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ParaNanoia and its Virtues

Towards a Global *ParaNanoid* Model of Innovation

Most current linear models of innovation flow from the actively innovating experts "upstream", in their academic, government and industrial laboratories, through a market-oriented development process, and on to the passively receiving consumers "downstream". A truly "social turn" in innovation theory should not only attempt to reverse this over-simplistic linear flow towards a public consisting of passive consumers: beyond recognizing that this public includes a good proportion of active users who invent and reinvent technology through innovative uses, it should also include a close consideration of the collective defence mechanisms actively developed among the public in order to prevent the potential dangers linked to new technological developments. For the various segments of the innovation cycle to go truly "broadband", we need to include in our model a broad approach to the treatment of Environmental and Health Safety (EHS) issues, an approach relying not only on *ad hoc* mechanisms set up in place in order to deal with each particular new technology and its hazards, but an approach rooted in thick and dense relationships embedded in and congruent with the fabrics of societies. If "social benefit" is to be the key driver to innovation—as everybody officially agrees, be it only for lip-service—, if innovation is expected to meet the collective needs and requirements of adopting cultures, then the first question we should ask is how to assess the desirability and acceptability of a new technology.

Asking whether "the public wants" (or "rejects") a new technology suffices to show the countless traps which undermine such a question. What defines "the public" is its non-univocity, the conflicting nature of its many desires and fears. Taking into account this conflicting nature of the public assessment of the social benefits (or hazards) linked to a new technology has far-reaching consequences, which this chapter will attempt to sketch. A truly "broadband" innovation cycle should put this multifariousness of the public and its inherent conflictuality at the core of its dynamics. Recognizing the ubiquitous inventiveness of people in all walks of life as well as the need for exponential increases in openness and communication among the participants in every aspect of the innovation process cannot go without accepting the most radical consequences of democratic empowerment. This radicality appears clearly in that a truly "broadband" innovation cycle should be forced to consider a possibility which is usually excluded from the scope of mainstream discussions about innovation: the collective decision to *abort* an otherwise promising process of innovation.

This chapter will consider recent events in the French debate about nanotechnology, briefly presented here through a series of five "stories". It will then set forth and discuss a number of principles necessary to reframe the question of the assessment of the "social benefits" of innovation. Its last section will attempt to explore some of the practical consequences of such principles, within a "ParaNanoid model" of socio-political controversies about innovation.

Malice in Nanoland (five stories)

1. ***The Magic Nano Scare*** *(or how to turn a fluke into a campaign)*. In March-April 2006, a bathroom cleaner called *Magic Nano* goes on sale in Germany. It proudly uses nanoparticles in order to boost its cleaning power. It is soon withdrawn from the market after nearly 80 people reported severe respiratory problems and six were admitted to hospital with fluid on their lungs. Apparently, the culprit was the anti-corrosion liquid inside the propellant can—*not the nanoparticles*. Nanosceptics hoped that this most recent episode would create a health scare over nanotechnology. In fact, the reverse seems to have happened: the publicity about *Magic Nano*—in particular, that it provides as much as six months' antibacterial resistance to bathrooms—has brought Kleinmann (its producer) more business than ever.

Story 1: Kleinmann's *Magic Nano*

Story 2: Samsung's *Silver Wash*

2. ***The Silver Wash*** *(or how to turn a washing machine into a pesticide)*. *Silver Wash*, a washing machine made by Samsung, claims to employ nanotechnology to release hundreds of billions of silver ions during a wash to sanitise fabrics. The US Environmental Protection Agency rules that ion-generating devices that claim to kill germs must be registered as a pesticide and tested to show they pose no unreasonable risk. The German branch of Friends of the Earth, *Bund für Umwelt and Naturschutz Deutschland*, asks consumers not to buy these new types of washing machines that use silver nanoparticles. BUND criticizes such products, claiming that considerable amounts of silver could enter sewage plants and seriously trouble the biological purification process of water waste. Claims made by Silver Wash's add to remove 99.999 percent of germs are said to be exaggerated — but the machine seems to be selling well.

3. ***The Grinch who Stole the Debate*** *(or how to turn a campaign into a fluke)*. In the Fall of 2009, the French government, through a supposedly independent National Commission on Public Debate (CNDP), organized a dozen of town hall meetings across the country, in order to boost the "social acceptability of nanotechnologies". Millions of euros are spent in promoting these events, presenting them as an opportunity to hold an open debate about the pros and cons of a new field of research still largely unknown to the public. Many governmental agencies and private companies collaborate in explaining the potential benefits

of nanotech, eager to prevent hostile reactions against them. At the same time, a collective of activists going by the name of *Pièces & Main d'oeuvre* (P&MO), based in Grenoble (an world center for nanotech) and created in 2002, launches a website, *The NanoWorld Today*, devoted to provide counter-information on the "totalitarian" nature of nanotechnology. P&MO considers the series of public debates as a sheer advertising campaign in favor of nanotech (paid by public money), and, along with other radical groups of activists, does its best to sabotage these public events: demonstrators interrupt the speakers, chant loud enough to prevent any discussion, throw paper balls, etc. In spite of the organizers' best efforts to filter out those who look like counter-activists at the entrance of such events, none can take place without disruption, and most of them end up aborted or cancelled.

