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Book Reviews

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The Paradoxes of Risk

'In reality, our world has become one big laboratory,' writes Jakob Arnoldi in the conclusion of his book entitled *Risk. An Introduction*, thus summarising the nature and role of risk in the modern world. While this is not a new claim (cf. Krohn, Weyer 1989, Beck 1988), it draws attention to the importance of potential threats associated with developments in science and technology (S&T) for the functioning of modern societies. Arnoldi then elaborates on that point (p. 181) by saying: 'The real tests are carried out not in the laboratories but in the ecosystem, and no one can know the outcomes because new technologies are introduced faster than possible effects of the old can be scientifically established.'

Throughout a large part of the book, Arnoldi provides justification of that statement. While his work is avowedly a concise introduction into sociological thinking on risk, it does not shun claims or analysis of problematic issues. The author has managed to reconcile contradictions in at least a few respects. Despite its modest size, the book is by no means cursory. While the author attempts to give justice to a large array of concepts, stances and theories on risk, he offers in-depth discussion which is carefully thought-out, without unnecessary verbosity. And, finally, despite its course-book style, Arnoldi's work does not only summarise various theories and concepts but also attempts to evaluate them and engage into constructive discussion.

Technology-Related Risk and Social Risk

Let us briefly reconstruct the picture of the field, i.e. Arnoldi's depiction of reflection on risk. At the outset, he makes an important distinction between technology-related risk and social risk. The former occurs when we deal with consequences of certain technologies or of S&T progress at large (those are the so-called 'side effects', such as ozone depletion caused by the use of freon, global warming resulting from high carbon emissions or diseases caused by smoking). The recent disaster in the Gulf of

Mexico which resulted in a giant oil spill into the ocean can serve as an admonitory example of this kind of risk.

'Social risk' is a more metaphoric notion, referring to lifestyles in the developing modern society, and associated with the processes of individualisation. This approach to risk draws attention to the fact that individual lives are saturated with high-risk decisions, entailing individual responsibility in the case of failure. In neo-liberal systems, the prevalent attitude based on maxims such as 'everyone is the maker of their own fortune' or 'you needs to take your life in your own hands' burdens individuals with the responsibility for success and the risk of failure. Meanwhile, risk-taking becomes an element of a social attitude which is being promoted. Social risk is noticeable in spheres such as career, education, family, social insurance or throughout the course of an individual's life.

In his work, Arnoldi takes account of both those understandings of risk, technology-based and social, yet it gives more attention to the former, which seems in line with the proportions of available research on risk. As he points out at the outset, the separation of technology-based risk from social risk does not mean that the former is purely physical. On the contrary, both types of risk are social in their nature, as risk often represents a social and political problem (for instance, global warming or smog in cities), thus being addressed by specific social institutions such as, e.g., insurance companies or regulators. Risk, however, is social also in the epistemological and ontological dimension: the cognitive frames in the community determine whether and how risk occurs and becomes targeted by specific social actions. We fear certain types of risk more than others, willing to accept some but not other types. We consider some risks to be irremovable but try to eliminate others. We are afraid of plane crashes and terrorist attacks yet we fearlessly get behind the wheel of our cars, one of the most lethal weapon out there. We believe that air pollution is the price to pay for the growth of the automotive industry but reject traditional electric bulbs in fear of global warming and climate change. We fight obesity and excess weight, without worrying much about artificial additives in our foods.

Transformations of Risk in the Modern Era

Arnoldi examines institutional practices addressing risk as well as socio-cultural filters in the perception of risk. He is interested in risk as a phenomenon, or an aspect of S&T developments, but also as a notion used by social systems in their practices. Going back to David Hume's ideas, Arnoldi shows how the notion of risk spread within the modern culture. A turning point occurred when risk was turned into an object of scientific investigation, and harnessed by probability calculus: from that moment, symbolic for the early days of modernity, risk ceased to be a stroke of fortune or of supernatural powers, an unexpected misfortune or divine retribution but, instead, became a calculable, predictable, preventable and controlled phenomenon. The idea of risk as the likelihood of certain losses opened the way to risk calculation and incorporation of risk in planned actions.

