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Going South. How STS could think science in and with the South?*[†]

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ABSTRACT

Social studies of science (STS, science studies) have played an important role in the renewal of social sciences in the course of their institutionalization. However, especially in France, where the authors are working, they have paid only limited attention to the research on science done in the South. The diverse perspectives developed from/on the South would, if taken into account, broaden the discussion of knowledge, its places and circulation. In particular, we think that postcolonial approaches provide relevant tools for this reflection and that they give the means for a more mature globalization of STS - relying on a better integration of the Global South to the science studies landscape. Our proposal is developed as such: 1) understanding why science studies have shown little interest in the South until recently, 2) analysing the processes which have enabled the move of STS to the South, 3) mapping the challenges of the "creolization" of STS that mixes post-colonial approaches with science studies approaches.

KEYWORDS

social studies of science; the Souths; geopolitics; postcolonial approaches; modernity; and globalization

Introduction: globalization of STS

The growing number of works in the field of social science studies – "Sciences, Technologies, Societies" (STS) or science studies - conducted in the South in recent years indicates that the North/South dynamics in scientific production are receiving increasing attention. Despite this popularity, the capacity of STS to decentralize is open to discussion. Can STS "lose their bearings" in the North and (re)gain them in the South – a capacity that is both metaphorical (as in the famous world map presented "upside down") and completely literal – by taking into account theoretical and empirical contributions from the South. Indeed, while STS globalization is well underway, it is still far from complete.

The story of the expansion of the STS perimeter and their globalization calls for several remarks. First, the official genealogy of the influence (editorial, thematic and geographical) of STS is most often limited to articles by academics writing in the North, or from a

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Northern point of view, about the scientists from the "major" countries that have dominated scientific production and technological innovation since the end of the 19th century. Until recently, the most visible STS publications have all come from these countries. For a quarter of a century, the work carried out in developing and emerging states has multiplied, and in the South STS approaches have been institutionalized. Yet, one cannot avoid noting the disproportionate weight of studies on the major countries of the North, reducing only too often the "global" dimension to a representation of the common places of power located in the major institutions of the wealthier countries. In addition, STS have examined negotiations on the cultural frontier of science (Gieryn 1999) and subcultures within scientific communities (Star & Griesemer 1989; Knorr-Cetina 1998), on the fabrication of culture in a techno-scientific world (Haraway, 1991, 2008) or even on the co-production of sciences and societies (Jasanoff 2004; Latour, 2007). However, with a few exceptions, authors have for a long time kept their distance from the cultural criticism that confirms differences between views of the world.

The geographical and corporeal anchoring¹ of scientific production based on a more decisive conception of culture has been neglected. Attention to the specific historicities of places and their relationships, and to a wider range of "knowledge," has been developing, but only slowly.

These remarks suggest that although there has been globalization of STS, there is still room for a geographical diversity of approaches. Globalization has been conducted mainly as a Euro-American-centric research program.² Consequently, criticism of scientific universalism and technical rationalization is still made, only too often, with the North as the main point of reference and with only minimal attention being paid to the issues raised by these concepts in the rest of the world. This prompts us to reformulate the issue of expanding the STS perimeter by questioning its relation to the South. This should be questioned on two levels.

We propose to pay greater attention to the sheer diversity of work on the science that has been developed in and by the South for many years, in order to propose new genealogies of the expansion of STS, taking full measure of the contributions of science studies carried out in – and on – the South. We feel it is essential to situate the contribution of these works in a broader genealogy of surveys devoted to the issues of science in the South, such as those conducted by historians of colonization and researchers working on development. It is thus the more fundamental relationship between STS and the topic "South" that really interests us, our aim being to promote a research program that integrates more satisfactorily the various new approaches.

Next, we believe that the critique formulated in postcolonial approaches can open up new ways of analyzing more acutely the challenges of scientific and technological development on a global scale, and shed light on asymmetries in the process that produces globalized STS.

¹This current is articulated with the spatial turn in STS focused on the "sites" of production, proclaiming that "science should be put in its place" (the title of Livingston's 2003 book), but differs from it in the attention it pays to the diversity of countries and of continents. The two currents converge, however, in the cultural and corporeal emphasis of their approach to the sites producing science.

²It should be noted that the latest issue of the *Revue française de sociologie*, 2016, 57 (3) on "the internationalisation of scientific research" is still focused exclusively on a few "central" countries and on the articulation between national science policies and the circulation of models between dominant countries.

Under the notion of "postcolonial approaches" we bring together a very broad range of work.³ We are less interested in tracing the outline of a set of "studies" than in following the "thread" of questions that seem common to this field of research. We argue that this work helps to formulate a more accurate critique of the mechanisms of cultural hegemony and "invisibilization," of the role of knowledge and subordinate subjects, of development, and of the "modernization front" (Latour 1991). Initiating a discussion of their contributions to scientific studies would make it possible to continue and complete the movement globalizing STS, which has very often merely changed its mode of presentation: from the sober uniform of methodological nationalism to the dress costume of gala cosmopolitanism.

In starting out from the South our discussion on the globalization of STS, we bear in mind the specific nature of our own positioning and geographic biases,⁴ and also the particular character of the space of francophone (as against anglophone) discussion,⁵ where it still seems premature to speak of the emergence of a current of Postcolonial studies in techno-science (Anderson & Adams 2008). In order to present the argument more fully, we will proceed in three stages.

The first part of this paper points out that the relative indifference of STS to the South during the 1980s and 1990s did not mean that social science studies were non-existent in the South. This brings to light several groups and currents in research that have questioned the role of science in the South without always being recognized at the centre of the discipline. The second part of the paper qualifies our initial statement by showing how since the turn of the millennium STS work has taken hold of the "Southern" issue. There is a growing interest in globalization processes and in attention paid to asymmetries and historical legacies. A cross between STS and postcolonial approaches is thus already forming, although it is still limited by other concerns. In the third phase of our article, we map the challenges posed by a "creolization" of STS, in the case of a contribution by postcolonial critics that has been given more recognition.

