

Current Sociology

<http://csi.sagepub.com/>

Risk and Environment as Legitimatory Discourses of Technology: Reflexivity Inside Out?

Brian Wynne

Current Sociology 2002 50: 459

DOI: 10.1177/0011392102050003010

The online version of this article can be found at:

<http://csi.sagepub.com/content/50/3/459>

Published by:



<http://www.sagepublications.com>

On behalf of:



International Sociological Association

Additional services and information for *Current Sociology* can be found at:

Email Alerts: <http://csi.sagepub.com/cgi/alerts>

Subscriptions: <http://csi.sagepub.com/subscriptions>

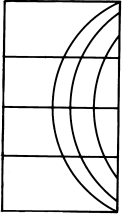
Reprints: <http://www.sagepub.com/journalsReprints.nav>

Permissions: <http://www.sagepub.com/journalsPermissions.nav>

Citations: <http://csi.sagepub.com/content/50/3/459.refs.html>

>> [Version of Record](#) - May 1, 2002

[What is This?](#)



Brian Wynne

Risk and Environment as Legitimatory Discourses of Technology: Reflexivity Inside Out?

Introduction

Given that technology and its instrumental culture are perhaps *the* pervasive issue in the attempted civilization of modernity, the idea that technology requires social assessment of some kind is hardly controversial. Yet this bland conventional wisdom harbours deep and far-reaching differences of meaning and vision. The latter half of the 20th century saw a succession of man-made technological disasters – Challenger, Bhopal, Chernobyl, BSE, World Trade Center, being the tip of the iceberg – which branded into popular awareness an uncomfortable reality that, for all the formidable powers and benefits of modern science and technology, lack of full control is normal, including lack of intellectual control, that is, unpredictable consequences. This same period saw many increasingly intense and persistent public controversies over new technologies, which can be seen as attempts at social assessment (Cambrosio and Limoges, 1991; Nelkin, 1979; Rip, 1987).

Sociological analysis of such technology controversies has been ambiguous as to whether they were (or should have been) about the specific consequences of proposed technical developments (such as risks, or environmental harm), or whether they were about conflicting larger visions of a good society (Douglas, 1974; Martin and Richards, 1994). More reflexive analysis also saw such competing propositional claims to be constructing the implicit subject-identity of their author(s) at the same time (Callon and Law, 1982; Cambrosio et al., 1990). As will be shown later, when discussing the role of constructivist sociology of scientific knowledge (SSK) in these domains, this ambiguity over what is really at issue continues to thread through current debates about environmental risks and policies, and increasingly anxious official reference

Current Sociology, May 2002, Vol. 50(3): 459–477 SAGE Publications
(London, Thousand Oaks, CA and New Delhi)
[0011–3921(200205)50:3;459–477;024762]

to growing public (anti)pathy towards them. Before they became professionalized, environmental and risk critiques gained initial momentum in the 1970s and 1980s as manifestly cultural innovation movements. Yet it is argued here that this essential human-cultural political dimension – about what kind of human we aspire to be, and in what kind of human world – has been radically subverted and marginalized by the dominant scientific-institutional risk culture. Indeed this human dimension is effectively denied by the expert discourses of risk which are now the virtually exclusive institutional idiom of social appraisal of technologies, even while these very discourses propagate their own unacknowledged and unaccountable human models.

Risk has become the form of public discourse through which public meaning is given to technology and innovation, as defined in institutional discourses such as government, media, legal and commercial, all deriving from the scientific. Yet claims of risk are endemically and increasingly contested. This reflects more than mere uncertainty in propositional claims about consequences (Wynne, 2001b), which is all that official discourses recognize.

I suggest that, as a matter of democratic necessity as well as instrumental effectiveness, the epistemological ambiguity – implicit multivalency – of ‘realist’ environmental and risk discourse has to be recognized as essential; instead of being lamented, purified and deleted. The same applies to the unacknowledged human discourses which shape, and are projected by, the institutional scientific policy discourses of risk (Wynne, 2001a).

The dominant belief has been that properly effective public knowledge for policy needed to be not only true, but also clear. If gaining the clarity needed for public authority meant compromising strict truth, this was a sound bargain. The field of science and public policy was founded on this instrumental and positivist premise (Caldwell, 1968; Price, 1965). However, SSK in environmental and related policy fields has shown that often it is *ambiguous* knowledge that is necessary to sustain the hybrid epistemic networks spanning multiple subcultures and local frames of meaning (Van der Sluis et al., 1998), for example in order to maintain an epistemic network sharing a scientific and policy perspective such as climate change and greenhouse gas controls. Galison’s (1997) discussion of ‘trading zones’ between scientific subcultures, and Star and Griesemer’s (1987) concept of ‘boundary objects’, though different in detail, share some fundamentals with this perspective, suggesting the more general relevance of these questions about ambiguity, realism and coherence (see also Jasanoff, 1990; Porter, 1995).

In the climate change arena, Van der Sluis et al. (1998) have shown how the framing meaning of an apparently precise scientific concept with a clear objective referent, climate sensitivity – the estimated global-average sea-surface temperature rise for a doubling of carbon dioxide atmospheric concentrations – has varied markedly, but apparently unproblematically. Their

analysis suggests that this informal ambiguity, or hermeneutic flexibility, allowed it to be an 'anchoring device' in stabilizing an otherwise unstable and potentially incoherent policy-scientific community. It allowed these divergent meanings to coexist at local levels while creating normative and propositional convergence at a wider level. Waterton and Wynne (1996) have proposed a similar understanding of the informal (and fragile) role of formal realist scientific nature classifications in European policy concentration.

