fields". Obviously, the term "field" was common before Bourdieu, as illustrated by the simple expression " field of knowledge". However, in Bourdieu's case, while "field" does preserve the idea that the whole of knowledge can be divided up in a number of

1 Thanks are due to Frances K. Groen, my wife, who has saved me from countless Gallicisms, awkward sentence structures and fuzzy thinking. For his extraordinary generosity, my friend Subbiah Arunachalam should also be deeply thanked. I know of no one who can answer as fully and quickly as he does, even when on the road in difficult places. I should also mention that I discovered an excellent study by Eve Gray too late to incorporate it here. Titled: *Achieving Research Impact for Development. A Critique of Research Dissemination Policy in South* Africa, with Recommendations for Policy Reform, available on-line at http://www.policy.hu/gray/IPF_Policy_paper_final.pdf , it intersects many themes broached in this paper. I am also happy to report that we are in broad agreement. Leslie Chan and Heather Morrison, as well as Peter Suber have also helped me either to avoid some blunders, or strengthen my arguments. My warmest thanks to them as well.

distinct areas, it also acts as an arena where rule-directed forms of competition reign[2]. According to Bourdieu, the scientific field is the space where scientists compete for a monopoly over scientific authority. In turn, scientific authority is construed as being both technical capacity and social power. In other words, it is not enough to be an excellent scientist with great skills; one also needs to have power, and know how to use it.

Bourdieu's work has been extremely useful to introduce the question of power in the sociology of science. It completes and corrects the pioneering work of Robert K. Merton in fundamental ways. Yet, it too stands in need of some correction. For example, Bourdieu never questions the form of power observed in the scientific field. He does not even raise the possibility that its nature may have changed through time. In looking at how Open Access may help correct the over-arching system of power on a world scale, we need to question this very point. The reason is simple: the divide between "mainstream" and "peripheral" science, discussed below, reflects a reality, but this reality relies on specific forms of power to exist. Overcoming the divide will not be achieved through simple acquiescence to the present form of scientific power; followed by some superficial tweaking of the system. Correcting the existing inequities will require transforming the power structure of science as well.

2 National and international forms of scientific competition

In science, as in most social activities, exercising power takes several forms: directing an important laboratory is one of them, as is editing a leading journal or chairing a committee that adjudicates research grants. From the perspective that occupies us here, the quest for editorial positions is obviously of the essence. Scientific journals are not only organs of diffusion; they also serve as gatekeeping platforms. Scientists who play a role within such journals influence the ways in which submitted manuscripts are selected. They also enhance their visibility and status by virtue of the work they do: simply dispatching articles to reviewers implies the presence of a strong network that is being regularly fed and strengthened by contacts regularly renewed. Competing for an editorial position is part of competing in the scientific field. In an exemplary fashion, it illustrates the Janus properties of scientific power that Bourdieu had identified: recognized expertise justifies exercising a form of authority that can be concretely implemented in the daily decisions that are part of the editorial process. How is expertise recognized? How can it be used to justify authority? How is authority translated into decisions that reflect scientific power? Answers to these three questions make us understand better the nature of a "scientific field".

All scientific journals are not created equal. Again, competition is the rule. Within the scientific field, the competition between journals obeys specific rules. Despite some highly visible exceptions such as *Science* or *Nature,* journals generally limit their coverage to disciplines or specialities within disciplines. Less studied is the geographical reach of scientific journals: who read them where and why? These parameters have shifted in history but have not been studied precisely. Within their area of specialization and their geographical reach, journals can be ranked along some sort of scale where visibility, authority and prestige all intervene. What is important to note here is that the scale is inherently continuous. The reach and prestige of a journal are variables that can vary continuously. When we say that journals work on an international or even global scale while others remain more strictly national, we are talking about a gradient and not watertight categories. Moving from the national level to the international or even global level is an important transition in scientific publishing

2 Pierre Bourdieu, "La spécificité du champ scientifique et les conditions sociales du progrès de la raison", *Sociologie et sociétés*, vol. 7 No 1 (May 1975), pp. 91-118.

but it should not be construed as a threshold. How the gradual nature of journal ranking has been replaced by a discourse based on a divide is part of the transformation of the nature of scientific power. Because of the national/international distinction, the hierarchic structure of scientific journals is a two-tier hierarchy. At the top reigns a single set of journals; below the divide are collections of journals that enjoy various degrees of visibility or, should I say, invisibility, within geographical "silos" of variable size. How this system has come to emerge and how it is maintained is an important part of the analysis presented here.

The reasons for hierarchies are clear: within a country, institutions have developed a pecking order of their own, both stable and publicly known. While institutions do undergo periods of progress and periods of decline, these movements remain relatively slow and a prestigious institution will tend to remain prestigious over centuries. Prestigious universities or research centres will also tend to be supported more fully and readily than others, be it by governments, or by private funding. In both cases, the desire to nourish what works, or to be seen associated with what is prestigious goes a long way towards explaining institutional advantage. The pecking order of institutions does not translate directly into the power structure of national scientific associations, but neither is it totally absent from it. It could be said that it is "diffracted" in complex ways in the composition of national scientific associations, without any attempt here to clarify the nature of the diffraction metaphor. In turn, scientific societies create journals and, of course, populate them with the works of their own members or beyond. Thus emerges a power structure based on three components (institutions, associations and journals). It is easy to analyse each component separately, but a dense and complex web of interactions and influences link them in ways which, once again, characterize in some ways the scientific field. Institutions, associations and journals will also be relevant to any study of power and competition in the social sciences and the humanities, but they will not work in the same way as in science. Together, they form a national system of science.

On the international level, other parameters begin to appear. The status of a country and the reputation of its laboratories will be important. Linguistic dimensions will also intervene in this question. For example, until the second World War, at least three European languages could claim international status in science: German, English and French. One needed these three languages to monitor the progress of science at its highest level. Because other languages were often ignored, significant literature connected with them was often lost. Journals published in languages other than German, English and French were working under a strong visibility handicap. The ability to create a linguistic triumvirate, so to speak, corresponded to a specific historical form of scientific power that has not largely disappeared. recalling its existence shows that forms of scientific power do indeed change with time.

The defeat of Germany and the reduction in rank of France after the second World War opened the door to English becoming the world language of science. This meant that French and German scientific journals either had to shift to English or suffer a form of demoting that paralleled the retreat of these two languages on the international scene. Once again, the form of scientific power was transformed.

The rise of English as scientific *lingua franca* also factored in the growth of a new set of players: scientific international publishers (as distinguished from national publishers striving for an international audience for their largely national authors). The most obvious example of this new trend, and in many ways its pioneer, was Robert Maxwell and his series of *International Journals of ...* under the imprint of Pergamon Science[3]. As Brian Cox puts it in his somewhat sycophantic article on Maxwell:

3 A review of the literature on Robert Maxwell is available at http://www.ketupa.net/maxwell.html.

> Pergamon was the child of his timing, vision and drive. ... [Science publishing] was becoming increasingly international... The international reach of STM publishing was already evident in the list of journals and books that Maxwell acquired in 1951[4].

The emergence of a *lingua franca* also gave commercial publishers a competitive advantage by allowing them to go international, and thereby reach a potentially much wider audience, yet deal with only one language. In parallel, the sharp rise in the number and size of universities after the second World War signalled the emergence of a world-wide market for scientific publications. Perspicacious businessmen like Robert Maxwell understood this trend more quickly than most and moved to take advantage of it. It is also the period when Elsevier began its mutation from a national (Dutch) company in the early '50's to becoming the largest publisher of scientific, technical and medical (STM) materials in the world[5].

In retrospect, it is easy to see that commercial publishers were generally quite agile in moving beyond the national scene (with international customers) to reach the state of multinational and ultimately global companies. Scientific associations and societies, bound as they were (and are) to a largely national membership, found it much more difficult to become global.

How scientists compete internationally is somewhat different from the rules at work within a single country. Because science claims to be universal, i.e. claims that its results apply equally everywhere, scientists easily extend this basic principle to issues of methods and even to the level of values: as a result, criteria to judge scientists can also claim to be universal and, therefore, a global competitive field can be instituted on the basis of universalism. International prizes are important to order this process, as are international conferences and seminars. Likewise, the creation of international scientific institutions provides new forums for international competition, often coupled with an ideology of "internationalism"[6]. In the end, however, publications emerge as the most important device to regulate the international system of scientific competition. Publications embody a great deal of power because they form the basis for the management of scientific careers everywhere. Unlike prizes, meetings and seminars that occur only at discrete times and places and touch only small fractions of all possible participants, journals are constantly on scientists' minds if only to monitor the progress of their competitors.

Consequently, the development of an international system of scientific competition has led the scientific field gradually to evolve into a two-tier system, one tier national and the other international. The international tier has come to act as the main quality arbiter while the national tier includes more complex mixtures of quality assessment with institutional politics and, sometimes politics *tout court*. Policy issues are also of the essence at the national level as many governments desire to harness the power of science to improve the well-being of their country. Once again, however, it must be emphasized that the national and international tiers are not watertight categories. They provide useful ways to analyze divergent forms of scientific behaviour whenever they are met, but transitioning from a mainly national role to primarily an international role could still be thought as a gradual shift, and not

4 Brian Cox, "The Pergamon Phenomenon 1951-1991: Robert Maxwell and Scientific Publishing", *Learned Publishing* vol. 15 No 4 (October 2002), 274.

5 Brian Cox, *Ibid.*

6 Paul Forman, "Scientific Internationalism and the Weimar Physicists: The Ideology and its manipulation in Germany after World war I", *Isis*, vol. 64 (1973), 151-80. It can be noted that the International Mathematical union, the International Astronomical Union and the International Union of Pure and Applied Chemistry were founded in 1919. On the effects of the First World war on scientific communities in Europe and the United States, see Brigitte Schroeder-Gudehus, *Les scientifiques et la paix. La communauté scientifique international au cours des années 20* (Montréal, Presses de l'Université de Montréal, 1978).

an abrupt discontinuity until roughly the second World War or shortly after. Until then, the two tiers defined a slope to climb, not a barrier to overcome.