Dynamics and marginalization of STS in the South

Ranging from denunciation of the ill effects of science in Europe and the United States and of the Eurocentric bias of Western science, to a critique of modernity as a whole, criticism has never been limited to the STSs of the North. As a result, if we are to move beyond a mere acknowledgement of the lack of interest taken by the STS of the North in developments in the South, we should no doubt trace another genealogy, showing the currents

³Studies from the field of cultural and literary studies are usually designated by this expression, and also from that of subaltern studies and their recent ramifications, e.g., the "decolonial" current (the modernidad/colonialidad/descolonialidad – MCD group), and also writing by authors who had taken part in struggles during the period of decolonisation and who in many cases are viewed today as tutelary figures by activists in the various currents of thinking mentioned above.

⁴We work mainly in Latin America (Mexico), in Africa (Morocco and Kenya), and in India, in French institutions (IRD, IHEAL), and it is from within our own disciplines (history, sociology, communication sciences) and our own experiences in our work, and our discussions with colleagues in the global South that we raise the question about the construction of a transnational space for research on globalized STS. Although we hope to succeed in bringing out the main lines of the convergence between STS and postcolonial studies, it is not yet really possible to do full justice to the wealth of interest to be found in these two approaches.

⁵With the exception of the noteworthy contributions of the history of sciences and some issues of *Revue d'anthropologie des connaissances* (vol. 2, n° 3; vol. 5, n° 3; vol. 6, n° 2), the STS that have taken on board thinking about the subject of North/ South relationships do not yet enjoy very high visibilty, in particular in handbooks (Dubois 1999; Martin 2005; Pestre 2006; Vinck 2007; Bonneuil & Joly 2013); discussion of postcolonial approaches is organized in a specific way.

that have laid the foundations for attention paid to sciences in the South – currents that criticized the historical expansion of modern science, but without always receiving in current science studies the recognition they deserve. In this section we stress the importance of the history of the relationship between science and colonization; of the analyses of scientific systems and communities conducted by researchers coming from countries of the South; and of studies in science and development. We conclude by noting the long-standing lack of a real meeting point between science studies in the South and postcolonial approaches.

Colonial history and sciences

Since the 1980s, at the crossroads between the history of science and science studies, research on the development of science and its diffusion have changed our understanding of the ways in which the relations between science in metropolises and science in their colonies, relations between science and imperialism, and those between colonization and independence movements, have converged to construct present-day nations.

In this respect, an international group working on Science and Empire – set up in 1990 in India, Great Britain, the United States, Spain, Mexico, Brazil and France – has established the limits of the contribution of colonial scientific activities to the emergence of national sciences (Petitjean et al. 1992). Southern historians have raised the question of the reception of colonial knowledge (Prakash 1999), that of the emergence of national sciences (Saldaña 2005b), that of their confrontation with non-European sciences, that of the participation of local actors in colonial scientific institutions (Raj 1997), and that of the role of so-called vernacular knowledge, for example in writing the history of ethno-sciences (Hunn 2007) or in putting into perspective the industrialization of developing and emerging countries (Krishna 1996). An international comparative perspective has highlighted the importance of social, economic and political dynamics in understanding the contributions of the Arab (Rashed 1997), Indian (Raina 2003), Chinese (Needham 1977), pre-Hispanic (Saldaña 2005a) and colonial experiences of the British, French, Spanish and Portuguese empires in the construction of modern science.

By taking into account the influence of circulations, exchanges, conflicts and negotiations on interconnections (Habib & Raina 1999, 2007; Petitjean 2007, 2009; Cueto 1994), this historical research has contributed largely to re-contextualizing contemporary globalization, so that it can be viewed as part of the longer historical movement of the globalization of science between the seventeenth and twentieth centuries (Raj 2007; Gruzinski et al. 2005; Jacob 2007, 2011; Pestre 2015). It has prepared the way for questioning the relationship between political domination, the circulation of knowledge and the production of asymmetric spaces for scientific research, a central issue for the New History of Science and of Global History (Werner & Zimmermann 2004; Romano 2014, 2015).

Social science studies by authors from the South

In the South, apart from science historians, a number of scientists – in many cases close to the powers that be – also questioned the current development of science and technology. In India, as in Latin America, although at different times, this questioning has focused on

the relationship between science and the efforts of the Southern economies to catch up with those of the North and also the relationship between science and the economic and political domination of the centre over the periphery (Arellano & Kreimer 2011; Feld 2015; Krishna 2017). These writings belong to the Third World school of critical thought that has developed since the 1960s, based on the theory of dependence and advocating a "third path" of development in a putative Third World based on solidarity (Amin 1973). As a concept, the centre/periphery relationship forms the basis of an overall explanation of the relations between industrialized countries and those of the Third World, and of the difficulties encountered by the latter in industrializing (Vessuri 1987). Two main themes underlie all the work carried out with this in view: 1) the unequal integration of the formerly colonized world into the scientific world order, and 2) the institutionalization of sciences, with each on a national basis.

In India, a community has been formed around the NISTADS (National Institute for Science, Technology and Development Studies) and the CSSP (Centre for Studies in Science Policy). Since the end of the 1990s, the work of this community has been relayed by the journal *Science, Technology and Society*. In Latin America, sociologists, anthropologists, economists, initially mainly located in Cendes (Venezuela) and at the University of Campinas (the circle of the anthropologist Hebe Vessuri) have been joined by economists from the Economic Commission for Latin America (ECLAC) in advancing structuralist thinking and the theory of dependence, and in shifting criticism towards production sectors. These research groups, who are mainly interested in the problem of "catching-up" with industrialized economies, have subsequently broadened their initial concerns with the institutionalization of science and technology, and are now working on the relationship between science, technology and innovation, on the construction of science policies, on the emergence of national scientific communities, and on their disciplines in the national contexts that are now developing (Diaz et al. 1983; Cueto 1989).

