Public controversies and the Pragmatics of Protest

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Toward a Ballistics of collective action

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EHESS, Paris

February 2009

NB This paper has been written as a support for a communication given at Harvard University, "Culture Workshop" Feb. 2009, 13th. Resulting from a first rewriting of different working notes, fragments of reports or communications given during last few years, the draft sent for discussion has been rewritten a few weeks after to give the present version. For their help in translation and for their advice, discussion and encouragement, I am grateful to Josquin Debaz, Jean-Michel Fourniau, Sheila Jasanoff, Claire Lamine, Michele Lamont, Markku Lehtonen and Christiane Louis.

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Abstract

By using long run case studies and comparative analysis, I will address different processes by which alerts and criticisms are taken seriously by different actors and lead them to transform or to defend devices, norms and institutions. To deal with this kind of process, I will present an analytical model which runs on the recent controversies about radioactivity, GMOs and nanotechnologies. For many years, these fields have been marked by struggles in which scientific arguments are seldom dominant but are nevertheless relevant. I will underline the way by which actors produce different knowledges and alternative visions of future of science and technologies in society. How do controversies, public debates, court trials and political mobilizations affect the course of scientific development and innovation? This research takes place in a larger program on disputing processes. In this program, a key issue is at stake: in what conditions new arguments could appear, could be transformed in common features and could inform the design of standard devices? I will show how sociology may organize its laboratory to follow actors who have the competences to mobilize networks and tools, and who are able to produce discourses, testimonies and expertises. What kind of device must we use to ground our descriptions when Internet provides massive discussions and informations, so difficult to evaluate? Empirical and theoretical aspects can communicate by using a set of sociological tools built around Prospero software. The main goal is to provide instruments for analyzing the operations that persons and groups perform when they resort to alarm, criticism, claim or political action. The result could be a sociological ballistics, enabling us to really follow actors and arguments through a wide series of arenas by which public controversies and social conflicts arise and are transformed.

Keywords

Argumentation, Conflicts, Controversies, Crisis, Pragmatics, Precautionary Principle, Protest, Public Issues, Risks, Social Movements, Sociology, Science and Technology Studies, Trajectories
Asbestos, GMO, Nanotechnology, Nuclear waste, Radioactivity

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For a decade, in France, a new trend in sociology has been trying to find its own way at the crossing points of four academic fields: political sociology, science studies, argumentation theory and sociology of alerts and risks. Involved in different research programs with a group of colleagues, I am trying to exploit the cross-fertilization of these very dynamic fields through the analysis of big issues like controversies about asbestos, radioactivity, GMOs, nanotechnologies or microwaves dangers, and many other cases. The collected materials are rich enough to provide many configurations of actors and arguments. They help us to describe the transformations or trajectories over time of argumentative configurations, and to detect and formalize characteristics of different public controversies commonly defined as typical risk society issues[1]. The works to which I am referring here is anchored in a pragmatic sociology which has been developing in order to create a space of recombination between general sociological concerns and the STS field. Thus, this paper aims to provide, and put into discussion, analytical categories and tools which are more balanced between the cognitive and political levels. Even if many watchwords turning around "science in democracy" seem to achieve this program, some real difficulties rise when we try to follow, in many arenas, a large set of actors and arguments. We must be precise in our language of description to understand more closely what is a strong argument, what kind of public proof is able to end controversies, what range of values and principles are relevant for actors, and what kind of background conflicts will still resist to political attempts of regulation or social acceptability. With this intention, I rely on the analysis of complex affairs and controversies where, of course, science and technology may easily be found, as they are pervasive through our societies, but where other questions arise, like: what is a collective action? What is a norm? What is an institution? What is "public opinion"? Who do activists really represent? Why people accept, or not, to participate to public debates? What is an acceptable standard or a grounded norm? Thus, we need to use comparative analysis on different affairs, to build transversal analytical tools which enable matters to enrich one another.

This argumentation will be presented in five parts (1) I will come back to the theoretical background of the surge of new pragmatism in France since the early 1990's; (2) in order to show that we have left the "risk society", the one Beck had defined in the late 1980s, I will give a quick overview on a general configuration which can be described as a tension between two major trends: the rise of participatory democracy and of new social protest on one side, and the development of policies oriented towards "global security" on the other side; (3) afterwards, I will consider different fields – nuclear power, GMOs, nanotechnologies and other ones – and try to show how criticism is engaged in such big issues. (4) I will return to theoretical aspects of sociology: how do we conceive the balance between controversy, defined as an argumentative activity, and conflict, which is often based on political struggle? I will first look at the place of argumentation in sociological descriptions and (5) I will suggest a form of modelling developed around the notion of "ballistics". In the aim to fulfil the new pragmatic program, this model is based on a description of the different combinations of actors and arguments and of the transformations of these combinations in the course of contemporary public issues.

[1] See Barbara Adam, Ulrich Beck and Joost Van Loon (eds), The Risk Society and Beyond (Sage, 2000).

1. Sociology, Pramatics and social criticism. Should we go back to grounded pragmatism or must we boot a post-pragmatic turn?

I do not share the idea of a recent "pragmatic turn" in sociology. A first reason is that the idea of "pragmatic turn" engages the long run history of social sciences, with great founders such as Peirce, James, Dewey or Mead, and is closely linked to the pragmatic shift in linguistics, with Austin's and Searle's famous studies on speech acts and performatives. A second reason is that classical ways of making sociology still dominate in academic fields in Europe and that, factually, the pragmatic claim concerns small epistemic communities, even if some concepts and theoretical grids or tools have gained some clear success in the last years. As an evidence, we find a weak inscription of "new sociologies" in French universities and research institutions. But undoubtly, there is a powerful intellectual dynamics in this sector of the social sciences and many colleagues now read, comment and apply key ideas of Science and Technology Studies (STS) or pragmatic sociology. From a certain point of view, these currents operate like laboratories of ideas with a tangible influence, but with some problematic distorsion, on sociology, on political sciences, on anthropology and even on history - but no real influence on economics after the failure of the economics of conventions, a trend relegated to the margins as a business of heterodox economists ...

In France, partly in contestation to Bourdieu's hegemony, many controversies have been mobilizing "new sociologists" in many camps or paradigms. One common feature can be summarized as follows: actors are very skilled and social scientists must be treated as actors without any kind of epistemological privilege. Although they share many presuppositions, "actor network theory" (Latour and/or Callon) can be opposed to "moral sociology" (Boltanski & Thévenot) and to "the modelling of situated actions", a community oriented towards the renewal of ethnomethodology and interactionism programs (Quéré, Pharo or Conein). New trends in pragmatic sociology try to rearticulate these different approaches. Talking about pragmatics of transformation, the sociology which I defend is first concerned with the grips or grasps ("prises") developed by lay or professional actors to keep a hold on their ordinary world, and the problems which arise when they experiment a break or a lack of grip or grasp. Alerts, controversies, polemics and crisis appear like heuristic moments in which new systems of action and judgment can be adopted by many actors, even if conflict persists. I must underline here a huge difference with a habermassian standpoint: actors and arguments involved in the processes do not necessarily seek an agreement, and a new balance of power, a new space of public positions is a result as important as a new regulation principle or institution which supposes a general agreement. More recently, the so-called pragmatic turn in sociology has got a new problem since social criticism, almost left for dead in the late 1990s becomes again, with the new century, a major topic for many actors and institutions.

Theoretical background	Main domain of validity
Fields, habitus and social theory (Bourdieu)	Social trajectories, activities and tastes in groups, symbolic imposition of cultural norms, modes of legitimation in fields of power
Discursive Democracy (Habermas)	Public debate on public debate and rules of democracy
Ethnomethodology (french version of situated action: Quéré)	Cognitive procedures in context, practical reasoning, production of accounts in front of troubles and the routines of everyday life
Sociology of justification (Boltanski and Thévenot)	Sense of justice and opposite definitions of public good from ordinary interactions to public affairs
Actor Network Theory: re-assembling the Social (Latour and/or Callon)	Science in action, controversies, innovations and public assessment of research programs
Argumentative Sociology and Pragmatics of transformation (GSPR and friends)	Emergence and trajectory of new sets of actors and arguments through a wide range of arenas; shifting process between controversy and conflict

In a paper first published in French, Thomas Bénatouïl, a philosopher of social sciences, made a comparison between what he called two paradigms, well represented according to him, by Bourdieu's theory on one side, and Boltanski's theory on the other side[2]. His paper tries to elaborate a compromise and invites to go beyond this theorical opposition. Nevertheless difficulties persist to accept without a deep discussion the framework provides by the two approaches. The "total sociology" developed by Pierre Bourdieu, and prolonged nowadays, with an interesting aggiornamento by a sociologist like Bernard Lahire, supposes that each event, dispute or process is overdetermined by the social positions of actors, who are defined by the relations between habitus and social fields in which they get capital and legitimacy. These relations are studied through main social properties and the most important thing here is to unveil forces and structures under the apparent actions and discourses. Actors have some reflexivity but this reflexivity is relativised by their position in the fields and the way they reached this position. Even if it is true to say that Bourdieu's theory is not simply determinist, it focuses on the social determination of actions and judgments. On the opposite side, Boltanski's standpoint, and more especially Boltanski and Thévenot in their pragmatics of justification[3] , gives a large leeway to actors who are able to shift and to change the frame of situations, and in the same movement, have an important reflexivity on social constraints – even if this reflexivity is equipped by the social sciences themselves. The problem here is not determinism but the importance that the authors give to moral and justice, as if the whole

[2] T. Bénatouïl, "A Tale of Two Sociologies. The Critical and the Pragmatic Stance in Contemporary French Sociology", European Journal of Social Theory, vol. 2, n° 3, août 1999, pp. 379-396.

[3] L. Boltanski and L. Thevenot, On justification. Economies of Worth, Princeton University Press, 2006.

range of social situations and processes were run by problems of justice – as it tends to be claimed by an author like Axel Honneth[4].

Another position, well known in the STS field, and also more and more active in political studies, is held by the movement called ANT (Actor Network Theory). Bruno Latour tried to put at a distance this approach in his latest texts and books, but the background paradigm remains unchanged: there is no one science and one society but only articulations of many associations involving and mixing together heterogeneous human and non-human actors, which sociologist must describe in action – even if "action" consists here of bargaining and connecting in networks. Commenting the famous Latour's watchword "follow scientists and engineers through society"[5], S. Jasanoff notes that "simple to state, that injunction has proved not so simple in practice", because the "pathways that scientists, and their close kin in medicine and engineering, trace through society in modern times have grown increasingly complex"[6]. In order to handle this complexity we must go beyond speaking of science and society, or science and democracy, by elaborating a more consistent description language than the rhetorics based on actors and networks. One way is to reactive the theory of inquiry[7]. The central focus of Dewey's philosophy was what has traditionally been called "epistemology". However, Dewey expressly rejected the term "epistemology," preferring the "theory of inquiry" or "experimental logic". As a result, the concept of *reality test* is central to the framework of pragmatic sociology[8]. Agreement between actors is not exclusively based on rhetorics. In order to confirm or disprove different interpretations of reality, objects, environments and devices must be incorporated in arguments and reasons. They reduce uncertainties on the appropriate actions to be taken. But in some cases, disagreement rises and the actors enter in violent struggle or at least in long run polemics. So, knowing that Dewey's theory of inquiry is a kind of standard for STS and sociology of participatory democracy, what's new in the pragmatic stance in contemporary French sociology? I can summarize it in three points:

- A sociology of grips or grasps[9]. These notions concern the means that lay or professional actors develop in their ordinary world in order to keep control on current actions, and the

[4] A. Honneth, The Struggle for Recognition: The Moral Grammar of Social Conflicts, Polity Press, 1996.

[5] B. Latour, Science in Action: How to Follow Scientists and Engineers Through Society, Cambridge, MA: Harvard University Press, 1987.

[6] S. Jasanoff, "Making Order: Law and Science in Action", in Handbook on Science and Technology Studies, 3rd ed., MIT Press, 2008, p. 761.

[7] See the volume edited by B. Karsenti and L. Quéré, La Croyance et l'Enquête: aux sources du pragmatisme « Raisons pratiques », Paris, Éd. de l'EHESS, 2004, 349 p.

[8] In my attempt to deploy pragmatics on long run issues, I do not focus only on moral aspects of disputes. For the connection between moral issues and reality test, see L. Boltanski & L. Thévenot, "The Reality of Moral Expectations. A sociology of situated judgment", Philosophical Explorations, vol.III n°3, september 2000 (transl. by Jo Smets), pp.208-231.

[9] The concept of "grip" (in French "prise"), is difficult to translate by an analog word in english. It is possible to introduce the notion of a "hold", where the subject may "have a hold over" and/or "be afforded a hold". In french the term « prise » has a very large range of meanings and has been used to conceptualize the relationships between persons, objects and environments through a perceptual work which can be distributed on a continuum joining transparence of external world and pure representationnal activity. Many terms may be used to mean "prise": grip, grasp, hold, purchase ... it must be ajusted in context. For an application, see the paper on alerts,

problems which arise when they experiment a break or a lack of grip. The main argument here is that perception is not representation; actors are not always governed by representations and are able to develop different grips by acting in the world; how do people manage the gap between the sensitive world, experimented in action, i.e. hand to hand experiences, and collective expectancies based on knowledge or belief? It is another way to consider a very classical problem: "people have many representations, now let us look at what happens in practice"! In order to produce a social world, persons and groups need "common grips".

- The precise description of processes by which an alert or a criticism is taken seriously by different actors and enables them to transform collective devices, norms and institutions. This aspect is especially developed in the research I have developed in collaboration with Didier Torny[10]. I will return more deeply on this aspect by showing how the proliferation of alarming signs has changed the social condition of whistleblowing processes.

- A third point is concerned by the following question: what kind of disputing procedure is available and how actors deal with the plurality of debate arenas or with the different forms of public discussion? How controversies, public debates, court trials and political mobilizations affect the course of social transformations? It takes place in a larger program on disputing processes. In this program, a key issue is at stake: in what conditions new arguments could appear, could be transformed in common features and could inform the design of standard devices? We can see here a circular property which describes a social learning process: through disputing trials, common grips based on tangible assertions, outgoing from collective tests, are gradually embedded in ordinary practices.

Another important aspect of this fieldwork is concerned with data processing and the design of what we call socio-informatics, in order to adapt social science in front of the web revolution which has transformed many notions and social problems, at least the relationship between scholars and citizens, and, in the same movement, the status of public information and collective action. In this paper I will only focus on the sociological program, relegating computers and sociological softwares in a short annex[11]. But keep in mind that there is a strategic connection between sociological inquiries and the design of instruments: a pragmatic sociology must help to define alternative tools or to reformulate classical ways of processing with complex data. And it can achieve this goal by underlying two main characteristics forgotten in other methods: the way by which actors build arguments and the key role of temporal modalities[12].

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awareness and responsabilities of human agents at the workplace, in "Vigilance and Transformation. Corporal Presence and Responsibility in the Operation of Technological Apparatus" Networks, first published in 1997.

[10] The principal publication is Les Sombres précurseurs (The Dark Forerunners. A pragmatic sociology of alert and risk (1999); you will find an update with an english paper called: "Mobilising around a risk: from alarm raisers to alarm carriers" (2005). (Available on line)

[11] See G. Bowker, L. Star, W.A Turner, L. Gasser (eds.), Social Science, Technical Systems and Cooperative Work: Beyond the Great Divide, New Jersey: Lawrence Erlbaum Associates, 1997; T. Malsch, "Naming the Unnamable: Socionics or the Sociological Turn of/to Distributed Artificial Intelligence" draft sent by the author, september 1999. F. Chateauraynaud, Prospéro. Une technologie littéraire pour les sciences humaines, Paris, CNRS Editions, 2003.

[12] R. Kosseleck, Futures Past: On the Semantics of Historical Time, Columbia University Press, 2004; F. Chateauraynaud, "Visionnaires à rebours", GSPR, 2007 (text available on line).

