Diving in magma: how to explore controversies with actor-network theory

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The cartography of controversies is a set of techniques to explore and visualize issues. It was developed by Bruno Latour as a didactic version of Actor-Network Theory to train college students in the investigation of contemporary socio-technical debate. The scope and interest of such cartography, however, exceed its didactic origin. Adopted and developed in several universities in Europe and the US, the cartography of controversies is today a full research method, though, unfortunately, not a much documented one. To fill this lack of documentation, we draw on our experience as Latour's teaching assistant, to introduce some of the main techniques of the social cartographer toolkit. In particular, in these pages we will focus on exploration, leaving the discussion of visualization tools to a further paper.

1. Warning: the cartography of controversies will not make your life easier

The cartography of controversies is the exercise of crafting devices to observe and describe social debate especially, but not exclusively, around technoscientific issues. It was initiated by Bruno Latour[1] at the *École des Mines de Paris* some twelve years ago and it is currently taught in several European and American universities.[2] Recently, the cartography of controversies has also become the object of the EU funded consortium MACOSPOL (MApping COntroversies on Science for POLitics), which gathers together eight European universities and research centers.[3]

Since its introduction, the cartography of controversies has someway served as an educational version of Actor-Network Theory (ANT). Like ANT, it is a method "to live, to know, and to practice in the complexities of tension" (Law and Hassard, 1999: 12). Unlike ANT, it avoids conceptual complications and is thereby more accessible to students. With some approximation, we can describe the cartography of controversies as the practice of ANT unburdened of all theoretical subtleties.[4] As such, the cartography of controversies may appeal to those who are intrigued by ANT, but wish to stay clear from conceptual troubles.

At first, the cartography of controversies seems to fall into line with these expectations. During his lessons, when asked to spell out the instructions of his cartography, Bruno Latour

answers with a nonchalant shrug: "just look at controversies and tell what you see." Such slick definition is often received with some skepticism and not without reasons. If Latour's cartography is nothing more than "observing and describing," it's not just actor-network theory that is put aside, but pretty much *any* social theory as well as *any* social methodology. Indeed, as suspect as this may sound, controversies mapping entails no conceptual assumptions and requires no methodological protocols. There are no definitions to learn; no premises to honor; no hypothesis to demonstrate; no procedure to follow; no correlations to establish.[5] Like zoo-born animals released in the wild, students entering cartographic projects report bewilderment and euphoria.

Euphoria, however, is not to last long. Despite (or rather *because of*) its theoretical and methodological minimalism, the cartography of controversies is no piece of cake. Far from being a simplified version of ANT, the cartography of controversies turns out to be every bit as thorny and intricate.[6] What seems to be, in theory, the simplest assignment ends up being, in practice, the hardest exercise. "Just observe and describe controversies"—nothing easier, except for two little problems: "just" and "controversies."

Those looking for some ready-to-apply research guidelines will be disappointed. The combination of "just" and "controversies" makes social cartography as complex as ANT. That's why we chose to begin this paper with a warning: unlike most research techniques, the cartography of controversies has never meant to facilitate investigation, but to make it slower and harder. Between the parenthesis of "just" and "controversies," the easiest operations (such as observing and describing) become the most troublesome. Documenting social controversies, we have little to offer other than a long list of difficulties—so long, in fact, that we decided to break it into two articles. In the following pages, we will show how "just" and "controversy" turn the simplest *observation* into a huge problem. In a further paper, we will focus on *descriptions* showing how the cartography of controversies makes them awfully difficult.

To be sure, the distinction we draw between observing and describing is largely artificial. It is just for the sake of clarity that we are going to separate two dimensions which are in fact seamlessly entwined. Yet, the distinction is worth maintaining in order not to confuse the task of *deploying the complexity* of controversies (this article) with the task of *ordering the complexity* of controversies (next article).

2. The three meanings of "just"

When Bruno Latour instructs his students to "just observe" collective life, he doesn't mean "just" as mere emphasis. As often happens in Latour's discourse, the smallest word carries here the greatest meaning. In this case, a simple adverb implies at least *three major consequences* for the practice of social sciences.

The first consequence of "just" is that, as we said in the introduction, social cartography does not require any specific theory or methodology.[7] This claim needs to be explained: "just observe" does not mean that researchers are forbidden to employ pre-established theories and methodologies. On the contrary, not imposing any specific philosophy or procedures, the cartography of controversies invites scholars to use every observation tool at hand, as well as mixing them without restraint. At least at the beginning of their explorations, cartographers should make any effort to remain as open as possible. Surprise and curiosity should inspire their notions and protocols more than the other way around.[8]

The second consequence of "just" is that researchers cannot pretend to be impartial just because they comply with some theoretical or methodological guideline. According to the

cartography of controversies, research perspectives are never unbiased. Some viewpoints may offer a wider or clearer panorama on social landscapes, but no observation can escape its origin. Objectivity can be pursued only by multiplying the points of observation. The more numerous and partial are the perspectives from which a phenomenon is considered, the more objective and impartial will be its observation.[9] That's why the cartography of controversies refuses to engage with any single philosophy or protocol and encourages instead theoretical and methodological promiscuity.

