



Diving in magma

Tommaso Venturini

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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 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 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.

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 Latour¹ at the *École des Mines de Paris* some twelve years ago and it's currently taught in several European and American universities². Recently, the cartography of controversy has also become the object of the EU funded consortium MACOSPOL (MAPPING Controversies in Science and technology for POLitics), which gathers eight European university and research centers³.

¹ Of course, Bruno Latour was not first scholar to study controversies nor the first one to acknowledge their potential in the study of science and technique. In particular, Latour's cartography inherited many of its tenets from the works of the schools of Edinburgh and Bath (for a review of STS studies on controversies see Pinch, 2006). Still, it was Bruno Latour who developed the cartography of controversy into a full didactic and research method and that's why in the following pages we will repeatedly quote Latour's works and ideas.

² Including the *Institut de Science Politiques de Paris*, the *Massachusetts Institute of Technology*, the *University of Oslo*, the *University of Munich*, the *University of Liège* and others.

³ Macospol partners are: the *Fondation Nationale des Sciences Politiques* (France); the *University of Oslo* (Norway); *Observa*, Vicenza, (Italy); *University of Munich* (Germany); *Université de Liège* (Belgium); *Ecole Polytechnique Fédérale de Lausanne* (Switzerland); *University of Amsterdam* (Holland); *University of Manchester* (United Kingdom).

As readers can easily understand, the cartography of controversy is a collective undertaking that which has been and is nourished by the work of a large community of researchers and teachers. 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 Benvegna, Christelle Gramaglia, Brice Laurent, Mathieu Jacomy, Axel Meunier, Valerie Pihet).

Since its introduction, the cartography of controversies has somehow 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, 1999: p. 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. As such, the cartography of controversies may appeal to those who are intrigued by ANT, but find its philosophical implications too demanding. Concentrating on the practice of mapping and staying clear from conceptual troubles, students and researchers may hope to reduce ANT to a user-friendlier version.

At first, the cartography of controversies seems fall into line with these expectations. When asked to spell 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 establish⁴. Researchers are not even asked to *explain* what they study⁵, but only to observe a controversy and describe what they see. Like zoo-born animals released in the wild, students entering cartographic projects report bewilderment and euphoria.

Euphoria, however, is not to last long. Despite its theoretical and methodological minimalism⁶, the cartography of controversies is no piece of cake (as students discovers with disappointment as soon as they actually begins their training). Far from being a simplified version of ANT, the cartography of controversies turns out to be every bit as thorny and intricate⁷. What seems to be, in theory, the simplest consign ends up being, in practice, the hardest exercise. “Just observe and describe controversies” – nothing easier, except for two little problems: “just” and “controversies”.

⁴ Of course, we are not saying that all these time-honoured research props cannot or should not be use. We are just saying that their use is not imposed on social cartographers (see later for more details).

⁵ Unlike most other social methodologies, ANT cartography has no interest in unveiling some general structure concealed behind phenomena. Its only purpose is to provide the most detailed description of social phenomena as seen by their protagonists. To use Latour’s own words: “if your description needs an explanation, it’s not a good description” (Latour, 2004a: p. 67).

⁶ For reasons that we will introduce later, it would be fairer to say that the cartography of controversies is a painful exercise *because of* its theoretical and methodological minimalism.

⁷ “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: p. 64).

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 and perhaps more. 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 the cartography of controversies, we have little to offer other than a long list of difficulties – so long, in fact, that we decided to break it in two articles. In the next 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 in the exercise of social cartography. Distinguishing observation and description, we don’t mean to portray two consecutive operations (first observe and then describe). Observing and describing controversies are always performed *at the same time*. Yet, the distinction is worth to be maintained 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).

The three meaning 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. 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 the 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. In social cartography, observation always *precedes* theory and methodology⁸.