2. Beyond risk society: a focus on the means used by actors to identify and control old and new risks

One can find many differences between a pragmatic sociology of risks and the well known theory developed by Ulrich Beck:

"Risk society begins where nature ends. As Giddens has pointed out, this is where we switch the focus of our anxieties from what nature can do to us to what we have done to nature. The BSE crisis is not simply a matter of fate but a matter of decisions and options, science and politics, industries, markets and capital. This is not an outside risk but a risk generated right inside each person's life and inside a variety of institutions. A central paradox of risk society is that these internal risks are generated by the processes of modernization which try to control them. » [13]

The problem here is the high level of integration that Beck's "model" supposes. Can we go back to such a macro level of theorizing without describing precisely a large range of processes – knowing that many of them are not even over? In the introduction of the collective book The Risk Society and Beyond (2000), Barbara Adam and Joost van Loon wrote:

"The essence of risk is not that it is happening, but that it might be happening. Risks are manufactured, not only through the application of technologies, but also in the making of sense and by the technological sensibility of a potential harm, danger or threat. One cannot, therefore, observe a risk as a thing-out-there – risks are necessarily constructed. "

For the authors, analysing risk therefore takes us out of both "the empirically accessible world of social facts" and "the sphere of pure social construction". This is so because of three properties: latency, invisibility and contingency. Thus a sociology of risk find a difficulty at two different levels: "it forces theorists to transcend not only the choice between realism and constructivism but also the reliance on the empirically accessible world of social facts." It is true that a significant number of technologically-induced hazards, such as those associated with chemical pollution, atomic radiation and genetically modified organisms, are characterized by an inaccessibility to the senses:

"They operate outside the capacity of (unaided) human perception. This im/materiality gives risk an air of unreality until the moment at which they materialize as symptoms. In other words, without visual presence, the hazards associated with these technologies are difficult to represent as risks, let alone sustain their 'existence' beyond their momentary emergence. Radiation from nuclear power is a case in point."

I agree with a part of this argument but to my opinion, there is a paradox in the definition of "perception". How is it possible to say at the same time that risk perception is a social construction because we have no accessibility and that the main characteristics of risk are

[13] Ulrich Beck, Politics of Risk Society, 1998.

latency, invisibility and contingency? In fact, this argument underlies two definitions which are not completely clarified: a conception of perception as a natural process (like the "direct perception" in a cognitive definition) or as a pure representation. The main point is not that risks are immediately visible or not but:

1/ they suppose a computational space based on a representation of the future;
2/ they involve different tools and modes of perception to become tangible, and, thus, some precedents in which actors had an experience of real danger;
3/ scientists, experts and public actors (administrations, firms, NGO...) may share grips with ordinary people to reduce the gap between everyday life and political agenda.

As we have seen above, the concept of *reality test* is central to the pragmatic framework. Agreement between actors is not exclusively based on rhetorics. To confirm or disprove different interpretations of reality, objects, environments and devices must be incorporated in arguments and reasons. This is the way uncertainties over the appropriate actions to be taken are reduced.

What happens when too much alarming signs are threatening the alarm processes by invading public space?

In a recent book, World at Risk, Ulrich Beck shows that risk – future events that may occur, that threaten local and global entities – becomes a political force that transforms the world[14]. In this part of the paper, I will come back to the question of global risk issue and especially to the balance of power between global security forces (drawing a quite anti-utopian world) and the civic movements aiming to establish a largest participatory democracy, in which threats, dangers and risks are caught by public and citizens. We have to keep in mind that issues like climate change or avian influenza tend to bring together classical risk assessment and political and economical questions about inequalities and the redefinition of global governance.

Nowadays, we attend a proliferation of sources of alarm and risk. Henceforth, all is potentially transformed into alarm, controversy or public discussion. The widespread use of the category of risk throughout society and in daily life reflects its importance in the rationalisation process of our time. Commentators say that a *new sensitivity to risk* has appeared as a result of the rise of material comfort and individualism in western societies. Many authors have built a global representation based on the idea that in a mass consumption society, the social solidarity of class and the sense of belonging to a community are losing ground, while new social movements and networks of actors are emerging. It is stating the obvious to say that the mobilization of the civil society and more particularly the rise of environmental concerns are putting into question the political authority. The faith in progress that has dominated western societies until recently has rendered, in the eyes of many actors (ecological associations, real or potential victims), the state and its public agencies responsible of the containment of risks. But this task is ever more difficult to perform as the economic sphere is getting more autonomous and influent as a result of globalization. And the nation-state has become too small to manage technological risks, since they often have cross-border effects. Among these new risks, one finds:

[14] U. Beck, World at Risk, Polity Press, 2009.

- Major technological risks. They are generated by industrial complex and their damage is close to those generated by natural risks. They encompass chemical hazards like Seveso in Italy, Bhopal in India or atomic hazards like Chernobyl in Ukraine.

- Food and sanitary risks. They are resulting from the interplay of the market and technologies: for instance the contamination to HIV/AIDS in the contaminated blood crisis, the bovine spongiform encephalopathy (BSE or “mad cow disease”) resulting in the development of the variant of Creutzfeldt-Jakob disease in humans, the intensive struggles around GMOs (genetically modified organisms), and last but not least, the bird flu / avian influenza global alert.

- Environmental risks. They stem from mass consumption and the consequences of industrialization on the climate, the ozone layer, the quality of water, the accumulation of pollutants in the ground. One of their characteristics is to be global in scope: the climate warming or the depletion of the ozone layer have effects that concern the whole planet. People and states are more than ever interdependent from each other, since their behaviours have an impact on others in proportions which had never been reached before.

These are obvious features today and common sense has been clearly modified by these figures. Focus on forms of manifestation of the hazards and risks in the sensitive world leads to be attentive to the grips or grasps developed by social actors. But the making of grips or grasps may depend on the evolution of common representations. Thus, in ten years, the mode of existence of risks in the public arenas has completely changed in its nature and form. The period of crisis, began in France with the tainted blood affair that arises in public space only in 1991, reached a high point with the chaining of four consecutive major issues: asbestos returned after 15 years of "silence"; the nuclear issue hit the headlines with alerts in La Hague and the tenth anniversary of Chernobyl (1996); at the same time, the mad cow crisis arised, and, a few months later, it was the turn of GMO with a shipment from the United States intercepted by Greenpeace in autumn 1996.

All these issues have one thing in common: science and technology play a decisive role and the question of the validity of expertise and forms of regulation related get a strong meaning for all actors involved. 1996 was also the year of widespread references to the "precautionary principle", coming from a long series of studies and discussions, especially through the Rio Summit (1992). At the turn of the century, sources of alert and dramatic events saturate the political and media arenas, along with an extension of the risks linked to terrorism in all its forms (the threat of bioterrorism is central since "9 / 11"). We can notice, in public discourses, an increasing presence of serial reasoning, pointing to the idea that the world has entered an era of instability and huge uncertainty. I will come back to this notion of “uncertainty” now incrusted in public argumentation and playing the role of a doctrinal watchword for authorities and experts.

Depending on contexts, different figures are associated: events such as the burning of the Mont Blanc tunnel (1999), the explosion of the AZF factory (September 2001), the Concorde crash (July 2000), the mad cow crisis (1996-2000), the SARS outbreak (2003) and the risk of pandemics linked to avian influenza (2005-2007) ; the rise of the global alert on the climate and the occurrence of the "big one" with the December 2004 tsunami[15]; on another line, you

[15] See Bill McGuire, “The Enemy Within. Super-Eruptions, Giant Tsunamis, and the Coming Great Quake”, Global Catastrophes, Oxford University Press, 2002.

will find as series organized around the attacks of 11 September 2001; with bombing in Madrid (March 2004), London (July 2005), Bombay (2008). Here and there, bridges collapse, airplanes crash, toxic waste spread, ferry reverse, fires rage, and floods devastate entire regions. And many commentators, taking the role of the prophet of doom, say that it will go from bad to worse! Indeed, artefacts which are intended to cure, treat or replace (drugs, substitute products, technological innovations, including the famous nanomaterials) engenders mistrust and anxiety, alarm and controversy - as shown by the numerous cases of "withdrawal of product", whether cocktails therapeutic or toys for children. No milieu and activity seems preserved, so that any precursor achieving a sufficient degree of public visibility produced great excitement that generates roughly the same configuration: Actors announce impending disaster, journalists convene experts generally do not agree, government and industry say they will be vigilant and set up committees or commissions to curb the danger.

With climate change and avian influenza issues, prophecy of doom has become an official way of communication.

Ten things you need to know about pandemic influenza (WHO, 14 October 2005)

1. Pandemic influenza is different from avian influenza.

Avian influenza refers to a large group of different influenza viruses that primarily affect birds. On rare occasions, these bird viruses can infect other species, including pigs and humans. The vast majority of avian influenza viruses do not infect humans. An influenza pandemic happens when a new subtype emerges that has not previously circulated in humans. For this reason, **avian H5N1 is a strain with pandemic potential**, since it might ultimately adapt into a strain that is contagious among humans. Once this adaptation occurs, it will no longer be a bird virus--it will be a human influenza virus. [...]

2. Influenza pandemics are recurring events.

An influenza pandemic is a rare but recurrent event. Three pandemics occurred in the previous century: "**Spanish influenza" in 1918**, "Asian influenza" in 1957, and "**Hong Kong influenza" in 1968**. The 1918 pandemic killed an estimated 40–50 million people worldwide. That pandemic, which was exceptional, is considered one of the deadliest disease events in human history. [...] A pandemic occurs when a new influenza virus emerges and starts spreading as easily as normal influenza – by coughing and sneezing. Because the virus is new, the human immune system will have no pre-existing immunity. This makes it likely that people who contract pandemic influenza will experience more serious disease than that caused by normal influenza.

3. The world may be on the brink of another pandemic.

Health experts have been monitoring a new and extremely severe influenza virus – the H5N1 strain – for almost eight years. The H5N1 strain first infected humans in Hong Kong in 1997, causing 18 cases, including six deaths. Since mid-2003, this virus has caused the largest and most severe outbreaks in poultry on record. In December 2003, infections in people exposed to sick birds were identified. Since then, over 100 human cases have been laboratory confirmed in four Asian countries (Cambodia, Indonesia, Thailand, and Viet Nam), and more than half of these people have died. Most cases have occurred in previously healthy children and young adults. Fortunately, the virus does not jump easily from birds to humans or spread readily and sustainably among humans. [...]

4. All countries will be affected.

Once a fully contagious virus emerges, its global spread is considered inevitable. Countries might, through measures such as border closures and travel restrictions, delay arrival of the virus, but cannot stop it. The pandemics of the previous century encircled the globe in 6 to 9 months, even when most international travel was

by ship. Given the speed and volume of international air travel today, the virus could spread more rapidly, possibly reaching all continents in less than 3 months.

5. Widespread illness will occur.

Because most people will have no immunity to the pandemic virus, infection and illness rates are expected to be higher than during seasonal epidemics of normal influenza.[...] Few countries have the staff, facilities, equipment, and hospital beds needed to cope with large numbers of people who suddenly fall ill.

6. Medical supplies will be inadequate.

Supplies of vaccines and antiviral drugs [...] will be inadequate in all countries at the start of a pandemic and for many months thereafter. Inadequate supplies of vaccines are of particular concern, as vaccines are considered the first line of defence for protecting populations. On present trends, many developing countries will have no access to vaccines throughout the duration of a pandemic.

7. Large numbers of deaths will occur.

[...] Death rates are largely determined by four factors: the number of people who become infected, the virulence of the virus, the underlying characteristics and vulnerability of affected populations, and the effectiveness of preventive measures. Accurate predictions of mortality cannot be made before the pandemic virus emerges and begins to spread. **All estimates of the number of deaths are purely speculative**. WHO has used a relatively conservative estimate – from 2 million to 7.4 million deaths – because it provides a useful and plausible planning target. This estimate is based on the comparatively mild 1957 pandemic. [...]

8. Economic and social disruption will be great.

High rates of illness and worker absenteeism are expected, and these will contribute to social and economic disruption. Past pandemics have spread globally in two and sometimes three waves. Not all parts of the world or of a single country are expected to be severely affected at the same time. Social and economic disruptions could be temporary, but may be **amplified in today's closely interrelated and interdependent systems** of trade and commerce. Social disruption may be greatest when rates of absenteeism impair essential services, such as power, transportation, and communications.

9. Every country must be prepared.

WHO has issued a series of recommended strategic actions [pdf 113kb] for responding to the influenza pandemic threat. The actions are designed to provide different layers of defence that reflect the complexity of the evolving situation. [...]

10. WHO will alert the world when the pandemic threat increases.

[...] WHO works closely with ministries of health and various public health organizations to support countries' surveillance of circulating influenza strains. A sensitive surveillance system that can detect emerging influenza strains is essential for the rapid detection of a pandemic virus. Six distinct phases have been defined to facilitate pandemic preparedness planning, with roles defined for governments, industry, and WHO. The present situation is categorized as phase 3: a virus new to humans is causing infections, but does not spread easily from one person to another.

What is the political meaning of such a dramatic communication? A controversy arises when FAO (Food and Agriculture Organization) contested this world wide alarm arguing that veterinary experts must be more supported by international organizations and national governments, and, at the same time, a greater help must be provided to farmers in zones of outbreaks. A shared interpretation says that the precedent of SARS spread in 2003, which revealed serious difficulties of coordination at international scale, had definitely persuaded WHO's experts on emerging diseases that a strong signal, even flirting with catastrophism, is more efficient than a conventional, and weak message: the one best way to provoke adequate

preparation plans in all the countries[16]. But there is another process at stake here: scientists, experts and politicians seem to share a general scheme named “global security”, in which many kinds of issues are mixed together: the risks in health and environment are less and less treated apart and are now associated, not only with natural catastrophes or technological breakdowns, but with economical crisis, political conflicts around the world and, sign of times, with terrorism. By contrast, the surge of democratic expectations and of open and transparent debates in an information society created a huge tension: the contradiction between the rise of participatory democracy and of new social protest on one side, and the development of policies oriented to "global security" on the other side, takes a particular dimension in conflictual issues like nuclear or GMOs, and is latent in the field of nanotechnologies.

Uncertainty, reversibility and the precautionary principle

Conceived as a moral and political principle, the precautionary principle states that if an action or policy might cause severe or irreversible harm to the public or to the environment, in the absence of a scientific consensus that harm would not ensue, there is a responsibility to intervene and protect the public from exposure to harm.. The main idea, especially in Europe, is that public authorities must help scientific investigation in order to discover plausible risk - the worst attitude being th one which consists to wait evidence through the rise of illness or catastrophe. The protections that mitigate suspected risks can be relaxed only if further scientific findings emerge that more robustly support an alternative explanation. In some legal systems, as in the law of the European Union, the precautionary principle is also a general and compulsory principle of law. In France a Charter for the Environment was put in the country Constitution, after the will of the former President, Jacques Chirac, expressed in a public discourse in 2003.

“Art 5 - When the occurrence of any damage, albeit unpredictable in the current state of scientific knowledge, may seriously and irreversibly harm the environment, public authorities shall, with due respect for the principle of precaution and the areas within their jurisdiction, ensure the implementation of procedures for risk assessment and the adoption of temporary measures commensurate with the risk involved in order to preclude the occurrence of such damage”

Even if, in this English version, the term of “uncertainty” is not engaged – the text focus on the idea of “unpredictability” – interpretations of this regulatory principle all insist on the reverse of burden of proof: even if you cannot prove a danger or a risk you have to show that you are able to act, to watch, to investigate and to take transitory resolution or disclose bad news before it would be too late. How do stakeholders manage this new constraint? It depends on the meaning they put on the word “uncertainty”. Let us distinguish three meanings of uncertainty: restlessness or fear; probability and computation; non-determination, vagueness of future orientation or unpredictability. The first meaning is linked to the ordinary sense of danger – and we all know that a certain degree of worriness is necessary to perform everyday activities in a constant vigilance; the second lies on a computational space: scientists often speak of uncertainties to point confidence intervals; the third one turns to history and the

[16] Some actors take support on the Dupuy’s Enlightened Catastrophism. See J.-P. Dupuy, Pour un catastrophisme éclairé. Quand l’impossible est certain, Paris, Seuil, 2002

question of democracy as an endless process. According to Claude Lefort democracy creates the condition for an ongoing debate, with "the dissolution of the markers of certainty" and the recognition of a "fundamental indeterminacy as to the basis of power, law, and knowledge"[17]. As he puts it: "Modern democracy invites us to replace the notion of a regime governed by laws, of a legitimate power, by the notion of a regime founded upon the legitimacy of a debate as to what is legitimate and what is illegitimate – a debate which is necessarily without any guarantee and without any end".

The precautionary principle so often invoked in Europe caused an inversion of the very old logical order between proof and action: henceforth, in case of uncertainty, a lack of evidence must lead to action and not to abstention. Far from removing the question of tangibility, this configuration gives it more weight: it is necessary to identify, "upstream", ambiguous signs, "weak signals" which are not yet tangible. In front of fleeting entities or imperceptible processes which give no grip to common sense, what kind of support can we get in order to build a conviction? Authority, routine, computation, waiting for further resolutions, are common means to compensate for a lack of tangible facts. In certain situations, these motives allow to "do without", to do "as if" – for instance, to do as if an absence of significant nuclear incident during the last years was a proof of nuclear safety. But such approximations could expose protagonists to new developments or sudden revivals, to the differed return of reality test, temporarily repressed. After having sketched the main components of the precautionary principle, Godard discusses different types of catastrophisms and shows their lack of self-consistency. He has two targets: Hans Jonas (the principle of responsibility); Jean-Pierre Dupuy (the enlightened catastrophism).