Dependent as it is on the scientific system of communication, the international tier of scientific competition needed to evolve a pecking order of publications even more than the national scientific communities. However, until the '60's and early '70's of the last century, the hierarchy of scientific journals was largely based on reputations and evaluations that remained largely impressionistic. Essentially, leading scientific countries had been producing sets of leading publications and, in the international arena, a floating assessment of the aggregate produced a rough consensus about world elite journals. For example, the monumental *Royal Society's Catalogue of Scientific Papers* covered a little more than 1,500 titles from all over the world (read Europe and the United States) and, as such, pointed to the nineteenth-century equivalent of "core science"[7]. In a similar fashion, various countries developed international disciplinary bibliographies and indices, and these provided *de facto* core disciplinary sets.

These first large-scale international bibliographies helped arbitrate the international scale of scientific competition. As Paul Forman puts it: "...it is praise from parties with a negative bias, from competing nations, which is regarded as most genuine and cogent; thus the great prestige carried by *foreign* honors".[8] Having one's journal included in a foreign bibliography fits this description.

In an interesting twist, Forman limits the intensity of scientific competition by introducing the possibility of some forms of cooperation among scientists: for example, the need to manage large quantities of data coming from all over the earth or the recognized advantages of some division of labor. Forman, however, refuses to be taken in by situations apparently contradicting the competition principle and prefers to interpret cooperation as forms of "cartelization". Likewise, the production of scientific bibliographies with some degree of international coverage, while it does serve to manage and regulate science competition, also succeeds in excluding all but a few competitors and reinforces thereby the cartelized nature of internationalized science. It is this international, informal, cartel of science that we must keep in mind for the rest of this paper. It is this particular power structure that can help to understand how a slope became a barrier[9].

Since the 1930's, thanks to Bradford's law[10], librarians had noticed that some journals, for any discipline, seemed to be more "productive" than others. "Productive" here means yielding more relevant articles than other titles. This approach obviously led to a different vision of what "core" journals represented: rather than being (grudgingly perhaps) admitted as valuable source of information

7 Interestingly, the idea for this project apparently originated in the United States, first with E. B. Hunt and Joseph Henry. Henry offered the idea at a British Association for the Advancement of Science meeting in Glasgow in 1855. See Donald deB. Beaver, "The Smithsonian Origin of the Royal Society Catalogue of Scientific Papers", *Science Studies,* vol. 2 No 4 (1972), 385-393. The author reminds us that between 1800 and 1860, the United States produced no more than about 10,000 scientific papers. By comparison, the Royal Society catalogue for the period extending from 1800 to 1863 included about 215,000 articles. Many of the US papers were probably not included in the Royal Society's Catalogue.

8 Forman, *op. cit.* (note 6), 154.

9 For a different, yet compatible, vision of the historical development of science on a world scale, see Michael A. Peters, "The Rise of Global Science and the Emerging Political Economy of International Research Collaboration", *European Journal of Education*, Vol. 41 No. 2 (2006), [225]-44.

10 Samuel C. Bradford first published his law in 1934. "It states that journals in a single field can be divided into three parts, each containing the same number of articles: 1) a core of journals on the subject, relatively few in number, that produces approximately one-third of all the articles, 2) a second zone, containing the same number of articles as the first, but a greater number of journals, and 3) a third zone, containing the same number of articles as the second, but a still greater number of journals. The mathematical relationship of the number of journals in the core to the first zone is a constant n and to the second zone the relationship is n^2." http://www.gslis.utexas.edu/~palmquis/courses/biblio.html.

by foreign bibliographies, and thereby acquiring some degree of prestige, core journals would be viewed as the best sources of information for a given research field. Librarians then translated this observation into subscriptions and, as a result, core journals also became much more accessible than their competitors. In the '60's, Eugene Garfield's transformed Bradford's distribution law into his own concentration law[11] and this allowed him to create a *Science Citation Index* (*SCI*) that, although limited to a few hundred titles at first, could credibly be offered as a fair representation of "core science". Firmly grounded in statistical evidence, the list of titles used by *SCI* quickly enjoyed a great deal of credibility. It even became a reference for librarians aiming at building an acceptable collection of scientific journals in their libraries[12].

From this new situation, three consequences followed:

1. *SCI* fundamentally contributed to reshaping the two-tier structure of scientific publishing that had gradually developed since at least the nineteenth century. The designing of the *SCI* list of journals hardened the effects of the inclusion/exclusion principles already at work in the making of earlier bibliographies. However, its effects were felt more widely because, unlike most earlier bibliographies, it was not limited to a particular discipline. Moreover, *SCI*'s design readily lent itself to quantitative treatments: numbers of citations (impact) and average number of citation per article of a journal over a two-year period (impact factor) became accepted forms of quality measurements[13]. By separating scientific publications between those that could be readily evaluated quantitatively (however problem-ridden the measurement may be) and those that could not be so readily evaluated, *SCI* essentially created a barrier between the two categories. It radically separated "core science" from the rest of scientific publications and then it took upon itself to decide which publications could or coud not be included in the *SCI* list;
2. As more and more librarians took the habit of referring to the list of journals included in *SCI* as a good starting point to build credible collections, their acquisition patterns began to converge. This process laid the necessary ground for an inelastic market of scientific journals, a point quickly noted by various businessmen, in particular Robert Maxwell. The so-called "serial pricing crisis" began to unfold[14];
3. The new way to define the two-tier hierarchy of scientific journals also proved useful to complete the process of wrestling the control of scientific publishing out of the hands of German publishers because Eugene Garfield very strongly favoured unifying all of world science under one single language: English[15]. Thus, it accelerated the institution of English as the sole *lingua franca* of science. This trend had started as a consequence of the first World War, but its full effect began to be felt only after 1945.

---

11 See http://www.garfield.library.upenn.edu/essays/V1p222y1962-73.pdf.

12 I have examined this question in greater detail in my article "In Oldenburg's Long Shadow: Librarians, Research Scientists, Publishers, and the Control of Scientific Publishing" available on-line at http://www.arl.org/resources/pubs/mmproceedings/138guedon.shtml.

13 It might be more appropriate to write "measurements" to cast some doubt on the validity of the claim: normally, in science, measurements are offered accompanied by error estimations. One routinely sees impact factors given with four significant figures and no justification for this level of precision.

14 The whole saga can be followed, blow by blow in Marcia Tuttle's *Newsletter on Serial Pricing Issues* available at http://www.lib.unc.edu/prices/. One of the latest developments in the battles waged between libraries and large publishers is the decision by the Max Planck Institute in Germany to cancel all of its subscriptions to Springer journals starting in January 2008. See http://mailman.nhm.ku.edu/pipermail/taxacom/2007-October/026230.html.

15 See "Interview with Dr. Eugene Garfield", *Serials Review* (1999), Vol. 25 No. 3, 67-80. Available on-line at: http://www.garfield.library.upenn.edu/papers/beacarawayinterviewy1999.html.

Robert Maxwell understood how much leverage there was in *SCI*, in particular to organize and justify the international pecking order of journals. For decades, he tried to gain control of *SCI*, by cajoling or threatening[16]. Had Eugene Garfield not resisted, Maxwell would have been able to promote all his journals – now squarely construed as publishing forms of investment – into the *SCI* list almost at will and, as a result, the international scientific cartel could have morphed into an outright monopoly with incalculable consequences for the life and evolution of scientific research. The prospect of a publishing monopoly in science publishing may appear less probable nowadays, but the constant movement toward concentration is bringing us ever closer to an oligopoly situation that is not so very different from Maxwell's dream[17].

Cartels allow oligopolies to work as if they were a monopoly and this is precisely the situation we observe nowadays. Moreover, publishing cartels are far more stable than most other forms of cartels because they deal in non-rivalrous goods. Unlike a cartel like the Organization of the Petroleum Exporting Countries (OPEC) that wants to maximize profit by limiting production, but where individual member may want to increase revenues by surreptitiously increasing production, publishers do not have to fear the effects of over-production so long as they keep a firm grip on the size and nature of core science. Essentially, this has been one of the main roles of *SCI* in the last thirty years. A private company – Thomson Scientific (formerly known as Thomson ISI) - unilaterally, and largely unaccountably, decides how many journal titles will be included in its basic list and everybody else abides by its decisions.

3 The divide between "peripheral" and "mainstream" science

In analyzing world science, the terms "centre" and "periphery" regularly recur. It is derived in great part from "dependency theory". Dependency theory – more a set of roughly converging approaches than a real theory in actuality[18] - generally opposes development theory by interpreting the poverty of a majority of world countries as a necessary condition for the prosperity of a small group of nations, rather than as a phase in the history of a world that is generally developing. In effect, it rejects a naïve and optimistic faith in some progressive fate. But it also lends itself too easily to a simplistic, and even Manichean, vision of our world. Neither the "centre", nor the "periphery" is monolithic and, on at least some issues, they display points of convergence. Open Access to the scientific literature is a good example of such a possible convergence: most scientists everywhere can agree that it will improve their ability to work and to contribute to the evolution of science. But they may have different arguments to support this viewpoint.

To examine how the "centre and periphery" discourse translates in actual situations, let us look briefly at one particular issue: how is the presence or visibility of "peripheral science" treated in central, and then in peripheral, forums? Once again, *SCI* will be at the heart of our preoccupations, which is not surprising given its strategic role in the present power structure of world science.

---

16 Private conversation with Eugene Garfield. See also http://www.garfield.library.upenn.edu/papers/history/heritagey1998.html et http://www.garfield.library.upenn.edu/papers/oralhistorybywilliams.pdf.

17 See, for example, Kathleen Robertson, "Mergers, Acquisitions, and Access: STM Publishing Today" *Library and Information Services in Astronomy IV* (July 2-5, 2002) Prague, Czech Republic B. Corbin, E. Bryson, and M. Wolf (eds). Available on-line at http://www.eso.org/gen-fac/libraries/lisa4/Robertson.pdf.

18 See, for example, Omar Sánchez, "The Rise and Fall of the Dependency Movement: Does It Inform Underdevelopment Today?" available on-line at http://www.tau.ac.il/eial/XIV_2/sanchez.html.

