Making tangible facts.
Investigations and the sudden appearance of proof

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I will developp my arguments in five points :

1. First, I give three examples which could not be fully developped here, but provide very typical aspects of our fieldworks.

2. I present four theoretical orientations generally used in sociology to reduce the question of proof.

3. I suggest an integrated model based on concepts like "tangibility", "common grip", "marking test" and "computation space".
4. I insist on two aspects of any investigation : bringing together and cross-checking processes.

5. What is at stake is being able of analyzing complex affairs marked by different configurations of actors and arguments.

1. Three case studies

First, I quickly summarize the cases described in my full text.

The first case is a famous french scandal : « sniffer planes » ("les avions renifleurs"). At the beginning of 1976, the representatives of a financial group inform the Erap company, related to Elf Aquitaine that an invention will upset oil research : apparatuses allow "to see" under ground until to several thousands of meters of depth and to undoubtedly identify the oil and gas layers, the water reserves and so on. It was a complete hoax, but it took 3 years to be revealed.

So this case allows us to describe the installation of a suspicion which leads to the final proof of the hoax. Caused by the blindness of a collective expectation, this historical hoax shows what is an absence of grip on a device: the stacking of anticipations had created a hiatus between the beliefs and the factuality. To clarify the persistent doubts on the effectiveness of the geological device of detection, an expert of the CEA required to transfer the experiment from the ground, where all was under the control of the "inventors", to the laboratory, in

which he could isolate the object from his manipulators: the authentification supposed to break the mode of influence in which the forgers hold their customers on the ground. While bringing back the device in a controllable space, the expert found his marks and uncovered trickery.

My second example is the nuclear power plant of Blayais, located on the Garonne estuary. This nuclear plant was widely covered when the December 1999 storm occurred. A major accident almost happened, whose occurrence had never been taken into account by nuclear engineers. Pushed by the wind, water of the Gironde penetrated in the building : the flood ran through the openings of the enclosing wall, simple plaster connections necessary to the passage of the cables. This incident shows another figure of proof: the sudden appearance of the unthinkable or unforeseen event, which puts at risk a computation space, bringing the proof of an incompletness of safety devices. The safety authorities tried to maintain a probabilistic reasoning while at the same time the incident has all the characteristics of a precedent which destroys, by its only existence, the framework of former calculation. On the other side, antinuclear criticism is built against the probabilistic reasoning. It takes support on a "logic event" , more convincing for whistleblowers than the mathematical logic which underlies risk assessment and of which technical coherence and political relevance are threatened by the occurrence of improbable events.

The last case brings us closer to the use of the "precautionary principle", dominating public sphere (in Europe) during the last years. The case of Gaucho, name of an insecticide marketed by the German firm Bayer, is rather typical of contemporary controversies relating to the doubts about the dangerosity of a product. In 1998, alarm is spread in public space but the accounts insist on the anteriority of the process: "since 1994, the rumour swelled in the French hives". If Gaucho protects sunflowers from coleopters and other parasites, it would also decimate colonies of bees. A Few years later, the uncertainty is not completely reduced. The actors multiply investigations and measurements, developing a collective vigilance which installs their probing activity in an alternation of conflict and negotiation. By modifying the conditions of investigations, as in the case of BSE, elements of precaution can destroy the evidence that a catastrophe was indeed in gestation.

An object, an event, a process. Each figure involve a different mode for the production of tangibility. Before coming back to these figures, I shall develop the theoretical aspect of my work.

2. Moving the sociological frames : beyond cynicism and morals, a strong pragmatic program in sociology of proof

Analyzing how public tests and debates affect social processes needs a critical reflection about the status given to argumentation by models in social sciences. In which conditions, could an argument transform the positions of actors involved in a debate ? The strength of an argument is not located in an underlying balance of power or in a pure logical space. It depends on its linkings between three types of constraints: the set of tangible evidences which are used by actors; the compatibility of different representations and interests in a common computational space; at last, new ways of thinking the relationships between past, present and future. Then, investigations and public debates appear like moments of invention of new argumentative features that are able to resist against critical variations. The forms of attestation which result from these critical processes determine the possible closure of disputes, showing the "moment of thruth" recognized by all actors.

We shall not underestimate the complexity of the problem disputes conclusion. The solution depends on the type of principle of reality we prioritize. In sociology, different theories are available to settle this point.