"In spite of early confusion, the precautionary principle is very different from the principle of abstention that asks the promoter to bring the certain proof of safety of a product or a technology before it can be authorized, and the authorities to forbid any product or technology for which there is a scientific doubt. The main idea brought by the precautionary principle is that of earliness in taking account of potential threats of huge and irreversible damage to the environment. But this idea of earliness is counterbalanced by the requirement that precautionary measures are provisional and proportionate. Thus the precautionary principle is all but a catastrophism; moreover it is for good reasons that this principle has maintained itself far away from various forms of catastrophisms.[18]

Analysis of mobilizations and public decision-making processes in a wide range of domains reveals that three major parameters govern how an alert is transformed in radical protestation: the degree to which the "catastrophe" can be predicted; the degree of intentionality implied by the real or possible damage; the degree of reversibility attributed to the phenomena in question. Is there an agreement on the point of irreversibility? Afterwards: what would have happen if X instead of Y? The choice between relativization or dramatisation is first a matter of realistic temporal scale. How to predict catastrophes? / How to prevent catastrophes? We have seen above, how a prophecy of doom can be presented in a rational style, as a inescapable alert: necessarily, things will take a turn for the worse. Many authors predict that

[17] Claude Lefort, Democracy and Political Theory (Minneapolis: University of Minnesota Press, 1988), first published as Essais sur le politique (Paris: Seuil, 1986).

[18] Olivier Godard, "The principle of precaution is not a doomwatch", Contrôle (review of the french Authority of Nuclear Safety, ASN), february 2006.

a short time is left for humankind to avert an inevitable catastrophe. Many models and theories usually speak about a degree of reversibility. But is it possible to speak about something like a degree? What does it mean to compute a ladder of reversibility? What kind of calculus is implicitly involved in arguments which use such a notion? From a logical point of view, a process is irreversible or reversible. Let us make the hypothesis that referring to a degree of reversibility can mean three different things: the chance to repair some thing – a infectious or chronicle disease for instance; the practical perception of ways of acting, the kind of leeway you get in front of a process – avoiding conflict or war and returning to negotiation; the cost or the prize that an actor is able to pay to change a situation. Anyway, reversibility is connected to possibility of action, and more: it points out the ability to configure the conditions of possibility, to make things possible!

3. Case studies on new radicalism: how activists oscillate between counter-expertise and anti-scientific mobilization

In the following pages I will address more particularly the question of radical criticism – to point out processes or conflicts for which the notion of controversy is too weak. In other words, we need to go away from internal descriptions and analysis in order to follow actors who are concerned by science, research and technology but who frequently deny the necessity of a close understanding of the dynamics within pure scientific controversies: in front of a scientific statement, they jump to consequences and political attempts. In France, and, at some degree, in many countries in Europe, it is particularly the case in three battlefields: nuclear industry, GMOs in agriculture and food, and nanotechnologies. The three issues I suggest to compare are marked by an important level of activism and are on the border: the shift in political violence, including hard, even lethal, action or conflict, is always taken seriously as a real possibility. For instance, anti-nuclear movement, voluntary mowers or anti-nanotech groups try to create a new balance of power by using spectacular modes of action, which put them at risk, but produce some effects on what stakeholders call “public opinion” or “public perception”. There is a connection with the cognitive dimension widely developed by STS because of the kind of constraints met by critical actors:

- they must give some evidence to assess the negative consequences of the scientific or technological devices they contest; in order to achieve this critical task they show a clear preference for “consequentialism”, or “arguing by consequences”. Thus, they have to mobilize counter-experts; and the grasps or grips on which counter-expertise is built suppose a cognitive work, which is to learn a minimum from things occurring in the scientific fields.

- they must unveil economical interests and political purposes which show that scientific - knowledge is not developed to achieve the public good; and this point needs a double sociological skill: a bourdieusian objectivation of hidden interests and a latourian intelligence of socio-technical networks. It would take many times to show the base of this association but the two sociologies could work together, because of their common cynical view of actors and strategies. The difference essentially lays on the static conception of domination on one side, and the preference for dynamics and processes – things being done or “in action” – on the other side.

- Critical actors must show alternative or different ways of development: renewable energies, bio agriculture, open source technologies without any link between science, army and police (the core criticism developed for instance by PMO (a group of activists) in the city of Grenoble is the military-led development of nanotechnologies).

Even if we accept these main constraints, their description does not answer to the prior question: why such an anti-science activism? I suggest three hypotheses:

- First, the strong node between state, industry and science gives arguments to the idea that expertise and public communication about scientific research and its applications relies on a specific structure of lobbying. In France, the formation of the elite is always under control of the same "lobbies" – like the CEA [19]. Here actors are at odds with big asymmetries.

- Second, the three fields have in common a problem of ordinary hold or grip: radioactivity, transgenic process or nanoscience are clearly breaking all kind of continuity between everyday life way of perceiving things and scientific knowledge. The making of devices, plants, machines or laboratories produces a break in common sense; and radical criticism like worriness are normal attitudes for any rational person or group placed outside the techno-scientific area. And I will add: the "technical democracy" model, with "hybrid forums" and "public knowledge" do not take into account the costs implied by the conquest of solid grasps on scientific or technological developments.

- Third, the big divide in social sciences themselves generates a kind of loss of messages and signals when a precise description – e.g. of laboratory practices or scientific discovering – is put in circulation in public sphere. In other words, if you have paid the cost of going inside scientific activities, you do not share the same view and you have real difficulties to reconnect to social movements and so on. There are some exceptions, like in France the group "Science Citoyenne" in which you will find some sociologists or historians of science...

Environmental and anti-nuclear movements in France (1994-2008)

The commemoration is now a generalized ritual so that the anniversary of an event is an occasion for actors to start again alerts and controversies. It is the case every year, in April, with the Chernobyl accident. This accident was not only a rupture in the already long list of apocalyptic figures of catastrophes. It has contributed to deep changes in expert and lay visions of radiation dangers[20]. In the nuclear field, there is a big divide between health problems and safety problems. Protection against radiation is not a dominant issue or, more precisely, nuclear medicine had a small place in the organization of nuclear safety, and concerned mainly workers. The populations were not really considered as exposed to radiations. In France, if we turn to the evolution of the nuclear energy debates, health issues are recent ones: leukaemia around the Hague plant (1995-1996), thyroid cancers linked to

[19] The CEA (Commissariat à l'Energie Atomique) is the French government-funded technological research organisation; firstly involved in nuclear energy and nowadays engaged in many fields, like nanotechnologies ...

[20] See S. Boudia, "Global regulation: controlling and accepting radioactivity risks", History and Technology, décember 2007.

Chernobyl accident (since 2000-2001). The increasing call to scientific expertise in nuclear protest movement is very weak on the so-called thread "health-environment". From this point of view, the year 1994 was a turning point in France as the counter-expertise took an important place in the public controversies with the rise of "independent laboratories" well-equipped to launch radioactive alerts and to discuss official measurements [21]. The CRIIRAD played an important role in the emergence of the French association of sufferers of thyroid disease, demanding the conviction of those responsible for having 'disinformed' the French public about the nature and extent of the Chernobyl fallout in the country.

Three main points are at the "forefront" in the French nuclear field: an eventual coming trial on the government management of Tchernobyl consequences; the endless problem of nuclear waste and the opposition between local movements, associated with some area residents, and official agencies, especially ANDRA, around a project of landfilling radioactive wastes for a long period [22]; the new nuclear program and the public discussions about energies in a context characterized by a surge of radical criticism and a legal frame requiring a serious procedure of public debate. Because the relationships between public participation, pluralism of expertises and radical activism play a key role, and can be found in other domains (GMOs, nanotechnologies, microwaves ...) I will focus on the last issue[23]. One question is: why nuclear elites failed to create a system of regulation based on participatory devices? Perhaps the answer lays on this double observation: the deficit model of public understanding of science has been maintained against all odds, and at the same time there was a coming back of radical criticism. A network of anti-nuclear organisations, "Réseau sortir du nucléaire" was created on December 1998. This network-actor contributed to the return of the polarisation of debates and radical contestation of nuclear energy. Today, 'Sortir du nucléaire' has about 800 member organisations.

On April 2004, the parliamentary debate on nuclear program in France led to the endorsement of a "new" reactor, called EPR (European Pressurized Reactor). In October 2004, the site of Flamanville was chosen for implementation. As stipulated by law, Electricité de France (eDF) asked for the CNDP (French National Commission for Public Debate) to organise a national debate on this new reactor[24]. Many authors have analyzed the Habermasian orientation of CNDP: the debates are not based on representativeness in the traditional sense – since even the smallest of organisations is allowed access to the debate on an equal footing with largest organisations, the CNDP defends the principle of "best argument" rather than interest group

[21] For a precise desciption of this period, see F. Chateauraynaud & D. Torny, Les Sombres précurseurs (1999).

[22] ANDRA : French Agency for Radioactive Waste Management. See the position of International Atomic Energy Agency (IAEA) in The Long Term Storage of Radioactive Waste: Safety and Sustainability, 2002.

[23] A. Stirling, "'Opening Up' and 'Closing Down': Power, Participation, and Pluralism in the Social Appraisal of Technology." Science Technology Human Values 33(2), 2008, p. 262-294.

[24] This case study is drawn from: F. Chateauraynaud, A. Bertrand and J.M. Fourniau, Nucléaire et démocratie délibérative: les technologies nucléaires à l'épreuve du débat public. Un projet d'observatoire des débats publics sur l'avenir du nucléaire civil. Document du GSPR. Paris, EHESS. I must thank Markku Lehtonen (University of Sussex) who develops an important comparison of nuclear policies in UK, Finland and France, and who sent me the result, in English, of his attentive reading of our analysis, thus facilitating the task for translation of excerpts from our own text! See the work of M. Lehtonen The Governance of nuclear power in the UK, Finland and France (report to be finished in 2009).

representation[25]. This procedure contrasts with the more traditional institutions of participation – as the Grenelle of Environment will resume in autumn 2007, by the formula of "five parties at the table": government, local powers, industry representatives, most important trade-unions and biggest environmental NGOs.

In December, the CNDP decided to give the debate a national focus, to cover not only the localisation of the plant, but the entire programme of construction of EPRs. On the 1st June 2005, the CNDP declared that a public debate on the EPR would start on 19 October. But on July 17th, NGOs protested against the fact that the eDF had already started the construction of the EPR! Conditions were therefore favourable for an explosive debate, as many suspected that the debate would simply serve to legitimize a decision already made. But an incident disrupted the procedure: in September 2005, after a control made by the defence minister, CNDP must declare that a few lines in the pre-submission arguments by the militant network "Réseau sortir du nucléaire" would have to be deleted from the summary report, since they referred to a document classified as confidential under law concerning defence secrecy. What was this document about? It explained that a plane intentionally sent on the reactor could destroy its protecting enclosure! A pure effect of the 9/11 attacks in the USA! As a compromise solution, the CNDP suggested to set up a committee of independent experts aimed at facilitating and mediating the debate and which could access to confidential documents. The industry minister Loos rejected this compromise solution, while eDF nevertheless conceded an experts access to documents classified under business secrecy. On the following day, less than a week before the debate was scheduled to begin, all NGOs opposing the EPR project declared they would withdraw their participation and conduct their protests from the outside. The alleged lack of transparency and legitimacy therefore led to a radicalizsation of protest. Nevertheless, the CNDP tried to maintain the equilibrium in the debate, by organizing thematic preparatory workshops, in order to put forward and highlight some of the existing controversies around the project.

Despite this highly problematic starting point and the boycott by the NGOs, the debate was launched indeed on the 3rd November of 2005. The dominant comments concerning the EPR debate highlighted the fact that a choice had already been done apart from, and without regard for, the democratic processes. This view, close to the NGOs criticism, was dominant in the national press, whereas the specialised economics press put emphasised arguments concerning competitiveness, without referring to the process of public debate under preparation. The main concrete outcome of the debate was the commitment of eDF to greater transparency regarding the access of certain associations to nuclear safety reports prepared by the company, and access of selected academics to information considered of national security interest. Two other important points should be pointed out: the debate began at the same moment that the construction of the new EPR reactor started in Finland; and at the same time the CNDP launched another debate on the future of radioactive wastes. The first meetings within the CNDP in September 2005 revealed the key points of NGOs' criticism: the debate came too late, the decision had already been made (talking about waste disposal research 'laboratory' was perceived as an attempt to disguise the real objective to construct a disposal site), and the four months of debate allowed by the CNDP were not enough, but represented instead a "caricature of democracy". Instead of an unavoidably flawed debate, a referendum should be organised to give people a real opportunity to express their views. If a debate were to be organised, it should be national, not local in scope. Greenpeace argued that the decision to

[25] Martine Revel, Jean-Michel Fourniau et *alii* (dir), Le débat public: une expérience française de démocratie participative, Paris, La découverte, 2007.

construct an EPR had made the debate on radioactive waste pointless, claiming that France should first of all stop producing nuclear waste.

Here I am skipping many details, but the debate on radioactive waste was considered by observers of relatively high quality. It started from a "clean table" and CNDP produced a rather iconoclastic report rejecting the geological deep burial as the only alternative, and suggesting underground storage as a solution that would ensure "reversibility". In particular, the debate resulted in a conclusion favouring further research on a range of options, extending a politics of indecision[26]. The old consensus on a geological disposal of high-level radioactive waste was thereby broken, as the debate called for greater analysis of possibilities for shallow, close-to-the ground storage as a relatively permanent rather than simply intermediary solution. But, concretely, the debate resulted in the Law 2006-739 on radioactive waste management, which did not follow the deliberative conclusions!

The nuclear debates in France have been characterised by a return of activism in public policy also present in other controversies around technologies such as GMOs and nanotechnologies. While concerns for health impacts caused by exposure to radioactivity were at the forefront in the late 1980s and the most part of 1990s, the focus has more recently shifted to topics such as security of supply and climate change, but also to transparency, and the necessity of "deliberative norms". The safety of EPR was a subject of significant controversy, as the industry minister claimed in 2003 that EPR technology was "ten times safer" than present nuclear technology. This view was contested by anti-nuclear groups, who referred to a German expert (Henrik Paulitz) holding an exactly opposite view on the respective safety of current and EPR technologies. Debates on the threat of terrorism and the security of the plant in case of a plane attack gave rise to the debate on "defence secret".

Key arguments put forward by the *pro-nuclear*	***anti-nuclear* camp key arguments**
- nuclear is a fully national energy source (apart from uranium) - electricity demand has grown surprisingly fast, hence new capacity is needed - new nuclear power plants will in any case be built in China and India; from the international nuclear safety point of view it would be more preferable that France, rather than a less stable country such as Russia would deliver the equipment -	- new nuclear (or other) capacity would probably not be necessary in 2015, when decommissioning of existing plants is expected to begin - the need for energy diversity speaks against a further increase of the share of nuclear power in France - the only rationale for building an EPR would be to improve the coherence of French nuclear system, as this would legitimize the reprocessing plant in La Hague; however, this would result in increased risks of nuclear proliferation

CNDP's strategy has been largely influenced by its position as a facilitator and enabler of debate. This commission can neither pronounce an opinion on the choice to be made, but nor can it simply leave the different actors play their game at will, because this would consolidate

[26] See Y. Barthe, Le pouvoir d'indécision, Paris, Economica, 2006.

the status quo and do nothing to even out the asymmetries of power. Indeed, the CNDP needs to – and has decided to – take active measures against the tendency of public debates to become forums where strong and well-organised actors are able to deepen and develop their strategies and alliances. The debate on the EPR seems to have been decisive for CNDP's strategy, as the organisation consistently underlined the principles of good debate. The challenge, especially for the less resourceful participants in these debates is how to retain a degree of control and influence over the situation (to keep a hold, "garder une prise") without allowing their own action to be framed from the outside. Ironic commentary is a strategy often used by marginal actors precisely to avoid co-optation and submission to pre-given framings.

The strategy chosen by the CNDP in navigating amongst these conflicting objectives has been to emphasise the procedural principles of the debate. The initial guiding principles were three: transparency of information, equality between participants and the argumentation of positions. As a consequence of the 'defence secrecy affair', two other principles were added: comprehensiveness of the handled questions and pluralism of the given responses. By obliging the participants to follow its own logic, governed by these founding principles, the CNDP shapes the debates and the interactions between participants. Somewhat paradoxically, one of the weaknesses of the CNDP – the fact that it cannot provide recommendations – is perhaps one of its major strengths. Principles such as the "freedom of speech" and the "openness to marginal" and even extreme players would be unlikely within a decision-making institution. Many of the members of the specific commission of CNDP are academics or retired people, who tend to take an approach close to civil society organisations, and – consequently – often unpopular among the developers. Thus the CNDP has managed to gradually build up its legitimacy and credibility. In particular, it has gained authority among the NGOs, which were highly sceptical about CNDP's independence at the beginning. This greater authority has resulted from the CNDP's decision to adopt a more critical standpoint with regard to the nuclear establishment and to defend the associations' right to voice their views and participate in the debates on an equal footing with stronger players.

