Quotes from the book “Citizen Science: A Study of People, Expertise and Sustainable Development”

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INTRODUCTION

Page 1 - “This book is written at a time when the relationship between public groups, science and environmental challenges appears more pressing than ever.”

Page 2 - “Social development has reached a stage where a rethink of the linkage between science and everyday life is urgently needed.”

Page 4 - “In that way, it becomes possible to construct a citizen’s view of science rather than (as is more common – at least in the printed form) a scientist’s view of citizens (as ignorant, misled or plain contrary)”

Page 5 - “Citizenship questions in this book will centre on the place of individuals and groups of individuals in the face of technical ‘progress’ – in what way is it possible for their voices to be heard? What obstacles currently exist? What would the consequences be for current institutions and social processes? In order to deal with such questions, we will need to unravel the concept of citizenship and the issues of knowledge, trust and identity upon which it hinges.

Page 7 - “Thus, there will be no ‘sustainability’ without a greater potential for citizens to take control of their own lives, health and environment. However, success in this goal requires some careful thought about the relations between technical expertise, citizen needs and contemporary culture.”

1 SCIENCE AND CITIZENSHIP

Page 10 - “The notion that the ‘future belongs to science’ has underpinned most accounts of the relationship between citizens and science. However, there have also been a number of more critical accounts which draw upon the ‘tragedy of technology’ theme (as discussed in the previous chapter) and on a notion of ‘science as ideology’ in order to ask starker questions about the impact of scientific dissemination on everyday life”

Page 11 - “In the twentieth century, the need for a greater awareness of science became a major theme of the ‘visible college’ of scientists and writers who adopted a socialist perspective on scientific progress.5 As J.B.S. Haldane put it in the Preface to his 1939 book, Science and Everyday Life: I am convinced that it is the duty of those scientists who have a gift for writing to

make their subject intelligible to the ordinary man and woman. Without a much broader knowledge of science, democracy cannot be effective in an age when science affects all our lives continually.6”

Page 12 - “The Association of Scientific Workers thus offered a model of ‘progress through science’ which resonates strongly with many contemporary statements of the need for both greater public understanding and public acceptance of science: ‘Science offers means to use unprecedented powers with which a finer, more beautiful and happier world then ever before can be built. With mankind using a vigorously developing science for social ends, the future can be bright and inspiring’.10 However, unusually for a group of scientists, the Association recognized that this new world would require scientists to adopt an explicitly political role in society.

Page 13 - For now, rather than pursuing them through a general debate, we should begin to look a little closer at actual examples of the contemporary citizen-science interaction. Is there any evidence that science is being used within society as a legitimatory rather than an empowering device? Can the lack of communication between ‘science and its publics’ be successfully explained by public ignorance or instead by some deeper-rooted set of causes?

Page 28 - “Equally, the three cases suggest something of the notion that science can be an impartial and ‘value-free’ agent in such public cases – certainly, the ‘official’ parties involved would reject vehemently (and be highly offended by) any suggestion that the information which they were presenting was in some way ‘biased’. Their claim to authority was based precisely upon the impartiality and neutrality of the expertise which they proffered (and also upon the ‘good will’ and ‘fair play’ of the decision-making structures within which they operate). This became an issue especially in the BSE case with numerous allegations of ‘false experts’ on the ‘opposing’ side. Thus John Gummer was quoted in the House of Commons as stressing the significance of ‘true’ expertise: He hoped the BBC, ITV and others would ask before interviewing people as ‘experts’ whether they had published in journals which their peers could check or if they had submitted evidence to the Tyrrel Committee. If they had not, he hoped they would not be introduced as experts but merely as people with an idea or two.42”

Page 30 - “When local concerns do become a focus of attention, e.g., during a planning inquiry, citizens often feel alienated from the mixture of technical and legalistic procedure being followed. Similar points could be made with regard to 2,4,5–T or BSE – references to public hysteria and irrationality serve, from this perspective, the distinctly ideological purpose of downgrading public concerns and reinforcing the authority of existing decision-makers. Science is the servant of power – its investigations claim to open up the possibilities for policymaking but instead serve to reinforce the existing social order.”

Page 33 - “Is it possible for a ‘citizen-oriented science’ (or ‘citizen science’ in that sense) to emerge from these debates over the relationship between science, technology and wider society?”