⁸ Giving priority to observation, however, is easier said than done. As a general rule, the more scholars have been trained in social sciences, the harder they find to get rid of their conceptual and procedural bias. Younger students, especially those coming from technical school, are generally well disposed toward social cartography, whereas experienced researchers are often reluctant to abandon their theoretical and methodological equipment. Most of ANT theoretical complications were introduced to persuade well-trained sociologists to be

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 landscape, but no observation can escape its origin. Neither theory nor methodology can provide researchers with an objective viewpoint. Objectivity can be pursued only by multiplying the points of observation⁹. The more numerous and partial are the perspectives from which a phenomenon is considered, the more objective and impartial will be its observation¹⁰. 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 consequences of “just” is that researchers are obliged to reconsider their attitude toward their subjects of study. The cartography of controversies entails the reasonable but subversive idea that participants to social phenomena may be as informed as outside investigators. After all, actors are constantly immersed in the issues that scholars contemplate for a limited time and from an external viewpoint. Neglecting actor’s observations and ideas just because they are not based on scientific theory or methodology is arrogant at best¹¹. Social cartographers must have the greatest respect for the actors they observe¹². They should be humble enough to recognize that when it comes to religion, there are no grater 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,

less confident in the notions and protocols they were taught. The actor-network approach is, in fact, an anti-theory much more than a theory. That’s why it is imprecise to defining the cartography of controversy as “an educational version of ANT” or “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 According to ANT the fact each observation is indissolubly linked to a particular point of view does not constitute a limitation as long as researchers are able to multiply their observations while switching perspective from one to the other “The great thing about a standpoint is, precisely, that you can change it! Why would I be stuck with it? From where they are on earth, astronomers have a limited perspective... And yet, they have been pretty good at shifting this perspective, through instruments, telescopes, satellites. They can now draw a map of the distribution of galaxies in the whole universe. Pretty good, no? Show me one standpoint, and I will show you two dozen ways to shift out of it” (Latour, 2004a: p. 65).

¹⁰ Latour calls “second-degree objectivity” this 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.

¹¹ 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 Chernobyl fallout described by Brian Wynne (1992). In such interesting controversy, British scientists and technocrats failed implementing an effective safety policy because they refused to negotiate it with Cumbrian shepherd (and Cumbrian sheep).

¹² To use Latour’s words: “actors know that 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, and not they who are missing the explanation of why they are unwittingly manipulated by forces exterior to themselves and know to the social scientist’s powerful gaze and methods. ANT is a way of delegitimizing the incredible pretensions of sociologists” (Latour, 1999a: p. 19, 20).

doctors, caregivers, patients and microbes are far more experienced than sociologists. The purpose of the cartography of controversies is not to teach actors what they are supposedly incapable of understanding, but to learn from them how to observe their collective existences¹³.

Let's recapitulate the three consequences of "just", as they constitute the three commandments of sociological 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. If social cartography refuses theoretical and methodological monogamy, it is certainly not to attain ascetic clarity, but to flirt with confusion and complexity. 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 possible¹⁴. Such is the lesson of 'just': *observation devices are the more valuable, the more they let those who are observed interfering with those who observe*¹⁵.

Readers should begin to grasp why the conceptual and procedural minimalism of the cartography of controversy will not make their life easier. Putting observation before theory and methodology was never meant facilitate research. If Latour glued "just" to "observation", 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 subjects¹⁶.

What's in a controversy?

¹³ No matter how poor is their formal education, actors are always far more informed on their issues than the scholars who studies them: "If you were studying ants, instead of ANT, would you expect ants to learn something from your study? Of course not. They know, you don't. They are the teachers, you learn from them. You explain what they do to yourself, for your own benefit, or for that of other entomologists, not for them, who don't care a bit" (Latour, 2004a: p. 70).

¹⁴ 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* (1999: pp. 80-112).

¹⁵ See the work of Isabelle Stengers on the cosmopolitics of science (and in particular Stengers. 2000).

¹⁶ Saying that observation has to be as rich as its subjects is, in fact, a simplification, for it assume that complexity could only come from the observed side. According to Latour, observation richness is neither a property of the observed nor of the observer nor of the observation device. Richness or articulation is rather a property of the relations among the three "learning to be affected means exactly that: the more you learn, the more differences exist" (2004b: p. 213, see in the same paper the example of the odour kit).

Controversies are certainly and by far the most complex phenomena to be observed in collective life. In Macospol official 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”; it does not mean that there is a fierce dispute nor that it has been politicized; we use it as a general term to describe *shared uncertainty*

Letting 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 (the cold consensus of reciprocal unawareness and the warm consensus of agreement and alliance) can be called a controversy¹⁷.