This kind of work suggests that in the more culturally extensive, fractured social worlds typical of modern public policy, ambiguous terms of discourse may be more realistic because their meanings are multivalent and flexible. These terms are more effective than artificially precise, apparently unambiguous ones for the difficult task of representing the objects of interest to, and creating bridges of common purpose and meaning across otherwise differentiated social worlds. Even where there is apparent cohesion, alternative human meanings may still be in need of exploration and practical articulation; thus this exploration of ambiguity – plurality of meaning – is a more general issue than might appear from measures which assume such plurality must always be manifested in overt conflict. Indeed many modern technology controversies involve manifest plurality of public meanings which scientific discourses are heroically trying to translate into their own restricted one-dimensional terms, or to deny entirely. Ambiguity is fundamentally different from mere lack of precision, to which it is nevertheless often reduced by the scientific culture of modern policy.

Constructivism, Ambiguous Reason, and the Critique of Meaning

All this offers an unusual perspective on the possible role of SSK. The conventional response to SSK work on environmental and risk knowledge has been to decry its supposed destruction of any authority for action, critical or not, by denying, or at least questioning the reality of those problems. It is assumed to be unequivocally anti-realist. Dunlap's (1994) critique of Buttel and Taylor's (1992) SSK analysis of the construction of global environmental problems is a typical example, though his more recent work (Dunlap, 1997) has developed beyond this. Radder's (1998) attack on Wynne (1996a), which focused on Wynne's refusal to tell us what to do, implied a similar complaint that to question the existing realist representation of scientific framings of climate change prediction does undermine the realist basis which tells us what should be done. However, as we see below, this interpretation of constructivist SSK from a realist perspective can read it only as *either* realism *or* its opposite, anti-realism. It seems unable to see that it may be about a more complex imagination of reality, one which accepts the reflexive need to bring implicit subject-constructions into wider question as part and parcel of

corresponding object constructions – the co-construction stance (Burningham and Cooper, 1999; Irwin, 2001; Jasanoff, 1999; Jasanoff and Wynne, 1998; Latour, 1987, 1992; Wynne, 1996a). It seems appropriate to call this ‘constructivist-realism’, to distinguish it from simple-realism which does not recognize reflexive processes of subject–object co-construction, nor the essential contingency involved.

Thus the more wide-ranging, multivalent and rich human meanings which constitute public concerns are excluded from official institutional discourses of technology appraisal, as if they were solely instrumental simple-realist questions of controlling a risk (as pragmatically defined by the prevailing science). These deleted meanings and concerns – natural as well as social *realities-in-the-making* – can be brought into play by SSK analysis. Physical reality still courses through these contending and overtly less determinate representations and meanings, but different versions of reality are not only competing in the sense of claiming or denying the reality of an element of nature. They may also be making conflicting claims that a real element is more salient once one gives the issue a particular meaning. The same natural reality thus shows up differently, depending on the intersections it is given with human questions and commitments.

As Irwin has put it, SSK is ‘not turning away from the reality of environmental problems, but [is] instead capturing a richer and more diverse sense of that reality’ (2001: 159). Without quite getting to the full treatment of these reflexive issues, he hopes that the hegemonic simple-realist interpretation of the misconceived ‘realist *versus* constructivist’ polarization may at long last be superseded, at least in the academic world, if not yet in the public domain (see also Jasanoff, 1999).

The institutional risk discourses referred to above combine a simple-realist representation of the salient realities (consequences) with a presumption about what is salient, what the meaning of the issue actually is for people (predictable consequences). Thus realist public discourse imposes, not so much a propositional straitjacket on the public domain, but more perniciously, a *hermeneutic* one, where the supposedly universal objective meaning is left unquestioned – risk and consequences. In other words the simple-realist epistemic pre-commitment of these institutional discourses embeds a corresponding implicit projection of the citizen-subject, ‘the public’, which constructs them as having a common objective instrumental frame of meaning – risk and fear of its manifestation. Being constitutive of the institutional culture, these projections are emphatically not provisional hypotheses to be tested out in public dissemination – they are institutional-cultural dogma.

It seems inevitable that public discourse requires some form of realist language. However, a key element in the current crisis surrounding public mistrust of institutional scientific policy languages of risk management does

seem to be the inability of their simple-realist institutional framings to accommodate various public meanings and concerns (including instrumental 'risk' ones). It was already a striking exception to typical practice when the UK House of Lords (2000) Select Committee on Science and Technology report, *Science and Society*, acknowledged that the public mistrust crisis crippling scientifically-led public policy institutions, is not so much due to public misunderstanding, as to just this routine institutional denial of many public concerns about such issues as GM agriculture and food, or radioactive waste disposal, beyond those represented in the reductionist terms of the official framework of meaning. In other words it could be said to be due to the very reverse of 'public misunderstanding of science'.

This institutional syndrome can be understood as a self-confirming elaboration of its founding simple-realist cultural discourse, as a constitutive thinking habit, not an object of rational deliberation. Thus just as the simple-realist misinterpretation of constructivist SSK as anti-realist circles within and confirms its own unquestioned simple-realist premises, so too the common institutional response to public disaffection, criticized by the House of Lords, confirms its own premise that the public is only concerned with risk when considering broad scientific-technological enterprises such as commercialization of genetic manipulation. Since the issue's meaning is presumed to be risk alone, a scientific matter, then the widespread public disaffection now being suffered can only be assumed to originate in rejection or misunderstanding of the science. This is a vicious, narcissistic circle of self-reference – one ironically exercised in the name of self-reflexive scientific rationality.