4. ***Mad Scientists, Big Government and Evil Capital*** *(or how to turn a scientific question into a political issue).* On its counter-informational website, besides carefully mapping the intricate collusion of interests between government agencies, research labs and high tech industries, P&MO invites the public to "*Fight NanoWorld Now!*" It tells a well-known story: nanotechnologies provide key components to the Nano-Bio-Info-Cognitive convergence (NBIC), which promises to lead mankind to a total and totalitarian mastery of "matter", from the atom to human populations. Scientists who collaborate to innovations in NBIC are the accomplices of such a totalitarian project: what power, what freedom, what dignity, what autonomy will be left to human individuals after nanoprobes and nanochips have profiled and reprogrammed each one of us? Nanotech are only the latest expansion in a series of *necro-technologies* which also include the nuclear industry, Genetically Modified Organisms, mad cows and other hormone-fed animals, etc. They are driven by capitalist greed for profit and by government lust for control—not by democratic process. They are sold as a way to improve our life and as a way to correct damages produced by industrialization, but they only push further the same industrial madness which is ruining our environment beyond repair. The "public debates" promoted by industries and governments alike are only another way to sell nanotech to the public: they need to be boycotted and sabotaged, by any means necessary, including (non-violent) paralegal actions.

Story 4: P&MO's slogans against *Necrotechnologies*

5. ***The Marvels of ParaNanoia*** *(or how to turn the Voice of Capital into a Red-Green Radical, and back again).* A P&MO commando recently infiltrated the central offices of the London weekly *The Economist*—the unequivocal champion of global capitalism and technoscience—and managed to insert an officially-looking article about nanotechnologies among the "leaders" of the November 22 edition. This article consisted in three sections, excerpts from which read as follows. *1° On human and environmental risks*: "Plenty of research suggests that nanoparticles of harmless substances can become exceptionally dangerous. There is also a lot of uncertainty over what happens to these substances at the end of their lives. Carbon nanotubes have been used for years in industry. But it remains unknown, for instance, if they can enter groundwater when the products that contain them are dumped or broken up." 2° *On serious shortcomings in risk management*: "Scientists worry about a conflict of interest at the National Nanotechnology Initiative—because it must both promote nanotechnology and mitigate its risks. Many governments take the view that, in terms of product-safety, nanotechnology changes nothing. In the absence of any firm guidance from governments as to exactly what tests are needed to ensure a product is safe, businesses are devising their own. On the whole, that is the right approach in a market economy, but the uncertainties make it hopelessly over-optimistic for nanoparticulates (*sic*). The task is beyond some small companies. "We talk to them and they say they are just doing titanium dioxide and they are not concerned, because it is a safe material, and we think they're whistling to the graveyard on EHS risks", says an analyst. Businesses have good reason to make safe products. But the temptation for a company, especially a small one, is to spend its precious research budget on new products rather than basic investigations into the safety of nanotechnology that would benefit everyone, including its competitors." *3° On the difficulty of monitoring the mere presence of nanoparticules*: "Today's legislation is based on an ability to measure and monitor materials, and calculate risk. Unfortunately, "we don't have a clue what kind of standards there are for nanoparticles in air or water", says an EPA official. In water there is no ability to monitor the presence of nanomaterials. Even if these things could be measured, he adds, nobody knows how to control them. At the moment, it is virtually impossible to weigh a ten nanometre-sized particle with any accuracy." *Conclusion*: "What does it mean to regulate nanotechnology materials when you cannot even measure their release into the environment or agree on how to weigh a nanoparticle?"

Contrary to the four first stories, the fifth is indeed a "story" (not a fact): P&MO never infiltrated *The Economist* in order to spread ParaNanoia over the brightest brains of the globalized Western world. It did not have to. All these (edited) quotes are taken from an "authentic" article actually published by the London weekly on Nov 22nd 2007[1].

ParaNanoia and the Politics of Innovation

These five stories do not merely raise the question of the environmental and health risks associated with innovation (nanotechnologies in this particular case). Of course, nobody knows whether nanotech are or will be dangerous, and at what level of risk. At this stage—and this is precisely the stage which defines "innovation" as such—the question is *not* "Does this new technology present a (serious) risk?", but rather "Since we have no way of knowing

[1] "The Risk in Nanotechnology. A Little Risky Business", *The Economist*, Nov 22, 2007. Stories 1 and 2 are also drawn quasi word for word from *The Economist*, respectively April 12, 2006 and April 17, 2008. Stories 3 and 4 are documented from P&MO's website at http://www.piecesetmaindoeuvre.com/ as well as from the article "Débâcles et poussières. Contribution au bilan des débats publics sur les nanotechnologies" published by the French journal ***Z****, revue itinérante de critique sociale*, 3 (Spring 2101), p. 28-35.