In 1982, a meeting was held at the Institute for Scientific Information (ISI), the home of *SCI*, where the issue of the presence, representation and impact of "peripheral" or "Third-World" countries was debated. Some statements illustrate clearly the way in which the issues were cast. For example, D. J. Frame was described as approaching the issue in the following manner:

> If the purpose of the bibliometric indicators is to help in the building of a national scientific inventory, telling us what kind of research is being performed at different institutions, then coverage of local as well as mainstream publications would seem important. On the other hand, if one is primarily interested in investigating Third World contributions to world science, then publication counts taken from a restrictive journal set would seem most appropriate.[19]"

In brief, two very different tasks that both apply to developing nations are contrasted here: a national inventory of scientific activities on the one hand, and their "contributions to world science" on the other. The first task, clearly related to issues of national policy, is ultimately dismissed, presumably as a provincial exercise of no interest to the rest of the world. Without justification or analysis, a distinction is then drawn between "local publications" and "mainstream" or "world science", as if it were an evidence. Publications are either "local" or "mainstream" and there is a definite gap between the two sets. The restricted set of "mainstream publications" is also brought forward without question: it is used to investigate "Third World contributions" to "world science" and is thus "most appropriate". The simplistic nature of the argument is clear. Indeed, what is "world science"? If it is indeed the science publications selected by *SCI*, it is not difficult to point to the bootstrapping move that allows *SCI* to claim it is doing just the right thing. Dr. Pangloss in Voltaire's *Candide* could not have expressed it better himself: *Tout est pour le mieux dans le meilleur des mondes...*

We should also note the expression "contribution to world science". The intended meaning, of course, is that only "world-class" works can be noticed. The "excellence" of such works is guaranteed by the filtering devices of "mainstream publications", in particular, one would assume, peer review. However, even without questioning the peer-review process itself, other parameters beside the quest for excellence are obviously at work in the selection process of publishable articles for a given journal. The credibility of the institution and of the laboratory are not insignificant in assessing a paper, and neither is the name of the author: by deleting the author and affiliation, many journals hope to avoid or decrease the biases stemming from that knowledge. The journal itself implements some editorial policy, explicit or not, that will allow it to exclude papers not on the basis of quality, but of relevance. In this case, relevance can mean a number of things ranging from a set of topics related to a particular field of knowledge to issues that attract the interest and attention of researchers in rich countries. It can also refer to "hot" topics that will attract readers, and therefore citations, thus enhancing the impact factor of the journal. In any case, the term "contribution" tends to take on a new meaning, having much more to do with the necessity to fit within some patterns of topics deemed suitable or even fashionable by "centre"-based scientists. At that point, the researcher from a "peripheral" country must use scarce resources to attack a question that may be of very little interest or relevance to the institution or the country of work. Our hypothetical researcher is truly "contributing" something quite extraordinary since he/she is trying to buy some visibility in order to advance his/her career by dealing with issues that do not serve his/her community directly. Community here is taken both in the narrow sense of

19 D.J. Frame. "Problems in the Use of Literature-based S&T indicators in Developing Countries." In: H. Morita-Lou, ed. *Science and Technology Indicators for Development.* Boulder, Colo.: Westview, 1985, pp. 117-122. The quotation is from *The Uncertain Quest: Science, Technology, and Development* (Paris, United Nations University Press, 1994), Jean-Jacques Salomon, Francisco R. Sagasti, and Céline Sachs-Jeantet and is available on-line at: http://www.unu.edu/unupress/unupbooks/uu09ue/uu09ue0m.htm. According to S. Arunachalam who attended the ISI meeting, it took place in 1982 and not in 1985. Personal communication from S. Arunachalam, November 4th, 2007.

professional colleagues and the wider sense of one's societal context. The end result is a paradoxical and unexpected form of foreign "contribution" (or aid) flowing from poor countries to rich countries[20].

What is even more striking is the fact that, sometimes, the reverse foreign aid syndrome is aided and abetted by officials of the poorer countries. One case in India is quite revealing in this regard. The late Sambhu Nath De, a cholera investigator based in Calcutta who died in 1985, was nominated several times for the Nobel Prize by no less than Joshuah Lederberg. However, in his own country, he was not even nominated a fellow of any Indian academy[21]. Presumably, cholera was too close to local preoccupations to qualify as a prestigious topic... Or, more simply, he was not deemed prestigious enough by some of his own countrymen.

All these aberrations stem in part from a perverse interpretation of scientific universalism: while universalism means that scientific results are equally valid everywhere, it does not mean that they are equally useful or applicable everywhere. Neither does it mean that they have to fit with fashionable topics in prestigious laboratories abroad to be of the highest quality.

Eugene Garfield, the creator of *SCI*, displays lines of reasoning similar to those of D. J. Frame when he studied science in the Third World. By following the citations of Third World articles that appeared in *SCI*-listed journals, he predictably discovered that their impact was quite slight. More surprising is his use of circular logic. For example, Garfield states that the "First World" countries produced 84% of the 1973 articles in *SCI*, and concludes: "Clearly, the *SCI* database reflects the dominance of First World scientific publications." Given the selection of titles to build the *SCI* database, any other result would have been startling. His next sentence does not refer to the *SCI* database but it is a good deal more revealing (and accurate): "Western journals control the flow of international scientific communication almost as much as Western news agencies monopolize international news."[22] Garfield probably meant to say "dominate" but in a revealing *lapsus calami* wrote "control" which is exactly the point I have tried to make from the beginning of this paper.

The Garfields and Frames of the world project the image of a world science dominated by a few countries and underscore the fact that other countries have no choice but to latch on to "world science". However, authors from so-called peripheral countries have looked at the map of world science through different lenses and reached different conclusions.

---

20 S. Arunachalam in a private exchange dated October 30th, 2007, writes: "Much of the research done in DCs is of this kind - trying to fill in gaps in the literature. Often scientists returning from universities in the advanced countries (where they go for their Ph D and postdoctoral stints) continue to work on the same (or similar) problems in their home countries." My thanks to Dr. Arunachalam for an extremely swift, full and useful answer to my question. S. Arunachalam has published a number of papers on the centre/periphery issue, for example ""The Links between Mainstream Science and Journals on the Periphery", *Journal of Scientific and Industrial Research*, Vol.47 (1988), 307-14; ""Peripherality in Science: What Should be Done to Help Peripheral science get Assimilated into Mainstream Science?" in R. Arvanitis and J. Gaillard, *eds., Science Indicators for Developing Countries* (Paris, ORSTOM, 1992). There is also the issue of direct exploitation of so-called "indigenous knowledge" by scientists and industries from central coutries that S. Arunachalam explores in his "Science on the Periphery Enriches Mainstream Science, but at what Cost? the Case of Ethnobotany" in *Les sciences hors d'Occident au XXe siècle*, ed. Roland Waast. Vol. 6, *Les sciences au Sud. État des lieux* (Paris, ORSTOM, 1996), pp. [29]-50. See also F. Spagnolo, "Brazilian Scientists' Publications and Mainstream Science: Some Policy Implications", *Scientometrics*, Vol. 18, Nos. 3-4 (1990), 205-18. Spagnolo (p. 215) lists a number of problems associated with publishing abroad, for example, the weakening of local journals, the increased difficulty for students to access articles in foreign journals, the neglect of problems mainly of national relevance, etc.

21 See P. Balaram, "Science, Scientists, and Scientometrics", *Current Science*, Vol. 86 No. 5(March 10, 2004), 623-4. I wish to thank Dr. S. Arunachalam for attracting my attention to this telling case.

22 E. Garfield, "Mapping Science in the Third World", *Science and Public Policy* (June 1983), 112-27, in particular p.114. See also *The Uncertain Quest... op. cit.* (note 19).

The issue of representation in the database is of course the first area of concern. Arunachalam and Manorama, for example, find that only ten Indian journals appear in the 1987 version of *SCI* (out of 3,000 titles). However, in 1986, another database, BIOSIS, covered 9242 titles and included 273 journals published in India[23]. Chemical Abstracts included 288 Indian journals.[24] Later, the issue of how people cite is raised and our authors note somewhat ironically that a Third-World address seems to "repel citations".

The same point is actually made by Eugene Garfield in a less obvious way when he noted that Third World authors were cited more often when they collaborate with a scientist from a developed country[25]. Quite often, a citation is supposed to grant a degree of authority to the citing author[26], but citing someone from an unknown or unfamiliar laboratory, in a poor country, and with an exotic name will simply not achieve the desired result.

S. Arunachalam notes similar results with regard to selection of papers and referees:

> ... when it came to choosing manuscripts for publication editors of reputed international journals would more likely select the one from Harvard in preference to the one from Hyderabad – even though both manuscripts may be of comparable quality. To most editors in the West, Harvard seems a sounder bet than Hyderabad[27]

Authors from India or Latin America have also pointed out some of the characteristics of scientific publishing in their countries: articles often appear in low-impact journals or even non-*SCI* journals; many references used are fairly old; papers published in such journals are cited less and more slowly; many of these citations will come from colleagues in the same country. In short, issues of access are clearly at work both from the perspective of the citing author (fewer, older articles are the only sources available) or the cited article. Arunachalam and Manoram conclude as follows:

> The few elites among scientists of such societies depend upon their contacts (invisible college membership) abroad. In fact, one can see a distinct dichotomy in many scientifically peripheral societies: a small minority of better performers who draw sustenance from their overseas associates as well as contribute to better cited international journals and attend many international conferences, and a vast majority of scientists who are also in science but barely making their existence felt."[28]

Obviously, such a dichotomized set of scientists can lead to interferences of all kinds with the scientific process. In effect, the autonomy of the scientific field is threatened. Peer review, grant allocations, support for attendance at international conferences can all fall under complex mechanisms where politics, bureaucracy and favoritism are given much freer rein. Limited resources are allotted according to rules that reach well beyond the scientific ethos. More fundamentally, Arunachalam and Manorama also point to a troubling situation which is common in Third-World countries (or elsewhere for that matter):

---

23 Ironically, BIOSIS is now part of Thomson Scientific.

24 S. Arunachalam & K. Manorama, "Are Citation-Based Quantitative Techniques Adequate for Measuring Science on the Periphery?" *Scientometrics,* vol. 15, Nos 5-6 (1989), 394.