With these considerations in mind, I next address how environmental and risk critiques of technology arose, and then how institutional responses related to them. We see how institutional attention continues to reflect the same problematic technological-determinist assumptions as those which sociology of technology and its political equivalents have been attempting to remove for so long. Moreover, an entrenched simple-realist cultural perspective has systematically diverted attention from crucial reflexive questions about the human-subject that are key to the practical and academic issues of democratizing technology in a sustaining, and sustainable, way. Thus the many recent initiatives to render science and technology more participatory, transparent and accountable to society, for all their laudable aspects, have perversely reinforced attention only on back-end scientific questions about consequences or risks (reflecting an embedded implication of prediction and control). This excludes more reflexive questions about the human purposes and visions which shape front-end innovation commitments. Thus the forces shaping these innovation commitments remain as protected as ever from democratic accountability, perhaps even more so given their further globalization. Threading through this outline historical perspective will be an interest

in the tacit processes of cultural objectification or reification of human meanings and subject-identities, and the institutional implications of these.

Technology: Retrieving a (Sustainable) Human Agenda?

The first attempt at institutionalizing the social assessment of technology – the Technology Assessment (TA) movement of the 1960s and 1970s – was crippled by its scientific pretensions to full deterministic predictive ability, for both environmental and social impacts; and by its unremitting mystification and protection from accountability of the contingent technical and social processes by which technologies are developed and become established ‘working’ technologies. The technological determinism of TA rendered innovation, development and design irrelevant as possible sites for sociological research and social deliberation (Winner, 1980; Wynne, 1975). As Schot (2001) has described, this focus only on back-end impacts or consequences questions has been carried into most of the elaborate participatory initiatives which seek to gain citizen input to hitherto sovereign scientific domains of decision, as the formula for regaining public authority. Included in this enlarged, but resolutely only back-end, arena of accountability, and of relentlessly increasing political prominence, are issues of risk and safety – of consequences – arising from technological choices and designs.

The substantial work in SSK-inspired sociology and politics of technology (e.g. Bijker et al., 1987; Feenberg, 1999; Latour, 1992; MacKenzie, 1989; MacKenzie and Wajcman, 1999; Rip et al., 1995; Winner, 1986) has emphasized the importance of understanding the contingency of social and technical constitutions of technologies, as a matter of (an enlarged agenda for) democratic technology policy and design, on the basis of more upstream, socially-inclusive, more continuing and more open-ended processes of human negotiation. Explicitly or implicitly, innovation, design and their driving interests would be matters for democratic deliberation, not merely impacts. However, although they are increasingly the exclusive focus of attention, they remain a limited back-end agenda. The previously concealed (and still latent) *upstream* political agenda of technology uncovered by sociology of technology and Constructive Technology Assessment has in many respects been diverted over the last decade into a largely one-dimensional and instrumental, downstream-consequences *risk* discourse. This has perpetuated the exclusion of many other salient human issues that should be addressed by that still-awaited democratic *upstream* political and social agenda of (more co-constructed, hybrid and contingent) technology. This would focus on innovation, its proper human purposes and conditions. The central point of this paper is to elaborate this theme.

In evaluating whether, and under what conditions, we should commit

society to major new technologies such as genetically-modified crops, it is natural to focus attention at first on the possible consequences. This increasingly means questions about risk of harm, to whatever it is that is valued. Thus it may be unsurprising that risk issues have come to define the very meaning of 'social assessment of technology'. However, this dominant risk discourse excludes many other questions. These can be distilled into three general types:

- other issues and interconnections, such as driving purposes, intended social benefits, and conditions (e.g. of ownership, implementation, investment and control, regulation and accountability);
- what is meant by 'the technology' as putative 'cause' of possible impacts? and
- are the consequences-questions even answerable, and if not, what then?

Consistent with the opening up of technological 'black boxes', the sociological perspective on technology has delineated some of the contingent organizational-cultural conditions creating dramatic forms of risk such as the Challenger space shuttle disaster (Vaughan, 1996; Wynne, 1988), which may or may not be regarded as 'inevitable' consequences of a technology (Perrow, 1984). The technical neglect, or rationalization, of such social contingencies at the heart of the issue of rendering modern technologies viable and controlled, has made cases such as Challenger (and also, for example, the neglect by experts of mundane slaughterhouse and rendering-plant practices as key to the human risks from the UK BSE epidemic) iconic in the modern cultural mood of pervasive human-created risk and insecurity alongside decaying trust in technical expertise and its institutions. This has become a defining theme of late-modern politics and culture, encapsulated in the theoretical discourse of reflexive modernization (Beck et al., 1994; Irwin, 2001; Kerr and Cunningham-Burley, 2000; Welsh and McKechnie, 2002).

Institutional bodies of government and policy have been forced to experiment with increased public participation in various arenas of expert decision over risks and technology regulation, in response to waning public trust in their processes and outcomes. The influential House of Lords Select Committee on Science and Technology (2000), composed of former senior scientific advisers and policymakers, described British public confidence in scientific advice as in a state of wholesale crisis. The European Commission White Paper on Governance (EC, 2001), contained a chapter on 'Democratizing expertise' which acknowledged the same broad crisis across Europe.

Risk issues, from the BSE-vCJD fiasco to genetically modified crops, food safety crises, nuclear energy, contaminated blood services, hazardous wastes and genetic cloning, are the basic fuel and currency of this ramifying discourse and its associated institutional initiatives. The greater transparency and inclusiveness of these processes has been championed as the route to

greater trust and thus more effective governance. Thus, official institutions have implicitly echoed Beck's (1992) account of risk society and reflexive modernization, which involved the growth of a new defining public consciousness of risk, but with growing public alienation from the inability of official science to control those risks which it created. However, it is necessary to examine the extent to which these processes of public involvement have addressed the real origins of that widespread public disaffection. This requires closer examination of the meanings assumed by the institutional discourses which are imposed on the public, as well as asking what the origins and character of that negative public consciousness may be in the first place.