These currents, which "took off" in the 1990s, have pursued their development, with the creation of the journal REDES (Revista de Estudios Sociales de la Ciencia, in 1994) and subsequently that of the Latin American association of science studies ESOCITE (in 1995), in a dialogue with the STS approaches of the North. This has made it possible to call into question the place assigned to the periphery in modern science and technology, and to advance a critique of the role of S&T, and their asymmetrical relationship with Europe and the United States (Arellano et al. 2012). The most important feature of these developments - in contrast to the science studies developed in the North and on the North – is that both in India and in Latin America their social studies of non-Western sciences have called into question all national scientific systems that have not been stabilized from within but from outside, by virtue of their historical interaction with Western science. The North/South relationships, the ways in which sciences have been written into historical narratives, and the constant exchanges between geographically-located scientific systems – all themes that are practically absent from the science studies of the 1980s and 1990s (with the exception, as we have seen, of the history of science) - are fundamental to estudios sociales de las ciencias and to Science, Technology and Society - in Latin America and India respectively. For example, in France during this same period – apart from the group of historians working on Science and Empire – only the CNAM and UNESCO showed any interest in these questions raised in the South (Salomon et al. 1994; UNESCO 2010). More recently, several years after the turn of the century, work of this sort was institutionalized in a number of new international networks organised in various ways: the Asia Pacific STS Network, the East Asian STS Network and the STS Africa network.

In this regard, the spatial centre/periphery perspective reflects not only the asymmetrical relations between the so-called "hard" sciences, but also – retrospectively – the basic organisation of the STS field. The dominant relationship between the North and the South has certainly been one of the factors behind the lack of interest shown by the science studies of the North in the Southern science studies that have been developing since the 1980s.

Science and development

The third set of publications, whose contribution has been largely underestimated by STS, at least in France, consists in studies of the relationship between science and development. In the mid-1980s, the issue of North/South relations in the development of science and technology interested only a single multidisciplinary team in France: the Science, Technology and Development (STD) work-group at ORSTOM. This team was convinced that science and technology could be effective means of development and act as levers to deal with economic and social crises at both the centre and the periphery (Arvanitis & Chatelin 1984; Waast 1995). Collaborating in particular with the social science study groups in Latin America and India and with the group of sociologists from CREAD working in Algeria⁶ (El Kenz & Waast 2013), the STD team has been making quantitative and qualitative surveys of national scientific communities, of the construction of science policy, of science management, of science migrations, and of technological learning since the mid-1990s (Gaillard, Krishna & Waast 1995).

If these social sciences produced elsewhere have also developed in France, it is first and foremost to further implementation of the cooperation policies of the French State. At the crossroads between sociological analysis and technical expertise, these studies became part of development sciences, usually the analysis and practice of development involving various disciplines, such as agronomy, rural sociology and anthropology (Olivier de Sardan, 1995). As a result, for a long time the team has had little to do with the predominant concerns of STS. Its areas of interest have developed outside the areas on which other researchers are focused. As a body intended primarily to provide support for official technical and scientific cooperation policies, it is not part of the mainstream French university system; it is composed of researchers who work abroad, usually far from France, in partner institutions in the South (Gaillard 1999; Waast & Kleiche-Dray 2009; Gaillard & Arvanitis 2014; Kleiche-Dray & Villavicencio 2014).

Nevertheless, within this framework, sociologists, anthropologists, historians and economists have sometimes found a niche in which they can question the presuppositions of scientific and technical development policies, and lay the foundations for a critical approach to the North/South divide in science. In particular, some of the group's work engages with or relays a critical appreciation of the putative universality of Western science; this was the case at the symposium "Sciences outside the West" organized in 1994 (Waast 1996). More generally, reflection on the role of science in the North/South divide has been part of the current search for alternative development paths, and of the cultural and geopolitical critiques of

⁶Research Centre on Economics Applied to Development (Centre de recherche en économie appliquée au développement).

development that sociologists, historians, anthropologists, economists and agronomists are working on and in the North/South collaboration (Shinn 1997; Vessuri 1999, 2004).

During the 1980s and 1990s, reflection on the sciences in the South was thus to be found less at the heart of the STS domain than on its margins. This problem emerged in three complementary contexts: in the participation of other parts of the world in the historical narratives of modern science; in the linkage between colonial expansion and the development of sciences in the North; and, in the South, in the linkage between the developmental mindset and scientific institutions. However, most of the work produced in the course of these discussions, which have kept the links alive, has itself remained a closed book to critics in another area: that of postcolonial studies, long ignored (Kleiche-Dray & Waast 2016), but that today reveal new cleavages within the STS communities of the South.

Post-colonial approaches

The fourth set of studies we are looking at here has questioned not so much the use of science and technology, as their foundations. This particular trend started out as a critique of the cultural anchoring of science and technology in Western knowledge. Especially since the Second World War, many approaches and studies have challenged the supremacy of the scientific and technical rationality seen as "Western" in geographical areas considered peripheral and often still under European domination. This attitude first arose as part of the struggle against colonialism, neo-colonialism and imperialism; since then, from the 1970s onwards, it has developed in academic work. This work has undertaken a critical deconstruction of the discourse and representations produced by Western societies in dealing with the rest of the world. Today, these studies constitute a broad movement connected to studies of colonial situations, to "Third-Worldism," to the critique of neo-colonialism, and to studies on development. Their aim is to give back to the peoples dominated during the colonial period their rightful place in history.

Seen schematically, four key moments shaped this movement:

- Anti-colonial studies of political and economic conditions, that deconstruct the imperial history of the former colonies and of Overseas France, the French Caribbean and Caribbean countries (James 1983; Césaire 1950; Fanon 1952; Amin 1973; Balandier 1977);
- Post-colonial studies that deconstruct colonial discourse in the comparative literature departments of American universities (Saïd, 1980; Spivak 1988; Chakrabarty 2009; Bhabha 1994; Appadurai 1996; Mbembé 2000);
- "Subaltern studies" that re-write history "from below" (Guha 1997; Shahid & Chakrabarty 1996; Guha et al. 1988; Latin-American Subaltern Studies Group 1993;⁷ Rodriguez 2001);
- 4) "Decolonial studies" that since the turn of the century have raised the question of the effects of colonization on cultural and epistemological identities, proposing to thoroughly review the entire history of modernity and its great narratives, in the

⁷This group was founded at the LASA Colloquium in 1992 and was dissolved in 2001; see the article read by John Beverley, one of the founding members, at the LASA meeting in 2001(Beverley 2002).

