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Public participation in environmental policy: considering scientific, counter-scientific and non-scientific contributions

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Environmental policy depends for its success on public participation. However, the scientific construction of environmental issues often means that such participation in policy-making is difficult when the public is not considered scientifically 'expert'. Even if the notion of 'expertise' is broadened to deal with this problem, this does not ensure truly 'public'—i.e. lay—involvement, because lay ideas are still not included but are discounted as 'non-scientific'. Further, emphasis on the scientific and environmental education of the general public will not guarantee policy implementation by individuals. Therefore, if we wish to design environmental policy that can be successfully implemented, we must consider other ways in which people relate to their environments as well as through scientific mediation—ways in which people 'understand' their environments through culture, morality and social interaction—and build these into environmental policy.

Introduction

Policy-makers in the 1990s have accepted that the general public should be involved in policy discussions over contentious issues such as the environment. But one of the circumstances that can militate against this admirable objective is where the discussions are dominated by 'experts' of one sort or another. This precludes wide public involvement by defining the discussions as the exclusive preserve of 'experts'.

We need to explore this problem in order to advance the robustness of both environmental policy and academic understanding of its development. Specifically, we need to show whether scientific domination of the debate precludes public participation in policy design, and how this is manifested. Since such domination would also diminish policy implementation, we would have to consider how this might be remedied for environmental policy. Academic authors have already suggested ways in which the scientific debate might be widened to include views besides those of the traditional scientific 'experts'. These suggestions, although laudable, do not address the main problem because, as will be shown, they still exclude truly public or 'non-scientific' participation in debate. Also, they do not necessarily lead to the successful implementation of policy because they do not address the other ways in which people relate to their environment, ways which influence the uptake of environmental policy in everyday life. Consequently, policy tends to assume that providing environmental information and education will secure behavioural change, when behaviour is in fact intimately dependent upon public interpretations of the issues. I am therefore

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arguing that we need to consider more than the 'scientific' understandings held by the public when we address environmental policy. Widening the notion of science and the scientific contribution to environmental policy will not fulfil this objective, so we must also address other forms of contribution, especially those linked to the socio-cultural aspects of environmental issues.

I want to lay out my arguments by first establishing that public participation is increasingly stressed in environmental policy. Secondly, I shall show whether environmental policy is dominated by scientific and other 'expert' representatives, thereby forming an exclusionary debate. Thirdly, I shall consider the burgeoning research into the complementary but 'non-scientific' ways in which people understand their environments. Fourthly, I shall consider ways in which environmental policy debates might be broadened by extending the notions of expertise being used. After considering the limitations of these, I shall argue that other forms of 'understanding' besides the scientific might prove useful as passports to policy-making consultation, and that these require further research attention in the environmental field.

Public participation for successful environmental policy in the 1990s

> Countries . . . should encourage public participation in discussions of environmental policies and assessments.[1]

The necessity of public participation for successful environmental policy has been recognized for some years at both the international and the national level. At the international level, the documentation generated by the United Nations Conference on Environment and Development in Rio in 1992 (UNCED or the 'Earth Summit') emphasized the need for public involvement in the design and implementation of all sorts of environmental policy, as the quotation above illustrates. The Rio Declaration of key principles emanating from UNCED includes public involvement at paragraph 10 of nearly 30:

> Environmental issues are best handled with the participation of all concerned citizens, at the relevant level. At the national level, each individual shall have appropriate access to information concerning the environment that is held by public authorities . . . and the opportunity to participate in decision-making processes. States shall facilitate and encourage public awareness and participation by making information widely available.

Under this globally agreed interpretation, environmental policy should aim to involve the public not only in its design, to ensure thorough representation and consultation, but also in its implementation, to ensure that its targets are met through the actions of all individuals. Of course, the two aspects are complementary: policy should be designed so that it *can* be implemented by individuals, i.e. it must appreciate their views and constraints. Successful environmental policy has therefore been linked to the notion of 'concerned citizens', coupling individual action to institutional change in the name of environmental protection.[2]

In the major UNCED statement, *Agenda 21*, there is considerable reference to local and public participation, including participation by specific sections of the population, e.g. women, children, indigenous peoples and farmers. Specifically, Chapter 8 notes the need for better dialogue and 'mechanisms to facilitate the involvement of concerned individuals, groups and organizations in decision-making at all levels', and Chapter 28 says that all

local authorities should consult with citizens and local groups to build a consensus around a 'local *Agenda 21*' by 1996. This kind of policy emphasis has been interpreted to indicate that 'a new language of "empowerment", "citizen participation" and "multi-stakeholder partnership"' has been fostered by *Agenda 21*.[3] But such 'empowerment' is not clearly built into policy formulation. Often, public participation is relegated to the discussion of awareness and education, which implies passive absorption of information rather than active consultation. There is therefore apparently a difference between empowering people to *know* and empowering them to *act* which often goes unappreciated in environmental policy. For example, Chapter 36 of *Agenda 21* begins by noting 'a considerable lack of awareness of the interrelated nature of all human activities and the environment, due to *inaccurate or insufficient information*' (emphasis added), and primarily concerns itself with how to promote more appropriate values and behaviour through awareness and education. Participation is limited to specific structural changes within established channels of consultation and these reach out to non-governmental organizations (NGOs) rather than to the general public:

> whilst there has been considerable talk of the need for community participation and involvement in wider processes of public decision making as an integral part of sustainability, to date there has been little evidence of such participation outside the impressive but still limited arena of academics, NGOs, government and business.[3]

The UK offers an example of how public involvement has been incorporated into national policy-making. Since the 1990 White Paper on the environment,[4] the UK's Department of the Environment has clearly identified a strong role for individual action in accomplishing environmental changes, in line with the Conservative Government's aim of reducing regulation on individual action, and it employs notions of 'good citizenship' to emphasize this.[5] This makes the individual the repository of environmental responsibility and hence responsible for the success of governmental policies. Yet the public role is limited to participation in implementation, not in policy consultation. We can see this reflected in campaigns conducted by the UK Energy Efficiency Office since 1991, which used the theme of individual responsibility to encourage public participation in domestic energy efficiency and hence in reductions in carbon dioxide emissions. The campaigns drew upon scientific statements of the causes of global warming and linked this to everyday household uses of electricity. For example, in 1991 a full-page newspaper advertisement bore the slogan 'Global Warming. How much of the responsibility rests at your door?' over a picture of a kettle sending steam into a lightning cloud (presumably representing global warming). Such campaigns therefore focused upon participation in implementation rather than participation in policy-making.