Thus it is worth first reviewing how risk and its accompanying critical theme, environment, came to prominence in such a way. Further, it is worth addressing the implications of this dominant overall language of objective reflex – of nature speaking back to our choices and intentions through the unanticipated and unintended environmental or other consequences of those commitments. Beck (1992: 176) suggested in 1986 that 'statements on risk are the moral statements of scientised society'. More recently, he stated: 'In risk society theory, environmental problems are no longer conceived as external problems. Instead they are theorized at the centre of institutions' (Beck, 2000: 224). However, elsewhere he has been criticized for giving too realist an account of the cultural reflexivity processes produced by these now-uncontrollable natural reactions to our escalating interventions in nature (e.g. Lash, 1994; Wynne, 1996b; see also Beck, 2000). But his proposals that risk is a moral discourse shaped in a scientized culture, and that environmental problems are inseparably intertwined with institutional problems of order and coherence, hint at a more complex epistemic status to risk and environmental knowledge. This has not been recognized or addressed in institutional responses to public disaffection and environmental critique. Indeed, to the extent it has been recognized at all, this non-instrumental, human dimension of public disaffection has been lampooned as unfounded in objective reality, as purely emotive and irrational, as in urgent need of education; or alternatively accommodated as legitimate but still intellectually vacuous and thus secondary, ethical or trust concerns (Wynne, 2001a). It is not seen to bear at all on the very same simple-realist cultural discourse which divides reality so rigidly in this way into the objective and the subjective, the real and the unreal.

Risk and Environment as Critique – Reflexive Subjects?

Both risk and environment are relatively very recent as discursive idioms of broad popular critique of technology and its attendant cultures. Ewald (1986) and Bernstein (1996) both describe how risk was first imagined as an

essentially modern cultural form, and significantly operationalized in early mercantile capitalist shipping, where individual losses in rapidly expanding global trade became large enough to encourage their socialization in insurance arrangements. These implied some viable if crude forms of measurement and scaling of risk. Apart from natural hazard assessment, a much later, separate origin of systematic risk conceptualization was the mid-20th century engineering interest in complex technologies such as nuclear and chemical plant, or aerospace. Here, probabilistic risk reasoning was crucial for rendering acceptable the worst-case possible dangers of such technologies, because the odds of such catastrophic events were calculable as extremely low, assuming various design and operational conditions. Risk was defined as the product of consequence and probability, thus socially manageable.

However a crucial, usually unnoticed point about these insurance or engineering trajectories of contemporary risk awareness is that they involved *an essentially clear idea of the object at stake* – shipping cargoes with a clear market value; later, human life or property, or in engineering an unwanted outcome, such as an explosion, toxic release, or collision. Although sociologists have described the greater ambiguity of such terms (MacKenzie, 1989; Vaughan, 1996), to their specialist practitioners and those they worked for the meaning of the issue engaging attention could nevertheless for practical purposes be taken as *unambiguous, 'obvious'*. The risk concepts, methods and measures were refined within private technical debate, but not subjected to wider debate about the object deemed to be the source of risk (e.g. a nuclear power station), or the unwanted consequences deemed most salient to control, or alternatives which might be pursued instead. The normally neglected salience of this reduction of open questions of meaning, to matters of proportional 'uncertainty', is explained below.

Thus, although in the 1970s risk did become the focal discourse of critique and public controversy in domains such as nuclear technology, this began in mainly technical critique performed by critical scientists, often ex-insiders, capable of disputing the methods and conclusions of complex technical risk assessments. However, this kind of critique did not challenge prevailing assumptions about the meaning of the constructed object, risk, and thus of the issue overall, which was perhaps by default confined to risk. The critique mainly followed and reproduced those same basic assumptions and meanings.

As explained elsewhere (Levidow and Marris, 2001; Wynne et al., 2001), lack of institutional self-reflexivity about where such dominant meanings and framings come from, what meanings and concerns they leave out, how they might vary across society, and how they may need to be altered in response to democratic deliberation over them, has also been a major problem for the institutions promoting genetically-modified crops and foods. These institutions have further embattled themselves by continuing, in the face of evident public scepticism, to propagate a monovalent simple-realist discourse

in which 'the risks', though they may be imprecisely known, have a meaning which is taken for granted, not a political-cultural artefact whose meaning and definition have been (deliberately or not) *constructed*. To this cultural imagination, to suggest such meanings are *constructed* would be interpreted as saying that the risks are unreal. Moreover, the attendant idolatry of scientific thought here allows the notion of risk so conceptualized to become the assumed objective and universal meaning of the overall public issue, to the exclusion or subordination of all other dimensions of meaning with which the technology, its driving aims and conditions, and its possible implications, may be invested.

I suggest that this lack of reflection about meanings or framings of issues has been inadvertently encouraged by the history of risk, in which original objects of risk attention were unambiguously clear to those concerned; and also, control of that risk was all that the issue meant to them. This lack of primary reflection was thus entrenched even when issues involving risk became more hermeneutically contingent and complex – or that neglect of this perhaps immanent complexity became more significant. I locate this emergent complexity and ambiguity in the last 30 years, when risk attention broadened from its insurance and engineering plant focus to escalating environmental processes too.

Corresponding with this problematic lack of institutional reflection as to basic meanings, is what I call *the cultural reification of risk* in late-modern society. What does such cultural reification of risk involve? One can identify some key elements embedded in the narrative form of the influential history of risk by Bernstein (1996). His valid point about the essentially modern cultural imagination required for a concept of risk to be meaningful, is:

The revolutionary idea that defines the boundary between modern times and the past is the mastery of risk . . . a group of thinkers whose remarkable vision revealed how to put the future at the service of the present . . . by showing the world how to understand risk, measure it, and weigh its consequences, converted risk-taking into one of the prime catalysts which drive modern Western society. (Bernstein, 1996: 1)

In this narrative, 'risk' was there waiting to be discovered, carrying its own intrinsic meaning, which the visionaries, through their heroic powers of access to the mysteries of Nature, were able to reveal to men of commerce and others who could then drive the economic, cultural and technological revolution of modernity:

By defining a rational process of risk-taking, these innovators provided the missing ingredient that has propelled science and enterprise into the world of speed, power, instant communication and sophisticated finance that marks our age. Their *discoveries* about the nature of risk . . . lie at the core of our modern market economy that nations around the world are hastening to join. (Bernstein, 1996: 2; emphasis added)

We can note from this account of risk how an implicit normative framework and a claim of control are advanced as defining features of this new state of enlightenment. It is this scientific risk discourse which gives total control of 'the future at the service of the present', the implication being that risk analysis identifies and domesticates all significant future consequences of the relevant actions. In this way ignorance and unanticipated consequences – lack of control – lying beyond the reach of existing scientific knowledge, thus potentially embarrassing in future to risk assessment, are seamlessly deleted. Risk is thus assumed to define the full sphere of conceivable meaning for considering new technologies and their implications, and science reveals this independent meaning.

This is the prevalent epistemic understanding of risk and risk knowledge – that they are not *constructed meanings*, but objectively given ones. Moreover, they exhaustively define the objective meaning of the public issues of technology.

A striking contemporary resonance is to be found between this scholarly understanding of risk, and the predominant understanding of the domain of lack of control, or ignorance, exposed by Grove-White (2001) in an exchange with the chair of a key UK government scientific advisory committee. As a member of the UK Agriculture and Environment Biotechnology Commission, Grove-White was questioning the institutional scientist at a public hearing. The relevant passage was as follows (Grove-White, 2001: 471):

[Grove-White, GW]: 'Do you think people are *reasonable* to have concerns about possible 'unknown unknowns' where GM plants are concerned?

[Scientist]: *Which* unknowns?

[G-W]: That's precisely the point. They aren't possible to specify in advance. Possibly they could be surprises arising from unforeseen synergistic effects, or from unanticipated social interventions. All people have to go on is analogous experience with other technologies . . .

[Scientist]: I'm afraid it's impossible for me to respond unless you can give me a clear indication of the unknowns you are speaking about.

[G-W]: In that case don't you think you should add health warnings to the advice you're giving ministers, indicating that there may be 'unknown unknowns' which you can't address?

[Scientist]: No, as scientists, we have to be specific. We can't proceed on the basis of imaginings from some fevered brow . . .

This nicely delineates the dominant, entrenched, cultural-institutional mind-set in which any consequence that may lie outside prevailing scientific risk-knowledge cannot be described – by definition, because it is a matter of scientific ignorance – and cannot therefore be given any standing, even as a general category, of which there are many real, costly, examples. Responsibility for such possible effects is thus pre-empted and externalized,

and anyone who might wish to refer to their relevance suffers from 'a fevered brow'. The public meaning of the issue is thus very tightly confined to what we can control, practically or intellectually, with the institutionalized discourse of risk. Bernstein's historical celebration of scientific risk's role in permitting the modern technological nirvana of control, has manifestly constructed the meaning of risk by limiting it to 'what we can specify, predict and control now' and then assuming this meaning as the legitimate public meaning. Grove-White's suggestion, derived from academic research on public attitudes (Grove-White et al., 1997; Wynne et al., 2001), that the public may have different meanings which would address the implications of indeterminacy and lack of control (for example by being more rigorous in questioning original aims, purposes, controlling interests and conditions), was simply unimaginable to a modern institutional scientific actor, who seemed unwittingly to reflect identical cultural habits to those of Bernstein.

Thus the forms of institutionalization of risk have not just reduced the scope of *instrumental* attention – they have also produced a kind of *hermeneutic* sanitization, deleting any other public meanings which are not subsumable to this one-dimensional realist risk framework. For the sake of democracy, not only instrumental effectiveness, I suggest that the epistemological ambiguity – implicit multivalency – of 'realist' environmental and risk claims, as key parts of the critique of modern scientific and technological culture, has to be recognized as essential, instead of being purified and deleted. In various technological and environmental issues ranging from nuclear power (Wynne, 1982) to GM organisms, global climate change and sustainable development (Irwin, 2001; Macnaghten et al., 1996), this simple-realist institutional discourse and its implicit meanings have been presumptively and rigidly imposed on the issues, and on those involved, with damaging effects on public identification with those same institutions supposed to be representing the public interest. Through all such issues, ever since the earliest years of expressed public concerns about nuclear technology, clearly defined human issues and meanings have pervaded and inspired those 'environmental' concerns, not as dishonest or misconceived 'hidden agendas' (as they have been caricatured, if recognized) but as authentic dimensions of public meaning – of what is understood to be at stake. Yet the sovereign institutional discourses have systematically deleted them, and the very condition of ambiguity, from sight, while perversely thereby imposing their own normative but unacknowledged human visions.

Conclusions

The environmental and risk critiques of the last 25 years or more, and their substantive resonances in the growing mood of public scepticism, have been

critiques, not just of modern technology as conventionally understood, but of its constitutive institutions which are supposed to be the guardians of the public interest in matters of science and technology. This already indicates the *essential* ambiguity, or openness of meaning, of those issues – not as a default of objective clarity, but as a reflection of a complex relationship between nature and humans. These critical movements were intended to be a main avenue for the subjection of scientific and technological innovation to more effective forms of democratic debate and influence. They have been infused with urgent warnings of environmental extinction, or mutually assured nuclear annihilation; but as the examples given before show (see also Welsh and McKechnie, 2002), even the most ostensibly scientific environmental or risk knowledge, in the very act of calling itself such, embodies implicit reference to human questions as well as natural ones. The realist discourse thus overlies unstated human contingencies, and questions of meaning-ambiguity.