25 Garfield, *op. cit.* (note 22).

26 Anthony Grafton, *The Footnote. A Curious History* (Cambridge, MA, Harvard University Press, 1997), p. 8.

27 S. Arunachalam, "Information technology: What does it Mean for Scientists and Scholars in the Developing World?" *Bulletin of the American Society for Information Science*, Vol 5 No. 4 (April-May 1999). Available on-line at http://www.asis.org/Bulletin/Apr-99/information_technology___.html. Arunachalam is quoting an editorial from *New Scientist* (November 1st, 1997), 3.

28 Arunachalam & Manoram, *op. cit.* (note 24), 394-6.

> If the mandate of a CSIR[29] laboratory in India is to adapt existing technologies for use by the local industry, then it will be unfair to evaluate the performance of the laboratory by the number of citations won by the few research papers coming from that laboratory.[30]

In short, this 1989 article raises some difficult questions: for example: should good scientists, impelled by the desire to help their country, decide to move away from so-called "mainstream science"? However, a closer examination of the situation reveals that the issue is not "mainstream science", or at least not directly. The Nobel Prize winner Abdus Salam put it very aptly: "Without internationalization science cannot flourish; ..."[31]. However, internationalization does not necessarily mean exclusive contact with "core" scientific countries. New ideas, respect of rigorous standards and transfers of laboratory techniques can occur between various kinds of scientific "nodes", all of which are not necessarily located at Harvard, Oxford or other "central" institutions. Moreover, if the literature is freely accessible, some of the obstacles to internationalization can also be removed or at least their effect diminished. The basic issue, therefore, is achieving some form of *internationalization*, not connecting with mainstream science, whatever meaning is assigned to this dubious expression. And achieving a satisfactory degree of internationalization is a function, among other important factors, of access.

Two years before the article penned by Arunachalam and Manoram appeared, Hebe Vessuri published a most interesting analysis of what she called the "peripheral scientific journal"[32]. She develops a strategy for the nurturing and evolution of national scientific journals based on the experience of a Venezuelan publication. Basically, she rejects the notion that national journals simply are second-rate publications, and she also advocates not limiting the evaluation criteria of such journals to international impact (as measured by *SCI*). If this is done, she argues, the national journal can be viewed as a much richer and more significant project. In particular, and this is absolutely crucial, it allows rejecting the idea that the divide between local and international publications is insurmountable. She pursues:

> ...si ... se trataba de generar un sistema de communicación científica local/regional paralelo, que eventualmente permitiera la participación en el ámbito internacional con la mayor visibilidad y soporte que da el pertenecer a una communidad científica local o regional dinámica y creativa, la defensa y promoción de la publicación nacional adquiría otro sentido.[33]

The level of scientific development of a given country, she argues, is not measured simply by its impact on world science. For one thing, it is almost always minuscule. It is more important to develop a better knowledge of who does what where within the country or the region, and begin to identify the salient themes of research that emerge within comparable countries while seeking ways to network researchers as densely as possible. Local or national journals can become a very useful instrument to move in that direction.

Vessuri shows that *Acta científica venezolana* began to attract larger numbers of authors when evaluation tools were not limited to impact measurements. Sole attention to impact, she remarks, leads to local scientists being treated as if they were working in a rich country, which is a fiction with negative consequences. The reality is that the local scientist, at best, remains subordinated, through fragile personal contacts, to research teams and institutions located in rich countries. It also means

29 Council for Scientific and Industrial Research

30 Arunachalam & Manorama, *op. cit.*(note 24), 406. This brings us back to the issue of "relevance" to the local scene vs. "relevance" to the editorial orientations of a foreign journal.

31 Quoted in Arunachalam & Manorama, *Ibid.*

32 Hebe M. C. Vessuri, "La Revista Científica Periferica. El Caso de *Acta Científica Venezolana*", *Interciencia*, vol. 12 No. 3 (May-June 1987), 124-34.

33 *Ibid.*, 126.

being constrained in the choice of research themes while living in the shadow of foreign team leaders. However, she also argues, a strategy based on narrow and rigid forms of nationalism would not be desirable either because it would encourage isolation, provincialism, invisibility. Ultimately mediocrity would come to dominate, as has so often been noted by various observers. Much better is the strategy which consists in encouraging publishing in local journals with the view to strengthen local networks so as to prepare them gradually to reinforce their presence on international stages.

One main issue emerges from this excursus into the contrasting perceptions of the divide between "peripheral" and "mainstream" science: can it be reduced or even erased. From the point of view of rich countries, the situation appears straightforward: we are "mainstream" science and there is no alternative. We produce most of it. Poor countries must strive to "contribute" to "mainstream" science as much as possible and, gradually, the situation will improve. However, the situation is not that simple and we have already seen that such a strategy will not necessarily succeed while generating problems of its own. Through devices such as global bibliographies, and particularly thanks to *SCI*, contribution really means trying to publish in journals that belong to the set of titles defined and controlled by Thomson Scientific.

This situation is clearly marked in a recent article about African science. Speaking about "flagship" journals from Africa, the author asks:

> Which of them could be candidates to bridge the divide between local science and the international research frontiers, and in the process, achieve sufficiently high levels of international visibility to possibly become a [S]CI-listed journal?[34]

Tijssen's work follows the strategy that Hebe Vessuri rejects: he calculates the impacts of journals that do not belong to the *SCI* set on the *SCI* journals. The results are quite dismal, of course, and that was predictable. However, more importantly, they also reveal that the distribution curve of impacts is continuous[35]. This, of course, clearly illustrates the artificial nature of the divide: the dividing line separating *SCI* journals from the others is the result of human decisions, not of a natural law of scientific publishing:

> In summary, no evidence is found of a clear cut distinction between a small "elite" set of [S]CI-listed journals that are relatively highly cited in the international literature and the large majority of poorly cited non-[S]CI journals. The [S]CI/non-[S]CI dichotomy seems inadequate to categorize journals according to their international standing[36].

In effect, this result tends to shows that "mainstream" science is nothing more than an artefact of *SCI*. Supporting this hypothesis is the fact that representation inside *SCI* has long been a point of contention between Thomson Scientific and scientists and journal editors from various "peripheral" countries.[37] Issues of language and money, as well as evaluation, seem to have been regularly mentioned as causes for exclusion. The testimony of scientists involved with *Archivos de Investigación Médica*, as recounted in *Scientific American*, appears quite instructive in this regard :

---

34 Robert J. W. Tijssen, "Africa's Contribution to the Worldwide Research Literature: New Analytical Perspectives, Trends, and Performance Indicators", *Scientometrics*, vol. 71 No. 2 (2007), 317. In passing, note the recurrence of the word "contribution".

35 Tijssen, *Ibid.*, 318.

36 Tijssen, *Ibid.*, 323.

37 See, for example, Rafael Aleixandre-Benavent, Juan Carlos Valderrama Zurián, Alberto Miguel-Dasit, Adolfo Alonso Arroyo, Miguel Castellano Gómez "Hypothetical Influence of non-Indexed Spanish Medical Journals on the Impact Factor of the Journal Citation Reports-indexed Journals", *Scientometrics*, vol. 70 No. 1 (2007), 53-66. See also Rogerio Meneghini and Abel L. Packer, "Is there Science Beyond English?", *Embo Reports*, Vol. 8 No. 2 (2007), 112-16.

> Of course, there were conditions: to remain in the *SCI*, Archivos had to publish its issues on time, provide English abstracts for its Spanish articles--and purchase a $10,000 subscription to the index. All of which the journal did, until 1982. "But then the country went through a terrible economic crisis, resulting in a delay of publication for six months," Benítez recalls. Although the editors explained the situation to ISI and pleaded with its managers for patience, "they couldn't care less," he says. "We were out of the database."[38]

All this makes more credible the claim that one of *SCI*'s main roles is to adjudicate the pecking order of journals in such a way as to preserve the present, cartelized, structure of science publishing. This role is rarely, if ever discussed, hidden as it is by all the bibliographic and scientometric functions of *SCI*. But without *SCI*, the cartelized structure of scientific power would not exist as it does, and it would not have lasted as long as it has.

4 Overcoming the divide: a role for Open Access

The emergence of Open Access owes nothing to the kind of political analysis that precedes. It is true that the "serial pricing crisis" denounced by librarians included political overtones, but they were actually quite subdued considering the gravity of the situation. Librarians argued more often in terms of fairness than in terms of subverting a power system[39]. Scholars and scientists first dreamed about the possibilities opened by digitization and the Internet: the reduced entry price meant that more journals could be created. To readers who, in the late '80's and early '90's, were perhaps not quite ready to use a modem and fetch articles on-line, open access could appear to be an attractive compensation. It is only gradually that all these disconnected efforts came together and the convergence point is often taken to be the meeting in Budapest convened in early December 2001 by the Information program of the Open Society Institute (OSI). On February 14th 2002, the Budapest Open Access Initiative (BOAI) was published and the Open Access (OA) Movement began its amazing run toward Open Access[40].

The Budapest manifesto carefully describes two approaches to Open Access. The first one, based on journals and sometimes called the Gold Road, advocates the creation of OA journals or transforming existing ones into OA journals. It has since given rise to two main sub-strategies: in one case, the costs of production are shifted over to the production side instead of being loaded onto the reader's side; in the other case, when the costs of the journals are already largely subsidized by public money, moving to full subsidies for the production of journals is no great, traumatic, step.

The first sub-strategy is sometimes called the author-pay method and refers to a publication cost per article or per page. In actuality, the author hardly ever pays himself; rather it is a granting agency, a research institution or a university that pays the charge. In effect, this approach moves from an assisted reader model to an assisted author model. The shift appears difficult because the institutions involved are not the same. In the assisted reader model (or the subscription-based business plan for journals), libraries pay. Libraries are indeed meant to procure reading material for selected or general constituencies. In the author-assisted model, libraries can also be involved, and some have, but granting

38 *Scientific American*, August 1995. The citation was pulled from the *Scientific American* web site at http://www.sciamdigital.com/index.cfm?fa=Products.ViewIssuePreview&ARTICLEID_CHAR=082AA6E7-13D1-4610-81F4-EEC68867A24.