Programa Modernidad/colonialidad/descolonialidad (MCD).⁸ (Quijano 1994, 2000; Dussel 2007; Mignolo 2000, 2013).

All of this work deals with themes that are only apparently distinct from those of STS: the effects of colonization on the construction of images of the Other, otherness, the production of cultural identities, and the diversity of epistemologies. These studies have brought to light the psychic dimension of colonial power (Nandy 1983; Ruscio 2002), criticizing the Eurocentric bias of modernity (Dussel 2007; Escobar 1995), in order to restore the visibility of subordinate actors of history and their knowledge (Guha 1983), questioning the construction of representations of the Other (Glissant 1997), and denouncing the build-up of institutional racism (Rodney 1973; Brossat 2012) in order to restore the imaginary dimension of historical experience and rectify its representations, dealing more adequately with the sheer complexity of the processes of construction of State power (Bayart, Mbembe & Toulabor 2008). However, until recently, all this work has been relatively seldom used in STS research.

In this first part of our study we present four dimensions of North/South relationships that have remained relatively inconspicuous in social studies of today's globalized sciences, that is, in the factual aspects of colonialism, in the construction of national research systems in the South, in development sciences, and in experience of the postcolonial world. Today, the hitherto unsuspected diversity of the geopolitical, economic and cultural contexts of the South is leading social science researchers from institutions in the North who are working in the South to press their questioning still further. They are finding that the presuppositions of their approaches to science are based on ideas of North/South relations that stem from colonial history. This also holds for the construction of national research systems in the South, for developmental sciences and for postcolonial angles of approach. In the next section, we will try to analyze work in social studies on sciences that give place of pride to Southern terrains in order to identify more clearly communities and fields of research.

"Les Suds" - a new terrain for STS?

It would be a mistake to confine our comments to the lack of interest shown by STS in "southern" issues, and in particular in postcolonial approaches. In recent years, it is the reverse that seems true. According to John Law and Wen-Yuan Lin (2017), "STS is not short of postcolonial studies." Michael Fischer (2016) has studied the rise of an "anthropological STS" that pays more attention to cultural contexts, and Adele Clarke (2016) has hailed the meeting between gender, race and (post-) colonial studies in the sciences as one of the movements that are now driving the discipline. In a way, this is a new generation of work on the issues of science in the South. It comes together with a new wave of globalization in STS studies and the institutionalization of self-designated STS communities in a number of countries.⁹

This work has applied STS to terrains in the South by integrating postcolonial critiques more directly. An example is the "LOST" (Law, Organisation, Science and Technology)

⁸The M/C/D group was founded in 2005 at LASA , and was intended as a radical foundational act, breaking away from the historical branches of postcolonial studies.

⁹For example in South Korea (Quet & Noël 2014).

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group in Germany, led by anthropologist Richard Rottenburg and the group working on Anthropology of African Biosciences set up at the London School of Hygiene and Tropical Medicine. Both groups have applied the STS approach to African fields and have devoted research projects to this type of analysis. Furthermore, the geographical shift has contributed to discussions and sometimes to comparisons with postcolonial approaches in the central institutions of the discipline, as can be seen from the latest conferences of 4S and EASTS, and from articles and survey issues of journals (*Social Studies of Science*, 2002; *Science as Culture* 2005; Anderson & Adams 2008; *Postcolonial Studies* 2009; Harding 2011; *Science, Technology and Human Values* 2014, 2016). This work has opened up space for questions on the production of power, on the geopolitical anchoring of relations in colonial history, and on the hybridization of knowledge – questions that are not too far removed from the concerns shown in the research we have described in the preceding section.

This development thus raises a question: how exactly do the contributions of previous work fit into this overall movement? Our hypothesis, developed in the course of our reading and argued here, is the following. There is a link between the first wave of social studies on science in the South, postcolonial approaches, and some current research in the field of STS. This link has taken shape in a series of methods, names and forms of sensibility and attention that have been evolving and have moved away from the work described in the first part of this article. The influence of postcolonial studies on social studies of science in the South should be viewed in a broader context. This should make it possible to relate our particular work to other academic and political currents: feminist studies on science, the critique of development, political ecology, and work on forms of government, the State and trade. We have to take into account evidence not only of divergence and ruptures, but also of continuity between the different currents that have confronted the problem of science in the South. To show this, we will raise three series of issues that pervade current work. The first series concerns the practices of government in the postcolonial system; the second series deals with the consequences of the intertwining of technical development and market practices; and the third series deals with the production of postcolonial subjectivities. This triptych - "government, market, subject" - is the core of the current explanatory work on STS in the South.

Governmental practices

The first set of questions consists in asking exactly how to label and analyse the forms of government and the ways in which power is imposed and perpetuated – or challenged. This entails looking into the dominations that are active in the South, and interactions between the South and the North and between the South and the South. All of this has to be described and conceptualized, allowing for a variety of singular situations while at the same time thinking in terms of forms of power and domination that are transversal. "Governmentality" and imperialism are central concepts here: they can describe not only relations between States, but also relations between States and firms, foundations, development banks, etc. (Escobar 1995). The deployment of these actors and their instruments constitutes one object of analysis. Many studies have sought to characterize the specificity of power situations that have been set up in the articulation between scientific research and other active institutions. The role of science in the construction of State power and of nationhood in a postcolonial framework is an important topic of research.

Research has thus focused on the ambiguous role of science as an instrument of both colonial power and of liberation (Prakash 1999); on the link between national postcolonial and national imaginary projects and on the development of knowledge and technology (Abraham 1998; Jasanoff & Kim 2009); and also on the trans-nationalization of the State in technical projects (Kuo 2011). Abraham (1998) shows in particular that the construction of Indian nuclear power is a result of the merger between on the one hand, the security discourse produced in the context of hostility to Pakistan, and on the other, the developmental discourse proper to India's postcolonial policies. He explains that the policies of science and technology are part of a long history of colonization, of the ideals of development and of the science that development spreads. These policies are also part of particular nationalism and technological positivism with geopolitical concerns (Kuhn 2013). This type of research is a useful extension of the issues raised both by historical studies of colonial science and by practical analyses of science policy in the South.

