STS Research and Nanotechnologies: Emerging Patterns of Depoliticisation and Engagement

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Introduction

Research has politics. There is little need to show that academic research is often useful to further purposes. For instance, according to Wallerstein, the concept of "development" was elaborated post World War II by the social sciences in relationship with colonialist perspectives. Ultimately, it would foster the instauration of an idea of the modern world as unique (rather than divided between modern occident and non-modern Third World) and induce the idea of progressive steps to take toward progress. In this perspective, the concept of "development" would serve the geopolitical interests of powerful nation-states, thereafter conceived as models toward which the undeveloped nations could tend. This model, promoted by the US government, was actually adopted and advertised for this very purpose by the USSR authorities (WALLERSTEIN, 2006, p. 24-26).

As an area of research that could possibly be qualified as a whole field of research, Science and Technology Studies (STS) do have politics as well. Many scholars from multiple disciplines, ranging from history and philosophy of science to political science and economics are nowadays gathered around the study of science and technology. This field is essentiellially interdisciplinary, although important disciplinary boundaries remain in practice. Its history is written in a very short-term perspective, since the theoretical foundations of the field as such were laid down back in the 1960s and until the late 1980s, when

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they reached a first level of maturity with the introduction of the Social Construction of Technology (SCOT) approach (BIJKER, HUGHES & PINCH, 1987).

Tracing roughly the key points in the history of STS (part 1) would allow a better understanding of where the field comes from. Based on those elements, we will outline the inherently political dynamics of STS. Doing so, we will underline two emerging patterns in the curse of STS: the one of depoliticisation and the one of increasing engagement (part 2). Of course, those two patterns are theoretical constructs that do overlap a great deal in reality, and are even paradoxical in many respects, although they are complementary as well and probably part of a broader overall picture of the STS field. From this departure point, we will address the case study of a particular set of technologies that have a particular and deeply intertwined history with the STS: nanotechnologies (part 3). In this part, we highlight the features of nanotechnologies and the responsive challenges addressed by these to the STS community. As a conclusion, we will see how the political dynamics of the STS as a field are crucial and relevant for the development of nanotechnologies and how deeply intertwined those concerns are, especially as regards to the issue of the governance of nanotechnologies.

1. An overview of STS history

a) An initial political commitment

The overall history of STS actually started with a strong political commitment, an academic response to the political and environmental contestations of the 1960s and 1970s. By this time, "STS" research, even not labelled as such, was ongoing in many places and different forms, such as history or philosophy of science and/or technology. The first attempts to bridge together those works under the acronym STS – that would then stand for *Science and Technology in Society* – was more characterised as a "movement" (CUTCLIFFE, MITCHAM, 2001, p. 2). Those scholars would mainly advocate social change and thus would explicitly politicize their works. The very fuel of this movement was what Cozzens called "*STS, The Problem*", that is the basic underlying assumption that, broadly speaking,

"*science and technology are in society, and that they do not sit comfortably there*" (COZZENS, 2001).

The political commitment of this period could be translated as a reaction against determinism. Sharing the common ground of a problem implies to seek for solutions to solve it. The first mandatory step was therefore to demonstrate the *possibility* of social change. This can be linked together with the broader scope of the global issues that were increasingly rising by this time. Societies would be spectator of the development of overwhelming forces, a subtle combination of stronger and stronger economics, politics, and political economy. Those forces would lead to the heart of the neo-liberal movement later on, and would be somehow symbolised by the famous "There Is No Alternative" (TINA) doctrine of Britain's Prime Minister, M. Thatcher. Science and Technology, as theorised by some representative figures of the STS movement, would be envisioned as part of this developing and expanding picture, one of those "no alternative" pictures that societies could only suffer without any possibility to interfere with, or only partly (ELLUL, 1954).

b) Deconstructing the myth of autonomous technology

Therefore, one might see the development of a critical relativism tradition as a logical step: in order to establish the possibility to change the curse of technological development, its contingency must be proved – that implies a deconstruction of the foundational myths that lies behind. Firsts STS scholars then had a grasp on critical perspectives in epistemology developed by both Popper and Kuhn (POPPER, 1963; KUHN, 1962), who marked the field with their "intellectual imprint", even if some caution is needed when it comes to the actual endorsement by those authors of, say, epistemological relativism (see RIP, 1999).

