Sociotechnical Environments

Actors, Technologies, Geographies and New Kinds of Action

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Abstract: This section draws from the opening plenary session of the 6th STS Italia Conference "Sociotechnical Environments" (Trento, 24-26 November 2016). The section was dedicated to the topic "Sociotechnical Environments: actors, technologies, geographies and new kinds of action". It is composed by three contributions which articulate different relationships among actors, technologies and sociotechnical environments. Felix Ekardt presents an analysis of the scope of technologies with reference to societal problems, analysing the case of climate change. The idea of sufficiency as leading human behaviour for a sustainable normality drives the author's analysis of the node technology-environments-action. The second contribution by Luigi Pellizzoni is an epistemological travel around possibilities and conditions of an alternative science. Drawing from philosophical and STS literature the author inquires the (not) surprising convergences between critical STS literature and neo-liberal approaches, pointing to the concepts of materiality and materialism, In the third piece of the section Christine Fassert focuses on the node of actors-technologies-geographies through the case of Fukushima contaminated territories. She presents technologies of zoning in their ambivalence towards residents' life and multifaceted consequences of scientific controversies in territorialised risks.

Keywords: Sociotechnical environments; climate change; alternative science; contaminated territories; STS Italia Conference.

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Sociotechnical Environmnents: New Challenges for STS

Felix Ekardt

This contribution analyzes some new challenges for STS which have increasingly been discussed lately – especially the scope of technological solutions for societal problems and the way we explain human behavior. In the following, the big issue of climate change will serve as an example.

Climate change is an existential problem for human kind, because anthropogenic global warming will threaten food and water supply. It will increase the risk of massive natural disasters potentially triggering huge migration movements and might lead to wars over scarce resources. Consequently, a new global climate agreement was passed by heads of states all over the world in December 2015. While details remain vague and are legally not binding, the overarching target however is clear and binding. The Paris agreement requires limiting global warming to well below 2 °C. According to the Intergovernmental Panel on Climate Change, a 2 °C limit implies for an industrialized country with high per capita emissions such as Germany to reduce their greenhouse gas emissions by 95 % by 2050 in comparison to the commonly used base year of 1990. Furthermore, the Paris agreement aims at pursuing efforts to limit the temperature increase to 1.5° C. A 1.5 °C limit (or a well below 2 °C limit) requires reduction goals to be met considerably faster; this creates the necessity for emerging countries to soon commit to reduction measures as well. Looking at current politics, those targets however are beyond reach in our hemisphere.

Despite the common notion of us being the role model of climate protection, if not of environmental protection as a whole (Moreno, Speich, Chassé and Fuhr 2015), neither Germany nor the EU in terms of either absolute numbers or development pathways correspond to that image. Being a role model is frequently falsely claimed officially and publically. Looking at the development trend since 1990, emissions in Germany have – weeding out calculation errors – by no means decreased by 25 %, as official statistics claim (see ibid.). It is e.g. neglected that many emissions have been transferred abroad – displacement effects since 1990 alone account for more than claimed emission reductions in the EU (concretely in a mainstream economic calculation even almost twice as much – Peters, Minx, Weber and Edenhofer 2011; Hoffmann 2015). In a globalized economy, emission intensive production stages occur in emerging economies, even if the produced wealth goods are used by German consumers. Sometimes, emissions during use are reduced at the cost of higher production emissions (abroad). The alleged success of German toxic substance policy since the 1970s can be deconstructed in a similar manner (neglected e.g. by Fatheuer, Fuhr and Unmüßig 2015; on the empirical evidence Peters, Minx, Weber and Edenhofer 2011; Hoffmann 2015).

Renewable energies and energy efficiency as technical perspectives might by themselves not be enough to meet the above-mentioned global temperature limit. To address various problems associated with the current energy supply system, sufficiency might become necessary. Sufficiency describes in short the idea of a simple life. It stands for a sustainability strategy and a vision for the future. A vision achieved through changing behavior (instead of only technology).

Even though purely technical solutions seem appealing to solve environmental problems such as climate change, they might just not go all the way. New technologies create new markets and employment, whereas behavioral change often means eliminating a good from the market and eventually question an economic model which is based on growth. Also, a purely technical transformation can be more convenient and therefore easier to implement than changing behavioral patterns. There are different aspects however, which speak against exclusive (!) technical problem-solving. This is true for climate change, but even more so regarding other environmental problems. Just to mention some of the relevant aspects:

Firstly, the scope of problems caused e.g. through climate change has to be considered. Taking into account the speed of innovation so far, it seems not very probable that a transformation to increased renewable energies and energy efficiency will globally reduce greenhouse gas emissions to zero by 2030 or 2040. It remains uncertain whether the potential of renewable energies is always estimated correctly by their proponents (see DLR 2006). New findings of resources will merely put off the problem; in case of climate change they even aggravate the situation.

Essential is also that some problems cannot be solved by technology, for example regarding food. The majority of produced emissions in the food sector can be allocated to animal produce. This is because the long chain from animal feed to animal calories leading to human nutrition requires a multitude of plant production (for animal feed) and therefore a multitude of fertilizer, land as well as other emission sources, such as the notorious methane flatulencies of cattle. This can be avoided by reducing consumption of meat and other animal products which does not however imply technical measures, but behavioral change.

This leads to the maybe most important point: in order to sustain living conditions (as well as the economy and to preserve world peace) other environmental problems besides climate change have to be tackled. However, for many of them, technical solutions are much less available than they are for climate change. Key examples are damaged eco-systems and loss of biodiversity, disturbed nitrogen cycles and soil degradation (for more see Ekardt 2016). Solutions will require mankind to retreat from land use and to restrain agricultural production. This implies putting a stop to ever growing personal living space and continuously growing consumption of animal products; likewise it will not be possible to compensate the elimination of mineral fertilizers by constantly expanding land use etc. It will also not be possible to replace all materials used for goods

in wealthy societies with renewable or quasi infinitely available resources (especially since most of them will compete with food production and cause further problems: Ekardt 2016).

Even if all of the points above prove to be wrong, and it would after all prove to be possible to solve climate and other environmental problems purely relying on technology (and ergo with continuous growth here and globally), there is the unsolvable problem that, with continuous growth, we would have to constantly (!) improve technical options. Because then, more than the current level of energy consumption has to be produced. At this point at the latest, the endless spiral is bound to collide with the physically finite nature of this planet – thus the question is less about "if", but rather about "when".

