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Risk as social process: the end of 'the age of appealing to the facts'?

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Abstract

This paper utilises the notion of the risk society to argue that the ways in which technical practices, knowledge and rationality have become structured into governance are counter-productive and now instrumental to the proliferation of risk and destabilisation of governance. This problem is epitomised by how decisions have evolved to become a matter determined by 'facts' rather than by a determination of the community impact of outcomes and further compounded by the institutionally embedded blindness to wider social concerns that this entails. It is argued that what are required are processes integrating 'factual' technical and 'value-laden' societal concerns and avenues for this and their ramifications are elaborated and explored. Central to such developments will be a democratisation of technical practices and the institutions in which they are embedded. The broader political implications of these developments are examined and found to involve a radical extension of democracy involving an extensive reshaping of the topography of governance.

Keywords: Risk; Governance; Risk society; Technical practice; Scientific rationality

1. Introduction

Risk determinations are an unrecognised, still undeveloped symbiosis of the natural and human sciences, of everyday and expert rationality, of interest and fact. They are simultaneously neither simply the one nor only the other. They can no longer be isolated from one another through specialisation, and developed and set down according to their own standards of rationality. They require a cooperation across the trenches of disciplines, citizens' groups, factories administration and politics, or — which is more likely — they disintegrate between these into antagonistic definitions and *definitional struggles* [1].

At some time or other the colours change. The meaning of the unintentionally utilised points of view is becoming uncertain, the way is being lost in the dusk. The light of the

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great cultural problems has travelled on. Science also prepares itself to change its point of view and its conceptual apparatus [2].

While the rise of social theories of risk over the last two decades has become an accepted and unremarkable matter what is perhaps of more fundamental import is how risk has become a focus of intense interest within broader social theory. This work, exemplified by the German sociologist Ulrich Beck's Risk Society thesis [1], advances the view that the social production of risk has become systemic to contemporary industrial societies and requires resolution at the level of governance. These studies not only deliver a range of significant insights concerning potential institutional innovations and key social factors such as trust, but may also portend a fundamental reconceptualisation of how matters of risk and governance are conceived. Of central importance among the specifics of this work are critical analyses of technical knowledge and practice that generate calls for the reform of both practices and institutional arrangements. This paper builds upon these studies by briefly elaborating their logic, clarifying their implications for contemporary matters of risk and governance, and exploring their ramifications for technoscientific [1] practice and rationality and their relationship to governance.

Ulrich Beck [1–4], and also notably Anthony Giddens [5,6], diagnose a condition of heightened urgency, risk and uncertainty as characteristic of contemporary industrial society (henceforth interchangeable with modernity, a synonymous term describing the society or movement arising from the enlightenment). For them, the dynamics of this condition are defined by risk and the expertise they consider to be partially constitutive of it, with expertise understood in terms of not only its established diagnostic role, but also in terms of a critical involvement in how risk is produced and disseminated in industrial societies. Beck identifies risk as the central organising principle of industrial societies with the production and distribution of risk now the key to understanding contemporary societies in the same way that the production and distribution of material goods have been traditionally regarded. Beck's analysis involves a wide-ranging diagnosis of the contemporary condition in which declining community faith in the ability of science and technical expertise to deliver certainty and control contributes to an erosion in the authority of dominant institutions, notably of governance, that traditionally relied on this expertise both functionally and to legitimate their authority. Giddens is particularly concerned with trust identifying its vital role in the maintenance of social stability and its vulnerability in the face of the risk profile of modernity. Both Beck and Giddens believe this state of affairs may be resolved by extending democracy from the traditional political sphere into the public sphere so as to embrace activities traditionally seen as apolitical including the production and dissemination of knowledge, a notion elaborated below. Beck believes that the only alternative to such an approach is an "authoritarian technocracy" [7] that courts catastrophe by reinforcing the current institutional arrangements, around which the proliferation of risk centres, and can only retain power by coercive means.