Since the White Paper, public participation has been emphasized in the UK's sustainable development strategy (1994), which was prompted by UNCED developments, and this looked more intently at possible mechanisms of consultation with various publics as required by *Agenda 21*.[6] This strategy set up three bodies specifically for wider consultation: the British Government Panel on Sustainable Development (with 'environmental experts' as members), the UK Round Table on Sustainable Development (NGO representatives and academics as members) and the Citizen's Environment Initiative (environmental and political figures as members). The Panel was set up to ensure that the strategy progressed and specifically took 'environmental education and training' as one of its first two general topics, because this would:

> provide the population, including the workforce, with an understanding of how the environment relates to everyday issues and what action they can take personally to

> reduce their own impact on the environment at home, at work or in their leisure activities.[7]

Again, this emphasized information being passed 'down' to the public as well as implementation of policy by the public. In this way, the responsibility for action was separated from the responsibility for decisions.

The Citizen's Environment Initiative was set up to bring the message of sustainable development to both individuals and local communities, and the body was rapidly relaunched as the *Going for Green* campaign in 1995. Its campaign seeks to involve and promote individual behaviour, rather than focus solely upon education and awareness:

> *Going for Green* aims to turn the nation's good intentions concerning the environment into actions by encouraging, supporting and enhancing green campaigns and initiatives involving the public countrywide, and providing evidence of the environmental benefits.[8]

The campaign and comments by the UK Secretary of State for the Environment, John Gummer, at its launch focused on this link between awareness and implementation:

> sustainable development is something which we are seeking to insist on as part of, indeed at the centre of, all the policies of a Government. But it isn't any good if it stays there, if that's all that it is. It can only work if it becomes part of the decision making processes of every group one can imagine.[9]

This does not imply that every group will become part of the policy decision-making process: it is strictly a 'top-down' involvement of the public, contrary to what *Agenda 21* seems to be arguing for.

So, there is much emphasis on public participation in environmental policy in the 1990s, but it does not always make the important link between participation in implementation and participation in debate and policy-making. Even where this link is made and consultation is prioritized, there is as yet little evidence that this has made any impact in policy circles. NGOs have therefore continued to call for wide consultation and openness in environmental debates. For example, in a document prepared by a number of environmental NGOs in the UK in order to influence the UK Government's position at UNCED, the groups called for eleven principles for sustainability, number 10 being a 'commitment to full public participation in decision making and freedom of information in all sectors.'[10]

Of course, other forms of policy similarly emphasize public participation, especially in implementation. Health policies which advocate lifestyle changes are clearly predicated upon the individual adoption of policy advice, e.g. to stop smoking and to reduce the dietary contributions of salt and certain fats. However, environmental policy particularly has received a lot of media and regulatory attention in the 1990s as the field has gone through rapid and far-reaching expansion.[11] Moreover, the interdependence of environmental processes means that the effects of individual actions may not only impact on the individual but also reflexively influence the situations of other (often quite remote) individuals and groups. Coupled with the potentially synergetic quality of environmental change, this implies that environmental policy must therefore deal with large-scale (global) and high-risk impacts rather than more containable, individualistic effects. This makes environmental policy an interesting area for monitoring the progress of public participation, where the lessons learnt may also be applicable to similar, if more individualized, foci of policy development.

Science and public participation: some groundwork

Having established that environmental policy identifies a strong need for public participation, we need to examine the second half of the problem as to why this is not being fulfilled. This revolves around the way that the debates are constructed mainly by and for 'experts' in scientific disciplines, largely excluding the public and therefore making their participation less sure and the process of policy implementation strictly 'top-down'.

Although several authors have considered this, one who examines it particularly clearly for environmental issues is Ulrich Beck.[12] For Beck, environmental examples predominate as illustrations of risks in his 'risk society', e.g. risks from modern factories (Bhopal), risks from modern nuclear power generation (Three Mile Island), and risks from the ingestion of modern pesticides.[13] He argues that science mediates between some actual environmental process and the perception of an environmental 'problem' by social groups, making science influential in environmental policy debates. In this way, environmental science is a fundamental (although not the only) identifier and definer of environmental issues as 'problems' requiring policy action, because environmental threats are increasingly only evident through science's sensory organs, rather than through people's everyday senses.[14] This makes science the main channel of environmental information, especially for global issues:

> We know we have global environmental problems because, in short, science documents the existing situation and ever tightens its predictions of future changes.[15]

Perhaps the best (and best known) example of a global environmental issue influenced by science and brought to international policy attention is stratospheric ozone depletion, a problem derived from modernization (in this case, from new chemical compounds: chlorofluorocarbons or CFCs) and primarily constructed in terms of atmospheric chemistry: the observations are taken by a small number of specialists and then communicated to the public and other groups in the environmental debate. The globalized change is located in the results from teams like the British Antarctic Survey, not in the everyday experiences of members of the public. So, it is not too simplistic to say that without the science of atmospheric chemistry, we would not see any ozone problem.[16] Moreover, science at first calculated out these ozone depletion measurements by regarding them as errors, only later to regard them as 'facts' once the techniques of measurement and its interpretation were (internally) changed, emphasizing science's hold on the identification of the 'problem':

> The debacle of the 'hole' in the ozone layer, undiscovered for so many years because its observers programmed their computer to ignore measurements that diverged too greatly from expected norms, notoriously proved how highly 'interpretive' such climatic experiments can be.[17]

Hence, the problem was constructed and presented to the public, firstly by science but with rapid uptake by the media, business groups, government and international policy debates. It was then globally recognized in the 1987 Montreal Protocol, an international agreement to control substances implicated in stratospheric ozone depletion. It was, however, also very strongly linked to public action at the individual level: the boycott of CFC-containing spray cans orchestrated primarily by Friends of the Earth in 1988 was very successful in communicating the scientific consensus, which had by then emerged, to the UK consuming public and reinforcing regulatory incentives for business change. In this case, scientific argument and international policy became interdependent, with input from industrial technology. But public participation remained in the realm of implementation.