Against this background, it can be said that technical improvements are able to decouple growing prosperity from nature devastation. This however will not be nearly enough and will eventually be exhausted in the above explained manner (Hoffmann 2015; Becker and Richter 2015; missing the point Handrich et al. 2015). The dogma of decoupling, known among economists as Kuznets curve, was not even valid at the point of its invention in the early 20th century. A fact of which even Kuznets was well aware (closer calculated by Piketty 2013). Of course, not only the future in general, but also technical innovation cannot be predicted with certainty. Furthermore, the development of environmental problems, one of which being climate change, are also subject to high uncertainties. Also the scope for action needed is subject to normative discussion, while general objectives such as the far-reaching reduction of greenhouse gas emissions, stabilizing ecosystems, stopping soil degradation etc. have elsewhere been proven to be imperatively necessary (Ekardt 2016). It is therefore possible to determine a tendency that behavioral change has to play a central role. This is by no means exclusively an issue of distribution; it will not nearly suffice if only the rich restrict themselves as becomes evident looking at the figures above.

There is a tension between sufficiency as one (!) part of a sustainability transformation and the dominating political idea of infinite economic growth on a global and occidental level. If, as seen, sufficiency needs to play a crucial part in the sustainability transition, less goods and services will be sold (e.g. less holiday flights). This could, if taken to a considerable scope, lead to an unplanned transition towards a post-growth society, meaning to a society that has to cope without growth or even with degrowth in the long run (Schulz and Bailey 2014). The predicable finite nature of growth is a thus fundamental problem, considering that modern societies are in many ways dependent on economic growth.

After what has been said, sufficiency is probably necessary, but ambivalent in its consequences. At the same time, the finding at the beginning shows that the general enthusiasm for sufficiency is obviously limited (even more so than for new technical options and their comprehensive insertion in the short and middle term). On the other hand it seems that

citizens, politicians, enterprises etc. are quite enthusiastic about non-sustainable behavioral patterns – both individually and collectively – how can that be explained? This leads to the next challenge for STS (which is also relevant for subjects other than sufficiency). There are several competing methods to unravel human behavior and its motivations. Only some of them are promising. This lack of methodology presents – as can only be briefly touched on in this article – a basic problem of social sciences (Kivimaa et al. 2015; Ekardt 2016). It is sometimes forgotten here that not only sociologists, but also economists, cultural scientists, psychologists etc. do behavioral research.

Inquiring after behavior and motivations, i.e. in interviews is confronted with several problems. One obvious problem is that the respondents might not be honest. Other falsifying factors include social desirability, i.e. the wish to please the interviewer, or to remain within social conventions. Also, the way in which questions are asked and the context of a conversation will influence possible answers and might preclude some answers from the start. The latter problems can be minimized by the setting of the interview, even though it will be hardly possible to eliminate them entirely. Other issues are harder to avoid. Especially regarding motivations, but also talking of a variety of every-day behavior, which is relevant for sustainability, is limited by the complexity of its implications and subconsciousness. People are also prone to misconceptions on their behavior and motivations of e.g. denial, cognitive dissonances etc. By the mere act of actively raising a question, behavior and motivation is already potentially considerably reshaped.

These objections are in broad terms also applicable to experiments of game theory and modified formats such as focal groups or real-world laboratories, even if such experiments can in fact be quite informative (largely neglected by Schäpke et al. 2015). Additional problems are that the realization of experiments presents a significant alteration to reality and the translation of generally highly complex realities (regarding set positions and courses of action) that are almost impossible to reflect in a simple experiment, and are also subject to the desire to comply with socially acceptable behavior etc. It is also possible to repeat which is characteristic for experiments in human science. Furthermore, set situations and options for action are in reality tainted with many uncertainties and actors are neither fully aware nor entirely unaware of motivations of others. This cannot be adequately reflected in an experiment setting. The hypothetical character of an experimental situation is also problematic. Because behavior is hard to assess that way, the respective methods have to be complemented by other approaches such as personal observation, i.e. participant observation used primarily in anthropology and religious studies. Characteristic for this method is that no observation setting is specially created, but real-life situations are used to make observations. Self-observation, ethnological or historical material and interpretations which allow for conclusions from human tribal history can be useful as monitoring tool.

Based on these (pluralistic) methodological approaches, it was shown elsewhere that non-sustainable and non-sufficient behavior has various sources in different actors and that it should therefore be avoided to focus relevant aspects on behavioral science only. Pure knowledge of facts has proven to be only a small aspect of triggering behavior. More important is an understanding of how actors are interdependent. The behavior of citizens for example is influenced by politicians and vice versa, the same goes for the dependency between enterprises and consumers. It is part of a certain economic system to constantly acquire customers that buy more and new products without caring about the means of production and that are inclined to find products which are produced socially and ecologically exemplary too expensive. But it also requires enterprises which offer – or in fact do not offer – customers products to trigger needs in order to constantly increase their profits, ergo keeping up the spiral of growth and high resource intensity. It would be misled however to simply talk in Marxian tradition of exploitation and estrangement, particularly since many individual liberties have been achieved in modern societies at the same time (see Ekardt 2016). As suggestive offers to consume might be, production and consumption are not forced by just one side and many individual suppliers and demanders make their contributions[1]. The role of factors – determined by all above mentioned methods – such as self-interest, the dilemma of public goods, path dependencies and conceptions of normality as aspects of motivation in this interaction, especially looking from an economic point of view has been described by many. Two aspects crucial to comprehensively explaining the reluctance to act on sufficiency are however frequently neglected.