For Beck the calculative instrumental rationality underpinning both technoscience and contemporary governance currently serves not to reduce or mitigate risk but to compound it. This rationality — on which the ability of technical expertise to deliver certainty,

[1] This term is used as a convenient shorthand for natural science and engineering.

prediction and control is predicated — is coming under increasing pressure in the realms of both risk-management practice and governance. In the realm of practice, the insistence on traditional methods of prediction and control in the face of circumstances whose scale and complexity belies simple causal analysis hinders the implementation and development of more wide-ranging and sophisticated approaches, while governance is much complicated by the resultant heightening of public mistrust. Beck is particularly concerned with how this rationality and its failings are reflected in current institutional arrangements. He describes how the "prevailing rules of causality, guilt and liability" [8] act against their own claims to result in a lack of accountability and liability. In a useful analysis of Beck's work, Goldblatt elaborates upon how these failings are reflected 'in the prevalent relations of definition... a legal, epistemological and cultural matrix' [9] appropriate for the 19th century, but long superseded by contemporary conditions. This is elaborated in terms of how current regulatory systems embody principles of liability and attribution applicable to causally identifiable risks emanating from unitary sources, but are often inappropriate for contemporary conditions in which hazards are more characteristically diffuse, pervasive and indeterminate in origin. In particular, he sees the current inability of many industries and communities to obtain insurance in the face of a spectrum of contemporary risks [2] as convincing empirical evidence for the failure of current arrangements. The pertinence of these insights can be appreciated by an examination of any number of current issues and developments. From Brent Spar to BSE, we see these matters reflected in controversies whose resolution more often than not rests on the authorities divesting themselves of their original imperatives and taking up those long held by the broader community!

At the time of writing (late 1999) an instructive example of many of these matters [10] [3] is provided by the British Government's [11], and also the *Royal Society's* [12] approach to public concerns over genetically manipulated crops (GMC). Long standing UK public concern over this issue has escalated to widespread public disruption of GMC field trials in the face of official denials of risk and long-term inaction on the issue. Public mistrust has been amplified by an institutional obviousness to their concerns [10,13] in the face of the widely accepted partial nature of our understanding of this novel technology [10,14–16]. In disputes of this nature, technical knowledge and expertise lend themselves not so much to any 'rational' determination of them, but to their use as a resource drawn upon by protagonists to promote their positions (and more often than not denigrate that of their opponents). While the British Government and *Royal Society* act on the assumption of a legitimacy granted by the knowledge and expertise they command, wider UK civil society evidently sees things differently. However, not only is this legitimacy increasingly questioned by civil society [11,13], but the authorities actions (or rather inaction) are of themselves exemplary

[2] Beck cites the inability of nuclear power plants to obtain private insurance as a contradiction of their own claims of safety. Analogously the recent rapid increase in payouts for damages from natural disasters and the related sensitisation of the insurance industry to climate change is reflected in the inability of communities, such as populations on the eastern seaboard of the US, to now obtain insurance for storm damage.

[3] Written by the editor of the *Lancet* after this section was written this article not only effectively conveys many of the arguments presented here but also gives a valuable insight into the tensions generated within the scientific community by them.

of the erosion of that legitimacy [13] [4] . These are complex matters that cannot be done full justice here, but expanding upon one point crucial to the further argument of this paper. The assumption of a legitimacy resting on technical knowledge and expertise relies on the notion that these are perceived as apolitical. The concerned public, however, clearly perceive the ways in which 'facts' and 'values' are inextricably intertwined in these matters. While the authorities and expertise generally still remain heedless to these changes in broader public perceptions, often confounding themselves by pervasive misreading of the public mind (such as the long standing, but specious maxim that the public unreasonably demands zero risk [11,17]), civil society has been acting on revised understandings of science and expertise for some time. Greenpeace's very effective political use of science against science in recent years is perhaps the highest profile example of this, although such tactical and strategic use of scientific knowledge now extends far more widely. A example recently sighted by the author on prime time television witnessed the housewife leader of a residents group opposing the instalment of a replacement nuclear research reactor in one of Sydney's outer suburbs castigating authorities for not being up to date with the radiological literature!