Their epistemologies were precisely developed in a critical relativist stance for most STS researchers. These would proceed to the mandatory deconstruction of such concepts as knowledge that would establish its "contingency" (BERGER & LUCKMANN, 1966; SISMONDO, 2004, pp. 51-64) and, later on, of scientific facts (LATOUR & WOOLGAR, 1979) and knowledge-driven technical artefacts. This

intrinsic contingency is one of the central tenets of nowadays' STS (HACKING, 1999).

c) From "deconstructivism" to "constructivism" onward

This stage, that could be called the "deconstructivist" stage, is actually the essential step toward the "constructivist" theories, which were built upon those epistemological bases in the 1980s onward, in a quite paradoxical fashion as regards with terminology. The *Social Construction Of Technology* (SCOT) approach was inspired by those epistemologies[2] and the developments in the sociology of knowledge, and laid down the foundations for developing one sociology of technology and technical artefacts (BIJKER, HUGHES AND PINCH, 1987). The SCOT approach would shape further attempts to understand the dynamics of technological development, such as the large sociotechnical systems (and how they "gather momentum" – HUGHES, 1987 and 1994). A powerful methodological approach was developed to combine the views of technological determinism and social constructivism, namely the Actor-Network Theory, within the framework of the sociology of translation (CALLON, 1984; LATOUR, 2005).

In the lecture that we want to suggest here, those developments constructed a better understanding of the social processes underlying the technological development that is committed to open the black box of technology. Therefore, they enabled a greater detection of what we call "social interstices", within those very sequences, whereas "society" (at large) could be involved into. At this point, two things were going on.

On the one hand, the STS (Science and Technology in Society as a movement) became a known and recognised field of science, STS (Science and Technology Studies) with its epistemologies, and inherited methodologies (from different established disciplines that together form and inform STS – the field). To turn STS into a field, scholars had to specialize themselves, develop countless

[2] One could argue that those epistemologies came to a dead end at that time with the development of the "Strong Programme in the Sociology of Knowledge" (the school of Edinburgh), and by further radicalisation of the sociology of knowledge – the anarchist statements of Feyerabend (*Against Method*).

empirical studies and dismiss some of its former political dimensions, by getting closer to academic neutrality (SCLOVE, 2001). This turn to more empirical and pragmatic approaches would be later on analysed as a quite significant shift in the curse of STS. Bijker, one of the founding fathers of the field, did not stated something else, when he concluded that the interests in STS issues were formerly politically motivated and that, nevertheless, ongoing researches were leading toward a "the highway of *institutionalized academic work*" (BIJKER, 1995, pp. 279-280 – author's italics).

On the other hand, an increasing awareness of all the concerns arose by scientific and technological developments lead to an growing pressure towards greater intervention from social scientists.

d) Participatory Democracy in Science and Technology

Policymakers and scholars then got involved in numerous "public participation" exercises, involving the laypeople and getting benefit of their "nonexpert" expertise. The seminal approach, doing so, has been the one developed within the framework of Beck's Risk Society. He clearly showed how, when it comes to risk, different kind of rationalities are at stake, bringing different set of values. In a society dominated by rational and scientific rationality, it would become necessary to confront and debate value-laden "risky" policies, to ensure their broader social acceptability (BECK, 1986).

In the same fashion, within STS, soon enough it became clear that if science and technology (the main producers of Beck's modern risks) were value-laden, then the values had to be unpacked and publicly debated. Of course, public debates already occurred back in the 1970s, for instance about the development of biotechnologies (LAURENT, 2009). Still, we argue this was more intuitively set up than the more "reflexive" participatory methods established in the 1980s and the 1990s to involve the public (at large) directly in decision-making processes (e.g. JOSS & BELLUCCI, 2002). Those processes would rely on the deliberative ethics theorised, among others, by Habermas (the truth is saw as the consensus emerging from an "ideal speech situation" – HABERMAS, 1984, p. 49).