for sure whether they will be dangerous, nor how dangerous they may be, *how can we reach a reasonable decision about controlling their development?*". Many arguments and procedures in our current debates about innovation are designed precisely to *avoid* or *short-circuit* such a fundamental question. Three common attitudes do just that:

(a) *Enterprising carelessness*, the default attitude which usually prevails (until something really bad happens), evades the issue by vaguely hoping that nothing too big and too embarrassing will come out of the innovation process. This attitude ranges from interested negligence (research into EHS risks is costly, uncertain, and potentially damaging for the companies which have invested money in the promises of innovation), all the way to cynical cover-ups, as demonstrated in the past by the cases of asbestos, chemical contaminations, nuclear accidents, etc.

(b) A symmetrical attitude, theorized and advocated mostly in France under the title of the *precautionary principle* (le *Principe de précaution*), calls for the suspension of any form of innovation in which the risks cannot yet be measured with some degree of certainty. The burden of proof should be on the side of the innovators (rather than on the side of the potential or actual victims): instead of waiting for something to go wrong before taking measure against its repetition, the researchers and developers should be in a position to demonstrate that their innovation will likely be innocuous. If one suspects a risk, even if one can *not* establish it upfront with due proofs and certainty, one should abstain from innovating.

(c) As enterprising carelessness seems to allow for irresponsible experiments from gung-ho researchers and greedy labs, and as the precautionary principle threatens to stifle any form of significant innovation, most actors adopt a third position of retreat and apparently common sense, which relies on *the virtue of expertise*: in a situation where one does not know upfront whether a new technology presents a (serious) risk, one humbly acknowledges one's limitations, and one calls for a commission of experts to gather their specialized knowledge and reach an agreement assessing the real or probable risk, to the best of their expert ability. According to this common and dominant view, Science plays the initiating role in the innovative process, and Science is in charge of monitoring its unfolding along the way. Lay people are supposed to "learn" from the scientists; decision-makers (in the best of cases, i.e., when business interests or political processes don't interfere) are expected to "follow" the recommendations objectively calculated and debated by the experts.

It is precisely this (often implicit) feature of the linear model which appears strikingly insufficient in light of our five stories. In story 1, the *Magic Nano* scare could still be brushed off as mere superstition: scientific expertise can trace the respiratory problems encountered by the 80 victims of the product as linked to the anti-corrosion liquid inside the propellant can and not to the nanoparticles. But already in the *Silver Wash* story 2, who in the scientific community can predict with a reasonable amount of probability what will be the long-term side-effects of releasing hundreds of billions of silver ions in every wash, at the level of the sewage plants, of the lakes and rivers, or of the human bodies who will later drink that water? As stories 3 (*The Grinch*) and story 4 (*Mad Scientists and Evil Capital*) bring P&MO activists in the picture, the place and status of "scientific expertise" becomes even muddier. Not only do some members of the scientific community share some of P&MO's concerns, based on their very expertise, but—more importantly—scientific expertise about the innocuousness or risks attached to the release of silver ions and other nanoparticles is *only one among many dimensions* of extremely complex socio-political (rather than physics') problems. As we have seen in story 4, what P&MO (and many other activists) object to nanotech is not merely that some particles might cause environmental and health hazards: they more radically oppose the type of social relationships embedded in and congruent with the fabrics of societies producing nanotubes, GMOs or nuclear waste. You cannot have a nuclear power plant without having some form of a police State in charge of preventing "terrorists" from putting their hands on

the highly dangerous waste it generates. While scientific expertise is a necessary ingredient in the discussions relative to such innovations, the type of social relationships most desirable for our future is clearly *not* a question that can be arbitrated (only) by "experts".

The double conclusion of story 5 (*The Marvels of ParaNanoia*) steers us towards a rather different way of addressing such issues. First, it confirms the need to go beyond mere techno-scientific expertise. The concluding question—"What does it mean to regulate nanotechnology materials when you cannot even measure their release into the environment or agree on how to weigh a nanoparticle?"— emblematically demonstrates the disturbing (but daily) fact that we have to make decisions in the absence of proper expert knowledge. We live in the ignorance of the consequences of our actions, day in, day out, whether we decide not to take an umbrella for a Sunday stroll, or whether we decide to buy a house. It is inherent to innovation that we have "to regulate things we cannot measure nor agree on how to weigh them". Their "weight" is never only a matter of grams or micrograms: it is always also a matter of *value* to the life forms we happen to favour. The debates about innovations will always eventually turn out to be, first and foremost, debates of *choices between various life forms*. And here again, while scientific expertise is one important way to help us choose between possible life forms, we cannot rely on it to make such choices *for us*: we have to make them *by and for ourselves*, largely in the dark, with our affects, intuitions, sensibilities, as much as with our (very limited) capacity to interpret our world in terms of calculable causal effects.

