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Spanish Philosophy of Technology –
Contemporary Work from the Spanish Speaking Community

Belén Laspra and José A. López Cerezo (Eds.)

BORRADOR

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Part IV. New Technological Frontiers

Part V. Case studies

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The Culture of Risk: STS Citizens Facing the Challenge of Engagement

José A. López Cerezo[34] and Belén Laspra[35]

Abstract Plurality and divergence of opinion, based on freedom of thought and information, are nowadays broadly recognized as requirements for the healthy performance of a democratic society. The aim of this chapter is to take this idea somewhat further by characterizing the agents of such performance. We do so by highlighting a culture of risk with respect to the Science and Technology System. In our view, risk culture implies having a skeptical awareness grounded on sound information towards science and technology, combining an overall positive attitude and awareness of their limitations and threats, and adapting one's behavior accordingly. We argue that risk culture is a key element for democratic governance in contemporary risk societies with increasingly pressing technical issues open to social debate. Accordingly, we first review the concept of risk culture within the framework of scientific and technological culture, and then proceed to examine the role of this risk culture in social engagement. Finally, we reflect on some challenges of the implications of risk culture for the relation between society, science, and technology.

1. Risk Culture

In recent decades, research on scientific and technological (S&T) culture has generated a considerable amount of literature in the field of Science, Technology and Society (STS), as well as a diversity of related areas like Science Communication, Science Policy, Science Education and Public Understanding of Science (PUS). Despite the

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many attempts to reach an operational concept of S&T culture, or at least to develop a commonly shared framework, the question of what scientific culture is still remains open. For example, the absence of a theory that enables a suitable interpretation of the results of public understanding surveys has been pointed out as one of the major weaknesses of the PUS field (Pardo & Calvo 2002). In this chapter, based on previous research (Cámara Hurtado & López Cerezo 2012), S&T culture is understood as a process that involves the consumption of S&T information and entails the cognitive enrichment of the individual, the readjustment of his or her beliefs and attitudes according to the information acquired, and the resulting generation of behavioral dispositions and changes in habits.

Research on S&T culture usually refers to three types of elements: epistemological, axiological, and praxeological[36]. The epistemological elements include knowledge of science and technology (S&T), both concerning scholar science[37] and cutting-edge science[38], as well as knowledge about political, economic, cultural, or ethical issues in S&T (i.e., meta-scientific knowledge). The axiological elements refer to interests, values, and attitudes associated with S&T. The praxeological elements are those related to behavioral dispositions and human action. Here, we shall focus on a cross-cutting axis of S&T culture, present in each of these dimensions: the culture of risk. We shall use the term 'risk culture' to refer to the epistemological, axiological, or praxeological elements of S&T culture, thus related to knowledge, valuation, and action or disposition to action, in relation to negative effects and risks produced by S&T change.

We understand the culture of risk as framed within S&T culture. Although there is some overlap between the two concepts, the culture of risk has certain features that make it different. Specifically, as far as the epistemological elements are concerned, in the case of risk culture, these logically comprise more relevant knowledge concerning current S&T issues, such as knowledge related to scientific controversies or the existence of potential risks and benefits of specific fields of technological change. This does not mean that a basic level of scientific literacy is not required to make sense of current debates on issues involving negative or potentially negative aspects related to S&T (Miller 2012). As to the axiological elements, from the perspective of the culture of risk, the focus lies on the perception and valuation of risks versus the benefits of S&T in general and on the perception of the risks or negative impacts associated with specific applications of S&T. Also within the axiological dimension, although the focus is on interactions between interests, values, and attitudes, trust and distrust are particularly important in risk culture, as both play a key role in the praxeological dimension, i.e., in

[36] These terms are understood in their Greek sense. Episteme: concerning justified beliefs. Axiology: concerning values. Praxis: concerning actions.

[37] 'Scholar science' refers to that basic body of knowledge originally set by the American Association for the Advancement of Science in 1989, through the document entitled *Science for All Americans*. This body of knowledge is measured in PUS surveys by quiz tests on basic scientific literacy.

[38] 'Cutting-edge science' refers to S&T results that appear in the newspapers and tend to raise social controversy. There are many examples in the fields of fracking, vaccines, car engines, nuclear energy, cybersecurity, human reproduction, etc.