Moreover, since the reflexive turn in the humanities and social sciences, it has become impossible to ignore the ways in which propositional statements about the environment, risks or technologies, be these critical or not, embody and project tacit performance of corresponding models of the human subject, that is, of human culture-in-the-making. If one believes that the environmental and risk problems associated with late-modern scientific and technological culture, which have been so extensively analysed and debated over the last 30 or so years, are more than just technical problems, but also pose radical challenges to us moderns as human subjects, and to what our culture assumes as constituents of modern cultural identity, then we cannot ignore these self-reflexive *public* issues buried in our discourses. (A slightly less-instrumental argument for the same conclusion is that these questions need to be aired for reasons of our humanity, whatever may happen to our chances of biological survival.) This is true whether we are talking of ‘real-world’ political discourses, or ‘ivory-tower’ academic ones. In this spirit, a critical, public ‘political economy of the human subject’ is called for, akin to the kind of agenda suggested by Rose (1999), though connected more directly to a human archaeology (Darier, 1999; Foucault, 1970) of ostensibly objective discourses of environment and risk also.

This article has attempted to review some of the less obvious ways in which the hope has been undermined of more democratic and environmentally sustainable forms of influence over science and technology as cultural, not only material, programmes. The positive notions have been articulated, that reflexive societal processes of ‘self-critique’ of our dominant modern instrumental culture have been induced inter alia through ‘green’ critiques (Beck, 1992; Beck et al., 1994), and the different idea that self-reflexive awareness, as a supposed intrinsic property of modern scientific culture, has diffused into popular awareness, thus universalizing this self-reflexive

capacity (Giddens, 1994). I want to suggest (Wynne, 1996b) that these real developments are severely compromised by the extent to which that dominant culture reinvents and extends its unreflexive founding commitments in the face of such critique and public disaffection; and also by the way much of that critique projects itself in the same basic terms.

I therefore suggest that much of this potential self-reflexivity has been diverted into the intense, but radically reduced, arena of simple-realist argument over the reality or scale (or precise causes) of diverse threats to our security from technology's consequences, leaving aside the greater issues of what the proper human meanings, conditions, limits, and purposes of scientific and technological innovation should be. It cannot be assumed that institutionalized realist forms of public discourse can facilitate the (perhaps oblique) articulation of those inevitably less precise, less explicit but crucial dimensions without suffocating them in the process. It remains to be seen whether appropriate institutional change, and appropriately focused confrontation, could induce a more flexible, complex and capacious form of (necessarily) realist public discourse.

In particular I want to propose that the definitive modern focus of public discourse on the theme of *risk* and insecurity alone, as if this were the universal natural meaning of the public issues involved over new sciences and technologies, is a key obstacle to any democratic impetus. The effortless cultural-institutional reification of risk is an essential factor in this seamless reduction of public meaning, and this institutional process seems to intensify rather than abate. The responsibility of SSK is to prise open these scientific, risk and environment-consequences cultures, so as to invite democratic entry. Exposing the underlying ambiguity of such discourses is crucial to that project. This does not deny reality, but engages with a more complex, indeterminate, human-natural reality in the making. It is the simple-realist outlook, whether political or academic, which is in denial of essential dimensions of reality – in that sense, *anti*-realist.

Only a false reductionism can read constructivist accounts of the social construction of environmental risks knowledge as claims that those risks 'therefore' do not exist, or that natural reality 'therefore' plays no role in producing the knowledge. Constructivist environmental and risk SSK is also *necessarily* realist, though the reality to which constructivist understanding refers is:

- a natural-social-artefactual hybrid;
- contingent (ultimately in those classifications themselves, too);
- unfinished, always in the making; and
- forever incompletely represented.

This awareness would entail a more complex and contingent (constructive-)realist public discourse if more widely established. In breaking down

the public denial of lack of control which, despite the growing emphasis on 'uncertainty', is still a central feature of the dominant institutional culture, this would automatically render this culture more democratic, and its science and technology more robust (Nowotny et al., 2001). A key to that broadening would be recognition of the cultural reification of risk which has become a defining feature of this contemporary institutional culture.

As I have already suggested, the dearth of any public epistemic debate around purposes rather than consequences, not only of technology but of scientific knowledge itself, would seem to suggest that reflexive modernization as a genuinely reflexive focus on exposing and collectively deliberating our own culture's 'naturalized' and constitutive human contingencies is at best exaggerated, at worst a delusion. This could never be an uncompromised cultural reflexivity, since that would be a contradiction in terms; but this does not mean that it needs to be as crippled as it is now. This struggle must also be recognized as an issue of power, resistance and responsibility, and of institutional change. So long as simple-realist cultural blinkers are allowed to restrict our focus to questions of consequences, we will continue to await the social invention of a democratic reflexive politics of innovation that might render technology humanly and environmentally sustaining.

Finally, it can be noted that the sociological debates about technology, risk, public alienation and reflexive modernization have all tended towards a rather modern western, developed-world cultural parochialism. The cultural blinders and conflicts involved in what is still seen by institutions in late-modern society as 'public misunderstanding of science' and incipient, often rampant public irrationality, are increasingly seen to be convergent with those identified by anthropologists over the global presumptions of that same western scientific modernizing culture (Hobart, 1993; Leach and Mearns, 1997; Scoones, 1999; Robbins, 1998; Scott, 1998). These parallels deserve more considered attention, especially in the context of further globalization and new social movements which are attempting better to integrate indigenous cultural qualities and human rights commitments with conventional modern discourses of environment and risk, and with richer, more compassionate notions of global responsibility, solidarity and citizenship.

References

- BECK, U. (1992) *Risk Society: Towards a New Modernity*. London: Sage. (First published 1986, *Risikogesellschaft: auf der Weges Einem Andere Moderne*.)
- BECK, U. (2000) 'Risk Society Revisited: Theory, Politics and Research Programmes', in B. Adam, U. Beck, and J. Van Loon (eds) *The Risk Society and Beyond: Critical Issues for Social Theory*, pp. 211–28. London: Sage.
- BECK, U., GIDDENS, A. and LASH, S. (1994) *Reflexive Modernisation: Politics, Tradition and Aesthetics in the Modern Social Order*. Cambridge: Polity Press.