The third consequence of "just" is that researchers are obliged to reconsider their attitude toward their subjects of study. The cartography of controversies entails the idea that participants to social phenomena may be as informed as investigators. After all, actors are constantly immersed in the issues that scholars contemplate for a limited time and from an external viewpoint. Neglecting actors' observations and ideas just because they are not based on scientific theory or methodology is arrogant at best.[10] Social cartographers must have the greatest respect for the actors they observe.[11] They should be humble enough to recognize that when it comes to religion, there are no greater experts than the believers themselves; that when it comes to art, no one knows more than artists, critics, merchants, museum directors; that when it comes to disease, doctors, caregivers, patients and microbes are far more experienced than sociologists.

Let's recapitulate the three consequences of "just," as they constitute the three commandments of observation according to the cartography of controversies:

1) you shall not restrain your observation to any single theory or methodology;
2) you shall observe from as many viewpoints as possible;
3) you shall listen to actors' voices more than to your own presumptions.

Bearing in mind the three meanings of "just" should also prevent scholars from misreading Latour's recommendation. "Just observing" has nothing to do with the myth of unmediated observation. Deprived of the protection of concepts and protocols, observation does not get any purer. On the contrary, it opens to all sorts of interferences and impurities. Far from being a clear substance distilled from collective chaos, scientific knowledge is the result of as many contaminations as possible.[12] Such is the lesson of "just": *observation devices are the more valuable, the more they let those who are observed interfere with those who observe*.[13]

Readers should begin to grasp why the conceptual and procedural minimalism of the cartography of controversies will not make their life easier. If Latour glued "just" to "observe," it was to prevent students from reducing investigation to single theory or methodology. In the cartography of controversies, all concepts and all protocols deserve consideration, especially if they come from actors themselves. All shortcuts declined, observation is compelled to be as rich and complex as its subjects.

3. What's in a controversy?

Controversies are certainly and by far the most complex phenomena to be observed in collective life. In Macospol documentation, controversies are defined as such:

> The word "controversy" refers here to every bit of science and technology which is not yet stabilized, closed or "black boxed" ... we use it as a general term to describe *shared uncertainty*. (Macospol, 2007: 6, emphasis in original)

Leaving aside the reference to science and technology (which will be discussed later), the definition of controversy is pretty straightforward: *controversies are situations where actors disagree* (or better, agree on their disagreement). The notion of disagreement is to be taken in the widest sense: controversies begin when actors discover that they cannot ignore each other and controversies end when actors manage to work out a solid compromise to live together. Anything between these two extremes can be called a controversy.[14]

Consider, for instance, the controversy on global warming. It all started as a specialized dispute among climatologists and in a few decades it grew to involve a huge number of scientific disciplines, industrial lobbies, international institutions, social movements, ecosystems, natural species, biological networks, geophysical and atmospheric phenomena. A few years ago no one would have seen the connection between cars and glaciers. Today we know that they may be opposed on the climatic chessboard, as well as air conditioning and polar bears, sea levels and economical growth, airplanes and crops. A seemingly simple question on earth temperature ("is it increasing?") engendered a huge snowball of issues: how should temperature be measured? Are variations exceptional? What are the causes of warming? What are the consequences of climate change? Should we worry about temperature increase? Can we slow down or invert the temperature trend? Should we invest in mitigating the effects of global warming or in adapting to them?

Not all disputes are as dynamic as the one on global warming and few ever reach the same worldwide audience. Yet, some of the features of the climate change debate are common to all social controversies.

1) *Controversies involve all kind of actors*, not only human beings and human groups, but also natural and biological elements, industrial and artistic products, economic and other institutions, scientific and technical artifacts and so on and so forth. To be sure, this is not to say that all actors are equals or that they all act in the same way. Migrating butterflies and hydrogen vehicles inhabit utterly incommensurable worlds and yet, in the dispute on global warming, they may end up sharing the same battle front. Controversies are the place where the most heterogeneous relationships are formed.[15] Economic assets of biodiversity, CO_2 international quota, intergovernmental scientific panels—the debate on global warming develops through the relentless invention of new chimeras. Every controversy functions as a "hybrid forum," a space of conflict and negotiation among actors that would otherwise happily ignore each other.[16] After all, where else could coral reefs and recycling factories meet if not in the global warming debate?

2) *Controversies display the social in its most dynamic form*. Not only new and surprising alliances emerge among the most diverse entities, but social unities that seemed indissoluble suddenly break into a plurality of conflicting pieces. While butterflies and hydrogen find themselves unexpectedly enrolled under the same coalition, apparently stable and definite entities, such as the "continental climate" or the "internal combustion engine," explode under the pressure of internal oppositions. In controversies, no natural or technical assembly can be taken for granted. Consider airplanes. In the last fifty years, we all got used to considering jet engines as an obvious component of modern aircraft. We could discuss low-cost business models, air routes' sustainability, train vs. airplane expansion, but we all agreed that modern airplanes have jet engines. Today, under the pressure of carbon footprint awareness, more and more manufacturers are retrieving ancient propellers as eco-friendlier alternatives. The global warming controversy has developed all the way down to the very black box of airplane engineering. Consider any controversy and you will have a clear illustration of the meaning of the hyphen in Actor-Network Theory. In controversies, any actor can decompose in a loose

network and any network, not matter how heterogeneous, can coagulate to function as an actor.[17]