2 SCIENCE, CITIZENS AND ENVIRONMENTAL THREAT

Page 34 - “The notion of bringing closer together the concerns of citizens and the understandings of science is not in itself new – many of the same preoccupations can be discerned in the ‘science

for the people' movement of the 1960s and 1970s or various attempts at 'public participation' such as the Dutch 'broad energy debate' of the 1980s. Nevertheless, this book will argue that both our practical experience and also our understanding of science and technology have 'moved on' in such a way as to make a re-evaluation especially timely".

Page 37 - "The main purpose of this chapter is to introduce one of the more important contexts within which citizens encounter science and technology – issues of risk and environmental threat. I will argue that, for a number of reasons, this is an especially crucial area – not least because of the high levels of public concern which it engenders but also because of the special problems encountered by science. In introducing this area, it will be important also to consider sociological arguments about the 'risk society' and the changing relationship between 'society' and 'nature' which these suggest."

Page 44 - "For Giddens and Beck, the social structure is undergoing a period of change; from modernity – with its faith in the Enlightenment tenets of Progress, Truth and Science – to late (or new) modernity – where the old truths have given way to radical doubt, reflexivity and anxiety over how each of us should live. In such a situation, questions of uncertainty, self-identity (who we consider ourselves to be) and risk become central. Everyday life becomes 'risky' not necessarily because of any new threat to our welfare or survival but because, at least according to Giddens, 'the self' has become fragmented and exposed. The institutions and belief systems which once protected us from 'ontological insecurity' (notably science) are now open to widespread challenge. In this new context, each of us is aware of the choices which exist within daily life – even the decision to pursue a 'traditional' lifestyle must be made in the awareness that there are possible alternative ways of life."

Page 46 - "Science thus no longer represents 'enlightenment' but a force to be struggled against. Of course, the more science loses its special status as the 'highest' form of rationality – as Beck sees occurring within environmental disputes – the less successful it will be as a source of legitimation for powerful social institutions such as government and industry. Scientific rationality thus encounters inherent contradictions such that one can argue that the risk society threatens the very 'failure of techno-scientific rationality'. In order to re-establish this legitimacy – and in order to serve a useful societal purpose – science needs to recognize its own role as a source of 'modernization risks' and to make institutional changes accordingly. Beck's challenge to science is to find new ways of operating within the risk society on the grounds that: 'scientific rationality without social rationality remains empty, but social rationality without scientific rationality remains blind'.18

Page 47 - "The 'risk society' is not about physical or ecological risks alone but rather the way in which citizens feel themselves 'at risk' from social and technological development."

Page 48 - "According to this analysis, science is not a storehouse of 'facts' which different social groups can plunder – nor is it a prescribed 'method' for the acquisition of 'objective knowledge'. Instead, science is presented as a much more diffuse and flexible collection of social institutions. This collection includes a diversity of intellectual domains whose boundaries are constantly negotiated and renegotiated with other social institutions."

Page 49 - "In the case of acid deposition, obvious interests included those of the British government and electricity generators in avoiding external controls – partly for reasons of cost but

also because of a broader reluctance to concede to environmentalist and international demands. Science from this perspective becomes a weapon used to further economic and political interests in a somewhat covert manner; science essentially becomes ‘politics by other means’”

Page 50 - “A final source of inspiration derives from feminist debate and scholarship as it relates to science and technology. Feminist analysis is important in this context for its inter-connection of the development of science with a particularly ‘masculinist’ attempt to dominate the natural world and to impose a one-dimensional form of rationality on everyday reality.”

Page 50 - “In particular, women’s knowledge and understanding can become denied by the tight inter-connection of male-dominated institutions and ‘masculinist’ science.27”

Page 50 - “The discourse of science can structure and constrain through its imposition of one form of knowledge. Meanwhile, alternative understandings become dismissed as ‘non-scientific’ and ‘irrational’.”

Page 56 - “First of all, there is pragmatic uncertainty; scientists may be asked to offer practical advice at very short notice and without sufficient equipment or staffing resources.”

Page 57 - “Second, there is theoretical uncertainty as occurs when there is no strong theoretical framework (or ‘paradigm’33) which unites a scientific field but instead a disparate pattern of disciplinary approaches and academic perspectives. This seems particularly relevant in the present context since, as we have already noted, acid deposition research draws upon a large variety of backgrounds (including chemistry, meteorology, the biological sciences, physics and geology). It is to be expected that these different disciplines will each highlight different aspects of the acid deposition problem and will carry a separate ‘toolkit’ of analytical techniques. Such a multidisciplinary pattern is a regular feature of research fields which have developed in a ‘problem-oriented’ fashion rather than emerging from a single established discipline.”

