The Politics of Knowledge

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32 Statement by Professor Sir Richard Southwood for presentation to the European Parliament, Investigative Committee on BSE, Strasbourg, December 9, 1996 (personal communication to the author).
33 On this theme, see Alan Irwin and Brian Wynne, eds., *Misunderstanding Science? The Public Reconstruction of Science and Technology* (Cambridge: Cambridge University Press, 1996).
34 Jasanoff, "Restoring Reason."
35 National Science Foundation, *Science and Engineering Indicators 2006*, ch. 7, "Science and Technology: Public Attitudes and Understanding."
36 The science journalist Daniel Greenberg has written scathingly of US scientists' persistent blaming of a scientifically illiterate public for their imagined woes. Greenberg finds no association between PUS and science funding. See Greenberg, *Science, Money, and Politics: Political Triumph and Ethical Erosion* (Chicago, IL: University of Chicago Press, 2001), pp. 205–233.
37 See in particular Brian Wynne, "Public Understanding of Science," in Sheila Jasanoff, Gerald Markle, James C. Petersen, and Trevor Pinch, eds., *Handbook of Science and Technology Studies* (Thousand Oaks, CA: Sage, 1995), pp. 380–392.

2 The politics of non-knowing

An emerging area of social and political conflict in reflexive modernity

Ulrich Beck and Peter Wehling

1 Introduction: the emerging politics of non-knowing

Before the financial crisis, the political and economic experts pretended to know everything; in the financial crisis, they suddenly know nothing any more (without really admitting this to themselves and to the public). The crisis of the globalised financial markets has again brought home in a dramatic way to a both amazed and deeply distraught public that, especially in the self-proclaimed knowledge societies, phenomena and dynamics of non-knowing are acquiring an importance that is difficult to overestimate as the scale of the threat emanating from civilisation increases. Who – apart from a handful of Cassandras who were mostly dismissed as mavericks and 'prophets of doom' – foresaw, or even had an inkling, that within a short space of time the financial sector would experience dramatic collapses across the globe (Beck 2009), that major banks could be prevented from going under only through state aid on a gigantic scale and that even whole states could be rescued from bankruptcy only with difficulty? In retrospect it turned out that the actors who made such a show of their knowledge in the financial markets did not know what they had got themselves into with the so-called innovative financial products. At any rate, they were incapable of assessing the associated risks. The financial crisis is not the only example which illustrates the explosive power of what is not known in contemporary societies. The threatening, man-made climate change, too, and the potential, but unknown consequences of the release of genetically modified organisms (GMOs), of the spread of 'swine flu' viruses and of the diffusion of environmental chemicals throughout the world emphatically underline that, notwithstanding all assertions to the contrary, numerous spheres of action and politics in contemporary societies are conditioned by non-knowing rather than by knowledge.[1] Especially in a world of delimited threats – world risk society – we are compelled to act under conditions of more or less non-knowing: that is the message which has the significance of a ticking political time bomb.

It is not simply a factual, 'objectively' given lack of relevant knowledge that is secretly propelling the dynamics of ostensible knowledge societies,

however, but above all emerging social debates and conflicts concerning the recognition, definition, evaluation and communication of what is, or is supposed to be, not known. Are the limits of knowledge routinely and tacitly neglected or even consciously denied – or are they openly admitted and taken into account? How is ignorance or non-knowledge to be understood and communicated: as a merely temporary information deficit or as a persistent and even irreducible inability to know? Are we faced with known unknowns or with completely unknown and unforeseeable unknowns? And on which of these contrasting framings could and should we rely when we are dealing with the unknown in politics, economy and science?

Such questions are driving a *politicisation of non-knowing* in reflexive modernity whose primary manifestation is the clash between divergent interpretations of what is not known in public conflicts (Beck 1994, 1998; Wehling 2007). Whereas the one side is willing to concede at most manageable knowledge deficits, the other fears that previously unknown and unpredictable environmental and public health harms will occur; for example, through the release of GMOs. While the one side points to apparently clearly known causal connections between the use of fossil fuels and global warming, between smoking and the spread of lung cancer, and calls for appropriate countermeasures, the other side emphasises the enduring uncertainties and gaps in knowledge in order to prevent political interventions and regulation.[2] Clearly non-knowing or 'ignorance claims' (Stocking and Holstein 1993) can be employed deliberately and strategically to achieve specific goals and to promote interests. In other contexts, non-knowing is even being increasingly appealed to as a positive value, above all in the 'right not to know' in predictive genetic testing. This right is supposed to prevent people from being hampered by knowledge concerning future health risks without having access to reliable options for prevention and therapy. Among the questions which arise in this context are: How much do individuals want and need to know about themselves and how much may (or must) interested third parties (employers, insurance companies, state institutions) know about these people and their dispositions to, and risks of, illness? Of course, such debates and controversies do not take place in a power vacuum. On the contrary, it is extremely important who acquires the public power of definition over what is not known, its scope, its relevance and its possible consequences. This holds both in the domestic and international spheres and can refer to political and to sub-political actors. One must distinguish in this context between strategies for *governing non-knowing* and strategies for those who seek to *govern through non-knowing*, like Foucauldian power strategies, for instance, on global financial markets or in the realm of climate politics. Yet, as far as non-knowing speaks to our inability to anticipate what the future holds, there are *limits to governance*. These limits undermine and disrupt the efforts of governing (through) non-knowing in diverse and interesting ways.

The emerging politics of non-knowledge is, of course, intimately bound up with the politics of knowledge, though it cannot be reduced to the latter. The politicisation of non-knowledge differs from the politics of knowledge primarily in the elusiveness and 'absence' of its object. Non-knowing, by contrast with knowledge, is not a 'tangible' good which can be patented and traded, and over whose possession and use conflicts can arise. It is in the first place 'merely' a definitional construct, a social self-attribution or attribution by others, which asserts the inadequacy and incompleteness of what is known concerning external phenomena and reality. However, because conflicts concerning the nature and scope of non-knowledge refer to the real or presumptive *lack* of knowledge, they cannot be conducted, much less ended, by appealing to available empirically established facts. Thus they quickly veer into the domains of the hypothetical, the seemingly speculative and the paradoxical, and just this is a crucial feature of their political dynamics. By definition, the question of whether thus far unknown and undiscovered negative effects of GMOs 'exist' cannot be answered on the basis of available empirical data, nor can it be decided conclusively by scientific authority. For even if new causal connections were to be discovered, the basic question would remain open whether *yet further* phenomena exist about which we know nothing, and hence which we cannot investigate systematically because we are unaware about where, when and how they will manifest themselves.[3] Such problems are characteristic of the domain of the politics of non-knowing, and it is not surprising that this calls for the creation of new political arenas, new forms of public debate and new decision rules which as yet exist only in rudimentary forms.