Moreover, notably under the influence of Michel Foucault's theorizations, much of this research on political power shows that the practice of science always involves both project management and population management (Prince & Marsland 2014). Science is seen as a means of governing, generating surprises and resistance among populations (Vaughan 1991). Scientific constructions are also instruments that produce governability, as can be seen in the racialization of reports in certain colonial medical practices (Anderson 2006), and in the persistence of racialized reports today (Fullwiley 2011). Fullwiley (2011), in her survey of sickle cell disease in the United States, France and Senegal, shows how the disease has been defined in terms of ethnicity and nationality, even at the genetic level. Some studies have gone so far as to characterize this sort of governing as an "experimental" practice, treating populations as subjects of experiment (Chamayou 2008; Nguyen 2009; Tilley 2011), though this particular interpretation has sometimes been more nuanced (Lachenal 2010; Rottenburg 2009). The specific nature of this policy of experimental "clinical work" in the South has probably been established on the ruins of colonial history, thriving on the crying need for medicine and for scientific and technical knowledge that could legitimize most of the interventions presented under the aegis of science.

Market organizations and scientific and technological development

The second series of questions revolves around the forms of market organization, the articulation between modes of capital accumulation and scientific and technological development, and in particular their consequences in the countries of the South. This has received more attention in current research than in previous work on STS, although the issue of the privatization of research systems, for example, was already raised in studies during the 1990s (Waast 1995). The current question is therefore one of describing at one and the same time the dynamics of scientific and technical development, the expansion of markets and forms of commoditization, and the localized effects of techno-commercial processes in the South. Work on this subject shows how the field of development has become a space for techno-commercial experimentation (Redfield 2016; Goldman 2005).

At another level, it is the role itself of "techno-commercial" objects (Pestre 2014) in Southern societies that is being investigated. This is done by studying configurations in which objects (for example medicines) that circulate, are at one and the same time technologies, consumer articles, and agents of social recomposition (Sanabria 2016). The transnational circulation of these objects is in fact inseparable from an economic framework that generates dynamics of commoditization and technologization that affect the development of societies. The dynamics of commoditization have been studied by several authors who are interested in issues related to the human body – organs (Cohen 2003), and gametes (Cooper & Waldby 2014); they show in particular that these activities are still based on strong economic asymmetries between countries and between individuals. These commoditization dynamics have also been highlighted in environmental issues, such as nature conservation and environmental services (Büscher et al. 2012; Büscher et al. 2014), "green grabbing" (Fairhead et al. 2012), bio-prospecting (Hayden 2003; Osseo-Asare 2014), seed management (Jasanoff 2006), and mining (Alimonda 2011; Bebbington 2012). These dynamics redraw the lines of power and ownership in agrarian production, in order to facilitate the extraction of natural resources (Altieri & Bravo 2007; Holt-Giménez & Shattuck 2011). They eventually redesign places and spaces on international, national and sub-regional scales.

Some work has also sought to conceptualize the forms of capitalism that emerge from new linkages between scientific disciplines, legal regulations and market strategies (Sunder Rajan 2006; Thomas & Boisvert 2015). In particular, this work explains specifically how and why the South has been included in the globalization of trade – an inclusion that debunks the fantasy of capitalism developing only in the most developed countries. The authors thus reconstruct the political economies specific to the markets of the South, seeing them as an integral part of globalized capitalism (Peterson 2014),¹⁰ with their forms of regulation outside the ambit of rules prevailing in so-called "regulated" markets; the informal market for medicines is an example (Reynolds Whyte et al. 2002).

Subjectivation processes

The third series of questions addressed by STS research in the South concerns the processes of subjectivation that result from the dissemination of techno-science in different spaces. Who are the subjects produced in postcolonial techno-scientific configurations? How do they enter into and, if need be, resist the process? In this context, studies have often tended to focus on individuals and social groups, in order to counterbalance political discourses and technological imaginings (Biehl & Petryna 2013); this research can share certain concerns in anthropology developed by authors in the "subaltern studies" school.

A lot of work has also been done on the production of racialized relations and racialized subjectivities. Here, the powers – or, on the contrary, the limits – of techno-science have often been accompanied by discourse on individuals and populations. For example, Livingston (2012) analyzes the ways in which discourses on the low prevalence of cancer in Africa are often used to justify the paucity of resources devoted to the diagnosis of the disease in sub-Saharan African countries. Crane (2013) shows up the concomitance of discourse on African non-compliance with HIV treatment and the unavailability, for

¹⁰The author shows that the presence of fake medicines is a reflection of a global political economy of pharmaceuticals, and merely indicates that Nigeria is part of trade networks that have been structured by inequalities and domination effects.

economic reasons, of treatment in the countries concerned. In the environmental field, Agrawal's work has highlighted, by applying the notion of "environmentality," the production of new environmentalist subjectivities in impoverished populations of the South (Agrawal 2005). Environmental governance also gives rise to a racial classification of populations according to the value of their ecological practices (Ulloa 2004).

Lastly, research has taken note of new political subjectivities, new relationships with the State emerging from the construction and institutionalization of technical professions, as in the case of pharmacists and traditional doctors (Tousignant 2014; Bocarra, 2013). This can also be due to the introduction of new technological procedures (Cohen 2016), or to direct interaction with diseases, where toxic elements lead to a redefinition of individuals' status. In this case, the interaction between science and State is evident in the construction of the status of "seropositive" (Nguyen 2010), and in that of uranium toxicity – as a result of scientific, commercial and geopolitical negotiations (Hecht 2012).