39 However, we should not forget the motives behind the creation of the Scholarly Publishing and Academic Resources Coalition (SPARC): create competition in scientific publishing to put pressure on prices. A strategy based on the reasoning of political economy was clearly at work in the launching of this organization. Nowadays, it has become even more political in its actions. See http://www.arl.org/sparc/.

40 BOAI can be found at http://www.soros.org/openaccess/. Much information can be found in Peter Suber's excellent site, http://www.earlham.edu/~peters/fos/, including a timeline offering a detailed chronology of this movement.

agencies have been very much in the vanguard on this front. The Wellcome Trust, in fact, was the first institution that initiated this trend. It reasoned that publishing was an integral part of the research cycle in science and that it cost only a very small fraction of the cost of research (around 1%). As a result, the cost of publishing ought to be wrapped into the cost of research[41].

Several organizations, some non-profit, such as the Public Library of Science (PLoS), some commercial, such as Biomed Central (BMC) or Hindawi Publishing Corporation have followed this route. Together they have proved a number of points. For example, they have demonstrated that OA journals could quickly reach very high impact factors (PLoS), that they could create several hundred new OA journals (BMC) and finally that they could transform existing, toll-gated, journals into OA journals (Hindawi). In short, the so-called author-pays model has been shown to work, although the practical experience provided by the last few years has also demonstrated that this route is not without serious difficulties. Some even question its sustainability[42]. In the opinion of this author, it is a route worth pursuing, but it is not the most promising avenue toward Open Access as perceived from this point in history, i.e. late 2007.

The second sub-strategy simply takes notice of the fact that, in many cases, journal subsidies are already present and that these subsidies are significant. Brazil has been extremely active on this front and it occupies a commanding position on the world scene thanks to the successes of SciELO. Of all the bundles of journals offered in Open Access, SciELO is the largest (around 400 titles) and the most internationalized (with 10 countries, including Spain and Portugal). It also demonstrates an impressive ability to keep costs of production down. To give an interesting comparison, SciELO was able to put about 160 titles in Open Access in 2005 with only 1 million dollars. With nearly three times as much money, Canada plus the province of Québec were supporting about the same number of social science and humanities journals, but they were all toll-gated. Clearly, the SciELO model is a success and it dispels many of the automatic criticisms addressed to government-run enterprises: no, it is not wasteful; yes, it works.

Interestingly, the subsidy route has remained largely undervalued, if not outright invisible, in most OA discussions. There are several probable reasons for this situation. In a number of countries, for example the United States, the UK and Australia, governmental journal subsidies are simply not available or are extremely limited and, as a result, the issue appears moot. At the same time, many of the people most involved in Open Access debates come from these three nations and many others work for commercial publishers (or scientific societies that follow business plans similar to those of commercial publishers). The only country where many people also participate in the Open Access debates and where journal subsidies are very much present is Canada, but even there, the subsidies touch only the social science and humanities journals, leaving most of the scientific journals untouched. Most of the OA debates have centred on Science, Technology and Medicine (STM) publications. The outcome is that much attention has been focused on the so-called author-pays solution, to the point that sometimes it is equated with Open Access, despite the fact that a majority of the OA journals listed in the Directory of Open Access Journals (DOAJ)[43] do not follow this particular business plan.

The main lesson that can be drawn from the experience of OA journals is that it works best when

41 On this issue, see an interview of Peter Suber in the journal *Neo-Americanist* available on-line at http://www.neoamericanist.org/archive-spring06/suber.pdf.

42 Barbara Kirsop, Subbiah Arunachalam, Leslie Chan, "Access to Scientific Knowledge for Sustainable Development: Options for Developing Countries", *Ariadne*, No. 52 (July 2007), available on-line at http://www.ariadne.ac.uk/155u3-52/kirsop-et-al/. The authors write (in the section on affordability): "...it remains to be seen whether the 'author's institution pays' models are sustainable."

43 See http://www.doaj.org.

serious institutional and/or governmental support is present. Again, the SciELO example is extremely important because it shows what can be done with resources that, although significant, are also well within the means of governments everywhere[44]. And this result is important because it converges nicely with the experience that has emerged from the second strategy toward Open Access – namely the self-archiving approach, sometimes called the Green Road to Open Access.

Self-archiving, like author-pays is not an entirely satisfactory term as "doing it oneself", although very much foregrounded by some supporters of the Green Road, is not the essential part of this strategy. More importantly, only a small proportion of authors, perhaps 10 to 15%, spontaneously archive their papers (or have them archived by someone). Secondly, a great deal of the archiving going on nowadays involves the use of institutional repositories, many of which are run by libraries. It is true that many libraries, in order to encourage authors to do most of the archiving work themselves, offer simple procedures to do so. However, the important point is that, with institutional repositories, peer-reviewed articles are collected in one form or another, at the level of the author. The lesson to be learned from the archiving efforts of the last few years is that, behind the deceptively simple procedure to archive lies a series of habits, cultures, constraints and plain indifference that has made the approach less successful than desired.

To improve the archiving situation, supporters of the Green Road have increasingly argued in favour of a mandate to archive. Their reasoning is quite simple: the research results financed by public or foundation money should be available at least to all researchers to help them carry out their own work, wherever they may be, and probably to other segments of society as well. At various times, various people, including myself, have argued that patients could benefit from freely accessing the medical literature, as will doctors working in relative isolation, far from any good university library. Likewise, the school system, at least the secondary level, could benefit from free access to the research literature, particularly in the social sciences and the humanities. Citizens would also have a chance of being better informed. In any case, even with limiting oneself to researchers, the need to populate the repositories remains very high and should be addressed. For this reason, efforts are being carried out at all levels, from departments to whole countries to mandate the depositing of research results subsidized by public money. And progress can be noted, slowly but surely[45]. In Brazil, the mandate to archive may be solved at one stroke of the pen with a national law. As documented by the excellent blog managed by Hélio Kuramoto from IBICT[46], the law 1120/2007 is being discussed in the House of Representatives in Brasilia. This draft requires all universities and research centres that they set up a suitable repository for the archiving of research articles, and then to require of all researchers to deposit their papers in the appropriate archive[47]. In doing so, the Brazilian draft law follows in some ways the requirements found in the Australian Scheme for Higher Education Repositories (ASHER)[48] except that ASHER, although

44 We shall lave aside here the issue of "Open choice" whereby various publishers, in particular Springer who initiated this strategy, will allow articles to be published in Open Access if the authors or some proxy pays a publishing fee - $3,000.00 in the case of Springer. For one thing, and despite the willingness of some granting agencies to support this, few people have taken advantage of this possibility. For another thing, it can be seen, and it was described, as the discovery of a new revenue stream for the publishers, coming directly from the granting agencies. Open Choice is at best a very ambiguous move on the part of the publishers, to which I personally respond with great ambivalence and even skepticism.

45 Voir http://www.eprints.org/openaccess/policysignup/.

46 See http://blogdokura.blogspot.com/ or, for a slightly different presentation, http://kuramoto.wordpress.com/.

47 This is how the draft law is presented at http://www.eprints.org/openaccess/policysignup/fullinfo.php?inst=Brazil%2C%20House%20of%20Representatives. Further details are available on H. Kuramoto's blog at http://kuramoto.wordpress.com/. A petition in favour of the law is also available on-line at http://www.petitiononline.com/mod_perl/signed.cgi?PL1120.

48 See www.nteu.org.au/policy/current/rqf/destfactsheets/ashersheet?file=FactsheetASHER30May07.pdf&friendly.

national in scope, is not a law. It is tied to an evaluation objective related to the funding of Australian universities, unlike the Brazilian draft law.

An interesting analogy can be drawn between both the difficulties and successes encountered by Gold and Green OA strategies. Both have met difficulties. Creating OA journals or transforming existing, toll-gated, journals into OA journals has proved quite challenging every time a cost recovery or profit making objective is pursued. It can be done, and PLoS, BMC and Hindawi have all demonstrated this possibility, but the total number of titles following this route remains limited to about 300 titles. This, of course, is small compared to various lists covering the field of scientific journals, and even lists like DOAJ covering OA journals. Symmetrically, repositories, particularly institutional repositories, do not fill when deposit is the responsibility of the author, even with the best efforts of the librarians. On the other hand, success, in both cases, has been fostered by strong institutional or governmental requirements. Granting agencies like the Wellcome Trust have pioneered the use of mandates, as have some universities and departments[49] and the results have been extremely good. And, of course, strong national commitments either in the form of laws or of policy have yielded very strong results and should continue to do so. In this regard, the ASHER policy in Australia, the draft law 1120/2007 in Brazil, the recent passage of an appropriation bill in the US Congress in both houses[50] – all reflect a constant theme: mandating archiving is needed and is a positive move to allow the largest possible use of research results. These initiatives extend similar decisions already taken by the Wellcome Trust, the Research Councils in the UK, the Canadian Institutes of Health Research, and actions affecting national institutions in various countries.

What has not been seen so clear is that Open Access journals also depend on strong institutional policies. On that front Brazil stands very much in the forefront with SciELO. It offers to the rest of the world an example resting on a strong governmental commitment. Like the mandates on the repository side, it also involves a clear vision of what is needed to obtain success.

Returning to the issue of the divide, Open Access actually plays different roles for different categories of scientists. For all scientists, from rich or poor countries, Open Access provides more opportunity to build on the work of predecessors and colleagues/competitors from all over the world. Scientists-as-readers are served equally well by Open Access, and for the scientists in poor countries, provided the internet connections are available with sufficient bandwidth, the information gap under which they labour will tend to decrease with the rise of OA. This is the argument most often put forth to justify creating new OA journals or archiving peer-reviewed articles in suitable repositories.