In what follows, we would like first to trace the historical process by which a certain interpretation of non-knowing became established in modernity and, against this background, to depict the forms and consequences of the contemporary politicisation of what is not known. In this connection, we will introduce some differentiations of non-knowing which facilitate the analysis of how the perceptions of non-knowing are currently pluralised. Following on this, we would like to illustrate specific forms of the politics of non-knowing and their respective dynamics, using the four examples of global financial crisis, climate change, genetically modified organisms (GMOs) and predictive genetic testing. In a concluding review, we will make a twofold plea for a politics of recognition of non-knowing: on the one hand, non-knowing must be explicitly recognised as an enduring and central condition of action under conditions of reflexive modernity; on the other hand, the variety and plurality of interpretations of what is not known must also be regarded as legitimate and used as a resource of action. In other words, there is not just one 'correct', scientifically certified way of dealing with non-knowing. One consequence which should be drawn from this is the creation of social fora and political arenas which would enhance the democratic accountability of the politics of non-knowing in world risk society.

2 The politicisation of non-knowing – backgrounds, forms and consequences

From the seventeenth century onward, with the emergence of modern science, a new kind of cultural interpretation of non-knowing has become established which has been of major legitimatory and motivational importance for the dynamics of knowledge in modern societies. This new interpretation involves two interconnected aspects. Zygmunt Bauman has characterised the first in very forceful terms as the *temporalisation* of non-knowing (or ignorance):

> Instead of paralysing action, ignorance prompts more effort and boosts the zeal and determination of actors. Ignorance is a not-yet conquered territory; its very presence is a challenge, and the clinching argument of any pep talk summoning support for the next attack in the indeterminable, yet always confident of the ultimate victory, offensive of reason.
>
> (Bauman 1991: 242)

Thus what is not known is always regarded merely as that which is *not yet* known; nothing in the world is held to be unknowable and hence the triumph of knowledge is only a matter of time. In this way ignorance or non-knowing are defined in advance 'as another feather in science's cap. Its resistance is significant solely for the fact that it is about to be broken' (ibid.). This temporalisation of non-knowing can be traced historically to Francis Bacon's grounding of modern science at the beginning of the seventeenth century. An examination of Bacon reveals that this interpretation was not simply a consequence of the liberation of a 'natural' human curiosity from the shackles of religious authority. Rather it was itself shaped by religion – both by the goal of human domination over nature through the accumulation of knowledge as 'a precondition of the recovery of paradise' (Blumenberg 1983: 232) and by the assurance that God concealed the secrets of nature only in order that they could be discovered by human beings.

The second element of the classical modern interpretation of non-knowing consists in its *moral devaluation*. If there is nothing in the world that cannot be known in principle, then non-knowing must be attributed to the inadequacy of the efforts of human beings, whether they attempt to explore nature with questionable methods or they remain mired in settled and comfortable habits of thought. This forms the starting point in Bacon's *Novum Organum* of 1620 for the famous doctrine of the 'idols'; that is, of socially conditioned prejudices and habits of thought which hold the human mind captive and prevent it from gaining access to truth (Bacon 1990: 101ff.). Because and insofar as non-knowing is a result of submission to the idols, it is seen as self-inflicted and a negative moral valuation is attached to it. Not only can it be overcome in principle but it *must* be overcome so that science can contribute to the domination of human beings over nature. The astronomer Johannes Kepler formulated this imperative to overcome non-knowing in particularly drastic terms: 'So long as the mother, Ignorance, lives, it is not safe for Science, the offspring, to divulge the hidden cause of things' (quoted from Proctor 2008: 30).

The twofold interpretation of non-knowing, as temporalised not-yet-knowing and as self-induced ignorance, achieves a dominant position in modern societies, though this has not prevented repeated attempts to question it from religious, philosophical and even scientific points of view. Only over approximately the past three decades, however, has there been at least a partial change. This has been brought about by the new kinds of risk conflicts and ecological debates on the one hand, and by new perspectives in philosophy, sociology and history of science on the other. This change is reflected in an increasing pluralisation and politicisation of social perceptions and interpretations of what is not known. While it remains dominant, the classical modern interpretation of non-knowing is no longer the only possible and only conceivable one. Thus in certain contexts it is being contested that non-knowing must always be evaluated in negative terms and that it is only a question of time before it is superseded by reliable and complete knowledge. In addition, it is being questioned whether non-knowing is always merely a 'native or originary state' (Proctor 2008: 4) prior to science. For more recent developments in philosophy and sociology of science have shown that non-knowing can also be a *consequence* of scientific knowledge and its technological application. We speak in this sense of *manufactured non-knowing* (Beck 1999, 2009).[4] For science is by no means always capable of anticipating or observing the effects of its interventions in the world. Moreover, since the acquisition of scientific knowledge rests necessarily on selective observations of limited scope, non-knowing is in the process always co-produced along with knowledge (on this see already Fleck 1935), even if this fact usually remains latent and undetected. Thus non-knowing is not merely a result of mental lethargy and bias, of a *lack* of scientific thinking but is simultaneously a product of science itself. Moreover, it is not merely that, with every piece of knowledge acquired, new, as yet unanswered questions also arise, as Karl Popper, for example, repeatedly emphasised. Rather, science, as the example of the 'ozone hole' demonstrates, often does not even know what it does not know and where it should direct its attention and research. Its non-knowing remains latent, implicit and unrecognised – it does not open up any new horizons of enquiry, but often becomes apparent and 'visible' due only to completely unexpected events with potentially grave consequences.

The pluralisation and politicisation of non-knowing represents an extremely complex social and cultural phenomenon. It can be captured

more systematically if central importance is accorded to the *relations of definition* of (non-)knowledge as *relations of power* (Beck 2009). 'What the "relation of production" in capitalist society represented for Karl Marx, "relations of definition" represent for risk society.... They form the legal epistemological and cultural power matrix in which risk politics is organized' (Beck 2009: 31–32). This means that the question of which definitions of the unknown are socially accepted and become dominant largely depends on different actors' command of powerful resources such as scientific or political credibility, access to mass media, scientific journals and regulatory institutions, or the ability to do research and produce scientific results. Given this background, we distinguish three dimensions along which social actors contrastingly define and appraise what is not known: the epistemic dimension of the *awareness* (or unawareness) of non-knowing (section 2.1), the social dimension of the *intentionality* of non-knowing (2.2) and the temporal dimension of the *persistence or reducibility* of non-knowing (2.3) (for a more detailed account see Wehling 2006: 116ff.). Occurrences of non-knowing are conceived, defined and interpreted in different ways in each of these dimensions and are thus rendered open to political negotiations, scientific controversies and social struggles.