3) *Controversies are reduction-resistant*. Disputes are, by definition, situations where old simplifications are rejected and new simplifications are still to be accepted or imposed. In controversies, actors tend to disagree on pretty much anything, including their disagreement itself. That's why issues are so difficult to solve, because they are impossible to reduce to a single resuming question. Ask an easy question such as "is world temperature increasing?" and actors will immediately start arguing about what *world* means (some area of the world? The world average? The surface or the atmosphere? Urban, rural or wild areas?), about what *temperature* means (how is temperature measured? Which instruments are used? Which temperature scale is to be considered?) and about what *increasing* means (is temperature augmenting or fluctuating? On which time scale should variation be evaluated? Can past trends suggest present and future evolution?). The difficulty of controversy is not that actors disagree on answers, but that they cannot even agree on questions.

4) *Controversies are debated*. Controversies emerge when things and ideas that were taken for granted start to be questioned and discussed. Before the disputes on pollution and on global warming, few people considered economic growth as something worth discussing. There might have been distinctions on *how* to foster economic growth, but everyone more or less agreed on its desirability (at least in Western countries). Today, we have hundreds of opposing definitions of *what* economic growth is and we are even beginning to wonder if we shouldn't *de*-grow instead.[18] What is most amazing is that the same happens for what we are used to considering as natural phenomena. A few years ago, no one thought that sea levels could be the object of a public debate. Today we know that we cannot quarrel on economic growth without quarreling on oceanic growth as well. Controversies are discussions (even if not always verbal ones) where more and more objects are discussed by more and more actors. Who, before global warming, ever thought that Inuit communities or polar bears may have opinions on industrial strategies? Today we know that they have and that they should be listened to.

5) *Controversies are conflicts*. Even though some controversies never reach the intensity of open fights,[19] the construction of a shared universe is often accompanied by the clash of conflicting worlds. This is why, for instance, the assessment of climate change cannot be left to climatologists alone. National economies and industrial sectors may rise or fall according to how temperature is measured, biological species may proliferate or extinguish and indigenous cultures may be revived or wiped away. Not all controversies concern vital issues. Still, no matter how trivial their objects may be, actors always take quarrels very seriously, for they know that social order and social hierarchy are at stake.[20] Controversies decide and are decided by the distribution of power. Actors are not born equals in controversies: Arctic seals and political leaders were both concerned by the Bali climate conference, but the second were probably slightly more influential. Controversies are struggles to conserve or reverse social inequalities. They might be negotiated through democratic procedures, but often they involve force and violence.

In a few words, when you look for controversies, search where collective life gets most complex: where the largest and most diverse assortment of actors is involved; where alliances and opposition transform recklessly; where nothing is as simple as it seems; where everyone is shouting and quarreling; where conflicts grow harshest. There, you will find the object of the cartography of controversies.

Readers should now fully understand why we said that "just" and "controversy" make observation impossibly difficult. Social cartographers are asked to face the highest complexity (*controversies*) without the slightest simplification (*just*). "Just observing a controversy" is like wandering in a maze with a twine of threads to follow.

4. The magmatic flow of collective life

After all we said about the complexity of "social controversies" and the non-simplification of "just observing," readers may be tempted to drop this paper and the cartography of controversies. It is a legitimate feeling. Like Pinocchio's talking cricket, Latour's cartography doesn't promise anything other than complications and difficulties. To the scholar drowning in the quicksand of social complexity, the cartography of controversies refuses any handrail and recommends swimming. No wonder that readers felt somewhat unmotivated to dive in. Still, before smashing the cricket, let us provide a couple of reasons to consider complexity under a less gloomy light.

In the first place, *if the cartography of controversies is complex, it is because collective life itself is complex.* Have you ever tried to start a rock band? To organize a chess tournament? To set up a bird-watching association? To share a flat or a car? If you have (or if you have participated in any other collective action), you learned that coordination can be difficult. Collective situations are always intricate and the more actors are concerned, the more intricate they can get. It is not the cartography of controversies which complicates something simple; it is the other sociological approaches which simplify something complex.[21]

Be careful though. We are not saying that social life is inexorably chaotic and therefore impossible to interpret. Nor are we saying that complexity is such that no stability, order and organization are possible. Despite all its twists and turns, collective existence does have a sense (even if not straightforward, unique or simple). Actors are constantly striving to reduce the complexity of their interactions. After all, bands are formed, tournaments arranged, associations founded and things shared. Simplifications are possible. Yet, every collective simplification needs work to be built and maintained. Consider the most unsophisticated of social distinctions: the opposition between the inside and the outside of a group. From social insects to modern societies, enormous amounts of resources are constantly mobilized to preserve such boundaries. People and objects devote their existence to giving sense to in/out distinctions—ask prison guards, doormen, bouncers, walls, fences, barriers. We will return to this question in our next paper. For the moment let's just say that if social cartography requires hard work, it is because social life itself is made through hard work.