A further manifestation of the increasing legitimacy of the CNDP amongst the NGOs lies on the changes in the argumentative modalities that occurred in the course of the public debate over the EPR. For example, the major anti-nuclear NGO, Réseau Sortir du nucléaire shifted the target of its criticism from CNDP towards the government: while in September 2004 it still accused the CNDP of having accepted the "masquerade" of public debate on nuclear, in autumn 2005 on the contrary it criticised the government for disrespecting and undermining the debate organised by the CNDP. If the public debate has no effect on the games of players and the balance of power, adding that epiphenomena and anecdotes to the path of an irreducible conflict itself, there would be no change in argumentative way as in the following excerpts.

Réseau Sortir du nucléaire (01/09/2004):
Tout en reconnaissant que "les arguments avancés par le maître d'ouvrage sur le caractère stratégique de ce projet, dans un secteur-clé de la production d'énergie (...) lui donnent un caractère d'intérêt national", la CNDP tente de minimiser l'importance de l'affaire: "considérant qu'il s'agit du renouvellement, à technologie différente, d'une usine existante, (...).". Enfin, la CNDP reconnaît qu'Areva a déjà tranché: "considérant enfin l'état d'avancement de ce projet et les actions locales d'information dont il a fait l'objet depuis mars 2003". Mais, au lieu de dénoncer un passage en force du lobby nucléaire, ***la CNDP cautionne la mascarade [CNDP endorses the masquerade]*** *De façon générale, le Réseau "Sortir du nucléaire" estime que les débats organisés par la Commission nationale du débat public (CNDP) constituent une* ***véritable parodie de démocratie [real travesty of democracy]*** *destinée à donner une apparente légitimité à des décisions déjà prises dans le dos des citoyens.*

Réseau Sortir du nucléaire (13/09/2005):
*Pour le Réseau "Sortir du nucléaire", **ce n'est pas la CNDP qui est en cause [the CNDP is not charged]** (en diffusant la contribution dans son intégralité, elle peut être attaquée pour "compromission"). Ce sont l'industrie nucléaire et le pouvoir français qui sont responsables de l'opacité et du mensonge qui entourent le nucléaire.*

Réseau Sortir du nucléaire (14/11/2005):
*L'information de la population et sa protection face au risque nucléaire majeur doivent primer sur le secret Défense. Une démocratie dévoyée et exaspérante **Le gouvernement a véritablement miné le débat public CNDP [The government has actually undermined the CNDP public debate]** et démontré le peu de cas qu'il accorde à l'expression des citoyens et à la "transparence" sur le nucléaire.*

The CNDP's credibility was likewise strengthened by the fact that the organisation appeared in a positive light in the 'defence secrecy' trial – as a reasonable mediator seeking constructive compromises, whereas the government was criticised for refusing the compromise solution suggested by the CNDP. No doubt that this case could help to extend and discuss the map of public participation in science and technology designed by Bucchi and Neresini[27]: social movement and participatory procedures can mix together and produce at the same time new argumentative diagrams and new balance of power. But, this makes it difficult to provide a stable map.

Forms of mobilization and legal tests around GMOs

Since the beginning of the 1990s, the GMO case occupies one of the first places in the hierarchy of the objects of alarms and controversies, not only in France but in different countries, especially in Europe. The accumulation of events, studies, mobilizations, public debates and decisions generated a considerable documentary mass in which it is increasingly difficult to appreciate the range of each new contribution, for the purpose of synthesis, new expertise or production of new arguments. To clarify the different phasis of this long run issue, we have tried to rebuild the GMO corpus and to organize its follow-up, in order to allow a better understanding of the balance of powers, sets of actors and arguments. It permits to re-read past series, to characterize the present configuration adequately and to distinguish the future potentialities[28].

As many other issues, the question of biotechnologies in agriculture and food is marked by the plurality of author-actors, the proliferation of arenas and events, and therefore by a strong uncertainty over their future developments. Three main issues can be used as discussion thread to investigate GMOs: firstly, we study the evolution of protest forms, this fieldwork acted like a true laboratory in the open world for the return of criticism and radical action; on a second level, we look at how the plurality of legal forms and the legal arenas are used as resources by protagonists; finally, we examine the cosmopolite dimension through the means

[27] M. Bucchi and F. Neresini, "Science and Public Participation", in The Handbook of Science and Technologies Studies, MIT Press, 2008, p. 449-472. I refer to the figure 19.1 page 462.

[28] This research is developed with Antoine Bernard de Raymond and Gilles Tetart, associated researchers within GSPR. We have built an important corpus, made of more than 10000 texts between 1986 and the end of 2008.

by which multiple localities are linked through networks in a globalized space of mobilization under national framing constraints. These three questions enable us to grasp the constraints which weigh on various actors and the doctrines they develop on different aspects of the case, such as the use of the precautionary principle or broad ecological topics, models of agricultural production and consumption, philosophy of biology or living beings law, economic stakes and political balance of powers, forms of democracy or the role of research and expertise.

There is no doubt that the collective mobilization around GMOs has played a decisive role in the evolution of this matter in France, which therefore is no more a "scientific controversy," a "health and environment warning" or a "legal issue" (even if - as we shall see - these elements appear and play a key role), but rather a political conflict marked by struggles and violent events. If we take this issue from public discourses, the term "controversy" is quite inadequate and the most appropriate term is rather polemics, in the strong sense linked to the etymology of the word - "which relates to the war". In brief, the GMOs issue has evolved from an internal controversy to a violent conflict in the outside world, a conflict that is considered irreversible. Like in the nuclear field, actors and arguments are engaged in huge confrontations and there is no public discussion which does not lead to a clash of world views, considered by protagonists as heterogeneous and antithetical.

It looks as GMOs as a highly political issue, marked by the confrontation between opposing sides. If we consider the politicization of the case and its aggregation as decisive, we must not essentialize these properties. They are the product of a historic building. In the end, we will show how GM is a borderline case where there are two sides to world views irreducible to one another and where there is strictly speaking no discussion and even no possibility to develop studies in social sciences who are not suspected of bias.

Everyone agrees on one point: the French debates over GMOs turned to conflict, although there are different points of view on the causes and reasons for this change of regime. Basically after 1998, environmental controversy seems to have become less important than agriculture future in politics and economy. Accordingly, the status of events, actors, arguments, to the laws and regulations has been completely transformed. One of the challenges in our corpus construction is the deployment of visions of the future of this issue. On a whole range of visions of the future since "the case is over in France" (but the problem is reported to the "rest" of the world beginning with Europe), to "innovations eventually impose GMO on a case by case principle", through the balance of power will continue changing regularly game and challenge (such as the defence of the organic agriculture, the emerging device called “Genoplante” etc.).

The protagonists in the case of GMOs themselves try to write the history of GMOs in France and its periodisation. In a way, exposing a view on GMOs supposes to make their history. The stories and chronologies these social players produce are then used in support of other stakeholders to identify and move in this matter. For example, the book published by Hervé Kempf (journalist for the newspaper Le Monde), The secret war of GMOs, first published in 2003, is widely used by actors who arrived later into the debate so as to rationalize their position. So was it useful for researchers to produce their own chronology of the case, since the actors were likely to produce their own grids? The usefulness of such an approach appears if we consider two aspects of any periodisation: on the one hand, the identification of events shared by the players and on the other hand, the identification of periods of configurations, that is to say games of arguments and specific sets of actors.

According to Joly et alii, field trials of genetically modified crops, initially constructed in the 1980s as a cognitive endeavour to be preserved from lay interference, were reconceived as "an intrusion in the social space," which had to be negotiated with actors of the civil society. In order to analyze this transformation, the authors develop an interpretive framework that combines theoretical perspectives from science and technology studies and the sociology of social problems, and emphasizes the way in which actors compete in a heterogeneous public space to put forward alternative framings of problems. They present a global picture of the interactions and conflicts between actors in diverse social arenas[29]. In our research program based on socio-informatics tools, we have tried to draw more precisely the different phases or steps by which the standpoints of official experts, scientists and activists were reconfigurated. As a result we provide a more precise periodization.

An essay of periodization in order to analyze the trajectory of GMO "controversy" in France

Period	Configuration
Période 1: 1987 – november 1996	*Internal attempt to frame an undustrial regulation*
Période 2: november 1996 – january 1998	*From alert to « mad soybean » (« soja fou ») to the first destruction in Nérac*
Période 3: january 1998 – august 1999	*How may citizens debate on GMOs? The First Citizens Conference in France*
Période 4: august 1999 – april 2001	*GMOs and globalization – Attack against a fastfood restaurant in Millau*
Période 5: april 2001 – novembre 2003	*Think global, act local*
Période 6: november 2003 – may 2007	*Voluntary mowers and the radical turn of anti-GMO movement*
Période 7: may 2007 – may 2008	*The Grenelle of environment » and the law. A last strategy for coexistence*

"The conferences of citizens have been constructed as social experiments, but they have led to social explosions" (an ecologist)

"For me, the debates have no more sense, it's over. Environmentalists have demonstrated that they refused any social compromise "(a Biologist)

All the persons whom we interviewed agreed on several events that have tipped the case during the years 1997 to 1999:

[29] Christophe Bonneuil, Pierre-Benoît Joly et Claire Marris, « Disentrenching experiment: the construction of GM-Crop field trials as a social problem », Science Technology and Human Values, 33 (2), 2008, p. 201-229.

- The change of policy with the withdrawal of authorization of transgenic corn in early 1997 (Juppé's decision) and the resignation of Axel Kahn (a famous geneticist) from the CGB (Commission du Génie Biomoléculaire);
- The conference of the Jospin government in November 1997 (agreement for the Novartis corn and announcement of the citizens' conference);
- Action in Nérac, in early 1998;
- The citizens' conference in June 1998 and the approval of MON810 (Monsanto);
- The first mowing - the action against a laboratory (INRA) in Ariège, and a rice crop (CIRAD) in Montpellier in 1999.
- The dismantling of MacDo in Millau (summer 1999)

The first acts of destruction of GMOs (St Georges d'Esperanche, 1997 and Nérac, January 1998) took place at the initiative of members of the Peasant Confederation, with a motivation centered on the risk of seeds contamination. The specific case of Nérac was to alert public opinion by destroying GM seeds, which were held on French territory to be sold to farmers, while their inclusion in the official catalogue had not (yet) occurred. Activists of the Peasant Confederation involved in this action wanted to protest against what they saw as a policy of "fait accompli" – already made decision - which would generate irreversible effects, after which any form of protest would be futile. The forms of protest had crystallized around mowing, and a unified front was early constituted against GMOs between environmental organizations, consumer organizations and farmers unions. If we examine the records of judicial actions of mowing or destruction of GMOs, there is no surprise to see that in the early years (until 2003), these actions were almost exclusively the result of activists of the Peasant Confederation, accompanied by ATTAC activists or environmentalists.

The movement organized around an agriculture defined as "peasant" will be joined over the years by representatives of organic farming, and more recently by beekeepers. This broader base of participants in mowing actions carries a double challenge: firstly it goes hand in hand with a larger recruitment policy, and secondly on the legal front, creating precedents in courts, as have done municipalities which took anti-GMO decisions[30]. One of the great successes of the anti-GMO movement is to be able to form a common argumentative front. Then the critical players are less sought to diversify their arguments so as to strengthen a common central argument, linking clusters of arguments and entities to make it more robust. This is the way we can interpret the gradual addition of issues related to organic farming, bees and beekeeping, as well as quality agriculture or natural parks.

Civil disobedience has generated many writings since the publication of the famous Thoreau's manifesto[31]. With the case of anti-GMO movement in France, we have another practical experiment, which sounds perfectly legitimated for the protagonists: "When all legal means have been exhausted, there are only civil disobedience to enforce respect for biodiversity, the right of farmers to use their seeds and the will of citizens." (Voluntary mowers, words

[30] M-A.Hermitte, « Les zones sans plantes génétiquement modifiées – l'illégalité comme stratégie juridique », *Journal international de bioéthique*, 2006, vol.17 n°3. According to Hermitte, different mechanisms are in an on-going process of recognition. For example, activists against GMO can use the decision of several Appellations of Origin (AOC) to ban GMO from animal feed.

[31] R. Encinas de Munagorri, «La désobéissance civile: une source du droit? », Revue trimestrielle de droit civil 2005, p. 73.

reported by AFP, 2 November 2004). I do not have enough places here to tackle the legal aspects of "GMOs civil war", but it is important to notice two main aspects: courts were used by groups of activists as public arenas and the series of judicial decisions were seriously transformed by a decision in favour of mowers referring to a "state of necessity". Through trials, biotechnologies were at the bar and many experts and counter-experts were heard by courts producing an important feedback on the whole disputing process[32].

How did the authorities react in front of this collective action? In 2003, the Commission of the European Communities developed guidelines for a co-existence policy between genetically modified (GM) and non-GM supply chains. This project only applies to agri-food products, to the exclusion of all other genetically modified organisms (GMO). In founding texts, the Commission sets out guiding principles for a project of segregation of agri-food productions, leaving the responsibility of implementing it to member states[33]. The relevance and feasibility of such a policy have been the object of multiple debates and are always at stake after the vote of "GMO laws" in France in June 2008.

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The movement of voluntary mowers has seriously driven GMOs from controversies and debates to activism and conflict. The new step reached by the conflictual process put backwards the question of counter-expertise and of the production of scientific arguments. Even if many actors persist to be vigilant on the bioscientific productions – Greenpeace, CRIGEN, Inf'OGM and several critical scientists like Jacques Testart ou Gilles Eric Seralini - since the political turn which took place in 1996, the place of scientific controversy is marginal in French configuration. Some studies are used by protagonists as arguments and counter-arguments, but without a real contradictory process of discussion. For instance, if we follow different scientific publications which reveal a potential danger, the scope of these critical informations is relatively limited in France while they seem to have an impact on international networks. One reason is that nobody believes in the coming back of an argumentative discussion and each information is treated as a strategic, even machiavellian, one. As an example, a study claiming that *"genetically Modified Peas Caused Dangerous Immune Response in Mice"* (2005)[34] was not really discussed in public arenas, as well as the

[32] S. Jasanoff has shown how the law intervenes by defining what can be patented as a scientific discovery, who can be considered a scientific expert or what counts as definitive proof. If legal processes depend on political configurations in different countries (relations between lauwyers and politicians is not the same in France and in common law countries for instanceMany trials were leading to public distrust of experts – especially in medecine, as we have seen in recent period which the growth hormone affair in France. S. Jasanoff, Science at the Bar: Law, Science, and technology in America, Cambridge, MA: Harvard University Press, 1995. For a french examination of this problem see O. Leclerc, Le Juge et l'Expert. Contribution à l'étude des rapports entre le droit et la science, Paris, LGDJ, 2005.

[33] Marie-Angèle Hermitte, "The Juridical Nature of Co-existence Policy between GM and non-GM Supply Chains Technological Pluralism and Freedom of Trade and Industry", contribution in Integrated Project "Co-Extra", under the 6th Framework Programme of the European Commission , Priority 5, Food quality and safety.

[34] According to researchers, genetically modified (GM) peas under development created immune responses in mice, suggesting that they may also create serious allergic reactions in people. The peas had been inserted with a gene from kidney beans, which creates a protein that acts as a pesticide. When this protein is produced naturally in beans, it does not elicit a response from mice." When produced in the GM peas, however, it did cause a reaction. Thus, the transgenic proteins in GM foods may have subtle undetected differences that are causing health problems. It is sobering to note that if the GM peas were tested with only the methods used on soy and corn, it likely would have been approved as well." See Jeffrey Smith, « 2005, A Scary Year For Genetically Engineered Crop" (website, 2006). Jeffrey M. Smith is working with a team of international scientists to catalog

recent ad that *"genetically modified maize lowers fertility in mice, study finds"* (2008) [35]. Each information, each statement or argument is immediately interpreted under the famous "argumentum ad hominem"[36].

Nanotechnologies: nano issues assembled by a giga discursive matrix

When nanoscience and nanotechnologies arrived in France, the issue interested a few authors-actors, even if the circle enlarged slowly but surely between 2002 and 2005. At the beginning, nanoscience was a scientific revolution which left behind all the precedents: a definitive rupture which led Jean-Pierre Dupuy, a french philosopher, to speak about an irreversible transformation of science, nature and culture. Replication and self-assembly appeared at the same as a major challenge of nanotechnology and a coming rupture in philosophy[37]. Parallel to the move in technological perspectives and philosophical discussions, many actors, having (or thinking to have) learned the lessons of the political conflict on GMOs, turned quickly to the study of "societal impacts"[38]. Following scientists and philosophers, many sociologists, economists and lawyers got involved in the rise of nanotechnogies in Europe by introducing the theme of "public engagement" in nanotechnology. In 2004, two important reports outlined the "need of upstream engagement": a report of the Royal Society in the UK, which advocates for an increased involvement of the public in the decision-making process, and the demand for a "public dialogue" formulated by the European Commission[39]. And, showing that the world is sometimes very small, we find Pierre-Benoît Joly as a French specialist of

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all known health risks of GM foods. He is the author of Seeds of Deception, the world's bestselling book on GM food, and the producer of the video, Hidden Dangers in Kids' Meals.