On the side of scientists-as-authors, the situation differs between rich and poor countries. In the rich countries (as well as for the small elites of scientists from developing nations that manage to publish in "core" journals), publishing in Open Access journals will provide, as many studies have shown, increased visibility, use and, ultimately impact.[51] However, for many scientists in developing nations, they may discover that getting an article accepted in an OA journal located in a "central" country is just as difficult as being accepted in a toll-gated journal, and perhaps even more difficult if they have to plead for funds to pay the publishing charge. Many journals do mention possibilities of removing this barrier or lowering it for scientists from the developing world, but this does not remove the extra (and potentially difficult or even humiliating) step of asking for special financial treatment[52]. This means

49 For a list of archiving policies, with or without mandates, see http://www.eprints.org/openaccess/policysignup/.

50 http://www.libraryjournal.com/info/CA6494533.html#news1

51 A fast-growing literature already exists on the often-named OA-advantage. See http://opcit.eprints.org/oacitation-biblio.html.

52 See Jennifer Papin-Ramcharan and Richard A. Dawe, "The Other Side of the Coin for Open Access publishing – A

that many of the problems associated with publishing in foreign "core" journals are again at work in this new situation and may even be occasionally exacerbated in the case of the "author-pays" business plan. On a more positive note, students would find it much easier to consult the work of their professors in such OA journals.

If getting into a "core" OA journal is at the least as difficult as being published in a core, toll-gated, journal, creating an OA journal on the "periphery", on the other hand, is a good deal easier. The cost of creating an OA journal and making it work in the sense that it is recognized, used and cited is lower than the cost of creating a new, toll-gated journal. The fact that it can be made visible and accessible from all over the world, and the fact that it can be included in lists such as DOAJ or Open J-Gate[53] ensures a certain level of impact. An OA journal coming from anywhere stands much better chances of being used everywhere than a toll-gated journal, and the growing power of various search engines will only increase the possibilities in this regard: Google (and particularly Google Scholar), Yahoo and other powerful search engines, in effect, begin to level the playing field that high-cost bibliographies (such as *SCI*) warped. For the developing world, this means that OA journals can be expected to cross the divide more easily than before. Such OA journals may not be listed in *SCI*, and in general they will not be, but their presence in OA lists and their availability in well-organized portals will begin to compensate for the barriers that the cartelized system of science has set up, in particular around *SCI*. There lies the power of the SciELO portal and the inclusion of its journals in lists such as DOAJ and Open J-Gate. Already, a number of "core" universities include SciELO journals in their offerings of electronic journals and this means that these journals are going to be used a great deal more. In seeking for signs that the artificially-constructed divide can indeed be bridged, I can think of no better example than finding the *Brazilian Journal of Biology* through the library portal of my own university.

SciELO has now been joined by several other countries, thus providing a degree of the internationalization that Abdus Salam had been calling for. Various Latin American countries plus several institutions from Spain and Portugal are now building a strong collection of publications that may develop outside the constraints imposed by the cartelized structure of scientific publishing. This suggests that the SciELO strategy can be repeated elsewhere, based on countries like India, China and South Africa, for example and other regional clusters of publications could thus develop on the Brazilian model. Also, as the experience of SciELO with health research suggests, thematic clusters could also be developed in a variety of fields, linking the regional clusters in new ways, and reinforcing the internationalization of a new scientific pole in the world, one that could develop autonomously with regard to "core" science. "Autonomously" here means acquiring a degree of freedom in choosing the important topics and the important problems to be solved while maintaining all the scientific standards and methods at their highest levels.

In the competition for good authors, journals working on the same basis as SciELO, i.e. fully subsidized in one manner or another, will enjoy strong comparative advantages. Only quality will (and must) count and, once accepted, an article can be published without any further financial request from the author. In effect, a SciELO journal works like a small, peer-reviewed and thematic repository that would be endowed with a title that acts like a logo (for branding purposes) and some publishing capacity, including copy-editing. As a result, the SciELO formula works toward blurring the distinction between a Green and Gold approach to Open Access. Seen from the perspective just described, the two

Developing Country View", *Libri*, Vol. 56 (2006, 24. The authors state: "Most of our researchers report feelings of embarrassment at even contemplating the making of a request to a journal to waive the page charges because of financial need".

53 See http://www.openj-gate.com/. Open J-Gate is located in India. It announces the coverage of 4261 Open Access journals. A majority are peer-reviewed, but some are trade publications.

roads begin to converge and look like two complementary, mutually supportive approaches. Contrary to the concerns of some supporters of the Green Road the two approaches do not compete for rare resources and the Green approach will not be slowed down if some supporters of OA strive to develop the Gold Road instead. Ultimately, these two strategies will merge and in the next section, we will examine some ways to accelerate the convergence between the Green and the Gold roads to Open Access. As we shall see, this will allow lowering further the artificial divide barriers in science.

5 Creating symbolic value in Open Access

This paper started with a premise based on the competitive nature of science. This means, as we have seen earlier, that rules must exist for the competition to take place in an orderly fashion, and tools to evaluate the results of the competition must also be designed. With the advent of *SCI*, many of the parameters needed to manage the worldwide scientific competition were in place. The ability to measure "impact" by tracing the number of citations an article received was viewed as huge progress because of its quantitative nature. The possibility of ranking journals by their "impact factor"[54] added new possibilities of evaluation, some of which totally unwarranted. For example, passing judgment on individuals because they have managed to place an article in a highly-ranked journal provided but very little information about the actual value of the paper in question. However, it was tempting for administrators to buy into this mode of evaluation for a variety of reasons: in outsourcing the tools of evaluation, administrators could avoid generating controversies locally or shift them to new, more generic, grounds. The quantitative nature of the evaluation created a strong rhetorical effect capable of bringing discussions effectively to a close. Finally, it permitted comparisons to reach beyond the walls of the institution, thus affecting more than individual and journal comparisons, but also institutional and, ultimately, national evaluations. In his article, "Mapping Science in the Third World", Eugene Garfield was in effect extending the reach of the citation measurements to the whole planet[55]. Nowadays, the Web of Science, the present on-line incarnation of *SCI*, offers tools to evaluate not only journals (Journal Citation Reports), but also allows one to track highly-cited authors. Countries are routinely ranked and institutions are placed on a kind of honour roll. The whole list of possibilities appears in the "Essential Science Indicators" related to the Web of Science[56]. In short, Thomson Scientific offers quantitative intelligence on science from about any perspective needed.

Thomson Scientific has actually been pushing a double agenda: on the one hand, as noted above, it provides means of analyzing scientific activities from a wide variety of viewpoints. At the same time, it does so while defining itself the very terms of the evaluation. Remembering how the choices of journal titles needed to create the first versions of *SCI* ultimately contributed to erecting the divide barriers between "core" or "central" or "mainstream" science and "peripheral" science, we can now see that Thomson is intent on maintaining this control on the parameters of evaluation of almost everything. Their business plan is highly dependent upon the ability to rank every facet of science in their own proprietary ways.

Not surprisingly, such a lucrative business plan has aroused some envy on the part of other companies involved in the business of scientific publishing. Reed-Elsevier, the giant among these publishers, seems to have revived Maxwell's dream of holding both the publishing end of the scientific world and its bibliographic and citation-tracing side in an effort to control both journals and the means to evaluate them. For this reason, the creation of *SCOPUS* by Elsevier must be seen as a direct challenge to

54 A good introduction of the impact factor and its limits can be found at http://en.wikipedia.org/wiki/Impact_factor.
55 See note 20.
56 See http://in-cites.com/rsg/esi/.

Thomson Scientific. In the case of *SCOPUS*, the objective of overtaking *SCI* has been in part guided by the attempt to broaden the coverage significantly: *SCOPUS* claims to cover 15,000 journals including 1,000 Open Access journals and various other kinds of publications[57]. As a result, it does change some of the terms of the divide barriers and it also makes these terms more visible by comparison. However, a closer look at the selection criteria reveals a reiteration of the "core"/"periphery" divide that *SCI* did so much to build. For example, looking at the institutions that were involved in the designing of the *SCOPUS* database reveals a very heavy presence of European institutions (including some private companies such as Shell Global Solutions UK or Schlumberger). The Americas are poorly represented with six American institutions (including the company Qualcomm), one Canadian university and FAPESP in Brazil. In fact, Asia does better than the Americas with a basket of nine, generally prestigious, universities, although China is absent. In short, Elsevier's challenge to Thomson does not include reforming or challenging the "core"/"periphery" divide, but includes redefining it to Elsevier's advantage. The necessities of competition tangentially decrease the grip of Thomson over this crippling divide, but Elsevier's goal is certainly not to erase it and the tangential consequences could almost be characterized as unintended consequences that should probably not be encouraged. The advantages of the "core"//periphery/ divide are all too important for rich countries operating within a so-called "knowledge economy"[58].

More radical, because it comes from a search engine, and not a publisher's, perspective, Google Scholar does provide new opportunities for adding symbolic value to published documents anywhere. By helping discover documents that would remain hidden with either *SCI* or *SCOPUS*, Google Scholar creates a more level playing field for publications everywhere. Google's business plan rests in part on having more or less exclusive access to ever larger collections of digital materials. To this end, as is well known, Google has subsidized the digitization of entire libraries. Because these libraries are from "central" countries, a "central" bias will recur, but it will be less pronounced than in the tight definition of "core" journals in *SCI* or even in *SCOPUS*. Moreover, the page ranking algorithms used by Google rely on the whole web and, therefore, reflect world usage. There again, the rich countries will weigh in heavily, but so will China and increasingly large-population countries such as India and Brazil. As a result, Google Scholar can help bring to light many kinds of documents that would have remained invisible otherwise.

All these examples point to the great, the crucial importance of visibility and accessibility. While every possible use of Google Scholar should be fostered, while every mode of pressure on *SCI* and *SCOPUS* should be exercised to increase the number of titles covered in these bibliographic tools, efforts should not stop there. This is precisely what SciELO is doing with the development not only of its portal structure that has been mentioned above, but also through the development of scientometric tools that allow better tracking of the symbolic value of the SciELO articles[59]. The Chinese are pursuing a similar effort through their own Citation Index, the "Chinese Science Citation Database" (CSCD). In 2001,

57 See http://info.scopus.com/overview/what/. Recently, Microsoft introduced "Live search Academic" along similar lines. See http://search.live.com/.