In the second place, although thorny and intricate, controversies remain the best available occasions to observe the social world and its *making*. For reasons that will become clear in our following article, the cartography of controversies is utterly constructivist. According to this approach, nothing can attain a collective existence without being the result of collective work and controversies are the settings where this work is more visible. Imagine being interested in understanding a constructive technique, for example, how to bake a cake. Knowing the ingredients would be certainly useful as well as tasting the cake. Still neither the ingredients nor the final cake are enough to unveil its preparation. To learn how to bake a cake, you will have to step into the kitchen and observe the cooking *in action*. Even so, if cooks work at full speed without explaining what they are doing, you will have a hard time understanding what's going on. However, if cooks start disagreeing on quantities, disputing the order of operations, quarreling about the cooking time, there you can start to learn something. The

same thing is true for collective life. To understand how social phenomena are built it is not enough to observe the actors alone nor is it enough to observe social networks once they are stabilized. What should be observed are the actors-networks—that is to say, the fleeting configurations where actors are renegotiating the ties of old networks and the emergence of new networks is redefining the identity of actors.

Controversies are complex because they are the crucible where collective life is melted and forged: they are the social at its *magmatic* state. As the rock in magma,[22] the social in controversies is both liquid and solid at the same time. But there's more to this metaphor: in magma solid and liquid states exist in a ceaseless mutual transformation; while, at the margins of the flow, the lava cools down and crystallizes, some other solid rock touched by the heat of the flow melts and becomes part of the stream. The same fluctuation between different states of solidity can be observed in controversies.[23] Through this dynamic the social is unremittingly constructed, deconstructed and reconstructed. This is the social in action and that's why we have no other choice than diving in magma.

5. Choosing a good controversy

Although every collective phenomenon can be observed as a controversy, not every controversy makes a good object of study. Unfortunately, there are no exact instructions on how to choose a good controversy—all that we can provide are some recommendations to avoid bad ones:

1) Avoid cold controversies. As we said, we may want to call controversy anything between reciprocal indifference and full harmony. Still controversies are best observed when they reach the peak of their overheating. If there is no debate or the debate is lethargic, if all actors agree on the main questions and are willing to negotiate on the minor, then there is no authentic controversy and the resulting cartography will be either boring or partial. Good controversies are always "hot": they may involve a limited number of actors, but there must be some action going on.

2) Avoid past controversies. Issues should be studied when they are both salient and unresolved. Once an agreement has been reached, a solution has been imposed or the discussion has been closed in some other way, controversies lose rapidly all their interest. Past issues can be investigated only if observation can be moved back to the moment when the controversy was being played out.

3) Avoid boundless controversies. Controversies are complex and, if they are lively and open, they tend to become more and more complex as they mobilize new actors and issues. When selecting your study case, be realistic and resource-aware. Mapping huge debates, such as global warming or genetically modified organisms,[24] requires huge amounts of time and work. As a general rule, the more a controversy is restricted to a specific subject, the easier will be its analysis.

4) Avoid underground controversies. For a controversy to be observable, it has to be, partially at least, open to public debates. Confidential or classified issues as well as sectarian or Masonic groups expose social cartography to the risk of drifting towards conspiracy theories. The problem is not that few actors are involved in these controversies, but that these actors have a secretive attitude. The cartography of controversies was developed to map public space and it performs poorly when applied to underground topics.

After this list of negative recommendations there is, at least, one positive suggestion: favor controversies concerning scientific or technical issues.[25] Accounting for this preference would require a long detour into ANT that we prefer not to take in this article.[26] Let's just say that the cartography of controversies was developed largely because of the increasing difficulty in separating science and technology from the other social domains. Consider the major controversies troubling modern societies: the imbalances of industrialization, the depletion of natural resources, the ecological crisis, the bioethical dilemmas and so on. All these disputes spin around technoscientific issues, blurring the border between science and politics, culture and technology, morals and economy.

The cartography of controversies was conceived as a toolkit to cope with this increasing hybridization, as an effort to follow disputes when they cut across disciplinary boundaries. Social cartographers must be ready to push their investigation far beyond the limits of sociology and not only towards the neighboring human sciences, but also towards the much further domains of natural sciences. Questioning the stem cell debate, for instance, sociologists cannot avoid biological and medical issues. Which diseases can be cured with stem cell treatments; how is research on stem cells funded and organized; whether stem cells can be extracted from adult tissues; what is the stock availability of stem cells—far from being technical minutiae, these questions lie at the core of the controversy. If they want to grasp modern debates, cartographers have no choice but to dive into the technoscientific details.

This painstaking attention to technicalities is often believed to be the main difficulty of the cartography of controversies. This is seldom the case. As strange as this may seem, the didactics of social cartography have repeatedly proved that the more technical a controversy is the easier will be its observation. Several reasons account for this apparent paradox: scientific issues are generally more restricted, better documented and more openly and tidily discussed. Even scientific formalism, once mastered, becomes a help much more than an obstacle. That is why we recommend choosing controversies which are directly centered on science and technology. As there is no way to avoid technoscientific complications, scholars may as well focus their investigation on them.