One aspect is the common conceptions of normality (see also Deutscher Bundestag 2013; Schützenmeister 2010). Despite all intellectual recognition, we continue living in a high-emission world. After having put aside this article, the next meat buffet, the next car drive to work or the next holiday flight will not be far. These things are just ordinary nowadays, as long as one can afford them financially. Dismissing flights as a whole might lead to social pressure and an image as "weirdo". Lifestyle is also relevant to social standing, if in a current situation the social surrounding requires a certain apartment, cars and travels in order to belong to a certain peer group. This is increasingly true for countries outside the Western hemisphere, which follow the role models in industrialized countries. Especially decision-makers in politics and enterprises are often used to entertaining a lifestyle that includes frequent flights, opulent buffets, global friendships, regular meat consumption, and now they are required to think of abolishing it (with foreseeable results?). Perceptions of normality vary significantly at the moment; however the fact that people

[1] This is still true if supposed that people nowadays are determined by many very subtle mechanisms in jobs, leisure, romantic relationships, emotions, identities etc., even if this external determination utilizes the illusion of individual autonomy.

develop those perceptions (unconsciously) in order to simplify ordinary activities seems to be a biological invariable.

Human emotions are likewise relevant for all of us, including entrepreneurs, politicians, civil servants etc. (while the different aspects cannot be precisely differentiated; Klöckner 2015; Deutscher Bundestag 2013). Geographically and temporally distant, invisible, and highly complex causalities make it hard to imagine damages due to climate change yet caused by an ordinary activity. Those long-term or long-distant consequences are usually not emotionally accessible to people (citizens, politicians, entrepreneurs). On the other hand, a daily car drive to work and the next holiday flight are here and now allegedly very well visible. Time-space abstraction massively reduces empathy, which is also recognized in experimental psychology, e.g. in the notorious Milgram (1974) experiment and in holocaust research. Additionally, mankind has remarkable talent in emotionally preferring the comfortable, the dwelling in the accustomed, the denial of unpleasant interconnections etc. Another typical component of emissions is a justifying mechanism: others are even worse (SUV drivers, other political parties, other industries). The tendency to increase what is mine (in terms of votes, profits or personal belongings), sometimes even resulting in greediness, also seems to be equally imminent to mankind and can probably be traced back to evolution. The same might be said for the fundamental human pursuit of appreciation from other people, e.g. through "status goods", which also determine ones identity and place in social networks – by thriving for goods which display to myself and others that I am a well-off, nice, open-minded person. This is complemented by other, empirically well founded human inclinations (Stoll-Kleemann et al. 2001; Ekardt 2016) which also turn out to be rather fatal in the context of sustainability and climate change: inability to belief that future catastrophes will happen; notoriously underestimating moderate risks as well as the allegedly "only small" contribution to big, highly complex occurrences; tendency to solve problems with already known measures (which just might have caused the problem); tendency to judge big problems by way of personal experience as well as prominent or dramatic events (leading at times to major distortions); tendency to unrealistically positive perceptions of one's own efforts as well as shifted perception of some maybe less important risks compared to others. Such emotions well documented for the case of climate change; also in focus-group experiments (Stoll-Kleemann et al. 2001).

Whether the listed aspects should be categorized by "individual actions" and "collective structures" is a discourse in behavioral science disciplines and especially in sociology since Weber and Durkheim who thought the opposite. The controversy is however questionable since this would express concrete motivations of people, respectively interacting groups of people, or at least their side-effects and aggregated consequences. All aspects are to be encountered both in the individual and in structures – there of course in human – forms. "Self-interest", "concep-

tions of normality" or "emotions" are not only visible in individuals but are also shaping highly aggregated structures; so in the end, retention of power or accumulation of capital are collectivized variations of self-interest and path dependencies. Those who prefer to identify e.g. "capitalism" as a whole as driver for developments in society fail to clarify the aspect to which they refer. This leads to the here proposed position that it does not make sense to distinguish between "anthropology" and "social theory". At least, if assuming that not every social situation is deliberately broad about by someone. There are unexpected or unintended consequences to actions, and of course, individuals aggregate to structures. Individuals act, as already discussed, by no means always rationally and deliberately[2]. This speech will therefore neither advocate for methodological collectivism, nor for methodological individualism, but will rather assume that this confrontation is empirically inadequate.

Non-sufficient behavior is therefore easy to explain. At the same time, these findings hint at the fact that a fundamental turn towards sustainability and specifically sufficiency might be very hard to achieve, as there is reason to assume that especially emotions are part of a core biological configuration which cannot be eliminated. It will however be essential that different actors will move at once – and that aspects which can be changed are in fact changed, e.g. self-interest calculations or path dependencies, which can be influenced through new political frameworks such as levies or caps on fossil fuels. Pricing will also support a change in conceptions of normality (more in Ekardt 2016). However, because of the interdependencies of actors, it will hardly be possible to achieve change exclusively through political measures. It is of particular importance to have someone demanding new policies not only on the discourse level. The crucial point will be practicing new and more sustainable normalities.

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[2] Explicitly on this Greve (2015), who on p. 26 points out that individual actions cannot be allocated to "collective attributions" alone, because these attributions would again be actions, therefore leading to an infinite regress.

Is Another Science Possible? And Can STS Say Anything About It?

Luigi Pellizzoni

Is another science possible?

Naïve question, possibly. And yet, addressing the issue of sociotechnical environments, new kinds of action and key challenges for STS, I'll venture to say something on that.

Naïve question: science is what it is. If there is one thing that objectivist outlooks share with constructionist and co-productionist ones, it is the assumption that science has its own paths. Not that knowledge acquisition and technology development necessarily follow a predetermined trajectory. Rather, whether the chosen rationale is of ascertaining "givens" on which to intervene or eliciting a "response" from an agential materiality, the result of the process is just that one. As it takes place it rules out any other previous possibility, simultaneously opening a new space of possibilities which would have never been precisely the same if things went differently. Whatever the intricacies of the way research develops and technologies take shape – intricacies which STS has documented admirably – what happens, happens. This conveys a sense of necessity, no matter how much one tells oneself that inevitability appears only in retrospect.

There is another, more specific, reason why there is something compelling about the unfolding of science and technology, which SSK and co-productionist outlooks did not wash away but, if anything, strengthened by showing the embroilment of factors that characterize this unfolding. The reason is what Vicky Kirby depicts as "the extraordinary challenges and perceived success of so much scientific and technological research" (2008, 7). Aircrafts and rockets fly. Computers elaborate information with astonishing quickness. Drugs and surgery techniques become increasingly precise. The success of science and technology exerts an undeniable fascination. It expresses a solidity that overwhelms any fundamental "questioning". This constitutes a challenge for whoever aims to reflect on alternatives to the existent. Browsing STS literature, one realizes that technoscience's overall success, in spite of or even thanks to evidence of failures, is mostly taken as a starting point, very seldom as an object of inquiry.