2.1 *The (un-)awareness of non-knowing*

Often we have a pretty clear understanding of what we do not know, whereas in other situations we have 'no idea' of what is unknown to us. Hence non-knowing can be differentiated according to the extent to which social actors are aware or unaware of it. Expressed in ideal typical terms, in this epistemic dimension of non-knowing explicitly known, exactly specifiable gaps in knowledge[5] contrast with complete unawareness of what one does not know. Whereas in the former case one can enquire or conduct research in a more or less systematic manner, in the latter it even remains unknown *that* one does not know something and *what* one does not know. In this case all further enquiry is bound to come to nothing as long as one does not have at least a rough idea of what one is looking for. Under such conditions the modernist confidence, which claimed that our ignorance is only temporal and that the unforeseen effects of technical innovations would become known 'in good time' enabling us to intervene and correct them, simply evaporates. Cases such as the 'ozone hole' have made it clear that even the retroactive knowledge and/or causal attribution of damage which has already occurred depends on extremely demanding presuppositions and is often successful only thanks to favourable circumstances.

Against this background, controversies over possibly unknown non-knowing, or *unknown unknowns* (see Kerwin 1993; Beck 1999, 2009; Grove-White 2001; Wynne 2001, 2002; Wehling 2006; Böschen *et al.* 2010)

acquire particular explosive power in the social conflicts concerning technological or systemic risks. For in situations of 'negative evidence' (Walton 1996), where knowledge can be acquired only from the *lack* of empirical data, it is ultimately impossible to distinguish positive knowledge from unknown unknowns: Do we know that a new technology (for instance, the genetic modification of organisms) will have no harmful effects if we have (as yet) no empirical evidence of this? Or does this merely mean that we 'have no idea' of where, within what time frames and in what form negative effects could transpire – assuming that they have not already occurred but have not yet been detected?

> The more thorough the search has been, the more we can say that the outcome is no longer just ignorance, but positive knowledge that the thing does not exist. But in many cases, in the middle regions, it could be hard to say whether what we have is ignorance or (positive) knowledge.
>
> (Walton 1996: 140)

It is first and foremost in such 'middle regions' that the monopoly that science has enjoyed until now over interpretation of what is not known is being contested and is beginning to totter. Science can never provide sufficient guarantees to show that the search for unknown effects is complete or that the spatial and temporal horizons of observation chosen in the process are appropriate (see section 3). And if we do not know what we are supposed to be looking for, and even *whether* something unknown exists which calls for and justifies further systematic enquiry, the certainty that our ignorance is always merely temporary and provisional dissolves. At the same time, the notion of a clear and sharply drawn 'boundary' between knowing and non-knowing becomes blurred; it ultimately becomes a *political* question whether we interpret a given situation (the release of GMOs or nano-particles into the environment) as one of knowledge or of non-knowing – and act accordingly.

2.2 *Intentionality of non-knowing*

In the dimension of intentionality, non-knowing is differentiated according to the degree to which it seems to be attributable to the actions or omissions of individuals, social groups or organisations. To put it in ideal typical terms, here the explicit, conscious rejection of certain information ('unwillingness to know') by social actors stands in contrast to completely unintended, and hence apparently 'unavoidable' non-knowing. Intentional non-knowing can be further differentiated into cases in which the ignorance is *one's own* (a result, for instance, of lack of interest or of self-imposed taboos) and those which involve efforts to keep *others* ignorant, for example, through passing on information selectively, through

deception techniques, censorship, secrecy, etc. The 'agnotological' questions of the 'diverse causes and conformations' of non-knowing are situated primarily in this sphere of intended non-knowing (Proctor 1995, 2008; see also Stankiewicz 2008).[6] However, it must be kept in mind that, although non-knowing, as 'an actively engineered part of a deliberate plan' of certain actors (Proctor 2008: 9), presumably occurs more often than one would conjecture in modern, 'open' societies, it nevertheless represents just one aspect of the phenomenon. In addition, forms of unseen ignorance play an important role which result from a lack of attention or interest but are not consciously wanted or deliberately produced. Thus the notion of intentional non-knowing is not confined to the *explicit* intention of certain actors to refrain from knowing something, but includes as well those cases in which non-knowing, though not deliberately manufactured, may be causally attributed to the actions and omissions of persons or groups. Yet, it is obviously always contestable whether actors could in fact have known more in certain situations if they had only been more interested in acquiring knowledge.

In this dimension of non-knowing, pluralisation and politicisation comprise two seemingly opposed aspects. On the one hand, different interpretations arise concerning what actors in a given situation could or should have known. Was the 'thalidomide scandal' of the mid-twentieth century 'unavoidable' or could the manufacturer of the sleeping pill have discovered on the basis of comprehensive tests that the supposedly harmless active ingredient causes serious deformities in human foetuses (see Kirk 1999)? On the other hand, it is becoming a matter of controversy, at least in some spheres of social action, how much one should know and what one should better not know. The result is a partial positive revaluation and reappraisal of intentional non-knowing (see Townley 2006) which is diametrically opposed to the modern will to knowledge. The most conspicuous expression of this reappraisal is the by now widely recognised 'right not to know' in predictive genetic testing (see Section 3.4). However, trends towards a revaluation of deliberate non-knowing may be observed even in knowledge management within organisations, one of the core domains of a supposedly knowledge-based economy. Given a scarcely governable abundance of information, conscious ignorance seems to some observers to represent a way of remaining in a position to act and make decisions, with non-knowing even becoming a 'success factor' (Schneider 2006).

2.3 Temporality or persistence of non-knowing

The temporality of non-knowing speaks to the possibility (or impossibility) of transforming non-knowing into knowledge over the course of time. In this dimension, the ideal types of a fundamentally insurmountable 'inability-to-know' or 'inability-ever-to-know' stand over against an always

only provisional 'not-yet-known'. As already indicated, the latter represents the dominant perception of what is not known in modern societies and modern science, whereas ideas concerning a non-knowing which is irreducible *in principle* are generally regarded as metaphysical or religious residua. In fact, the modern temporalisation of non-knowing continues to enjoy a high level of persuasiveness in contemporary societies. Nevertheless, a pluralisation and politicisation of interpretations is also discernible with regard to the temporality of non-knowing. It is objected, for example, that the behaviour of ecological and technological systems or of globalised financial systems cannot be predicted or steered in principle on account of their dynamics and complexity (see on this also Rescher 2009: 100ff.). And even where unknowability is not assumed *in principle*, the question becomes important of whether knowledge of unforeseen effects of technological innovations can be acquired 'in good time', i.e. *before* the occurrence of serious, and potentially no longer rectifiable damage (on this see already Collingridge 1980). Beyond the quasi-metaphysical assurance that non-knowing is always only provisional, science cannot provide any convincing guarantee of this in advance for the simple reason that it often does not even know what effects it should be looking for and when these become apparent and detectable. Thus in political debates and social conflicts (over nuclear energy, agri-biotechnology, nanotechnology, etc.), it becomes controversial which interpretation should provide orientation. Whereas critics point to unknown unknowns and to the enduring 'unknowability' of complex causal interconnections, the supporters of technologies assume that the relevant gaps in knowledge are specifiable and can be overcome within manageable time-scales.