6. Five observation lenses

After choosing a controversy, scholars can start their observation campaign. Once again, the priority given to observation should not be misread. As we have already explained, observation in social cartography is never a quest for the ultimate holistic viewpoint. Far from seeking a purified vision, the cartography of controversies is always interested in multiplying interferences and contaminations. To help scholars in switching their perspectives, a number of observation lenses have been crafted through the years of teaching. Like the interchangeable lenses of a camera or a microscope, these lenses are prompts for observation much more than methodological guidelines. Their aim is not to tell us what to observe, but to focus our vision on different layers of our controversy. As such, they are neither mandatory nor exhaustive—they just remind us that a thorough observation is impossible without the superimposition of a variety of layers:[27]

1) *From statements to literatures*. When approaching any controversy, the first impression is usually that of a chaotic nebula of competing statements. Let's consider, for instance, the debate on genetically modified organisms. Such a dispute illustrates how controversies can function as generators of discussions for, when it comes to GMOs, there is virtually

nothing on which actors agree. Every new statement, no matter how marginal or technical, generates an avalanche of replies and discussions. A monarch butterfly (not) flapping its wings in Ithaca can *literally* set off tornadoes all over the world.[28] Considering GMOs' controversies, we leave the steadfast terrain of established beliefs and we are confronted with a magmatic battlefield where nothing can be given for sure without raising a storm of negations and alternatives. Identifying the full extent of the controversial arena, however, is only a first step in social cartography. While acknowledging the chaotic nature of controversies, cartographers must also recognize the existence of a thick mesh of relations among the statements circulating in a dispute. An assertion such as "GMOs should not be tested in open-field" is not an isolated claim, but the center of a wide net of statements concerning cross-pollination, genetic pollution, biodiversity, the precautionary principle and so on and so forth. The first task of social cartography is to map this web of references, revealing how dispersed discourses are woven into articulated literatures. Thanks to bibliographic and scientometric tools, these textual structures are particularly easy to trace in science and technology.[29] Nevertheless, literatures exist in every social domain and animate every collective debate.[30] To be sure, actual literatures have nothing to do with the tidy and well-organized images often provided by manuals and anthologies. Especially when they concern controversial issues, literatures are as dynamic and disputed as controversies themselves. Yet they constitute a first level of articulation that social cartography must be able to highlight.

2) *From literature to actors*. Following the webs of relations surrounding controversial statements, social cartographers are inevitably brought to consider connections that spread beyond the textual universe. Statements are always part of larger networks comprising human beings, technical objects, natural organisms, metaphysical entities and so on. In ANT and in the cartography of controversies, we refer to all these beings with the generic term of "actors." The meaning of such a term is of course the broadest: an actor is anything doing something. This definition is somewhat tautological, but it comes with a practical test: whenever you wonder if something is acting in a controversy, just ask yourself if its presence or absence does make a difference. If it does and if this difference is perceived by other actors,[31] then it is an actor. Let's go back to the GMO example: some ten years ago, no one suspected that monarch butterflies could be actors in the biotech controversy. In 1999, however, some scientists at Cornell University published the results of an experiment suggesting that monarch caterpillars could be threatened by transgenic crops (Losey et al., 1999). The news generated a wave of protests against GM plants and several authorizations were blocked by the precautionary principle. Suddenly, the humblest insect was turned into the representative of biodiversity. Suddenly the presence of monarch butterflies (almost unnoticed until then) started making a huge difference in the GMO debate—butterflies had become actors of the controversy.[32] This story is instructive because it invites social cartographers to devote the greatest attention to all actors, no matter if they are human, animals, artifacts or anything else.[33]

3) *From actors to networks*. Introducing the metaphor of magma, we explained how, according to ANT, there is no such thing as an isolated actor. Actors are always composed by and components of networks. Consider any biotech cultivar: each single transgenic seed is the result of the coordinated work of an extensive network made up of scientific protocols, field trials, research investments, technical instruments, industrial patents. At the same time, each little seed contributes to a wider network which gathers global corporations, scientific laboratories, non-governmental organizations, national and international legislation.[34] Actors are such because they inter-act, shaping relations and being

shaped by relations. Observing controversies is observing the unceasing work of tying and untying connections. In Latour's own words "Being connected, being interconnected, being heterogeneous, is not enough ... really, we should say 'worknet' instead of 'network'. It's the work, and the movement, and the flow, and the changes that should be stressed" (2004a: 63).

4) *From networks to cosmoses*. The emphasis we laid on networks' dynamics should not lead us to forget that most actors and groups aspire to some kind of stability. Few actors are interested in destabilizing existing social networks just for the sake of chaos. If you set up a crusade against transgenic crops, it is probably because you long for organic agriculture; if you fight modernization, chances are that you like tradition; if you sabotage global systems, you are a potential partisan of local communities. Even anarchists have pictures of the society they wish to establish; even opportunists have utopias. The fact that controversies make collective existence more and more complex does not mean that those who fight them are not led by a desire for simplification. Those who support the dissemination of GMOs in developing countries, for instance, are perfectly aware that they will disrupt the traditional organization of rural communities. Still they believe that innovation will eventually lead to more efficient agricultural systems. Yes, some ancient farming traditions will be shattered, but in the long run economical development and technical progress will give rise to better societies. In an analogous but opposite way, activists denouncing the failures of industrial agriculture are often inspired by romantic visions of tradition rural life. The importance of these ideologies[35] should not be underestimated. Of course, they don't resemble the actual magma of collective existence, but this doesn't mean that they cannot affect it. Ideologies are not meant to be descriptions of the world as it is, but visions of the world as it should be. While collective life is chaotic and erratic, ideologies are orderly and harmonious: they are not universes, but *cosmoses*. As such, ideologies can be more influential than any realistic calculation. Observation cannot be limited to statements, actions and relations, but has to extend to the meaning that actors attribute to them. Only by roaming from cosmos to cosmos, can social cartographers perceive the full extent of their controversies.