What does it mean, then, "another" science? And, first of all, why should we think of, or search for, another science? Yes, we know that the case for the unquestionable benefits of innovation, a narrative that from the West has spread in the globalized world, can be and is contested. Yet, contestation usually addresses issues of research choices (such as the

10/90 problem)[3] or of distribution of burdens and advantages, losses and profits, costs and gains of science and technology. Complaints nowadays rarely address their fundamental rationale and attitude towards the world, as it happened with such thinkers as Weber, Adorno or the much maligned Heidegger, whose critical writings have often been regarded as expressions of anti-scientism and technophobia rather than calls for another science and another technology. Even Actor-network theory perspectives make no exception in this regard. Once we realize we have "never been modern" (Latour 1993) and that this mistake enabled an unbridled intermingling with materiality, the ensuing case for a greater intimacy with and concern for the nonhuman world does not necessarily entail any actual change in the basic attitude, opening rather the way to, or legitimizing, technological interventions ever more powerful and invasive precisely as they get more intimate and concerned with matter. The question, in other words, is not intimacy and concern as such, but the spirit of such intimacy and the ultimate goals of such concern. Admittedly, however, this question resonates in recent approaches to the government of science and technology, such as "responsible research and innovation" (or "anticipatory governance"), according to which social actors and innovators should be made "mutually responsive to each other with a view to the (ethical) acceptability, sustainability and societal desirability of the innovation process and its marketable products" (von Schomberg 2013, 63); according to which, in other words, technology has to be inclusively shaped before technological "lock-in" sets in, having regard to both "how" and "why" issues. At least on paper, this sounds as good news, no matter if the basic aim underlying this framework is not redirecting science and technology but addressing people's "resistance" to innovation.

So, the theme of a different science can be not only inappropriate but also untimely. And yet, we find ourselves increasingly immersed in pervasive sociotechnical environments on which we depend for any aspect of our life. We are hit almost daily by worrisome announcements about climate change or energy and water scarcity. We are struck by claims concerning forthcoming technoscientific revolutions capable of fulfilling any possible need (clean energy, healthy food for everyone, personalized answers to diseases or "enhancement" desires, and so on), while dazed by opposed evidence of a decline in the rate of return on investments that the blossoming of ICTs and biotech, a massive reduction in wages and social expenditures, and the spiralling expansion of finance and debt have to some extent been able to conceal but not to reverse. We are confronted with equally dazing calls for "downshifting", "voluntary simplicity"

[3] The so-called "10/90 problem" concerns the fact that only 10% of health research worldwide is directed towards problems accounting for over 90% of the global burden of disease. In other words, the bulk of research is targeted to the health problems of affluent populations, instead of the more urgent ones of the poorest people in poor nations. On this issue see for example Woodhouse and Sarewitz (2007).

and "communal life", often proclaimed by people who travel around the world to diffuse the new gospel among admiring audiences that, in their turn, live in comfortably warm and well-equipped houses, at close distance from hospitals provided with high-tech facilities. We are confused by ag-biotech industry contentions that what they do is just what humans did for thousands of years, only more competently and precisely, or indeed what nature always did, additional confusion coming from champions of traditions who find nonetheless in genetic interventions a precious support for revamping forgotten plant varieties. We are disconcerted by expert claims of safety, reliability and trustworthiness when compared with (post-accident or side effects manifestation) statements from the same experts about how prediction is limited, scientific knowledge is progressive and hypothetical and the "costs of technology development" are worthy of shouldering – whoever has to shoulder them.

Fascinated and confused, attracted and worried or infuriated by this and much else, Walter Benjamin's image of modernity as an accelerating train on the verge of derailing comes to mind: "Marx said that revolutions are the locomotive of world history. But perhaps things are very different. It may be that revolutions are the act by which the human race travelling in the train applies the emergency brake" (2003, 402). It may even be that the image of a train running faster and faster is not the right one; that a more correct description of the technoscientific present is an engine running idle at growing speed and at constant risk of falling apart. Be that as it may, the question about the possibility of something else, a thoroughly different scientific and technical approach to the world, naïve or rhetoric that it may look, takes a sense of urgency which sounds also as a call to STS engagement.

To address such call, however, STS meets at least two difficulties. The first one has to do precisely with science's success. If science "works" (whatever the defects in its working), why not just trying to make it work "better" (addressing such defects)? And could another science work (better)? Coping with these questions raises a problem that Ian Hacking (2000) has effectively described. The notion of science's success, he notes, verges on tautology. Even the discovery of "fundamental constants of nature", like the velocity of light, is not immune from tautology. Any difference in observation, to count as a difference, is to be achieved within the same conceptual-experimental framework (same assumptions, equipment and tacit knowledge to use such equipment). Yet, if the framework is the same, no difference can emerge; or, if it emerges, it will likely be interpreted as a measurement error. Similarly, it makes little sense to say that an alternative science, to exist, should lead to as good results (for example in terms of yield of foodstuff) as the actual one. If this means that one has to pull off exactly the same specific material results of actual science, "then the alternative is not going to be an alternative" (Hacking 2000, S64).

The challenge, therefore, is to understand how an alternative science and technology can be first of all imagined. The problem bears similarity, but does not totally overlap, with an issue that Alfred Nordmann (2014) has raised in regard to the rationale of anticipation. There is an inherent contradiction, he remarks, in foresight exercises about technology. These seek to go beyond the depiction of "trivial" futures, that is, beyond a mere extrapolation from emergent trends, in order to grasp the possible shape of actual novelty: "black swans", "singularities" or at least "game changers" bound to make the world of tomorrow substantially different from the present. Yet, such "non-trivial" futures cannot be really anticipated, because a radically different world will be "inhabited not only by different technologies but inhabited by different people" (Nordmann 2014, 89). Here the problem is the gap between – borrowing from Niklas Luhmann (1976) – present-futures and future-presents, that is, between a future whose seeds can be discerned now and the future as it will actualize itself as a result of as yet indiscernible forces. The question of "non-triviality" of anticipation bears obvious relevance to the issue of an alternative science. The latter, however, has not just to do with the limits of discernibility and governability of change, but rather with whether and how a radically different path of, and approach to, change can be devised. Figuratively, we should conceive the gap as located not ahead of us but aside. The leap to be imagined is not forward but lateral.