This brings us to a central concern of this paper — the changing role of technical knowledge and expertise and the implications that this holds for matters of risk and governance. While decision-making has become increasingly based upon a purposive, calculative rationality, broader society's traditional faith in science's ability to provide determinate knowledge enabling prediction and control is coming under increasing strain. The problem this creates is compounded by how such conceptions of rationality have escaped their original confines in natural science and become the model for rational decision-making more broadly — including in the social and political spheres. This model assumes that it is almost always possible to characterise 'facts' defining an issue of concern in an 'objective' manner — that is to say in such a way as to ensure that those facts correlate robustly with the issue of concern untainted by 'subjective' considerations — and that effective decision-making involves determination by them. It is not just that the veracity of this approach is being questioned, but that the erosion in authority of traditional institutions correlates to a widespread public perception that the imposition of decision-making on these terms simply acts to privilege political or corporate interests. Now while many continue to maintain that current imperatives reinforce the necessity for such rational models of decision-making others are coming round to the view that these approaches are themselves pivotal to current problems. This latter view does not reject science and technical expertise as the best sources of knowledge on natural phenomena and their material application, but it does regard them as only one component in decision-making, viewed as a process that privileges human considerations rather than 'facts'. In this view managing current imperatives centres on choices fundamental to current and future lifestyles and the risk profiles they embody. Whether decisions are being taken on the management of a hazardous industrial installation, a watershed, or the greenhouse effect, we are in effect determining fundamental features of future societies and much of their flexibility of action. Looked at this way such decisions are not primarily technical matters to

[4] Haerlin and Parr [13] put it thus, "Arguing that science is the sole arbiter of policy action undermines trust in the concept of scientific analysis. The main culprits in the devaluing of scientific authority are not necessarily scientists themselves, but corporations and politicians, keen to rely on the illusionary picture of authoritative scientific arbitrators".

be determined by considerations of technology choice, ambient concentrations of pollutants or similar 'factual' considerations, but by matters of value. Values that revolve, most fundamentally, around what kind of future society we, the members of it, desire. This demands not an emphasis on 'facts', but an emphasis on the processes by which these decisions are arrived at, and on not only how 'facts', but also how 'values' are brought to bear in them.

To summarise. An insistence on 'rational' methods of decision-making, in which 'facts' are taken to determine outcomes, in matters where causal understandings are limited and risk, thus, indeterminate can both compound risk and fuel public disenchantment and distrust. In particular the inappropriate extension of this rationality to the value-laden domain of politics is contributing to a crisis of governance resulting from a continuing erosion in the perceived legitimacy of authorities arising from increased public distrust. Exemplified by the BSE issue [18] in which scientific appraisals were used to justify a particular agri-industrial beef production regime with disastrous consequences, these methods are reflected in current institutional arrangements and indicate a need for their reform. Such reforms should aim to achieve decision-making procedures able to integrate community and expert perceptions and insights so as to arrive at broad-based, and thus, more robust and sustainable outcomes.

The following section elaborates upon the implications of the risk society thesis emphasising the 'knowledge politics' perspective it grants to the role of science and technical expertise. The ensuing section elaborates upon more thoroughgoing analyses of technical practice and expertise that place them firmly among, rather than separate from other human activities, while the final section explores the insights garnered regarding future governance and technical practice.

2. The 'knowledge politics' of the risk society

For both Beck and Giddens risk has become a key societal organising principle, whose emergence parallels both the ongoing development of expert claims to define and control it and a rising public disenchantment with these claims. However, this disillusionment is itself reliant upon expert perceptions of risk (how else would non-experts understand modern hazards such as pollution, climate change, declining biodiversity, etc.) so that expertise becomes crucially constitutive of the risk society and inherently politicised as a result. This paradoxical knowledge dependency reflects the notion of reflexivity that is central to their work. This notion involves understanding modernity as being inherently reflexive in the sense that contemporary life is contingent upon and subject to ongoing change as the result of a dynamic flux of new knowledge and information. For Beck the paradoxical involvement of science in both the causes and solutions of contemporary risk is a crucial reflection of this reflexivity that he proposes to harness by institutionally reinforcing a trend toward a critique of its underlying assumptions that he discerns in the efforts of environmental and other similar citizen groups. His belief is that this will act to curtail the production of risk arising from the negative side effects of industrial development to which current arrangements are blind. He calls this process, described below, 'reflexive scientisation' [19]. Space precludes an examination of the effects of this reflexivity on the individual, on personal life and on conceptions of self, that are central to their analyses, but relevant insights to emerge are an increase in societal uncertainty and anxiety paralleled by

an expansion in opportunities for personal freedom resulting from an erosion of traditional constraints.