5) *From cosmoses to cosmopolitics*. The last layer of our list is by far the trickiest. Its understanding requires abandoning one of the most venerable ideas of Western culture: the belief that, behind all ideologies and controversies, some objective reality must exist independently from what actors think or say. According to this idea (which can be traced back to Plato's cavern[36]), both ideologies and controversies derive from the imperfection of human intellect. If all men could see reality as it really is, they would peacefully and rationally negotiate their collective existence. Besides being too human-centered (as it forgets that not all social actors are human beings), this idea has a major disadvantage: it often ends up justifying absolutism. As soon as an ultimate substratum of truth is postulated, actors start claiming to have a privileged access to it. Through philosophy, religion, art, science or technology—they hold—reality can finally be revealed and everyone will eventually agree (whether they like it or not). Unfortunately (or rather fortunately), no matter how confident these prophets may sound, not everyone eventually agrees. Take any philosophical, religious, artistic, scientific or technical truth and you will find a controversy. Sometimes disputes are temporarily silenced by the fact that some cosmos has prevailed over the others or by the fact that actors have found a resisting compromise, but no agreement, no convention, no collective reality has ever come without discussion. This does not mean that we could never inhabit a peaceful world, that we could never align our visions, that we could never agree on truth. A common world is possible, but

not as "something we come to recognize, as though it had always been here (and we had not until now noticed it). A common world, if there is going to be one, is something we will have to build, tooth and nail, together" (Latour, 2004c: 455).

7. How to build rich observation devices

Actor-Network Theory and Bruno Latour are often accused of not taking a stand on the issues they study and being therefore politically naïve (believing that social sciences could be impartial) or cynical (believing that social sciences can't influence social life). Multiplying actors and perspectives, viewpoints and arguments might be mistaken for a way to avoid commitments. This is not the case: ANT never tried to avoid its responsibilities and never questioned the fact that social sciences *could and should* contribute to public debate. The problem is *what* contribution they should give and *how*.

According to ANT, the role that research should play in collective disputes is not that of steering their closure. Actors (not scholars) are responsible for deciding controversies. Once again, it is a matter of respect. Controversies belong to actors: it was actors who sowed their seeds, who raised their sprouts, who nurtured their development. Scholars have no right to jump in and impose their solutions. Researchers can certainly express their ideas and social cartography encourages them to do so. Still, in displaying their opinions, they should pay the greatest attention not to hide others'. Unlike most social approaches, the cartography of controversies does not boast impartiality—it just requires its practitioners to present other partialities besides their own. Social cartography is not meant to close controversies, but to show that they may be closed in many different ways.[37]

It is true ANT is often hesitant when it comes to taking a stand, but such hesitation doesn't come from naïvety or cynicism. It comes from the fear of shortcutting the debate before it had the time to deploy its full richness, of pushing an interpretation before *all* actors had a chance to express their own. Those who study controversies have seen too many opposite cosmoses, too many contradictory definitions of problems and solutions, to believe they can easily tell who's right and who's wrong. Social cartographers know that issues are always too complicated, subtle and ever-changing to be sliced like Gordian knots.

Of course, this is only half of the story. As we said, social life flows like magma in a double movement of liquefaction and solidification. When we *observe* controversies, we focus on the liquid side. When we *describe* controversies, we contribute to the solidification of some portions of social magma. Both tasks are equally important and closely connected in the practice of social cartography (as well as in collective phenomena). However, "observing" and "describing" should not be confused for they have different purposes and different consequences. Bruno Latour discussed a similar distinction in a book dedicated to the "Politics of Nature" (2004d: especially pp. 108–16). While redefining political processes in contemporary collectives, Latour introduced four recommendations that can be easily extended to the practice of social mapping.

First requirement: You shall not simplify the number of propositions to be taken into account in the discussion. Perplexity.

Second requirement: You shall make sure that the number of voices that participate in the articulation of propositions is not arbitrarily short-circuited. Consultation.

...

Third requirement: You shall discuss the compatibility of new propositions with those which are already instituted, in such a way as to maintain them all in the same common world that will give them their legitimate place. Hierarchization.

Fourth requirement: Once the propositions have been instituted, you shall no longer question their legitimate presence at the heart of collective life. Institution. (p. 109)

What is most interesting is not recognizing the existence of these two sets of steps, but revealing their contradiction. Cartographers should not forget that whenever they chart a debate they lose part of its vibrancy and interest: an inevitable choice, of course, and still not to be taken light-heartedly. That's why it is important not to confuse observation and description and that's why we decided to leave the third and the fourth requirements (hierarchization and institution) to a further article.

As for the requirements of *perplexity* and *consultation*, they condense all we said about the observation of controversies. When it comes to evaluating the observation work of his students, Bruno Latour prizes *articulation* (the skill of "being affected by differences") much more than accuracy and consistency.[38] Observing a controversy is like setting up a scientific observatory: the quality of observation depends on the capacity to multiply the number and increase the sensitivity of monitoring devices. Only by accumulating notes, documents, interviews, surveys, archives, experiments, statistics, can researchers strive to preserve the amazing richness of collective life.