Page 58 - “It is because of uncertainties such as these that many commentators have seen technical advice within public policy disputes as exacerbating rather than eliminating policy disagreement.35 In a study of the role of scientific evidence in controversies over chemical toxicity, Graham et al. conclude that: On the one hand, when very simple questions are asked (by regulatory authorities), the conscientious scientist finds it difficult to know how to answer because of the ambiguity created by simplification. On the other hand, scientific knowledge is not adequate to answer the more elaborate questions with any measure of confidence. Our point is that scientists often seem to disagree with one another because they are caught between ambiguity and ignorance, between questions that are too hard and questions that are too simple.36”

Page 58 - “In the case of acid rain and BSE it appears – although this is inevitably difficult to document – that many government scientists were ill at ease with the official positions – their doubts were filtered out in the interests of presenting a ‘strong message’”

Page 59 - “At this stage, we can return to the opening section of this chapter and its concern with ‘Society’ and ‘Nature’. Whilst science attempts to describe the natural world it must also make social assumptions about our interaction with that world; how will a pesticide actually be put to use? What are the real conditions of factory farming? How will a chemical works actually be managed?”

Page 61 - “we are all part of social experiments about the environmental consequences of technological development.”

Page 61 - “the disassociation between the experimenter and the experimental object can no longer apply”

Page 61 - “It also needs to be stressed that, while science is regularly portrayed as offering possible solutions to environmental problems, there is a perception within the cases so far examined that science is a cause of those problems. This accusation generally takes two forms. First, the argument that many contemporary environmental threats are actually the products of science and technology (new chemical formulations, production processes, energy systems). Second, the argument that science has been antithetical to natural processes – in its very rationality it seeks to control, dissect and dominate the natural world (‘the rape of nature’). This is perhaps best expressed in the BSE example – hasn’t modern, scientific agriculture created such problems through its ‘unnatural’ methods? How then can science possibly claim to be the saviour of the environment? As Douglas and Wildavsky assert: ‘Once the source of safety, science and technology have become the source of risk’.42”

3 SCIENCE AND THE POLICY PROCESS

Page 62 - “Taken together, these analyses open up new possibilities for our understanding of ‘science’ and ‘citizenship’ within the context of risk and the environment. ‘Science’ becomes a contested and negotiated area of understanding.”

Page 63 - “In this chapter, therefore, we will explore the relationship between science and the policy-making process for risk and environmental threat. Chapter 2 established the limitations, uncertainties and social assumptions embedded within scientific accounts in this area – we can now explore the ‘official’ response to these in greater detail. How have these characteristics of the scientific assessment of risk been negotiated and then presented to public audiences – including, of course, the potential human victims of any threat or harm?”

Page 67 - “Their argument instead was that, with so many uncertainties relating to the pesticide, the most cautious move would be to ban the substance. The ACP, however, concluded that until better evidence emerged the only justifiable policy would be to permit usage.”

Page 69 - “The problem with this use of science as a legitimation device is that it obscures wider political and economic concerns. This is not necessarily an argument for the abandonment of expert advice, but instead a challenge to the notions of scientific objectivity and independence upon which it operates. One possibility, as has already been suggested, is to move towards a more ‘democratic’ mode.”

Page 72 - “The question raised in this section is, therefore, to what extent these apparently democratic forms of policy-making actually encourage and empower citizen views and understandings.”

Page 72 - “Nevertheless, the notion of ‘expertise’ is very much limited to the pronouncements of scientists. In Meehan’s account, scientists become guns for hire – with citizens reduced to the status of passive audiences rather than active participants.”

Page 77 - “There are substantial differences between the ‘pragmatic’ mode and the previous two. However, in terms of our concerns in this book the differences are not nearly so great as the similarities. Instead, as in the other two cases, we can see an enlightenment policy paradigm in operation: a paradigm which limits ‘expertise’ to certain professional groups and stresses technical argumentation over alternative forms of analysis and expression.”

Page 78 - “Of course, the presentation of risk issues as technical in nature has served as an important legitimation for this highly restricted concept of citizenship. The public is ‘ignorant’ and can therefore be legitimately excluded from influence”

Page 79 - “In that sense, the pragmatic mode may be the weakest of the three in offering a coherent legitimation of its conclusions – ‘trust us’ can seem an inadequate justification in the current climate of environmental concern and social challenge.”