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. All kinds of actors have been mobilized and enrolled in the fight on global warming. A few years ago no one would have thought that there could be any relation 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? is warming affecting climate? what are the consequences of climate change? should we worry about temperature increase? can we do something to slow down or inverse 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 reached the same world wide audience. Yet, some of the features of 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, institutional and economic 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 battlefield. Controversies are the place

¹⁷ 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 defying its object than in showing that it can be fruitfully applied to the broadest variety of social phenomena. Still, further in this article, we will provide some advices on how to identify a good controversy.

where the most heterogeneous relationships are formed¹⁸. Biodiversity economic assets, CO₂ international quota, intergovernmental scientific panels – the debate on global warming develops through the relentless invention of new chimeras. Every controversy functions as a “hybrid forums”, a space of conflict and negotiation among actors that would otherwise happily ignore each other¹⁹. After all, where else could coral reefs and recycling factories meet if not in global warming debate? Controversies are the living demonstration that the borders between physics and politics, finance and biology, law and engineering are as insuperable as they often seem.

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 consider jet engines as an obvious component of modern aircrafts. We could discuss on low-cost business model, on air routes sustainability, on 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. Global warming controversy has developed all the way down to the very black box of airplanes design. 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 be decomposed in a loose network and any network, not matter how heterogeneous, can coagulate to function as an actor²⁰.

¹⁸ The necessity to assemble heterogeneous arrangements to partake in controversial situations has been convincingly showed by John Law (1989). By analyzing Portuguese expansion in the XV century, Law reveals how Portugal navy succeeded in the controversies that hindered its expansion towards India by constructing an alliance made of ships design, navigation methods, sailing routes, pilots training, and military equipment. Laws calls “heterogeneous engineering” this gathering of elements coming from different worlds “that range from people, through skills, to artifacts and natural phenomena” (p. 129).

¹⁹ On the notion of ‘hybrid forum’ see Callon and Rip (1992). “Within a hybrid forum, networks of alliances (independent from existing organization and institutions) can rise and fall according to the emerging issues and to the arguments of the protagonists. They are forums since there are made of debating actors and since in any moment new actor can join. They are hybrids since the actors, the issues and the mobilized resources are heterogeneous” (p. 148, translation supplied). “Welcome to a cosmopolitan world where ozone layers cohabit with chemical industries, where the CO₂ interacts with the Plankton as well as with cars or catalytic converters; welcome to a composite and hybrid world in the sense that it establish long chains of interaction among technical artifacts, natural substances, organized or unorganized human beings; welcome to a world cut by differences and contradictions” (p. 154, translation supplied).

²⁰ 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 is reducible neither to an actor alone nor to a network. Like networks it is composed of a series of heterogeneous elements, animate and inanimate, that have been linked to one another for a certain period of time... But the actor network

3. *Controversies are reduction-resistant.* Disputes are, by definition, situation 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, included 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 that were taken for granted start to be questioned and discussed. That is why quarrels are so interesting for social sciences, because they open up *black boxes*, things and ideas that would otherwise be taken for granted²¹. Before the disputes on pollution and on global warming, few people considered economical development 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* development is and we are even beginning to wonder if we shouldn't *de-grow* instead²². What is most amazing, the same happens for what we are used to consider as natural phenomena. 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 quarrelling 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 fights²³, the construction of a shared universe is often accompanied by the clash of

should not, on the other hand, 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 in some new way and bring new elements into the network" (p. 93).

²¹ The relative invisibility of non-disputed facts is particularly evident in the case of technologies. As Bijker and Law point out in the introduction of an amazing book on technical controversies (1992), it is often necessary to wait for some tragic breakdown (and the disputes that go with it) to start reflecting on technology: "Most of the time, most of us take our technologies for granted. These work more or less adequately, so we don't inquire about why or how it is they work. ... The costs of technologies tend to become obvious only at the moment of catastrophic failure" (pp. 1, 2).

²² On growth/degrowth debate see Latouche 2004.