Of course, this will make interpretation more difficult. Of course, this will complicate the work of representation. Of course, this will slow down the construction of a shared cosmos. Still, there is no other way to make such construction a democratic enterprise, no other way to ensure that all actors and networks have a fair possibility to participate: "the burning desire to have new entities detected, welcomed and given shelter is not only legitimate, it's probably the only scientific and political cause worth living for" (Latour, 2005: 259). Far from eluding commitments, the cartography of controversies takes the strongest political stand: not just changing the world, but giving others the chance to do so.

Notes

1 Of course, Bruno Latour was not the first scholar to study controversies nor to acknowledge their potential in the study of science and technique (for a review of science and technology studies on controversies see Pinch and Leuenberger, 2006). Still, it was Bruno Latour who developed the cartography of controversies into a full didactic and research method and that's why in the following pages we will repeatedly quote his works and ideas.

2 Including the *Institut de Science Politiques* et l'*École de Mines* of Paris, the *Massachusetts Institute of Technology*, the *École Polytechnique Fédérale* of Lausanne, the *University of Manchester* and others.

3 As readers can easily understand, the cartography of controversies is a collective undertaking nourished by the work of a large community of researchers. This article itself would not have been possible without the support of such community and, in particular, of the controversies team of the *Fondation Nationale des Sciences Politiques* of Paris (Bruno Latour, Nicolas Benvegnu, Christelle Gramaglia, Brice Laurent, Mathieu Jacomy, Axel Meunier, Valerie Pihet).

4 To be very clear: the cartography of controversies and the actor-network theory do not constitute two separate approaches. They are, on the contrary, two different ways of expressing the same ideas about collective existence: ANT is more formal whereas social mapping is more practical, but they share the exact same principles. To understand the relationship between ANT and the cartography of controversies, think, for example, of the difference between learning photographic composition on a manual or learning it by taking pictures.

5 Of course, we are not saying that all these time-honored research props cannot or should not be used. We are just saying that their use is not imposed on social cartographers (see later for more details).

6 "You think description is easy? You must be confusing description, I guess, with strings of clichés. For every hundred books of commentaries, arguments, glosses, there is only one of description. To describe, to be attentive to the

concrete states of affairs, to find the uniquely adequate account of a given situation—I have, myself, always found this incredibly demanding" (Latour, 2004a: 64).

7   Speaking of "theories and methodologies," we refer here to the formal notions and protocols elaborated in social sciences. We do not refer to the cognitive structures and preconceptions that articulate every possible observation. Observations cannot be separated from such bias and that's precisely why the multiplication of viewpoints is so important (see the second meaning of "just").

8   Giving priority to observation, however, is easier said than done. Most ANT theoretical complications were introduced to persuade sociologists to be less confident in the notions and protocols they were taught. That's why it is imprecise to define the cartography of controversies as "ANT unburdened of all theoretical subtleties." The cartography of controversies should rather be defined as *the practice of ANT once all theoretical and methodological objections are overcome*.

9   Latour calls "second-degree objectivity" the effort to consider as much subjectivity as possible. Unlike first-degree objectivity, which defines a situation of collective agreement, second-degree objectivity is attained by revealing the full extent of actors' disagreement and is thereby typical of controversial settings.

10   Of course, this is true not only for social sciences, but for natural sciences as well. For an example of how scientific research can be undermined by the incapacity to acknowledge actors' competences, see the dispute on the Chernobyl fallout described by Brian Wynne (1992).

11   To use Latour's words: "actors know what they do and we have to learn from them not only what they do, but how and why they do it. It is us, the social scientists, who lack knowledge of what they do ... ANT is a way of delegitimating the incredible pretensions of sociologists" (Latour, 1999b: 19, 20).

12   Inviting social research to accept and welcome as many contaminations as possible, Latour offers a reflexive application of the ideas he developed studying natural sciences. See, for example, Latour's discussion of "Science's Blood Flow" in *Pandora's Hope* (1999a: 80–112).

13   See the work of Isabelle Stengers on the cosmopolitics of science (and in particular Stengers, 2000).

14   We are well aware that our definition of controversies is extremely vague. As readers will see, the cartography of controversies is less interested in strictly defining its object than in showing that it can be fruitfully applied to the broadest variety of social phenomena.

15   The assembly of heterogeneous arrangements in controversial situations has been convincingly described by John Law (1989).

16   On the notion of a "hybrid forum" see Callon and Rip (1992). "Within a hybrid forum, networks of alliances ... can rise and fall according to the emerging issues and to the arguments of the protagonists. They are forums since they are made of debating actors and since in any moment new actors can join. They are hybrids since the actors, the issues and the mobilized resources are heterogeneous" (p. 148, translation supplied).

17   The very notion of Actor-Network was developed by Michel Callon (1989) as an effort to describe the relentless association and dissociation of actors and networks in controversies: "the actor network should not ... be confused with a network linking in some predictable fashion elements that are perfectly well defined and stable, for the entities it is composed of, whether natural or social, could at any moment redefine their identity and mutual relationships" (p. 93).