58 On "knowledge economy" as distinguished and opposed to a "knowledge society", see Sverker Sörlin and Hebe Vessuri, « Introduction: The Democratic Deficit of Knowledge Economies » in *Knowledge Society vs. Knowledge Economy* (Londres, Palgrave MacMillan, 2007), pp. 2-32.

59 Latin America has been quite active in developing a number of tools to promote the visibility of the region's journals. One of the more important is Latindex – an important tool developed in particular by Ana María Cetto (Mexico) and Anna María Prat (Chile) – allows to follow 16,2000 journals of academic interest in its catalogue, and nearly 3,000 journals certified of international quality in its directory. See http://www.latindex.org. Another portal, Redalyc, offers open access to full texts from Ibero-American countries. Presently, it covers 488 journals and a little less than 75,000 articles. See http://redalyc.uaemex.mx/. Many thanks to Leslie Chan who reminded me of Latindex.

CSCD covered 991 titles, of which only 31 were located inside *SCI*[60]. The Chinese, like the Brazilians, are facing similar obstacles to inclusion in *SCI.* Similar ventures could develop in India, in South Africa, in Korea and in a number of countries that harbour significant scientific research. In the end, several thousand journals, most of which will have been neglected by *SCI*, will be available. Creating a joint citation index out of these national efforts will initially lead to clusters strongly organized around countries and languages, but with the right use of metadata and the right use of abstracts in (probably) English, such a device could help weave relationships, identify common concerns and open the door to new forms of collaboration that would build a very different "web of science". In short, the Chinese and the Brazilians are each working in the right direction; now they need to work a little more closely together, and with other partners as well.

We can now turn to the issue of adding value to repositories. Earlier in the paper, SciELO journals were compared to small thematic repositories, each with a title acting as a branding tool, and with some publishing functions, including copy-editing, setting up documents on-line and a variety of added functions or services such as search engines. Turning the question around it becomes possible then to ask what would be needed to transform repositories into the equivalent of journals. If repositories are to imitate journals, they must first be organized to help a researcher's work. In other words, they must be conceived in such a way that a normal scientist or scholar will turn to them without even thinking much about it, much as *SCI* is used nowadays, or any other database in common use. Too often, repositories are conceived from the perspective of a library and an institution. There is nothing wrong with the idea of building a show window for a university, as many repositories tend to do, but this will not serve the needs of a researcher.

To succeed with scientists, repositories must first demonstrate their efficiency and reliability for the individual in quest of information. Not only must it comply with standards guaranteeing inter-operability, but it must do so with the idea that a scientist, through an easy choice, can separate out the peer-reviewed materials from the rest. The "protocol for metadata harvesting" (OAI-PMH) is indispensable for this task as it allows the repositories to be collected by specialized search engines such as OAIster. However, OAIster itself is not always very helpful. For example, it does not always point to OA materials because some repositories do not make the distinction between what is in Open Access and what is restricted[61] . Neither does its search engine allow building queries that separate peer-reviewed materials from the rest. In short, the metadata must be refined to include this particular choice. It may be better to build yet[62] another search engine with suitable repositories than wading through the motley crew of documents found inside many repositories nowadays. In their present state, institutional repositories cannot yet claim to offer a one-stop search engine to the researcher[63]. An international effort with countries such as Australia, Holland and the UK that have a national repository policy in place to create a search engine really useful for researchers would be a step in the right direction. Its advantage over Google Scholar is that it would provide only peer-reviewed documents

60 See http://www.cscd.ac.cn/. On the structure of the Chinese Science Citation Database, see Loet Leydesdorff and Jim Bihui, "Mapping the Chinese Science Citation Database in terms of aggregated journal-journal citation relations" , marked as "forthcoming" in the *Journal of the American Society for Information Science & Technology* and available on-line at http://users.fmg.uva.nl/lleydesdorff/china01/art/cscd.pdf.

61 See http://www.oaister.org/restricted.html. Google does not distinguish Open Access materials either. Also, it has been reported that some academics, when finding freely accessible materials, tend to thank Google rather than Open Access provisions. See Papin-Ramcharan and Dawe, *op. cit.* (note 52), 20.

62 Several OAI search engines in various stages of development can be found listed at http://www.aepic.it/risorse.php or again at http://library.caltech.edu/digital/.

63 Google Scholar probably remains the best way to proceed for the moment. There is something very urgent to solve here if the Green Road wants to remain credible and useful.

that are in Open Access[64].

Assuming that the issue of a serviceable search engine is solved, more can be done to increase symbolic value. Let us return to the idea that a repository should emulate an OA journal to develop all of its potential. Obviously, if the articles deposited in the repository are peer-reviewed, the traditional form of scientific quality control has already been implemented. However, much more can be done. The peer-review process is a kind of pass/fail process allowing a given document to enter scientific territory. More than a quality control device, I prefer to interpret peer review as a kind of passport. The real evaluation comes after, in the ways in which the specialists of the domain read, use and cite a given paper. Citation impact is part of this *post hoc* judgment, but we have already seen some of the biases that weaken the results provided by this mode of evaluation. It should be kept, of course, but it should also be accompanied by newer, richer forms of evaluation.

At the level of repositories, possibilities to comment, correct or extend a given paper could be explored. Models for this already exist, as with PLoS One. This new journal in the PLoS family of scientific periodicals significantly alters the life cycle of an article. Instead of being immediately peer reviewed, copy edited and then published, it is simply lightly vetted for suitability and credibility. It is then immediately set on-line and offered for examination and comments by the relevant community of specialists. The guidelines and procedures developed for reader interventions on PLoS One could easily be adapted to repositories, first singly and later in clusters. It would not be difficult to create a second layer of evaluation above peer review which would help gauge the perceived value of a given article for a given community. In this fashion, the link between the texts contained in a repository and various communities of researchers would be much stronger and navigating through cutting-edge research would become a group effort that would be far better coordinated[65].

Repositories could complete the work of journals in a very interesting way: Brazilian repositories could gather the works of Brazilian researchers, unlike the SciELO journals that try to attract authors from as wide horizons as possible. Some of the papers placed in repositories would have appeared earlier in "core" journals but, in the repository, their intrinsic value would be gauged directly by specialists on the basis of their actual content, and not the reputation of the "core" journal where they appeared. Some of these papers will confirm the level of quality that their publication title suggest, but others will be found wanting. Symmetrically, some papers published in "peripheral" journals would shine much more than expected. As a result, a new evaluation layer would revisit and question the results of the barriers bolstering the centre/periphery divide. In particular, it could be demonstrated that some good papers have fallen on the bottom side of the divide, while some mediocre papers made it to the top. Presumably, this would lead the search for information to be less dependent upon logos. The actual quality of research results (as distinguished from branded reputation) could be reinstated at centre stage.

Building on the Dutch experiment known as "Cream of Science", repositories can also create a kind of honour roll for the best papers and best scientists as judged by their peers. Repositories thus become the foundation for the allocation of judgements and prizes. And the idea can be generalized even more to offer a possible solution to an old dilemma that has accompanied discussions around repositories: how

64 The European project DRIVER with its objective to create a European Research Space through repositories moves in this direction. On DRIVER, see http://www.driver-repository.eu/.

65 In the past, and a bit facetiously, I have likened this evaluation layer to a restaurant guide. The quality of articles would not be marked by forks and knives, but by brains. Readers could assess articles and suggest a one, two, three ... brain mark for it. The difference with a restaurant guide (where the marking is performed top-down) is that the markings would reflect the users' involvement with a given text. Just the number of comments would begin to give an idea of this involvement but other parameters can be easily thought up.

do thematic repositories like ArXiv or RePEc relate to institutional repositories?

As pointed earlier, most existing repositories are well positioned to gather a large variety of documents, including peer-reviewed articles, from the local constituency, but the distinction between peer-reviewed materials and other documents is not always clear. The problem is compounded by the fact that at least one important search engine – OAIster – because it does not limit itself to OA documents, complicates the task of the researcher further. Finally, a scholar or scientist will not generally perform a literature search through institutions. Disciplines structure searches and citations help in interdisciplinary situations. As a result, it is useful to think about thematic repositories as devices designed to add value for researchers. By extracting the peer-reviewed fraction from the institutional repositories and by organizing the selected documents into thematic collections, subject research would be greatly facilitated and thematic repositories would become far more attractive. The task of the search engines would also be eased, especially if the peer-reviewed nature of the document is inscribed in the relevant metadata. In the case of Brazil, a consortium of universities and/or SciELO could build these thematic repositories. The recent meeting of six Brazilian universities to push for strong deposit mandates in the country could certainly constitute the institutional foundation for such an effort[66]. The mandate for deposit could be accompanied by plans to organize a coherent network of institutional and thematic repositories.

Beside extracting peer-reviewed articles from institutional repositories, another approach, inspired this time by PLoS One, could also be implemented. Thematic repositories could include a separate section of articles that, unlike the previous set, is not made up of peer-reviewed articles. Instead, articles would be directly submitted to them and immediately subjected to public scrutiny, comments, corrections, and extensions. Accepted modifications by the original authors or by an independent editorial board could bring the new participants into the role of co-authors and this would be an important incentive for serious participation. Mechanisms could also be designed to shift some papers from the non-peer-reviewed section *à la* PLoS to the peer-reviewed section with a corresponding change in the metadata. Of course, rules and guidelines will have to be designed to avoid offering a co-author role for a trivial correction and to determine what kind of community scrutiny is at least equal to peer review but these issues can be left aside for later discussions. The point here is to propose broad ideas about the general structuring of various kinds of repositories.

Thematic repositories could also include a variety of procedures and/or algorithms to generate value judgements about their holdings, repeating on a broader basis the “brain” classification suggested earlier for institutional repositories. Such classifications would also be far more credible than the ones based on institutional repositories. They are capable of involving a wide variety of institutions which could reach beyond national borders, thus responding positively to the call for “internationalization” voiced by Nobel Prize winner Abdus Salam.