Firstly, we have sociologies of interest ("fully understood" interest). This solution generally linked to the so-called "methodological individualism" is also located in sociology of science, and more precisely, in the paradigm which connects facts to enrolments based on a cost-benefit scheme : tangible facts are the ones which are computed as necessary from an interest or computation space.

A more political version of this orientation is Bourdieu's theory which grounded the factuality on a "legitimacy imposition" – understood as a form of authority which mix legitimacy and power. If we accept to reduce evidences by strategies and power games, there is no reason to see other things than rhetoric or art of persuasion.

To escape from this logic of suspicion, with whom actors themselves, influenced by classical social sciences, often agree, a recent french school of sociology, run by Boltanski and Thévenot, has developped an alternative model of actions and judgments lying on a set of principles of justice which are supposed to be universal. Here, proof appears as a connection between states of things and principles of equivalence.

Nevertheless, the aim to understand practical experiences of the actors calls for a phenomenological approach, focused on sensitive modalities of the contact with the world.

By showing the passage from doubt to shared evidence, the notion of tangibility provides a contiuum between the perceptual abilities involved in the sensitive world and the most equipped techniques of proof. Actors have bodies and, if they do not always believe what they see or touch, they strive to fit perceptions and representations through marking experiences which work like pledges of authenticity.

From this point, we can tackle evidence differently : it is neither reduced to a negociation of interests, nor to an imposition of legitimacy, nor to the coherence of a representation of justice, nor a simple attestation of presence. There are mid-points between collective representations and perceptions in the sensitive world, spaces of computations and professional or lay knowledge, by witch actors develop the common grips that underlie agreements on factuality. So, the collective dispositions that underlie the "common sense" are not only the products of representations or alignments governed by interest : they result from a series of tests of tangibility through which the actors forge new grips.

3. Tangibility and the emergence of common grips

A mathematician told us his conviction there were three forms of proof: 1 To present the object or the fact; 2 to give a convincing plan of construction of it; 3 to show that "it cannot not exist".

How sociology would add anything ? What is a tangible fact for actors ? Contrary to "formal evidence", the expression of "tangible evidence" involves some kind of perceptual experience, as does "direct proof". A tangible proof resists to perceptual, instrumental and argumentative tests performed by conflicting actors. By pointing out the possibility of an enduring attestation, tangibility is an ideal concept, allowing to consider practices and devices used to make some phenomena obvious.

From exemplary cases, we have distinguished three forms of production of tangibility : a perceptual work in contact with things which provides new grips; the sudden appearance of a marking event which breaks a representation or a former computation space; the formation of a collective agreement on bringings together between signs. When the three forms converge, actors do not have any reason to keep on investigate. Then, common sense has a new point of support, which makes useless or unreasonable the attempts to start again the test and to re-establish doubts. The preoccupation or worriness about verification becomes itself suspect. It is no more necessary to interpret signs, now transparent. The most important thing, is to be able to verify in the event of emergency, doubt or dissension.

According to William James, the "verificability" is more significant than verification itself, because it points on a potential or virtual verification. The verificability merges with a feeling of confidence: it enables us to test the agreement between our ideas and reality, by an intuitive examination of the context which provides sufficient signs to cause our adhesion. Signs act like digests of verification, short-circuits, summaries. Thus, common sense can be described as the public use of this verificability principle.

4. Gathering and crosschecking : the dynamics of inquiry

The concepts of cross-check (recoupement) and bringing together (rapprochement) play a significant role in the description of the investigations. They make it possible to clarify the "relations" mentioned in the ordinary expression of tangibility [1]. The two operations testify to a cognitive division which calls for a synthesis in the form of new grips : the cross-checks aim at perceptual operations in contact with things ; the bringings together relate to the intellectual operations which associate, on the basis of concepts, taxonomies or prototypes, physically-separated objects. The work of any investigator relies on a cognitive economy which consists in maximizing the chances to obtain cross-checks and to reduce the list of the necessary bringing together[2]. But this economy is subjected to cycles or crises : one observes periods of intense activity in which the protagonists gather traces and clues ; but one also notes silent periods, marked by a rarefaction of signs, during which waiting dominates until potentialities appear, and new elements are forwarded to the laboratories of the investigation.