The second conclusion of story 5 is just as important, and just as troubling. Why is it relevant for most of us to know that it was *not* a P&MO commando who infiltrated a hoax article in the columns of *The Economist*, but that this article was indeed "authentic"? We tend to expect different stories coming from the ranks of radical ultra-left French activists and from the pool of journalists writing for the most eloquent and respected advocate of capitalism. We know that facts and ideas never reach us in a state of virginity, perfect openness and undirected availability. They always come to us with a certain label attached, with a certain "spin", with a certain orientation which pushes us closer to certain types of choices and farther from other types of choices. As countless theorists of "storytelling" have demonstrated for a number of years, public debates cannot be conceived along the simplistic model of a mere exchange of facts and arguments: the relevant strategic scale is that of the *story*, conceived as a sequence of events linked by a mixture of causality and chance, seen from a certain subjective perspective, and oriented along a certain system of values. It is though stories that we "organize experience in a distinctive way"[2]. While scientific expertise certainly helps us organise our experience in order to take advantage of what the material world can offer us, we need stories to provide this experience with distinctive *meanings*.

Are the promoters of nanotech "irresponsible" when they tell us their story of scientific progress towards the Promised Land of NBIC, with the perspective of reshaping mankind on a higher technological ground? Isn't their story believable to us, after two centuries of continuous and incredible improvements in the levels of material comfort enjoyed by the inhabitants of the rich Western world? Are P&MO activists "paranoid" when they see the shadow of a policeman lurking behind every nanotube, and the multiplication of future catastrophes brewing in the concoctions coming out of our most advanced labs? Isn't their story supported by a worrying track-record not only of punctual negligence (with dramatic outcomes named Chernobyl, Bhopal or asbestos), but also—much more worryingly—by a multi-secular but nevertheless unsustainable trend of spoiling our common environment and our limited resources, in the name of a narrowly technoscientific definition of Progress which is about to make the very maintenance of human life close to impossible on Earth?

[2] See Francesca Polletta, *It Was like a Fever. Storytelling in Protest and Politics*, University of Chicago Press, 2006, p. 11

What all this tells us is rather simple and unsurprising: "politics of innovation" are just that—*politics*. They unfold along the evolution of struggles between competing narratives, each of which is supported by different types of people and different types of forces. Political controversies have always shaped the progress (or the disqualification) of the sciences. These controversies need to be understood as *pressure games of push and pull*, wherein various actors affirm competing (and often collaborating) life forms tied together in multileveled power struggles. Within such power struggles, actors use scientific arguments as only one of their many weapons (a fact which in no way denies the epistemological specificity of scientific expertise). In order to be realistic *and* in order to assess (the scientifically inassessable) "social benefits" of emerging technologies, politics of innovation should therefore come up with a model designed (even very roughly) *to map the power struggles* which ultimately seal the fate of innovation. The following section of this chapter will somewhat immodestly attempt to provide a number of guidelines for such a mapping, obviously in a very sketchy form[3].

The ParaNanoid Component of the Lyon Innovation Model

Taken together, our five stories point towards the same problem: we have to live—and to innovate—in a world where it is increasingly difficult to make a clear distinction between irresponsible optimism and nostalgic paranoia. Since nanotech provides an emblematic illustration of this difficulty, let us call this situation *ParaNanoid*. As a provisional conclusion and with an attempt to translate these reflections into more practical recommendations, let us sketch ten of the many consequences such a *ParaNanoia* bears on the question at hand: not "Are nanotech safe?", but "How can we reach a reasonable decision about controlling the development of innovative technologies (like the nanos)?"

1. ***Politics of scientific innovation ought to be considered as political power struggles (much more than as scientific problems)***. While controversies about the potentials and risks of innovations obviously include scientific considerations, they are vastly over-determined by the vested interests which push for or against new technological developments. These vested interests can be observed in (at least) the following forms: investors' anticipation of financial gain, established players' fear of competition, researchers' expectations for career-advancement, politicians' needs to claim successes in front of electors, users' hopes for better service, citizens' fears of invasive governmental control, of health and environmental damages. In spite of their diversity in nature, these vested interests manifest themselves as *affects* (passions, emotions, desires, hopes and fears, love and hate) attached to certain *beliefs*, conflictingly composing a "political economy of affects" (a complex circulatory system made up of flows of desires and beliefs)[4].

2. ***Storytelling plays a crucial strategic role in framing and channelling the flows of affects within "the public"***. Within our modern "open" societies, controversies are arbitrated by the collective institution known as "the public". As Walter Lippmann and John Dewey

[3] Of course, most of the books and articles published by Bruno Latour and his colleagues in Science and Technology Studies during the last quarter of a century have been devoted to documenting such controversies and to analyzing such power struggles, their logic, their outcome as well as the illusions that usually cover them behind the veil of "scientific objectivity". A good place to enter his bibliography may be *Pandora's Hope: Essays on the Reality of Science Studies*, Harvard University Press, 1999. The overall spirit of my tentative reflection on these issues is, of course, heavily indebted to his work.