- BERNSTEIN, P. L. (1996) *Against the Gods: The Remarkable Story of Risk*. New York: John Wiley.
- BIJKER, W., HUGHES, T. and PINCH, T., eds (1987) *The Social Shaping of Technology*. Cambridge, MA: MIT Press.
- BURNINGHAM, K. and COOPER, G. (1999) 'Being Constructive: Social Constructionism and the Environment', *Sociology* 33(2): 297–316.
- BUTTEL, F. and TAYLOR, P. (1992) 'Environmental Sociology and Global Environmental Change: A Critical Assessment', *Society and Natural Resources* 5: 211–30.
- CALDWELL, L. K. (1968) *Science, Technology and Public Policy: A Selected and Annotated Bibliography*. Bloomington, IN: Indiana University Press.
- CALLON, M. and LAW, J. (1982) 'On Interests and Their Transformation: Enrolment and Counter-Enrolment', *Social Studies of Science* 12(4): 615–25.
- CAMBROSIO, A. et al. (1990) 'Scientific Practice in the Courtroom: the Construction of Sociotechnical Identities in a Biotechnology Patent Dispute', *Social Problems* 37(2): 301–19.
- CAMBROSIO, A. and LIMOGES, C. (1991) 'Controversies as Governing Processes in Technology Assessment', *Technology Assessment and Strategic Management* 3(4): 377–96.
- DARIER, E., ed. (1999) *Discourses of the Environment*. London: Routledge.
- DOUGLAS, M. (1974) *Implicit Meanings: Studies in Anthropology*. London: Routledge and Kegan Paul.
- DUNLAP, R. (1994) 'Struggling With Human Exemptionalism: The Rise, Decline and Revitalisation of Environmental Sociology', *American Sociologist* 25: 5–30.
- DUNLAP, R. (1997) 'The Evolution of Environmental Sociology: A Review and Assessment of the American Experience', in M. Redclift and G. Woodgate (eds) *The International Handbook of Environmental Sociology*, pp. 21–40. Cheltenham: Edward Elgar.
- EUROPEAN COMMISSION (2001) *European Governance: A White Paper*. COM(2001)428, 27 July 2001. Brussels: Commission of the European Communities.
- EWALD, F. (1986) *L'Etat Providence*. Paris: Editions du Seuil.
- FEENBERG, A. (1999) *Questioning Technology*. New York and London: Routledge.
- FOUCAULT, M. (1970) *The Order of Things*. New York: Random House
- GALISON, P. (1997) *Image and Logic: A Material Culture of Microphysics*. Chicago, IL and London: University of Chicago Press.
- GIDDENS, A. (1994) 'Living in a Post-traditional Society', in U. Beck, A. Giddens and S. Lash *Reflexive Modernisation: Politics, Tradition and Aesthetics in the Modern Social Order*, pp. 54–109. Cambridge: Polity Press.
- GROVE-WHITE, R. (2001) 'New Wine, Old Bottles? Personal Reflections On the New Biotechnology Commissions', *Political Quarterly* 72(4): 466–72.
- GROVE-WHITE, R., MACNAGHTON, P. and WYNNE, B. (1997) *Uncertain World*. Lancaster: Lancaster University, Centre for the Study of Environmental Change.
- HOBART, M., ed. (1994) *An Anthropological Critique of Development*. London: Routledge.
- HOUSE OF LORDS (2000) *Science and Society*, Select Committee on Science and Society, Third Report. London: HMSO.
- IRWIN, A. (2001) *Sociology and the Environment*. Cambridge: Polity Press.

- JASANOFF, S. (1990) *The Fifth Branch: Science Advisors as Policy Makers*. Cambridge, MA: Harvard University Press.
- JASANOFF, S. (1999) 'STS and Public Policy: Getting Beyond Deconstruction', *Science, Technology and Society* 4(1): 59–72.
- JASANOFF, S., MARKLE, G., PETERSEN, J. and PINCH, T. eds (1994) *Handbook of Science and Technology Studies*. London: Sage.
- JASANOFF, S. and WYNNE, B. (1998) 'Scientific Knowledge and Decision Making', in S. Rayner and E. Malone (eds) *Human Choice & Climate Change*, 4 vols, pp. 1–112. Columbus, OH: Battelle Press.
- KERR, A. and CUNNINGHAM-BURLEY, S. (2000) 'On Ambivalence and Risk: Reflexive Modernity and the New Genetics', *Sociology* 34(2): 283–304.
- LASH, S. (1994) 'An Aesthetic Perspective on Reflexive Modernity', in U. Beck, A. Giddens and S. Lash, *Reflexive Modernisation: Politics, Tradition and Aesthetics in the Modern Social Order*, pp. 113–57. Cambridge: Polity Press.
- LASH, S., SZERSZYNSKI, B. and WYNNE, B., eds (1996) *Risk, Environment and Modernity: Towards a New Ecology*. London: Sage.
- LATOUR, B. (1987) *Science in Action*. Buckingham: Open University Press.
- LATOUR, B. (1992) 'Where are the Missing Masses? Sociology of a Door', in W. Bijker and J. Law (eds) *Shaping Technology-Building Society: Studies in Sociotechnical Change*, pp. 172–191. Cambridge, MA: MIT Press.
- LEACH, M. and MEARNES, R., eds (1997) *The Lie of the Land: Challenging Received Wisdom on the African Environment*, London: James Currey.
- LEVIDOW, L. and MARRIS, C. (2001) 'Science and Governance in Europe: Lessons From the Case of Agricultural Biotechnology', *Science and Public Policy* 28(5): 345–60.
- MACKENZIE, D. (1989) *Inventing Accuracy*. Cambridge, MA: MIT Press.
- MACKENZIE, D. and WAJCMAN, J., eds (1999) *The Social Shaping of Technology*. Buckingham: Open University Press. (Orig. pub. 1985.)
- MACNAGHTEN, P., JACOBS, M., GROVE-WHITE, R. and WYNNE, B. (1996) *Public Perceptions of Sustainability Indicators*, report for Lancashire County Council. Lancaster: Lancaster University, Centre for the Study of Environmental Change.
- MARTIN, B. and RICHARDS, E. (1994) 'Scientific Knowledge, Public Controversy and Public Decision-Making' in S. Jasanoff, G. Markle, J. Petersen and T. Pinch (eds) *Handbook of Science and Technology Studies*, pp. 506–26. London: Sage.
- NELKIN, D., ed. (1979) *Controversies: Politics of Technical Decisions*. Beverly Hills, CA: Sage.
- NOWOTNY, H., GIBBONS, M. and SCOTT, P. (2001) *Re-Thinking Science*. Cambridge: Polity Press.
- PERROW, C. (1984) *Normal Accidents*. New York: Basic Books.
- PORTER, T. (1995) *Trust in Numbers*. Princeton, NJ: Princeton University Press.
- PRICE, D. K. (1965) *The Scientific Estate*. Cambridge, MA: Harvard University Press.
- RADDER, H. (1998) 'Responses and Replies: The Politics of SSK', *Social Studies of Science* 28(2): 325–41.
- REDCLIFT, M. and WOODGATE, G., eds (1997) *The International Handbook of Environmental Sociology*. Cheltenham: Edward Elgar.
- RIP, A. (1987) 'Controversies As Informal Technology Assessment', *Knowledge* 8(3): 349–71.