One could, of course, make a very different argument for global warming. Science is part of the construction of this 'problem' in that it measures temperature change, monitors the atmospheric levels of 'greenhouse gases', such as carbon dioxide and methane, and paints a global picture of change. The politicization of the issue was also clear enough at UNCED in 1992. However, the roles of the media, people's own experiences[18] and the possibility of addressing the problem and therefore of reducing the risks have all been very different from the ozone case. Another aspect that militates strongly against international agreements to curb greenhouse gases is cost, due to the centrality of the implicated fuels in western economies. Here the discourses of physical and chemical sciences seem to be in increasing opposition to those of economics and business. Like the physical sciences, economics has always embraced positivistic methodologies, through quantification, modelling and 'rationalist' and modernist assumptions about human behaviour. But the sustained differences between the two sets of discourses remind us that science, at least in terms of input to policy-making, is not a heterogeneous enterprise, but a multiplicity of approaches which may display more or less unity depending upon the implications of a particular environmental issue for the fortunes of each. In addition, the connection of economic 'science' to more pragmatic business paradigms of environmental management strengthens the policy influence of this nexus, which may at times reinforce (physical) scientific arguments and at other times argue against adopting policy targets without an evaluation of their costs and benefits.[19] The latter case is perhaps best illustrated where global warming policy discussions have centred around ideas of a carbon tax, particularly in Europe where business has steadily lobbied against such measures in the face of a consolidating scientific consensus.[20]

However, to a certain extent, economic and business discourses are reactive to both the identification and the confirmation of environmental issues by physical sciences. Hence, the former's influence has been on the design of environmental regulation and negotiation of targets, rather than on the initial content of the environmental agenda. Indeed, during the late 1970s and early 1980s, the development of scientific interest in stratospheric ozone depletion was resisted by business interests because of its implications for research and development expenditure and operational restructuring.[21] Once the scientific and political consensus globalized, i.e. after the Montreal Protocol was finalized in 1987, industry sought to recapture its control over the environmental debate by claiming proactive measures to meet and exceed the Protocol targets. For example, in 1988 Du Pont announced that it would stop producing CFCs completely and a collective of eight British CFC manufacturers did the same.[22] We can see that science is a key identifier of environmental issues for policy attention, but the adopted policy forms are also influenced by other discourses about economics and business.[23]

Scientization of policy and politicization of science

In general, it is clear that the role of science is changing, especially where scientific authority is called upon by policy-makers and pressure groups with reference to global environmental issues.[24] Beck argues that the 'perceptible' risks of starvation, of exposure to naturally occurring diseases and to other (pre-modern) risks in society are now being overtaken by the 'imperceptible' risks stemming from modernization itself, the classic case of such a risk being radioactivity. However, because people cannot perceive these risks through their normal sensory organs, they become 'dependent upon external knowledge'[25] so that they lose their 'cognitive sovereignty' even over very personal hazards to their health and well-being. According to Beck, people rely on 'second-hand non-experience' because of the

'imperceptibility' of risks, and especially they rely instead on science's identification of risk causality in order to recognize and understand their own (personal) risks and their position in the 'risk society'.[26] This 'second-hand non-experience' is exemplified in the case of global environmental risks as suggested above.

> As knowledge concentrates in specific sites in the social order, access to it is maintained through relations of trust and authority. What can no longer be called in by the individual from his [*sic*] own personal memory is called in from a trusted knowledge source.[27]

We arrive at the scientization of environmental problems: they are identified and primarily constructed through the application of scientific techniques and reasoning, as we saw for ozone depletion above.[28] As this scientization proceeds, Beck suggests, the latency of risks begins to give way to their recognition: they become more obvious, and more exposed to public view through scientific mediation, while other not-yet-recognized risks remain latent and multiply in obscurity.[29] Because it is central to the identification of environmental risks, science is becoming increasingly important to a vast array of policy decisions on how to deal with those risks, raising its public profile and strengthening its ability to shape society, especially in the regulatory realm under the 'expertization' of science.[30] This is particularly important in technical areas, e.g. environmental change, where even policy decision-makers feel excluded from information. For example, in response to a question asked of the Chair of the UK's *Going for Green* campaign mentioned above, he responded that the members of the central committee were 'not yet expert' and were therefore dependent upon other groups for information.[31]

But the transformation is reciprocal: as policy issues become scientized, science becomes politicized and drawn into policy formulation. Technical authority enters moral and socio-political realms, so that, in the case of transboundary acid rain in Europe, scientific results were used by different states to argue for particular policy positions.[32] In another example from recent years, the World Resources Institute (WRI) used greenhouse gas emissions data to rank countries in terms of their contributions to the global total. Because WRI had selectively used four key greenhouse gases, had not incorporated the effects of greenhouse gas 'sinks' as well as sources, and had employed deforestation rates averaged over short (and possibly unrepresentative) time periods, it was criticized for 'sweeping and unsupportable generalizations about the lack of responsibility for the past and the impossibility of knowing the future'.[33] These inadequacies were seen to favour ethnocentric western (particularly US) interpretations of global responsibilities, which preferentially placed the burdens of reform on countries in the South. These methodological criticisms were weighted further by the perceived US policy influence granted to the WRI because of its 'impeccable reputation within official circles as publishers of environmental data'.[34] Consequently, the Centre for Science and the Environment (CSE) in India offered a different interpretation of the WRI data to redress the balance in favour of the South and were in turn criticized as ethnocentric and crude in their assumptions.[35] The assumptions of scientific policy advice are therefore not inviolable, nor do they reflect merely disagreements within scientific circles, but they are contextualized by different policy and regulatory regimes. Hence, environmental science is politicized by its connection with policy and becomes more open to criticism and more dependent upon public legitimacy.[36] In particular, the whole debate about global warming has become increasingly bogged down by publicized scientific disagreement and dispute, leaving the public clearly aware of the concept but confused, frustrated and even disillusioned about the need for and type of action.

This case illustrates how the role of science in policy-making differs according to the political context. Jasanoff notes three main national approaches which illustrate the variability in the scientization of policy-making and its dependence on scientific expertise:[37]

(a) the German model, where decisions are made ultimately by technical experts in private forums (a technocratic model);
(b) the British (and Canadian) model, where decisions are made in the public eye, are based upon negotiation between scientific and administrative experts and advocate ad hoc, flexible legislation coupled with regulatory practices founded on cooperation and discretion;[38]
(c) the US model, where political experts take the final decisions after wide consultation in the public realm, even in areas of considerable scientific uncertainty (a decisionistic model).[39]

This does not mean that the USA has solved its public participation problems because it has a more formal incorporation of the public than other national policy regimes. It has developed formal participation based on generic rules of policy-making, but these can be changed only slowly and cumbersomely and the arenas of debate tend to be very adversarial and litigious because of the participation by many opposing groups.[40] Although the powers of the US administrative élites and the 'publicness' of their policy discussions tend to resist regulatory 'capture' of government agencies by their interest groups (especially by industry, often a problem for the UK's regulatory model), there is some debate over whether the resulting policy is any more effective than that resulting from more closed regimes.[41]

Moreover, the role of science can still be critical, if not determinant, in the more 'participatory' model. Although US policy-makers are vested with ultimate decision-making power, they still need to clothe their decisions with science, because of the political and cultural demand for scientific rationality. The difference between this case and that of the UK is that a decision in the former may be merely 'a scientific veneer for what remains in the end a subjective decision' rather than primarily a scientific decision.[42] This paper focuses on the European case so that, although what follows has some relevance to the US experience, we should bear in mind these divergences due to political cultures when considering its international applicability.