[35] "Feeding mice with genetically engineered maize developed by the US-based Monsanto corporation led to lower fertility and body weight, according to a study conducted by the University of Veterinary Medicine in Vienna." In the study, mice fed with the NK603 x MON810 sweetcorn variety over a period of 20 weeks showed a smaller litter size and lighter offspring than mice fed with non-engineered maize. The differences "were statistically significant in the third and fourth litters" Professor Juergen Zentek said. This research was commissioned by Austria's Environment Ministry. Everybody knows that Austria has long resisted calls by the European Commission to allow the use of genetically modified food. But it finally had to lift its ban on MON810 maize as animal feed last year. An expert panel of the European Food Safety Authority (EFSA) found in 2005 that this GMO was "safe for human and animal health." Following the release of the study at a conference in Vienna, Global 2000 and Greenpeace criticized EFSA's approval of the variety and called for a ban of genetically engineered maize. "It is now vital to keep animal feed in Austria free of genetically engineered maize, and an immediate ban on the use of genetically engineered maize MON810 in Austria is the order of the day,". Source: The Earth Times, November 12, 2008.

[36] D. Walton, Legal Argumentation and Evidence, Pennsylvania State University Press, 2002.

[37] J.-P. Dupuy, "Complexity and Uncertainty", in Foresighting the New Technology Wave, High-Level Expert Group, European Commission, Brussels. 2004; B. Bensaude-Vincent, "Self-Assembly, Self-Organization. A Philosophical Perspective on a Major Challenge of Nanotechnology", Position paper France Stanford Meeting on Nanotechnology, Avignon December 2006.

[38] M.C Rocco and W.S. Bainsbridge (eds.), Societal Implications of nanotechnology, Dordrecht, Kluwer Academic Publishers, 2001.

[39] Royal Society, Nanosciences and nanotechnology, London, The Royal Society, 2004;

participatory processes in science and technologies public assessment[40]. A close analysis of the public discourses and debates shows that four great topics are mixed in the same issue: new scientific policies in front of global competition; transhumanism and the enhancement of human performances; a new society of control; and another source of health problems created by the dissemination of nanometer-size particles.

Many things have already been written on the subject – which attracts because of its novelty, as a bibliometric or mediatic survey can easily show. I only want to outline three dimensions relevant to understand the specific trajectory of this giga issue: the importance taken by technological promises and visions of future; the very surprising tone by which a small group of activists, located in Grenoble, has engaged the "critical job" of a new science-based system of power – inventing the neologism of "necrotechnologies"; and last but not least, the continuous rise of serious doubts and uncertainties about safety of nanomaterials.

From prophecy to sober reality?

Comparing different issues involving science, risk and governance as main topics, the case of nanotechnology is characterized by the intensive use of temporal modalities oriented to the future. Just take a short example:

"Europe is throwing its considerable financial and human resources into an emerging science that could radically change manufacturing, medicine, the environment and, possibly, life as we know it today. Nanotechnology -the art of manipulating matter at the atomic scale- has become a top priority of the European Union's recently approved Sixth Research and Development Framework Program and the focus of numerous regional R&D networks, such as Germany's NanoMat. "Nanotechnology offers golden opportunities for European scientists and entrepreneurs," said E.U. research commissioner Philippe Busquin, at the E.U.-organized conference "Nanotechnology: A New Industrial Revolution," in Grenoble, France, this past summer. "The complexity of scientific and technological challenges and the scale of investments needed to take innovations to market will require a determined international effort and strong public-private partnerships. This is why nanotechnology is one of the key priorities of the Sixth Framework Program. By integrating scientific excellence across disciplines and geographic borders and maximizing public and private investments, including risk capital, we will create the necessary critical mass to ensure European leadership in this exciting new area,' Busquin said"[41]

If we closely look to thousands of texts generated by the incredible list of technological promises and prophecies of happiness, few experts dispute nanotechnology's vast potential. But we find some attempts to promote a bit of relativization. For instance, Bendix Todsen, a nanotech expert at Deutsche Venture Capital GmbH warns that we have not to over-hype it: "we are still many years away from making this technology an economic force". But the general trend is to display a positive future, and technology improvement is hardly defended

[40] P.B. Joly and A. Kaufmann, "Lost in Translation? – The need for 'upstream engagement' wuth nanotechnology on trial", Forthcoming in Science as Culture (2009).

[41] M F Wolff, "Europe makes nanotechnology a top research priority", Research Technology Management, Wednesday, January 1 2003.

by the World Transhumanist Association, for which we are in route to the post-human condition: "*The Humanity+ (the World Transhumanist Association) is an international nonprofit membership organization which advocates the ethical use of technology to expand human capacities. We support the development of and access to new technologies that enable everyone to enjoy better minds, better bodies and better lives. In other words, we want people to be better than well."*[42] Expanding human capacities is connected to research in nanomedicine and belongs to the main features of the new revolution, open by converging technologies, and outlined by W.S. Bainbridge[43]. If, as André Orlean noted, the concept of "belief" is not commonly used in economics[44], we clearly assist here to the social making of a collective belief which send to a near or distant future the reality tests and the public proofs.

In fact, different models of future and mankind possible mutations are manifest if we take time to clarify the whole range of public arguments. From body transformations (like the enhancement of sensitive abilities) to imaginary creatures (especially living in science fiction world), implying series of entities which move from texts and laboratories to the real world (robots, androids, spiritual machines, nanochips, cyborgs, and other characters of genetics), some protagonists try to trace new boundaries and divides between normal expectations and unreasonable attempts, or between prophecies and normal scientific anticipations. To explore the complete series of anthropological futures involved in the great number of scientific promises and, at the same time, the many critiques they elicit, we need an argumentative sociology based on the linguistic modelisation of arguments described in their discursive environment. What kind of epistemological demarcations are produced by each discussion? How many positions are possible from classical rationalism to eschatology?

A standpoint can serve to put at test this collective production of scientific and technological promises: the prophecy of doom by which some actors announce the worst! In France, since 2005, a group tries to blow the whistle on all the aspects of nanotechnologies, reversing foresighting by denouncing an anti-utopian science and technology. This small group (less than 40 people), called PMO (Pièce et Main d'Oeuvre) is composed of members who defined themselves as "ordinary citizens" – even if their style of writing shows that they are far from being ordinary persons [45]. According to PMO, all the participatory devices and public communication campaigns launched by La Metro (urban community of Grenoble) or CEA have one only goal: the "social acceptability" of nanotechnology. Activists blame the "appearance of democracy". As in the nuclear conflict described above, PMO did not see how a public debate will change anything in the Minatec project since the major decisions had been already made. P.-B. Joly appeared as an enemy: a mercenary sold to the Minatec project, furthermore, engaged in an attempt to "sell nanotechnology" through particular academic disciplines like the sociology of innovation.

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[42] See the website http://www.transhumanism.org

[43] W.S. Bainbridge, Cognitive Technologies. Managing Nano-Bio-Info-Cogno Innovations: Converging Technologies in Society, pp. 203-226. Berlin: Springer, 2006.

[44] André Orléan, "Les marchés financiers sont-ils rationnels?" [Are markets rational?], in Philippe Askenazy et Daniel Cohen (eds.), 27 questions d'économie contemporaine [27 questions about the contemporary economy], Paris 2008, 83.

[45] See F. Chateauraynaud, "Nanosciences et technoprophéties. Les nanotechnologies dans la matrice des futurs », GSPR, 2005. Available on line.

At the end of 2005, six months before the opening of the first plant dedicated to nanotechnologies, Minatec, the Grenoble Opposition to Necrotechnology was determined to fight against "servile sciences for totalitarian industries" and managed to organize counterevents (movie projections, discussions in cafes) and finally a 1000 people demonstration on June 2, 2006, the day of Minatec opening. To the credit of the activists, La Metro, unlike the recommendations of the Joly report, did not organize a citizen conference. However it sponsored a series of "public debates", named Nanoviv, organized in Grenoble by Vivagora, an association led by a small group of scientific journalists [46]. As Brice Laurent notes in a short analysis of this participatory event, Vivagora is not only devoted to the organization of public debates, but is "strongly influenced by STS academic work"[47]. Organized during the second part of 2006, Nanoviv was designed to identify "actors and stakes", and to formulate recommendations for policy-makers. PMO refused to participate in the event and continues to develop pamphletarian criticism, sometimes relayed by the satiric journal, Le Canard enchaîné and particularly its journalist J.-L. Porquet, an anti-science journalist, fond of Jacques Ellul's vision of technoscience.

The translation of nano issue as a toxicologic problem emerges very early, but it takes more and more scope over time. On December 17, 2004, the Minister of Ecology and Sustainable Development, Serge Lepeltier, asked the Committee for Prevention and Precaution to examine the possible health consequences of the production and use of nanometer-size particles and the means currently available for organizing effective collective reporting and for developing the capacity to apprehend the risks. He asked the CPP to propose "measures for suitably monitoring and regulating the growth in the number of users and the dissemination of nanoparticles, and to issue guidelines for surveillance procedures, risk identification and the development of precautions adapted to this new scale."[48] After a few years of enthousiamic public discovering and of technological promises, a main precedent comes back on the stage: "Nanotubes, one of the wonder materials of the new age of nanotechnology, may carry a health risk similar to that of asbestos, a wonder material of an earlier age that turned into a scourge after decades of use when its fibbers were found to cause lung disease" [49]. Coming long before visible health problems, the warning is based on expert assessments which call for caution in handling nanotubes, these tiny and superstrong carbon fibbers. Discovered in 1991, nanotubes are rolled-up sheets of carbon that can be used to produce materials that are far lighter and stronger than steel. Scientists have also wondered whether it "might cause the same types of disease as needle-shaped asbestos fibbers"[50].

To avoid new crisis and protest, experts, scientists and industrials try to show that all is done upstream to minimize the dangers. Interviewed by journalists, Anthony Seaton, a professor of

[46] http://www.vivagora.org/

[47] B. Laurent, "Framing nanotechnology and citizenship. An empirical account of public engagement and activism", Paper presented at the annual meeting of the American Sociological Association, TBA, New York, New York City, Aug 11, 2007

[48] Comittee for Prevention and Precaution, Nanotechnologies, nanoparticles: what Hazards? what Risks? , Ministry of Ecology and Sustainable Development, Paris, may 2006.

[49] "In Study, Researchers Find Nanotubes May Pose Health Risks Similar to Asbestos", New York Times, May 21, 2008

[50] Researchers reported that injecting nanotubes into the abdomens of mice induced lesions similar to those that appear on the outer lining of the lungs after the inhalation of asbestos. See the Web Site of "Nature Nanotechnology".

environmental and occupational medicine at the University of Aberdeen in Scotland declared: " In a sense, we're forewarned and forearmed now with respect to nanotubes". Vicki Colvin, a professor of chemistry at Rice University in Houston, said that she "saw no need to restrict the use of nanotubes in products, but that their use should be better labelled. I'm not alarmed, but it seems we should have better information about where it is and how it's being used." In France this kind of argumentation was used by the Permanent Committee on Asbestos (CPA) with a formula copied on the Canadian model: the controlled use of asbestos[51]. Bringing together asbestos and nanoparticles will be facilited by the suspicion of the same health result: according to Dr. Donaldson, we can be sure that "given more time, the lesions caused by the long nanotubes would have developed into mesothelioma". As the prototypical formula, scientists claim for more research in order to determine the extent of the risk posed by nanotubes. The people in greatest danger would most likely be those working in laboratories or at nanotube manufacturers. Andrew D. Maynard, chief science adviser to the Project on Emerging Nanotechnologies at the Woodrow Wilson International Center for Scholars in Washington said: "I think there is clear evidence for caution in how they are used and handled". For him, nanotubes should be subject to the same rules and regulations as asbestos, which give "a good baseline starting point". Thus the sanitary trajectory of nanoparticles is on starting-blocks and nobody can say if a new scandal will occur or not in the next few years!

[51] D. Vogel and J. Bensedrine, "Comparing Risk Regulation in the United States and France: Asbestos, AIDS and Genetically Modified Agriculture", French Politics, Culture and Society, Vol. 20, 2002.

Some impacts of radical protest on the governance of risk activities

The comparison of different fields of public controversies and conflicts allows us to distinguish different forms of government. In the nuclear field, as is not much surprising, the state appears as an authoritarian and dirigist one (especially in France where the Gaullist heritage is important: here, political history is a huge constraint for the authors-actors[52]); in GMOs, the state tries, since the turning point of 1996 – confronting with the mad cow crisis and the surge of activism against GMOs, led by Greenpeace at the beginning – to be an arbitrator between different camps, and to build a compromise, as the European commission does, between economic interests and environmental arguments. But, when we take a closer look on debates and negotiations, we discover that it's more complex: many actors defend the idea that GMOs offer no interest for European agriculture; on the other side, we find the claim which underlines a decrease of research and development capacities in agrobiotechnologies. Nanotechnologies are at the crossing-point: a part of clear hierarchical management (attested by the presence of CEA and different related firms, like Minatec, in this new field) and a part of arbitration between a serious application of the precaution principle on the one hand, and the stimulation of innovation, with the great hope to save economical and technological growth in France on the other hand.

Nuclear	Organization of different public debates, which create a precedent: the introduction of deliberative democracy in a domain marked by strong asymmetry of powers. The CNDP, the French commission for public debate organized in 2005 and 2006: - a debate on nuclear wastes - a debate on new reactors (EPR, but also ITER) - and a debate on HT power lines … These debates do not end conflict but create a turning point for many actors
GMOs	Multiplication of researches on dissemination and contamination in the real world, and about economical conditions of coexistence between different types of cultures. In France the « Grenelle of environment » was presented as a opportunity to shape an agreement; but frictions within agriculture milieu are deep … Unexpected positions were taken in the recent period: *« Coexistence will be determined according to the principle that "the choice of some should not impact the choice of others", says M. Le Grand [UMP senator for la Manche].There must not be pollination of organic fields by GMOs»(* *« Everyone is in agreement on the GM issue: it is not possible to control their spread. So we will not take the risk. » (Jean-Louis Borloo, French minister of the environment,2007)*
Nanotechnologies	Industry and state spokesmen are pushed to reconsider ways of public consultation (citizen conferences …) and to organize a clear separation between different sources of alert and dispute: - nanoparticules and toxicity; - nanoscience as pure research under ethical control; - nanomedicine as new technological promise - nanopuces and social control as specific domain A group like PMO refuses these separations and tries to show a strategy of fragmentation

[52] Gabrielle Hecht, The Radiance of France – Nuclear Power and National Identity after World War II, Cambridge, The MIT Press, 1998.

4. Ways of arguing

Following actors and mapping social networks are very normal, quite undiscussed, methods in contemporary sociology, and seem to be sufficient to describe the rise and fall of public issues: acting, networking, bringing together human and non-human actors, topics and groups, devices and institutions ... but what about the birth and death of arguments? If many studies have focused on the rhetoric of science, STS and pragmatic sociology have much to gain from argumentation theories[53]. On what context does emerge an argument – and a counter-argument? What kind of trajectory does it take, and through which modifications? What does it mean to resist to criticism? Are the arguments immanent of the actor networks or are they produced by the disputing process itself, with a contextual relevance, impossible to reproduce at a distance? How can an argument travel from small communities through different kinds of arenas and groups, winning in strength and in surface, and becoming, step by step, a watchword, a political tool, a rule of law or a common sense feature? To understand the turning moments in the trajectories of arguments, we need to engage, in our conceptual and analytical toolbox, a good theory of argumentation able to work as close as possible to the actors' practical and critical reasoning.

Very classically, studies of argumentation are relegated by social scientists in a sub-field of linguistics called “discourse analysis”. In return, it is not surprising to discover many works which ask questions about the connection between discourse and society, as if a discourse was not, by definition, a social speech act! But even if you accept the idea that argumentation must belong to social studies, you do not overcome the differences between contradictory positions about the nature and the modus operandi of argumentative activity. In European discussions, different theories have emerged and are remaining heterogeneous, each school camping on its standpoint. Thus, a great divide has marked this strange field, developed at a crossing point between philosophy, logic, linguistics, rhetorics, history of literature or legal studies. The main border separates internal analysis and external approaches, opposition which becomes crystal clear if we compare the works of authors like Ducrot and Perelman[54]. One key issue here is the possibility (or not) to differentiate the concepts of “rhetorics” and “argumentation”.