[4] For more on this, see Yves Citton, « Esquisse d'une économie politique des affects » in Yves Citton and Frédéric Lordon, *Spinoza et les sciences sociales : de la puissance de la multitude à l'économie des affects*, Paris: Éditions Amsterdam, 2008, p. 45-123, or in English « Populism and the Empowering Circulation of Myths », *Open* (Journal published in Amsterdam), nbr 20 (2010) special issue on populism.

(recently revisited by Bruno Latour) have suggested[5], "the public" is to be constructed as "a phantom", constantly resuscitated by "problems" clumsily elaborated along the way and under the pressure of emergencies by self-interested agents who generally attempt to develop rational understandings but no less generally fail to do so. Within this conflicting construction of ephemeral "publics" around controversial problems, storytelling plays a structuring role: flows of desires and beliefs are oriented by the narratives which manage to capture and channel them[6]. The fate of innovations is sealed by the struggles between conflicting stories, much more than by the sheer epistemic strength of scientific results or arguments. The most enduring myth is the one which would have us believe that controversies about innovations are decided (mostly) by scientific means (rather than by mythical narratives).

3. ***In the power struggles raging around innovation within capitalist societies, there tends to be a structural imbalance in favour of those who have invested resources in the development of new technologies***. Since innovations have to be fuelled by capital, governmental expectations for successes and the researchers' career-minded hopes, their development is pushed by the (sometimes very powerful) forces which initiated them. The more advanced they are in the development process, the more momentum they have gathered along the way. Reactions against potential hazards, risks and nefarious consequences of innovations tend to come with *a structural delay*: if, as Dewey stated, "indirect, extensive, enduring and serious consequences of conjoint and interacting behaviour call a public into existence having a common interest in controlling these consequences"[7], "public reaction" can only come *after* the fact, i.e., after the development of the innovative technology has already gathered a strong momentum towards its completion. As a consequence of this delayed nature of public reaction, the controversies around innovations tend to be structurally rigged towards the forces that push in favour of the new technology (especially when it is capital-intensive, as in the case of nanotechnologies, genetic engineering, nuclear energy).

4. ***Scientific expertise alone can not be expected to arbitrate such controversies: it is part of the problem as much as part of the solution***. Between enterprising carelessness (too loose) and the precautionary principle (too restrictive), we cannot trust scientific expertise to arbitrate controversies relative to innovation. In capital-intensive technological developments, the existential interests of the researchers tend to be too closely connected with the financial interests of the investors to be trusted as impartial arbiters. Even if their personal "honesty" was above suspicion, or even if scientific procedures of control and verification managed to root out any form of data-twisting, three factors would nevertheless make their "purely scientific" conclusions subject to caution. Since the general orientation of their research is designed from the beginning to establish the feasibility of the innovation, they will (a) spontaneously tend to elaborate questions which are geared towards the successful completion of their project (rather than towards the emergence of obstacles which may threaten its success). Even if they purposefully cultivated a state of mind actively looking for objections, problems and difficulties (as the critical nature of scientific inquiry may push them to do), they would (b) find it hard to finance experiments tending to undermine the very project they are paid to realize. Finally, as we have already seen, (c) many of the problems and dangers raised by technoscientific innovations concern *remote* ("indirect, extensive, enduring") consequences which reach far beyond the limited field of expertise developed by

[5] Walter Lippmann, *The Phantom Public* (1925), New York: Library of Conservative Thought, 1993; John Dewey, *The Public and its Problems* (1927), New York: Swallow Press, 1954; Bruno Latour, "Le fantôme de l'esprit public. Des illusions de la démocratie aux réalités de ses apparitions", Preface to the French translation of Walter Lippmann, *Le Public fantôme*, Paris : Demopolis, 2008.

[6] See Yves Citton, *Mythocratie. Storytelling et imaginaire de gauche*, Paris: Éditions Amsterdam, 2010.

[7] John Dewey, *The Public and Its Problems*, op. cit., p. 126.

the participating researchers. This, of course, does not disqualify the results of their scientific expertise: it simply calls for a rebalancing mechanism of counter-inquiry.

5. ***In light of this structural imbalance, experts' advice needs to be counterbalanced by "paractivists", organized in grass-root movements***. Innovation-pushers organize in research teams, labs, firms, scientific associations and the likes. Members of the public concerned by the potential risks of an innovation organize in grass-root movements. A more realistic version of the cautionary principle consists in devising decision-making procedures and institutions which *give weight* to the voices expressed by such "*paractivist*" movements. In line with the Greek prefix *para-*, which referred both to the fact of being "on the side" and of being "against", paractivists are defined both by their minoritarian-*marginal* nature and by their *counter*-oppositional action. In the case of nanotechnologies (in France), P&MO illustrates the type of paractivism I have in mind, but each country has seen its paractivist organizations take over the nuclear industry, GMOs, agro-industry, Big Pharma, etc.