Drawing mostly on Ulrich Beck's concept of 'risk society' Arnoldi focuses on the turn which took place in the second half of the 20th century in the sphere of risk and its perception in Western societies. Following Beck, Arnoldi assumes the risk which accompanied existing technologies as an unwelcome yet marginal side effect, began to expand in recent decades, becoming a dominant factor in S&T. Risk became a mighty force which can no longer be neglected as an inevitable 'cost of progress'. This new nature of risk is rooted in a number of factors:

— An increasing scale of potential threats caused by the development of new technologies. In fact, it was not just the nuclear bomb that was a turning point but also the discovery, in late 1960s, of the delayed effects of nuclear explosions in Hiroshima and Nagasaki (cf. Scheer 1987). Developments in nuclear power in 1960s and 1970s, the Three Mile Island accident in 1979, and the Chernobyl disaster are the milestones marking the increasing role of risk in societies. At the same time, they clearly demonstrate the role of the social frames of risk perception in this process (the environmental movements and the Cold War played a considerable role here).
— An increasing scope of non-technological consequences of risk. The undesirable effects increasingly penetrate various fields of social life, entangling political, cultural, ethical and economic phenomena into Latour's hybrid actor-network, where the social can no longer be distinguished from the natural. The risk associated with the use of biotechnology in food production, medicine and industry is not just the problem of potential harms to consumer health or to the ecosystem, but also the problem of consequences for food production chains, the global balance of power between the North and the South, the prevailing notions of human life and body, ethics and religious ideas.
— Unpredictability of potential effects of technological developments which render the classic probability calculus useless. If we are unable to determine long-term effects of biotechnology in agriculture, there is no way to predict the likelihood of their occurrence and calculate the risk. Meanwhile, regarding the two points above, many technologies may have undesirable consequences we are unable to predict. For instance, for many decades people did not know how the use of freon as a cooling gas might be related to ozone depletion or how asbestos may be linked to lung cancer. Likewise, we do not know today whether and what kinds of consequences may ensue as a result of electromagnetic radiation in mobile telephones. The relationship between carbon emissions and global warming remains controversial whereas the effects of nanotechnology in medicine belong to the sphere of utter speculation. Closer to home, it is enough to invoke the common examples of side effects caused by drugs with a marketing authorisation, revealed only after some time, leading to drug recalls.

Sociologists Speak of Rrisk

Considering those transformations within the characteristics of risk, Beck speaks of the advent of a new type of risk, which he juxtaposes with risks typically found

in the industrial era. The main characteristics include the fact that such risk has no external origin (as was the case with natural disasters) but is a product of the modern system based on rapid S&T progress. With that new type of risk a new social order emerges, based on distribution risk rather than the distribution of goods. Meanwhile, we see new types of socio-political conflicts, focused on the distribution of risks.

Apart from Beck's ideas, Arnoldi also discusses the cultural theory of risk developed by Mary Douglas and Aaron Wildawsky and Foucault's *governmentality* perspective. Unlike the German sociologist, those authors are less interested in the phenomenon of risk and its transformation, paying more attention to the notion of risk and its functions in institutional practice. In their analyses, Douglas and Wildawsky focus on how the perceptions of risk by social groups depend on the prevailing classification systems and normative systems which, in turn, they saw as embedded in organisational structures of groups. The best-known element of their theory is the *grid-group analysis*, which refers to two variables: degree of autonomy and degree of incorporation. In order to illustrate the differences in risk perception dependent on those variables, they proposed four ideal types of structures: bureaucratic, individualistic, sectarian organisations and the excluded. While the theory developed by Douglas and Wildawsky is highly relativist, its authors making no attempts to hide their reluctance towards environmental movements, which they accuse of spreading panic and putting exaggerated emphasis on risk (apparently resulting from the structure of those movements), their theory does not challenge the existence or the importance of risk as an objective phenomenon. Constructivism invoked by those authors only plays an epistemological role, without touching the ontological level.