The second difficulty in addressing the issue of alternative science concerns STS's conceptual equipment. Much research and technology development is still carried out according to a traditional objectivist framework, to analyse and criticise which STS has equipped itself, along the years, with increasingly effective instruments. The cutting-edge of STS outlooks can be considered the new materialist, or "ontological", approaches that, in different versions, have gained growing momentum in recent years (Woolgar and Lezaun 2013). Key to this strand is an account of materiality as agential and in constant flux and transformation, of subjectivity as "decentred" and equally "becoming", and of human agency as on a par with (or even lesser than) nonhuman one. This outlook is well synthesised by Annemarie Mol and John Law (2006, 19) when they claim that "knowing, the words of knowing, and texts do not describe a pre-existing world [but] are part of a practice of handling, intervening in, the world and thereby of enacting one of its versions – up to bringing it into being".

This standpoint works fine when the task is to challenge traditional approaches to science and technology, as grounded on binary thinking (nature/culture, mind/body, subject/object, organic/inorganic, animate–/inanimate, reality/representation, matter/information, etc.). What happens, however, with cutting-edge research which, from physics to life sciences, from biomedicine to cybernetics, increasingly adopts non-binary

thinking? Should one buy into such science just because of this[4], neglecting in particular that an account of reality as disordered, emergent, constantly changing is key to post-Fordist capitalism and neoliberal governmental approaches? What happens if Friedrich Hayek's plea for market competition as the only efficient mechanism of value allocation, faced with the complexity of the socio-material world, meets Crawford Holling's ecology of disorder, with its celebration of instability and resilience as the only antidote to sclerosis and decline (Walker and Cooper 2011)? And if, whatever the researchers' intentions, science's increasing focus on the extremes rather than the norm meets capitalism's growing demand for flexibility and speed of change (Cooper 2008)? What happens if one finds that hardly distinguishable celebrations of technological transformations of an insubstantial humanity in the context of a dynamic, ever-changing, self-organizing materiality underpin both radical critiques of capitalism such as Rosi Braidotti's (2013) case for the post-human, and resolute restatements of the necessity of capitalism, as Roco and Bainbridge's (2002) case for technology convergence? What happens if the Anthropocene is increasingly taken, rather than a call to a profound change in our approach to the world, as a justification for "post-environmentalist" agendas aimed at an accelerated decoupling of social systems from biophysical systems (Asafu-Adjaye et al. 2015), the ultimate goal of which is "doing without nature", and if non-dualist ontologies underpin "post-natural" accounts of sustainability (Arias-Maldonado 2013) where human exceptionalism re-emerges in terms of agency over an indefinitely pliable materiality?

The convergence of cutting-edge STS with cutting-edge capitalist narratives and neoliberal regulations can be read in different ways. One, inspired to the idea of a "counter-revolutionary" use of notions and claims born with opposite intentions (Virno 1996; Boltanski and Chiapello 2005), maintains that theories of disequilibrium and adaptation have offered since the 1970s a framework for redirecting socio-ecological instability towards a new regime of accumulation (Walker and Cooper 2011; Nelson 2014). From this perspective, current ontologies of becoming are functional to legitimizing (even inspiring, perhaps) the most recent phase of capitalism, as this thrives ever more on unpredictability, turbulence and flux. Another reading, less unidirectional because drawing from Foucault's idea of "problematization"[5], acknowledges that a deep, broad so-

[4] New materialisms, actually, often build on new technoscientific outlooks on matter and agency, while these often find inspiration in philosophical and social science accounts of reality and (post-)humanity, in a game of cross-influences on which I have elaborated elsewhere (Pellizzoni 2014).

[5] By "problematization" Foucault (e.g. 2001) means a way of conceiving and circumscribing the range of what can be regarded as a problem or a possible answer to such problem that characterizes a historical period, being shared by even opposite epistemic, ethic and political perspectives.

cio-cultural change has begun in the 1970s undergoing a crucial intensification in recent years, but that such process has involved in a tangle of reciprocal influences all social spheres: scientific and economic, political and technological, philosophical and artistic (Pellizzoni 2015).

Whatever the interpretation, the convergence between critical outlooks on, and dominant approaches to, the government of science and technology represents a problem for the endeavour we are discussing, to the extent that it leads cutting-edge STS to linger on criticizing technoscientific conceptions and practices of lessening relevance while adhering too much to emergent ones to be ready to acknowledge that what is assumed to (and could earlier) work as transformative in an emancipatory sense is now often made subservient to exploitative designs.

Does this leave STS helpless faced with the compelling "facticity" of current science and technology? I would not say so. STS has on its side at least three important features that can work as antidotes to the overwhelming power of such facticity: self-reflexivity, theoretical and methodological pluralism, and a capacity to build bridges between the natural sciences and the social sciences and humanities. Indeed, the point is not disavowing any of STS's conceptual equipment and research orientations, but taking care to avoid reproducing what Foucault calls the "analytics of truth", that is the aspiration, profoundly inbuilt in the Western tradition, to get closer and closer to the actual nature of things, to reality "as it is" (no matter, in this sense, if conceived as substantial and stable or differential and endlessly becoming). As I have argued elsewhere (Pellizzoni 2015), it is crucial that – borrowing from Adorno – the non-identity between things and concepts, reality and our apprehension of the world, is always acknowledged and respected.

This basic orientation, I think, is premised on addressing the question of an alternative science. Habermas (1983) once claimed, criticizing Adorno, that "for the sake of removing socially unnecessary repression we cannot do without the exploitation of external nature necessary for life. The concept of a categorically different science and technology is as empty as the idea of reconciliation [with nature] is groundless" (Habermas 1983, 108). In this perspective the exploitation of nature constitutes a universal, culturally invariant imperative for social reproduction. As hinted, the overcoming of dualist thinking does not rule out but rather discloses the possibility of an intensified exploitation. Opposed to this stands Adorno's case (but the same could be said for Heidegger and other supposed technophobes), which is not for a farewell to reason and enlightenment, but for the possibility of a different reason and a different enlightenment – hence, first of all, a different science. D. Bruce Martin, quoting Evelyn Fox Keller (1985), finds an example of this different science in the work of geneticist Barbara McClintock, as based on a respect for difference that impinges upon methodology, concepts and theory development, whereby "the unique or exceptional is not seen simply as an example that proves or disproves a general law, but as an opportunity to

make those exceptions or differences meaningful 'in and of themselves'" (Martin 2006, 148). However, we have to add, a different science entails not only different theories, concepts and methods, but also, and first of all, different goals and criteria of success – capable of avoiding that the usual rationale is reproduced in disguised forms[6].