Page 79 - “Meanwhile, ‘citizenship’ currently only begins when ‘expertise’ has set the environmental agenda. Now, it is quite clear that scientific expertise has a major role to play in these issues – but we need also to reconstruct our understanding of the science–citizen relationship in order to acknowledge the possibility of wider sources of knowledge and understanding.”

4 WITNESSES, PARTICIPANTS AND MAJOR ACCIDENT HAZARDS

Page 81 - “One immediate objection to this line of argument might be to indicate the number of steps which are currently being undertaken to ‘disseminate’ scientific information to the general public. Especially through the mass media but also through more local initiatives (of the type which will shortly be discussed in this chapter), efforts are being made to improve the public understanding of technical issues.”

Page 82 - “our most direct and urgent message is for the scientists – learn to communicate with the public, be willing to do so, indeed consider it your duty to do so. . . . It is clearly a part of each scientist’s professional responsibility to promote the public understanding of science.2”

Page 82 - “Durant goes on to identify four different types of popular science: ‘philosophical science’ (the ‘big questions’ of the origins of life and the universe); ‘practical science’ (science that will change our lives); ‘political science’ (science that deals with pressing social or environmental issues); ‘para-science’ (non-orthodox or ‘deviant’ scientific thinking).”

Page 87 - “The model is one of informing rather than empowering the public.”

Page 93 - “One important aspect of these research areas was the generally high level of concern about factory accidents and pollution – alongside, of course, such predictable (and very real) concerns as unemployment, crime and violence and ‘the rising cost of living’.”

Page 98 - “Equally, the source of the information is inseparable from the information itself – in that sense, public assessments of technical messages seem to show a remarkable convergence with the ‘interests’ model within SSK (as briefly discussed in Chapter 2). The social position of the disseminator – in this case, industrial bodies which will inevitably wish to defend their pollution record – is seen to have a decisive effect on the framing, selection and construction of technical advice. Technical statements are ‘interested’ – as such they need to be treated with the same intelligent caution that one would treat the statements of a politician or neighbour.”

Page 98 - “In particular, discourses of expertise can engender a form of selfcensorship where objections will not be raised since they will be predefined as illegitimate.”

Page 98 - “How could a member of the public possibly engage in a technical dialogue? Silence in such a context is, however, very different from acquiescence.”

Page 99 - “‘The outside person would tell you it’s dangerous, but the company might co-opt them. The company might give them money for the project, it might have got to them.”

Page 99 - “Of course, implicit in this is the notion that science is unlikely to be co-opted by local people – but only by more powerful social groups.”

Page 101 - “‘A permanent experiment is being conducted . . . in which people serving as laboratory animals in a self-help movement have to collect and report data on their own toxic symptoms against the experts sitting there with their deeply furrowed brows’.12”

Page 103 - “The discussion of ‘technical dissemination’ has thus led into a discussion of the social context within which ‘real-world’ knowledges are received but also developed”

5 FREEING THE VOICES: A SCIENCE OF THE PEOPLE?

Page 110 - “Judgements of credibility and relative scepticism mean that science will not be accepted by citizen groups without considerable qualification and reshaping. Science must also ‘make sense’ to citizens within particular situations – a process which requires the active generation of everyday meaning.”

Page 117 - “In this situation, citizen understandings generally possess much less influence than those of the official bodies – as the next section will emphasize. However, this criticism of ‘popular epidemiology’ (or ‘citizen science’) only has weight if one accepts that all knowledge must (or must claim to) be ‘universal’ in character – a modernistic assumption which seems inappropriate to matters of environmental response where situations may be more than specific instances of some well-developed scientific framework.”

Page 118 - “However, the specific contexts offered by our ‘three stories’ seem remote from the world of scientific experimentation. They are inherently messy and uncontrollable since so may variables are at flux. From a scientific perspective, they seem unlikely to generate or falsify

universalistic claims. Accordingly, they are frequently reduced to the status of ‘sites of implementation’ where science is applied but not developed.”

Page 118 - “Once again, this is not to suggest that such knowledges are inevitably superior to those of science but rather to advocate a more symmetrical form of analysis and policy debate.”

Page 121 - “the inevitable resource imbalance leaves them weakly placed to offer ‘expert’ testimony – there is also a distinct shortage of scientists willing to go to the assistance of campaign groups without payment or technical resources. Furthermore, for a scientist to ‘mediate’ between oppositional groups and policy-makers can create real difficulties – the risk is that the scientist will then be seen to have lost ‘neutrality’. The institutional and professional pressure is for the scientist not to ‘get involved’.”

