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Science and democracy: tensions and co-evolution

Amid all the talk about the crisis of legitimacy and the need to reform, if not re-invent, institutions and forms of democratic governance, one institution is usually left out, although its importance for creating economic and societal growth is undisputed: science. It is the prime source and institutional site for the production of new knowledge. In synergy with novel technological developments science leads to innovation in pursuit of improvements of how our societies live and how they cope with the challenges threating their survival.

Therefore, it might be useful to remind ourselves that to the extent science and technology have become the major drivers of economic growth and intrinsically linked to innovation, the institution of science and its achievements have become subject to contestation. Their democratic legitimacy in being instrumental in the major societal transformations of living and working are challenged.

In the following, I will retrace some of the more recent contestations to the epistemic as well as social authority of science, the responses that followed and what the scientific community has learned from this experience. Whether such lessons are of any value outside the specific context in which they occurred remains to be seen, but they offer a view of the larger picture, one that is more complex and in need of differentiation than the partial glimpse of either science or of democracy allows.

The wave of public contestation of science started almost five decades ago. In contrast to the US, in Europe neither science nor the laws of nature discovered and verified by science, were the target. Rather, public indignation turned against the perceived or real risks that became associated with major scientific-technological developments. Protest organized by what is now called civic society was directed against the fact that the public had no say in major technological developments that would affect also future generations.

This certainly was the case with nuclear power, promoted as the new source of energy that would meet rising demand at low cost. This is not the place to retrace the origins and the unfolding of a public controversy which rapidly spread across national boundaries in Europe (Nowotny, 1979). In some parts of Europe the controversy around nuclear energy has left a long-lasting mark on public attitudes. When the German government recently announced its decision to close its nuclear energy plants in favour of initiating the *Energiewende* it received wide-spread support from the German electorate.

The nuclear power controversy quickly revealed that the traditional focus of scientific experts on safety features was far too narrow. The technical concept of risk had to be broadened as a consequence. It no longer sufficed to define risk as the probability of an event multiplied by the total of damage it caused, but whether the risk was voluntary or not and whether damage hit mainly individuals or entire communities. Thus, in the view of the opponents, much more was at stake than a merely technologically efficient way of securing energy. Decisions about novel scientific-technological developments of major societal relevance involved decisions about the kind of society people wished to live in, their imagined technopolitical futures. The Chernobyl accident uncovered, albeit in a dramatic way, a profound and simmering unease that became vindicated, it seemed, by a novel phenomenon described as the *Risk Society* (Beck, 1992).

Other scientific-technological controversies were to follow. They display some marked national variations which have been described by Gabrielle Hecht as 'technopolitical regimes', i.e. "linked sets of people, engineering and industrial practices, technological artefacts, political programs, and institutional ideologies" very often entangled with national identities (Hecht, 1998:12, quoted in Felt, 2013:3). Ulrike Felt has taken this notion further to show how specific sociotechnical imaginaries are constructed, nourished, kept alive and naturalized. She also challenges the widespread standard interpretation according to which resistance against any technology is a form of technophobia, as it goes against an innovation-friendly climate with its promise to overcome the current economic crisis (Felt, 2013).

To this day, the controversy about the alleged risks of genetically modified organisms, GMOs, persists in many part of Europe. While science is moving forward to create the next generation of GMOs, a new breed of transgenics, scientists freely admit that only some promises have been fulfilled, while many others have led to a polarized debate. Reliable information and evidence on the true, the false and the still unknown continue to be contested in emotionally charged exchanges between well-informed members of the public, an aggressively marketing industry and a scientific debate which is far from being closed (Nature, 2013).

A close analysis of the mixed reaction that nanotechnologies receive by citizens shows once more "that citizens by no means 'misunderstand' nanotechnologies by linking them in a straightforward manner to nuclear energy or agro-biotech – a fear frequently expressed by policymakers. Instead, they embrace a much broader and simultaneously more fine-grained vision of what is at stake…They clearly differentiate…between technological realizations which have a fit with broader values and those which seem disruptive" (Felt, 2013: 16).

Coping with uncertainty and how to accommodate the insatiable curiosity that is at the heart of the scientific and technological endeavour, clearly poses a dilemma. No society can permit science to be without any constraint in following its curiosity. It is unknown where it will lead and what will be the consequences. Taming scientific (and technological) curiosity has taken different routes: an economic, which attempts to channel research into directions that promise technological innovation and useful outcome; a risk-regulated route, which attempts to assess risks in advance and promises to manage them; and a value-guided route, which seeks to build societal consensus around contested, and often contradictory, values (Nowotny, 2008).