For Beck risk is now the key organising principle of modernity, the underpinning rationale now that of the distribution of 'bads' in the form of risks, resulting from technoscientific industrial production, rather than that of the distribution of material 'goods' hitherto taken to define industrial society. In this risk society the knowledge and expertise necessary to define, understand, ameliorate and control risk become a highly charged political commodity and "... the natural and engineering sciences *have become a branch office of politics*, *ethics*, *business and judicial practice in the garb of numbers*" [20]. Beck sees science as an unwitting accomplice to the proliferation of modern risks because of how "... *sciences' monopoly on rationality is broken*" [21], underlining how while science has become central to risk determinations these typically revolve around value judgements such as those implicit in the concept of *acceptable* risk. He identifies a break between 'social and scientific rationality' noting that "... scientific rationality without social rationality remains *empty*, but social rationality without scientific rationality remains *blind*" [22]. Beck, however, discerns the dominance of scientific rationality and a denial of social rationality in current institutional arrangements. This is reflected in how prevailing risk management methods and procedures are not only circumscribed in their ability to curtail current risk, but unwittingly central to the ongoing production of additional risk resulting from technical methods impervious to both the values they embody and those integral to their implementation. He coins the term "organised irresponsibility" [2,4] to describe how current institutional arrangements blindly engender the proliferation of risks while claiming to control them and concurrently act to denigrate and delegitimate opposition. This proliferation of risk occurs under 'relations of definition' (see introduction above) that induce an institutional blindness to these matters while the refusal to countenance other viewpoints reflects the monopoly of scientific rationality and denial of social rationality. Beck describes the consequences of this state of affairs in terms of the "social explosiveness of hazard" [3] identifying how incipient public disquiet with current institutional arrangements is capable of rapid escalation when tested. Recent examples that can be understood in these terms include the GMC field trails issue, discussed in the introduction above, and both the Brent Spar and BSE episodes.

Beck promotes the idea of an '*alternative* science' [23] to counter science's unwitting involvement in risk production. Science's role as "... *one of the causes*, *the medium of definition and the source of solutions* to risks" [24] means that science is often called upon to deal with the outcomes of its own practices. As science extends its methodological scepticism to itself a "... *demonopolisation of scientific knowledge claims* comes about: science becomes more and more *necessary*, but at the same time, *less and less sufficient* for the socially binding definition of truth" [25]. This process of 'reflexive scientisation', involving sciences application of its inherent scepticism to itself, results in a both a multiplication of knowledge claims and an extension of those involved in its production to encompass those to whom it is applied. While Beck perceives wider society to be central to this cultivation of an awareness by science of its failings and of its role in risk production, he emphasises the necessity of internal critique of science by scientists, although he is vague on the form of institutional vehicles for articulating these changes. In the sections below I will argue that such vehicles must be democratic bodies balancing cross-sections of relevant expertise with equally relevant cross-sections of societal interests, including politics, business and

the public, so that 'socially binding definitions of truth' can be arrived at that balance 'facts' with all relevant societal values.

The insights of Giddens are complimentary to those of Beck. Giddens is much less concerned with a detailed appreciation of science's role and more specifically focused upon the personal and psychological implications of the risk and trust profiles of modernity. Giddens makes a particular contribution in highlighting the crucial contemporary role of trust in large scale sociotechnical systems underlining how "*. . . the nature of modern institutions is deeply bound up with the mechanisms of trust in abstract systems*, especially trust in expert systems." [26]. While we rarely consider these dimensions when switching on an electric light or stepping onto an aircraft these relations maintain our world in ways such that threats to their stability fundamentally threaten social stability. In a discussion of trust and expertise Giddens describes people as making a "bargain with modernity. . . governed by specific admixtures of deference and scepticism, comfort and fear" [27] and is particularly concerned with the 'ontological insecurity' resulting from modernity's risk profile and its consequences. This latter concept refers to a deep-seated insecurity relating to matters fundamental to human existence such as ones self-identity and the constancy of ones surroundings, both social and material. He characterises a number of 'adaptive reactions' to this risk profile including 'pragmatic acceptance', 'cynical pessimism', 'sustained optimism' and 'radical engagement' [28] and identifies the latter, linked to contestory action and exemplified by social movements, as a vehicle for change. He elaborates such change in terms of a model for future governance that he calls a 'post-modern order' and that is briefly described in the final section. While Giddens is at pains to emphasise the difficulties of establishing trust in contemporary contexts his work indicates that the establishment and maintenance of such bonds is crucial to the viability and success of governance.