The aim of these studies has been to account for the redefinition of forms of citizenship in the current context of globalization of science, markets and risks. This work has of course also taken into account practices of participation, protest and representation entailed by these redefinitions. This shows up in advocacy practices (Fortun 2001), participation, and protest, e.g., against clinical trials (Bureau-Point & Sovannoty 2015; Grant 2016). It also appears in forms of distancing that are more difficult to characterize, and that are often rooted in the history of the relationship between research institutions and society (Fairhead et al. 2006). The gap between the differing environmental standards applied to racialized groups has given rise to numerous mobilizations and to new identities that are forged in resistance. The notion of "environmental justice" that qualifies these situations has become a fundamental notion in political ecology in Latin America (Martinez-Alier 2005) and India (Ravi Rajan 2014).

To conclude this section, we would like to stress that an encounter between the STS domain and previous approaches to the problem of the global South has definitely taken place, even though it has not yet been discussed very much in the French-speaking world. It took place thanks to pioneering proposals such as Sandra Harding's, suggesting that we apply different forms of criticism, in particular feminist and postcolonial criticism (Harding 2011), and bring them into line with the sciences. There was an obvious need to take into account the singularities of terrains and objects that had not been treated adequately in the past. The encounter made it possible to historicize STS research accordingly. It has also promoted a multi-polar reflection on geopolitical issues that all too often are summarily assumed to be due to the domination of the great Western powers. Last but not least, the convergence has enabled different analytical trends to express themselves: research was now focused on the hegemonic dynamics of techno-science, on bio-medicine, and on environmental issues – but also, on the contrary, on the irreducible nature of the different forms of rationality that collide in the flows of knowledge. Explicit recognition of the diversity of approaches and currents, which had previously remained implicit, is now making it more difficult to integrate the various perspectives more completely. It is this discussion between STS and postcolonial approaches that we will attempt to launch in the final part of this paper.

Science studies and postcolonial studies: overviews of their descendants

In this third phase of our survey, we will present more openly the challenges implicit in the intersection between STS and postcolonial approaches. The focus will be on cultural otherness and anthropological perspectives.

New geopolitics of science and of subaltern knowledge

In our opinion it is perfectly reasonable to pursue the "cross" between STS and postcolonial cultural criticism, as this opens up several new avenues to research. Among these are the political uses of subordinate knowledge in both South and North, the diversification of global hegemony, and the new focus on processes of relocation and universalization. Whereas older terrains can still be explored using relatively traditional STS tools, the latest field – that of diverse ontologies – obliges us to make deeper-seated changes in our methods.

With the emergence today of a broad trend that politicizes knowledge and criticizes "science," the new visibility and the strategic use of alternative epistemologies have both inevitably become a subject of STS research. As a political practice, this is first and foremost a characteristic of subordinate groups in the South - an effort to convert the otherness of their knowledge into a political resource. This can be seen in the demands of many spokespersons of indigenous movements (e.g., Indianist discourse in Latin America; Aboriginal discourse in Australia); in the demands of environmental movements; in public action mechanisms aimed at innovation, citizen participation, and inter-culturality (Walsh 2013); and in the dialogue between different forms of knowledge (Leff 2006).¹¹ Multilateral mechanisms are also being reframed in this way, giving them a higher visibility and providing institutional support. Examples of this are the Convention on Biological Diversity (CBD), and the International Panel on Biodiversity and Ecological Services (IPBES), the "conceptual framework" of which has integrated the notion of "motherland" (cf. Borie & Hulme 2015); the Paris Agreement on Climate and the IPCC (Foyer & Dumoulin 2017); and the declarations on Food Security (World Food Summit, 1996; Rome Declaration on World Food Security).

Analysis of these approaches by STS is all the more important today as the politics of otherness – and even of "incommensurability" – is becoming a central dimension in many political conflicts; the critique of science and the valorization of alternative forms of knowledge are being increasingly deployed,¹² sometimes instrumentalized by elites of the South in the service of what could be termed a certain "Westernism."¹³ Anti-capital-ist nationalism in Bolivia, for example, has forcefully played the international card, celebrating "ancestral knowledge"; and conservative nationalism in India, in the context of increasingly industrialized medical knowledge (Gaudillière & Pordié 2015), has launched ambitious programs promoting traditional Hindu knowledge.

¹¹Mexico can also be cited here, as it has backed some of these projects to bring more visibility to traditional forms of knowledge, e.g., in the form of the *Biblioteca Digital de la Medicina Tradicional Mexicana* that groups projects that started up during the 1990s with support from Mexican governmental organs (Argueta et al. 2011). See too Apffel-Marglin & Marglin (1996).

¹²STS themselves are caught up in this mechanism of "double interpretation" that has been analyzed by Anthony Giddens (1987).

¹³Counterpart of E. Saïd's (1980) "Orientalism," discussion of "Occidentalism" would be well advised to study ways in which economic (Carrier, 1992) and spiritual criticism (Bonnet 2004) also make use of a critique of the sciences.

These "alternative modernities" (as practices and as representations) are also developing in the North, often with the imprint of the ecological movement; the trend is not due exclusively to the presence of migrants and diasporas from the South (Latour 2009). The alternative knowledge associated with these "other" versions of modernity is always hybrid, sometimes resulting from transnational cultural transfers that follow on an age-old borrowing. They are also often based on a revival of local memories: the "re-enchantment" of peasant identity and the revival of archaic seeds (Demeulenaere 2014) or of the rural world, now seen new as an anchor for de-colonial activism (Gervais 2015). The diversity of ontologies also comes into play in controversies over terroirs and the bio-dynamic practices (Teil, Barrey, Floux & Hennion 2011). In all of these cases "mainstream" thinking is hybridized with indigenous spiritualities perceived as ecological knowledge (Berkes 2008). This re-conceptualization of "beliefs" and "spiritualities" constitutes another horizon of the decompartmentalization of research (cf. Latour's "faitiches," 2009), be it in healing, the arts of "witches" (Favret-Saada 1977), apparitions (Claverie 2003, 2008), or pseudo-sciences such as "ufology" (Esquerre 2013; Lagrange 1993, 2012). The overlap between STS and anthropology has made it possible to revitalize the analysis of contemporary societies in the North by focusing it on the highly diverse relationships between "human and nonhuman" (De la Cadena & Lien 2015; Thiery & Houdart 2011).