Anyway, these participatory approaches, reflected by qualitative methodologies and research design – such as focus groups, Delphi methods, science shops or, say, consensus conferences – proved to be somehow limited. Sometimes, the framework of the participation was often the one of the "deficit model" and the social scientist would be solely committed to the public acceptance of the innovation. According to this model, the public needs to be engaged because of its ignorance and what it does not understand is driven straight from what it doesn't know. If well informed, then it will accept further new technological developments. (WYNNE, 2006). Sometimes, despite a very fruitful and meaningful intervention, further steps would be missing to actually incorporate the outcomes of such public participation exercises within the research and development (R&D) processes itself (MACNAGHTEN & al., 2005).

In line with what we stated in the introduction, these new approaches do matter. They correspond to a more normative stage, in which it is supposed and – at least implicitly assumed – that a public debate actually need to be held or that broader societal concerns have to somehow catch up with the scientific and technological developments.

2. Emerging Patterns in Politics of STS

The STS began as a movement, and its initial perspectives were inherently political, though it remained "passive". Whereas scholars were politically engaged, they would use the traditional research tools inherited from classic disciplines such as history, philosophy or sociology. The common standpoint was the recognition of a "Problem" in the way science and technology were interfering with society. Although the acknowledgment of this problem was a political statement in itself, it needed to be theorised by "neutral" research tools. The research activity was then progressively undertook in parallel with explicit, but distinct, political commitment and activities.

Popper and Kuhn's epistemologies provided the most adequate background to deconstruct the social dimensions of the institutions of science & technology. Those epistemological grounds were political as such, and one could argue that fellow scholars relied on them on the sole purpose of creating capacities to open

the scientific and technological black box. This was a first step toward more engaged research methodologies, although the former authors within the STS field were actually creating what would become an institutionalised research field. Still, this stage of "engagement" was implicit; the politics of STS would underline the analytical perspectives on new epistemologies, rather than positively interfering with the technologies themselves.

From this critical relativism perspective, attempts were made to positively understand the dynamics of the development of new technologies in society. It was the foundational SCOT approach and its further evolution, the theory of large sociotechnical systems or the actor-network theory. Those new understandings of the innovation processes would leave room for doing things differently. Therefore, a somehow normative content could be supplied through the innovation chain, and provide the overall process of technological development with social insights. This was the aim of all the public participation exercises vastly undertook during the 1990s onward. This can be analyzed as a shift from the somehow 'passive' deconstruction (simple analysis) to a rather 'active' construction, with the explicit will to bring actual outcomes in the decision-making process with regards to new technologies. According to Bijker, his trend is globally embedded in the path toward what he calls "policy studies" in science & technology, which explicitly aim at informing the decision-making process (BIJKER, 1995).

But, at the same time, as Feenberg puts in, "*Where the old determinism overestimated the independent impact of the artifactual on the social work, the new approach* [namely, the SCOT or constructivist approach] *has so disaggregated the question of technology as to deprive it of philosophical significance. It has become matter for specialized research*" (FEENBERG, 1999, p. 12). So, the contrasted trend is as follows: the more engaged the STS research became (with the normative statement underlying public engagement), the more specialised and institutionalised it would become. This trend would undoubtedly take over the former commitments at the beginning of the field, more politically motivated and essentially oriented toward education (RIP, 1999). Therefore, it would loose the meaning of the overall S&T picture at some point.

On the basis of those elements, we now outline two patterns of shifts in politics of STS research that we will illustrate with the case of nanotechnologies. One the one hand, the STS research follows a depoliticisation path, which is the one of (over) specialisation. The more STS research get involved into deeper and deeper detailed account about technologies, the less it is able to grasp the meanings and the politics that occur at a broader level (this statement is shared among many scholars, see SCLOVE, 2001 or FEENBERG, 1999).