Finally, several thematic repositories could exist for a given discipline. To the extent that they would be harvested by a single search engine, this multiplication of repositories should not pose any problem from the perspective of the researchers. At the same time, each thematic repository can develop a reputation for quality and judgement and thus become a branding site in its own right. As a consequence, researchers would begin to place their trust in some depositories over others, as they do nowadays with journals. However, the reputation-building process would be entirely new and open to all. A healthy competition based on the quality of content could thus develop across the planet. It would

66 See the report by Sely Maria de Souza Costa, available on-line at https://mx2.arl.org/Lists/SPARC-OAForum/Message/4025.html. This originally came through the AmSci Open Access forum but, for some unknown reason, the archives presently do not go beyond June 23rd, 2006.

not be limited to rich countries. Hopefully, it would not recreate the pernicious divide we have to contend with, but it would certainly encourage the groups responsible for a given depository to pay attention to the ways in which they select and judge their documents.

We must remember that all these repositories are in true open access. This opens up a number of possibilities that would greatly facilitate objectives such as preservation and better metrics. For example, the set of thematic repositories, once sufficiently developed on a world scale, could create an Author Digital Identifier (ADI), i.e. a unique author number that would greatly contribute to disambiguate the uncertainties linked to the various ways in which names can appear. In my own personal case, the fact that my first name is, in French fashion, a hyphenated first name made up of two names, and the presence of an acute accent on the "e" of my last name leads to the slicing of my scholarly identity into four or five variations at least which I discover when I want to trace who has cited one of my articles[67].

The open nature of these archives should be a great aid to long-term preservation. The reason behind this is that the best solution for digital preservation is the solution which, in effect, emulates nature's way to maintain the stability of DNA code: the LOCKSS project[68]. Like nature's way of preserving the stability of species, LOCKSS relies on the dynamic exchange and multiplication of texts. However copyright barriers have impeded the implementation of the exchange process, fundamental to LOCKSS (It is easy to imagine what would happen to the human species if parts of the DNA code were under copyright and someone should write a science-fiction novel on that theme). Clearly, OA documents do not face that hurdle and the family of thematic repositories could band together to create a robust preservation base for all of their documents.

One last point can be made about Open Access thematic repositories. They respond to a very important concern that Clifford Lynch has expressed with force in recent years. He has rightly reminded us that Open Access is not enough because Open Access documents, digital as they are, must also open their computational potential[69]. Digital documents, unlike writing on material surfaces, lend themselves to more than what Lynch calls "human-centric" activities – namely reading, copying, annotating, etc. Data mining, as the jargon goes, already refers to retrieval capabilities that reach well beyond what one can do with indices, tables of content and other tools that gradually developed around writing and, later, printing. Even more exciting possibilities are now emerging that, in essence, lead us to the edge of automatic knowledge production from the factual content of large textual corpora. John Wilbanks at "Science Commons" regularly lectures about the ways in which fragmentary facts can be concatenated automatically to create new knowledge[70]. Actually, the knowledge is not really new. It is simply embedded in large collections of texts and, as such, remains invisible to most observers. It is the kind of knowledge that still largely falls in the category of "erudite knowledge", for erudition is nothing more than the ability to put together bits and pieces of facts that are widely dispersed in texts either very recondite, or very rare, or both, and to put them into a new form of meaningful narrative. An erudite person can do this through much reading and the use of memory (aided and abetted by writing in the form of notes), but the profoundly artisanal nature of most erudite exercises is quite obvious (and

67 In passing, this problem, and that of the title abbreviations of journals is a source of significant error in various citation calculations and they should be estimated to give an upper limit on the number of significant figures one ought to use when dealing with impacts or impact factors.

68 http://www.lockss.org/lockss/Home.

69 Clifford Lynch, « Open Computation: Beyond Human Reader-Centric Views of Scholarly Literature », *Open Access: Key Strategic, Technical and Economic Aspects*, publié sous la direction de Neil Jacobs (Oxford, Chandos Publishing, 2006), pp. 185-93. Disponible à l'adresse suivante : http://www.cni.org/staff/cliffpubs/OpenComputation.htm.

70 See http://sciencecommons.org/projects/data/.

somewhat disheartening). Computers and digital texts radically change the situation in this regard and OA repositories, particularly thematic ones, will be extremely useful in this regard, again by eliminating access problems to computational exercises of all kinds. John Wilbanks often offers the example of chemical reactions embedded within synthetic paths which can be concatenated differently to yield new, unsuspected synthetic paths and also new research avenues. In an entirely different area, that of historical biographies, concatenating the elements of an individual's life that can be found across many books would certainly lead to critical possibilities that reach far beyond our present feeble possibilities.

The point here is not to develop these possibilities, but simply to make evident all the research potential of OA repositories, if they are organized in an intelligent way, i.e. according to the needs of scholars and scientists. In so doing, designers must never forget two rules: scientists and scholars, as readers, will be satisfied if the repositories lead them faster and in better ways to more and better information than is presently the case in their concrete working situation. Such an evaluation will depend, of course, on the quality of the local library and the local quality (and cost) of internet connections[71]. The second rule addresses the scientists and scholars as authors. There visibility, branding and accessibility are of the essence. The present, toll-gated, system provides the two first points to most of the whole planet, but the third point is reserved to the members of rich institutions, the great majority of which lie in rich countries only. Open Access repositories can offer all three possibilities to all scientists and scholars everywhere, provided they develop mechanisms to build symbolic value around them. It has been argued here that this creation of symbolic value, independently from the present system based largely on toll-gated journals and *SCI*, is quite possible. The importance of doing this is to weaken the power of the cartelized system of scientific communication that presently dominates our planet. By opening up the possibility of new evaluation centres with worldwide legitimacy, the power system of science would be deeply transformed. It would go well beyond what the competition between *SCI* and *SCOPUS* can offer to bring about the perspective of overcoming the divide barriers that presently divide our world between the haves and have-nots of the so-called knowledge economy.

6 Conclusion

We can now go back to Bourdieu and thank him for having foregrounded, as he did, the question of power in science. We can even thank him for indirectly attracting our attention to the fact that the very nature and form of power is part of power itself, and that it must be changed too if real change is to occur. This has allowed locating Open Access in a new way because various forms of Open Access activities affect the issue of scientific power and its modalities in different ways. In doing so, it becomes obvious that the two roads to Open Access, the Green and the Gold roads, may not be entirely adequate ways to define what is needed for the whole planet. Journals that require some form of payment up front, the so-called "author pays" strategy, may hurt the developing world even more than the traditional, toll-gated world since they remove barriers only to the scientist as reader, but brings up new barriers to the scientist as author. Likewise, the institutional repository movement can help the scientist as reader to some extent, although the present situation of the repositories does not help the search for information and is, therefore, unlikely to convince researchers to use this route preferentially to others, unless there is really nothing else available. In other words, in its present state, institutional repositories coupled with Google Scholar and OAIster may be of some help to scientists and scholars in poor institutions, but they will not help their colleagues in rich institutions with good, subsidized,

71 See Papin-Ramcharan and Dawe, *op. cit.* (note 52), 21. The criticism they address to Open Access articles (large pdf files, for example) apply equally well to toll-gated electronic publications.

access to the literature. Also, in its present state, the repositories offer very few incentives to the scientist or scholar in terms of authority and prestige. In poor countries, this leaves intact the difficulty of publishing in "core" journals and does not help at all overcome the barriers bolstering the knowledge divide that presently plagues our world.

This paper identifies the facets of the Gold and Green Roads that make sense in addressing the scandal of the knowledge divide. It brings to light essentially two fundamental strategies: on the Gold side, fully subsidized journals that do not financially penalize authors from poor countries, or do not submit them to humiliating forms of pleading for special treatment are essential. On the Green side of Open Access, the way to create symbolic value in competition with what presently supports the divide barriers is to organize a coherent system of institutional and thematic repositories. The former are charged with collecting and preserving all that they can and want to preserve. It is through institutional repositories that depositing mandates should be implemented as mandates can originate from a variety of institutions with some political clout, universities, research centres and granting agencies among them. However, it is through thematic repositories that the (research) wheat can be separated from the chaff and it is through them that various forms of new and useful forms of symbolic value can be created. In Brazil, the OASIS portal could easily evolve to incorporate some of the suggestions mentioned earlier in this text[72].

Out of this analysis, one interesting fact should clearly emerge: Brazil is in a very good position to play a formidable role in this battle to remove the divide barriers or, at least, lower them. With SciELO, the resolve of several universities and the tireless efforts of IBICT (with Hélio Kuramoto and his colleagues), Brazil is moving on all fronts at once and beginning to select those facets that can serve similar countries. Progress is going to be both swift and decisive in the next few months. At the same time, all interested Brazilian participants in this area need think about strong international collaboration with well-targeted countries to build a base for the reform of scientific power in a credible way. These countries are quite easy to identify and have already been mentioned before: they include China and India. Africa must be included because it is suffering the most from the knowledge divide that has been constantly decried, criticised and attacked in this text. Other countries can also be involved and SciELO's strategy to involve countries that are somehow"core", but marginal at best within the "core (Spain, Portugal) is interesting and deserves further reflexion and extension. Perhaps a number of so-called transition countries coming from the old Soviet Empire could also be included, as well as some of the "tigers" from Asia. Think of Korea, Malaysia and Indonesia for a start.

The importance of Open Access as a movement should be obvious by now. First, it promises to make the word system of science work better by improving its communication infrastructure. More importantly, it opens the door to hope: with Open Access, redressing many of the inequities and injustices inherent in the knowledge barrier that stands between the so-called "central" and "peripheral" nations becomes a distinct possibility. By contrast, the distinction between "centre" and "periphery" suggests a kind of benign neglect and distant elegance that is best suited to the ethereal needs of diplomatic exchanges, but not to the grave urgencies of our world. Juggling centre and periphery within subtle dialectical structures undoubtedly fulfils the desire for "calm and reasoned dialogues" that is expected within international conferences. It cannot, however, hide the murderous forms of reality that must haunt us whenever we let issues of health and well being come to the fore[73].

72 See http://www.ibict.br/oasis.br/.

73 Here again, the names of S. Arunachalam, Barbara Kirsop and Leslie Chan must be mentioned. Their work with Bioline is simply extraordinary.