²³ 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

conflicting worlds. This is why, for instance, the assessment of climate change cannot be left to climatologists alone. National economies and industrial sectors may raise or fall according to how temperature is measured, biological species may proliferate or extinguish and indigenous cultures may be revived or wiped away. Evidently, 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. Controversies decide and are decided by the distribution of power. Actors are not born equals in controversies and seldom have they equal opportunities: arctic seals and political leaders were both concerned by 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 violence²⁴.

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 simple as it seems; where everyone is shouting and quarrelling; 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 a maze with a twine of threads to follow.

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 quit both this paper and the cartography of controversies. It is a legitimate feeling. Like Pinocchio’s talking cricket, Latour’s cartography has nothing to promise 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 and shredding this article, let me provide a couple of reasons to consider complexity under a less gloomy light.

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.

²⁴ This last feature of controversies is crucially important. By saying that all involved actors deserve to be listened, the cartography of controversies makes no optimistic assumption on social life. We all know very well that not all actors will be given a fair possibility of expression and that some voices will eventually cover the other. Studying controversies, one should never overlook conflict and injustice. As pointed out by Fabrice Flipo (2006) “Kyoto was not a cheerful happening gathering the scientist, the civil society and other guests such as the climate and the greenhouse gases. The state of climate produces droughts and floods, harvests and famine” (p. 493, translation supplied).

In the first place, if the cartography of controversies is complex, it is because collective life itself is complex. Have you ever tried to gather 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 participate 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 (especially if non-human actors are involved). It is not the cartography of controversies which complicates something simple; it is the other approaches which simplify something complex²⁵. As social researchers, we should be ready to handle at least as much complexity as the actors we observe.

Be careful though. We are not saying that social life is inexorably chaotic and therefore impossible to interpret. Nor we are 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 their interactions. After all bands are formed, tournaments arranged, association founded and things shared. Simplifications are possible. Yet, every collective simplification needs work to be built and work to be maintained. Consider the most unsophisticated of social distinction: 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 give sense to in/out distinctions – ask to 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 of hard work. Claiming to have simple access to simplicity, while actors are constantly struggling to manage complexity, would be disrespectful at best.

In the second place, although thorny and intricate, controversies remain the best available occasions to observe social world and its *making of*. 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 a 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 once it is ready. Still neither the ingredients nor the final cake are enough to unveil its preparation. To learn how to bake a cake, you'll 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 hard time understanding what's going on. However, if cooks start disagreeing dosages, disputing on operations order, quarreling on cooking time, there you can really learn something on cakes. 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 –

²⁵ 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).

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. These configurations constitute the object of ANT as well as of the cartography of controversies.

According to Bruno Latour, the social cannot be studied either at its solid state (the stabilized networks) or at its liquid state (the isolated actors): “In both cases, the social vanishes. When it is taken as a solid, it loses its ability to associate; when it's taken as a fluid, the social again disappears because it flashes only briefly, just at the fleeting moment when new associations are sticking the collective together” (2005, p. 159). To observe how the social is built, scholars have no other choice than diving into controversies no matter how difficult and dangerous this could be. Controversies are complex because they are the crucible where collective life is melted and forged: they are the social at its magmatic state. According to the definition of the Encyclopedia Britannica, magma is a flow of “partially molten rock”²⁶, a configuration in which rock is both liquid and solid at the same time, exactly as social is in controversies. But there's more to this metaphor: what is most interesting in magma is that solid and liquid states exists in a ceaseless mutual transformation. On the one hand, the solid rock touched by the heat of the flow melts and becomes part of the stream. On the other hand, at the margins of the flow, the lava cools down and crystallizes.

The same dynamic can be observed in controversies, the same fluctuation between different states of solidity²⁷. 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.

Choosing a good controversy

Although every collective phenomenon can be observed as a controversy, not every controversy makes a good object of study. When starting a mapping project the first thing to chose is always which controversy to analyze. A happy choice will make investigation interesting and feasible; a wrong choice will lead to failure. Unfortunately, there are no exact instructions on how to choose a good controversy – all that we can provide is some recommendations to avoid bad ones:

²⁶ More precisely: “molten or partially molten rock from which igneous rocks form. It usually consists of silicate liquid, although carbonate and sulfide melts occur as well. Magma migrates either at depth or to the Earth's surface and is ejected as lava. Suspended crystal and fragments of unmelted rock may be transported in the magma; dissolved volatiles may separate as bubble and some liquid may crystallize during movement” (*The new Encyclopedia Britannica*, 15th edition, 1998, vol. 7, p. 673).