On the other hand, a very powerful force is struggling about this trend, which is the increasing willingness manifested by STS scholars to engage the R&D process and to provoke shifts in the technological development. One of the central tenets of STS assumes that science and technology do matter to societies, do have politics (following the seminal paper from WINNER, 1985). At some point, this statement legitimizes (if not encourages) a push forward influencing these ongoing processes of social change. This increasing engagement draws on the passive 'critical' deconstruction, and the possibility of a somehow 'different construction'. In this perspective, SCOT, LTS or ANT approaches all have underlying politics, yet implicit: to unpack the processes by which a technology is developed so that one could provide to it insights that would better reflect societal concerns. Explicit normative content was brought up later on in the development of the field, with the idea to organize public participation and debates about the value-laden scientific and technologic development, in order to inform / influence / shape the political decision-making process. In that sense, public participation exercises were yet more politicized. There was an explicit intervention of STS scholars in order to provide outcomes in the innovation development, in a more engaged fashion. Those happened to be more and more sophisticated in order to actually integrate the R&D process, especially through technology assessment practices (e.g. RTTA – GUSTON & SAREWITZ, 2002; CTA – SCOTT & RIP, 1997). So, this push forward more and more effective engagement occurs within the framework of an increasing engagement of STS research.

We shall address now the specific issue of nanotechnologies. At the heart of our argument here lies the chronological proximity between the development of

nanotechnologies and the one of Science & Technology Studies as a field of research.

3. Nanotechnologies: responding tomorrow's uncertainties

In this part, we will provide a few clues about what nanotechnologies are and how they are framed in terms of public policies. We then briefly give an account of their controversial history and political context. Then, we address the connections between their developments, from an STS perspective, and how that does relate with STS developments themselves.

a) From "Nanotechnology" to "Nanotechnologies"

Nanotechnologies are an interesting case both for the STS community and for an informed reflection upon STS discipline as such and its political *ethos*. Roughly, almost none human being could get a glimpse of the overall research ongoing under the label "nanotechnologies". Formerly called "nanotechnology", the term generally evolved toward the plural form, acknowledging the existence of a "plurality of nanotechnologies" (BARBEN & al., 2008). Furthermore, I state that this small semantic shift actually reflects way more than just a question of singular or plural. It reflects upon deeper uncertainties and complexities that arose in the nanotechnologies case.

Roughly, nanotechnologies are related with all the materials, devices and systems located at the nanoscale, that is one billionth of a meter. To detect (1981) and manipulate (1989) atoms at this infinitely tiny scale was made possible by the development of a very precise technological instrument, the STM (scanning tunnelling microscope). The interesting potential of nanotechnologies lies in the radically new properties of the matter at this scale. The promises are numerous: medical breakthroughs (nanosensors that could "smell", seek and destroy cancer cells, enhancing aged cells to have a better diagnosis of, and ultimately prevent, Alzheimer's disease), cheap and clean energy, water-cleaning

processes, or a global reduction of pollution by the reduction of raw materials needed for production, etc.[3].

The interest of policymakers in the development of "nanotechnology" came first from Senator Al Gore's *Science for National Interest*, a report released in 1994. Following this, strategic plans were adopted in order to launch nanotechnology programs and no to be distanced by other "technological zones" (BARRY, 2006). The Japan Government has been involved in this crucial issue since 1992 (*Atom Technology Project*), but the first massive public investment initiative originated from the USA, with the *National Nanotechnology Initiative* launched in 2001. This program was granted $ 300 millions, growing every year until it reaches a provision of $ 1,6 billion for 2010[4]. The European Union funds nanoscience and nanotechnology through its "*Nanosciences and nanotechnologies: an Action Plan for Europe 2005-2009*", with a public budget of about € 3 billions[5]. Nanotechnologies take benefit of important investments from public authorities.

There are three particularities about the development of nanotechnologies that we should mention in this account, in order to show how complex and controversial is nanotechnologies' development and how intertwined they are with the history of the STS.

b) The History of a Divide

Basically, the history of the nanotechnologies is the history of a deep divide between two sides (for an account "from the within" the community of nanotechnologists about this divide, see e.g. JOACHIM & PLÉVERT, 2008). The first side includes the partisans of the "bottom up" approach, which consists in the construction of a new molecule from the scratch. They would envision their research as mostly fundamental and believed that this approach (building

[3] http://www.nano.gov/html/facts/nanoapplicationsandproducts.html (last visited 8 January 2010).