How to conceive of these different goals and criteria, building on the available array of conceptual and methodological resources? This, to me, is a (perhaps the) core challenge for STS.

* * *

Living in/with Contaminated Territories: an STS Perspective

Christine Fassert

Territorialisation of a *Risk Society*

The "Risk society" described by Ulrich Beck (1986) now 30 years ago has become, for a part of humanity, an enduring and daily experience, which invades all parts of our daily life. Beck referred mainly to the extension of risks that do not stop at national borders, but I refer here to a more territorialised aspect of risks, i.e. to the development and "management" of contaminated territories. The causes of contamination may vary. They may be the result of poor management of industrial waste, as it is the case, for example, in the Marseille region in France. They may also be the consequence of accidents. A series of industrial disasters has led to

[6] This risk includes non-modern accounts of the embroilment of humans and materiality, if these are regarded as the solution to the problem. Think, for example, of indigenous American outlooks on the gathering together of the human and the non-human, the material and the spiritual. These are the addressees of many hopes as they are seen to underpin new "ontological struggles" against dams, oil drills, mining, deforestation, genetically modified crops – ontological in that they denaturalize Western binaries in favour of perspectives holding that "all beings exist always in relation and never as 'objects' or individuals" (Escobar 2010, 39). One should consider, however, that these "indigenous ontologies" are recent, indeed ongoing, elaborations of traditional cultures (Gudynas 2011), influenced by modern frameworks and understandings. Their "otherness" is therefore spurious: one might just find in them a distorted mirror of Western modernity.

the multiplication of contaminated territories worldwide. More and more people are now living in territories that are durably contaminated by a number of various toxic substances (petrochemicals, chemicals, pesticides, radionuclides). The extension of contaminated territories is part of the development of what Soraya Boudia and Nathalie Jas (2015) name a "toxic world", growing fast while current regulations fail to prevent the development of toxic substances in our modern society, making our world a more and more poisoned one.

Short-term and longer-term management of contaminated territories raise a number of questions: what is the basis for deciding that a territory is contaminated and what is the exact role of science and expertise in the "qualification" process? What are the actual choices of victims for staying or leaving these territories? What are the criteria defining "legitimate" victims? If staying, what may be the sanitary and psychological impact for the inhabitants? A number of research studies in social sciences, amongst which we can cite a few: Fortum, (2001), Centemeri (2015), Frickel (2007), and Kuchinskaya (2014) have explored how these questions are intertwined. The category of "contaminated territories" itself is a construct mixing scientific knowledge, State expertise, policy-making, and environmental activism. The New Political Sociology of Science proposed by Scott Frickel and his colleagues sheds a new light on the importance of power asymmetries, and institutional arrangements around those issues. In the post-Chernobyl situation, Kuchinskaya (2014, 9) uses the concept of "articulation": "the process of defining the scope and character of radiation danger and its actual effects, along with how to make them observable"; she argues that its very possibility often depends on "the existence of adequate infrastructural resources such as information systems and equipment", themselves embedded into institutional arrangements. She shows how some kind of invisibility of a number of health effects was produced after the Chernobyl accident. The resulting assessment of the consequences for health of the accident was indirectly supported by a number of international institutions, while local doctors and researchers grasped an entirely different reality concerning the consequences for the health of the population.

Zoning as a Political and Administrative Tool

Regarding the issue of "making visible/invisible" some risks, I will focus on the territorialisation of radiological contamination, and on its consequences for inhabitants after the Fukushima nuclear accident, drawing on research led these last years with Japanese colleagues[7].

[7] Reiko Hasegawa (Sciences Po), Rina Kojima, (ENPC) and Masashi Shirabe (Tokyo Tech University). This research led by IRSN focuses of the social and political consequences of the Fukushima nuclear accident, and is based on an extensive field work led these last five years in the Prefecture of Fukushima.

The policy of "zoning" is framed here as a political and administrative tool. In fact, zoning establishes and "reifies" the territorialisation of a risk which is, however, intrinsically difficult to circumscribe spatially and temporally: there are still important uncertainties on a number of aspects of contamination, and amongst others, on the radioecological models that predict the evaluation of long-term contamination in rural areas. Zoning boundaries establish an obligation for people to evacuate but also rights for a financial compensation. In Japan, after the Fukushima accident, these compensations were set up by TEPCO, the operator who caused the accident, following the recommendations made by a special panel of experts under the Ministry of Science and Technology (MEXT). Zoning is, at the same time, a dispositive which excludes from these rights certain persons who can be in a very similar "radiological situation" as those defined as "victims" under the compensation scheme. Zoning traces limits, which simultaneously includes some people and excludes others. In "The Land of Hope", the film maker Sion Sono shows how two neighbouring families, formerly friends, are brutally separated after a nuclear accident, with a border drawn by the zoning between their homes, which defines the forbidden zone and the other where people are allowed to stay.

Zoning and Individualization of Risks

Zoning is a major issue for populations after an accident because it simultaneously defines orders and rights to evacuate through the definition of compensation schemes for the population. It has a strong authoritative and constraining aspect, but it is combined with an insistence on individual choice: inhabitants may choose to return or not in their home villages after the Lift of Evacuation Orders. Moreover, if zoning "reifies" and territorializes risks, some inhabitants, outside of the "risky zone", may feel in danger: 60 000 inhabitants have evacuated the area even though they were not living in the designated evacuated zones. They were voluntary, or "self-evacuees", who made the decision to leave their home village mainly because they felt worried about the radiological situation. Zoning as a policy, and the process of drawing a line between what is "safe" and what is not, are fascinating objects for STS.