6. ***While paractivist movements tend to develop alternative forms of scientific expertise, their "non-expert" objections may be just as valuable as their counter-expertise in assessing the ultimate merits and dangers of innovations***. One crucial benefit of paractivism has obviously been to devise, finance and/or publicize scientific counter-expertise: data-collection, data-processing and the elaboration of new theoretical frames that construct a scientific argument supporting claims about the potential nefariousness of an innovation. But, here again, it would be too restrictive (and ultimately delusional) to take into account only those inputs which have managed to reach the level of explicitness defining scientific arguments. Intuitive forms of resistance to new processes (at the workplace, in social interactions, in our relation to our natural environment) are potentially rich of important warning signs, since our sensitivity is always a long way ahead of the explicit knowledge we develop upon it. While the inertia of habits or what would appear to the scientific mind as a leftovers of "superstitions" clearly deserve to be considered with a critical distance, countless past experiences show that it has been foolish and disastrous simply to discard them as irrelevant. Any innovation policy seriously concerned with "public benefits" should lend an a priori amount of trust to "non-expert" objections raised or merely "sensed" by potential users, on the assumption that some rational ground will often be unearthed by those who take such objections seriously enough to dig under apparently superficial feelings.

7. ***In light of the very compact collusion of interests pushing for capital-intensive innovations, it is to be expected that paractivists will resort to paralegal actions in order to mobilize a public around their cause for concern and caution***. Since paractivists are playing on a structurally imbalanced field, it would often be self-defeating for them to respect existing institutional rules that are tilted against them. When P&MO disrupted peaceful and rational discussions to the point of preventing the French national debate about nanotechnologies from taking place, this may have been perceived by the organizers and participants to this debate as a form of (verbal) "terrorism", but it should rather be seen as an unavoidable strategy fro reframing the terms and sites of the public debate, away from the original imbalance and bias that rigged it. The collusion of interests between scientific expertise, high-tech industries and the French State is famous for having skilfully persuaded the Chernobyl radioactive cloud to stop precisely at the borders of the national territory, in courtesy for the heavy investments made in nuclear energy (which covers 80% of French electricity production). With such track records (shared in many other countries), paractivists can only be incited to see their efforts as swimming upstream against disproportionate flows of resources, visibility, access, biases which would fatally silence their voice, were they strictly to follow the official rules of the game. Resorting to paralegal and disruptive (non-violent) means of action should be seen as way to nurture a meaningful public debate, of which paractivists are the authentic carriers.

8. ***The structural need for paractivists goes beyond their subjective limitations***. Even among many of the French greens and critics of government- and capital-driven nanotechnologies, the type of discourse developed by P&MO is often perceived as nihilistic, backward, sectarian or dogmatic. In light of the complexity of the issues related to controversies about innovations, paractivists' attitudes may often seem to be as one-sided as those of self-interested investors in precluding the question at hand: they do not seriously ask "how we can reach a reasonable decision about innovations" since, in their minds, the decision has already been taken on the basis of its "obvious" nefariousness. It should however be accepted that *all* beliefs—insofar as they actually matter, i.e., insofar as people are ready to act upon them—necessarily lean towards a form of (more or less blind) "faith", and that the scientist defending her privilege to be the main arbiter in such issues is no less (nor more) "blind" than the paractivist acting upon the subjective certainty of the danger he is denouncing. Beyond such subjective limitations, our increasingly capital-intensive processes of innovation crucially need the (oppositional and cautionary) engagement of paractivists in order to raise otherwise hidden issues linked to the socio-political implications of technoscientific innovations. Our societies need strong paractivist movements to broaden perspectives which tend to be excessively restricted by the very nature of scientific expertise, and to nag innovative forces with counter-biased questions ("Are we willing to threaten our resources of drinking water in order to wear odourless socks or to have *Silver Wash* kill 99.999 percent of their germs?").