²⁷ If you want a live example consider any page of Wikipedia. Each definition of this collectively edited encyclopaedia 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 of Wikipedia a hybrid media (sharing orality and literacy features) and accounts to a large extent for its enormous success (see Venturini, 2006).

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 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, requires huge amounts of times 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 controversy 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 that can be given to scholars pondering which dispute to turn to: favor controversies concerning scientific or technical issues²⁸. Accounting for this preference would require a long detour into ANT theory that we prefer not to take in this article²⁹. 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 domains³⁰. Consider the major controversies troubling

²⁸ Readers looking for examples of how scientific and technical issues can be analysed can find inspiration in the work of Harry M. Collins and Trevor Pinch (see in particular 1993 and 1998).

²⁹ Interested readers, however, can find more about the contribution of STS (science and technology studies to social sciences) in Latour, 2005 (p. 87-99).

³⁰ Instead of resisting such growing confusion among sciences, technologies and other social sectors, the cartography of controversies tries to take advantage of it, as claimed by Bruno Latour himself "I have stopped in the engineering school where I teach, to give a social science class: I only ask the young engineers to follow for one year, in real time, a scientific or technical controversy... They learn more science –meaning research– and it just happens that, without even noticing it, they learn also more law, economics, sociology, ethics, psychology, science policy and so on, since all those features are associated with the piece of science they have chosen to

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 assembly of modern collective existence rests upon the contribution of scientific and technical actors. Viruses, ballistic missiles, stock exchange indices, crops, chromosomes, ozone layers, embryos, ecosystems – all these actors (together with their associated scientists and the engineers) have entered our societies and won't go away. Few things in modern societies can be understood without taking science and technology into account³¹.

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 stem cells debate, for instance, sociologists cannot to elude biological and medical issues. Which diseases can be cured with stems cells treatments; how is research on stem cells funded and organized; can stems cells be extracted from adult tissues; what is the stock availability of stems cells from *in vitro* fertilized embryos – far from being technical minutiae, these questions lie at the core of the controversy and deserve the greatest attention.

If they want to grasp modern debates, cartographers have no choice but to dive into techno-scientific details no matter how cryptic they may seem. This painstaking attention to technicalities is often believed to be the main difficulty of the cartography of controversy. This is seldom the case. As strange as this may seem, the didactics of social cartography has repeatedly proved that the more technical is a controversy the easier will be its observation. Several reasons account for this seeming 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's why we recommend choosing controversies which are directly centered on science and technology. As there is no way to avoid techno-scientific complications, scholars may as well make focus their investigation on them. Contrary to scholar's first impression, this will make observations easier and more interesting.

follow. ("From the two cultures debate to cosmopolitics" contribution to a special symposium in *Zeit*, available online at www.bruno-latour.fr).

³¹ According to Latour, although especially evident in modern western societies, the impossibility to separate human actors from non-human actors is true for all groups attaining a higher complexity than a baboon troop, see Latour, 1994c. To be sure, this does not means that controversies couldn't or shouldn't be observed in baboon troops. On the contrary, baboons' complex and controversial collective life is very interesting for the social cartography as it shows what it would be a controversy without the contribution of science and technique (see Strum, 1994).

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 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 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 remember us that a thorough observation is impossible without the superimposition of a variety of layers³²:

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 dispute illustrates exemplarily 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 tornados all over the world³³. Entering GMOs' controversies, we leave the steadfast terrain of established beliefs to enter 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 principle of precaution and so on and so forth. The first task of social cartography is to map this web of references, revealing how dispersed discourses are weaved into articulated literatures. Thanks to bibliographic and scientometric tools, these textual structures are particularly easy to trace in science and technology³⁴. Nevertheless, literatures exist in every social domain and animate every collective debate³⁵.

³² 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 gets far more complicated and each level is often tangled with each other.