The institutional alternative advocated by both Beck and Giddens involves forms of decentralised democracy in which much decision-making, including that around technoscience and its implementation extends throughout civil society. These ideas and their implications are the focus of the final section below.

3. Risk, social process and technical practice

The view of risk and governance given in this paper involves an implicit understanding of the interdependence of technical and social matters ('facts' and 'values'). This perspective, is however, ill served by the western intellectual tradition that has evolved to deny these interdependencies and to promulgate a view of technical and social matters as existing in parallel, but autonomous domains [29,30]. This is a significant failing now widely reflected by both academic disciplines and institutional structures and practices, which are conceived primarily in terms of the perceptions of either one domain or the other, but rarely both, and almost never the interdependencies between them. Whereas for technoscience reality is social and understood to consist of established relationships between natural phenomena and their reflection in human material accomplishments, for the humanities and social sciences reality is a fundamentally social or cultural matter for which the natural and material aspects of existence are typically a backdrop of little consequence. This paper rest on the proposition that this set of dichotomous premises are fundamentally flawed, and a key to the ongoing

proliferation of risk and the destabilisation of governance at the core of Beck's analysis. The paradox of the proliferation of risk in the face of ever more stringent risk management efforts results from an institutional blindness to the inextricable intermeshing of social and technical matters, brought about by the unreflexive exercise of the view that facts exclude values and vice versa. Now while our practical handling of many contemporary problems (global warming perhaps being the exemplary case in point) implicitly acknowledges the complex interdependencies between technical, political and economic matters this working acknowledgement is pragmatic and lacks any firm conceptual recognition or basis. The premise that the technical and social are autonomous domains runs very deep in our culture, with Beck and Giddens both reflecting it in their work for example [31], and attempts to reconceptualise them in an integrative manner have only recently become a dynamic area of scholarship. This section briefly discusses examples of this work emphasising the value and nature of the insights they deliver.

Some of the most sophisticated unitary descriptions of the social and the technical/natural have emerged, somewhat paradoxically, from within critical science studies in which 'social constructivist' understandings that privilege the social in much the same way as conventional technical understandings privilege the natural/material have traditionally dominated. Among the most established of these unitary approaches is actor-network theory [29,30,32,33] that subsumes the social and natural within 'hybrids' or 'collectives' so that, for example, we can understand ozone depletion to be as much a matter of the internal politics of the chemical industry and of the Parties to the Montreal Protocol as it is of stratospheric chlorine loading, polar stratospheric clouds, CFCs, HCFCs, HFC etc. In this perspective risk can be understood to result from the interactions of complex collective ensembles of humans and non-humans, often today of a planetary scale. A condition of risk can be said to exist when the performance of an ensemble varies, or deviates, from that intended in such as way as to result in unwanted, deleterious consequences. While Beck explains the logic of the risk society in terms of how our efforts to control risk act to produce risk, this explanation serves to illuminate how the risks attendant upon ensembles are likely to be reflected in their scale and complexity (while not denying that the continuing application of technical fixes blind to wider considerations will likely act to compound risk). A notion recently developed within this tradition is that of 'ontological politics' [34] which serves to highlight how the choices that arise in the recognition of the interdependence of the social and the natural go to shape 'reality' [5]. Other related work includes that of Andrew Pickering, whose analysis emphasises the interweaving (he utilises the term 'mangling') of the social and material in technical practice [35] and how the 'facts' that arise are very much a hybrid affair, and the philosophical work of Joseph Rouse who also emphasises the central role of practices and drawing upon Foucault underlines the ways in which technical knowledge and power are co-constitutive [36,37]. The work of Beck and Giddens is itself reflective of a still conceptually immature thrust within broader social theory and sociology e.g. [9,38] motivated to account for the interdependence of the social and the material, but that is yet to deliver insights of a power surpassing those of Beck [6].