The notion of *governmentality* is used in the context of risk by Francois Ewald, Nikolas Rose or Ian Hacking. Those scholars are interested in risk as a kind of 'independent variable': they do not deal with risk itself and matters such as, e.g., current environmental problems but, instead, they look at how risk is used in governance of social groups. Those authors identify the existence of new regimes (governance systems) based on dispersed power, embedded mostly in scientific practices. Examples include vital statistics and statistics referring to income, housing conditions and family relations, health and hygiene, providing grounds for governing the society. Knowledge about risk plays a key role here, allowing decision makers to plan policies for the community concerned.

Further on, Arnoldi briefly presents other contemporary theories of risk by Niklas Luhmann, Anthony Giddens and those developed within the Actor-Network Theory (ANT) and Social Amplification of Risk Framework (SARF). The second part of the book brings an overview of specific issues within the field of social studies on risk, such as environmental problems, risk assessment, the role of scientific research, cultural frameworks of risk, risk and the media, individual risk-taking in the consumer industry or risk as an element of politics and power. It is important to note that subsequent chapters are visibly interconnected: the theoretical notions presented in the first part are employed later on, empirical issues are elucidated from various perspectives, and various problems are shown as intertwined.

Three Paradoxes of Risk

A reader of Arnoldi's book is left with the impression that risks in the modern world are paradoxical in nature. Before attempting to indicate various aspects of this paradoxical nature, let us look at the diagnosis which the author formulates towards the end of the chapter on the history of risk. He points out that we are dealing with the crisis of the idea of risk, whereby potential threats 'are calculable and manageable and that such calculation and management are beneficial' (p. 36). Arnoldi invokes Frank Knight's analytical distinction into uncertainty and risk: the former is incalculable and impenetrable whereas the latter is calculable and cognizable. Based on this distinction, Arnoldi argues that 'there is now more uncertainty and less risk' (p. 36).

Taking this diagnosis as a point of departure, we can formulate at least three paradoxes of risk which can be found (sometimes, alas, only implicitly) in Arnoldi's book. The first paradox refers to the origins of risk typically found in the modern era. The notion of risk originates from attempts to harness and control uncertainty related to threats faced by societies and individuals. Following F. Ewald, Arnoldi shows that risk is no longer perceived as external ('natural') and unpredictable in the modern era but becomes calculable and predictable thanks to developments in mathematics and science, probability calculus and statistical tools. In a sense, risk can be 'tamed'. This internalisation of potential threats by social systems means that risk ceases to be a natural phenomenon and becomes a social problem to be managed. In this way, risk becomes separate from uncertainty (following the aforementioned distinction introduced by Knight).

Based on the modernist ideal whereby humans could find emancipation from the power of blind natural forces, attempts to control threats were expected to free humans from uncertainty and fate and, as a result, to ensure universal safety in modern societies. Paradoxically, as pointed out by Beck, that internalisation of risk, intended to control it, did not improve global safety but achieved quite the opposite: escalation of risk. Although we live longer, healthier and more pleasant lives, the number of potential threats around us has not shrunk. It is just their nature that has changed. As implementation of safety-boosting strategies progressed (e.g. people ventured to control potentially threatening spheres of nature, by regulating rivers or forecasting weather, to improve social security through social insurance, to rationalise new spheres of social life in order to predict their dynamics and directions of development) the scale and nature of side effects grew. At some point they stopped to play a marginal role and led to the emergence of a 'risk society'.

The second paradox is, in a sense, a follow-up of the former and involves a kind of regression of risk which, again began to emerge as an uncertainty typical of the preindustrial era. On the one hand, as mentioned earlier, risk begins to escape the classic probability calculus, which means that people lose hope for being able to control risks. Science, which was expected to free mankind from uncertainty and unpredictable natural threats, turned out to generate new risks without being able to handle them. The role of science in itself is paradoxical, in three senses. Arnoldi writes (pp. 86–87):

First, without science no one would have any knowledge of a broad range of risks and the technologies causing risks would not have come into existence. Second, public concerns about risks are often accompanied by distrust of scientific assurance that the technologies are safe, and yet public concerns are in many cases based on scientific findings. Third, science seems to produce as much uncertainty as certainty.