But let us return to the reaction of the scientific experts when they felt the first blow to their authority upon being challenged by the lay public's protest against nuclear power. Not surprisingly, the first response was one of dismissal: 'the public' was seen as scientifically ignorant. Worse, their views and what was perceived as an irrational technophobic refutation of scientific-technological progress, were attributed to ignorance which should therefore disqualify the public of having a legitimate voice in the decision-making process on technological developments. Such a stance was neither in line with democratic rights, nor could it stop the contestation.

Hence, a flurry of activities followed in the attempt to fill the perceived 'knowledge deficit' on the part of the lay public. This lack had to be overcome by educating the public. The emphasis was put on 'public understanding of science'. If only, so the argument went, the public would be offered sufficient scientific knowledge and the right kind of scientific evidence, if it was to 'understand' science, public acceptance of new technological developments would follow.

It soon turned out that the promotion of 'public understanding of science' rested on a profound misunderstanding (Wynne, 1992). Simply feeding the public more information on scientific facts did not lead to greater acceptance. Nor did the occasional construction of the public as being 'anti-scientific' hit the mark. The reasons for non-acceptance, as STS scholars have demonstrated over and over again, lay elsewhere and often had little to do with the contested science and technology per se.

In some cases, science and technology were an easy target, while the protest and refusal was actually directed against the interests imposed by big agro-business or big pharma. They were seen as being the real driving force behind new technologies, with scientific experts in collusion with profit-driven interests on the part of industrial lobbies. Thus, branding public reaction as 'rejection' distorts and oversimplifies. The alleged rejection can also be read as "a choice of one kind of future over another, chosen by one set of political actors- citizens and popular media – over another – politicians, lobbyists, and powerful technoscientific actors" (Felt, 2013: 17).

Next came the 'participative turn'. Political authorities and the scientific establishment responded in their own way to public demand for participation in decision-making. Especially the scientific community realized that trust in science and its epistemic and social authority were at stake. In order to maintain or re-gain trust, science had to open up and listen to the grievances and arguments put forth when ordinary citizens who felt affected protested or when citizens simply were taking up questions that nobody had asked them to take up.

A series of initiatives and activities was unleashed which took different, sometimes very innovative forms. Many of these experiments in public dialogue were initiated or organized from above: either by governments or other public authorities with support from the scientific community. Dialogue platforms and debate for a proliferated, as did consensus conferences and other forms of a newly discovered engagement with civic society. The official discourse changed as well. It moved from 'public understanding of science' and the somewhat naïve belief that all that was needed was to 'communicate with citizens', to a more or less authentic desire of science to 'engage' with society. While these various forms of public engagement led to a flourishing of diverse formats of public dialogues and participation, in the end public participation was unable to deliver

the anticipated 'solution'. Nor could it, if the expectation was to obtain public acceptance of whatever novel scientific-technological products or developments were on the horizon. With the benefit of hindsight it is obvious that this was an impossible goal. The agenda of obtaining public support as a 'carte blanche' was too broad and the content too diverse.

It also turned out that 'the public' simply does not exist. Instead, the public is a heterogeneous and fluid mixture of different groups who make use of the three options famously described by Albert Hirschman as 'exit, voice and loyalty'. Patient groups, for example, have specific needs and concerns regarding their treatment that differ vastly from the political concerns of NGO's monitoring global trade agreements for GMOs. Comparisons across different technopolitical regimes revealed profound differences in three Western liberal democracies in their national settlements with regard to the same technology, thereby exposing the complex entanglements among knowledge, technical capability, politics and culture. Jasanoff also reminds us that democracy is not a singular form of life but a common human urge to self-rule that finds expression in different institutional and cultural arrangements (Jasanoff, 2005).

Forms of public engagement can thus only be conceived in such a plurality, entangled in a complex array of political and institutional ensembles: on the side of a heterogeneous, even fragmented, public, embedded in different democratic life forms, as well as on the side of the sciences engaged in their attempts to regain trust at varying distance from the firing line. Moreover, 'publics' hold different and often contradictory values which can and do change over time.

Yet, the belief in the Enlightenment ideals of participatory and deliberative democracy as holding the key to mobilising public support for science, was persistent. It took some time to admit that all-inclusive participation was neither possible nor in the end desirable. To take but one example: the distinction between an 'invited' public and the 'other' – uninvited – public who continued to raise their voice protest, marks one of the limitations (Wynne, 2007). Both of these 'publics' represent citizens, but the way they exercise their rights and the control that can be excised over them could hardly be more different.