Even so, from this section, we can see that science is generally very important in environmental debates: in setting the agenda, defining the scale of the problems and evaluating solutions, often in conjunction with other 'expert' discourses as offered by economics and business. This is explicitly acknowledged in *Agenda 21* which states (in Chapter 35) that a 'role of the sciences should be to provide information to better enable formulation and selection of environment and development policies in the decision-making process', thereby bringing science within policy circles. Beck therefore argues that science is one of a set of 'subpolitics' which are increasingly gaining the political power which was once solely the preserve of government, and yet are failing to guarantee their own public accountability because of their distance from public attention and legitimation. This reinforces my initial problem whereby public participation is sought by policy-makers in policy implementation but neglected in policy formulation in favour of more scientific accounts. Where the link to implementation is built *subsequent* to policy determination, this weakens policy effectiveness.

Non-expert based public participation

From the above, we can note that public participation is necessary to environmental policy but is prevented with respect to global issues because of scientific mediation and dominance over policy formulation, particularly in Europe, which consequently exclude public input. However, once we move away from the global level, there are other ways in which the public can connect with environmental issues as well as through scientific mediation and 'top-down' environmental education, ways which can be seen as more empowering than these. They rest on a public ambivalence to science, which means that 'scientific' and what we might call 'non-scientific' environmental understanding can cohabit in the individual consciousness.

How can this happen? While once cultivated as a source of hegemonic authority by the traditional scientific community, the exclusionary nature of science, in effect autonomy without accountability, was seen by the Royal Society a decade ago as increasingly distancing science from ordinary people in the UK.[43] Yet there remains a widespread public interest in the environmental issues raised by science and the counter-science of environmental NGOs, e.g. stratospheric ozone depletion in 1988–1989 and air pollution and asthma in the summers of 1994 and 1995,[44] and many people still look to science as the ultimate arbiter of imperceptible, especially global, issues. This means that the public's relationship with science is complicated and, although people can be both critical and credulous of science, in the public arena they have not always had the power or the confidence of their own 'expertise' to raise their criticisms forcefully: people exercise self-censorship of their scientific critique because they perceive science to have far greater power than they do. In compensation for this silence in the public arena, Lash and Wynne suggest that a vernacular critique may operate in people's private worlds.[45] As Michael notes:

> People are not solely disenchanted and disinherited in the face of science; rather, they discursively maneuver [sic] around in a variety of trajectories that can, on the one hand, sustain the mystique and the status of science and, on the other, undermine them.[46]

It is the ways in which people undermine the domination of science in their own worlds which would seem to offer scope for active public participation in environmental policy. This is because although many global environmental issues are primarily identified and documented by science, science is neither the primary motivator of environmental action nor the main source of environmental knowledge. First-hand experience can also be empowering and contrasts with the 'second-hand non-experience' provided through science (according to Beck and detailed in the previous section). People therefore look for justification through non-scientific knowledge at the same time as seeking the 'second-hand non-experience' that science offers them.

Research into these issues has been quietly assembling in recent years, and I want to pick out a few key examples which examine other routes to environmental 'understanding' besides information from scientific 'experts'. For example, Ross draws out the differences between (first-hand) experience of local weather and the increasingly distanced (and second-hand) experience of global weather, to which we can attach global environmental issues more widely. He suggests that the US public's initial interest in global warming theories was *solidified* by (immediate and locally experienced) unusual weather and several noticeably warm years in the USA (to 1990), so that global warming took on 'a factual status in public consciousness'.[47] In the UK, the cold, wet summer of 1991 was perceived by people as a factual *contradiction* to the global warming theory, but the more recent hot weather of 1995

led to greater media coverage of global warming as immediately perceptible environmental change.

So, people look to science for unequivocal 'data' but can adopt their own interpretation through the use of either moral judgements or 'first-hand experience' (as opposed to 'second-hand non-experience') and hold to this where science would contradict it. The balancing of the two 'understandings' needs to be more fully addressed through research. Particularly, it seems important that we assess the relation of environmental knowledge to scales of perception. People's experiences often relate closely to local environments, and in this way contrast with the scientific dominance of the debate about the global environment. 'Their very strength is in the observation of specific areas of everyday reality' because this contextualizes public 'understandings' and compensates for science's search for universality.[48] This is shown in work on public understandings of environments, where these oppose or at least diverge from science's representations of those local environments. For example, Burgess *et al*. have explored how people compare their own more local perceptions with those of (traditional and counter-science) experts.[49] When the Rainham Marshes in Essex, UK, were proposed as a site for an entertainment complex, the nature (counter-) 'experts' built a case for the area's preservation against the arguments of the (traditional and business) 'experts' of the developers by focusing on the high natural quality of the marshes, in terms of rare species and importance of habitat. In contrast, local people perceived 'their' area to be of low natural quality and therefore did not accept the ('expert') conservationists' case.

Beder also examines an Australian case where first-hand experience was prioritized by the public over the traditional scientific authority of local government.[50] The pollution of Sydney's beaches was 'seen' through immediate usage by surfers and other beach-goers but not 'seen' through the scientific reports and rhetorical arguments of the authorities. In the mid-1980s, when the authorities in favour of new sewage outfalls attempted to close the debate through redefining the health debate about polluted water as a solely aesthetic problem, they failed because the beach-goers preferred their own experience and intuition that the visible pollution was damaging to their health. It was only in the light of rising environmental consciousness, however, that there was a real grassroots swell of protest by those using the area. Relying on their familiarity with the environmental conditions, they sought to reopen the debate on policy solutions and to participate in it more fully than previously.

So, first-hand experience of local environmental issues is contingent upon local knowledge, direct perception and familiarity. The conflict that this can have with 'expert' and 'second-hand' knowledge is clear from the studies of Burgess *et al*. and Beder, demonstrating that it is not only through scientific mediation that people perceive and construct ideas about their environment. However, we can usefully distinguish between the global and local environment because the former lends itself to scientific mediation whereas the latter is more open to public construction of ideas and therefore to potential policy input. It is clear that environmental policy at all scales needs to relate explicitly to everyday behaviour, not merely to educate people in the secrets of 'big' environmental science: the local and the mundane are also important.