In all three dimensions, it has been evident for a number of years that 'classical' modern, hitherto firmly established patterns of interpretation are being challenged by new evaluations of what is not known. In the areas of nuclear power, genetic engineering, nanotechnology, climate change or the globalised neoliberal market economy, society itself has become the site of large-scale experiments which appear to generate results that were in excess of reason's capacity to comprehend or manage. Controversial here are the scope, the significance, the causes and the possible consequences of non-knowing. Different 'ignorance claims' (Stocking and Holstein 1993) are in this way becoming both the object of, as well as instruments and resources in, political disputes. From a sociological perspective, the issue is not so much which of these claims concerning non-knowing is the 'correct' one. The decisive issue for the dynamics of the politics of non-knowing is rather that the hitherto dominant, seemingly self-evident interpretations of non-knowing as merely not-yet-known and as morally dubious ignorance are losing their unconditional validity and opening up a space for pluralisation and politicisation. Closely bound up with this is the fact that science can no longer maintain unchallenged its

prerogative on interpretation concerning what is not known. Although the established sciences generally still command significant material, cognitive and symbolic resources for formulating influential definitions of what is not known, its relevance and possible consequences, nevertheless their interpretation is ultimately just one among many. In the following section we would like to explore in greater detail the politicisation of non-knowledge and the attendant social conflicts, using the four examples of global financial crisis, climate change, genetically modified organisms and predictive genetic testing.

3 Politics of non-knowing and their dynamics: four cases

How is non-knowing becoming a topic of political controversies and a political resource, and what different dynamics of a politics of non-knowing may be observed? In an attempt to provide a differentiated answer to these questions we have chosen the four examples mentioned – global financial crisis, climate change, genetically modified organisms and predictive genetic testing – because they enable us to illustrate different facets of the politics and politicisation of non-knowing in each case.[7] In the first two examples, the politics of non-knowing still operates largely, though in very different ways, within a 'modernist' horizon in which the importance of non-knowing is played down. The example of the global financial crisis involves *ignored non-knowing*. Although uncertainty and non-knowing where fully recognised and theorised in parts of economic theory, they were more or less consciously ignored by the economic and political players in order to lend their actions the appearance of rationality and to realise their interests.

In the case of climate change, by contrast, non-knowing is not simply ignored but is transformed into a new kind of 'manufactured certainty' (one which does *not* rest exclusively on scientific knowledge), in order to persuade politics and the public and to prompt them to rapid action. We speak of *manufactured* certainty because here we are no longer dealing with an original self-assurance of scientific knowledge convinced of its truth, but with an actively constructed certainty which is the result of the containment of numerous uncertainties.

By contrast, the examples of genetically modified organisms and of predictive genetic testing exhibit a more far-reaching recognition of both non-knowing and the plurality of perceptions of non-knowing. In conflicts over GMOs, especially the form of *unknown unknowns* plays a central role as a political resource for critics of this technology, whereas in the debates over the opportunities and social risks of predictive genetic testing, a remarkable normative revaluation in the shape of the *'right not to know'* may be observed: deliberate ignorance of one's individual genetic constitution is understood as an interest which merits legal protection and calls for political guarantees.

3.1 Global financial crisis: ignoring the vast realm of non-knowing

It might be surprising that, as early as the 1920s and 1930s, non-knowing was discovered by a scholarly discipline which today no longer wants to have anything to do with it, namely economics. It was Knight (1921) and Keynes who insisted at an early date on a distinction between predictable and non-predictable, or calculable and non-calculable, forms of uncertainty. In a famous article in *The Quarterly Journal of Economics* (February 1937) Keynes (1937: 213–214) writes:

> By 'uncertain knowledge', let me explain, I do not mean merely to distinguish what is known from what is merely probable. The sense in which I am using the term is that in which the price of copper and the rate of interest twenty years hence, or the obsolescence of a new invention are uncertain. About these matters there is no scientific basis on which to form any calculable probability whatever. We simply do not know.

However, Keynes' admonition to open up the field of economic decision-making to the unknown unknowns of future systemic catastrophes hidden in normalised practices of risk-taking was completely neglected in the subsequent development of mainstream economics (including mainstream Keynesian economics). Subsequently, uncertainty was mostly understood as a form of knowledge in which the occurrence of future events can be estimated at least in a subjective way, whereas risk has been as objectively predictable and controllable on the basis of probability calculations. Only since the 1980s has what Keynes termed 'uncertain knowledge' been taken up again in decision theory and at the margins of economic theory under the heading of 'ignorance' (Collingridge 1980; Tietzel 1985; Faber and Proops 1993). Ignorance was then understood as a situation *beyond* both risk and uncertainty in which we are completely unaware of *which* events could even occur and *which* consequences of a decision we have to reckon with (Faber and Proops 1993: 113–114). Thus here the issue is not merely, as in Keynes, that we cannot predict the future development of certain variables (the price of copper, the rate of interest and so on), but in addition that potentially entirely new, unexpected factors will come into play.

In mainstream neoliberal economics, which emerged around the same time, however, these considerations have been largely ignored. Since the 1990s, actors on the global financial markets, relying on the irrelevance of non-knowing, began to introduce a variety of 'innovative' financial products (which are now commonly referred to as 'toxic papers') and in part to outsource them to 'shadow banks', in the mistaken belief that they could calculate and master the inherent risks on the basis of supposedly infallible mathematical models. The possibility of unexpected cumulative

effects, such as in fact occurred in the current crisis which began in 2007, was in effect excluded and denied. There are good grounds for assuming that precisely this collective ignoring of non-knowing, combined with the faith in the 'invisible hand' of a nevertheless ultimately opaque market, have profoundly influenced the scope of the crisis. Following the outbreak of the crisis a similar picture emerges: governments and economic actors are faced with the awkward problem of having to make decisions about unimaginable billions of dollars, pounds and euros, on the basis of more or less unadmitted non-knowing. How far the measures taken are successful remains, for the time being, open and difficult to foresee. At the same time, the governments find themselves compelled by the pressure of circumstances to make promises concerning control and security which they may be completely unable to keep in the future, given the incalculability of economic and political dynamics.