Page 121 - “It is easy to romanticize ‘folk science’ and it often can be erroneous. Nevertheless, the indigenous knowledge of the laity can at times represent a valid challenge to the scientific knowledge offered by ‘experts’. Awareness and identification of problems is one area where non-expert observations and judgements may be significant. Similarly, traditional knowledge, validated by trial and error over long periods of time, may embody understandings which could enrich science.21”

Page 126 - “the farmers felt that their whole identity was under threat from outside interventions based upon what they saw as ignorant but arrogant experts who did not recognize what was the central currency of the farmers’ social identity, namely their specialist hill farming expertise. This expertise was not codified anywhere: it was passed down orally and by apprenticeship from one generation to the next, as a craft tradition, reinforced in the culture of the area.29”

Page 133 - “‘The relationship between scientific knowledge and other forms of local and particular knowledges amounts to a challenge to an epistemology of science that rests on the belief that the world is separate from the scientific observer’.42”

Page 133 - “Typically also in the cases we have examined they are ‘knowledges for doing’ – they are highly practical, case-specific and instrumental in orientation with no necessary claim to general theory or application elsewhere. All this contrasts sharply with the statements of science and is, once again, deeply challenging to science which depends for its authority on the notion of impartial judgement and generalized (or ‘universalistic’) objectivity.”

6 BUILDING SUSTAINABLE FUTURES: SCIENCE SHOPS AND SOCIAL EXPERIMENTS

Page 136 - “Equally, and as might be expected, there is little attempt to build upon the citizen knowledges and epistemologies discussed in the last two chapters. Characteristically, these currently marginalized expertises define the ‘environment’ as part of a wider set of issues and as linked to everyday life and the construction of selfidentity.”

Page 137 - “participatory dilemma; put simply, should citizen groups participate in sciencecentred decision-making processes (such as those discussed in Chapter 3) which appear heavily stacked against them or stay clear and be effectively disenfranchised?”

Page 140 - “In particular, it serves to remind us that mere ‘participation’ is not enough, since such attempts can be designed to serve a number of purposes and will necessarily embody assumptions about the relative authority to be granted to different social actors and bodies of expertise.”

Page 141 - “The report in question was produced by the Organization for Economic Co-operation and Development (OECD) as part of a general initiative aimed at devising ‘effective means of informing the public of the implications of new technological developments, soliciting their reactions, and engaging them in decision-making processes’.”

Page 141 - “The OECD report identifies four main categories of government response to ‘public pressures for more direct participation in decision-making on issues related to science and technology’: informing the public, informing policy-makers, reconciling conflicting interests, collaborative decision-making.”

Page 143 - “the study circles do not necessarily lead to consensus – but can instead cause polarization. As has been noted in a separate study of public attitudes to nuclear power: ‘knowledge does not foster positive attitudes; on the contrary, those with negative attitudes are motivated to acquire knowledge and to construe it in support of their case’.1”

Page 144 - “Finally, the OECD report notes that public ‘education’ needs to go beyond points of technical detail and instead embrace wider social, economic and political aspects of scientific and technological developments. Thus, in an argument which again fits with the analysis offered in previous chapters, it is suggested that national experiences such as the above indicate that the general public is not especially interested in the technical detail of, for example, nuclear energy generation. Instead, broader issues of reactor safety, fuel reprocessing and waste disposal are seen as much more important to public groups. The public treatment of these issues will in turn relate to matters of trust and credibility: ‘Acceptance on the part of the public of certain risks appears to be heavily dependent both upon its government’s ability to weigh all of these factors and on public trust in government institutions, their legitimacy and credibility’.18”

Page 145 - “Within the ‘Science for Citizens’ programme attempts had been made to develop mechanisms which would provide citizens with the technical information necessary for effective participation in decision-making”

Page 145 - “However, media coverage of issues related to science and technology is often uneven, incomplete and highly selective.20”

Page 151 - “Participation’ without a willingness to broaden the scope of discussion and to establish appropriate social processes and procedures for the representation of views will remain reductionist in approach.”

Page 154 - “One further proposal which has attempted to deal with these problems of anticipation and intervention is ‘Constructive Technology Assessment’ as pioneered in The Netherlands. The

aim of Constructive Technology Assessment (CTA) is to tailor technical change to societal needs and objectives, like high employment and quality of labour, reduction of pollution, safety, reduction of costs, privacy and other ethical considerations."