Which place to grant to the degree of conviction or belief in this language of description? There is not any doubt that the term most usually opposed to the proof is that of belief. The belief emerges in our cases by the intermediary of epistemic marks or propositions containing their locutor ("according to X ", "X believes that P"). Whereas proof rests on clear and distinct categories and protocols allowing the repetition of tests, the idea of belief marks the state in which is the person who qualifies beings or phenomena (Bazin, 1991). One does not speak about "tangible belief".

Why ? Because there is no belief which we cannot question, since any belief can appear false [3]. According to Peirce, if it is inevitable to trust beliefs, one must replace, everywhere where that is possible, vague propositions by general propositions, less to refute them that to control them logically (Tiercelin, 1993).

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[1] For John Dewey, the word "relation" has three different meanings. A first class of relations relates to the symbols connected the ones with the others. The second returns to the way in which the "symbols are in relation to the existence by the means of the existential operations". Lastly, a third class convenes "the existences" which "are in relation the ones with the others in the function of proof in which the sign has a meaning" (Dewey, 1993). According to Dewey, these three modes of relation being very different, the use of a single word create a serious confusion…

[2] In the bloody Moon, J Ellroy provides a stylized example of the process at work in the legal instruction, and which is not reduced to pure gathering clues as Ginzburg wrote. After multiple investigations, its investigator manages to release two features of the "serial killer" that it seeks: first, the suspect has a microphone-tape recorder of high definition, provided in very small quantity on the territory; second, he was a pupil of an establishment at one well defined time. The investigator exhumes the lists of pupils starting from an estimate of the age of the criminal and looks at the book of the suppliers of microphone-tape recorders: he thus carries out a bringing together between two independent series of clues and hopes to see being carried out a cross-check. The same name emerges within the intersection of the two lists. The bond is weak since the killer can have bought the tape recorder under a false name, but a track is from now on opened.

[3] "a belief which could not be false, wrote Peirce, would be an infallible belief and infallibility is an Attribute of the Divinity" (Peirce, 1978, p. 42)

To be valid a cross-check supposes an independence of the states of things and states of persons : if investigators create the material conditions of each cross-check, they do not produce it. On the other side, if it is true that a bringing together is validated by the agreement of actors on the interpretation of signs, this agreement is more solid when they come by different ways to the same interpretation, while varying a maximum of theories and assumptions. By using the term of belief, one confuses bringing together and cross-checking, and, thus, there is hardly possible to make a difference between a true test and a fabrication, in the sense of Goffman.

Thus, what guarantees tangibility is not the fixity or the inaccessible character of a thing uneasy to handle, but the possibility of reiterating if necessary the true test. What is tangible perseveres in spite of, or rather thanks to, continuous variations.

So, probative force depends on the means by which the mobilized actors could test the persistence of cross-checks and the consistency of bringings together. Proof as a material and formatted inscription must give to all actors the possibility of a reproducible grip on the object and its associated environment. The participation every protagonist in the process of investigation is not only a regulating ideal of our democracies. The topic of accessibility is central in any agreement on evidence: others than people who bring proof must be able to produce it again without being prisoners of the device, which has to be subject to criticism. To provide proof, is thus to provide a procedure of accessibility to all protagonists. The necessity to give grips is not made to satisfy the cultural standards or interests of a community of actors, but to guarantee that proof is not under the constraint of a particular representation.

In the heart of these processes, the protagonists use various topics of proof:

- Direct attestation by senses;
- Proof obtained by cross-checking clues or testimony;
- Statistical correlation;
- Reproducible experiment in laboratory;
- Demonstration based on arguments considered to be undeniable.

The first figure is based on a spontaneous phenomenology of sensitive experience: people who doubt or who do not have a catch on the phenomenon are invited to share it. The second figure relies on a logic of redundancy in a beam of traces and clues. Once gathered, from available data emerges points of cross-check which allow to eliminate incoherent or improbable versions. Statistical tools redefine this empirical shape of cross-check in a computation space detachable from persons. The third topic is indeed statistical correlation, which breaks with ordinary cognitive operation and aims at producing counter-intuitive results able to reorganize representations (Desrosières, 1993). The fourth figure is the favored of experimental science, organized on a model of containment and exactitude, leaving simple correlations to reach causes (Licoppe, 1995). The tension is maximum between the undertaken statistical studies in opened world, subjected to the variations on the conditions of investigation, and experiments in laboratory, shown to reduce in a microworld complex and heterogeneous configurations. Lastly, the fifth figure raises more than one logic of

plausibility: by calling upon the argumentative reasoning, protagonists create spaces of variations able to put under discussion the tests instituted by sciences.