Promoting public participation: extending expertise

Having demonstrated that public involvement is called for in environmental policy but that policy formulation is dependent upon scientific expertise, we can see that the public tends to be excluded from policy formulation, especially on global environmental issues.[51] The need

to promote public participation in policy debates, and also in the resulting implementation, is clear; but the way to do this effectively is not.

One way that has been offered is through extending the notion of expertise in policy debates, particularly in Europe where open policy debate has been less common than in the USA. Authors have sought to retheorize or even revolutionize the basis of 'expertise' and therefore the criteria for public inclusion in the debates. This argument rests upon 'reflexive scientization', whereby science is subject to greater public exposure and consequent demystification and criticism, particularly where legal reasoning and rationality are the bases for legitimation—which is often the case in contested environmental issues.[52] From the German experience, where technical élites traditionally dominate policy formulation,[53] Beck claims that a new 'logic of risk distribution' would therefore democratize the workings of society because science would become less opaque to public view as it becomes more essential to the political process, albeit in strongly mediated situations.[54]

This democratization suggests that the exclusionary zones around science, built up through the role differentiation and specialization of 'experts', become less authoritative and more vulnerable to attack.[55] The scientific monopoly on rationality is broken and knowledge sources multiply so that a dialectic of expertise and counter-expertise is set in motion: science expands as other scientists enter the fray.[56] This can be seen as a positive contribution to the debate and even part of the increasing sophistication of disputes about environmental change.[57] Indeed, Fischer calls for 'participatory expertise' as a conscious part of the pluralization of knowledge to bring other points of view into scientific and business risk assessment, which he sees as too closed at present.[58] Similar arguments are presented by Tombs, who suggests that chemical industry managers could enter into a dialogue with the environmentalist counter-scientists, which intimates increasing participation in the sense of Beck and Fischer, albeit still emphasizing the power of the industry which initiates this dialogue (and presumably remains the more powerful participant).[59]

Such changes to expertise made in order to democratize the environmental debate have been explored particularly clearly and with an eye to policy by Funtowicz and Ravetz, in a European study which echoes some of Beck's arguments. Again focusing on global environmental science, they consider that the high risks and large potential impacts of the environmental changes involved mean that traditional science is no longer able to cope—it is incapable of reacting satisfactorily to 'civilizational risks'.[60] Hence, 'second-order science' develops which can acknowledge and embrace those high-risk problems because it incorporates 'extended facts'—those which are introduced into the scientific debate on policy but are not of scientific quality. They include 'people's beliefs and feelings … anecdotes circulated verbally, and then edited collections of such materials prepared for public use', and are not bound by the inadequacies of scientific uncertainty.[61] These enrich the cognitive basis of the debate and facilitate the extension of the traditional scientific community to those who are 'technically competent but representing interests outside the social paradigm of the official expertise', i.e. they have expertise in both strictly 'scientific' and 'extended' facts.[62] This partially echoes Beck's democratization of science where he asserts that reflexive modernization leads to the scientization of protest against science, i.e. that critics of the results of science (e.g. CFC producers) also use scientific techniques to research and argue their cases.[63] Moreover, risks produced by science (as technology) are less and less latent and more and more open to examination by publics. This means that, despite the failing credibility of science's 'truth', science expands through the emergence of 'public-oriented scientific experts' or, more clearly, 'counter-experts'. This view of 'new' experts is found in different guises in the literature, but for Funtowicz and Ravetz, this expansion of scientific scope produces 'extended peer communities':

> the exclusiveness of traditional science is broken down … where self-taught activists, aware of the presence of extended facts, and motivated by their concern for family and livelihood, become more skilled in the forensic side of the relevant sciences than the institutional experts whose own training in the area was modest …. The extended peer community thus functions as a first step towards a democratization of science … a diffusion of knowledge and power [from below].[62]

In other words, the politicization and democratization of science allows people, primarily activists within environmental NGOs, to become 'counter-experts' who are scientifically competent through self-education but also employ traditionally 'non-scientific' forms of argument, such as morals and emotions, particularly where the issues under discussion could have enormous public impact. According to Wynne, this means that 'relevant publics are no longer merely "impacted," they are knowledge generators', heralding 'a first step towards a democratization of science' and a diffusion of such information throughout the debate.[64] This process would herald a 'greener' form of science which would be more open and self-critical:

> it would make the uncertainties of scientific knowledge explicit and encourage rather than obstruct a wider public debate about the dangers and benefits of pursuing a certain path.[65]

The environmental debate is therefore an interesting amalgam of:

(i) traditional ('value-neutral') science;
(ii) counter-science, using traditional scientific methods and styles to argue for environmental protection; which also draws on:
(iii) what is often disparagingly called 'anti-science' but which Funtowicz and Ravetz more correctly call 'extended facts', which are needed to extend the scope of science in very risky and large-scale environmental debates and to reappraise its contribution in a constructive way.[66]

Here, we should be careful to distinguish the form of democratization. Beck concentrates on democratization through the extension of 'rational' forms of argument.[67] Funtowicz and Ravetz extend democratization in the direction of morals and feelings such that 'extended' expertise represents a self-conscious challenge to the ability of traditional science to make normative and policy judgements.[68] It employs moral arguments as well as new models of science. However, it does not necessarily deny all science and its methods in favour of justifying policy through spiritual or normative arguments alone, because environmentalist critics of science are critiquing not science or technology *per se* but their domination through scientism and technocracy.[69] Extended expertise is attempting to emancipate society from science through science, by using counter-scientific and alternative arguments in the extended debate.[70] However, Yearley sees things more pragmatically and argues that environmentalist counter-science *must* rely on the traditional authority of science because this is the only legitimation for the environmental movement in late modernity.[71] This is a more negative view of the relationship between science and the environmental movement and, like Beck, concentrates on the 'rational' and cognitive dimensions of the environmental debate.

But extended expertise is still expertise

This understanding of the increasingly permeable boundary of traditional science is important in elucidating the relationship between science and the public and between

science and the environmental movement, but it does not solve our problem for public participation in environmental policy. Counter-science is important for industrial and environmental NGOs, but the public still remain outside the realms of expertise, science and counter-science. Even in the more exposed USA policy-making arenas, it seems that the sophistication of many technically based debates, and the domination of decision-making by political interests, may still ensure that confrontation remains primarily between scientific and administrative élites, albeit in a public forum.[72] For the less participatory European case especially, Beck argues that the extension of the rational franchise and discursive power to all will lead to a 'rationality'-driven full democratization of the debate through the politicization of science and the politicization of people as alternative 'experts'.[67] According to Bronner, 'The vision of Beck is built on a belief in tolerance, multiplicity, and an "unfinished" notion of democracy'.[73] Even after acknowledging that this normative project is as yet incomplete, Beck's vision throws up some problems in terms of how the public can participate in the environmental debate: 'rational' contributions based on some form of scientific understanding are not the only possibilities, as we saw when considering local environmental information above.