Zoning also results in a series of specific situations, which makes the framework more complex than: "risk/evacuated versus no risk/not evacuated". For example, the Watari district of Fukushima city, was said to be, together with the Oonami district, the area most contaminated by radioactive fall-out within the city. The survey conducted by Professor Tomoya Yamauchi (specialist in radiation physics, radioactivity measurement and ion tracks) of Kobe University in September 2011 found that the level of radiation dose in the soil sample collected beside a temple exceeded 40,000Bq/kg and the air-born radiation level was recorded at over 20 μSv/hour at 1cm above the ground and 2.68 μSv/hour at 1m

above[8]. In October 2011, Fukushima city and the government's Nuclear Emergency Response Headquarters organized a meeting with Watari residents who were demanding that "radiation hot spots"[9] be designated within the district thereby assisting the families living in the elevated radiation environment to evacuate from the area. There was a discrepancy between the measures elaborated by the authorities and the measurements conducted by the residents. The government and municipal officials stressed that they would decontaminate the area. As a result, there was no case of evacuation assisted by the government from the Watari district nor Fukushima city as a whole.

What about the concerns of inhabitants in such a situation? Some inhabitants with young children evacuated their town, and others decided to stay. However, the consequences of radiological contamination on health have a slow outset, and cancers may develop after several decades. A father in the Watari district of Fukushima city confessed: "the difficult thing is that we have to wait for years to know whether we made the right decision for our children"[10].

The zones evacuated raise other concerns. After the Fukushima accident, a part of the inhabitants were evacuated and then could not return in their homes. The Mandatory Evacuation Zone established within the prefecture of Fukushima resulted in the evacuation of 110 000 inhabitants. The mayor of one of the evacuated villages, Kawauchi, explained:

> "Some old people died before this (evacuation) order was lifted, and said how much they regretted dying without the possibility to come back to their home villages. This was one of the reasons that pushed me to hurry the lifting of the evacuation order"[11].

Indeed, the Japanese authorities took the decision to "recover" the contaminated territories through a programme combining intensive decontamination and revitalisation measures. They promoted a "return" policy, and their overall objective was to lift all the evacuation orders by March 2017, except in some very specific zones (the "difficult to return zone", and the villages of Futaba and Okuma). The mayors of the evacuated towns had the very difficult task of implementing this strong "re-

[8] Tomoya Yamauchi (Kobe University), Report on the level of radioactive contamination – limit of decontamination in the Watari district, commissioned by Friends of the Earth (NGO), Fukuro-no-kai (NGO) and residents of the Watari district, 20 September 2011.

[9] The radiation hot spots are the spots detected with an air radiation dose of more than 20mSv per year situated outside of the official evacuation zone. Upon the validation of such spots by the local authority, the government designates them as 'specific spots recommended for evacuation' and provides financial assistance to the families living around the spots if they wish to.

[10] Interview R. Hasegawa and C. Fassert. October 2014.

[11] Interview October 2016, R. Hasegawa and C. Fassert, SHINRAI project.

turn" policy while facing the different wishes and specific interests of the inhabitants. For example, by "hurrying" to lift the evacuation order, the mayor of Kawauchi was confronted with another type of criticism, addressed by the inhabitants who were to some extent forced to return[12] to a place where some radiological contamination remained despite decontamination works. The promise, by the authorities, of the return to a radiologically "normal" situation (the 1 mSv/y recommendation of ICRP for so-called "existing situations") was not reached, mainly because in rural areas such as Kawauchi, covered by forests and mountains, contamination is difficult to remove, and even comes back. What does life look like when returning to "still contaminated" villages? With regards to children, the school director explained:

"Well, they live like before the accident, (…) well not exactly like before the accident. Pupils commute to school by bus and do not walk anymore. They are not authorized by their parents to go into the forests, or to swim in rivers like we, as children, used to do before. We were not allowed to do it, but still we did it (laughs). They do not climb trees"[13].

When the evacuation order was lifted, inhabitants were encouraged to return but some of them decided not to return. A majority of families with young children made this decision. Children are indeed more sensitive to ionizing radiation effects. The decision meant that parents had to weigh up the risks at stake, and it could lead to dramatic and engaging questions. A parent of two young children told in an interview[14]:

"On radiation risk, I heard from a friend who had consulted a doctor in Iwaki city, that the effect from radiation exposure could appear 10 years or even 30 years after the exposure. Therefore, even if there is no health problem today, it doesn't mean that there won't be in the future. When I understood this, I decided not to return to Naraha town. Because if one of my children gets sick in the future, I don't want to be in a situation where I wouldn't be able to answer their question: "Mother, why did you choose to return to Naraha when you knew the possible risk?".

The idea that you are accountable to your children for the decisions you made after the nuclear disaster carries a heavy responsibility and a feeling of enormous guilt for many parents. Such heart-breaking thoughts and decisions are now also part of the life in contaminated territories. It shows also the ethical dilemma that inhabitants face: some families were separated because the parents did not agree on leaving or not, or on returning or not to their former village.

[12] This is mainly because one year after the Lift of Evacuation Order, the compensations given to evacuated families will be suspended.

[13] Interview led by C. Fassert and R. Hasegawa. October 2016.

[14] Interview conducted by Rina Kojima. October 2015.

Attachment to Territory and its Limits

In Fukushima, people express very different forms of attachment to their hometowns. In Kawauchi, for example, some senior inhabitants have made the choice to return to their home. They present a common profile: people in their 60s, in good health, who possess a house that has sometimes been a "Family home" for several generations. These inhabitants, after the catastrophe, were evacuated, and most of them moved several times, sheltered by relatives, family or friends, or in dedicated temporary housing built in the aftermath of the accident. In this case, attachment is strongly linked to a set of desirable habits and rituals that form a way of life: a rural way of living (growing your own vegetables, sharing them with the neighbourhood, getting sensai (wild plants) in the forest…). It is also a way of living attached to community links and a strong sense of solidarity in this isolated part of the mountains: "I didn't want to come back if my neighbours didn't; in the mountains, you cannot live on your own" explained one of the senior people we met in an interview.

In her book, *Traverser Tchernobyl*, journalist and essayist Galia Ackerman shows the complexity and sadness of the post-Chernobyl situation, 30 years after the accident. She shows how some inhabitants of the so-called "exclusion zone" were forced to evacuate but they came back, illegally, in their former homes. They are called the "samossioly" and represent a form of resistance to the administrative scheme proposed by the government. Other inhabitants saw their houses destroyed by the authorities, in order to prevent them from returning (Ackerman 2016).

