Introduction

Practices and Rhetoric of the Internationalization of Science

Michel Dubois, Yves Gingras, Claude Rosental
Translation Peter Hamilton

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Introduction
Practices and Rhetoric of the Internationalization of Science

Michel DUBOIS
Yves GINGRAS
Claude ROSENTAL

Internationalization, transnationalization, globalization, etc., are terms whose sociological meaning varies from one sociologist to another but which all point to the same process observable in many areas, namely the rapid growth since the mid-1970s of supra- and infra-state exchange and circulation be it of an economic, cultural or scientific nature. A quick but effective and very telling measure of the use of these concepts can be carried out using the "ngram viewer" platform of Google Books[1] and it indicates that the first of these terms took off in the mid-1970s, before giving way during the 1990s to that of globalization.

As with many other social activities, scientific research has been developing on a global scale since the second half of the twentieth century, and its results are now instantly available to everyone around the world. This activity did not have to wait for the rise of official discourses promoting the globalization of markets and new communication technologies in order to emancipate itself from national borders (Crawford 1992, Crawford *et al.* 1992, Schott 1993, Welch 1997, Gingras 2002). Indeed, the circulation of scientists and ideas is very ancient, and took at first the form of the circulation of texts (Clagett 1964, Raynaud 2014). Institutionally, academic peregrinations quickly became a tradition, in the wake of the creation of universities in the thirteenth century. We have only to recall the students and teachers who travelled between Paris and Oxford and throughout Europe. Nicolas Copernicus, for instance studied at the University of Krakow, and completed his education in Bologna, Padua and Ferrara, before returning to Frombork. Consider also the introduction of sabbaticals at the end of the nineteenth century, which has helped to establish the model of research universities in some countries (Jöns 2010). This mobility is to some extent natural in the academic world because knowledge has, in principle, a universal, and therefore transnational, purpose. Finally, one could also recall the proliferation of international congresses from the end of the 19th century, facilitated by new means of transport such as trains (Schroeder-Gudehus 1990, Rasmussen 1990).

Describing contemporary science as a new "invisible college," Caroline S. Wagner (2008) rightly points out the gap that sometimes remains between the evidence of the highly visible national anchoring of institutions or agencies (such as the

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1. *https://books.google.com/ngrams*

Agence *Nationale* de la Recherche in France and the *National* Science Foundation in the United States) and the much more subtle reality of collaborative research practices. The extension of these practices can be measured in different ways: informally, for example, through the reconstruction of researchers' epistolary networks (Gingras 2010, Dubois 2014); or, in a more formal way and on a more global scale, by reconstructing the development of the co-authorship of scientific articles. In the last quarter of the twentieth century, we can see that the latter have been increasing steadily and almost in a linear way, rising from barely 5% to nearly 25% thirty years later. In countries of small scientific scale, more than half of the scientific articles now involve international collaboration. Practices tend to change before discourses, even though one sometimes tends to consider, wrongly, the latter to be the driving force of action. They are in fact only a reverberation, a distant echo of practices, and come fifteen or twenty years after the latter to formalize them in programmes and general discourses of science policy.

The globalization of research is also embodied in scientific policies that unfold at different levels and through several types of processes. Some of them concern support for the international mobility of researchers (scholarships, exchange programmes, international chairs, etc.). Others relate to the funding of international research centres, research development and demonstration programmes (Rosental 2013), major equipment, or major international scientific programmes, such as those developed in the 1980s to stimulate collaborations in sectors such as energy, space (Jouvenet *et al*. 2015) and information and communication technologies (Rosental 2015). This is illustrated in some articles in this special issue of the *Revue Française de Sociologie*, and more particularly in Morgan Jouvenet's socio-historical analysis of the scientific programmes that have structured the field of "ice core science," which lies at the crossroads of glaciology and paleoclimatology. In particular, the author stresses the importance of conceiving the climate as a global problem. The advent of a "climate regime" generated, in his view, profound changes in the geopolitics of the polar regions, as well as in the relations between scientific communities and their political guardianship. Also in this issue, Vincent Simoulin contributes to a sociology of scientific instruments and major scientific facilities. He shows that the generational dynamics of synchrotrons, very costly scientific facilities that make it possible to analyze the structure of matter, requires the promotion and coordination of major research organizations, particularly by the European Commission, to define regional scientific policies. Such a facility also implies the mobility of the engineers and researchers responsible for their construction and their supervision. They are international by their nature as well as by their uses, and national by their geographical location, the choice of which constitutes an important issue.