Environmental science is clearly being expanded, involving an 'extended peer community,'[74] but there are still many left outside that expansion. Inclusion requires some level of technical competence which may be complemented by 'extended facts' but not replaced by them. We have not yet seen the full democratization of science—there are still privileged groups and excluded groups. Knowledge, the passport to policy participation, is still filtered according the power relations in society,[75] and it is those power differentials that Beck does not address in his discussion of the democratization of science and the political debate.[76] People feel that their non-expert status is sustained by those in power and debate is engineered to be exclusive[77] and exclusionary, because of the power relations. Extended scientific knowledge may increase the number of players in the environmental policy debate but it will not change how the game is played.

For example, in the case of Rainham Marshes referred to above, 'first-hand' local knowledge (we should perhaps say visible or immediately perceptible knowledge) was prioritized as trustworthy over the 'second-hand', non-experienced knowledge of the experts, even though those experts represented what I have been calling 'counter-science' rather than traditional science.[78] In this case, Funtowicz and Ravetz's 'extended peer community' operated where activists made use of (ecological) science to argue their viewpoint on a diffuse and non-technical problem. However, despite this counter-science and extension of the scientific community, full democratization of science was not evident—the people interviewed in the study often identified themselves as 'non-experts' by ultimately deferring to science as the final authority and source of power. The perceptions of people particularly about their local environments may fit the realm of 'extended facts' described by Funtowicz and Ravetz, but this does not equip those people to enter into what they see as the scientifically constructed environmental debate, unless they are identified as representatives of counter-science, e.g. spokespeople for NGOs.

So, there has been an call for the opening and democratization of environmental debates through public inclusion but the completeness of this democratization is hampered by its dependence upon rationality. A fuller democratization would be founded in the exploration of 'extended facts'. In considering what these 'non-scientific' forms of expertise might look like, several characteristics suggest themselves. Firstly, they would offer 'local knowledge', grounded in their own experiences and observations.[79] Secondly, they would develop 'contextual knowledge' through holistically linking factors that science has traditionally separated, e.g. data collection and interpretation. Thirdly, they would involve

'active knowledge' which relates to practical actions and action situations, reinforcing the necessity of linking policy design and implementation through behavioural considerations. These would all emphasize plurality and heterogeneity in contrast to science's usual search for orthodoxy, replicability and universality within its modernistic frame of reference. Incorporating such knowledges and understandings into environmental policy formulation would not replace but complement more traditionally 'scientific' approaches, especially at the local level.

It is however difficult to see how such knowledges might achieve acceptability in the context of wider, especially global, environmental issues where it is far less possible to demonstrate their grounded strengths. Further, it is clear that the legitimation of these kinds of knowledges will take time and effort to establish: at present, the moral, ethical and even emotional arguments which they imply are often used expressly in order to denounce public (and sometimes NGO) policy participation as 'irrational', 'anecdotal' and 'unscientific', and to exclude publics from the debates, e.g. through the diminution of lay persons' arguments in the face of risk managers.[80] Traditional risk studies have shown the exasperation of scientists with the public's denunciation of scientific 'truth' because it fails to relieve their own concerns.[81] Beck asserts that this perception by traditional scientists (especially risk scientists) that public disquiet is irrational 'is *wrong*'.[82] The disquiet originates in the failure of science as part of the whole process of modernization and the 'fundamental gap between different forms of understanding and expertise'[83] rather than the failure of people to understand the risks they run. We can link this disquiet to the democratization of environmental science and the emergence of environmentalist counter-science. Both of these facilitate the expression of public disquiet by putting science more fully in the public spotlight and by providing criticisms of traditional science which draw on authority which (non-expert) people often feel that they lack.

It has further been argued that a concentration on the scientific and rationalistic forms of participation militates against the adoption of a 'diversity of contestation' whereby individuals can protest about and involve themselves in environmental policy formulation. This contestation should be wide enough to include symbolic protests drawing on emotional, artistic, moral and other forms of expression as part of people's immediate relation to their environment:[84]

> Gut feelings and intuitions are natural tools; they entail a mix of phenomenological authenticity and direct insight into the world.[85]

Where these feelings are rejected in policy debates, so is a whole realm of significant import to the design and implementation of environmental policy.

So, there is a divergence of views about the role of vernacular environmental knowledges in environmental policy debates. The current dependence on scientific construction militates against their inclusion, and yet the local level and the call for public participation in policy formulation would seem to necessitate their appreciation.

Public participation in implementation

Much of the above has concentrated on participation in policy formulation because this has been considered more in the literature under review. A related problem is the encouragement of public participation specifically in policy implementation. This is closely connected with policy formulation because, as already suggested, that formulation must anticipate and appreciate implementation issues. Therefore, participation in implementation logically presupposes participation in formulation. For example, policy targets must be

set in consultation with those who must act to achieve them in order to make the targets feasible and to consider the best means to encourage compliance. This is common to all kinds of environmental and non-environmental policy where non-regulated public actions carry the burden of policy success. In the area of industrial regulation, for example, business is customarily consulted during policy formulation precisely because its importance in implementation is recognized.[86] It is time that this argument was applied to *public* participation.

One problem is that public participation in implementation is commonly separated from participation in policy formulation. The *Going for Green* campaign mentioned above seeks to remedy this by linking environmental issues and personal action:

> The connection between the big idea and our own personal activity is very, very difficult to establish. And in a sense, that's what *Going for Green* is about. It's linking those great ideas and ideals to which we are committed and from which there is no turning back, to the every day actions and the way we live, so that they can be turned into reality . . . .
>
> There is a need to give to the ordinary actions of life that understanding of how they can affect our environment that will lead us all to change our lifestyle.[87]

But policy still fails to appreciate the huge gulf between information and action, between understanding as awareness and understanding as the cause of behaviour. Policy-makers seem to assume that environmental education, drawing from scientific work, will lead to people making the link between policy and action and acting in order to meet policy objectives. This again assumes that lay people do not grasp the scientific and rational reasoning behind policy debate, that they must be informed subsequently of its successful conclusion and the proposed solutions, and that the communication of these will produce public action.