Acknowledgement of the limits and limitations of public participation thus initiated the current wave in the tension-ridden arrangements between science and society. Participation does not function either as 'the solution' for assuring public acceptance nor does it have the capacity to include 'the public' in its inherent heterogeneity and plurality in the democratic processes of decision-making. Nevertheless, public participation assures a modicum of process legitimacy. Perhaps, in tune with the sober and more subdued mood in times of the present crisis and austerity, time has come to reflect and even allow for self-reflexivity on the part of the institutions involved.

This could begin by re-assessing the political imaginaries of science and democracy that continue to shape the co-evolution of their relationship. To take into account the larger picture of the changing role of science in contemporary societies and to understand the unprecedented new challenges that arise from it. Science and technology – the technosciences – have become the driving force for economic growth and social development. This leads to a much more intricate entanglement with economic, social, political and cultural strands all intertwined. The production of new knowledge covers a

wide range: from fundamental research pursued in the bottom-up, curiosity-driven mode to tackling the complexity of the 'grand challenges' which require global solutions. In an intensified climate of world-wide competitiveness, innovation - either in its radical form as exclusively science-based or in its various incremental forms - has become the key that promises to unlock the vast potential of science and technology for our future.

The inherent tension between science and democracy presently undergoes a shift from a risk-oriented preoccupation in the direction of how to cope with the uncertainties that are inherent to innovation. In the past, the experience of contesting the epistemic and social authority of scientific expertise was met with attempts to regain trust and mobilise public support for science. Risks, whether real or not, could be localized and focalized. With innovation as the new global imperative, the terrain is shifting to a much more diffuse and fluid, because transnational medley of actors and global framings. The focus on innovation opens up towards a much larger scope and scale of uncertainty, as it is not possible to predict in advance its multiple, and often contingent effects.

The larger picture reveals a long historical strand of processes of co-evolution. Protest and contestation alternate with eventually more responsive forms of governance which they trigger in form of regulating the new technologies. The law occupies a prominent place in such efforts to 'humanize' technologies, rather than fitting humans to match the latest technologies (Supiot, 2005). Such processes of co-evolution can be traced back to the beginning of industrialization. "Contrary to what managers, engineers, politicians and risk experts want to make us believe, it is the massive mobilization of the population, of dissident experts and of the victims which have led ministerial departments, industrialist, safety committees and courts of justice to modify their attitudes" (Pestre, 2013, p.151). But today's question is: who can, who wants to mobilize against innovation, if all hopes are pinned on it as getting us out of the crisis?

If one of the main conclusions to emerge from a broader and historically informed view is that new modes of governance continue to co-evolve with new scientific and technological developments, then efforts to obtain public support must be directed towards setting up adequate modes of governance that can cope with the uncertainties and challenges posed by new technologies.

Already now, new kinds of regulations proliferate. Some of them incorporate the precautionary principle, while many struggle with an inherent dilemma: the speed at which novel technological opportunities become available by far outpaces sufficiently robust knowledge about their impacts. Social acceptance cannot be expected without knowing what is to be accepted. Nor are users a category frozen in time. Their experience forms an indispensable part of any regulation. They continue to evolve with the uses to which they put new technologies. Social innovation is just as important as technological innovation. It is thus impossible to foresee all the consequences – we have entered what Allenby and Sarewitz call level III of complexity (Allenby and Sarewitz, 2011).

The evolving dynamics of new modes of governance and arrangements for regulation, standardization and harmonization, must strive to include the active participation of citizens. The input derived from their imagined futures and, perhaps most important, their individual and collective experience, requires new public spaces while acknowledging the limitations of public participation.

Such public spaces are needed as counter-weight to the blind forces of the markets and the neo-liberal agenda that upholds them. They must be institutional spaces in which citizens, in recognition of their heterogeneity and the plurality of values they hold, can experiment and share their different as well as common experience. Experiment, because only institutionalized public spaces can offer the possibility to step outside the accelerating pace of technological developments and to try out possible alternatives, at least on a small and temporarily protected scale. Experience, because this is the best way to receive feed-back from different kinds of users and from those who are affected in different ways. It is the richness and diversity of actual experience out of which new impulses for a creative shaping of the future come (Nowotny and Testa, 2011). To neglect this creative diversity in all its heterogeneity, with all its contradictions and messiness means to adopt the stream-lined path of a homogenized monoculture of governance – something against which ordinary citizens are very likely to rebel again.