Many science policies also seek to promote the international circulation of results, notably through grant funding for the creation of networks and electronic communication tools such as the World Wide Web (Dufour 1995, Paravel and Rosental 2003), or the European communication network GÉANT2.[2] It is also necessary to mention the initiatives aimed at promoting international activities and collaborations in the organization of scientists' university careers, by the setting up of evaluation criteria favouring this type of commitment. Finally, we should also mention the activities of supranational organizations, multinational companies, consortia of national agencies and legislators, which produce, with varying degrees of difficulty, a gradual harmonization of the modes

2. *http://www.geant.org/*.

of regulating research at the international level (Gaudillière and Joly 2006, Stephens *et al*. 2011, Brunet and Dubois 2012). The article on animal cloning in this special issue by Pierre-Benoit Joly, illustrates, however, the fact that this harmonization process is not self-evident. According to him, the fact that Europe and the United States continue to diverge in terms of their ways of understanding is partly due to the entrenchment of regulatory science at a regional, if not national, level. The relevant European agencies, in particular the European Food Safety Authority (EFSA), in fact attach considerable weight to the "precautionary principle," a principle that simply does not have an equivalent in the United States.

The internationalization of science is also based on the production of common technical standards. The European Union has thus made this standardization one of its priorities, while promoting the production of prototypes demonstrating the operational nature of new technologies, in order to develop new markets for them (Hendry *et al*. 2010, O'Neill and Nadaï 2012). It has also produced and used statistics and indicators to provide assessment and regulation tools in accordance with the neoliberal principles of New Public Management and the notion of *accountability* (Gingras 2014, Louvel 2012). This approach involves not only general competition between actors (researchers, universities, companies), but also an increased status given to collaborations, circulation and international exchanges in research activity.

The logic of scientific collaboration, be it intra-European or between Europe and other countries of the world, overlap with the logic of scientific and technological competition, particularly with the United States and Asia. They are part of counter-hegemonic dynamics that concern not only the European continent, but also unfold, for example, in South America (Canêdo and Muñoz 2004–2005, Keim 2011). These hegemonic and counter-hegemonic tensions are generally based on a well-known paradox: while it is in principle open because of its universalist ethos, the global research system has in practice no homogeneous geographical distribution (Mesurburger *et al*. 2010), and some communities (national or regional) are subjected to its rules, norms and values, while others help to dictate them (Altbach 2007, Dubois 2015).

These de facto inequalities between "centres" and "peripheries" partly explain the major trends in scientific migration. Although it is difficult to measure them precisely, these currents seem to have been massive from the 1960s to the 1990s and continue to grow (Jeanpierre 2010). Beyond the development of a state of knowledge on the subject (Gaillard *et al*. 1997, Gaillard and Gaillard 1998), various studies underline the importance of not taking a too simplistic view of these migratory flows (Gaillard *et al*. 1997; Gaillard and Gaillard 1998). Admittedly, the brain drain has long been described, particularly in the economic literature, as a returnless "exodus" that deprives countries of their scientific and technological capabilities (Das 1971, Beyer 1972). But the careful study of academic circulation suggests that the process can, over time and under certain conditions, be reversed and eventually lead to a real "brain gain" (Gaillard *et al*. 2015). In addition, the complex trajectories of many researchers working in several countries during their lifetime are difficult to take into account in a model that reveals migratory flows based on partial data about changes in administrative or occupational residences of individuals, a general methodological problem well known to population historians (Rosental 1999). Hence the importance for the sociologist of science of not using overly simplistic categories like "Northern science" vs. "Southern science," "hegemonic science" vs. "counter-hegemonic science," etc.