The purpose of these brief remarks cannot, of course, be to offer a comprehensive explanation of the global financial crisis, whose causes and scale until now even (and especially) economists do not understand. Rather we wanted to make clear that a certain politics of non-knowing – that of more or less intentionally ignoring what is not known (see Section 2.2) – represents an essential element of the global crisis dynamics. This is not a matter of a kind of 'innocent' and inevitable unawareness of non-knowing, but of an interest-driven suppression and marginalisation of knowledge or at least conjectures concerning the vast realm of non-knowing to which economic theory has in principle had access since at least Keynes. Without doubt, such a strategy of *governing by ignoring* can enjoy success for a long time; nevertheless the associated risk is clear – and is gaining momentum over time. For precisely *because* the manufactured illusion of control and accountability is making the economic and political actors progressively more risk-friendly, the scope and the 'explosive power' of ignored non-knowing are increasing. Thus the attempt to govern by non-knowing is always in danger of undermining its own foundation, as already suggested.

3.2 Climate change: the transformation of non-knowing into manufactured certainty

In 2007 the joint award of the Nobel Peace Prize to the UN Intergovernmental Panel on Climate Change (IPCC) and to Al Gore placed the ecological crisis squarely on the global political agenda. Carefully balancing knowledge claims and uncertainties, the IPCC report asserted that the evidence for man-made climate change is 'unequivocal', and thus almost certain. Apparently the climate scientists and the advocates of an effective reduction of greenhouse gas emissions have in recent years gradually acquired the power of definition over knowledge and non-knowing. Attempts to cite still-existing gaps in knowledge and uncertainties

concerning the anthropogenic causation of climate change, along with those concerning its scope and consequences, as reasons (or pretexts) for rejecting a climate protection policy have in the meantime lost their legitimacy.[8] This apparently holds even for the United States where the Bush administration, with the support of arguments from conservative think-tanks, was still pursuing such a policy of obstruction into 2008 (see Oreskes and Conway 2008). Remarkably enough, the 'miracle' (as one is almost tempted to put it) of a global consensus concerning the need to reduce greenhouse gas emissions which has been reached in the meantime (a consensus which does not exclude climate heretics and attacks on the scientific credibility of the IPCC but makes them possible) rests for its part less on the open admission of uncertainty and non-knowing than on what we would like to term 'manufactured certainty'.

How has the presumably indisputable fact of man-made climate change been 'socially constructed'? The IPCC, as a new kind of "boundary organisation" (Guston 2000) between politics and science, not only harmonises the interests and expectations of politics and science, but simultaneously systematises and unifies the state of knowledge of international climate science. It does this not least through a kind of boundary work which is intended to differentiate serious science from dubious speculations emanating from the ranks of the so-called climate sceptics. This represents an attempt to formulate clear statements concerning the future development of the global climate designed to motivate the political and economic players to take rapid and effective action.

Nevertheless, given the enormous gaps in knowledge which indisputably exist concerning the future dynamics of such a complex social-ecological system as the global climate, the result is not naive certainty and unambiguous knowledge. Existing uncertainties are instead being transformed into degrees of reliability and probability of the individual assertions and into ranges of future development, for example, of the degree of warming of the Earth's atmosphere to be expected, or of the rise of the sea level, depending on further emissions of greenhouse gases. Thus, for example, the Fourth Assessment Report of the IPCC of 2007 comes to the conclusion that it is 'very probable' that the greater part of the warming observed since the middle of the twentieth century is being caused by emissions of greenhouse gases by human beings. According to the IPCC's criteria of assessment, 'very probable' corresponds to a probability of 90 to 95 per cent.[9] For the rise in sea level, the report estimates a rise of between 18 and 59 cm until the year 2095, depending on the emissions scenario. However, the uncertainties concerning the rise to be expected exceed this margin, because of the lack of knowledge concerning, for instance, processes taking place in the continental ice sheet, as Stefan Rahmstorf, one of the leading German climate scientists, concedes (Rahmstorf 2007: 193). In fact, a rise of up to one metre or even more by the end of the twenty-first century cannot be excluded. Thus, in this kind of 'politics of

non-knowing', uncertainties, gaps in knowledge and limits of predictability are not simply denied and ignored, in the manner of neoliberal economists. Rather non-knowing is inscribed into the knowledge, as it were, resulting in the probabilistic qualification of the respective assertions. But at the same time, the doubt and uncertainties ultimately appear negligible because of the quantification in terms of probabilities, so that de facto certainty is 'produced'. Thus the result (and perhaps also the purpose) is that the findings of climate research are perceived as (virtually) uncontestable facts and as a reliable foundation for political action. In this way a factual *political authority* of science is (re-)produced which is by no means unproblematic and is radically questioned in other domains of social action and social conflicts (nuclear energy, genetic engineering, etc.).

Here it is not our intention to evaluate this strategy normatively, but to analyse it as a particular form of the politics of non-knowing. As such, in spite of its recognition in principle of the limits of knowledge, it continues to be shaped by the classical modern premises under two aspects. On the one hand, given the persisting resistance of economic and political lobby groups, many climate scientists and advocates of an effective global climate politics clearly believe that the willingness and ability to take political action can be generated only through 'manufactured certainty'. This view may be justified under the existing political conditions; nevertheless it does not take the step inherent in the so-called precautionary principle of demanding that political action should also be based on uncertainty and non-knowing. In this way it remains to a large extent captive to the paradigm of *prevention* of more or less precisely known events which is characteristic of industrial society, instead of taking *precautionary* measures against uncertain or even unknown risks (see on this Ewald 2002). On the other hand, non-knowing is transformed into an entity which is fundamentally known, in Merton's sense specifiable and, as regards its relevance, possibly even quantifiable, in the estimations and probability calculations of climate science. As a consequence, the unknown unknowns (for instance, unforeseen events or unexpected threshold effects) we mentioned in section 2.1 are more or less marginalised. Clearly this selective perception and probabilistic 'taming' of what is not known is not without risk. The supposedly exact ranges of the future development, specified to the last degree Celsius and centimetre, could prove to be overestimations (which would immediately lend ammunition to critics of effective reductions in greenhouse gas emissions), but they could also prove to be massive underestimations, as illustrated by the example of the rise in sea level. Thus the development could be far quicker and more dramatic than the scenarios of the IPCC assume. Therefore non-knowing, although seemingly absorbed and neutralised by manufactured certainty, remains an essential element of climate policy. It cannot be excluded that in future it will be thematised by social actors in the radicalised variant of unknown unknowns, as is already the case in the conflict over agrobiotechnology.