[5] In this perspective risk management can be understood as an exercise in 'ontological politics'.

[6] 'Unitary' approaches of the kind discussed here are discussed by Beck [4].

This work is wide-ranging. While pitched squarely in the philosophical tradition Rouse's 1987 book *Knowledge and Power* [39] elaborates, for example, upon how nature, and what we have come to regard as 'fact', have become so thoroughly intermeshed with society and value under contemporary conditions. He clarifies how current forms of technical control are predicated on a simplification of our external environment resulting from the extension of the laboratory and its methods. Rouse is not so much concerned to account for the direct impacts of new materials, processes and devices, but with their systemic effects and how they structure our options for action. The 'extension of the laboratory' he describes takes many forms and includes numerous taken for granted matters such as the imposition of universal quantification via standardised measures and the pervasive use of artificial and purified substances never previously found in nature. These all result in increasingly complex technical constructions transplanted into simplified and controlled external environments resulting in a constraint of 'natural buffering and self-regulation'. But the maintenance of both these technical constructions and simplified external environments requires human actions tied closely to their demands. These human made systems, thus, require the maintenance of 'complex organised actions' within narrow bounds and in some cases, such as nuclear power, may be catastrophically unforgiving of error or non-compliance. This therefore, results in a multiple amplification of risk — from the increased instability of simplified environments, and from human error or non-compliance with system demands and in the necessity for 'tight coupling' [40] between them. Power is reflected in how these relationships configure both what and how things are done, and with changed practices resulting from changes in knowledge reflected in a reconfiguration of power relations [7].

Such analyses serve to clarify many matters of significance. They clarify how our reality consists of a complex hybrid of humans, human made and non-human entities that embody human values on many levels. They clarify how, contrary to traditional perceptions, large scale technical systems are inherently political entities that serve to structure and maintain social opportunities and constraints. And most fundamentally they clarify how the systemic nature of contemporary problems requires systemic solutions open to a recognition of the interdependence of technical and social matters. They also clarify many specific insights concerning scale. Large scale technical systems require the maintenance of associated large scale social systems encouraging dependency, and requiring homogeneity and standardisation. They tend to be intolerant of error and a have a poor capacity to cope with change. Better, in terms of both risk and stable governance are more diverse, and generally smaller, arrangements that are likely be more forgiving of error and resilient to change.

While the concerns of this paper are reflected in recent regulatory developments, such as the precautionary principle (PP), their effect has been limited. Although, a detailed discussion of these matters is beyond the scope of this paper one significant point will I hope be becoming clear. Effectively resolving matters of risk and governance requires us to reappraise the persuasiveness of technical rationality in decision-making (rather than merely

[7] Rouse's later work in [37] extends this analysis in a number of ways emphasising the central role of practices in the construction of scientific meanings. Contrary to traditional notions of scientific meaning as a either: (i) a representation of universal aspects of external reality (science's own understanding of itself), or (ii) a representation of contextual effects (the 'constructivist' perspective), he shows them to be irredeemably local and situated in nature.

attempting to 'temper' it as the PP does). This will involve both a reappraisal of the technical practices that inform decision-making and the means by which their insights are applied, with resultant changes to both technical practices themselves and the institutional arrangements in which they are embedded. Ultimately, what we require are methods, procedures and institutional arrangements able to acknowledge, describe, convey and govern complexity beyond simple causality, often revolving around interdependencies between what are currently conceived of as either social or natural/material matters. The development of conceptual understandings able to facilitate such advances should be an urgent priority and provide a stimulus for greater trans-disciplinary dialogue between the natural and social sciences. Two broad interrelated current strategies aimed at these ends can be identified — firstly, opening up technical practice and related decision-making to broader society so as to ensure the values and commitments embodied reflect those of the community as a whole, and secondly greater rigour and sophistication in the conceptualisation and description of uncertainty (including potentially the role of 'values and commitments') [41]. In terms of present practice we can identify the rationale for 'opening up' technical practice to broader society at many points including local points of application, the decision-making arena and where technical advance has potential societal implications. A particular concern at local points of application is a tendency for local and indigenous knowledge and concerns to be marginalised or ignored, reinforcing the homogenising and standardising tendencies described above and risking the loss of potentially just those local resources able to ensure and maintain robust and sustainable outcomes. Greater attention to transparency, quality control and contextual inputs is especially crucial in the decision-making arena so that decisions are clarified as much in terms of the weaknesses and limitations of the knowledge base as of its strengths. Technical advance with potential societal implications requires supervision that balances interests across society and not just a narrow coterie of technical, corporate and political interests.