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decision-making and the generation of behavioral dispositions based on our beliefs and valuations concerning the threats or negative effects of S&T.

Although common surveys on the public perception of S&T do not usually pay much attention to the negative aspects of S&T (Cámara Hurtado & López Cerezo 2014), according to the available data-survey for Spain, people have a low perception of risks, at least when a balance between positive and negative effects is asked for. Results of Special Eurobarometer 340 (EC 2010) show that 68% of Spanish respondents totally agree or tend to agree with the statement "the benefits of science are greater than any harmful effects it may have". In contrast, 9% totally disagree or tend to disagree with the same sentence. These results are slightly higher than those from Special Eurobarometer 224 (EC 2005), where 57% totally agree or tend to agree, while 8% totally disagree or tend to disagree with the above statement. In both surveys, the level of "neither agree nor disagree" was significantly high (19% in EB 2010; 28% in EB 2005). The high perception of the benefits of science on the part of Spanish society is also shown in national surveys (see the FECYT 2002-2014 series). Results differ interestingly if risk and benefits are measured as two separate dimensions. According to the 2007 Ibero-American survey (FECYT-RICY-OEI 2009), a good percentage of people tend to perceive both many risks and many benefits when asked about the effects of S&T. As regards the case of Madrid (Spain), 17.1% perceive many risks, 42.2 % some risks, 32.2% few risks, and 8.5 % none; while 36.2% perceive many benefits, 47.7% some benefits, 13.7 % few benefits, and 2.4 % none.[39]

The logical context for reflecting on the political significance of the culture of risk is that of the risk society. Since it was proposed by the German sociologist Ulrick Beck in 1986, the concept of the risk society has spread widely and has served to highlight the existence of the hazards that accompany the benefits derived from S&T development. One salient feature characterizing the risk society is the recognition of global risks that transcend spatial and temporal boundaries. An accident at a nuclear power plant such as the one that occurred in Fukushima, a health alarm such as the one triggered by the Zika virus, or legislation on the commercialization of transgenic foods all have repercussions that go beyond national, gender, or generational borders. Besides, at the individual level, risk currently lies at the core of everyday life. Given the wide diversity of courses of action opened up by current S&T change, the binding traditions of the past have now lost their strength to regulate individual behavior. We thus have to constantly face taking risky decisions in our lives. For example, when deciding in the supermarket

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[39] This survey was promoted by the Spanish Foundation for Science and Technology (FECYT), the Ibero-American Organization of States (OEI) and the Network of Indicators for Science and Technology (RICYT). The survey was conducted in autumn/winter 2007 in seven major cities in Ibero-America: Bogota, Buenos Aires, Caracas, Madrid, Panama City, Santiago, and Sao Paulo. Here the traditional question regarding the balance between benefits and risks was split into two individual questions addressing the individual issues of benefits and risks. The salient fact was that, in all cases, the corresponding results comprised percentage sums above 100% in the perception of very many plus many risks *and* very many plus many benefits.

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whether or not to buy genetically modified corn, submit to a medical technique, or consume an artificial sweetener.

However, society is not merely a recipient of the risks and benefits of S&T. Its role is not limited to making one decision or another in contexts of risk. Current threats are no longer conceptualized as hazards, i.e., as unavoidable harm. Virtually all the evils that threaten us today are understood as risks, i.e., as harm resulting from the action or omission to act of any human being. In the past, and possibly still in some cultures strongly anchored in tradition or in remote corners of the globe, evils were attributed to fate, nature, or some supernatural will. Today, they are a common cause of attribution of responsibility to some social agent. Consequently, risk assessment and risk management have become high-visibility issues in the political arena, in response to this 'politicization' of threats conveyed by the notion of risk and an increase in social awareness of the impacts and potential risks of S&T change. Accompanying this phenomenon and fueled by the growing political leadership of a great diversity of social movements, society nowadays demands a more active role in decision-making processes whenever risks and benefits are at stake. How to build a scenario that enables social engagement in S&T is currently one of the challenges of contemporary S&T policies.