On the other hand, the effects of nature on the lives of societies have not been entirely harnessed. As illustrated by the most recent case of paralysed air traffic in Europe due to an entirely 'normal' volcano eruption in Iceland, we are still far from liberating ourselves from natural disasters. Considering those two aspects, we might say that the modernist risk management project has failed: not all uncertainties have been transformed into calculable risks and, moreover, new types of 'manufactured uncertainties' (to use Giddens' words) have emerged, escaping scientific assessment. This diagnosis seems to confirm the message expressed by Bruno Latour in the title of his acclaimed work: *We Have Never Been Modern* (Latour 1993).

The third paradox results, in a sense, from the previous two: despite the failure of the modernist project based on risk assessment and management, Western societies continue to rely on risk assessment devices based on the classic understanding of risk. The *risk assessment* and *technology assessment*[1] institutions, emerging since 1970s, play an advisory role to political authorities and use the classic idea of risk in their assessment of new technologies, trying to determine the likelihood of certain losses. This paradox is pointed out by Arnoldi, who writes:

[A]ll sorts of risk expertise are applied in all sectors of society at the same time that such practices and forms of knowledge are being questioned. (…). In other words, when faced with new uncertainties, most Western countries have responded with more risk assessment. Risk thus becomes an even more important concept when uncertainty emerges as a concern.

This process seems to be rooted in a more fundamental paradox related to the situation of science as such, as it plays a key role in the contemporary risk management. As Beck observes, we are dealing again with an entire series of paradoxes (p. 88): science today is a source of and a solution to risk-related problems; it is constantly confronted with its own products, forcing science to produce a specific type of reflexivity.[2] At the same time, science remains the only tool at the disposal of modern societies in order to both diagnose and prevent risks. However, as risks are evolving back into uncertainties, science is an increasingly unreliable tool. As Beck argues (pp. 89–90), risk assessment procedures turn out to be inadequate at present time for the following and other reasons:

— short-term lab tests are unable to reflect the complexity of the environment and all the potential interactions that the new technologies may enter into (as an example, we can think of genetically modified plants and animals introduced to ecosystems);

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[1] As examples, we can mention the Office of Technology Assessment established in 1972 at the U.S. Congress, the Büro für Technikfolgenabschätzung at Germany's Bundestag, the Danish Board of Technology or the European Parliamentary Technology Assessment network.

[2] Beck, who developed the idea of 'reflexive modernisation' with Anthony Giddens and Scott Lash (Beck, Giddens, Lash 1994), speaks about reflexivity in the sense of going back in order to describe a situation where modern societies have to go back to their own products to prevent crisis.

— extrapolation of previous findings onto future behaviours of the system becomes increasingly flawed with uncertainty as systems are highly dynamic;
— statistical analysis of risks associated with the exposure of human bodies to harmful substances is much above the levels of acceptable risks and unable to spot risk before it crosses a threshold value;
— there is a visible contradiction between expert opinions delivered by scientists and, as a result consensus is harder to reach;
— prevalence of the so-called zero-risk hypothesis which assumes non-existence of risk (e.g. the relationship between electromagnetic radiation from mobile telephones and brain tumours) and may be abandoned only when a high likelihood of risk has been established.

An outcome of these paradoxes is that our societies become increasingly like a 'society as a laboratory' rather than a 'risk society'. This notion, alternative versus that of Beck's, was put forward in 1980s by German sociologists Wolfgang Krohn and Johannes Weyer (Krohn, Weyer 1989). By looking at some of the above-mentioned risk assessment characteristics, they observe that many contemporary technologies have a singular characteristic: people are unable to predict their outcomes before implementation. In those authors' opinion, this is not a technical error caused by mismanaged lab tests, and avoidable at a greater effort, but an inherent characteristic of complex technology systems which, in view of their nature, cannot be sufficiently tested under laboratory conditions. In that situation, the only way to test new technological solutions which address risk is to launch them and watch them work. One example comes from military technology which is hardly testable on a training ground. This is why it has been admitted that the decision to initiate some military conflicts was largely driven by the desire to test new types of weapons.