9. ***We should learn to envisage innovation as running in (at least) two parallel flows, in constant competition and interaction: one of technoscientific devices, another in socio-political devices designed to control and steer the developments of technoscience***. Our non-linear model of innovation would certainly gain in assessing the progress of technoscientific innovations (TS) in relation to another (equally multifarious) line of innovations, relating to the socio-political institutions (SP) designed to promote, channel, steer, keep under check, redirect, neutralize or simply abort the former. In the previous pages, it has obviously been grossly reductive to attribute solely to "paractivists" the function of watching over the potential dangers of innovative technologies. Countless "ethics committees", "safety boards", advisory commissions and other regulatory offices are funded by governmental money as well as by the firms themselves to try and anticipate potential EHS issues. The fact that most of such institutions have emerged during the last century, if not during the past couple of decades, suggests that they are still in their budding state, and that much needs to be done to understand and improve them. Three benefits would result from including them within an integrated model of innovation. First, SP innovations would no longer be seen as a mere force of resistance, slowing down innovation processes (or blocking them), but as a flow of innovation in its own right, just as important and inventive as TS, maybe even more decisive as far as the social benefits of innovation are concerned, if only because it can work as a catalyst for redirecting flows of TS. Second, a joint overall mapping of TS + SP innovations would help us measure the relative strengths and weaknesses of each component, within a certain period, within a certain national territory or within a certain disciplinary field. This would not only help us understand the different speeds of development between these (imperfectly) parallel flows (we already suspect a structural delay in SP relative to TS), but it could also serve as a warning sign in itself, when a worrying weakness of precautionary mechanisms appears in a certain area—as it is currently the case in the field of nanotechnologies, according to *The Economist*'s article mentioned in story 5. Finally, such an inclusive mapping would probably demonstrate the crucial role played by paractivists within the multilayered devices our societies are currently inventing in order to protect themselves from the unintended consequences of the TS innovations. While it is in the very nature of paractivism always to *exceed* the place recognized to it within each social formation,

understanding the structural necessity of this exceedence would go a long way towards building more realistic and more accurate models of innovation.

10. ***In the age of global market competition and of global environmental solidarity, it is essential to include a ParaNanoid component into our models of innovation, which must be geared towards the promotion of sustainable, democratic and peaceful societies at the geopolitical scale***. If we are serious about putting social benefits to the core of our innovation policies, then we must inescapably devise our models so that the local and national levels of intervention are integrated on a geopolitical scale. And since one has, unfortunately, little reason to show much optimism in this regard, it is crucial to recognize the necessity of actively cultivating the *ParaNanoid* dimension of a model which puts at its core the corrective and precautionary work of paractivists. For, disheartening as it may be, so far in human history, it is mostly democratic Western powers which have abused innovative technologies to turn them into weapons of mass destruction (chemical during WWI for France and Germany or in Vietnam for the USA, nuclear during WWII for the USA again). The inexorable spread of nuclear weapons across an increasing number of countries over the last 60 years, the colossal (and worryingly unsung) part played by military budgets in the development of *all* forms of capital-intensive new technologies, the mind-boggling amount of devices of self-destruction accumulated by mankind over the last century, and the chronic weakness of all supra-national institutions devised to diffuse the most threatening forms of political tension, all of this may seem to dwarf punctual worries about *Silver Wash* and nanotubes. And yet, the real challenge of any innovation model would be not to turn a blind eye on such basic and massive consequences of technoscientific innovation, but instead to devise pragmatic ways to address them within one integrative framework devised with a global scope in mind. This is what the last section of this chapter will attempt to sketch.

Towards Global ParaNanoiactivism

It is at the level of the *global* power struggle that a ParaNanoid attitude towards innovation may prove most useful. If not even democracies ought to be trusted with the deadly toys devised by their military innovators, we should assume that "somebody"—let's say the other "bad" guys, even if historical record suggests it tends more often to come from our own ranks—will sooner or later misappropriate our innovations. Instead of letting this precautionary worry block any form of innovation, as it would if the precautionary principle was to be taken literally, let us reframe the questions raised by technological development within a global mapping of the forces that push and pull for or against each of them. Much would be done preventively to defuse the tensions that may lead to self-destructive competition or to apocalyptic wars if we managed to assess our innovation policies and their expectable consequences worldwide according to the criteria sketched above as comprising the ParaNanoid component of our model. This would be a work of *translation*, which can be summarized in the five following points, each of which can lead to a broad but hopefully non-trivial recommendation.

I. **Innovate towards a more equal global sustainability**. The structural imbalances observed at the local and national levels between promoters of capital-intensive innovations and their paractivist cautioners are obviously reproduced at an even higher scale when it comes to relationships between dominant nations and poorer parts of the world. A truly inclusive innovation policy at the global level should make it a priority to diminish such imbalances, since they increase the very pressure that may push disenfranchised groups or "rogue" governments to abuse technoscientific innovations for military/"terrorist" purposes. Since we have produced tremendous means of self-destruction, and since we are neither

willing nor likely to stop innovating in the future, it is our duty to reduce the causes that may lead to misappropriations of our given and future stock of innovations. More broadly still, sound innovation policies should be consistent with an overall effort towards reducing the various types of (environmental, social, psychological) pressures which make our existence on this planet less and less "sustainable". Serious suspicion should meet projects which seem likely to increase (rather than diminish) the stress we impose upon our shared resources and upon ourselves, or to expand (rather than reduce) extreme inequalities in income and standards of living across the world as well as within each society. The criteria of sustainability could generate the following *ethical recommendation*: "*Withdraw your support and participation in what you cannot want on a sustainable basis!*"