2. The challenge of engagement

'Engagement' refers to an aspiration, to a concrete way of understanding how the relationship between science and society should be modulated, and to the strategies developed to foster this relationship. It is, in a way, a talisman term, as is 'innovation', whose inclusion in certain documents often responds to the need to attract funding. To engage society more broadly in research and innovation activities is one of the goals of the strategy on Responsible Research Innovation (RRI) promoted by the European Union through the Horizon 2020 program. From a linguistic perspective, 'engage' has a French origin and meant 'to pawn or pledge something'. It entered English in the 15th century via French influence, adding the suffix '-ment' in the 17th century and meaning, in the general sense, 'a legal or moral obligation'. It is currently commonly used in English and means to be involved, interested, or engaged, in the sense of acquiring a formal agreement, e.g., to get married. It is a term frequently used in the field of labor relations and organizational culture, but has been gaining ground in the fields of STS and PUS. From a PUS perspective, the lineage of engagement could be said to be rooted in the enlightened aspiration of a literate society. When exploring its genealogy, we find names like John Dewey, Ronald Davis, Benjamin Shen, Jon Miller, and Walter Bodmer; institutions such as the National Science Foundation, the Royal Society, the House of Lords, and the European Commission; and documents such as *The Public Impact of Science in the Mass Media* (Davis 1958), *Public Understanding of Science* (Royal Society 1985), *Science and Society* (House of Lords, 2000), and *Public Engagement in Science* (European Commission 2008).

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The biography of engagement has been addressed by many authors. One of the most influential versions is that of Martin Bauer, Nick Allum and Steve Miller (2007). In this paper, the authors describe three paradigms in PUS that divide the evolution of the field into three main periods: scientific literacy (1960s-1980s), public understanding (1985-1990), and science-in-society (1990s-Present). Each of the paradigms includes a particular conception of the relationship between science and society. The paradigms point out the limitations that hinder the mutual approach between science and society, and the strategies to overcome these constraints. In short, the first paradigm emphasizes the low level of scientific knowledge on the part of society (cognitive deficit); the second stresses the lack of social interest in S&T issues (attitudinal deficit); while the third highlights the mistrust between political leaders, the scientific community, and society (trust deficit). The respective strategies to address each deficit are the promotion of scientific literacy, the reinforcement of science communication mechanisms, and the promotion of public participation.

The social engagement paradigm can thus be understood as an evolution of the third paradigm, or even as a fourth paradigm in the PUS field. In general terms, engagement entails the need for a new social agreement for science.

Some steps have already been taken in this direction. For instance, the *Public Engagement in Science* report (EC 2008) seems to constitute a step forward. This document acknowledges the shift from Public Understanding of Science (PUS) to Public Engagement with Science (PES) and the need to renew the social contract for science. Echoing earlier milestones –such as the Budapest World Congress for Science 1999, promoted by UNESCO and ICSU–, the report states, "There is an increasing body of evidence showing that interactions between science, civil society and the wider public can generate new forms of social intelligence and create mutual benefits by stimulating new directions for innovation" (EC 2008, p. 10). It also warns about the need for a more sophisticated view of the relationship between governance, ethics, and competitiveness in global innovation networks. Innovation and science cannot be considered a quantitative issue, as a simple race between competitors. The most important question is not 'how much?' or 'how fast?', which seems to prevail in political discourse, but 'where?', contemplating this process via a variety of possible directions that should be the subject of debate by civil society (EC 2008: 11).

There seems to be a common feeling supporting the demand that science and society tighten their ties for the benefit of both, and yet, despite the efforts, on looking back a question arises: Are we moving forwards or in circles? This is the question posed by Alan Irwin (2008, 2014), who, via his query, channels the distress of other authors such as Sheila Jasanoff (2014), Brian Wynne (2014), and Jack Stilgoe, Simon J. Lock and James Wilsdon (2014) concerning what appears to be yet another unsuccessful attempt to bridge the gap between society and science. Criticisms of the linear model of communication, the sacralization of expert knowledge, or the view of the public as a homogeneous natural kind are still in force today, more than thirty years after their formulation, as well as the constant claims on the value of non-expert knowledge, the overcoming of the dichotomy between experts and laymen, the promotion of dialogue,

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and so on. As Irwin puts it, “I can on a good day claim partial progress” (Irwin 2014, p. 73).