On the rhetorical front, recipient countries view migration as a "brain gain," while countries that lose their scarce resources see it as a loss and a "brain drain." But again, it is worth recalling that the available data are still too limited: the Royal Society (2011) rightly deplores the small number of large-scale surveys capable of accounting for the migratory flows of actors in scientific and technical research. Among the few studies available is the "Changing Academic Profession" (CAP) survey conducted between 2007 and 2008 in 19 countries, but France was unfortunately excluded for no legitimate scientific reason (Huang *et al.* 2014). We can also mention the "Global Science" survey conducted in 2011 by economists in 16 countries on a population of nearly 15,000 researchers in four main fields: biology, chemistry, materials science and environmental sciences (Franzoni *et al.* 2012, 2014; Noorden 2012). This survey shows that the United States continues to be the country of choice for researchers, while India continues to "export" abroad, and to the United States in particular, a very high proportion of its scientific community. It should also be noted that the European Research Council (ERC) support to research programmes can also contribute, though not necessarily intentionally and on a smaller scale, to the migration of the best researchers from the less well-endowed regions towards the best endowed. In fact, the evaluation of projects takes into account not only the quality of the researchers, but also that of the host community. This creates a new academic market in which the more entrepreneurial universities do their best to attract project leaders to them. The latter then move with their ERC resources to locations offering the best working conditions.

Beyond their specific contributions and limitations, these surveys help to remind us that scientific practice is embodied not only in people, instruments or organizations, but also in places and particular geographical areas. And as David Livingstone (2010) noted, the spatialization of science and technology, and even more so its multi-scale dynamics, has become in recent years a central topic of collaboration between historians, geographers and sociologists of science. Bibliometric techniques make it possible to analyze on a global scale the distribution of the characteristics of researchers and their publications, as well as their gender (Larivière *et al.* 2013). In this special issue, Marion Maisonobe, Michel Grossetti, Béatrice Milard, Denis Eckert and Laurent Jégou redefine the contemporary geography of scientific activities on the basis of an innovative treatment of massive datasets from the Thomson-Reuters "Web of Science." They show in particular that, far from announcing the erasure of national contexts, the increase in international scientific collaborations that has been so well documented up to now goes hand in hand with an unexpected increase in the density of intranational exchanges.

However, not all sciences are intended to be international or globalized in their practices. The very nature of their subject area helps either to limit or to favour cross-border collaborations often based on a technical division of labour. It is easy to understand that the financial cost of large scientific instruments and facilities such as particle accelerators may have forced the pooling of resources around a unifying body like CERN since the 1950s (Hermann *et al.* 1987). On the other hand, the social sciences and humanities frequently study local objects and are thus less easily adapted to an international division of labour than is the study of galaxies and black holes. This is reflected in the fact that the most internationalized disciplines in terms of co-publication are the least related to local subjects: firstly physics and mathematics, followed by biomedical sciences. Then we find the fields of engineering and clinical medicine, the social sciences and, finally, the humanities (Gingras 2002).

If the social sciences and humanities disciplines retain a national anchorage, it is because societies express the necessity of knowing themselves, and it is the "nationals" who are in the front line to satisfy this social demand, even if researchers can, of course, also become specialists of countries other than their own. Since the 2000s, however, there has also been an acceleration of international collaborations in the social sciences that benefit from programmes that promote, particularly in Europe, exchanges between its member countries (UNESCO 2010, Gingras 2011). But these exchanges can serve multiple interests and some international social science organizations are in fact used in part for local purposes. In this special issue, Thibaud Boncourt reviews the genesis and comparative development of eight European social science associations (EAESP, ECPR, EpsNet, EPSA, EASA, EEA, ECSR, ESA). The sociohistorical analysis of the dynamics of these international professional associations suggests that they represent a range of "resources" that can be deployed in the context of scientific rivalties, whether at the national or transnational level.