- RIP, A., MISA, T. and SCHOT, J., eds (1995) *Managing Technology in Society. The Approach of Constructive Technology Assessment*. London: Pinter.
- ROBBINS, P. (1998) 'Paper Forests: Imagining and Deploying Exogenous Ecologies in Arid India', *Geoforum* 29: 69–86.
- ROSE, N. (1999) *Governing the Soul*. London and New York: Free Association Books.
- SCHOT, J. (2001) 'Towards New Forms of Participatory Technology Development', *Technology Assessment and Strategic Management* 13(1): 39–52.
- SCOONES, I. (1999) 'New Ecology and the Social Sciences: What Prospects for a Fruitful Engagement?', *Annual Reviews of Anthropology* 28: 479–507.
- SCOTT, J. C. (1976) *The Moral Economy of the Peasant*. New Haven, CT: Yale University Press.
- SCOTT, J. C. (1998) *Seeing Like a State*. New Haven, CT: Yale University Press.
- STAR, S. L. and GRIESEMER, J. D. (1987) 'Boundary Objects for Science in Public Domains: The Museum of Invertebrate Zoology, Berkeley', *Social Studies of Science* 17(3): 211–30.
- VAN DER SLUIS, J. et al. (1998) 'Anchoring Devices in Science for Public Policy: The Case of the Climate Sensitivity', *Social Studies of Science* 28(2): 291–323.
- VAUGHAN, D. (1996) *The Challenger Launch Decision: Risky Technology, Culture and Deviance At NASA*. Chicago, IL and London: University of Chicago Press.
- WATERTON, C. and WYNNE, B. (1996) 'Building the European Union: Science and the Cultural Dimensions of Environmental Policy', *Journal of European Public Policy* 3(3): 420–40.
- WELSH, I. and MCKECHNIE, R. (2002) 'When the Global Meets the Local: Critical Reflections on Reflexive Modernisation', in F. Buttel et al. (eds) *Sociological Theory and the Environment: Classical Foundations, Contemporary Insights*. Boulder, CO: Rowman and Littlefield.
- WINNER, L. (1980) 'Do Artifacts Have Politics?', *Daedalus* 109(1): 121–36.
- WINNER, L. (1986) *The Whale and the Reactor*. Chicago, IL and London: University of Chicago Press.
- WYNNE, B. (1975) 'The Rhetoric of Consensus Politics: A Critical Review of Technology Assessment', *Research Policy* 4(3): 1–51.
- WYNNE, B. (1982) *Rationality and Ritual: the Windscale Inquiry and Nuclear Decisions in Britain*. Chalfont St Giles: British Society for the History of Science.
- WYNNE, B. (1988) 'Unruly Technology: Practical Rules, Impractical Discourses and Public Understanding', *Social Studies of Science* 18(1): 147–67.
- WYNNE, B. (1996a) 'May the Sheep Safely Graze? A Reflexive View of the Expert–Lay Knowledge Divide', in S. Lash, B. Szerszynski and B. Wynne (eds) *Risk, Environment and Modernity: Towards a New Ecology*, pp. 165–98. London: Sage.
- WYNNE, B. (1996b) 'SSK's Identity-Parade: Signing-Up, Off-and-On', *Social Studies of Science* 26(2): 357–91.
- WYNNE, B. (2001a) 'Expert Discourses of Risk and Ethics on Genetically Manipulated Organisms: The Weaving of Public Alienation', *Politeia* 17(62): 51–76.
- WYNNE, B. (2001b) 'Understanding, Managing and Communicating Uncertainty', paper given at the Biotechnology and Global Governance: Crisis and Opportunity conference, J. F. Kennedy School of Government, Harvard University,

May 2001. Lancaster: Institute for Environment Philosophy and Public Policy, Lancaster University.

WYNNE, B., et al. (2001) *Public Attitudes to Agricultural Biotechnologies in Europe (PABE)*, final report of EU research project, FAIR 38-3786. Brussels: D-G Research, Commission of the European Communities.