Why does engagement seem to be having such limited success? From our point of view, the key problem resides in how ‘the public’ is represented. There is a certain misunderstanding of the public by the scientific community and political managers that has made the goal of engagement only a partial success. We shall defend a more complex view of the relationship between science and society that is based on dialogue, but on a dialogue that includes many voices. Science does not speak with a single voice, nor does the public, and dissent, criticism, plurality of voices, and divergence of opinion are precisely the main indicators reflecting engagement as well as the main vectors promoting it among citizens.

A germane document to understand the fundamental issues of this debate is provided by an influential booklet entitled *The Public Value of Science*, authored by Wilsdon, Wynne and Stilgoe and published by the British think-tank Demos in 2005. These authors ask about the contribution of S&T to more general social ends and point out that this debate always runs the risk of ending up in one of two dead ends: determinism or reductionism. The former refers to the error of thinking that what is politically correct is to always define oneself as being pro-science and pro-innovation, without asking what science or what innovation, thus favoring by inaction the fostering of certain technological trajectories as if they were inevitable, and feeding a polarized pro-innovation versus anti-science discourse. The latter constitutes the error of believing that the purposes and orientation of science and innovation must be set by experts through tools such as the economic calculation or technical calculation of risks, thus excluding social debate about the ultimate purposes of S&T change.

The concept of ‘public value’, expressed through public preferences and materialized through the services implemented by public policies, defines a space for participatory deliberation which, according to these authors, helps to avoid the risks of determinism and reductionism. This concept also stresses the importance of promoting a model of participation in which this is not seen as a brake on progress, but as a way of maintaining and reinforcing the social contract that supports science, with the possibility to modify techno-scientific trajectories under the light of the discussion on public values that should guide S&T change (Wilsdon et al. 2005). For these authors, “disagreement and protest, as well as participation, are signs of a healthy democracy” (Wilsdon et al. 2005, p. 29).

In a chapter of the aforementioned report, *Public Engagement in Science*, James Wilsdon (2008) argues that 15 years of social debates about mad cows, transgenic foods, or nuclear waste do not seem to have been of much use in dealing with current nanotechnologies, fission nuclear energy, neuroscience, or synthetic biology. More that understanding or dialogue, what we really need, Wilsdon argues, is ‘upstream engagement’, with new forms of accountability and public involvement bringing to the forefront values, purposes, and underlying interests, and taking place in the initial stages of the research-development-exploitation cycle. The author thus aligns with the stated objectives of the Horizon 2020 program, in which the RRI strategy is understood as “an

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inclusive approach to research and innovation, to ensure that societal actors work together during the whole research and innovation process. It aims to better align both the process and outcomes of research and innovation, with the values, needs and expectations of European society" (EC, Online). According to Wilsdon and Willis (2004), we need to go beyond the risks versus benefits debate, beyond the question of whether a technology is safe or not, towards issues such as: What we want, what alternatives there are, what interests the technology promotes, and what long-term consequences it may have for my family and society.

Early involvement renders it possible to make these basic issues visible and to reveal the values and visions that guide science to public scrutiny, creating a valuable opportunity for the orientation of S&T change in line with social sensitivities and concerns. Nonetheless, it is important not to lose sight of the ultimate goal of engagement, namely to avoid the dead ends of determinism and reductionism in the negotiation of a new social contract for science. Emerging concepts such as RRI can lead to new forms of the deficit model, silencing social voices and closing the dialogue through a supposed business or scientist's assimilation of (their own representation of) public values. Similarly, it is important not to lose sight of the public of engagement, recognizing its diversity and heterogeneity: the public is not a homogenous, pre-existing entity. Gluten allergic individuals or astronomy lovers are not fixed natural kinds, but spaces in constant transformation, publics that are condensed around themes and technoscientific objects that arouse interest or concern, selectively intensifying the consumption of scientific information, and who demand opportunities in the political arena to participate in the construction of techno-scientific scenarios of the future (Jasanoff 2014).