Besides research on the uses of subordinate knowledge, research on epistemic domination and the "invisibilizations" that result from it should be diversified. The question of epistemic dominations other than that of Euro-American modernity has still to be raised if we are to update this new type of questioning that has emerged from postcolonial approaches. Could the emergence of dominations – regional or local rather than global – in the South merely be a shift of the "modernization front"? Is it now manned by the formerly colonized or dominated nations whose scientific communities have been growing and are now very large? Or are these simply different forms of post-developmental domination-by-knowledge? More detailed analysis shows that the modes of scientific hegemony differ according to the issues and disciplines mobilized: ontologies, new valuations, Man's place, modalities of the future – as shown by the mobilizations over GMO controversies (Bonneuil 2006) and nature conservation (Blandin, 2009).

Finally, the problems involved in *relocating* projects initially conceived of as "global" have taken on greater importance than those involving technology transfer or the circulation of scientific knowledge. The multi-situated anthropology of *connections* has become an accepted part of STS, showing up a great diversity of centre-periphery relationships, the "global" now seen as what *emerges* from a localization network rather than something that encompasses it. Moreover, the pre-eminence of this category "global" is tending to give way to a different questioning: how exactly is universality claimed, contested, filled out, and reconstructed by means of specific knowledge practices and technological choices? Starting out with analyses in terms of knowledge/power (Foucault) and of "situated points of view" (Haraway 1988), it has become possible to grow this knowledge of/in the South politically by inscribing more widely in "epistemologies"¹⁴ (De Sousa Santos 2014) and in a plural modernity.

¹⁴This use, out of scientific contexts, of the terms "epistemology" and "epistemological" has led to the emergence of a series of notions that are sometimes not carefully controlled, e.g. "epistemological racism" (Mignolo 2013), and "epistemic injustice" (Bhargava 2013).

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Still further upstream, the anthropology of nature (Descola 2005, 2014) is converging with the theoretical thinking of STS (Latour 1991, 2012; Jasanoff 2004): could it be possible to no longer consider "nature" as a universal? Recognizing the existence of a multiple nature or a pluriverse (Escobar 2003; Latour 2012) – and thus of a diversity of ontologies – opens up a highly promising approach to rethinking not only ecology in the South (Goldman et al 2011; Green 2013) but also the practices of laboratories in the North (Brives 2013, 2017).¹⁵ These ontological approaches, however, should not be simply opposed to previous thinking that analyzed differences in political terms. Rather, some authors attempt to understand the ways in which this sort of reflection on "nature" influences the very definition of confrontations thought of as "political" (Martinez Alier 2005; De la Cadena 2010). Mario Blaser's analysis (2013, 2016) in terms of "political ontologies," based on case studies of friction with indigenous populations, attempts to reveal the "cosmo-politics" that make it possible to reach a common world.

Are global STS contributing to epistemic domination?

This new research in both North and South has a deep-seated connection with today's circulations, interconnections and transnational flows between the scientific communities in Social Science and the Humanities. "Global history," "global studies," and even sociology have all integrated the questions raised by postcolonial approaches, underscoring Eurocentrism in science, and the domination – or asymmetry – that comes together with the internationalization of research.

Today, the vocabulary, concepts and theories of STS are circulating throughout the world, mobilized by social movements and intergovernmental organizations that recycle studies on the co-production science/society, aiming to make "epistemic plurality" part of their thinking. It is becoming increasingly clear that the production of STS in the South is no longer a merely peripheral activity without any political consequences. The political uses of STS force STS practitioners, just as it has forced anthropologists, to rethink their scientific approach. A new form of reflection on the production of STS is increasingly necessary, and postcolonial approaches can help with this.¹⁶ North-South collaborative practices within STS are not marked only by the unique epistemological heritage of their categories. The internal Euro-American hegemony in the functioning of science has been deeply embedded in inegalitarian "institutional structures" that govern the production of human and social sciences. This has been shown clearly both in the case of Asia (Law & Lin 2017) and that of Latin America (Da Costa Marques 2014; Kreimer & Zabala 2008). This institutional inequality obliges us to integrate four new dimensions into STS research projects in the South.

✓ Terrain and corpus. A detour to visit postcolonial approaches makes it possible to accompany transformations in the dominant practices of STS research in the South, bringing them closer to older disciplines (anthropology, development studies). This can be done by selecting the type of field work to be achieved (this takes longer);

¹⁵His work embodies this passage from the notion as used in medicine by Annemarie Mol to the analysis of Descola's major thought patterns and, in particular, the critique of that of "naturalism" applied to scientists (Mol 2002).

¹⁶Though the pervasiveness of the colonial nature of power, knowledge and being (Quijano 2000) may seem a rather exotic idea to some readers, it is fraught with a meaning that varies a lot from terrain to terrain.

or, it can be done by selecting a preferred method (and paying more attention to the longer story and its "invisibilizations," or to the role of *subaltern* memories); or by selecting another working language (involving more investment in learning); or by devoting increased attention to certain social practices and informants (so as to lessen the focus on elites); or by selecting the type of collaborative partnership and publication to set up (aiming explicitly at reducing this hegemony).