But the studies cited above undermine this happy logic. Environmental education may not lead to public participation because people make the links between their actions and the environment in other ways besides accepted rational and scientific ones. It is not solely through 'top-down' information that people act, but according to a panoply of cultural resonances and perceptions of their own environmental responsibilities.[88] For this reason, the UK's Panel on Sustainable Development called for an interdisciplinary approach to environmental education, which included 'philosophy, ethics, religion, and community and social responsibility' alongside natural science in order to develop in people 'an appreciation of environmental values.'[89] This reflects the emphasis in *Agenda 21* (Chapter 36) on environmental education as interdisciplinary.

Extending the notion of expertise, then, does not necessarily affect how people behave in relation to environmental policy, because they are still predominantly outside it and because it does not make a link to their everyday behaviour, only to their information levels. Rather, power should begin to flow 'downwards to communities and households . . . where people will have to adopt the initiative and the self-education *to learn how to act* as global citizens in a worryingly transforming world'.[90] I suggest that, if we want to make environmental policy successful, we need to look not only at the element of understanding and scientific awareness that is discussed in the notion of extending expertise, but also at how people connect their own lives to the environment, i.e. those 'active knowledges' mentioned above. This is the added dimension to public understanding that will go further towards successful environmental policy and, in underlining its importance, will emphasize the essential links between policy formulation and implementation. But it will also require a wider encouragement of participation beyond awareness and education.

Implications and conclusions

In this paper, I have suggested that public participation is necessary for successful environmental policy, but that its formulation depends upon scientific and expert discussions, thereby excluding the public and failing to make links between policy and people's lives and actions. Arguments that policy should therefore encourage extended expertise and public understandings of environmental science do not necessarily deal with these problems. If we want environmental policy to succeed, we should look not only at public understandings in scientific and rationalistic terms, but also at the moral, ethical, cultural and behavioural dimensions of environmental issues, especially those linked to local environments. In Beck, 'there is a fundamentalist reliance on science as both epistemological and institutional forms which subordinate other important reflexive domains ... [such as] a range of vernacular moralities and knowledges'.[91] To build successful environmental policy and adequate public participation, these different elements need to be conjoined, but this proves a problem for academia because of the disciplinary boundaries which divide studies of science from those of publics, cultures and morals.

Most work so far has looked at issues revolving around environmental understanding through the sociology of science. Science and counter-science have extended the area of 'facts' and increased mediation between science and its publics and, with politicization, this has made science less opaque and more open to public criticism, especially as formalized in the USA.[92] Yet the public still see themselves as outside the science/counter-science dialectic because of their 'non-expert' status. This implies a broadening of science through Beck's pluralization of experts[93] but not a democratization that overthrows power based on knowledge differentials. It is difficult to argue that this will ever happen through the extension of the rational franchise, as Beck relies upon,[94] because people continue to allocate scientific expertise on the basis of current knowledge differentials and therefore reconstitute the power/knowledge gradients and sustain the realm of expertise for policy-making:

> It is one thing to recommend that power and rationality be dispersed through society; it is quite another to demonstrate that this dispersal has already occurred ... perhaps knowledge, rather than being democratized, is becoming more exclusively the property of the particular interests it serves.[95]

And the more the stakes rise in the environmental debate, the more significant this latter suggestion will become. Where environmental debates seem predominantly constructed on (technical) rationality, even where counter-science expands, we should recognize the difficulties in granting a full franchise to all groups to participate.

But we need to consider more completely the notion of extended expertise. As well as cognitive aspects, moral, cultural and expressive concerns are implicated in local environmental issues and even in seemingly scientifically constructed global environmental issues. The limitations of concentrating on rationality to explain current shifts in modernity or producing future ones, as Beck does, have been explored by others.[96] The general point of expanding consideration beyond the cognitive has also been made by Wynne, who emphasizes that 'rationalities embody moral and social prescriptions'.[97] Only by acknowledging such non-scientific bases for public participation can we facilitate the democratization of the environmental debate. This would certainly imply a new social contract for science[98] as well as for interdisciplinary social science. In addition, the acceptance of local knowledges within policy debates would also help to revitalize public participation by redefining expertise so as to recognize the value of lay interpretations. While not necessarily solving any of the credibility problems faced by science, this

development could offer new opportunities to involve increasingly disillusioned publics in more inclusionary debates about locally and nationally significant environmental issues.

The outstanding problem seems to be how these 'non-scientific' contributions might gain legitimacy in policy circles. Referring to science at least draws upon an externally recognized set of claims to authority and understanding. The local knowledges representing non-scientific understandings are not necessarily bound by these claims and, in effect, their very multiplicity will work against the unambiguous categorization of their own claims to relevance. It is therefore not possible to offer a simple solution to the deficiencies of scientifically dominated debates, merely some avenues for the future development of public participation.

What we can say is that issues of both power and expertise demand further research attention to appreciate the complexities of the public relation with science and the overall development of the environmental debate. We need to bring together scientific, counter-scientific and non-scientific contributions to encourage full public participation and effective implementation. It is, however, a truism that the disciplinary foci used to study these different aspects will also make it more difficult to combine them within an interdisciplinary project of the kind such attention demands.

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also made for the depoliticization of science generally by Fischer, F., 1990, *Technocracy and the Politics of Expertise* (Newbury Park: Sage), p.220; and Barnes, B., 1985, *About Science* (Oxford: Basil Blackwell) for example.

I think that two different senses of 'politicization' are being referred to. In Beck's case, the implication is clearly, and justifiably, that science is increasingly part of the political process because it processes information, selects key issues for more investigation, is used in justifying policy choices and, in the process, is examined by (non-scientist) others as part of 'reflexive modernization'. In these matters, it is hardly apolitical. However, it must sustain an objective image in order to retain any form of 'rational' authority in the face of other, possibly morally grounded, arguments. In this sense, it can be connected with more technical solutions to problems, with the weighing, again in technical terms, of a range of possible policy solutions. This would represent a seemingly apolitical methodology which is firmly located in and connected to the political process. Hence, it is possible to argue that science is politicized in terms of its role but apolitical in terms of how its advice is represented. However, I do not think this is helpful and prefer to see science as politicized, while noting that Beck's notion of subpolitics points to this ambiguous relationship.