3.3 The conflict over GMOs: politicising the unknown unknowns

In hardly any other risk and technology conflict in recent times has non-knowing achieved such prominent and explicit importance as in the controversies over the growing and release of GMOs in agriculture. Moreover, apart from the debates concerning nuclear energy, if at all, hardly any other conflict has witnessed such a far-reaching shift of definitional supremacy over risks and non-knowing in favour of the critics of technology as that which may be observed since the middle of the 1990s, at least in most of the EU member states. Our thesis is that this development is closely bound up with the fact that in the controversy over GMO's there has been an unprecedented politicisation of contrasting interpretations of what is not known, above all of the inability-to-know and, even more so, of the unknown unknowns as opposed to known and specified knowledge gaps (see Grove-White 2001; Wynne 2001, 2002; Böschen *et al.* 2006, 2010). The scientists participating in the development of genetically modified plants and the associated companies (and also initially the political players) stressed over and again towards the public that cultivating these plants is absolutely risk-free and that the few outstanding gaps in knowledge could be rapidly closed through systematic research. Nevertheless (or precisely because of this), critics from among the NGOs, and in part also from science, succeeded in permanently unsettling the long-dominant interpretation of non-knowing as 'specified ignorance' and not-yet-knowns. Against the background of the BSE crisis, which came to a head in Great Britain around the same time as the conflicts over GMOs became radicalised, these players managed to cast doubt upon and discredit the official assurances of security. One of the main ways they achieved this was by introducing the unknown unknowns into the debate; that is, spheres of possible non-knowing beyond the established scientific horizons of perception (see also Magnus 2008). The critics were able to lend plausibility to this interpretation of non-knowing not only by appealing to earlier examples, such as asbestos or CFCs and the ozone hole, apart from BSE itself (see EEA 2001), but by referring to specific aspects of the release of GMOs. Once introduced into the environment, transgenic organisms can de facto no longer be withdrawn, their horizons of operation are almost unlimited in space and in time and the possible directions taken by the effects of genetic manipulations (gene transfer, effects on 'non-target organisms', etc.) are almost impossible to foresee in advance. In view of this, the conviction took root among large sectors of the European public that knowledge concerning the use of GMOs and their effects on the environment and human health is insufficient and that a vast landscape of risk-entailing unknown unknowns extends beyond the domain of what is known to be unknown. An additional factor was that, in view of the complexity and unpredictability of possible harms, the routine expectation 'that if there were harmful effects, evidence would emerge of its own accord and in good time for corrective action' (EEA-Editorial Team 2001: 172) was undermined.

In the conflict over GMOs, institutional reactions, above all in the shape of so-called post-market environmental monitoring, may be observed which, on the one hand, recognise the pluralisation of perceptions of non-knowing and, on the other, offer initial pointers for new ways of dealing with what is not known. The goal of the ten-year monitoring, obligatory in the EU, following the introduction of a transgenic plant is to establish possible threats to the environment or to public health which could *not* be detected in the preceding security and risk research, but which might become apparent only after the release into the environment. In this way the relevance of unknown unknowns for the debate over GMOs is accorded institutional recognition; that is, that the known and calculable risks, as well as the foreseeable uncertainties, possibly comprise only a small proportion of the potential effects and harms. Moreover, the legitimacy and rationality of different, divergent constructions and evaluations of what is not known in science and society is also at least implicitly recognised. However, even post-market environmental monitoring remains captive in one central point to the classical modern temporalisation of non-knowing, namely in its tacit assumption that the potential negative effects of GMOs on human health or the environment can be observed and causally ascribed, and hence also rectified, within the limited, standardised time frame of ten years. Clearly this presupposition is anything but trivial in a situation in which it is not known where, when and in what form such effects would arise in different cases.

Summarising, one can state that the politicisation of non-knowing, and especially of unknown unknowns, by critics of agrobiotechnology has proven to be a highly effective political resource in the conflict over GMOs. The strengths and weaknesses of this resource are two sides of the same coin. By definition, the appeal to possible unknown unknowns cannot be refuted by empirical facts – no more than the existence of unknown unknowns can be empirically justified. However, this should not be interpreted automatically as evidence of the irrationality of this construction of non-knowing. For both epistemological considerations and historical examples illustrate that it is by no means unjustified or irrational to reckon with unknown unknowns beyond the firmly established scientific horizons of observation and expectation. In fact, the at first sight purely speculative appeal to unknown unknowns no longer seems to meet with anything like a complete lack of comprehension and uniform rejection in reflexive modern societies. Instead, in recent years there has been at least a partial recognition of the legitimacy and relevance of different non-knowledge claims, in the EU at any rate, in the wake of risk and technology conflicts.[10] Nevertheless, references to unknown unknowns, or to an inability in principle to understand and control complex causal interconnections, are not simply replacing the hitherto dominant interpretations of non-knowing, but stand in tense and conflictive relations with the latter.

3.4 Predictive genetic testing: the positive revaluation of intentional non-knowing

As already mentioned, the politicisation of non-knowing also places in question the established normative valuations of knowledge and non-knowing. Knowledge was regarded (and of course is still regarded) in modern Western societies as desirable in itself and as having a more elevated moral status than non-knowing. Nevertheless, an astonishing reappraisal and positive revaluation of non-knowing, and in particular of intentional non-knowing, are becoming apparent at least in certain domains of action (see section 2.2). Without doubt the most incisive and interesting example of this is the so-called 'right not to know' in predictive genetic testing (Chadwick *et al.* 1997). Such a right is supposed to prevent individuals from being openly or subtly forced to acquire genetic knowledge concerning possible future diseases. Such knowledge could not only be burdensome, but, in addition, could expose those affected, as 'presymptomatically ill', to the threat of 'genetic discrimination' on the labour market or by insurance companies (see Geller 2002; Geller *et al.* 2002; Lemke 2006).