[4] http://www.nano.gov/NNI_2010_budget_supplement.pdf (last visited 24 September 2009).

[5] See European Commission, "EU Policy for Nanosciences and Nanotechnology", http://ec.europa.eu/nanotechnology/policies_en.html (last visited 24 September 2009).

molecules atom by atom) would provide humanity with a greater understanding of the matter and huge savings in the use of raw materials. One of those advocates of the "bottom up" approach was Erik Drexler, a leading scholar in the field of nanotechnologies, author of *Engines of Creation. The Coming Era of Nanotechnology*. This book was popularised through the popular fear of the "Grey Goo" scenario (self-replicating molecules that would autonomously proceed to their own replication, turning everything into "grey goo" and eventually destroying the whole world). This somehow dystopian view (although very anecdotic in Drexler's overall positive appreciation of nanotechnology) happened to cause the public dismissal not only of Drexler's theories (the Grey Goo) but also of Drexler himself (RIP & VON AMEROM, 2009). This public dismissal was actually undertaken by the actors who became the mainstreaming representatives of the second side, who advocated a more "top-down" approach of nanotechnology. The key idea there was to carry on with further miniaturisation of transistors and already known devices to a point where those artefacts would *de facto* reach the nanoscale. This was closer from industries' capacities and perspectives for a better-ensured return on investment. This view of technology was the one promoted and advertised by the US' *National Nanotechnology Initiative* (2001). So, the (short) history of nanotechnologies is primarily the one of a divide, of a mainstreaming controversy (SHEW, 2008). That does make sense as the outcomes of the R&D processes for nanotechnology are yet far unknown and actually unlikely to be fully knowledgeable.

Since nanotechnologies are totally out of reach for common human senses, they absolutely need to be mediated through the use of a dedicated instrument, the STM – which makes them very inherently rooted with uncertainties and makes it hard for laypeople to have a grasp on what actually are and means "nanotechnologies". This happens especially at an early stage of development – called "upstream" – whereas people have no clue of the emerging patterns and dynamics of the new technology.

c) A Context of Controversies: the Nano-phobia-phobia

Typical of the development of nanotechnologies is the existence of various and multiple controversies in the public sphere, or to be more precise, the expectation of such controversies by both policymakers and nanotechnologists. This is clearly related to the case of biotechnologies, whereas strong public controversies happened, especially about GMOs. So, from the very beginning, numerous actors claimed for lessons to be learned, from the biotechnologies development to the nanotechnologies one (DAVID & THOMPSON, 2008). Combined with the popularisation of dystopian imaginaries (as in Michael Crichton's Prey), this eventually lead to a fear of controversy and a political willingness to prevent them by any means, causing a phenomenon that Rip coined as a "nano-phobia-phobia" (RIP, 2006).

d) Nanotechnologies and STS

Built on the two previous points, a third interesting element must be outlined as for the development of nanotechnologies; it was – and still is – deeply intertwined with the history of STS and its contrasted trends that we described in the second part of this paper.

A first statement that we make consists in linking up the respective developments of nanotechnologies and STS, from a simple chronological perspective. The capacity to manipulate the atom at the nanoscale was made available by the end of the 1980s, at a time the SCOT approach was just released. From there, the constructivist viewpoint would be widely used and popularised as the main paradigm in STS. On its side, nanotechnologies would become "the next industrial revolution" (US, *National Nanotechnology Initiative*, 2001) and fulfilled with promises and expectations. An almost exactly concomitant "yuck" followed this "wow" hype. It was the consequence of an instantaneous deconstruction of the advertised myth of nanotechnologies by STS scholars (RIP, 2006). In this respect, different elements – previously mentioned – point out to which extend nanotechnologies were taken very seriously by the forming STS community, from the scratch: let us mention the different elements that shape an early "history of nanotechnologies", let alone the general context of "nanophobia-

phobia", which heavily relies on the STS literature and previous technological controversies, as GMOs.