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72 Jasanoff, S., 1986, *Risk Management and Political Culture* (New York: Russell Sage Foundation), pp.5, 52; Irwin, A., 1995, *Citizen Science* (London: Routledge), p.72; Habermas argues that in such decision-making regimes, the public cannot fully participate but can only legitimate the decisions made for them by élites: see Habermas, J., 1971, *Toward a Rational Society* (London: Heinemann), p.67.
73 Bronner, S. E., 1995, Ecology, politics and risk: the social theory of Ulrich Beck. *Capitalism, Nature, Socialism*, **6**(1), 67–86.
74 Funtowicz, S. O., and Ravetz, J. R., 1990, *Global Environmental Issues and the Emergence of Second Order Science*, Report EUR 12803 EN (Luxembourg: Commission of the European Communities).
75 Giddens, A., 1990, *The Consequences of Modernity* (Cambridge: Polity), p.44.
76 Rustin, M., 1994, Incomplete modernity: Ulrich Beck's *Risk Society*. *Radical Philosophy*, 67 (Summer), 9.
77 Wynne, B., 1992, Uncertainty and environmental learning: reconceiving science and policy in the preventive paradigm. *Global Environmental Change*, **2**(2), 115.
78 It is interesting to compare this understanding of the importance of experience with Collins' model of the 'distance effect' where 'the further from the research front, the more do results look certain': see Collins, H. M., 1987, Certainty and public understanding of science: science on television. *Social Studies of Science*, **17**, 692. But for complications with this notion see Rüdig, W., 1993, Sources of technological controversy: proximity to or alienation from technology? *The Politics of Expert Advice*, edited by A. Barker and B. G. Peters (Edinburgh University Press).
79 These characteristics are particularly drawn from Irwin, A., 1995, *Citizen Science* (London: Routledge), p.132.
80 For a case study, see the use made by NIREX of public criticism, in Kemp, R., 1990, Why not in my backyard? A radical interpretation of public opposition to the deep disposal of radioactive waste in the United Kingdom.

Environment and Planning A, **22**, 1239–1258. Also Irwin, A., 1995, *Citizen Science* (London: Routledge), p.120.

81 For example, Fischer notes that traditional scientists designate public beliefs as 'irrational' (i.e. not based in traditional science); see Fischer, F., 1993, The greening of risk assessment: towards a participatory approach. *Business and the Environment*, edited by D. Smith (London: Paul Chapman), p.101; Tombs notes that chemical industry scientists see the public's worries about their operations as 'irrational (mis)conceptions', in Tombs, S., 1993, The chemical industry and the environment. *Business and the Environment*, edited by D. Smith (London: Paul Chapman), p.136; Beder shows how local protests about beach water pollution in Sydney were dismissed as 'pseudoscientific' and non-expert by the authorities, in Beder, S., 1991, Controversy and closure Sydney's beaches in crisis. *Social Studies of Science*, **21**, 249; Wynne notes that objections to a oxide fuels reprocessing facility at Sellafield-Windscale were seen by the establishment as 'anti-scientific', in Wynne, B., 1992, Risk and social learning: reification to engagement. *Social Theories of Risk*, edited by S. Krimsky and D. Golding (Westport, CT: Praeger), pp.278–282. This is also implied by Yearley, S., 1994, Understanding science from the perspective of the sociology of science: an overview. *Public Understanding of Science*, **3**, 251, in claiming that science is often distrusted unnecessarily by its publics.

82 Beck, U., 1992, *Risk Society: Towards a New Modernity* (London: Sage), p.58; emphasis in original.

83 Irwin, A., 1995, *Citizen Science* (London: Routledge), p.131.

84 For example, poetry, art and living styles related to the road protests in the UK in 1994/5. Also see Welsh, I., 1995, *Risk, Reflexivity and the Globalisation of Environmental Politics* (Bristol: Centre for Social and Economic Research Publications, University of the West of England), p.11.

85 Michael, M., 1991, Discourses of danger and dangerous discourses: patrolling the borders of science, nature and society. *Discourse and Society*, **2**(1), 23.

86 Barrett, S., 1991, Environmental regulation for competitive advantage. *Business Strategy Review*, Spring, 1–15.

87 Gummer, J., 1995, Environment Secretary, *Going for Green* campaign launch conference transcript, 6 February, pp.3–4.

88 Eden, S. E., 1993, Individual environmental responsibility and its role in public environmentalism. *Environment and Planning A*, **25**, 1743–1768.

89 British Government Panel on Sustainable Development, 1995, *First Report* (London: Department of the Environment), p.13.

90 O'Riordan, T., 1991, Stability and transformation in environmental government. *The Political Quarterly*, **62**, 172, emphasis added.

91 Welsh, I, 1995, *Risk, Reflexivity and the Globalisation of Environmental Politics* (Bristol: Centre for Social and Economic Research, University of the West of England), p.2. Further, all three elements are essential to the reconstitution of the policy regime. 'A scientized society could constitute itself as a rational one only to the extent that science and technology are mediated with the conduct of life through the minds of its citizens': see Habermas, J., 1971, *Toward a Rational Society* (London: Heinemann), pp.79–80.

92 Lash, S., and Wynne, B., 1992, Introduction, in Beck, U., 1992, *Risk Society: Towards a New Modernity* (London: Sage); Jasanoff, S., 1986, *Risk Management and Political Culture* (New York: Russell Sage Foundation), p.56.

93 Beck, U., 1992, *Risk Society: Towards a New Modernity* (London: Sage), pp.172–173.

94 Welsh, I., 1995, *Risk, Reflexivity and the Globalisation of Environmental Politics* (Bristol: Centre for Social and Economic Research, University of the West of England); Rustin, M., 1994, Incomplete modernity: Ulrich Beck's *Risk Society*. *Radical Philosophy*, 67 (Summer), 3–12.

95 Rustin, M., 1994, Incomplete modernity: Ulrich Beck's *Risk Society*. *Radical Philosophy*, 67 (Summer), 9–10.

96 Lash, S., and Urry, J., 1994, *Economies of Signs and Space* (London: Sage); Lash, S., 1993, Reflexive modernization: the aesthetic dimension. *Theory Culture and Society*, **10**, 1–23; Rustin, M., 1994, Incomplete modernity: Ulrich Beck's *Risk Society*. *Radical Philosophy*, 67 (Summer), 3–12.

97 Wynne, B., 1992, Risk and social learning: reification to engagement. *Social Theories of Risk*, edited by S. Krimsky and D. Golding (Westport CT: Praeger), p.291. This point is also made obliquely by Schwartz, M., and Thompson, M., 1990, *Divided We Stand: Redefining Politics, Technology and Social Choice* (Philadelphia: University of Pennsylvania Press), p.29.

98 Ravetz, J. R., 1990, *The Merger of Knowledge with Power* (London: Mansell), p.21; Funtowicz, S. O., and Ravetz, J. R., 1990, *Global Environmental Issues and the Emergence of Second Order Science*, Report EUR 12803 EN (Luxembourg: Commission of the European Communities), p.16.

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