18   On the growth/de-growth debate see Latouche (2004).

19   When we sketch controversies as a sequence that goes from cold reciprocal indifference, to hot quarrel, to warm consensus, we are of course oversimplifying. Controversies may develop according to many different trajectories: they may go from apathy to alliance without passing through conflict; they can light up briefly and soon fall back into unawareness; they can burst into full conflict and never cool down.

20   Speaking of "social order" and "social hierarchy" we are not referring here to some global stratification, but the local distribution of power existing within a specific controversy. We do not believe power to be a universal resource that can be spent freely in every social domain. According to ANT, we conceive power as a local property that derives from holding a specific position within a specific network. The extension of such "power" depends obviously on the extension of the network itself. A child disobeying her parents and a political party contesting the results of an election are both fighting for power. The extension of their fights, however, is different.

21   On the reductionism of classical sociological methodologies and on the need for a more open approach to complexity see Law (2004: especially pp. 1–11).

22   According to the *Encyclopædia Britannica* (15th edition, vol. 7, p. 673), magma is "molten or partially molten rock from which igneous rocks form ..... suspended crystal and fragments of unmelted rock may be transported in the magma; dissolved volatiles may separate as bubbles and some liquid may crystallize during movement."

23   If you want a live example, consider any page of Wikipedia. Each definition of this collectively edited encyclopedia is constituted by a solid part (the definition itself) and by a liquid part (the history of all the modifications ever made to that page). Furthermore, the fact that contents can be easily transferred from one part to the other

makes Wikipedia a hybrid medium (sharing orality and literacy features) and accounts to a large extent for its enormous success (see Venturini, 2006).

24 To be sure, we are not saying that the disputes over global warming and genetically modified organisms (GMOs) are not worth studying. On the contrary, they are outstanding controversies whose developments will shape the future of our societies (and that's why we will use them as examples in this paper). Yet, these controversies are so huge and complex that they exceed the resources available to the average mapping campaign (at least in educational settings where most social cartography is still performed). Finding ways to deal with such enormous controversies is one of the challenges that social cartography will have to face on its way to becoming a full research method.

25 On the analysis of scientific and technical issues see Callon (1981) as well as the works of Harry M. Collins and Trevor Pinch (see in particular 1993 and 1998).

26 But see Latour (2005: 87–99).

27 For the sake of clarity, we will stack our lenses as if they were different levels of magnification in a microscope. Of course, in real controversies, things get far more complicated and each level is often tangled with each other.

28 We are here making reference to the immense debate on the coexistence of GMOs and wild biodiversity generated by a 1999 article on the effects of transgenic BT maize on monarch butterflies (see later in the text). On the "butterfly effect" see Hilborn (2004).

29 For a review of scientometrics theories and tools see Leydesdorff (2001).

30 The existence of literatures (or aggregates of documents) around social issues has been clearly revealed by the development of numerous cyber-geography methods. By analyzing the semantic contents and the hyper-textual connections of the web-published documents, these cyber-cartographies have proved that online debates can be fruitfully represented as literatures or landscapes. See for example Ghitalla, Jacomy and Pfaender (2006) and Marres and Rogers (2005).

31 This principle is explicitly enunciated by John Law (1989): "The scope of the network being studied is determined by the existence of actors that are able to make their presence individually felt on it ... Conversely, if an element does not make its presence felt by influencing the structure of the network in a noticeable and individual way, then from the standpoint of that network the element in question does not exist" (p. 131).

32 An extensive report on the development of the "Corn and the Monarch Butterfly Controversy" has been released by the PEW Initiative in 2003. For a discussion of how such controversy was developed in the media, see McInerney, Bird and Nucci (2004: 61–8) and for a cartographic analysis, see Leydesdorff and Hellsten (2006: 237–43).

33 Many scholars find it difficult to employ the notion of "actor" in such a wide sense. Action, they hold, implies intentionality and is thereby limited to human beings. Unfortunately, we don't have here the possibility to discuss such disputes. Let's just say that what matters to cartographic practice is not how "actor" is defined, but whether every contribution to collective existence (intentional or not) is fairly acknowledged. For an example, see Michel Callon's (1986) description of the domestication of the scallops and fishermen of St Brieuc Bay.

34 See for example the case of "Terminator's seeds" in Venturini (2008).

35 Bruno Latour (2005) calls them "panoramas" (see pp. 187–9).

36 See Latour (2004d: 10–18) for a discussion of the meaning and purpose of Plato's myth.

37 The interest for all available viewpoints derives largely from the "strong program" of the sociology of science developed at the University of Edinburgh and from its "symmetry requirement" (Bloor, 1991: 175–9). Requiring scholars to use the same explanatory resources for both the successes and failures of science, this principle was introduced by David Bloor as an expedient "to restructure our curiosity" (p. 176).

38 The decisive advantage of articulation over accuracy of reference is that there is no end to articulation whereas there is an end to accuracy. Once the correspondence between the statement and the state of affairs has been validated, it is the end of the story ... Articulations, on the other hand, may easily proliferate without ceasing to register differences ... the more contrasts you add, the more differences and mediations you become sensible to. Controversies among scientists destroy statements that try, hopelessly, to mimic matters of fact, but they feed articulations, and feed them well. (Latour, 2004b: 210, 211)

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