Any discussion about science and democracy has also to reflect the role played by what Yaron Ezrahi calls 'collective political imaginaries'. They are necessary, yet causative fictions. "A democracy, like any other political regime, must be imagined and performed by multiple agencies in order to exist" (Ezrahi, 2013, p.1). It is quite obvious that political imaginaries would be deprived of political legitimacy, would they not invoke citizens as the ultimate, yet largely fictitious beneficiaries of all the activities undertaken in the name of science, technology and innovation policies. As I have elaborated elsewhere, the dominant collective political imaginary in this kind of political public engagement with science – political, as it includes the imaginaries also of government agencies and public and private funders - is predominantly utilitarian and instrumental (Nowotny, 2013).

Collective political imaginaries are not uncontested, as the circulation of counter-imaginaries shows. The performativity of imaginaries is difficult to predict, as it is subject to contingent factors and constraints. Collective imaginaries are intertwined with the fluidity of the media world. The new media and information and communication technologies have brought about dramatic transformations which impinge on science as much as on democracy. Information from many different sources, although differing in quality and reliability, has become widely accessible. Among many other effects, this ready and abundant availability has brought about a change in authority relations. Arguably, information obtained through the internet and other communication media does not equal knowledge, but there can be little doubt that it has contributed to dilute scientific expertise.

Perhaps surprisingly, the new media and communication technologies also offer new ways of including citizens by making them participants in the research process itself. Such inclusion crosses the scientific expert divide and reconnects with a tradition which is as old as the origin of modern science in the 17th century. At the time, a small and enlightened minority claimed to be citizens in the imagined Republic of Science. They were part of a social movement that swept across Europe in what historians of science call 'the scientific revolution' (Heilbron, 2007).

Later, the Industrial Enlightenment began its ascent through a social movement consisting of craftsmen, local dignitairies, workers and amateur associations. Based on the belief that systematic useful knowledge was key to economic development, their

experience, dexterity, imagination, and intuition greatly helped to created new technology (Mokyr, 2009). In the second half of the 19th century, these amateur citizens, the 'lovers' of science and technology, became marginalized with the rise of formal training in special technical schools and universities and with research becoming a highly professionalized activity.

Today, we witness a remarkable opening of science towards what is called 'citizen science'. Remarkable, because it offers new ways of entry for ordinary citizens to participate in the research process, using the web and apps that by now have become everyday communication tools, especially for the younger generation. Other forms of participation have enabled ordinary citizens to become co-authors of scientific publications, fully acknowledging them as collaborators. Examples range from the famous 'fold-it' on-line competition, in which participants succeeded through the internet to come up with new solutions for how to fold a particular protein or the Galaxy Zoo project in which new galaxies were discovered by non-professional researchers (Nielsen, 2012). It may sound trivial when young researchers take to 'crowd-funding' to obtain extra funding for their scientific activities. Yet, it constitutes a novel form of out-reach through which citizens become interested in science (Feder, 2013).

None of these unconventional experiments in public engagement with science should distract from the core of the tension between science and democracy. Yet, they offer a new point of entry fostering the idea of 'civic epistemologies', i.e. how citizens know in common and how they can apply this knowledge to politics (Jasanoff, 2005).

As we have seen, the commonality of knowledge and even more, its application to politics remains continuously open to negotiation and struggle between different interests, access to resources, and a plurality of values. Science, technology and innovation in a democracy are not exempt from these conditions. "A democracy is not a political regime without conflicts, but a regime in which conflicts are open and in addition negotiable … Under this regime, conflict is not an accident, nor bad luck; it is the expression of the characteristic of the common good which can neither be decided scientifically, nor dogmatically … The political discussion is without conclusion, although not without decision" (Ricoeur, 1991, pp.166-167; quoted in Pestre, p. 155).

At the same time, science has something unique to offer to democracy: science is a public good with an inexhaustible potential for the future of humankind. It is unique in its capacity building. It brings to democracy with its in-built short-term cycles and considerations a long-term perspective, based on the systematic inquiry and engagement with the natural and social world. For better or worse, this one world is increasingly of our own making. It remains up to us, as individuals and to our institutions, to ensure that the scientific endeavour retains its openness in an ongoing process of tension and co-evolution.

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The translations of the quotes from Pestre and Ricoeur are mine, HN.