The new rhetoric developed by Perelman and Olbrechts-Tyteca is a model of argumentation that collapses Aristotle’s distinction between rhetoric and dialectic. Fundamental to this rhetoric are concepts of audience, argument, and adherence; these concepts are constantly modified by the practices of argumentative communities. Argumentation has an aim other than the deducing of consequences, and that is “to elicit or increase the adherence of an audience to theses that are presented for their consent”. An argumentation aims to link a thesis to the adherence that an audience already holds to certain ideas This aim of argumentation is not purely intellectual adherence, but includes the inciting of action or creating a disposition

[53] See W. Keith and W. Rehg, “Argumentation in Science: The Cross-Fertilization of Argumentation Theory and Science Studies”, in Handbook of Science and technology Studies, op. Cit., p. 211-239. This paper provides an impressive bibliography. For a critical point of view on relationships between, argumentation, STS and the “strong program”, see Y. Gingras, « "Please, Don't Let Me Be Misunderstood": The Role of Argumentation in a Sociology of Academic Misunderstandings » Social Epistemology, 2007, 21:4, 369 – 389.

[54] O. Ducrot et al. Les Mots du discours, Minuit, 1980; C. Perelman and L. Olbrechts-Tyteca, The new Rhetoric: a treatise on Argumentation, Notre Dame Press, 1969.

to act, which in turn involves attention not to the faculties (intellect, will or emotion), but to the whole person. Arguers attend to this with great adaptability: "depending on the circumstances, their arguments will seek different results and will use methods appropriate to the purpose of the discourse as well as to the audiences to be influenced" [55]

But a different approach has been developed in Europe, by Van Eemeren and colleagues. Their objective is to build a pragma-dialectical model in order to examine in which respect, and to what extent, argumentative practices deviate from a critical ideal of reasonableness. The ideal model of critical discussion serves as framework to analyze the different ways of arguing and to reduce (or not) a difference of opinions. Obviously, resolving a difference of opinion is not the same thing than settling a dispute. According to Van Eemeren and al., "a dispute is settled when the difference of opinion has been ended one way or the other, for example, by means of a vote or because an outsider intervened. However, this does not have to mean that the difference of opinion has actually been resolved. The latter is only the case if a regulated exchange of arguments and criticism occurs and eventually leads to a common agreement about the acceptability or unacceptability of the standpoints under discussion. In a critical discussion, the parties involved in a difference of opinion try to resolve their difference by means of a regulated exchange of views, in order to reach agreement on the acceptability or unacceptability of the standpoints under discussion."[56]

This approach of argumentation is useful to provide analytic tools and identify many indicators in actors discourses. A principle is important to invoke here: "A principle of restrained, or Modest Charity, similar to Grice's Cooperative Principle, can be urged for the special communicative activity of arguing. In general, it may be presumed that people who are stating arguments, and responding to each other's arguments, are trying to give good reasons for claims they genuinely believe, and are open to criticism concerning the merits of their beliefs and their reasoning. Generally, when people offer arguments, they seek to communicate information, acceptable opinions, and reasonable beliefs. Most of the time, people are at least trying to offer good arguments in which the premises lead in some reasonable way to the conclusion. When we come to interpret the arguments of others, we should bear this point in mind, and not represent arguments as flawed or implausible unless we have checked to make sure that there are good reasons for doing so. A principle of Modest Charity can be recommended. If your standardization of an argument is such that the argument seems to make no sense at all, or to contain wild leaps in logic, check the original text again to make sure that you have not been unfair to the arguer."[57]

Another strategy for argumentative analysis is to take seriously the techniques by which protagonists themselves perform the task to identify, classify and evaluate arguments. In France, exploring the path opened by Christian Plantin, a French specialist of argumentation, Marianne Doury provides powerful analytic grids to detect what kind of arguments or counter-arguments an actor takes in charge and what kind of argumentative movement is

[55] Christopher W. Tindale, Acts of Arguing? A Rhetorical Model of Argument, State University of NewYork Press, 1999.

[56] F. H. Van Eemeren, P. Houtlosser and A. Francisca Snoeck Henkemans, Argumentative Indicators in Discourse. A Pragma-Dialectical Study, Springer, 2007, p. 9

[57] Van Eemeren (Frans H.), Grootendorst (Rob), Kruiger (Tjark), Handbook of Argumentation Theory. A critical Survey of Classical Backgrounds and Modern Studies, Dordrecht (Holland): Foris, 1987, p. 61.

produced in interactions or monologic productions as texts and discourses[58]. The presence of key indicators like “argument”, “ claim ”, “problem” ..., critical attributes, comparative marks, signs of agreement or disagreement, temporal modalities and key adverbs, and many other linguistic tools, help to find and to analyze argumentative activities. As an example, let us take the following fragments extracted from texts belonging to the nanotechnology collection.

énoncé n°: 1445
It also should be noted that our current knowledge of the biological functions of the circulatory system is incomplete , so the design presented here *must be considered provisional at best* .
énoncé n°: 1446
But the principal challenge of the present work was *to advance a plausible argument* that a nanomechanical whole-body thermal and biomaterials transport system *would violate no known* physical , engineering , or medical *principles* , could *presumptively* be made adequately safe for the user , and might confer some significant advantages over simpler whole-body systems exclusively employing unlinked populations of individual bloodborne and tissueborne nanorobots .
énoncé n°: 1447
Ultimately , *and from the standpoint of* human-guided evolution , the body exists primarily to ensure the survival of the mind - not the replication of the genes , which was *the ancient paradigm* [586 , 587]. It would seem that a somewhat more advanced and compact version of the proposed device could function independently of nearly all noncortical tissue .

Freitas, “Vasculoid: A Personal Nanomedical Appliance to Replace Human Blood”, Journal of Evolution and Technology, Vol. 11 - April 2002

énoncé n°: 8
Oberdörster's father , Günter Oberdörster , a professor of environmental medicine at the University of Rochester , *have shown that* such particles can enter the brain .
énoncé n°: 9
The fish studies , however , were the first to indicate destruction of lipid cells , the most common form of brain tissue .
énoncé n°: 10
Dr .Oberdörster of S . M . U. said that the results underscored the *need to learn more about* how buckyballs and other nanoscale materials are absorbed , how they might damage organisms and what levels of exposure represent hazards .
énoncé n°: 11
But she *rejected arguments made by some nanotechnology critics* that the limited toxicological research to date justified a moratorium on the development and sale of the new materials .
énoncé n°: 125
"This is a yellow light , not a red one

New York Times, “Study Raises Concerns About Carbon Particles”, March 29th 2004

Let us define argumentation by the following statement – which I share with Marianne Doury. This definition states in a few words : *an argumentation is a discourse, linked or not to an*

[58] M. Doury, « Evaluating Analogy: Toward a Descriptive Approach to Argumentative Norms », in Houtlosser P. & van Rees A. (eds), Considering Pragma-Dialectics. A Festschrift for Frans H. van Eemeren on the Occasion of his 60th birthday, Mahwah (NJ) London, Lawrence Erlbaum Associates, 2006, pp. 35-49 ; M. Doury, « The accusation of ‘amalgame’ as a meta-argumentative refutation », in van Eemeren F. H. & Houtlosser P. (eds), The practice of argumentation, John Benjamins, Publishers, 2005, pp. 145-161.

ongoing action, whic is organized through a disputing process – or its anticipation – in order to defend a standpoint, an opinion or a thesis, and designed to resist against hard and relevant criticism or contention. It is to say that an argumentation contains, at least as implicit requirement, one or many counter-argumentations.

Thus, the mention of arguments by authors-actors is a mean to access to the successive transformations of standpoints and to detect the critical oppositions in a large corpus. A detailed analysis of argumentative moments becomes compatible with the description of complex public trajectories. By analyzing in detail argumentative activities in many arenas, including informal ones – like in everyday life conversation, ou specific negociations involved in ordinary routines – the integration of external and internal aspects of disputes provide powerful analytic grids to detect what kind of arguments or counter-arguments an actor takes in charge and what kind of argumentative movement is produced in interactions or monologic productions as texts and discourses. It helps us to answer to a question that STS do not handle : why actors produce so many discourses and texts if only networks and interests are at stake ?[59]

In French sociology, Alban Bouvier is the only one to provide what he calls "an argumentativist point of view"[60]. Dealing with the cognitive dimension of social facts, Bouvier develops a research program taking collective beliefs into account. To put it in a few words, Bouvier tries to move social theory from a framework based on methodological individualism and rational action theory, toward a more cognitive approach turned to a social epistemology of argumentation. By this way, he meets the sociology of controversies and public debates, conceived as arenas in which collective beliefs are at stake. For example, he has studied, from an argumentative point of view, the public debate on the layout of an electric power line crossing a famous natural park – the Verdon in the South-East of France. But, even if epistemic confrontation on technical aspects was rich, he concludes that in this kind of public procedure the different arguments were hardly revised and that each group tries to reinforce its own beliefs – like in a "*dialogue of deafs*. ". We encounter here the question of skepticism in front of the habermassian conception of discursive democracy – as seen above in the nuclear or GMO cases. In the last years, Bouvier rerouted his interests on scientific controversies in which dialogic approach has shown its fecundity.

By recognizing that actors often refer to an ideal of pure critical discussion, we do not necessarily share a Habermassian view[61]. But it helps us to take seriously the mobilization of an "adversarial principle", since this constraint is strongly institutionalized! For instance, a civil trial, is by definition a trial between the parties. It must be "contradictory". This constraint is perfectly expressed in the Code of Civil Procedure (Article 16): *"A judge shall, at any event, cause to comply, and shall himself comply, with the adversary principle. He may not, in his decision, take into consideration issues, explanations and exhibits relied upon or*

[59] See M. Callon, «Some Elements For A Sociology of Translation : Domestication of theScallops and the Fishermen of St-Brieuc Bay», in J. Law. (ed.), Power, Action and Belief : a New Sociology of Knowledge?, London, Sociological Review Monograph: Routledge and Kegan Paul, p.196-223.

[60] A. Bouvier, "An Argumentativist Point of View in Cognitive Sociology », European Journal of Social Theory 10(3), 2007, p 465–480.

[61] J. Habermas, On the Pragmatics of Communication, MIT Press, 1998.

produced by the parties save where the parties had an opportunity to consider them in an adversarial manner. He shall not found his decision on points of law which he has raised ex proprio motu without having first invited the parties to comment thereon."

Such an ideal process of argumentative confrontation serves as a principle in many different arenas: working committees of stakeholders (negotiated rule-making and bargaining), public debate procedures, consensus conferences or citizen panels, scientific controversies and legal trials involving an adversary principle. But to what extent can we use the term of "controversy" for describing the social processes in which actors strongly defend opposite arguments and views? When do they shift from controversy to conflict and vice versa? That is a main question asked by the argumentative sociology involved in the pragmatical ballistics presented here in order to analyze trajectories of big issues through "turning events" or "strong tests". A "strong test" can be defined as a situation of confrontation in which the divide between critical discussion and critical struggle is at stake. To put it differently, the bifurcation of an issue largely depends on the ways of arguing developed by protagonists in very specific scenes: an expert commission, a public debate, an audience in court, a political mobilization, a coming out of events and opinions in media, a parliamentary vote, and so on.

When we compare several issues through a trajectory analysis, we can see the key role of the emergence of victims. Thus, there are many modes of existence of victims: as number, like in a death rate; as a group of persons sharing a prejudice; as carrier of a violent experience of trauma and injustice; or, last but not least, as a community which tries to resist to bad treatment and political domination[62] . The process by which the victims arise in the public configuration of an issue determines the kind of mobilization and confrontation and, by this way, changes the nature of the issue itself. By using a clear distinction between different types of critical movements, we can have a precise look to the main workings of disputing processes: settlement or development of a public issue depends on the protagonists ability to connect, or disconnect, worrying signs in the ordinary world, inquiry about the facts, collaborative controversy on the one side, injustice, intense denunciation and political conflict on the other side. In France, issues like nuclear and GMOs have shifted in a general conflict. Thus, since the end of the 1990s, no event, no alarm, no local affair, no expert discussion can be preserved from the struggle between pro- and anti-. The following table is an attempt to summarize the different critiques. One key problem of pragmatic sociology is indeed: what creates controversy and what makes people really angry!

	Alarm and Controversy	**Claim and Mobilization**
Type of problem	emergence of signs in the sensitive world or through instrumental devices (eg controversy about GMOs dissemination in crops)	*injustice suffered by persons or groups* *(eg farmer led to economical dependance by a firm; or beekeeper in front of death of bees with suspicion of a pesticide)*
Type of criticism	Collaborative criticism in order to improve a device how to define good norms and practices; for example to guarantee coexistence between GMOand non-GMOcrops	Radical criticism, denouncing a whole system *(« another world is possible » Alterglobalization)*

[62] James C. Scott, Weapons of the Weak: Everyday Forms of Peasant Resistance, Haven, Yale University Press, 1985; Domination and the Arts of Resistance. Hidden Transcript, New Haven, Yale University Press, 1990

As such, the skepticism about the impact of arguments in the debates and conflicts in general is heuristic because it leads us to imagine original forms of inquiry to clarify how sets of actors and arguments are produced. Sociology generally prefers "actors" or "players" and underlines their strategies, their interests and alliances. But how this realistic point of view does interact with the different forms of deliberation, which operate as constraints and resources? From this perspective, institutions are conceived as the social organization of compromises aimed at stabilizing relations between the actors, at pacifying their confrontations, and at providing standards of behaviour and trial, whose legitimacy is regularly called into question during new crises. It would seem obvious, moreover, that the times of confrontation and discussion of arguments are only short sequences in long series of transformation. Thus the analysis should focus on the development of power, institutional speakers, scientific actors-networks, business agencies and groups of citizens. In short, entering by arguments, would lead to miss the essential point: the dynamics of forces by which protagonist win disputes or settle crises –even if it depends on the context, when real interests are involved, bargaining could be a more efficient mean than deliberating[63]. But who said that bargaining is not a way of arguing? Empirical researches based on comparison of many issues show the opposite: by starting from the arguments we give ourselves the best chance to capture what is a power of conviction! However, in order to defend this view, we must put argumentation in variation. If we can easily show that the protagonists spend much energy to assess the scope of arguments, we ought to build the complete series of arenas in which arguments are brandished, from simple conversation to the political debate or the direct conflict. On the basis of this space of variation, we get an alternative model of political sociology based on different spheres of argumentation: ordinary conversations and disputes; expert controversies and public debates; legal trials, media polemics; political confrontation[64]. One cognitive consequence of this theoretical option is to help us to understand the different paths leading from controversy to conflict, from consensus to dissensus, from an orientation to agreement toward an orientation to disagreement... and vice versa, without defending a normative point of view[65].

[63] J. Elster, "Argumenter et négocier dans deux assemblées constituantes", Revue française de sciences politiques, 1994, vol. 44, n°2; J. Elster, « The Night of August 4, 1789. A Study of social Interaction in collective Decision-making », Revue Européenne de sciences sociales, Tome XLV, 2007, n°136, pp. 71-94.

[64] For a complete description of this "space of variation" necessary to think the "life and death" of arguments, see F. Chateauraynaud, "La contrainte argumentative. Les formes de l'argumentation entre cadres délibératifs et puissances d'expression politiques, Revue Européenne des Sciences Sociales, n°136, 2007, pp. 129-148..

[65] For instance, defenders of participatory democracy have a normative orientation which tends to prefer discussion over struggle, debate over conflict, argumentation over clash... As a result, each public issue produces a divide between participative promoters and activists, divide which plays a major role in left wing disputes ...

5. The analogy of ballistics and the dynamics of public issues

We all agree that the purpose of sociology is not to directly defend social movements and to skip along to specific actors[66]. It would seem obvious that the first thing to do is to reconstruct the genesis of the causes and movements, then follow their sociological trajectories. But, what does it mean to follow and analyze trajectories of actors and arguments ? We must agree on the language of description and analysis grids which are the most appropriate. The empirical materials indicate that the problem of protagonists is not to "turn around objects and concerns", but to enter in long run processes. Thus we must develop a social model of issues trajectories to think above all the cognitive and political conditions for the emergence and collective treatment of the causes, in many sociopolitical contexts, going from a minimum to a maximum degree of democracy, like participatory democracy[67]. We find in the literature different attempts to build a general framework in order to compare a large collection of conflicts[68]. Using a structural method, theses approaches have failed to connect micro- and macro- levels of analysis, and have generated many refutations based on the situated framing of disputing process, even when big issues are at stake[69].