II. **Innovate horizontally rather than vertically (top-down)**. The collusion of interests observed above between investors, experts and national governments is also reproduced at the global level between ruling classes who often promote their self-serving vision of the future rather than satisfying the basic needs of the majority. Here too, innovation policies seriously eager to promote "social benefits" should turn their ears to grass-root movements and paractivists rather than official experts nominated by national governments. If the challenge is to devise a model of *democratic* innovation, going beyond the top-down linear model (from the lab to the street), it should devote much attention to include strong recursive loops from the streets to the labs and, more importantly still, to the parliaments and to the board meeting rooms. Establishing and nurturing horizontal links between street-level paractivists (but also between researchers and users) across various nations from various (rich and poor) parts of the world should be a priority over top-down policies and campaigns promoting the "acceptability" of new technologies. Hence a *deontological recommendation*: "*Concentrate your efforts on implementing equal (horizontal) relationships with regards to innovation!*" And since the military represents the most extreme and rigid form of vertical hierarchy (apart from being designed to transform empowering innovations into deadly weapons), we could easily add a commonsensical (but nevertheless radical and probably utopian) *second deontological recommendation*: "*Withdraw support from any project geared towards military purposes!*"

III. **Innovate by trusting the nano rather than the macro**. Our current discovery of the nanoworld, with all its threats and promises, could serve as a metaphor for our attempts to map the new modes of composition emerging among human subjectivities in the global age. Here too, a vast new continent of infinitesimal connections (which used to fall below the sensitivity threshold of our previous radars) waits to be explored across the continents of our cultural diversity. Seventeenth-century Dutch philosopher Spinoza is famous for stating that "nobody has of yet been able to determine what a body can do": what *two* connected bodies (and minds) can do together is even more unpredictable, as for the *three* bodies problem, we know that their interaction escapes our best computing ability, even when the bodies in question are reduced to their simplest, physical expression. While some global *macro*-policies are clearly needed in order minimally to coordinate our survival on this planet (in terms of climate change, toxic substances, water management and the likes), it is probably at the range of *micro*- or *nano*-interactions among human subjectivities that each of us can start innovating in the infinitesimal decisions and behaviours of his daily life. Apart from the institutional procedures devised by our various political systems, radical democracy begins at the nano-scale: in the way my subjectivity connects itself to that of the fellow humans I encounter day in and day out. Hence a *methodological recommendation*: "*ParaNanoiactivism starts by establishing healthy nanoconnections at home, which it hopes to propagate by virtue of exemplarity!*"

IV. **Innovate in regulative institutions and paralogic intuitions, as much as in scientific procedures**. It would certainly be foolish to bet much on the survival of mankind if

we were to trust our future into the hands of the sole scientists. Since the vast majority of our behaviours and decisions rely on other forms of (collective) thought than the scientific method (which is only three centuries old, an immature newborn at the time scale of human history), we would be well advised to redirect parts of our innovative energies towards the institutions and intuitions which, in spite of all their shortcomings, have nevertheless managed to keep our cultures alive through centuries and millennia. At the global, i.e., multicultural scale, innovation should tap into the plentiful reserves of traditional forms of knowledge and practices we have inherited from our countless ancestors. Against the grain of the terrible track-record established by modern science, which believed it could flourish by crushing pre-scientific attitudes and customs, our innovation model should seize every opportunity to counterbalance the inherent (and refreshing) a-historical pretentions of the scientific method with a close attention to the untapped resources provided by our various cultural traditions. Hence an *epistemological recommendation*: "*Assume that there is much hidden wisdom to be drawn from traditional (pre-scientific) approaches to the human and natural world!*"

V. **Innovate in telling meaningful stories, as much as in making factual discoveries**. Connecting the diversity of human cultures through shared sets of narratives can be at the same time the biggest and the easiest challenge at the horizon of our global model of innovation. A man born in rural China, a woman born in a US metropolis, a boy raised in the Congolese wars and a girl growing up in an Indian village may not share the same languages, the same cultural references, the same myths, the same visions of happiness or distress. Translating their life-experience in terms that would allow them to understand each other, debate and agree on measures to be taken at the global level to alleviate poverty, violence or climate change might seem an impossible task. And yet, not only do they share a number of basic human needs, hopes and fears, but they are likely to experience their life through stories presenting remarkable and deep analogies under a surface of infinite diversity. Folktale analysts have listed a fairly limited repertoire of narrative motifs which seem to structure the stories humans tell each other all across the planet. In the age of the Internet and of global television, it may be fairly safe to assume that most of them will have heard (of) Michael Jackson, will have dreamt along some storylines provided by Holly- or Bollywood, will have toyed with the more or less realistic idea of seeing (or migrating to) other parts of the world. The innovations which will matter most in decades to come will probably take place within the realm of storytelling, as much as in scientific labs. These two crucial sites of inventiveness need to be equally valued by any realistic model of innovation, as their fate is narrowly tied to each other. Hence a *poetic recommendation*, to serve as a conclusion of this chapter: "*Take it as your main duty to inscribe your innovations, whatever they happen to be, into a meaningful story raising hope in the common future of mankind!*"