³³ We are here making reference to the immense debate on the coexistence of GMO and wild biodiversity generated by a 1999 article on the effects of transgenic BT maize on Monarch butterflies (see later in the text). On 'butterfly effect' see Hilborn, 2004.

³⁴ For a review of scientometrics theories and tools see Leydesdorff, 2001.

³⁵ The existence of literatures (or aggregates of documents) around social issues has been clearly revealed by the development of numerous cyber-geography methods. By analysing 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.

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 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 cartographer are inevitably brought to consider connections that spread beyond the limits of textual universe. Besides being connected to other claims, 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 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 any difference. If it does and if this difference is perceived by other actors³⁶, then it is an actor. Let go back to the GMOs example: some ten years ago, none suspected that monarch butterflies could be crucial actors in the biotech controversy. In 1999, however, some scientists of Cornell University published the results of an experiment suggesting that monarch caterpillars could be severely threatened by transgenic crops (Losey et al., 1999). The news generated a wave of protests against GM plants and several authorizations were blocked according to the precaution principle. Suddenly, the humblest insect was turned into the representative of wild biodiversity. Suddenly the presence of monarch butterflies (almost unnoticed until then) started making a huge difference in the GMOs' debate – butterflies had become actors of the controversy³⁷. The story of monarch butterflies is instructive because it invites social cartographer to devote the greatest attention to all concerned actors, no matter if they are human, animals, artifacts or anything else. Everything can be an actor as long as it makes a difference³⁸.

3. *From actors to networks.* Introducing the metaphor of magma, we already explained how, according to ANT, there's no such thing as an isolated actor. Actors are always interfaces

³⁶ 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).

³⁷ 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 (pp. 61-68) and for a cartographic analysis, see Leydesdorff and Hellsten (pp. 237-243).

³⁸ 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 engaging dispute. Let's just say that what matters to cartographic practice is not how 'actor' is defined, but if every contribution to collective existence (intentional or not) is fairly acknowledged. For the clearest illustration of what this means see Michel Callon's (1986) description of the domestication of the scallops and fishermen of St Brieuc Bay.

among different social collectives as they are both composed and component of networks. Consider any biotech cultivar: each single transgenic seed is the result of the coordinated work of an extensive net made of scientific protocols, field's trials, research investments, technical instruments, industrial patents. At the same time, each little seed contribute to a wider network which gathers global corporations, scientific laboratories, activists' organizations, national and international legislation³⁹. Contemplating GMOs in isolation, forgetting all the work they do and by which they are done, is the surest recipe for incomprehension. Actors are such because they inter-act, shaping relations and being shaped by relations. Social cartography cannot overlook this relational dynamism: 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. It all depends on the sort of action that is flowing from one to the other, hence the words 'net' and 'work'. 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, p. 63).

4. *From networks to cosmos.* The emphasis we laid on networks dynamics should not lead 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 means that those who fight them are not lead by a desire of 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 and stronger capitalistic economies. 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 ideologies⁴⁰ should not be underestimated. Of course, they have nothing to do with the actual magma of collective existence, but this doesn't mean that they cannot affect it. Ideologies are not meant to be description 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 *cosmos*. As such, ideologies can be more influential that any realistic calculation. Observation, therefore, cannot be limited statements, actions and relations, but has to extend the meaning that actors attribute to them. Only roaming from cosmos to cosmos, social cartographers can perceive the full extent of their controversies.

³⁹ See for example the case of 'Terminator's seeds' in Venturini, 2008.

⁴⁰ Bruno Latour (2005) calls them 'panoramas' (see pp. 187-189).

5. *From cosmos 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 of it. According to this idea (which can be traced back to Plato's cavern⁴¹), both ideologies and controversies derive from the imperfection of human intellect. Too many bias, interests, illusions, concerns distort the subjective vision of the world, so much that men are lead to believe that they live in different cosmos and that should fight for them. If all men could see reality as it really is, they would peacefully and rationally negotiate their collective existence. Besides being too man-centred (as it forgets that not all social actors are human being), 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 held – reality can finally be revealed and everyone will eventually agree (whether he likes it or not). Unfortunately (or rather fortunately), no matter how confident these prophets may sound, not everyone eventually agrees. That's one of the crucial lessons of the cartography of controversy. 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 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, 1994c, p. 455).