We reach here our second point: nanotechnologies were deeply studied through the empirical methodologies driven from the SCOT approach, and in that respect they accompanied the dynamic of institutionalisation of the academic field of STS. For instance, as we shall see later on, the amazing amount of work achieved with regards to nanotechnologies points out has not made it easier to think as such, let alone reflect upon, the large political stakes raised by nanotechnologies. Too many uncertainties tied with the nanoscale and the hardly unforeseeable status of tomorrow's nanotechnologies make it yet harder to define a shared political account about them. This context of institutionalisation can be traced along manifold piece evidence. Important research projects as regards to societal concerns of nanotechnologies were funded (e.g. the project DEEPEN at Durham University, EU); dedicated research centres were set up (e.g. the Center for Nanotechnology in Society, at Arizona State University and University of South Carolina, US); specific publications were dedicated to the study of societal issues of nanotechnologies (e.g. Nanoethics, Springer, NL); some volumes focused on the sole question of nanotechnologies, either through a series of Yearbook on their own (Yearbook of Nanotechnology in Society, CNS-ASU) or through specific issues (e.g. the 27th Yearbook of Sociology of Science, entitled *Governing Future Technologies. Nanotechnology and the Rise of an Assessment Regime*); furthermore, these initiatives somehow resulted in the recent creation of a specific scientific society, the S.NET (Society for the study of Nanosciences and Emerging Technologies). All those elements concurred with, and participated in, a dynamic of institutionalisation made of ever-deepening specialisation. For that reason, it became harder to entertain the politics of the object "nanotechnologies" as such, and this situation therefore drove to a depoliticisation of STS research.

Therefore, there are two consequences. First, nanotechnologies were envisioned from the scratch as the next very important technological development, especially since it would "by nature" promote the convergence of emerging technologies (the missing link to NBIC – Nano-Bio-Info-Cogno- convergence – see

ROCO & BAINBRIDGE, 2003). The STS community would therefore make a strong commitment to interfere in the R&D process of nanotechnologies, and to enhance their inclusiveness of social concerns. Nanotechnologies were a unique opportunity to take on. Second, it happened for the first time in a context whereas the SCOT approach was more or less dominating the field. There were theoretical possibilities to enhance the development of nanotechnologies by making them more "social", which was obviously requiring (if this program of action was to be pursued) sort of a normative position from the STS community (on *how* to make them socially resilient). The pragmatic limitations of deliberative action and public participation exercises were then outlined by the abundant literature published, for instance, within the framework of the Human Genome Project (HGP), and its few actual outcomes by comparison with the huge scale of the research projects (FISHER, 2005). Thus, there was a need to foster new models of governance for nanotechnologies, built upon previous experiences and with a strong external push forward effectiveness, as I should mention below. In our view, those commitments led to a increasingly engaged perspective of many scholars, determined to induce actual social changes in the curse of developing nanotechnologies.

Conclusions

Recent STS developments carry on with further developments along this double and somehow contradictory pattern. First of all, external pressures and policy mandates call for "responsible innovation[6]" and urge social scientists to take an active part in the governance of new technologies. This is currently redefining the work and responsibilities of social scientists (see BARBEN & al., 2008 and MACNAGHTEN & al. 2005). Secondly, there is an increasing need to come back to the broader picture and politics that surround the development of emerging technologies, especially nanotechnologies (see Bernadette BENSAUDE-VINCENT keynote address, the S.NET Conference, Seattle, WA, September 8, 2009). This statement actually refers to the long-acknowledged need for establishing a

[6] See for instance the US *21st Century Nanotechnology Act* of 2003.

common ground, both ideological and methodological, in the STS field, a one that would allow authentic interdisciplinarity (COZZENS, 2001).

As a conclusion, two main tendencies are animating STS and its politics: the one of depoliticization and the one of engagement. This might sound contradictory but we want to stress that it is not. What is happening there is a displacement of politics within the STS research, from the macro-political perspective to the micro-political perspective. Through engaged empiricism of STS research, micro facts and artefacts are more and more loaded with their own particular and context-dependent politics. At some point, this detailed approach prevents the restitution of a widely shared common ground, which could consist in a renewed political *ethos* when it comes to nanotechnologies.

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