3. The role of critique

As basic ground for the construction of engagement, the dialogue format entails the assumption of responsibilities on the part of both parties. The fact that dialogue stresses the need for greater sensitivity on the part of the scientific community towards social concerns and demands does not eclipse the part concerning society. Although greater social involvement in decision-making are targets of the political agenda, scientific literacy and public understanding in S&T continue to be agenda items. While the achievement of these objectives depends to a large extent on the political fabric making them possible, society must also have an interest in achieving them. Enabling mechanisms for people to participate in decision-making is of little use if the individuals involved are not sufficiently concerned parties. The challenge of dialogue between science and society thus seems to have a number of checkpoints. On the one hand, the promotion of scientists who are more sensitive to social demands and more committed to the dissemination of their research, i.e., the promotion of civic scientists (Lane 1997). On the other, the promotion of citizens who are in the best conditions to participate in decision-making processes, i.e., citizens with a critical and informed view of S&T,

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ready to contribute to the creation of technological scenarios of future by means of their oriented support of the S&T system.

The evolution of the PUS field makes it possible to detect a trend highlighting the value of criticism, scrutiny, and social implication in relation to the general objective of promoting the rapprochement between science and society. The vindication of disagreement, social protest, and informed criticism as signs of a healthy democracy is present in recent contributions such as those of Wilsdon, Jasanoff and Wynne, and is useful in dealing with powerful, ingrained preconceptions such as the dangers of determinism and reductionism mentioned above. However, long-standing inertias are difficult to overcome. In fact, the evolution of science policies since the 1960s has followed the patterns of social exclusion and rejection of external criticism that tended to adopt general technocratic policies, thus protecting themselves from social protest movements that demanded openness and accountability. This is a situation that has produced dysfunctional effects such as the so-called 'science wars' and fueled the post-positivistic contempt between the natural sciences and the social sciences (Snow's famous two cultures), in addition to stimulating a reductionist and inadequate view within the technical study of transdisciplinary problems such as those related to risk (e.g., Althaus 2005; Greenberg & Lowrie 2013). This situation also negatively affects the relationship between science and society, fueling a denatured image in the media both of science (mythical science) and of society itself (according to the deficit model): you are either pro-science or you are an ignorant devotee of anti-science. The results that have been feeding on public opinion is not surprising, namely alienation and distrust.

Although still partially veiled, especially from the public opinion studies on the public perception of science, society shows a type of critical awareness concerning science, of risk culture arising from familiarity and interest in science. It is the skepticism of the well-informed citizen that leads him or her to be aware of uncertainty, to compare and contrast sources, to seek a second medical opinion, etc. It is the kind of criticism expressed from the point of view of public opinion studies by the loyal skeptics of Martin Bauer et al. (2012) or the distrustful engagers of the 2014 PAS survey in the UK. For example, in the aforementioned survey, the profile of "distrustful engagers" (17% of the total population) corresponds to citizens who are very interested in science and who feel informed about it; think that science is beneficial to society, although they are cautious about scientists and regulation; consider that the public should play a role in decisions on science-related issues; and have a high educational level and generally a good social position. They are the citizens that we have called the 'many-many population' because they are distinguished in surveys (which are able to detect them)[40] as people who appreciate many benefits in S&T but also many risks

[40] See the aforecited 2007 FECYT-OEI-RICYT Ibero-American Survey (FECYT-OEI-RICYT 2009).

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(López Cerezo & Cámara Hurtado 2014)[41]. It is a population with an appreciable level of schooling, which keeps itself informed and has qualified and differentiated opinions regarding different areas and applications of S&T. These are also citizens usually inclined to give their opinion on controversial social issues related to the application of science or technological development. It is the population located to the far right of Bauer's so-called inverted U, in the association between attitude and knowledge characteristic of post-industrial societies[42].