Page 155 - "Accordingly, attention should focus on the design phase of a technology and on the anticipation of adverse social consequences at a very early stage."

Page 156 - "The aim of these so-called 'Science Shop' mechanisms is to promote socially-relevant Research and Development ('action research') on behalf of under-privileged groups. . ."

Page 156 - "Put simply, a Science Shop provides the means whereby members of the public who need information or technical assistance – but do not have the means to pay for it or collect it for themselves – can gain access to the necessary resources."

Page 158 - "Typically, the clients had no idea what to ask, because they had no way of knowing what science might or might not have to offer'"

Page 159 - "the task of the Science Shop is less to 'mediate' between the Science Shop client and the scientific community than to reformulate the 'problem situation' in terms which a scientist might recognize."

Page 159 - "if groups are committed to changing a situation then it is highly likely that they will already have decided that a problem exists. In that sense, a call for the testing of possibly contaminated ground or for the reassessment of an expert report will represent a call for scientific authentication of a problem rather than a 'curiosity-driven' information request."

Page 159 - "In such circumstances, it becomes even harder to imagine how citizen-generated requests might feed back into the research direction of scientists."

Page 160 - "Of course, demonstration that there is a high public demand for Science Shops does not negate this point. For Stewart, the demand is for scientifically-generated solutions to specific 'problem situations' which are simply impossible to achieve."

Page 160 - "To my mind, the major issue is indeed the gap between 'scientific expertise' and the needs of people. . . . In other words, the problem is that 'scientific knowledge' as currently constituted is not sufficiently relevant to the needs of people. . . . I think that the Science Shops experience shows that 'demystifying' – which we did, by and large, do – is not enough; people won't even really accept being 'demystified' unless they have something to put in its place. So I feel that nothing much can happen unless and until we start producing knowledge which is positively relevant.51"

Page 164 - "Of course, two other possibilities should also be considered. First of all, that social science may be more 'accessible' to public groups (it is easier to incorporate citizen views in the design of a questionnaire than in the analysis of a soil sample). Second, that the public expectation of social science (e.g., to 'survey' a community) is more clear than it is of science (what exactly does a mathematician do?)."

Page 165 - “Whilst conventional academic work leads to publication and research awards, and industrial consultancy generates recognition and research income, Science Shop involvement has a distinctly less glamorous aura. Especially if the research spin-offs from involvement are unclear, the benefits may not be apparent. To quote one academic: ‘Apart from altruism, it is difficult to see how individual members of staff derive any benefits from involvement’.”

Page 167 - “Quite obviously, the creation of such a ‘citizen science’ is a major challenge – although it might be argued that some of the more positive examples of social experimentation represent an already developing response. Clearly also, this is a challenge not just to science but also to wider society. However, the alternatives are either to argue that the current relationship between science and citizens is unproblematic and therefore does not require modification (a conclusion which is disputed by all the evidence in this book) or to deny that science should have everyday relevance (which will inevitably lead to an even greater public onslaught on science).”

7 SCIENCE, CITIZENSHIP AND TROUBLED MODERNITY

Page 173 - “The task is not to remove science from decision-making nor to erode its significance. Instead, questions of citizen science and sustainability present a challenge to integrate scientific expertise with other assessments, problem definitions and expertises; to acknowledge diversity as a positive element within sustainable development and to appreciate the inter-connectedness of ‘social’, ‘environmental’ and ‘technical’ issues and concerns.”

Page 176 - “There are a number of specific and general forms which this transparency might take: the greater inclusion of public groups in scientific priority-setting (e.g., at the level of science policymaking); the creation of new fora for discussing the scientific understanding of the public as this operates within scientific and technological development (e.g., with regard to the innovation process); support from scientific and related institutions for public debate which goes beyond the rigid and defensive parameters of the ‘public understanding of science’; support for local and citizendefined initiatives which seek to ‘make sense’ of science within the conditions of everyday life (e.g., the Science Shop model); the education of scientists in the wider dimensions of the relationship between science and the social structure. The central point, however, is that questions of the public understanding of science lead back to the social and technical processes which produce new sciences and technologies.”

Page 182 - “The crisis of the environment is unavoidably and simultaneously a wider challenge to our ways of knowing and acting in the world – including the relationship between various forms of expert knowledge and understanding. Our ability to cope with the threats and challenges of the environment will also be a wider test (if such were needed) of our ability to sustain current relations of knowledge and social action.”

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