- ✓ Concepts. This new dialogue is also accompanied by a choice of the new topics that are emerging from the current transformation of the social sciences. Among these are the relationships between species and, more broadly, between modes of existence (Latour 2012; Descola 2014); and radically different forms of anthropology (cf. the perspectivism of Viveiros de Castro 2010). Some experienced STS authors are also attempting to work in STS surveys with concepts drawn from non-Western cultural traditions: e.g., Melanesian categories of traditional exchange (Anderson 2008), traditional Chinese medicine (Farquhar & Zhang 2012), and traditional measurement ceremonies (Schaffer 2014). More generally, Amartya Sen has suggested the reconstruction of the indicators of development, basing them on a rethinking of universalist concepts found in different cultural traditions (2001); while Law and Lin (2017) have suggested an even more ambitious way forward to be followed by "China-inflected STS."¹⁷
- ✓ Publications. It is also urgent to *make visible* (a fundamental notion in much feminist work, as in postcolonial studies), that is, to valorize and legitimize social studies of the sciences produced in the South, while respecting their difference. For example, the concept of a dialogue between different types of knowledge *diálogo de saberes* -(Leff 2006) that has its roots in the pioneering work of the Brazilian educationist Paulo Freire (Pedagogy of the Oppressed 1974) and of the Colombian sociologist Orlando Fals Borda (1979); and Catherine Walsh's (2013) critical inter-cultural sociology that stems as much from Freire and Fanon's thought and from the de-colonial school. This form of collaboration that accepts theoretical contributions in other languages and from other intellectual traditions could also lead to new publishing projects.
- ✓ Teaching. Today, intercultural education has been developing in many countries of the South (e.g., "indigenous universities" in Latin America, Mato 2012, and new generations of anthropologists coming from minorities); alternative universities are being set up that explicitly aim to build a *pluriverse*. The learning process of science is now marked by a postcolonial questioning that has begun to penetrate science education everywhere, even among practitioners in the erstwhile "central" countries. For STS researchers themselves, presenting STS studies especially in the course of training students in STS, in the North, as in the South has become problematic: how is one to avoid reproducing a genealogy full of epistemic blind spots, "invisibilizations" and epistemic dominations? How should one direct curiosity towards more diversified fields and conceptualizations that reflect different modes of knowledge (Aikenhead & Ogawa 2007)?

¹⁷The authors present an argument in favour of the use of non-Western analytical resources in STS studies outside their usual context, and provide as an example the assessment of the "effectiveness" of health policy in England.

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Conclusion

We have tried to show in this article that so far the globalization of STS has been too unequivocal to be satisfactory, and that there would be a lot to gain by integrating the contributions of currents of investigation that have sprung up in the South. Historical studies of science and colonization, studies of science and development, studies of the sciences practiced in the South but also of the interdependence between science in the South and science in the North: all of this gives us food for thought that should not simply be taken as settled; it deserves further discussion. The full impact of post-colonial approaches on the study of science and technology in the South has not yet been fully appreciated. Post-colonial thinking also provides tools that can give us a grasp of the different forms of modernity that are shaping the phenomena known as globalization.

The detour through the South has thus largely contributed to freeing STS from the straitjacket, while staying in line with the project of critical analysis of science and technology that has been driving this field since its inception. This evolution has been facilitated by several changes in the sub-discipline. We have identified four fronts on which STS research is opening up.

- A front is opening up beyond the opposition a caricature between, on the one hand, postcolonial approaches that tend to be philosophical and literary, discussing the grand narratives, and on the other hand, STS that is more empirical, attentive to the material details of the interactions of hybrid collectives, a number of STS authors are engaged in sweeping theoretical surveys of the critical social sciences. The emergence of postcolonial STS is embodied not only in these theoretical essays on alternative forms of modernity and cosmopolitanism, but also in a series of empirical studies.
- Another front is opening up beyond the traditional disciplines of sociology, laboratory ethnography, political economy, innovation and European scientific history, STS is devoting a large place to the global history and anthropology of knowledge, including in-depth field work in the South.¹⁸ This undertaking is being "fertilized" by various critical approaches to science that go beyond *postcolonial studies*. This expansion of the discipline has helped to transform the object of postcolonial questioning.
- A third front is opening up around scientists and elites. Official "Science," the people who produce it and the technologies that spring directly from it, now form a single province of STS. New territories have opened up under the more hospitable banner of "knowledge" (Pestre 2015). This has accommodated, not only the contributions by "amateurs," but also new transversal approaches that combine traditional and modern ("scientific") knowledge (Agrawal 1995; Watson-Verran & Turnbull 1995; Verran 2002; Kleiche-Dray & Waast 2016). Research on this front is now going into the possibility of taking into fuller account different social categories, other relationships with the world and other emancipation projects: e.g., the defence of territories, opposition to major projects, medical patients' activism, alternative forms of modernity that articulate traditions to innovation e.g., in India, the Bolivian Andes, and the outskirts of large African cities.

¹⁸To some sociologists, it seems difficult to articulate "cultural criticism" with "a properly sociological approach" in STS, as a member of our team pointed out when we were preparing for our conference on the question "STS and the Global South," held on 04/08/2015.

On a fourth front, research is going beyond not only the territorialized and standardized North-South dichotomy, but also beyond a form of nominalism that recognizes only a diversity of localities. Both North and South have become largely plural categories (the neologisms *Nords* and *Suds* in French); they have been de-hierarchized and have even become partly metaphorical, in accordance with the pluralization of relations to modernity (de Sousa Santos 2014). STS is no longer limited to studying the North or even the North in the South. They can now study the North as seen from the South (in line with colonial and centre-periphery studies), the South in the North (diaspora and revivalism), and even the "South" or the category "South" as a strategic essentialism, used by the nations and groups of the South to assert their difference by means of scientific criticism.

From a methodological point of view, these contributions should encourage us to enrich our surveys in the countries of the South with more empirical material, to be more curious as to the local histories of places in which projects with a global design are deployed, and to pay more attention to the concerns of the populations targeted by our surveys and those of researchers in the countries we visit. Paying attention to both the multiple nature of power (that we know only from sites of observation that are different) and the interplay of forms of otherness, we should strive to avoid a major pitfall in the approaches of critics of globalization: oscillation between essentialization of the dominated party (in orientalism, racism, etc.) and essentialization of the dominant party, essentializing fragments instead of the whole.

Discussion of postcolonial approaches has not yet settled down (in France even less than elsewhere). The ideas proposed in this article will no doubt seem rather dishevelled to researchers who are not deeply interested in the cultural dimensions of globalization, and to those who are defending the identity and academic territory of STS. As we see it, our opening up of STS is by no means a disguised attempt to dilute this stream of thinking about social sciences. On the contrary, its aim is to enrich and revitalize the currents and disciplines that have produced most of our knowledge of "elsewhere." By questioning the "modernization front" and the categories that accompany it, starting out from a critique that includes the South, it unquestionably takes up a forceful position in the debate on the geopolitics of knowledge. It is to this debate that we wish to invite future research in STS.

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