While this might sound like conspiracy theory, Krohn and Weyer argue that the notion of society as a laboratory is not only a metaphor; introduction of technological innovations does have attributes of experimental production of new knowledge. Technological innovations are 'real-life experiments'[3] where the function of potential falsifiers is played by… accidents. Therefore, risk in that case is not just produced and purposefully assumed but it is equivalent to the laboratory-like trial and error methodology.

What's Next for Risk?

The paradoxes and problems associated with the transformation of the nature of threats in contemporary societies provoke a number of questions, both analytical and practical. In the analytical dimension, one might wonder about the sense of further use of the notion of risk. Even if we only consider the words quoted above, we are not dealing with risk today in the same sense as it was understood throughout history. When we are unable to determine the likelihood or the nature of potential damage, how can we continue to talk about risk?

[3] For 'real-life experiments', please refer to Krohn et. al. 2005.

In this conceptual muddle, a considerable proportion of blame goes to Beck, who introduced the notion of risk into the public debate, turning it into a cornerstone of its 'risk society' theory. At the same time, his theory can be seen as fierce criticism of that notion, focused on demonstrating that we are dealing with something different in quality, i.e. with completely new types of threats. Arnoldi himself observes that 'Beck is in fact writing more about uncertainty than about risk or dangers' (p. 52). Undoubtedly, some other notions would be more adequate than 'risk' in describing potential dangers in today's world. Some authors have already suggested talking about various degrees of ignorance, not just uncertainties (cf. Wehling 1996, Stocking, Holstein 1993, Proctor, Schiebinger 2008, Stankiewicz 2008). In this context, Brian Wynne distinguishes between risk, uncertainty, ignorance and indeterminacy (Wynne 1992: 114):

—risk: occurs when the probability is known;
—uncertainty: the probability is unknown but key parameters may be known;
—ignorance: we do not know what we do not know;
—indeterminacy: open nature of cause-effect chains and networks.

Taking note of the 'unknown unknowns'[4] will allow us to spot the problematic nature of the notion of risk based on probability and engineering-driven predictability. Regretfully, Arnoldi does not seem to appreciate it, nor does he problematise the issue of further use of the long-established notion of risk.

Analytical precision is not the only concern. Arguments in favour of abandoning discussions on risk also have a practical dimension. The first argument might refer to the third paradox: despite the inadequacy of the notion of risk, its persistent use conserves the equally inadequate risk assessment system which still underlies the control and assessment of new technologies. In other words, the use of the notion of risk supports the illusion that threats are controllable and predictable, and legitimises the operation of an ineffective risk assessment system. When judging acceptability of new technologies in the light of their 'side effects', the decisive vote still belongs to experts in advisory bodies, expert committees and scientific boards. This, necessarily, makes it more difficult for societies to face new threats generated by the modern civilisation which are increasingly unrelated to risk, moving towards uncertainty, ignorance or indeterminacy.

Another practical problem is that social controversies focused around new technologies are framed as 'risk disputes'. Unacceptability of technological innovations (or some of their aspects) apparently lies in lay risk assessment, which is different from expert assessment, the former being erroneous and exaggerated. In the report entitled *Science and Governance. Taking European Knowledge Society Seriously* (2007) Ulrike Felt and Brian Wynne argue that this assumption obscures the normative nature of risk and is based on an artificial separation of facts from

[4] At this point it is worthwhile recalling words uttered by Donald Rumsfeld, U.S. Secretary of Defense: 'There are known knowns. These are things we know that we know. We also know there are known unknowns. That is to say, there are things that we do not know. But there are also unknown unknowns—the ones we don't know we don't know' (quoted after Proctor 2008: 29).

values. What worries people about new technologies is not just their potential harmfulness but also the consequences for social life, neglected or unknown, and the ability of social institutions to address them. This, one might add, stems directly from the third paradox and from the dominance of expert-based risk assessment systems that leave little room for analysis of non-technological aspects of risk.

Experimenting with Risk?