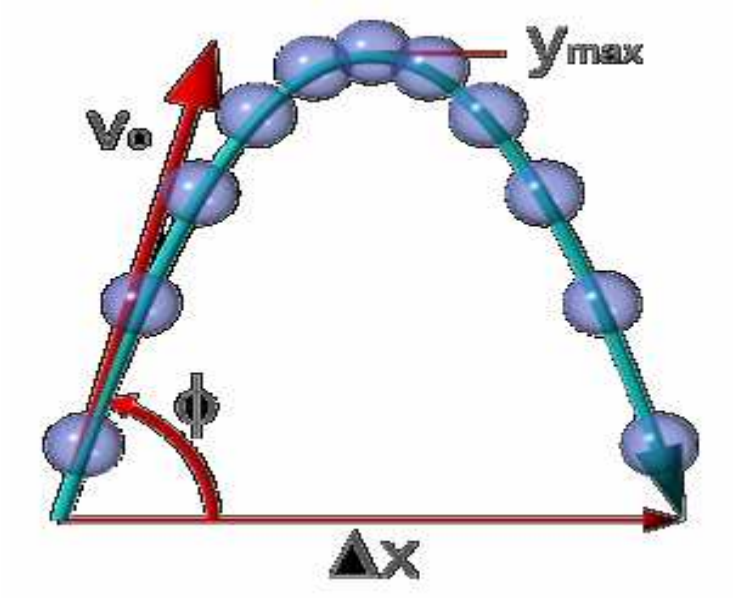
Let us go for a little trip to science of ballistics. The term ballistics refers to the science of the trajectory of a projectile in flight. Exterior ballistics is founded on the physics of a projectile as it moves through air. It includes launching technique, path through the air, and path through a target. As experts sustain themselves, studying the impact of projectiles is a complex matter. But, I just want to retain here the general modelling of ballistics problem as variations around a pure parabolic curve.

[66] Alain Touraine has given a prototype of social theory closely related to the emergence of social movements. "Sociological intervention" has been conceived as a participation to the early stages of making consciousness of the collective goals – and it was described through notions like "historicity", "subject" and "collective consciousness". See for instance, the case study in Poland: A. Touraine and alii, Solidarity: The Analysis of a Social Movement (1983).

[67] A. Fung, "Democratic Theory and Political Science: A Pragmatic Method of Constructive Engagement" in American Political Science Review, Vol. 101, No. 3 (August 2007): 443-58 ; A. Fung, Democracy at Risk How Political Choices Undermine Citizen Participation, and What We Can Do About It, Stephen Macedo, Brookings Institution Press 2005.

[68] Doug MacAdam, Sidney G. Tarrow and Charles Tilly, Dynamics of Contention, Cambridge, Cambridge University Press, 2001.

[69] D. Cefaï, Pourquoi se mobilize-t-on?, Paris, La Découverte, 2007.



The parabolic model of standard ballistics

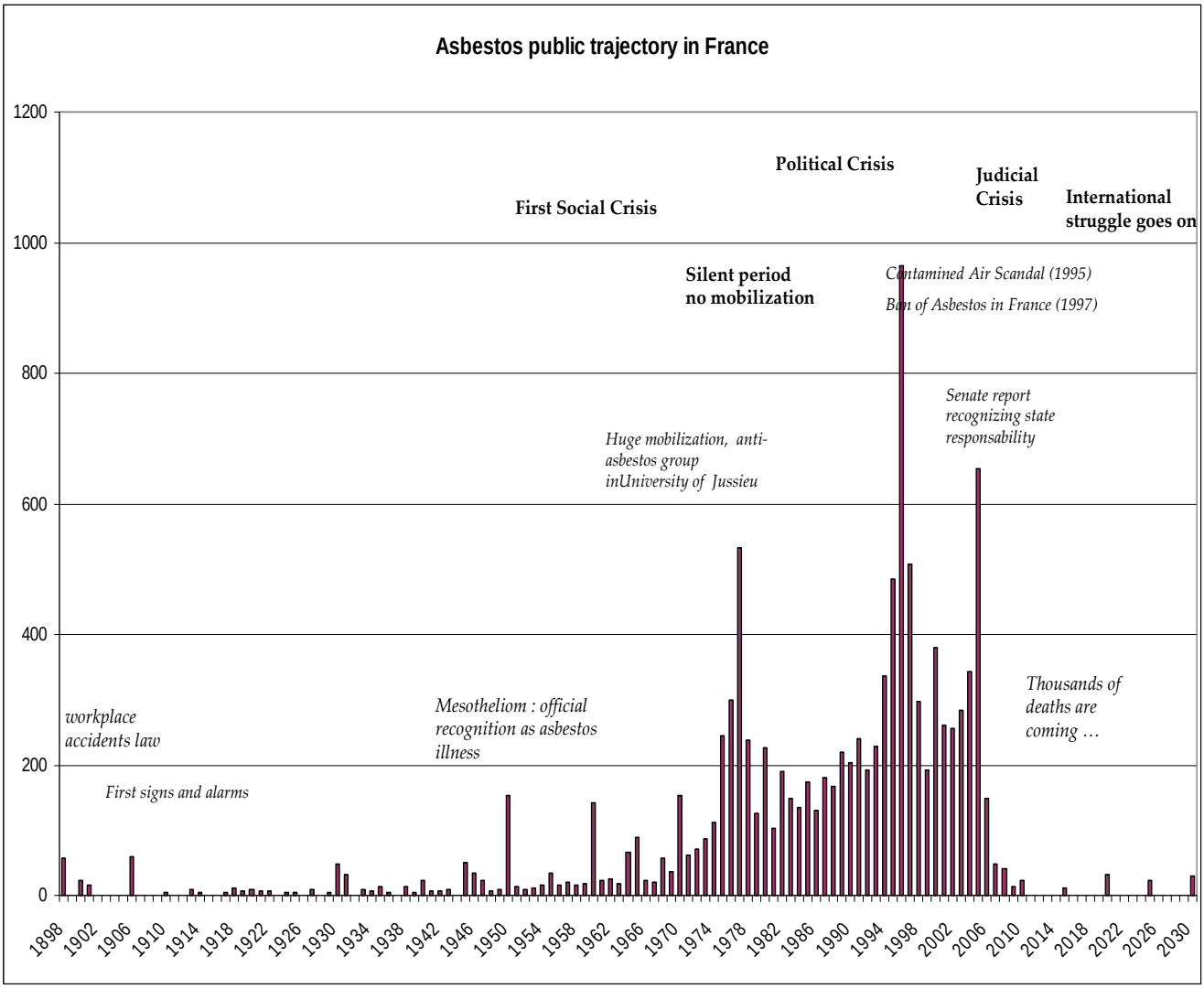
In sociology, such a parabolic model cannot be used even as a pure prototype to describe social processes ; but it could be useful for developing an alternative model of balistics using a rich language-game – in order to put it more explicit, because we use it when speakin about public affairs and collective mobilizations : keywords like “target”, “targeting”, “trajectory”, “scope”, “impact” , “launcher”, even “colateral damage”[70]
The title of the very famous text published by Hilgartner and Bosk, “The Rise and Fall of Social Problems”, in which they developed the key notion of “public arenas”, was an implicit use of this pure model of trajectory[71]. But, obviously, a great number of case studies show that the curve is far more complex. For instance, let us take the case of asbestos in France.

The modelling of issues trajectories by Hilgartner and Bosk underlines two dimensions : the competition between social problems to find a place in public agenda and, by the way, the carrying capacities of the different arenas – think to the classical problem of organization of the front page in media : what is the most important problem for media etc ; the second dimension is what they identify, after Gusfield, as the importance of drama : “The huge number of competing sollicitations places a high premium on drama, encouraging operatives to cast problems in dramatic and persuasive terms” (p. 61). But in long run issues that I try to follow and to compare, the problem seems different – even if the constraints of public arenas have a certain weight on the so-called public trajectories : First of all, we must take in account

[70] **As a** damage that is unintended or incidental to the intended outcome, the expression of “collateral damage” originated in the U.S. military, but it has since expanded into broader use. According to the *USAF Intelligence Targeting Guide*, the term means: " *[the] unintentional damage or incidental damage affecting facilities, equipment, or personnel, occurring as a result of military actions directed against targeted enemy forces or facilities. Such damage can occur to friendly, neutral, and even enemy forces*". For our purpose, collateral damage can refer to situations in which actors seek to mobilize and to make strong alliances but create some unintended consequencies – for instance, by awaking opposite interests and new stakeholders !

[71] Stephen Hilgartner & Charles L. Bosk, « The Rise and Fall of Social Problems: A Public Arenas Model», American Journal of Sociology, Vol. 94. n°1, jul. 1988, pp. 53-78.

the way by which actors and arguments are put in disputing process (early period of identification of signs, informal discussions, scientific controversies, merry-go-round of official reports and counter-expertises, public debates, legal trials, political mobilizations and so on ...) ; the transformation of actors, arguments and public arenas (or forms of argumentative activity) and the way by which they influence the trajectory of an issue are quite incomprehensible if we do not watch the different temporal modalities in which actors think, judge and act : emergency or delay, return to the past or anticipation of future, growing actuality or intermittent events, attempts and representation of trends ... By taking into account these two key dimensions, we are able to enrich the language of description in order to improve the performance of actor-network model !



This graphic is based on statistical distribution of the mentions of years in discourses and texts composing asbestos french corpus studied with Prospéro

The concept of bifurcation is particularly used in connection with complex systems. Physicists speak of "transition phase" to characterize the synchronization of individual processes causing mutation macroscopic qualitative in nature, what mathematicians call precisely "bifurcation." But in the case of social problems, the "transition phase" implies visions and intentions, rules and institutions, involving a high degree of reflexivity. The interest of this analytic framework is (a) to compare the trajectories of very different issues ; (b) to make visible the sources of resistance, bifurcation, distortion, and to take in account every thing which can alter the targets and movements ; (c) to watch how actors articulate or combine their designs (their targets) and the actual path (objective trajectory) produced on the ground.

Ballistics and activism

Ballistics seems to be a very deterministic notion. Precisely, how do actors perform the right trajectory for an alarm, criticism and mobilization, and symetrically, how they fail to convince, to mobilize and to achieve their goals. Here is the link with the focus on radical criticism and activism : what is an activist job ?

- to push or to pull forward a problem – or a solution;
- to open or close controversy or public debate – in order to have the last word;
- to target public opinion and political sphere – by campaigns, demonstrations and performances[72];
- to change law or institutions, or to defend them;
- to implement real actions on the ground and get tangible effects, after resolutions officially taken.

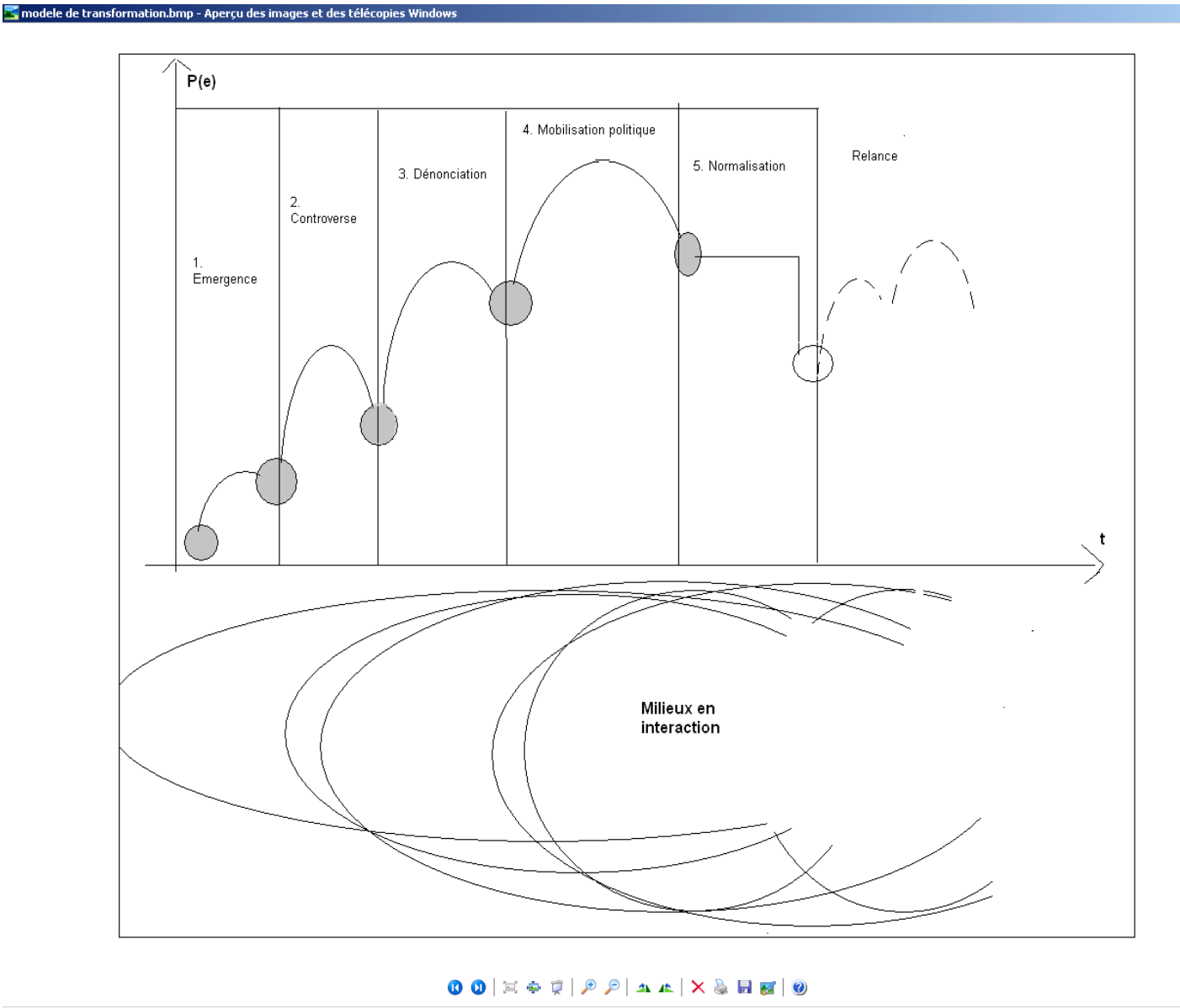
Then collective actors are intentional ones and developp a ballistics. But does our ballistics imply a teleological rationality ? No necessarily ! We can take it in a pragmatic sense : that is if we look at variations and bifurcations, unexpected movements and effects, and at the same time, the capacity of actors to adapt, or not, context by context , on the ground, to change their targets in the course of action. Unexpected events and intensive moment of argumentation are key frames for understanding the turning points in a long series of disputes and mobilizations. The key moments of argumentation are crucial (critical) and play an important role in the shifts, from vigilance to alarm, from alarm to controversy, from controversy to polemics.

Different programs, called “mapping controversies”, deal with such conceptual and methodological problems[73]. But, better than “topics”, we can watch “sets of actors and arguments”, and in place of reifying “networks”, we can deploy long run transformations, in which visions of past, present and future are taken seriously with a strict symmetry.

[72] C. Tilly, Contentious Performances, Cambridge, Cambridge University Press, 2008.

[73] See the « Issue Crawler project » sur http://issuecrawler.net. N. Marres, “Tracing the trajectories of issues, and their democratic deficits, on the Web: The case of the Development Gateway and its doubles”, Information Technology & People, 2004, Vol. 17, 2, p. 124 - 149

Furthermore, it allows us to distinguish different phases: emergence (making new signs and problems visible), controversy (agree or disagree on facts and matters of facts), claims, denunciations and polemics (defining victims, responsibilities and guilt people), political mobilization (in the aim to modify or to defend law and conventions), normalization and regulation (put in practice texts and rules, by involving many actors in a process of governance ...).



We do not know a priori in how many arenas and in how many argumentative regimes actors will engage in order to launch or to stop, to support or to erase, to reinforce or to weaken an alarm or a claim. As Jasper showed in many texts, changing the configuration of a disputing process and the scope of protest not only supposes strong arguments and stick groups, but involves emotions[74]. "Denial of democracy", "parody of public debate," "contempt of

[74] J. M. Jasper, The Art of Moral Protest: Culture, Biography, and Creativity in Social Movements, Chicago, University of Chicago press, 1997; James M. Jasper, « The Emotions of Protest: Affective and Reactive Emotions In and Around Social Movements », Sociological Forum, vol. 13, n°3, 1998, 397-424.

citizenship," "rogues law", numerous expressions are available to proclaim outrage at political processes contrary to democratic standards and calling on citizens to mobilize. Any process of mobilization entrenched at least two movements or two operations that push to break the ordinary routines: an expression of anger or denunciation facing a decision, a reform or an unacceptable, and a test of strength through collective action. That is why the question of the debate and the discussion are secondary in the vast literature inspired by the sociology of mobilization. It is assumed that the players are convinced and they are not looking to persuade their opponents with arguments and rationale, but spectacular performance or demonstrations to impose negotiations. In addition, other types of events interspersed between collective actions and public debates: the court procedures are indeed frequent, either because of the trials are at the heart of the dispute process - such as when a petition circulating in defence of "whistleblowers" attacked in defamation by industry - either because the mobilizations overlap multiple sectors of activity, by engaging in legal or regulatory requirements.