The limits to the internationalization of science are also apparent at many other levels. They express themselves in scientific policies and legislative systems regulating research that consolidate national specificities, highlight the need for significant adjustments of models to respond to local situations (Jasanoff 2005). In this issue, Séverine Louvel and Matthieu Hubert review the evolution of nanoscience and nanotechnology in France in the 2000s. These changes are described as inseparable from the process of "editing" major international models of research management, that is, a sequence of operations of their decontextualization and recontextualization. In describing various concrete forms of this process for nanoscience, the article highlights how actors are trying to resolve the tension between those who think that, in science and technology, it is impossible to simply imitate foreign examples, and those who consider it useful, or even indispensable, to be inspired by them.

Many other limits to the internationalization of science can be mentioned. Some are fuelled by policies favouring linguistic diversity in the face of the predominance of English. Others are based on local research policies, or on the difficulties encountered on sites whose operation involves international collaboration. Finally, we must remain attentive to the unintended consequences of certain policies focused on internationalization which, in ways that are unforeseen, cause the abandonment of research topics and problems that are more difficult to place (or "sell") in so-called "international" or "high impact factor" journals (Gingras 2014). In the end, the role of science policies in the dynamics of the internationalization of science must not be overstated, ignoring practices and rationales that are incompatible with, or run counter to them. On the contrary, it is necessary to measure the actual effects using appropriate data, both qualitative and quantitative, in order to - as has been suggested in a number of recent works (Frickel and Moore 2006, Frickel and Hess 2014, Gläser and Laudel 2016) – look at research policies as important sociological objects worthy of investigation.

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The coordinators would like to use the occasion of this special issue devoted to sociology of science to pay tribute to Gérard Lemaine, who passed away on June 6 2016 in Paris. Former research professor (*directeur d'études*) at the École des Hautes Etudes en Sciences Sociales (EHESS), Lemaine founded, in the late 1960s, one of the first research units dedicated to the study of science: the Groupe d'Études et de Recherches sur la Science (GERS). In 1969, his article published in the *Revue Française de Sociologie* ("La lutte pour la vie dans la cité scientifique," co-authored with Benjamin Matalon) inaugurated in France a sociological approach to the study of research strategies. This theme was repeated and further developed in his book on sleep neurophysiology (*Stratégies et choix dans la recherche. À propos des travaux sur le sommeil*, 1977). During the same period and with the support of the CNRS, Lemaine also introduced the "ethnographic" approach in laboratory studies (*Les voies du succès*, 1972). It was a type of approach to scientific organizations that would later have considerable international influence. Focusing on teamwork, his work tackles multiple dimensions of scientific activity, including the dynamics of disciplinary fields (*Perspectives on the Emergence of Scientific Disciplines*, 1976), the division of scientific work (*Noopolis. Les laboratoires de recherche fondamentale: de l'atelier à l'usine*, 1982) and even scientific controversies (*Hommes supérieurs, hommes inférieurs: la controverse sur l'hérédité de l'intelligence*, 1985). Endowed with a strong critical mind (see his book reviews in the *RFS*), Gérard Lemaine was a pioneering figure in the sociology of science in France, a field of research to which this issue of the *RFS* is designed to make a contribution.

Michel Dubois

Epidapo
CNRS-UCLA Institute for Society and Genetics
Box 957221, Life Sciences Building
621 Charles E. Young Dr. South
Los Angeles, CA 90095-7221 – USA

michel.dubois@cnrs.fr

Yves Gingras

Centre Interuniversitaire de Recherche sur la Science et la Technologie (CIRST)
Université du Québec à Montréal (UQAM)
C. 8888, Succ. Centre-Ville
Montréal, Québec – Canada, H3C 3P8

gingras.yves@uqam.ca

Claude Rosental

Centre d'Étude des Mouvements Sociaux (CEMS)
Institut Marcel Mauss (IMM)
CNRS-EHESS
54, Boulevard Raspail
75006 Paris

claude.rosental@ehess.fr

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