Predictive genetic testing is geared to detecting dispositions to specific illnesses through the analysis of the individual's genome. The focus here are both seldom-occurring mono-genetic illnesses, like Huntington's disease, which are apparently triggered by a single genetic deviation, and such widespread 'endemic illnesses' as cancer, Alzheimer's disease, diabetes, etc. In the latter cases, genetic factors constitute only *one* element in the complex aetiology of the disease, alongside environmental factors and lifestyle influences. In these cases, DNA tests can establish at best statistically increased risks of becoming ill; it remains unclear, however, whether the person affected will actually become ill, and even if so, when and how serious the illness will be. Moreover, for many of the afflictions mentioned there are either no effective preventive and therapeutic measures (as in the case of Alzheimer's disease) or these are themselves highly invasive, as with prophylactic breast amputation in the case of a genetically increased risk of breast cancer. But also in the case of diseases whose occurrence can be predicted with almost 100 per cent certainty, as in the case of the fatal Huntington's disease, there is often almost a complete lack of preventive or therapeutic possibilities. Thus predictive genetic testing confronts the individuals concerned with a probabilistic biomedical knowledge of future illnesses which, in the most unfavourable cases, offers them grim prognoses, yet without making available possible courses of action in the form of improved prevention or therapy. A significant number of people, especially from so-called risk families, therefore decline to have genetic tests performed. Against this background it is not surprising that, in connection with predictive genetic testing, the at first sight peculiar, if not 'anti-modernist' idea of a *right* not to know has gained increasing legal and political acceptance.

An aggravating factor is that knowledge of the genetic dispositions of persons is potentially highly interesting for certain institutional players, for example, life insurance and health insurance companies and employers. Potential customers or employees with statistically elevated risks of illness could be exposed to severe forms of discrimination, whether it be that they would have to pay higher insurance premiums or that they would find only temporally employment or none at all.[11] Thus the right not to know is not a claim restricted to the action of the individuals in question, but calls for legal and political regulations for its protection. Political decisions must be taken, for example, concerning whether and, if so, under what conditions insurance companies or employers can demand a predictive genetic test, or the disclosure of the results of an earlier test before finalising an insurance or employment contract. While this is permitted in some countries, albeit with restrictions, in others it is completely forbidden.

The case of the right not to know in the context of predictive genetic testing provides a highly illuminating example of the emerging politics of non-knowing under two aspects. On the one hand, a normative revaluation has taken place here which no longer discredits the deliberate refusal of possible knowledge ('unwillingness to know') as moral failure but, on the contrary, acknowledges that the option of not knowing, of refusing even scientific knowledge is an important individual resource and a legal interest which merits protection against those who strive to use predictive genetic knowledge in order to meet their economic ends. On the other hand, how far the protection afforded by this right should extend, and to what extent it restricts the interests of other actors, are becoming matters for direct political regulation. In this way, intentional non-knowing, its legitimacy and scope, constitute a new object of political and social conflict. It is to be assumed that the associated political controversies will continue and that their outcomes remain open. In particular, new scientific findings which, for example, would render the DNA tests more informative and reliable, would enhance preventive or therapeutic possibilities or would widen the circle of illnesses which can (in fact or supposedly) be explained by genetic deviations, may again challenge or even undermine the established legal-institutional determinations of the right not to know.

4 Conclusions: towards recognising the politicisation of non-knowing

As the four examples presented above show, one can speak in a twofold sense of a politics of non-knowing. First, non-knowing as well as ascriptions of non-knowing have become important resources in social controversies. One can appeal to absent knowledge to explain and to justify one's own way of acting, or, by contrast, one can ascribe non-knowing to other persons, groups or organisations in order to win opportunities for criticism and to strengthen

one's own position. And, of course, through secrecy and censorship one can also pursue one's own interests and goals, just as one can try, through consciously ignoring (as in the case of the right not to know), to protect oneself from burdensome knowledge or simply from "information overload". Second, the politics of non-knowing comprises definitional struggles between social actors concerning which interpretation of what is not known is appropriate in each case, struggles aimed at the acquisition of public power of definition. This definitional dimension is also at least implicitly addressed where non-knowing is employed as a resource of criticism or justification. Someone who legitimises or excuses her conduct by an appeal to non-knowing tacitly assumes that it was a case of unavoidable non-knowing – there was simply no way to know. By contrast, someone who accuses others of non-knowing generally implies that their lack of knowledge was not unavoidable, but rather intentionally generated, be it that the actors concerned more or less consciously ignored their non-knowing or, at least, neglectfully failed to acquire adequate knowledge. With a somewhat different emphasis, it is argued (for instance, by critics of agrobiotechnology or nanotechnology) that with regard to complex interconnections and long-term effects non-knowing is in any case unavoidable, so that the introduction of new technologies whose consequences we cannot anticipate would be irresponsible. In such constellations, the politics of non-knowing is generally closely bound up with the politics of knowledge. The appeal to non-knowing can serve, on the one hand, to reinforce one's own claims to knowledge or to justify corresponding research projects and, on the other, to undermine the (alleged) knowledge of others, to represent it as incomplete and to delegitimise it.

Under these conditions, the modern assumptions concerning non-knowing forfeit their apparently self-evident validity. What is not known is not perceived under all circumstances as merely *not yet* known, nor can the refusal of knowledge be conceived of straightforwardly as morally questionable and as something to be overcome. This does not mean that henceforth, new (presumptive) certainties take the place of the old ones: the modern conviction that everything in the world is knowable is not simply replaced with the equally questionable idea that the world is unknowable in principle. Instead, there is a slightly growing awareness of the fact that knowledge is a contingent and fragile achievement which itself produces non-knowing as its "shadow-side" (Stocking 1998; Wehling 2006). Moreover, non-knowing is by no means in all cases a positive resource of action that deserves protection, but can in fact have disastrous consequences. Thus how we can and should respond to what is not known and to the various constructions of non-knowing has to be negotiated ad hoc, and often under conditions of cognitive and normative disagreement. Here we can appeal to the presumptive authority of science only to a very limited degree. For many examples show that the sciences often do not even know what they do not know, or completely underestimate the relevance and explosive power of what is not known – with the result that

many individuals and groups lend scarcely any credibility to the routine safety promises. The politics of non-knowing in reflexive modernity accordingly means recognising that there are no longer any apparently guaranteed certainties which can provide a basis for decisions concerning how to deal with non-knowing – except the single certainty that there are no certainties, indeed that there is not even a clear and reliable dividing line between knowledge and non-knowing. Thus non-knowing is in fact the always accompanying, if frequently invisible and inaccessible, shadow-side of knowledge. Here, the coincidence of (more or less unacknowledged) non-knowing with global risks (such as climate change, the global financial crisis and terrorism) poses dilemmas of a new kind for state action, which is supposed to guarantee the security of citizens: "the hidden critical issue in world risk society is how to feign control over the uncontrollable in politics, law, science, technology, economy and everyday life" (Beck 2002: 41). One could, of course, also say: "how to feign knowing in order to govern the non-knowing (by non-knowing) – staging a smart, specific, side-effects-free, information-driven utopia of governance" (Valverde and Mopas 2004: 239; see also Amoore and de Goede 2008).