One of the issues of mobilization process is to change the amplitude of the collective grips or grasps. Indeed, when a mobilization takes shape and produces effects, it marks lasting list of actors and arguments that are important and that are in the common calculation or reasoning; arguments and reasons become handled by spokespersons of the most diverse camps. From a sociological point of view, the existence of sustained conflict is as important as the agreement or consensus, as it allows for a clarification of relations between groups of interests and positions, producing unbreakable link between actors and arguments: a slogan such as "we now know that to save the planet we must act, and fast!" can come only from green position; a phrase such as "stop to make us afraid of falling in disaster! ", necessarily comes from the camp of" entrepreneurs ". But sometimes a chiasm occurs. The duration of a conflict raises interesting issues of measurement and scale: for example, on the question of environment, we can consider that the dispute remained unchanged and that new forms, like everything that has been drained by the Grenelle of the environment, only cover a irreducible conflict, which dates back to ancient times. Sociology constantly varies between the idea that public tests are only actualization of underlying conflicts and the idea that every issue is an opportunity to rebuild the political link and redefine the ontology of social actors. The question is not to choose between two opposite options, but to have the means to assess what each dispute will change, not only in the media but also in the devices in which people act in everyday live.

Since the beginning of the 1990s, policy makers have to tackle new challenges: not only the growing complexity of markets and technologies, of norms and institutions involving many stakeholders, but also more and more public controversies. The description of these controversies cannot run only in the public spheres, even in a pluralistic model. It must go to the birth middle of actors and arguments, and, for example, focus on the local production of indicators, of signs, and on their diffusion under the shape of narratives which make sense to the public and may base a feeling of likely "harmlessness", which plays a key role in what Remi Barbier called, using Isabelle Stengers expression, the "ironist attitude"[75]. More explicitly: when a reform occurs in an area of activity or an institution, a sociologist cannot be surprised if, after a delay, protest arises while politicians thought that the dispute was finished

Recently, in a discussion of de Vries's strategy to redirect the attention of the STS community towards politics, B. Latour has tried to summarize some of the "successive meanings of

[75] Rémi Barbier, "Nature and role of a local governance in environmental policies" , communication in 4S, Paris, August 2004.

political through which a given issue might pass"[76]. One key topic here is the degree of political construction of an issue and the degree it contributes to redefine politics and policies. *"Whatever the term one wishes to use – object, thing, gathering, concern – the key move is to make all definitions of politics turn around the issues instead of having the issues enter into a ready-made political sphere to be dealt with. First define how things turn the public into a problem, and only then try to render more precise what is political, which procedures should be put into place, how the various assemblies can reach closure, and so on."*

One product of this discussion is a table crossing steps or phases of "political", fundamental issues (what is at stake) and social science programs. I reproduce here the table, providing five definitions of politics – and showing how much Latour goes far away from laboratory life!

Meanings of 'political'	*What is at stake in each meaning*	*Examples of movements that detected it*
Political-1	New associations and cosmograms	STS
Political-2	Public and its problems	Dewey, pragmatism
Political-3	Sovereignty	Schmitt
Political-4	Deliberative assemblies	Habermas
Political-5	Governmentality	Foucault, feminism

This partition is not, by itself, incompatible with a ballistics based on the successive transformations of sets of actors and arguments, but it tends to reify the trajectory and to underestimate the role of actors' environments (what we call "milieu" in French) and the modalities of devices anchorage in social areas, which are more or less resistant and create a form of metastability for political or social order[77]. It sounds strangely to say about Latour's text that it underestimates the creativity and inventivity that actors are able to develop, in social processes, to displace the constraints and the rules associated with political systems. Following actors need to take seriously the modalities of arguing and acting they get in real contexts – in other words, the kind of grip they conquer and they try to share or defend.

[76] B. Latour, "Turning Around Politics: A Note on Gerard de Vries' Paper", Social Studies of Science, 2007; 37; 811.

[77] Simondon argues that it is impossible to understand metastability without introducing "the notion of the potential energy residing in a given system, the notion of order and that of an increase in entropy." This term designates a situation that is far from equilibrium. Metastable situations have higher magnitudes of energy than simply stable ones. See G. Simondon, "The Genesis of the Individual," in J. Crary & S. Kwinter (eds.), Incorporations (New York: Zone Books, 1992): 297–319.

Conclusion: sociological Ballistics and the cultural Repertoire Theory

The paradigm shifts which have characterized the social sciences since the 1980's, have significantly modified the analysis categories and tools that a long tradition had locked into the label of "conflict"[78]. If "social conflict" had been, from the outset, constructed as a central object of sociology to the point of saturating the conceptual space of the discipline up to the late 1970s, new sociologists have referred the notion of conflict to the mechanisms of criticism inherited from Marxism. In most analyses, conflict has become synonymous of failure of a policy or of public communication, when it is not assimilated to the necessarily negative effect of a "resistance to change" by some social categories on the decline[79].

In the fields of sociology and political sciences, the impressive literature which has dealt with the notions of "public space", then with that of "deliberative democracy" or "discursive democracy" demonstrated a clear preference to models of agreement and consensus, coordination and justice, endowing itself with actors prompted by a common concern with "public interest"[80]. In this literature, since any public action is subjected to a legitimacy constraint, it requires the emergence of a wide scope agreement or, if not, an acceptable compromise allowing linking heterogeneous agents to common interests and values. Hence the proliferation, since the middle of the 1990's, of supposedly unifying topics from "equity" to "governance" and "sustainable development", including "transparency", "sharing knowledge", "network" and "cooperative spirit" or the inevitable "participatory democracy". This consensus based conception of social issues led to the emergence of several theories on agreement, among which the "economics of conventions" and the well known "sociology of justification"[81]. The actors are supposedly acting in the name of high principles or universal interests, against which no head-on criticism is possible, unless it means breaking the social pact and collapsing into civil war. It takes one principle meeting the same universality axioms to contest the legitimacy of another principle. From the perspective of social sciences investigation, these approaches had the merit of leading to explore the "*means of criticism*", while considering the cognitive tools and moral standards on which the actors rest in order to promote any contestation and win a cause. But in the meantime, studying the numerous disputes and conflicts has required returning to a conflict sociology likely to allow a careful consideration of antagonism, which is not limited to the unfortunate outcome of a misjudged dispute, but also includes the expression of an argument, described by Lyotard through the opposition of damage (related to compensation) and wrong (immeasurableness factor)[82]. Starting from the project of restoring the balance between "cynical sociology" (everything is

[78] Simmel considered conflict as one of the major factors structuring social ties. Georg Simmel, Le Conflit, Circé, 1995. Georg Simmel. "The Sociology of Conflict: I", American Journal of Sociology, 9 (1903): 490-525.

[79] For a recent investigation on conflict rehabilitation in the field of labour sociology, refer to J.-M. Denis (dir), Le conflit en grève? Tendances et perspectives de la conflictualité contemporaine, Paris, La Dispute, 2005.

[80] An archaeology of agreement models, which have dominated the recent trends in sociology between the middle of the 1980's and the beginning of the 21st century, could rest on the successive readings undertaken on the works of John Rawls, Jürgen Habermas and Paul Ricoeur.

[81] Refer to L. Boltanski and L. Thévenot, On justification, op.cit.

[82] Jean-François Lyotard, Le Différend, Paris, Éditions de Minuit, 1983. (The Differend: Phrases in Dispute. University of Minnesota Press, 1988).

subject to power relationships) and "moral sociology" (everything derives from principles which can be universal), I have tried to demonstrate in this contribution the way conflict may be reinserted in a sociology of controversies and collective mobilizations, by proposing to reflect, within the same frame, upon power relationships and the argumentation repertoires used by these actors[83].

The focus on argumentation invites to discuss the role of cultural background and more especially the idea of different repertoires that people can mobilize in case of dispute or any kind of situation producing a quest for justification. As it had been already addressed in different discussions[84], the empirical attention to action and justification in context has been done in order to illustrate the efficiency of general principles, which were embodied through a long history. Where do actors find the range of arguments and principles of evaluation they deploy in the disputing process? The main interpretation of Boltanski's theory was, to put it in a few words: you have to adapt your argumentation to the situation by using the right repertoire at the right moment! However, this understanding creates many problems:

- It underestimates the sometimes long process by which actors, associated in the same camp or position, discuss the relevance of topics and arguments and produce a collaborative work to fit their argumentative strategies. Even in the individual cases, everyone knows that each actor tries to strengthen his claim or defence, by turning to advisers – from close friends to specialists. Thus, the repertoire is put at test and continuously reinvented by protagonists.

- From what kind of repertoire do emerge new arguments? To what extent are actors able to create new facts and matter of facts? Disputes, controversies and conflicts have this common property to push protagonists to develop and make explicit things which were not clear – and it is one of the main products of all these disturbing processes: definitions, categories, rules, norms and so on.

- Another point is linked to the relationship that people establish, or not, between cultural membership or identity, and social roles or public positions: there is no clear general relation between milieu and public action. Through a wide range of disputes, we can show that social environment and public devices are subjected to co-redefinition – think to the example of voluntary mowers and the alliance between peasants and urban citizens in the GMOs case, but in a more general way, the making of residents as citizens – like in nuclear waste or incinerators.

- A difficult point is concerned by the strategic aspects of argumentative processes, notably when law and legal issues are at stake. Many works have shown that claims for justice are rarely congruent with legal procedures – and when a junction occurs, it produces a great precedent.

[83] Thus, we can defend the following statement : argumentations become practically effective through frictions, not in an ideal process of communication. For a clear construction of the concept of "friction", see A. Lowenhaupt Tsing, Friction. An Ethnography of Global Connection, Princeton University Press, 2005.

[84] See for instance I. F. Silber, « Pragmatic Sociology as Cultural Sociology. Beyond repertoire Theory? » European Journal of Social Theory, 6 (4), 2003, p. 427–449.

- A last observation: the claim for justification is, in many situations, the clear manifestation of a power; as a result, a justification is less a process of agreement than a mode of domination: if the control of “accountability” is the key of power, public discussion, and in a more general way deliberation as an argumentative process, implies a symmetry and a collaborative organisation – except if actors consider public debates as a space of public representation of readymade interests and values.

To conclude on this point, let us consider that a cultural repertoire works as a ressource that actors can use in different contexts. For what purpose? In order to clarify, by narrative or storytelling, the cultural backgrounds involved in their reasoning; or, as it is often the case in big issues, it works as a tool to create a balance of power in a conflict, or bargaining, by showing clearly things which are impossible to touch: A kind of red line! By contrast, one can easily consider that the strength of collective mobilizations will depend on the possibility to build, for a short or a long run, a large combination between different views, going through cultural divisions or specificities. Therefore, cultural differences are precisely tested in the process itself and the success or the fail of a collective mobilization produces retrospective effects on the so called cultural repertoires. Here is the main point concerning cultural sociology : how can people have a ideal discussion if they do not share cultural backgrounds, language and values ? How the cultural differences may influence the exchange of arguments ? The pragmatic position consists here to observe situations and events in which cultural identities and differences are engaged by protagonists. On one side we cannot develop a pure relativistic point of view (all is subjected to different interpretations) ; on the other side the common world or the common sense is always in a process of construction ...

Annex

Socio-informatics: collecting, modelling and following public affairs and controversies

To produce comparative analysis on different issues, we have built transversal analytical tools which enable to enrich matters one another. The literary technologies conceived from Prospéro and Marlowe ("home-hand-made" devices developed in our own laboratory since 1995) share three key characteristics:

- They are founded on a semantic and pragmatic study of arguments and sets of actors who support, criticize or transform them. From this point of view, they suppose data-processing tools able to enter the complexity of documents and to link the logico-linguistical analysis of statements and the one, more statistical, of great corpuses.

- These techniques have as a main virtue to enable the following of affairs and controversies in the course of their evolution, without closing in advance the list of relevant documents, and they make possible the comparisons between cases.

- A collection of case is generated dynamically by the network of users; in addition to the building of a memory for cases, it provides bases of hints and concepts transposable from one corpus to the other. Finally, these tools are designed to support a co-operative space of research into which each user introduces his own grids of analysis and subjects them to the collective discussion. The confrontation of different competences and theories makes emerge standard categories and methods which enrich in return the data-processing protocols shared by researchers

Available for collective test and comparison, our "e-sociologists", Prospéro and Marlowe, are like cognitive artefacts especially designed to equip sociology of controversies : these tools are particularly adjusted when actors use to mobilize many tools, produce many discourses, testimonies and expertises, and when Internet provides massive information, very difficult to evaluate. Here is the thread we call socio-informatics, a set of sociological tools built around Prospero software. The main goal is to provide instruments for analyzing the operations that persons and groups perform when they resort to alarm, criticism, claim or political action.

Asbestos	Big crises in France: first in seventies; second in nineties. Silent period during 15 years. Nowadays: many complaints and lawsuits. The question of the penal responsability of state is engaged. Recent news: The very strange story of the aircraft carrier Clemenceau!	National issue Conflict +++ Biomedical +++ Through Closure?
Benzene	A specific thread inside the large (and worldwide) issue of air pollution. A suspicion of effects of benzene on children, and more precisely of peaks of pollution on child leukemia incidence... but there few alerts are rising in public space and the expert and counter-expert communities are not strongly organized	Alternately Local/ National Conflict – Biomedical + Silent ongoing
Bird Flu / Avian Influenza / H5N1	An animal epidemic. The threat of a global pandemic is taken seriously by international stances and governments. The WHO as an alert carrier, taking the role of an official prophet of doom. But a controversy araised: is it at first a human health problem or a veterinarian affair?	International (global) issue Conflict – Biomedical +++ Openendness Global mobilization
BSE / made cow	One of the most outstanding crises in Europ. All spheres of activity were affected, in particular between march 1996 and 2001. The question is now asked: was the alert on the new variant of CJD so efficient that the pandemic was countered?	European / International Conflict + Biomedical +++ Through Closure?
Doping scandals	Through a long series of doping scandals, a decisive rupture took place in the sporting field. Biomedical and judicial actors, new regulation antidoping devices... a complete reconfiguration to observe. See Trabal.	International (global) issue Conflict + Biomedical +++ Global mobilization
Ebola	Ebola haemorrhagic fever (EHF) Category of emerging diseases. Many outbreaks in central Africa. WHO has managed the international alerts. The natural reservoir of the Ebola virus is unknown despite extensive studies, but seems to reside in the rain forests on the African continent and in the Western Pacific. Fears of diffusion in Europe or America are not very visible. Extension to Marburg disease...	Local / international Conflict – Biomedical +++ Silent watch

Gaucho (insecticide)	Imidacloprid is suspected of killing the bees. Alerts and controversies are strongly determined by a struggle between firms and honey producers	Alternately Local/ National Conflict ++ Biomedical + Through Closure?
GMO (Genetically Modified organism)	a matter marked by many public debates and legal decisions. A field dominated by the precautionary principle	International (global) issue Very specific development in French context Conflict +++ Biomedical ++ Global mobilization
Electro – Magnetic Fields (EMF)	It is an old issue, beginning with the threat of power lines – see Currents of Death. Nowadays, the problem is concentrated on Mobile phone risks. Numerous studies of 'extremely low frequency magnetic fields' try to demonstrate a causal link with malignant disease. For official experts, there is no plausible biological mechanism through which EMF might cause real disease	Local / national / international Conflict + Biomedical + Local alarms and international reframing
Nanotechnogies	Convergence of multiple sciences. Invisibility and the grey goo prophecy. Threat on freedom and the question of limits of security and social control. The posthuman issue. Towards a new ontology? See the NBIC report: Converging Technologies for improving Human Performance. Cautious evolutionism / Radical discontinuity	International (global) issue Conflict + Biomedical + Global mobilization
Nuclear radiations	Two series of problems: safety and prevention of accidents; low level exposure and the biomedical evidence of causes of cancers. Presence of an important movement of protestation and new radicalism	International (global) issue Conflict +++ Biomedical ++ Global mobilization
Pesticides	A key issue in health and environment alerts and controversies. Nature, technologies, agriculture, food and health problems are mixed together. This matter already has a very long history. A study is just beginning in GSPR: contract with AFSSET: The French Agency for Environmental & Occupational Health Safety	Local / national / international Conflict + Biomedical + Local alarms and international reframing
SRAS	Emerging disease and international in 2003. Problem of global transparency, standardization of diagnosis and vigilance, and international coordination.	International (global) issue Conflict - Biomedical +++ Closed