4. The challenge of fostering STS Citizens

As we pointed out at the beginning of the chapter, the culture of risk focuses specifically on the perception and acceptability of risks, based on beliefs, valuations, and decisions/actions. A clear manifestation of the presence of a culture of risk is the trend towards high discrimination in the assessment of benefits and risks in diverse fields of S&T, i.e., in a disaggregated assessment by specific areas of application. It is thus a population that does not manifest itself uniformly or as many-benefits/few-risks (enthusiastic pro-science), nor as few-benefits/many-risks (pessimistic anti-science). These individuals believe in science, but not in the myths of science; they do not place religious faith in science, as in the unconditional support of enthusiastic pro-scientists (Evans 2014). For example, according to data from the International Social Survey Program (ISSP) and the US General Survey (GSS) between 1993 and 2010 for 12 Western countries (including Spain, the UK, and the USA), although there is a positive significant association between educational level and general confidence in science (in the sense that it provides values and goals and can solve human problems in general), this association is still significant but reverses its sign concerning the relationship between educational level and faith in the ability of science to solve particular problems related to technological applications in the physical world (e.g., those related to health or the environment). If it were not somewhat irreverent, one would be tempted to call them 'STS citizens'.

We use the adjectival term STS to refer to individuals, materials, events, contents, etc. that fulfil certain features very familiar for the STS readership (Spiegel-Rösing & Solla Price 1977; Jasanoff et al. 1995; Mitcham 2005; Felt et al. 2017): they acknowledge the deep-rooted interdependence between the S&T system and the social

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[41] With a clear-cut trend of a parallel percentage increase with increasing schooling level, this population segment comprises 50% of the population with university level of schooling in the aforementioned survey.

[42] A typical public opinion survey result is the significant positive association between the level of scientific knowledge and a favorable attitude towards science. In the more industrialized countries, however, this association usually reverses its sign from a certain level of knowledge onward, revealing the existence of a cultured, but cautious population, aware of the great potential of S&T, familiar with both, but also aware of the risks and negative effects of technology-based industrial development, as well as skeptical of the mythical images of science (see, e.g., Bauer et al. 2012).

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context in which it is framed, an interdependence that means that the former cannot be understood outside the latter and affects the understanding of both.; they break with the expert/lay dichotomy, moving away from a scientistic view and the risk of reductionism (Wynne 1992); they acknowledge that S&T development is not determined by some kind of inner logic, but rather is open to a diversity of influences, including those arising from non-expert knowledge, and, accordingly, they are in favor of the incorporation of the public in all stages of the R&D process; finally, they are aware that S&T development has a strong impact on society, an impact that implies both benefits and harms (Functowicz & Ravetz 1993).

In post-industrial democratic societies, the quality of society's voice and the mechanisms available to include this voice in decision-making processes are indicators of the health of the democratic system. In this respect, dissent and freedom of opinion, accompanied by upstream participation, are basic elements for the proper functioning of a democratic society. A society with an excessively positive attitude towards science will show an uncritical attitude towards it. Better information and a less acritical image of science are conditions for greater personal leadership and greater social participation. The challenge is to stimulate personal empowerment built on a critical and informed attitude, in line with the ethics of non-power espoused by Jacques Ellul (1954), the rebellion against the tyranny of things in Herbert Marcuse (1964), the active implication in the S&T process described by Callon and Rabeharisoa (2008), and the like.

Nonetheless, a number of difficulties should be pointed out. Incorporating society's voice in decision-making may trigger answers which run countercurrent to what would be considered a pro-science attitude. Attitudes of distrust and suspicion may respond to ignorance, but they may also be the product of the acquisition of scientific information and be present in informed individuals who hold critical attitudes. A potential secondary effect of fostering a critical attitude can sometimes be the generation of truly unscientific behavior. This point deserves some consideration.

The anti-vaccines movement is a good example in this regard. This movement is made up of generally well-informed people who, on the basis of the available information and their own judgment, freely decide not to vaccinate their children. The presumed origin of the anti-vaccination movement can be found in an article published by Andrew Wakerfield in the medical journal *The Lancet* in 1998, where it is argued that the famous triple-virus (measles-rubella-mumps) causes autism in children. Faced with the avalanche of criticism of negligence and concealment of data that he received from the scientific community, the author retracted and the magazine eventually removed the article. However, the fuse of distrust and suspicion of institutional messages on vaccines was lit in the population. Side effects, pharmaceutical interests, and disagreements between pediatric associations, the World Health Organization, drug agencies and political leaders contributed to fueling skepticism. A key element in this process, in our view, was the use of the traditional diffusionist conception of public communication of science (Bucchi 2008). The anti-vaccination movement is nothing more than the fruit of the tree that has nurtured institutions over recent decades via the diffusion of a distorted image of science and the assumption of a poor image of the

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public: the tree of suspicion and distrust. However, these same suspicions of institutions are what have made nuclear power plants safer, that succeeded in suppressing DDT, that made genetic engineering a safe working field, and which are behind the many agencies and instruments which contribute to making today's technological products and installations much safer.