There is a fundamental relation between tangibility and the convergence of the multiple systems of proof. Because there is at least a common constraint to various topics of proof: they must offer a tangible return. The more one phenomenon resists to the variations introduced by other investigators, the more it is tangible.

5. Space of variations and long run transformations : a new methodological way

Five strong moments emerge from the processes of investigation whe have studied.

- The emergence of a question, a doubt or an uncertainty ;
- The routing of clues, traces and testimonies ;
- The organization by each authority of the investigation of a network of conceptual connections (bringings together) and relevant crosschecks (steppings) ;
- The confrontation or crossing of expectations and arguments invested by different actors ;
- Finally, an act of closure and public validation allowing the confirmation or the reinstallation of a common knowledge.

The follow-up of cases on the long term reveals the intermediate states of the procedures of proof, the steps by which is organized what William James called a "process of validation". Linguistic markers make visible this process of transformation: "not the least beginning of proof…", "simple presumption…", "the first elements direct towards…", "subject to checks, one can affirm… ", "it seems acquired that… ", "in the absence of contrary proof"...

Allowing us to see successive states, these marks illustrate the dynamic development of evidence. Because proof emerges in the confrontation of representations and perceptions whose expression varies through the successive tests. It is because a series of doubts and uncertainties deepen at the joining points of representations and experiences in the world, that actors engage in investigations and invent procedures to solve them.

But there is a plurality of ways which, when the investigation operates in opened world, increase the risks of an impossible closure and a permanent revival. New events, new sets of actors and interests come to complicate the collective organization of tests.

Thus, the history of affairs and controversies can be described like an alternation of showdowns and collective developments of spaces of common reasoning (Dodier, 2003). The main problem is to describe the transformations of these configurations without bringing down states of uncertainty, plurality of arguments and future openings used, in each period, by actors.

To develop such a sociology of proof, we have built a corpus of public affairs and controversies which make particularly visible tests of tangibility. These collective tests involve series of experiences in development. Generally, protagonists suppose that inquiries

will produce more and more tangible things. But many counter-examples show there is no automatic resolution to enigmas.

The complexity of cases and the duration of processes imply the use of techniques allowing the treatment of numerous texts and discourses, in which multiple kinds of evidence are announced, awaited, discussed, validated and invalidated. I have no time to present in details the literary technologies and softwares like Prospero, shaped by and for pragmatic sociology. I have just developped here formal aspects of the processes we study.

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A few statements to conclude…

Recent trials and crisis in France, from "tainted blood scandal" to "GMO (genetically modified organisms) conflicts" had shown how actors could create temporary procedures, linked to the gradual property of tangibility. The precautionary principle so often invoked 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 gave 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.

If the analysis of the processes of investigation allow to see how reality is seized and collectivized, it supposes to remotely put the concepts of "social constructions", "imaginary" or "beliefs" on which are still based on multiple paradigms of social sciences. There is a play between perceptions, representations and judgements, inside which takes place the perceptual work founding the common grips of actors. By taking seriously collective organization of tangibility, one avoids the two pitfalls which form a "conventionnalist" point of view - the social meaning of reality would consist in making as if the grips were common - and a "relativism" marked by the final separation of persons or groups in cultures or communities which see the world differently.

The common sense of reality is not a simple stock of beliefs. It forms the continual trace of a collective work aiming at reducing the tensions between several ways of producing factuality, and at facing the transformations which more or less deeply affect the backgroung certainties [4].Because they know that investigations are possible, actors are able to overcome

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[4] In its Treaty of proofs (1840), Bentham connected the theory of evidence to the continuous transformation of common sense. He examined the legal treatment of the changes which affect the common knowledge, such as

the gap between the idea of an "uncertain world" and the opposite idea of a strong anchorage of common sense [5]. The notion of "transformation" plays here a key role : to the actors, environnements and devices are susceptible to change, and the strenght of their grips on the world depends more on a control of processes than on a reference to eternal truth tables.

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for example the time necessary to go from a place to another (decisive element in the investigation into a crime !).

[5] For a pragmatician like William James, there is indeed an objective world, which precedes the experience that we make. But the latter is of primary importance, because the stopping of uncertainty or unrest does not come from the representations but from the shocks caused by experience: is real what resists in the experience (Lapoujade, 1997).