Opportunities for greater rigour and sophistication in the conceptualisation, description and communication of uncertainty include not only more advanced formal approaches [42,43], but also more informal discursive procedures involving all relevant parties and, of critical importance, the synergies between them [41]. Current approaches to uncertainty management are capable of particular enhancement with regard to the inclusion of criteria omitted or inadequately conceptualised and represented by current approaches [42–45]. The resultant ability to transcend broadly technical and social concerns will be crucial to the success of any 'opening up' of science along the lines described above and facilitate the production of new forms of 'public knowledge' integrating technical and social concerns. The generation of bodies of 'public knowledge' amalgamating technical expertise with broader societal insights, knowledge and values will be a demanding exercise [41]. Required will be means for developing shared meaning between parties who bring not merely different expectations, but also different cognitive preconceptions and value frameworks to the table. Inter-mutual trust and a respect for the knowledge claims of others will be a prerequisite for the development of such understandings. Frameworks of uncertainty encompassing both technical and broader societal parameters and concerns grant a particular opportunity for the generation of such bodies of 'public knowledge', but their effective application requires integration in effective processes structured to achieve these ends. Work on the procedural and institutional dimensions of these matters is of singular importance, but presently

immature [46,47], although promising developments in these directions can be discerned in the literature [48,49].

4. Wither governance and technical practice?

Beck and Giddens both develop a vision of governance that I have elaborated elsewhere in terms of a decentralised politics centring upon a democratic politics of knowledge [41]. This vision and its implications are expanded upon below after a brief outline of the proposals put forward by Beck and Giddens.

For Beck, the dynamics of the risk society will without remedy ensure the reinforcement of centralised state power around existing 'relations of definition' resulting in an 'authoritarian technocracy'. Beck outlines a number of solutions to this scenario centring on an extension of democracy and a restructuring of the 'relations of definition'. For an instructive analysis see [50]. In his master work, *Risk Society*, he elaborates such ideas in terms of a 'differential politics' [51] in which centralised state level politics becomes less a leader and more a player within a broader democratic process encompassing a decentralised civic politics which he terms 'sub-politics' [52]. 'Sub-politics' describes how para-state institutions and life across the public sphere including business, the professions, culture, personal life and pivotally science are becoming increasingly politicised. Beck's call for the institutionalisation of 'sub-politics' requires "*. . . the extension and legal protection of certain possibilities for sub-politics to exert influence*" [53] and involves strong and independent courts and media in addition to institutionally protected "opportunities for *self-criticism*" [53] as specifically envisaged in 'reflexive scientisation' (see above).

Giddens proposes a 'post-modern order' [54] encompassing 'multilayered democratic participation' and 'the humanisation of technology' closely echoing features of Beck's 'differential politics'. He describes 'multilayered democratic participation' in terms of ". . . democratic participation in the workplace, in local associations, in media organisations, and in transnational groupings of various types" [55] drawing upon an analysis of social movements and echoing Beck's notion of 'sub-politics'. He similarly correlates the 'humanisation of technology' with ecological movements and the need to curtail the instrumental impulse behind modern technological innovation and scientific development reflecting similar concerns to those underlying Beck's notion of 'reflexive scientisation'. By mapping 'multilayered democratic participation' and 'the humanisation of technology' together a very similar vision to that of Beck's 'differential politics' emerges. Central to this shared vision is a democratically facilitated politics of knowledge, predicated on extensive mediation and negotiation between interests across society, providing the underpinning to a broad based democratic process encompassing society as a whole.