Another practical consequence of the perception of new technologies and their outcomes as risks is that opportunities which, in fact, represent the reverse side of risk, tend to be ignored. A focus on risks means that people mostly notice the undesirable consequences of certain technologies whereas, as indicated by the 'side effects' perspective, risk is a price paid for opportunities and hopes opened up by new technologies. If we talk about 'risk society', we might ignore this positive dimension of technological developments. Many authors point out that contemporary Western societies are pervaded by risk aversion: we are no longer dealing only with a modernist attempt at controlling risk (which assumes some degree of acceptance) but attempt to uproot any uncertainty and threats from social life:

> Fear of technological risks has been present in the Western world since the industrial revolution in the 19th century, and from this time onwards responses to technology seem to oscillate along the spectrum of prohibition, prevention, precaution, foresight and blind euphoria. Following the triumphant belief in scientific and technological progress of the 1950s and the related zenith in risk acceptance, the tide changed in the late 1960s and reached its nadir in 1986 with the Chernobyl, River Rhine and Challenger disasters. Public reluctance to accept certain key technologies maximized or even shifted towards outright 'per se opposition'. Today's richest, long-lived, best-protected, most resourceful civilization is on its way to becoming the most frightened and cultivates the vision of a zero-risk society. (Kirchsteiger 2005)

Attempts to build a 'zero-risk society' may be interpreted as linked to the first paradox described above and seen as a result following from the collapse of the modernist idea of risk assessment: if we are unable to control the side effects of technological progress, or even to predict them, we attempt to eliminate those risks from social life altogether. The problem of acceptability of risk, put forward in 1969 by Chauncey Starr in his *Science* article with a meaningful title 'How safe is safe enough?' (Starr 1969), seemed to remain unsolvable for a long time. Today, the answer seems straightforward: only 100 per cent safety is enough. This approach, however, means that any innovative technologies may be rejected on those grounds and, when taken to the extreme, the S&T progress may be paralysed.

Criticism of this trend in Western societies provides a point of departure for fairly radical propositions formulated by authors such as Aaron Wildawsky (1988) or Wolfgang van den Daele (1993). They suggest a pro-active risk policy, focusing not on risk avoidance but on embracing it as an opportunity. In his 1988 book *Searching for Safety*, Wildawsky directly calls for increasing the amount of risk in the social system in order to maximise flexibility. This approach would be based on an assumption, taken by Wildawsky from laboratory research, that more learning comes from errors than from successful experiments. Likewise, societies could learn more from the

implementation of various scenarios, however undesirable, than from elimination of risks. Wildawsky's suggestion evoked diverse criticism, focusing mostly on the ethical dimension. Wildawsky himself does not neglect the problem and talks about the need to introduce the 'rule of sacrifice' i.e. sacrificing part of the system in order to improve the whole. Thus, if people decide to risk another Chernobyl, the disaster will not be wasted experience and will contribute to improvements in nuclear technology. What Wildawsky suggests, then, is nothing else but the very same real-life experiments mentioned earlier. Regretfully, his arguments provoke concerns about the society being treated as a laboratory in the face of new technologies. In short, the consequences of errors may be much more grave than is the case with laboratory errors, and may not be limited only to parts of the whole system. For instance, the consequences of introducing biotechnology or nanotechnology on a mass scale may significantly step outside the border of an experiment and, as such, become irreversible.

In his theory, Wolfgang van den Daele draws on the ideas drawn from the concept of 'finalisation in science' developed jointly with Wolfgang Krohn and Gernot Böhme, which assumes indeterminacy of directions in science & technology developments (cf. Schäfer, Böhme 1983). This point of departure allows him to notice alternative paths for S&T development. Instead of a linear vision of progress, based, to some extent, on technological determinism, we would be dealing with a ramified network of roads, not necessarily leading to the same final destination. As far as risk is concerned, this approach would allow us to choose the more favourable option and rush forward. Wolfgang van den Daele argues that instead of rejecting risks and, consequently, rejecting new technologies and maintaining the old, often more harmful ones, one should seek less risky yet 'progressive' avenues. Therefore, instead of blocking S&T developments by rejecting progress in biotechnology and continuously wrestling with unsolved problems in areas such as health care or food production, one should, through purposeful experiments, seek a 'third road' that would be free from the risks of biotechnology while retaining its advantages. This kind of approach, however, calls for a remodelled public policy in the sphere of science and technology. In the present situation, dominated by the logic of free market, governments have a very limited power over deciding how new technologies will be used and developed. Only some technologies are regulated by governments (energy, telecommunications, road systems) whereas the majority are ruled by supply and demand and must only meet safety requirements. Also when it comes to setting the directions for new technologies, governments have little influence in view of the privatisation of science which has led to a situation where most pivotal technologies today are owned by private multinational corporations of global reach.