What political conclusions, in the widest sense, can be drawn from these findings? The most important consequence, in our view, should be a *reflexive politics of non-knowing* which must include al least three elements:

- First, the explicit recognition of the fact that non-knowing is an inescapable condition framing social and political action, all the more so in reflexive modern societies pervaded by science and technology which are inclined to present themselves as 'knowledge societies'. However, non-knowing is not simply 'a not-yet conquered territory' (Zygmunt Bauman) which stretches out before us and which, although boundless, can nevertheless be conquered step-by-step. What is required is instead to become aware that non-knowledge is always produced together with the acquisition of knowledge – and by no means exclusively in the form of Mertonian specified ignorance or of what is merely 'not-yet-known' for the time being.
- Thus, second, the plurality, legitimacy and equal status in principle of different perceptions and interpretations of non-knowing must also be recognised. It has become apparent that the temporalisation of non-knowing is a contingent historical premise and postulate of early Western modernity which, although it has not, of course, lost its importance entirely, is nevertheless beginning to forfeit its unconditional and exclusive validity. Competing interpretations of what is not known, as unknown unknowns or as inability-to-know, can no longer be discredited and marginalised as 'irrational' or 'hysterical' against this background. Rather they give expression to an independent social rationality in dealing with what is not known. Something similar holds for the firmly established cultural a priori that equates non-knowing, and in particular the conscious refusal of knowledge, with something morally deficient. In this regard, too, it must be acknowledged that under certain circumstances there can be good reasons for preferring non-knowing to knowledge – even though a generalised preference for non-knowing cannot be derived from this. Which of these respective interpretations one can and should follow is becoming the topic of context- and situation-specific social conflicts and political decisions.
- Given this situation, reflexive modern societies require, third, an extended repertoire of practices and 'techniques' for dealing with what is not known. Among these are, for example, forms of systematic observation of technological innovations and their effects aimed at learning from the unexpected, such as those postulated within the horizon of a 'real experimental' treatment of interventions into society and the environment (Gross and Hoffmann-Riem 2005; Gross and Krohn 2004). However, since even such concepts tacitly rely on the modern assumption that undesirable effects will become visible and rectifiable in good time, they must be supplemented by the development of 'second-order' indicators of non-knowing, such as those proposed, for instance, for chemicals policy (Scheringer 2002; Böschen *et al.* 2010). These should provide indicators for the extent and relevance of unknown unknowns *before* a possibly uncontrollable and unstoppable experiment with new technologies or financial instruments is initiated. The innovative and provocative or, if you will, 'revolutionary' idea implicit in such a politics of non-knowing consists in declining to use certain forms of knowledge and technologies, not because concrete risks can be specified, but 'only' because the scale of the non-knowing entailed seems too great and too risky. In addition, novel forums of discussion and decision-making are needed which are open to different, contrasting perceptions of non-knowing, thus overcoming the dominance of the modernist assumption that non-knowing is always merely temporal.

The politics of non-knowing, whose contours we have attempted to trace by drawing upon a range of examples, will lead – this much can be predicted – only in rare exceptional cases to clear, definitive and consensual solutions. It is instead constituting itself as a new field of social conflicts over the interpretation and relevance of what is not known, and over how we wish to and are able to deal with it.

Notes

1 The discussion on the topics of ignorance, non-knowledge, uncertainty and so on lacks "an agreed-upon nomenclature" as Michael Smithson (2008: 209) has rightly remarked. Contrary to Smithson or Gross (2007), we do not use 'ignorance', but 'non-knowing' (or 'non-knowledge') as the overarching concept, mainly in order to avoid the moral devaluation that might be linked to ignorance, for instance, in the sense of 'ignoring something'.

2 Against this background the historians of science Robert Proctor and Londa Schiebinger have recently developed a research programme, *agnotology*, which is devoted to the analysis of non-knowing and its cultural production (Proctor and Schiebinger 2008; Proctor 2008). The issues dealt with by agnotology are similar to those which we address in our contribution: "We need to think about the conscious, unconscious, and structural production of ignorance, its diverse causes and conformations, whether brought about by neglect, forgetfulness, myopia, extinction, secrecy, or suppression" (Proctor 2008: 3). However, we do not focus exclusively on the causes of non-knowing but also on the various ways in which it is perceived and construed by social actors and on the political controversies which erupt over definitions of what is not known.

3 Such considerations derive their plausibility and forcefulness from historical examples of persisting and unknown non-knowing (see EEA 2001). The most 'prominent' and far-reaching example of this is probably the so-called ozone hole, the destruction of the ozone layer by chlorofluorocarbons (CFCs). When the industrial production and utilisation of these synthetic substances began in the 1930s, people were completely unaware of their grave side-effects in the upper layers of the atmosphere. Only more than forty years later, in the 1970s, did science begin to get to the bottom of the underlying causal interconnections (Farman 2001).

4 Jerry Ravetz, in the early 1990s, coined the concept of 'science-based ignorance' for this; he uses this term to designate "an absence of necessary knowledge concerning systems that exist out there in the natural world, but which exist only because of human activities" (Ravetz 1990: 217).

5 Robert Merton (1987) has termed this 'specified ignorance', thereby making clear that in science demanding efforts are required to differentiate limited and manageable problems out of the wide, amorphous field of what is not known.

6 In addition to military secrecy, the *agnotology* developed by Proctor deals above all with the tobacco industry's long-standing conscious production of doubt and ignorance around the consequences of smoking (Proctor 1995, 2008: 11ff.). Proctor regards this as a prime example of actively 'manufactured ignorance' (Proctor 2008: 11).

7 These examples speak mainly to the social processing of self-produced economic, ecological and technological risks. We do not mean to imply by this that these are the only contexts in which the politics of non-knowing are emerging. Other important examples are, for instance, the mobilisation of self-attributed non-knowing in dealing with the Holocaust (see Longerich 2006) or the connection between racism and non-knowing (Sullivan and Tuana 2007; Mills 2008).

8 Yet, as the poor results of the Copenhagen Conference in December 2009 demonstrate, this does not mean that the majority of national governments are in fact willing to launch adequate and effective political strategies in order to mitigate global climate change.

9 The third Assessment Report of 2001, by contrast, assessed this as merely 'probable'; this corresponds to an assumed probability of between 66 and 90 per cent.

10 Important in this context may also have been the fact that in recent years it has transpired that, even within science, there exist different but equally well-founded 'cultures of non-knowing'; that is, different forms and practices of interpreting and dealing with what is not known (see Böschen *et al.* 2006, 2010).

11 However, forms of genetic discrimination could also develop within informal social contexts, such as the marriage market. Now that relatively cheap individual genetic tests are increasingly available over the Internet, it is by no means improbable that in the future people will also take account of the genetic profile of potential marriage partners.

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