This vision, thus, equates to a thoroughly democratic polity in which state level political institutions act as a mediator and facilitator for a complex web of decision-making bodies, prominent among which are those focused upon matters substantially technical, distributed throughout civil society. These are configured such that matters of technological innovation, scientific research, the impacts of infrastructure development, but also lifestyle, workplace and other singular personal and community level issues become properly the province of intense societal debate and consideration. Such a politics would be very different to the

representative forms of democracy with which we are familiar. Decision-making by proxy would be replaced by a dynamic and extensive process extending throughout the community and be predicated on power sharing between conventional political institutions and a host of newly legitimated bodies across the public sphere. Many of these will be focused upon the resolution of matters encompassing matters of techno-economic development and become fora in which new forms of 'public knowledge' amalgamating technical expertise with broader societal insights, knowledge and values will be articulated. This 'public knowledge' would exemplify the insights discussed above allowing complex technical understandings to be framed, discussed, and represented in ways that clarify embodied values allowing both more effective choice and their articulation so as to embody broad based societal values. The input and support of all relevant societal interests in these shared agreements or understandings will facilitate better, more robust outcomes. Not only will they garner the legitimacy and trust so increasingly problematical under current arrangements, but also demonstrate improved functionality in conventional terms. By bringing a broader range of perspectives and understandings together decisions are likely to demonstrate enhanced functionality in specific contexts, due to the input of contextually specific insights and understandings, and improved stability and resilience, both in social and more conventional technical terms.

While much of this may sound far from both current practice and what may be achievable it is instructive to examine correlations with present realities. An article to hand at the time of writing — "The non-governmental order — Will NGOs democratise, or merely disrupt, global governance?" [56] in the normally conservative *Economist* magazine actively canvasses the notion that NGOs may be heralding an extension of civil governance along lines convergent with those outlined above. In the risk field the promotion of participatory approaches on the basis of their functional advantage is widespread [46–48,57–60]. Unfortunately, while having become institutionalised in text books [61] these approaches are still only marginal to practice. In terms of governance the UK GMC episode described in the introduction is only one of many that epitomises the tensions identified by Beck and Giddens and elaborated here. Such failures of traditional institutional arrangements echo more mainstream political analyses and the prescriptions they advance. David Held, renown for his work on democratic theory [62–64], has recently articulated the idea of a 'cosmopolitan democracy' in which "It is possible to conceive of. . . a continuum from the local to the global, with the local marked by direct and participatory processes while larger areas with significant populations are progressively mediated by representative mechanisms" [65] reflecting key features of the vision elaborated above. These ideas also reverberate more broadly with for example, the discursive approaches to green democracy articulated by Dryzek [66] and Barry [67] amongst others. In terms of practice particularly notable is the emergence of participatory approaches echoing the concerns of this paper in the areas of Environmental and Natural Resource Management [68–70]. The participatory basis of these reflecting a particular concern to effect an integration between conventional technical and community understandings so as to ensure better, more effective outcomes.

5. Conclusion

The foundation upon which science has built its success — its instrumental, purposive, calculative rationality has now become a weakness. While the appropriate deployment of

this rationality is still critical to the ongoing viability of industrial society its inappropriate application in value-laden domains has become not only counter-productive, but deleterious, resulting in the proliferation of risk and destabilisation of governance. Deploying this rationality in such domains requires procedures and methods capable of mediating and integrating between what we have come to regard as 'facts' and 'values'. While the conceptual basis for such procedures are still weak it is apparent that an emphasis must be given to the processes by which this mediation and integration is brought about. Avenues toward the development of these include, but are not restricted to, extended approaches to uncertainty management, participatory processes and the linkages between them. The development of these will have important synergies for the further development of related conceptual understandings, but requires more substantive dialogue between the natural and social sciences than yet achieved.

An important current driver for these changes is an emergent recognition of the pivotal role of trust. In particular, a nascent understanding that community trust does not reside in technical rationality per se, emanating originally from science, but now the model for decision-making more generally, but in the institutions and procedures that embody and reflect it. As these fail this trust evaporates, necessitating the development of institutions and procedures able to regenerate and sustain satisfactory trust relations. Under contemporary conditions of complex, pervasive and multi-faceted risk only transparent processes that cater for all relevant societal interests in making the trade-offs necessary to decision-making are able to achieve this. The continued development of such democratic processes will be of profound consequence for the broader evolution of governance linking with and reinforcing a more general extension of democracy. Whether decision makers take up this challenge remains to be seen, but the alternatives are bleak resting on a paradoxical proliferation of risk achieved at the cost of increasing levels of coercion.

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