While Arnoldi's book does not directly invoke the aforementioned problems resulting from the application of risk as a notion in scientific and non-scientific practice, it nevertheless encourages reflection on those problems, offering ample material for such pursuits. It is a pity, though, that the author has published another book with the word 'risk' in the title, inadvertently reinforcing the trend of thinking about science and technology in terms of this paradoxical and controversial category.

References

Beck, Ulrich, Giddens, Anthony and Lash, Scott. 1994. *Reflexive Modernization: Politics, Tradition and Aesthetics in the Modern Social Order*. Stanford: Stanford University Press.

Beck, Ulrich. 1988. *Gegengifte. Die organisierte Unverantwortlichkeit*. Frankfurt am Main: Suhrkamp.

Felt, Ulrich and Wynne, Brian. 2007. *Science and Governance. Taking European Knowledge Society Seriously*. Expert Group on Science and Governance, Brussels, European Commission D-G Research, Science Economy and Society Directorate, EUR 22700.

Kirchsteiger, Christian. 2005. "Review of industrial safety management by international agreements and institutions." *Journal of Risk Research*, 8(1): 31–51.

Krohn, Wolfgang and Weyer, Johannes. 1989. "Gesellschaft als Labor. Die Erzeugung sozialer Risiken durch experimentelle Forschung." *Soziale Welt*, 3: 349–373.

Krohn, Wolfgang, Hoffmann-Riem, Holger and Gross, Matthias. 2005. *Realexperimente. Ökologische Gestaltungsprozesse in der Wissensgesellschaft*. Transcript Verlag.

Latour, Bruno. 1993. *We Have Never Been Modern*. Cambridge MA: Harvard University Press.

Proctor, Robert N. and Schiebinger, Londa. 2008. *Agnotology: The Making and Unmaking of Ignorance*. Stanford: Stanford University Press.

Proctor, Robert N. 2008. "Agnotology: A Missing Term to Describe the Cultural Production of Ignorance (and Its Study)," in: Robert Proctor and Londa Schiebinger, *Agnotology: The Making and Unmaking of Ignorance*. Stanford, Calif.: Stanford University Press.

Schäfer, Wolf and Böhme, Gernot (eds). 1983. *Finalization in Science: The Social Orientation of Scientific Progress*. Springer.

Scheer, Jens. 1987. "Grenzen der Wissenschaftlichkeit bei der Grenzwertfestlegung. Kritik der Low-Dose-Forschung," in: Berkhart Lutz (ed.), *Technik und Sozialer Wandel*. Frankfurt/Main: Campus: 447–454.

Stankiewicz, Piotr. 2008. "Invisible Risk. The Social Construction of Security." *Polish Sociological Review*, 1(161): 55–72.

Starr, Chauncey. 1969. "Social Benefits versus Technological Risk. What is our society willing to pay for safety?" *Science*, Vol. 165, July/September: 1232–1238.

Stocking, Holly S., and Holstein, W. Lisa. 1993. "Constructing and Reconstructing Scientific Ignorance: Ignorance Claims in Science and Journalism." *Science Communication*, 15(2): 186–210.

van Den Daele, Wolfgang. 1993. "Restriktive oder konstruktive Technikpolitik?", in: Wolfgang Krohn and Krücken Georg, *Riskante Technologien: Reflexion und Regulation. Einführung in die sozialwissenschaftliche Risikoforschung*. Frankfurt am Main: Suhrkamp, 284–304.

Wehling, Peter. 2006. *Im Schatten des Wissens?: Perspektiven der Soziologie des Nichtwissens*. Konstanz: Uvk.

Wildawsky, Aaron B. 1988. *Searching for Safety*. New Brunswick: Transaction Publishers.

Wynne, Brian. 1992. "Uncertainty and environmental learning," *Global Environmental Change*, June: 111–117.

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