How to build rich observation devices

Actor-Network Theory and Bruno Latour are often accused of not taking stand on the issues they study and being therefore politically naïve (believing that social sciences could observe and describe without interfering with their objects) or cynical (believing that social sciences can't influence social life). What we said about 'just observing controversies' may someday confirm such critiques. Multiplying actors and perspectives, viewpoints and arguments might be mistaken for an expedient to avoid commitments. This is not the case: ANT never tried to elude its responsibilities and never questioned the fact that social sciences *could and should* contribute to public debate. The problem is *what* contribution should they give and *how*?

According to ANT, the role that research should play in collective disputes is not of steering their closure. Actors (not scholars) are responsible for deciding controversies. Once

⁴¹ See Latour (2004d, pp. 10-18) for a discussion of the meaning and purpose of Plato's myth.

again, it is a matter of respect⁴². Controversies belong to actors: it was actors who sow their seeds, who raised their sprouts, who nurtured their development. Scholars have no right to jump in and impose their solutions. Researcher 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 ways⁴³. Its purpose is not to silence discussion in the name of *Scientific Truth*, but to show that many more truths deserve to be listened to.

It is true: ANT is often hesitant when it comes to taking a stand, but such hesitation doesn't come from naivety 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 cosmos, 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 complicate, subtle and ever-changing to be sliced as a Gordian knots. The worthiest contribution that cartographic observation can give to collective discussion is not to reduce its complexity, but to make sure that it remains complex enough for every voice to be listened to.

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, as only in quarrels, disputes and fights, new actors can make their way to the surface of society. When we *describe* controversies, we contribute to the solidification of some portions of social magma reducing its complexity to a manageable level. 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. 108-116). While redefining political processes in contemporary collectives, Latour introduced four recommendations that can be easily extended to the practice of social mapping.

⁴² To be sure, respecting actors does not mean believing they are infallible. Actors rarely close controversies for their best. Controversies are nothing like rational negotiations among reasonable actors: they are conflicts and conflicts are often decided by force and violence. Acknowledging that might is often right, however, does not authorise scholars to take the place of actors. In the first place, because no actor is ready to concede such authority to social sciences. In the second place, because arrogating to social sciences the right to decide on social issues would only substitute an abuse with another.

⁴³ The interest of social cartography for all available viewpoints derives largely from the 'strong program' of the sociology of science developed at the University Edinburgh and from its "symmetry requirement" (Bloor, 1991, pp. 175-179). Requiring scholars to use the same explanatory resources both for the successes and failures of science, this principle was explicitly introduced by David Bloor as an expedient "to restructure our curiosity." (p. 176).

“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 proposition 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).

There is nothing particularly original in these requirements. No serious investigation in social sciences could do without observing the complexity of collective life *and* simplifying it through descriptions. What is groundbreaking is not recognizing the existence of these two sets of steps, but revealing their contradiction □ for there is an evident contradiction between exploring the infinite richness of social landscape and drawing a map to make such landscape graspable. 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 lightly.

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 requirement (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 evaluate the observation work of his students, Bruno Latour prizes *articulation* (the skill of ‘being affected by differences’) much more than accuracy and consistency⁴⁴. 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 not to reduce 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 to collective existence: “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: p. 259) Far from eluding commitments, the cartography of controversy takes

⁴⁴ “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... There is no such trauma with articulation because it does not expect accounts to converge into one single version that will close the discussion... Articulations, on the other hand, may easily proliferate without ceasing to register differences. On the contrary, 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: pp. 210, 211).

the strongest political stand: not just changing the world, but giving others the chance to do so⁴⁵.

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⁴⁵ "We, researchers, users, sponsors, simple citizens, students or journalists, we are all confronted to a new question: how could we display all the opposing versions of the technological and scientific issues, which, in every interesting matter, require our attention and our deliberation? How could we find an objectivity which doesn't lie on a deferential silence, but on the range of contradictory views on the same issues? How could we reconnect all these versions to build our own opinion? This is the challenge of the cartography of controversy" (Latour, 2007: 83, translation supplied).

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