As Ragnar Löfstedt (2009) points out, the lack of trust in society is not necessarily bad. Between visceral rejection and emotional acceptance lies a wide-ranging and fertile territory of what we may call "critical trust". Trust really does not disappear; it is only qualified through criticism of traditional actors (government, industry) and redirected as an asset to new actors (NGOs, universities, judiciary). It is a redirecting in which, moreover, trust often changes its nature: from an understanding of trust as technical competence, it becomes understood as independence or integrity (if not as empathy), or vice versa.[43] No longer trusting the government due to its opaque and controversial management of an environmental threat echoed in the media may lead us to start trusting ecological groups regarding the matter in hand because we consider the latter to be more independent of industry and therefore more credible (trust transference: same type of trust, different target group). Or no longer trusting physicians because of the bad news on one's terminal illness and their lack of sensibility to their patients may redirect a new type of trust towards doubtful healers in order to be able to preserve some hope (trust transformation: different type of trust, different target group).

5. Final remarks

From an etymological point of view and in line with Aristotle, the human being is a political animal, as it only develops its capacities in association with other human beings, in the community of the *polis*. The contemporary city, that of modern societies in industrialized countries, defines an environment of potentialities and threats that requires scientific culture and a culture of risk, as well as the political coordination of individuals for the full exercise of citizenship. However, the new social realities defined by a vertiginous technological transformation of our living conditions, in addition to the obsession for security and aversion to risk generated by the evolution of the recent global geopolitical board, have created new challenges that must be faced by our post-industrial society.

The *Science and Society* report opened with the following diagnosis:

> Society's relationship with science is in a critical phase. […] On the one hand, there has never been a time when the issues involving science were more exciting, the public more interested, or the opportunities more apparent. On the other hand, public confidence in

[43] Something similar happens with risk: it is not destroyed; it is only transformed. When we try to minimize it, we often only manage to redistribute it, transforming the original risk into a new risk that may affect the original population or a new population (Graham & Wiener 1995).

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> scientific advice to Government has been rocked by a series of events […]; and many people are deeply uneasy about the huge opportunities presented by areas of science including biotechnology and information technology, which seem to be advancing far ahead of their awareness and assent. In turn, public unease, mistrust and occasional outright hostility are breeding a climate of deep anxiety among scientists themselves. (House of Lords 2000, art. 1.1)

Social mistrust has usually been understood as problematic and undesirable. In the literature of political theory and risk management (e.g., Slovic 2000), we often find the idea that trust is a capital asset for the proper functioning of a society. Trust is certainly a key element of social capital in contemporary society. However, besides being misunderstood, it is possibly overestimated to the detriment of public scrutiny and accountability. Trust is not an on/off attribute: it may have different modalities and easily migrates from one actor to another. Mad cows, dioxins in food, and other recent crises that have particularly affected European countries, coupled with the intensification of citizen activism that demands participation, have created a new scenario in which it no longer seems possible to maintain a traditional view of institutional trust as the main support for efficient social functioning.

Thus, in a world in continuous and accelerated transformation due to S&T change, with a diversity of actors struggling for limited resources in the public arena, a certain amount of skepticism and caution is fundamental today to generate transparency, accountability, and spaces for citizen participation. It also seems to be a good indicator of a mature attitude that contributes to democratic governance (Poortinga & Pidgeon 2003). The new trends in the evolution of the PUS field, in particular the research on the culture of risk, allow us to espouse the value of social criticism for the advancement and good health of science itself. Just as literary or cinematographic criticism lend a good service to the novel or the cinema, critical and well-informed attitudes towards science (in the sense of critical awareness, not anti-scientific rejection) contribute to rapprochement between science and society, to the good health of public policies in the matter, and to strengthening science in the service of society.

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