Attachment of people to their hometown is not an absolute rule, it is only a part of the picture. A number of reports and institutional recommendations that claim to "learn from the Fukushima accident" insist on the "dangers of evacuation" and on the need to foster "remediation strategies", supposedly helping people to recover after a nuclear accident. Attachment of inhabitants to their hometown is here essentialised, if not considered as a dogma. This is for example the case in Publication 111 of ICRP (2009) that states: "Worldwide experience following nuclear and non-nuclear accidents shows that neither nations nor individuals are very willing to leave affected areas". Also the reference to resilience spread out in a number of discourses linked to the Fukushima post accidental "management". However, these discourses are underlined by a number of strong assumptions that need to be examined in the light of concrete situations, in order to reveal a more complex reality than this straightforward and unconditional "attachment" notion. First, the case of "self-evacuees" shows that attachment is far from being unconditional. Besides, attachment comes with mixed and contradictory feelings in the nuclear accident victims: resentment against the nuclear operator, feeling of loss, anger, and fear for future and anxiety for health, claims for justice, willingness to "turn the page". No large scale inquiry that allows us to grasp the extent

and solidity of "people attachment" to their living area has been conducted yet. Such an inquiry would allow us to examine, for example, how much attachment to home town may, after a nuclear accident, resist negative effects such as durable radioactive pollution, the need to manage your contamination through a set of "appropriate behaviours", the loss of services, or of employment.

A "Safe" Threshold?

Zoning policies are based on the choice of a threshold which distinguishes the "safe" zones from "unsafe" ones; this threshold becomes an essential element which determines evacuation policies and their related consequences. It is difficult to trace back precisely the criteria which led to the choice of a "20 mSv" threshold in Japan. Authorities have justified their position by insisting on the harmlessness of ionizing radiations at "low doses". They have communicated, from the beginning, a very reassuring view on the dangers of ionizing radiations, advocating that there are almost no risks below the threshold of 100 mSv/year in spite of an enduring controversy on the "low-dose" radiation risk (Fassert 2016).

The Japanese authorities have also insisted on the fact that they have chosen the lowest limit of the values (20 – 100 mSv) established by the International Commission of Radiological Protection (in charge of setting recommendations for radiological protection in normal and accidental situations). In fact, when they set up this threshold, in April 2011, the situation was no more considered as "an emergency situation" in terms of radiological risks. According to the evacuation order issued at the time, the inhabitants could indeed evacuate their homes within the period of one month (e.g. Litate village). The situation could be thus qualified as an "existing situation", where values should be rather chosen between 1 and 20 mSv/y (and not 20-100 mSv/y) (Boilley 2016).

This shows that the selected threshold of 20 mSv/y was not purely drawn from scientific basis but also from other considerations. Simulation tools can indeed tell the scope of possible consequences for the population at any chosen threshold. The French Institute for Nuclear Safety and radioprotection (IRSN) calculated, using these simulation tools, that at the threshold of 10 mSv/year, half of the chosen dose, 70,000 more residents would have had to evacuate, which would have caused an additional financial burden to TEPCO and an economic impact on the region. Furthermore, this would have produced a strong symbolic message of a grave nuclear accident. Yamauchi[15], for example, estimates that such a threshold was precisely chosen in order to avoid evacuating important key cities of the Fukushima prefecture: "Fukushima city is the capital. It was symbolic, you could not evacuate the capital city without recognizing the significance of the consequences of a nuclear catastrophe".

[15] Interview conducted by R. Hasegawa and C. Fassert, Kobe, May 2016.

The threshold was decided, without addressing the intrinsic uncertainties and controversies on the dangers of low doses with representatives of the affected population[16]. It was decided by the authorities who took into account political, symbolic and economic interests in addition to (controversial) scientific evidence. These aspects have been given little public scrutiny. Moreover, the global strategy based on intensive decontamination and recovery of territories is also a general framework which was not discussed with the population.

Accidents are an opportunity to "deconfine" controversies, and may offer opportunities for "citizen science" to be more visible in the public space, opening debates on radiological measurements and health issues (Kimura 2015). The 20 mSv/year threshold played an important role on this scene and sparked vivid debates and protests. They came mainly from within Japan, but also from the international scene. In Japan, the most spectacular protest was the resignation of a government advisor for radiological protection, Professor Toshiso Kosako, who declared that he could not scientifically nor morally accept the 20mSv/year as the threshold applied also to children. A number of scientists, such as Kodama and Shimazono (University of Tokyo), Koide (University of Kyoto), and Sakiyama, a member of the parliamentary accident investigation commission (NAIIC), also criticized publicly against this threshold. Protests also came from a number of NPO (Greenpeace Japan, Citizens' Commission on Nuclear Energy, in Japan, and, for example, ACRO in France). The Special Rapporteur of United Nations, Anand Grover, also addressed in his report a number of criticisms to the Japanese government for its post accidental policies. His criticism goes beyond the "threshold" controversy. Indeed, Anand Grover discusses the very basis of radioprotection for post accidental situations. He argued: "The ICRP recommendations are based on the principle of optimization and justification, according to which all actions of the Government should be based on maximizing good over harm. Such a risk-benefit analysis is not in consonance with the right to health framework, as it gives precedence to collective interests over individual rights. Under the right to health, the right of every individual has to be protected." (Grover 2012, p. 16). This criticism may result on a reconfiguration of the controversy on "low doses", and on a more fundamental questioning of radioprotection policies in the future.

Conclusion

I will terminate this set of reflections with a methodological plea: contaminated territories and their residents, staying or leaving, demand specific types of research settings which require extensive field work over a long period of time, not restricted to the immediate aftermath of the acci-

[16] Masashi Shirabe, Tokyo Tech, internal deliverable of SHINRAI project. August 2016.

dent that led to the contamination. Research agendas are more and more guided today by short-term results and concerns. However, the consequences of accidents, and the life in contaminated territories demand long-term involvements of researchers in STS but also in transdisciplinary settings. Ulrich Beck (1986) had predicted "accidents without an end": this calls for a type of involvement that lasts even when the accident is declared "over" in the political discourse.

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